Evaluation of Immunization Coverage among 0 to 24 Month Old Children in Dzimauli Village, Vhembe District, South Africa

Mzwakhe Emanuel Nyathi (11543178)

A mini-dissertation submitted in partial fulfillment of the requirements for the degree of Masters of Public Health in the School of Health Sciences, University Of Venda

Supervisor: Dr. T.G. Tshitangano

Co-Supervisor: H.A. Prof. Akinsola

February 2015

DECLARATION

I, Mzwakhe Emanuel Nyathi, solemnly declare that the information presented in this mini-dissertation is my own work. Where other peoples' information has been used, it has been duly acknowledged. This document has not been submitted to the University of Venda or any other University before.

Mr. Mzwakhe Emanuel Nyathi

Signature: Nyathi M.E. date 30/04/15

ACKNOWLEDGEMENTS

I acknowledge Dr. T.G. Tshitangano, Prof. H.A. Akinsola and the late Dr. R.L. Mamabolo my supervisors for their assistance, encouragement, guidance; and useful comments in making this project a success.

I also acknowledge Prof. P.O. Bessong of Malnutrition and Enteric Diseases Network for giving permission to use its data for this study.

I would like to express my sincere gratitude to the Univen Research and Innovation directorate for funding this project.

I also thank the mothers and caregivers who participated in the study for their cooperation.

Finally, many thanks to my family and friends, for moral support they gave me during my programme.

DEDICATION

This mini-dissertation is dedicated to my late supervisor Dr. R.L. Mamabolo.

TABLE OF CONTENTS

Page

LIST OF ACRONYMS

BCG	Bacille Calmette Guerin
CDC	Centre for Disease Control
DAF	Demographic Assessment Form
DHIS	District Health Information System
DHS	Demographic and Health Survey
DOH	Department of Health
DPT	Diphtheria Pertussis and Tetanus
DTaP-IPV//HIb	Diphtheria, Tetanus, Acellular Pertussis, Inactivated Polio Vaccine
EC	Eastern Cape Province
EPI	Expanded Programme on Immunization
EPI-SA	Expanded Programme on Immunization – South Africa
FS	Free State Province
GAVI	Global Alliance for Vaccines and Immunization
GP	Gauteng Province
HST	Health Systems Trust
Hep B	Hepatitis B Vaccine
IPV	Inactivated Polio Vaccine
KZN	KwaZulu Natal Province
LP	Limpopo Province

MAL-ED	Malnutrition and Enteric Disease
MOA	Monthly Assessment Form A
MOB	Monthly Assessment Form B
MP	Mpumalanga Province
MV	Measles Vaccine
NC	Northern Cape Province
NW	North West Province
OPV	Oral Polio Vaccine
PCV	Pneumococcal Conjugated Vaccine
RV	Rotavirus
SCR	Screening form
SPSS	Statistical Package for Social Sciences
UN	United Nations
UNICEF	United Nations Children's Fund
VIF	Vaccine Information Form
WC	Western Cape Province
WHA	World Health Assembly
WHO	World Health Organization
ZA	South Africa

LIST OF FIGURES

LIST OF TABLES

ABSTRACT

Background: Children under-five years old are at increased risk of fatal acute infectious diseases. Immunization has proven to be an effective public health intervention strategy that provides the necessary immunity against children's fatal acute infectious diseases, leading to significant reduction in morbidity and mortality in children.

Purpose: This study aimed to evaluate the immunization coverage amongst 0 to 24 month old children in Dzimauli Village.

Methods: The study employed a quantitative approach, using the cross-sectional descriptive survey design to review the immunization data collected by the Mal-ed research project. The sample included 242 records of children born between 2009 and 2013. Vaccination status was ascertained by secondary analysis of Mal-ed data and review of the Road to Health Card/ Booklets. Excel and the Statistical Package for Social Sciences version 21 were used to analyse the data. Ethical clearance was obtained from the University of Venda ethics committee and permission to use the Mal-ed data was granted by the Mal-ed principal investigator. The data was presented descriptively using tables.

Results: The results revealed that 72% of the children received their required vaccination doses. The dropout rate was 37% and factors influencing lack of vaccination and untimely vaccination were Obstacles, 40%, Lake of information, 31%, and Lack of motivation, 29%.

Conclusion: The study concludes that immunization coverage in Dzimauli village is lower than the targets set by WHO and UNICEF which is at least 90% vaccination coverage by 2015, and dropout rate is higher than the accepted rate of 10%. Under 24 months old children should be registered and be monitored to make sure they get all vaccines on time.

Keywords: Evaluation, Immunization coverage, Children

CHAPTER 1

BACKGROUND OF THE STUDY

1.1 Introduction

Children under-five years old are at increased risk of fatal acute infectious diseases. Immunization, also called vaccination, has proved to be an effective public health intervention strategy that provides the necessary immunity against these fatal acute infectious diseases (Health Systems Trust, 2013). Immunization is the most successful and cost effective health intervention, with meaningful, substantial contribution to reductions in morbidity and mortality from diphtheria, tetanus and pertussis (WHO, 2013). Increasing immunization coverage for vaccine preventable diseases has become an important developmental issue, and an area requiring more research (DISH II Project, 2002).

The use of vaccines started in 1796 when Edward Jenner developed a vaccine against smallpox. In 1974, the World Health Organization introduced the Expanded Programme on Immunization (EPI) with the aim of vaccinating all children below the age of one year against most preventable infectious diseases. Since then, immunization coverage has increased in four decades from less than 5% of all children to 85% (Centers for Disease Control and Prevention, 2009).

In 1979, the World Health Organization (WHO) certified the eradication of smallpox and, since then, targets have been set to eradicate poliomyelitis, measles and to significantly reduce other infectious diseases through vaccination (Odyssey, 1980). In South Africa, the Expanded Programme on Immunization (EPI) was adopted and introduced in 1995, and, initially, it covered vaccines against six childhood diseases, namely polio, diphtheria, tuberculosis, pertussis, measles and tetanus.

The EPI-SA schedule has been adjusted according to the country's disease epidemiology, and Hepatitis B was the first vaccine to be introduced to the EPI-SA schedule in 1995. In 2009, government introduced the revised childhood immunization schedule, (see Annexure A), and on it were added the Rotavirus vaccine, and a combination vaccine of Diphtheria, Tetanus, Acellular Pertussis, Inactivated Polio vaccine and Haermophilus Influenza type b (DTap-IPV//Hib) (Barker, 2010).

The new EPI-SA schedule attests to government's commitment to achieving Millennium Development Goal 4, which aims at reducing the mortality rate among under five year old children by two-thirds by 2015 (WHO, 2013). Government commitment is also seen in the increase in the budget for the Department of Health. In 2012 the budget for the Department of Health was R1.25 billion (Heever, 2012).

Immunization programme performance is measured through indicators such as vaccine protection, estimates of vaccine efficacy or effectiveness, that is, the reduction of vaccine preventable diseases (VPD) in under five year old children (Heever, 2012). Effectiveness of the immunization programme is measured by the immunization coverage of under one year old children. This is also a proxy indicator of the health system. Measures of vaccine coverage are used to address questions of what proportion of the population has been reached with the vaccines (Heever, 2012). Therefore, constant evaluation of immunization coverage rates is vital, in order to give an indication of the performance of the immunization programme and the health system.

The three main instruments used for assessing immunization coverage are, nationally generated programme statistics, specialised immunization coverage surveys, and household surveys. Immunization coverage surveys use a simplified sampling design for rapid and less expensive assessment of coverage, and they can be used to validate programme statistics, while household surveys provide information on a number of indicators; they can provide information on variables affecting immunization coverage (Burton, Monasch, Lautenbach, Gacic-Dobo, Neill, Karimov, Wolfson, Jones & Birmingham, 2009).

Programme statistics are based on data collected at health facilities, and they record the number of children immunized with specific vaccines. Programme statistics have weaknesses that affect both the numerator and the denominator. This may lead to invalid or unreliable estimates of immunization coverage. The numerator is the number of children immunized by health personnel, the denominator is unknown, and it has to be estimated as the number of the target population. At district level, estimates of the denominator may also be affected by migrations and immigrations (Eduard & Batson, 2000). The national statistics are generated according to the District Health Information System (DHIS) data flow policy shown in annexure B.

The DHIS calculates immunization coverage from health facilities records. These statistics are reported to the Provincial Health Department (PHD) that reports to the National Department of Health (NDH) which then reports to WHO and UNICEF.

1.2 Problem statement

The immunization coverage of Dzimauli village is unknown, documented immunization coverage statistics are at District, Provincial and National level. There is no research done at village level to evaluate immunization coverage according to the Expanded Programme on Immunization (EPI-SA). It is against this background that the researcher identified a need to accurately evaluate immunization coverage and see if there is a similar trend in Dzimauli village as seen at District Municipality level, Provincial level and National level.

1.3 Rationale

There are noticeable data discrepancies in the statistics reported by the HST, HSRC, as well as the WHO and the UNICEF for different antigens and the overall national statistics. In 2011, the National Department of Health reported 96% immunization coverage, while WHO and UNICEF reported a low coverage of 72%. The national BCG coverage was 98% as reported by the District Health Information System in 2011, while UNICEF and WHO reported estimates of 78%. In 2008, the BCG national coverage was according to DHIS 96.6%. The Human Science Research Council of South Africa (HSRC) reported 85.5%, while WHO/UNICEF reported 76% (HST, 2013; WHO, 2012) in 2008 DPT3

coverage, as reported by the HST, was 116%; HSRC reported 63%, while WHO/UNICEF reported 98% (Massyn, Day, Peer, Padarath, Barron & English, 2014; WHO, 2012). Figure 1.3 shows the discrepancies in data reporting from facility level through to the district, the national department and the WHO and UNICEF.

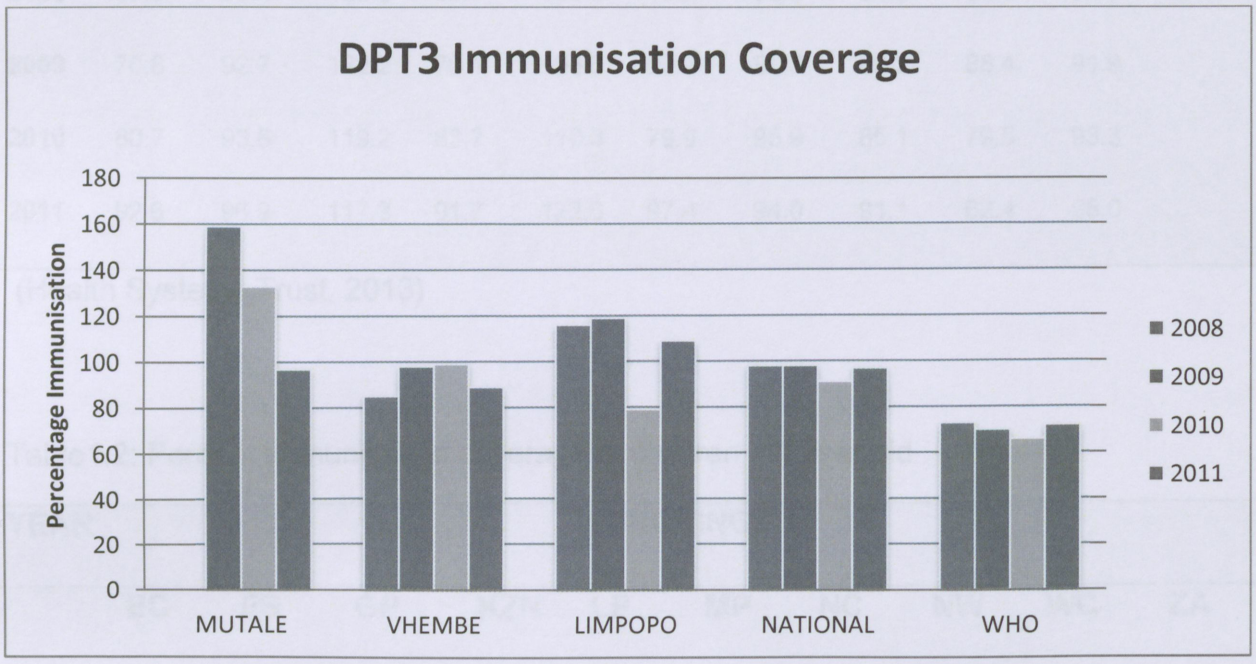


Figure1.1: DPT3 Immunization coverage (Massyn et al., 2014)

The other noticeable worry is that South African districts and the HST report vaccination coverage of more than 100%, despite the fact that maximum immunization coverage is capped at 99% (*Massyn et al.,* 2014). Tables 1.1 and 1.2 show examples of reported statistics between 2008 and 2011 that are over the threshold of 99%.

Table1.1: Percent BCG immunization coverage by province

YEAR	PROVINCE										HSRC
	EC	FS	GP	KZN	LP	MP	NC	NW	WC	ZA	
2008	67.6	93.4	129.9	86.6	103.5	102.7	98.0	84.9	83.9	94.6	85.5
2009	70.8	92.7	122.2	76.1	108.5	90.1	88.9	89.2	88.4	91.9	
2010	80.7	93.6	119.2	83.7	110.3	79.9	95.9	85.1	79.5	93.3	
2011	92.6	96.9	117.3	91.7	122.5	97.4	94.0	91.1	62.4	98.0	

(Health Systems Trust, 2013)

Table1.2: Percent immunization coverage of children > 1 year old

YEAR	PROVINCE									
	EC	FS	GP	KZN	LP	MP	NC	NW	WC	ZA
2008	82.0	83.9	111.0	83.1	90.9	83.3	91.4	82.7	101.6	90.6
2009	90.6	87.0	113.7	84.6	99.6	92.8	92.4	86.4	102.2	95.3
2010	78.5	83.8	111.3	85.4	93.7	69.8	91.9	77.3	90.8	89.2
2011	84.2	91.9	114.6	98.6	96.7	73.9	95.1	82.9	89.5	95.2

(Health Systems Trust, 2013)

The high immunization coverage rates reported by HST in Vhembe District Municipality, Limpopo Province in the past six years include both valid and invalid vaccine doses. Only valid doses are of importance to policy makers, but reported immunization coverage is only subjected to crude figures and they are not correlated with the total valid coverage rates. Therefore, reported statistics do not account for dose validity as seen in Uganda where reasonably high vaccination coverage was reported, but mostly not timely.

Many children were unprotected for several months although at the end of the follow up period they were vaccinated (Fadnes, Nankabirwa, Sommerfely, Tylleskar, Tumwine & Engebretsen, 2011).

1.4 Significance of the study

The study will provide evidence on areas that need improvement in the current immunization coverage of 0 to 24 months old children in Dzimauli village. Policy and decision makers may use the results as a basis to act on time to address the weaknesses of the programme and also to maintain its strength.

1.5 Aim of the study

This study aimed to evaluate the immunization coverage according to the Expanded Programme on Immunization amongst 0 to 24 month old children in Dzimauli village in Vhembe District, Limpopo Province of South Africa.

1.6. Objectives of the study

The objectives of the study are to:

1. Evaluate the crude immunization coverage among 0 to 24 month old children in Dzimauli village in Vhembe District, Limpopo Province of South Africa;
2. Evaluate the valid immunization coverage among 0 to 24 month old children in Dzimauli village in Vhembe District, Limpopo Province of South Africa;
3. Evaluate immunization dropout rates among 0 to 24 month old children in Dzimauli village in Vhembe District, Limpopo Province of South Africa; and
4. Determine reasons behind failure to immunize 0 to 24 month old children in Dzimauli village in Vhembe District, Limpopo Province of South Africa.

1.7. Definition of terms

1.7.1 Evaluation – According to the ENCARTA THESAURUS, evaluation means appraisal, estimation, calculation, valuation ang costing (Jellis, 2001). The social

research method website describes evaluation as a systematic acquisition and assessment of information to provide useful feedback about some object (Trochim, 2006). In this study, evaluation means the acquisition and assessment of information on the vaccine uptake according to the Expanded Programme on Immunization by 0 to 24 months old children in Dzimauli village in Vhembe District, Limpopo Province, South Africa.

1.7.2 Children –In this study, Children refer to individuals born between 2009 and 2013, who reside in Dzimauli village.

1.7.3 Immunization coverage – This is the proportion of the target population which has been immunized evidenced by cards where applicable or by history from mothers/guardians (UNICEF, 2008). In this study, the operational definition is the same as that of the UNICEF definition of Immunization coverage.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter reviews literature on the trends of immunization coverage as per the Expanded Programme on Immunization schedule, and the factors associated with infant immunization, as well as barriers contributing to failure to adhere to the EPI schedule. Literature from journals and official reports is reviewed, with the intention of identifying areas that need to be improved, in order to improve routine immunization coverage.

2.2 Global immunization coverage statistics

Childhood vaccination initiatives in the United States of America employed a wide range of efforts such as outreach campaigns, disease monitoring and vaccine research. This has led to an elevated immunization coverage rate. As a result of the high vaccination coverage, there was a 95% reduction in vaccine preventable diseases (Satcher, 1999). Despite the success of vaccines in reducing vaccine preventable disease, administration of vaccines faces a number of challenges that result in non-adherence to the schedule.

Researchers have suggested that shifts in global immunization goals have resulted in unintended effects in developing countries, leading to fragmentation in the implementation of vaccine programmes at local level (Hardon & Blume, 2005). The initiatives are seen not to be building on past experiences due to failure to learn from previous mistakes and, therefore, lack sustainability and relevance to the overall objective of preventing vaccine-preventable deaths (Hardon & Blume, 2005). Timeliness of children's vaccination was seen to be widely varied between and particularly within countries, and yearly published national coverage does not capture these variations (Clark & Sanderson, 2009).

These suggestions may be considerably true since factors associated with the low uptake of vaccines include; socio-economic factors, service delivery, parental beliefs and

motivations, professional knowledge, attitudes, and training (Costa-Font, McGuire & Hernandez-Quevedo, 2010).

A study in Germany, revealed that half of the children were found to have been vaccinated later than recommended and this resulted in incomplete vaccinations for a number of antigens (Fell, David & Reintjes, 2005). It was also noted that coverage estimates for individual vaccines were greater than 80%, but the immunization series completed levels were much lower (Barker, Luman, Zhao, Smith, Linkins, Santoli, McCauely, & Centers for Disease Control and Prevention (CDC), 2001). This signaled that high immunization coverage does not necessarily mean protection from vaccine preventable diseases. It was then recommended that, ongoing epidemiological research was needed to identify subpopulations with low coverage and barriers to vaccination coverage, and that development and implementation of effective strategies to encourage vaccination in under vaccinated subpopulations be introduced. Also a major concern was the drop in polio vaccine coverage rates (Barker *et.al.,* 2011).

In the United States of America, it has also been shown that one in three children were undervaccinated for more than six months in their first 24 months of life, and one in four children were delayed for a least four vaccines (Barker *et al.*, 2005). In another study, nine out of ten children received at least one vaccine dossage cutside the recommended age ranges, revealing that, high vaccination status of children at the age of 24 months does not reflect the reality that many vaccinations are not given at the appropriate ages (Barker *et al.*, 2002).

In a study on the barriers of adult immunization, it was confirmed that many adults in the USA, did not receive immunization as recommended, and it also revealed that false assumptions, such as the belief that healthy people do not need immunization, are important reasons for failure to receive vaccinations (Johnson, Nichol & Liczynski, 2008). It was further reported that 66% of the respondents thought that consumers avoided vaccinations because of concerns about side effects, a dislike for needles, and fear that the vaccines will make them ill. Adults with such beliefs and fears were likely not to have their children immunized (Johnson *et al.,* 2008).

It has also been revealed that only ten (10) percent of infants and children in a private practice had their immunization completed and/or were up to date (Alto, Fury, Condo & Aduddell, 1994). Another study showed that 67% immunization coverage had only 29% up to date immunizations despite the availability of free vaccines (Bates, Fitzgerald, Dittus & Wolinsky, 1994).

In another study in Brazil, where complete basic vaccination was 71.9%, only 61.8% were valid doses. The study revealed a very high percentage of delayed vaccination with the exception of BCG (Yokokura, Silva, Bernardes, Lamy, Alves, Cabra & Alves, 2013). In another study in Argentina, it was found that there was a high proportion of missed opportunities and, mainly, a delayed vaccine schedule among less than 24 months old children (Gentile, Bakir, Firpo, Caruso, Lucion, Abate, Chiossone & Debbag, 2011).

A survey in India showed that respondents had satisfactory knowledge about the universal immunization programme, but they were unable to name or to identify other diseases besides tuberculosis and poliomyelitis (Manjunath & Pareek, 2003). This was considered to be an indication that health education was necessary to enhance respondents' knowledge about the complete vaccination programme. Mothers' low knowledge of the Expanded Programme on Immunization was found not to have an association with the children's vaccination status, but there was a better health seeking behavior among the more educated mothers (Siddiqi, Siddiqi, Nisar & Khan, 2010).

In Pakistan, a simple education intervention designed for low-literate populations improved DPT-3 and Hepatitis B vaccine completion rates by 39%. It was shown that home-based focused education to mothers, regarding the importance of vaccines through pictorial messages using simple language was effective in improving children's immunization rates in low-income and low-literacy populations (Owals, Hanif, Siddiqui, Agha & Zaidi, 2011). It has been recommended that efforts to increase vaccination coverage should take into account factors that contributed to the incomplete vaccination status of children. Up-scaling of antenatal care among pregnant mothers was seen as a positive contributor to the complete immunization status of the children, and improving girls' education was perceived to improve sustainability of child immunization in future mothers (Sensarma, Bhandari & Kutty, 2012).

Appropriate information dissemination about the programme, aggressive campaigning and family involvement were suggested as necessary factors needed to cover gaps on the knowledge about the correct age of vaccine administration, doses and place of vaccination, along with efforts to improve the literacy status of the mothers (Nath, Singh, Awasthi, Bhushan, Kumar, & Singh, 2008);(Nath, 2008).

It has been revealed that, there is a need for further advocacy for increased knowledge on the importance of vaccination and affordable public immunization programmes focusing on higher risk households in Bangladesh, such as those with pit facilities, lack of electricity and no participation in a microfinance group (Andrew-Chavez., Biswas., Gifford., Eriksson and Dalal, 2012).

In China, it was found that individual influence factors, social factors, and system factors immensely contributed to high immunization coverage rates (Tarrant & Thomson, 2008). Dharan (2011) found that rural mothers in India had poor knowledge and negative attitudes towards immunization compared to urban mothers. Surprisingly, rural areas had high immunization coverage than urban areas. Despite the awareness and willingness to have children vaccinated, coverage based on immunization Card/ Booklets was reported to be as low as 37%, indicating a discrepancy between high levels of knowledge and positive attitudes (Dharan, 2011).

In another study in India, it was shown that DTP dropout rates were as high as 40% and OPV dropout rates were even higher at 50% (Mukherjee, Ray, Kar, Mandal & Biswas, 1990). Dropout rates for polio were seen to be as low as 3% among children living in urban areas of Pakistan, while those living in rural areas had dropout rates as high as 15%. (Dhadwal, Sood, Gupta, Ahluwalia, Vatsayan, & Sharma, 1997).

It was further revealed that older children and adults were more vulnerable to diphtheria than younger children who had received the primary doses of DPT on time. Older children had not received the booster DTP3 vaccines on time, hence constituted 75% of diphtheria cases (Ray, Das & Saha, 1998). It has been shown that, of the high reported crude immunization coverage of DPT3 (97%), only 66% of all children surveyed in Bangladesh,

had received valid doses of all vaccines at the age of 12 months (Khan, Rahman, Awal, Islam, Musa & Tofail, 2005).

The child's gender, mother's education, place of residence and the job they do, were found not to affect the pattern of immunization among 2 - 24 months old children. However, negative attitudes, such as the mother being afraid of vaccinations, had a significant effect on the immunization status of children, signifying incomplete knowledge and inappropriate practices of the people (Mabrouka, 2011).

On the contrary, Ibnouf (1997) found that there was a significant relationship between vaccine coverage and place of residence and the level of mothers' education. This was further supported by Fassin (1989) who found that immunization was affected by sociocultural variables such as mothers' education level and house ownership (Fassin & Jeanee, 1989). It has also been shown that parents lacked knowledge with regard to their children's vaccination and, further, that the outcome of the child being fully immunized depended on the availability of vaccines, as well as the willingness and efforts by parents to have them immunized (Sylvia, Caingles, Joanne & Lobo, 2011).

In Iraq, health education campaigns and peer spiritual leaders have been shown to be positive contributors to improving vaccination coverage rates and significantly reducing dropout rates between DTP1, DTP2 and DPT3 and measles vaccines (Abdul, Al-Dabbagh & Al-Habeeb, 2013).

It was shown that under immunization of young children was associated with negative immunization experiences at immunization visits. The negative immunization experiences revolved around three main themes, a child's negative reaction to the vaccines, attitudes of the medical and ancillary staff members, and the waiting times at the health care centres (Chubilleau, Comte , Robin, Cassel, Randirmaherison, Bouffard, Purbert, Pascouau & Ingrand, 2011). It was recommended that the use of techniques that decreased the pain associated with immunizations, improved the attitudes of medical and ancillary staff members, and cut down the waiting time, could result in increased immunization coverage.

On one hand, Eskola (1998) suggested that more information about vaccines, including their properties and proper use, could lead to high motivation among families and, thus, high vaccination coverage, Babalola (2011), on the other hand, suggested that timely completion of the immunization schedule was dependent on improving vaccine supply, strengthening provider's capacity for quality service and increasing community knowledge about immunization (Babalola, 2011; Eskola, 1998).

2.3 Immunization coverage in Africa

A survey in Somaliland revealed high dropout rates of 25.4% (UNICEF, 2008). It was also revealed that for children who had received vaccination in their first birthday, coverage level at 24 months of age was low signaling high dropout rates (Dietz, Stevenson, Zell, Cochi, Hadler & Eddins, 1994). In Congo, dropout rates were found to be worringly high and needed to be corrected if vaccination coverage was to be improved in rural areas (Talani, Nzabn, Bolanda, Ongouo, Mayanda & Yala, 2004).

Lack of knowledge of the EPI by midlevel managers was a contributor to failure to maximise delivery of service in Kenya, hence, a low immunization coverage with high dropout rates (Ayaya, Liechty, Conway, Kamau & Esamai, 2007). Religion was also found to have an effect on the Benin, parent's decisions to or not to vaccinate their children. Reticence of parents towards vaccination was found to be mainly related to parents' religious principles (Fourn, Haddad, Fournier & Gansey, 2009).

In Mali, a priority programme that included decentralisation, the active search for missing children, and deployment of health personnel, materials and financial resources was seen to have improved the EPI immunization coverage rate (Koumare *et al.*, 2009). In Congo it has been shown that involvement of fathers and fathers' level of education along with the mothers' experience in EPI targeted diseases, contributed positively to the complete immunization status of children in the high-coverage health zones. It was also revealed that mothers' vaccine-related knowledge was a predictor of the immunization status only in the low-coverage zone (Mapatano, Kayembe, Piripri & Nyandwe, 2008).

In Burkina Faso, it has been shown that there is a positive relationship between parental knowledge of the preventive value of immunization and complete immunization status of

children aged between 12 and 23 months. (Sanou, Simboro, Kouyate, Dugas, Graham & Bibeau, 2009). These findings were congruent with previous findings in Nigeria that showed that high vaccination coverage was correlated with the mother's knowledge of immunization (Odusanya, Alufohai, Meurice & Ahonkhai, 2008).

Although still falling short of the 2010 goal of 90% coverage, Africa, with an estimated 74% coverage and South-East Asia with estimated 69%, has a positive improvement in immunization coverage attributed to national year planning, district level planning and monitoring, re-establishment of outreach services and the establishment of national budget lines for immunization coverage strengthening (Duclos, Okwo-Bele, Gacic-Dobo & Cherian, 2009).

2.4 Immunization coverage in Southern Africa

A study in Malawi showed that, on average, all vaccines were given one to three months later than recommended on the EPI schedule. The high crude immunization coverage does not reflect the valid doses, nor does it mean protection from vaccine preventable diseases (Vaahtera, Kulmala, Maleta, Cullinan, Salin & Ashorn, 2000). Furthermore, young mothers with children getting a BCG vaccination in Zambia were likely to bring their children for DPT1 vaccination than older mothers (Pilay & Conaway, 1992). It was revealed that, avoidance of missed opportunities for vaccination and incorrect vaccination will increase the vaccine coverage for the clients that visit health facilities in Mozambique (Jani, Schacht, Jani and Bjune, 2008).

2.5 Immunization coverage in South Africa

In South Africa, a significant decline was observed in the national immunization coverage statistics, 93.2% was reported in 2009/10 and 86.7% in 2010/11, with 72% of all districts recording a low coverage compared to the previous years. The public sector strikes in August of 2010 and the shortages of the newly introduced Pentaxim vaccine were viewed as a contributory factor to the decline in immunization coverage. In Vhembe District, immunization coverage rates declined from 100.8% in 2009/10 to 93.9% in 2010/11. These rates, based on reports from the District Health Information systems and from

national surveys, are often characterised by under or over reporting because of over or under estimation of populations (Massyn *et al.,* 2014). It has been acknowledged that there were reporting problems, but trends in vaccine coverage are valid since reporting problems has been present throughout the years (Arevshatian, Clements, Lwanga, Misore, Ndumbe, Seward, & Taylor, 2007).

The decline in immunization coverage indicates a failure to sustain achievements made previously, and this is a major concern for the country. I has also been revealed that vaccine coverage in South Africa was seen to be lower for the vaccines given at an older age, and, more importantly, in poorer areas (Fadnes *et al.*, 2011).

It has been proven in many studies that vaccination coverage is not a good indicator of age appropriate vaccination where vaccine coverage statistics are high, but often not timely. Children were unprotected for several months despite being vaccinated at the end of the follow up exercise (Fadnes *et al.,* 2011).

CHAPTER 3

METHODOLOGY

3.1 Introduction

LoBiondo-Wood and Haber (2002: 116) describe research methodology as a method for carrying out research and that it presents the method for data collection, measurement, as well as the techniques used for data analysis. This chapter describes the research design, study population, sample and sampling methods, ethical considerations, data collection tools and data analysis techniques.

3.2 Study design

It is a retrospective study based on a secondary data set. The design is however quantitative, descriptive and cross-sectional. A cross-sectional study design is defined as a design where all the data is collected at a single point in time (Bonita, Beaglehole, and Kjellstrom, 2006). This design was used because the researcher wanted to describe the immunization coverage rates at the time the data was collected.

3.2 The study setting

This study was conducted in Dzimauli village which is located in Mutale Municipality under Vhembe Districts, Limpopo Province of South Africa. Dzimauli village comprised of 12 linear settlements that are adjacent to each other with no clear boundaries between them. It is about 45 km from the University of Venda and the roads within the area are filled with potholes and muddy during the rainy season, dusty during the dry months. The estimated population of Dzimauli villages is 9000 with a mean age of mothers of 31 years, and the mean age at first pregnancy of 19 years. Residents has access to 3 health centers or clinics, Rambuda clinic is the most accessible and it is located central to all villages. Tshilamba health centre is to the east of the villages and to the north is Xihwadza clinic. Twenty kilometers west of Dzimauli villages is the Vhufuli hospital were

most of the participants were delivered. Figure 3.1 shows the 12 villages, namely Baimoro, Madadani, Pile, Pfimbida, Matshavhawe, Mbahela, Tshandama, Tshapasha, Tshibvumo, Thongwe and Xihwadza and its relationship to the country and the province.

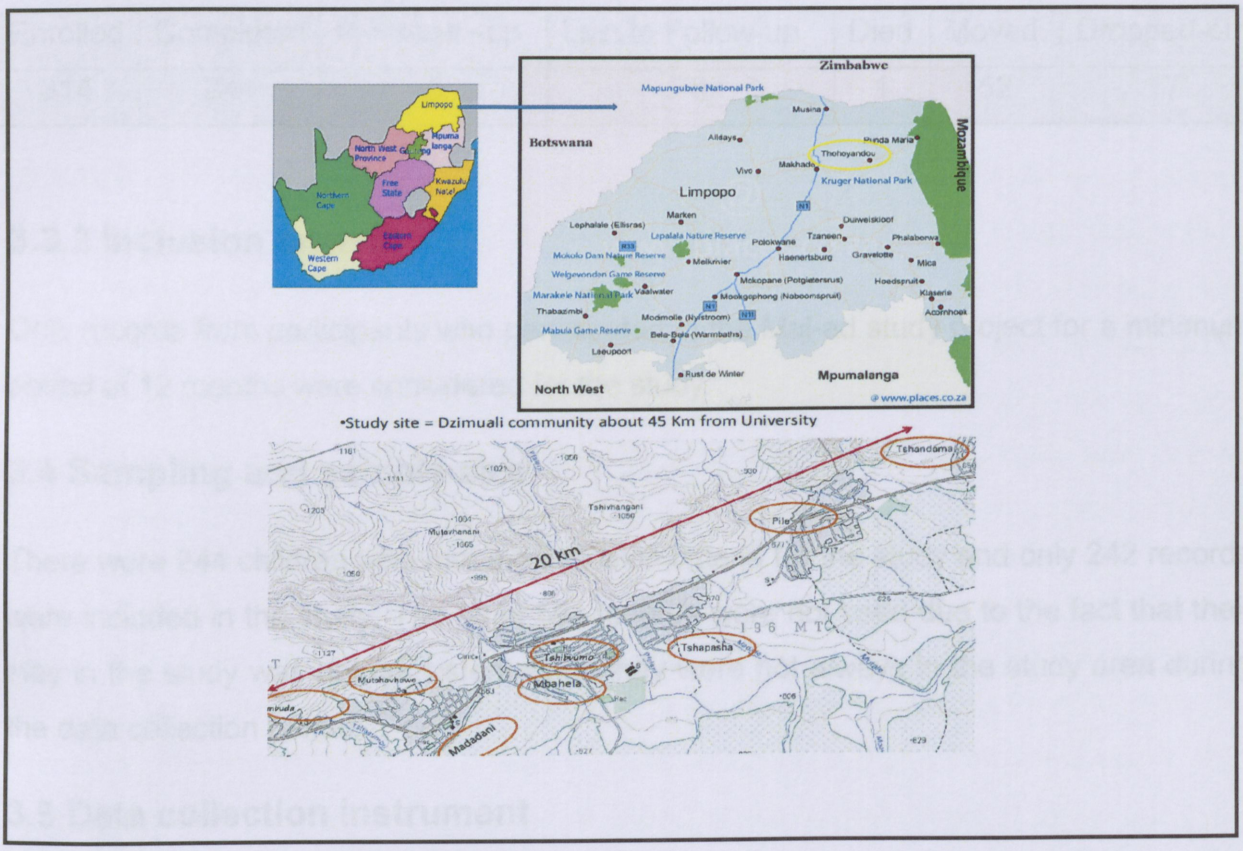


Figure 3.1: Map of the study area

3.3 Target population

The target population for this study comprised children enrolled in the Malnutrition and enteric diseases (Mal-ED) cohort in Dzimauli village, Vhembe District in Limpopo Province of South Africa.

3.3.1 Study population

Three hundred and fourteen (314) children were enrolled in the Mal-ed study project, between November 2009 and February 2014. Table 3.1 shows the Mal-ed study population together with the follow-up statistics.

Table 3.1: Mal-ed Enrollment and Follow-up Statistics

Enrolled	Completed	In Follow –up	Lost to Follow-up	Died	Moved	Dropped-out
314	244	0	70	1	52	17

3.3.2 Inclusion criteria

Only records from participants who participated in the Mal-ed study project for a minimum period of 12 months were considered for the study.

3.4 Sampling and sample size

There were 244 children who met the inclusion criteria for the study and only 242 records were included in the study. The other two records were not used due to the fact that their stay in the study was not consistent since they were not always in the study area during the data collection period.

3.5 Data collection instrument

A data sheet (see **Annexure C)** was used to extract relevant data from the Mal-ed data base for analysis.

3.6 Ethical considerations

3.6.1 Permission to conduct the survey

This study involved secondary data analysis from the Mal-ed research project as well as collection of additional data from mothers/caregivers of the children in the Mal-ed project. Permission to use the Mal-ed data was sought and obtained from Mal-ed South Africa site, as well as permission to collect additional data. The School of Health Sciences Higher Degrees Committee, University of Venda Higher Degrees Committee, Research Committee and University of Venda Ethics Committee approved the secondary analysis

of the Mal-ed data and collection of additional data for the purpose of this research project (see Appendix H). Additional informed consent was not required.

3.8 Data collection process

3.8.1 Secondary data

The Mal-ed data was collected from a cohort between, November 2009 and February 2014. Close ended validated questionnaires were administered by trained fieldworkers using the local Tshvenda language to ensure understanding and accuracy of response. Children's surveillance data and immunization data were collected twice weekly within two days before and two days after the birth date anniversary every month for two years by fieldworkers and entered into the Double Data Entry Database. Data from Mal-ed Double Data Entry Database were extracted for analysis by means of a data collection sheet.

A screening form (SCR) (see **Annexure C**) was used to screen potential participants with less than seventeen day old babies to determine if they met the criteria for participating in the study. The mothers had to be older than sixteen years old and be able to give written informed consent. Selected mothers were expected not to have plans to move out of the study area within six months of enrolling in the study. Three hundred and sixty two (362) children, aged less than seventeen days and born between November 2009 and March 2012 were screened. Seventeen were dropped because their mothers were either less than sixteen years old or had indicated plans to move out of the study area within six months of screening. Twenty-seven mothers refused to participate in the Mal-ed cohort study.

Demographic data were collected on enrolment using a demographic baseline form (DAF) (see **Annexure** D). A monthly assessment form A (MOA) was used to collect anthropometry, nutrition, and immunization data from zero birth to 8 months of age, and a monthly form B (MOB) (see **Annexure F**), was used to collect anthropometry and immunization data from 9 to 24 months old children. A vaccine information form (VIF) (see **Annexure F**), was used as a quality control tool to collect immunization data every 3

months, and this data were compared with the immunization data from the monthly (forms for consistency).

3.8.2 Additional data

Additional data were collected from the mothers/caregivers of children who were found to be partially immunized from the secondary analysis of Mal-ed data. Data were collected through interview –administered questionnaires (see Annexure D, Section C).

3.9 Data analysis

Data processing included the following steps: Sorting, categorisation, coding, cleaning, entry validation and entering into a Double Data entry Microsoft Access-based database. The Double Data entry system allows data to be entered twice and if both entries are correct, the data is transmitted to the final excel-based files were analysed using Excel and SPSS. This system takes care of data entry errors and improves the quality of data.

The data cleaning process began with the field workers checking if everything written on the form was correct. Errors, were corrected, signed for, and then dated. Field supervisors also checked the form for errors before submitting to the data management centre.

Data capturer one also checked the form for errors before entering the information into the database. After entering data, the form was handed to data capturer two, who further checked for errors before entering the data into the database. Forms found to have errors at any level of data processing were sent back to the fieldworker for corrections. Thereafter the same process was followed. The excel files generated from the double data entry were used to extract the information necessary to carry out this study. The SPSS version 21 was used for data analysis. Results are presented by means of tables and graphs.

3.10 Scope and limitations of study

Immunization coverage has been shown in many other studies to be significantly related to socio-economic status of mothers and caregivers (Aboubakary, 2009; Yokokura,

2006). This study was carried out in a rural community which has people with varied socio-economic statuses and, therefore, its results cannot be generalised to urban settings. Further studies in different municipal areas may be required to draw conclusive immunization coverage for the district and the country.

CHAPTER 4:

PRESENTATION OF STUDY RESULTS

4.1 Introduction

This chapter presents findings of this study in five sections, namely, characteristics of participants, crude immunization coverage, valid immunization coverage, immunization dropout rates, missed opportunities, and reasons for failure to immunize 0 to 24 month old children. Information obtained from the records is presented in tables and figures below in the form of descriptive statistics.

4.2 Characteristic of participants

Out of 244 records of children meeting the study criterion, only 2 records were excluded because on lack of sufficient information. Thus, a total of 242 records were reviewed. About 50.4% (n=122) of the participants were male children and 49.6% (n=120) were female children.

4.3 Characteristics of the children's mothers/caregivers

Table 4.1 indicates that the majority of the mothers, (25%) (n=61) are between 16 and 20 years of age, (23%) (n=56) are between 21 and 25 years of age, (18%) (n=44) are between 26 and 30 years of age, (17%) (n=42) are between 31 and 35 years of age, 12% (n=30) are between 36 and 40 years of age, and (4%) (n=9) are between 41 and 45 years of age. About (38%) (n=107) of the mothers were younger than 25 years old. About (40.5%) (n=98) of the children's mothers were never married while (43%) (n=28) are in monogamous marriage, (0.4%) (n=1) is married and the first wife, while (11.6 %) (n=28) are polygamous marriage. A small number of mothers (3.7%) (n=9) are divorced and 0.8% (n=2) widowed. Mothers who were younger than 25 years of age and still going to school constitute (17%) (n=41) of the study participants and (38%) (n=107) of the mothers are younger than 25 years.

About 10% (n=25) of the mothers had primary education, (86%) (n=206) had secondary school education and (4%) (n=10) had tertiary education.

Table 4.1: Socio-demographic characteristics of child's mother

VARIABLE		N	FREQUENCY (%)
Age			
	16 – 20	61	25
	21 – 25	56	23
	26 – 30	44	16
	31 – 35	42	17
	36 – 49	30	12
	41 – 45	9	4
Marital status			
Never married		98	40.5
Married only wife		104	43
Married first wife		1	0.4
Married second or higher wife		28	11.6
Divorced		9	3.7
Widowed		2	0.8
Level of Education			
Primary		25	10
Secondary		206	86
Tertiary		10	4

4.4 Crude immunization coverage among 0 to 2 year old children

Crude Immunization Coverage is defined as immunization doses given to a child evidenced by cards, where applicable, or by history given by mothers/guardians (UNICEF, 2008). In this study crude immunization means immunization doses given to a child evidenced by the road to health booklet/chart.

Table 4.2 presents the crude immunization coverage rates of all individual EPI vaccines measured by card only. There are two vaccines administered at birth, namely BCG and OPV (0). An average of 99% (n=238) vaccination doses were administered. The six weeks vaccines, according to the EPI (SA) schedule, comprise of OPV (1), RV (1), DPT (1), Hep B (1) and PCV (7). The average crude immunization coverage at 6 weeks is (99.5%) (n=241). At 10 weeks, DPT (2) and Hep B (2) are administered and the average crude immunization coverage for the 2 vaccines is (95.5%) (n=231). The 14 weeks vaccines as per the EPI (SA) are RV (2), DPT (3), Hep B (3) and PCV 7 (2), and the average crude immunization coverage for these vaccines is (91.5%) (n=221). At 9 months only 2 vaccines are administered, namely, Measles (1) and PCV7 (3). The average crude immunization coverage at 9 months is (79%) (n=192). The two vaccines administered at 18 months are Measles (2) and DPT (4), and the average crude immunization coverage for these vaccines is (55.5%) (n=135). A total of 3638 vaccine doses were administered and that constitutes 88% of the 4114 expected doses.

Table 4.2: Crude immunization coverage amongst 0 to 24 month old children

CRUDE IMMUNIZATION COVERAGE			
AGE OF CHILD	**VACCINE TYPE**	**N**	**FREQUENCY (%)**
AT BIRTH	BCG	234	97
	OPV (0)	241	100
	AVERAGE	237.5	98.5
6 WEEKS	OPV (1)	229	95
	RV (1)	236	98
	DTP (1)	239	99
	Hep B (1)	241	100
	PCV7 (1)	240	99
	AVERAGE	240.5	99.5
10 WEEKS	DTP (2)	227	94
	Hep B (2)	235	97
	AVERAGE	231	95.5
14 WEEKS	RV (2)	211	87
	DTP (3)	209	86
	Hep B (3)	215	89
	PCV7 (2)	227	94
	AVERAGE	221	91.5
9 MONTHS	Measles (1)	219	90
	PCV7 (3)	165	68
	AVERAGE	192	79
18 MONTHS	DTP (4)	122	50
	Measles (2)	148	61
	AVERAGE	135	55.5
Total doses administered		3638	88

4.5 Valid immunization coverage among 0 to 24 months old children

Valid Immunization Coverage is defined as doses administered to a child as evidenced by a road to health card. Doses given are appropriate to the age of the child. For example, the BCG vaccine is given within the first week of birth, and the measles vaccine is administered at the age of nine months (UNICEF, 2008).

Table 4.3 below presents the valid immunization coverage rates of all individual EPI vaccines measured by card only. The average age appropriate vaccine coverage rates of vaccines administered at birth, namely BCG and OPV (0) is 94.5% (n=228). The six weeks vaccines, according to the EPI (SA) schedule, comprise of OPV (1), RV (1), DPT (1), Hep B (1) and PCV (7). The average immunization coverage at 6 weeks is 77% (n=185.5). At 10 weeks, DPT (2) and Hep B (2) are administered and the average immunization coverage for the 2 vaccines is 43% (n=104). The 14 weeks vaccines according to the EPI (SA) schedule are RV (2), DPT (3), Hep B (3) and PCV 7 (2), and the average immunization coverage for these vaccines is 51.5% (n=124.5). At 9 months only 2 vaccines are administered, namely Measles (1) and PCV7 (3). The average immunization coverage at 9 months is 44% (n=105.5). The two vaccines administered at 18 months are Measles (2) and DPT (4), and the average immunization coverage for these vaccines is (24%) (n=58.5). A total of 2298 vaccine doses were administered and that constitutes 56% of the 4114 expected doses.

Table 4.3: Valid immunization coverage among 0 to 24 months old children

VALID IMMUNIZATION COVERAGE			
AGE OF CHILD	**VACCINE TYPE**	**N**	**FREQUENCY (%)**
AT BIRTH	BCG	227	94
	OPV (0)	229	95
	AVERAGE	228	94.5
6 WEEKS	OPV (1)	189	78
	RV (1)	169	70
	DTP (1)	158	65
	Hep B (1)	195	81
	PCV7 (1)	176	73
	AVERAGE	185.5	77
10 WEEKS	DTP (2)	44	18
	Hep B (2)	164	68
	AVERAGE	104	43
14 WEEKS	RV (2)	107	44
	DTP (3)	63	26
	Hep B (3)	129	53
	PCV7 (2)	120	50
	AVERAGE	124.5	51.5
9 MONTHS	Measles (1)	120	50
	PCV7 (3)	91	38
	AVERAGE	105.5	44
18 MONTHS	DTP (4)	51	21
	Measles (2)	66	27
	AVERAGE	58.5	24
Total doses administered		2298	56

4.6 Immunization dropout rate

Dropout Rates refer to the percentage of children who receive one vaccine, but do not receive the subsequent vaccines, for example, the percentage of children receiving the BCG vaccine, but not receiving the measles vaccine or the percentage of children receiving DPT1 but not receiving DPT3 (UNICEF, 2008).

Table 4.4 represents the dropout rate from DTP (1) to DTP (3). It shows the crude immunization coverage of (99%) (n=239) of the children who received DTP (1) at 6 weeks At 14 weeks (86%) (n=209) children received DTP (3), an average dropout rate of 37% (n=136). There were 158 valid doses of DTP (1) administered at 6 weeks, a decline of 60%; only 63 children received the valid doses of DTP (3).

Table 4.4: Dropout rate among 0 to 24 months old children

DTP (1) TO DTP (3) DROPOUT RATE			
	DTP (1)	DTP (3)	RATE
Crude coverage	239	209	13
Valid coverage	158	63	60
Average	199	136	37

4.7 Valid immunization versus crude immunization coverage

The results of the study revealed that there is a huge difference between crude and valid immunization coverage rates, with a dropout rate of 37%. The trend in both coverage rates is similar, high at birth and a gradual decline as the children get older. Figure 4.1, below shows the relationship between crude and valid immunization coverage, as well as its inverse proportionality with the age of the children.

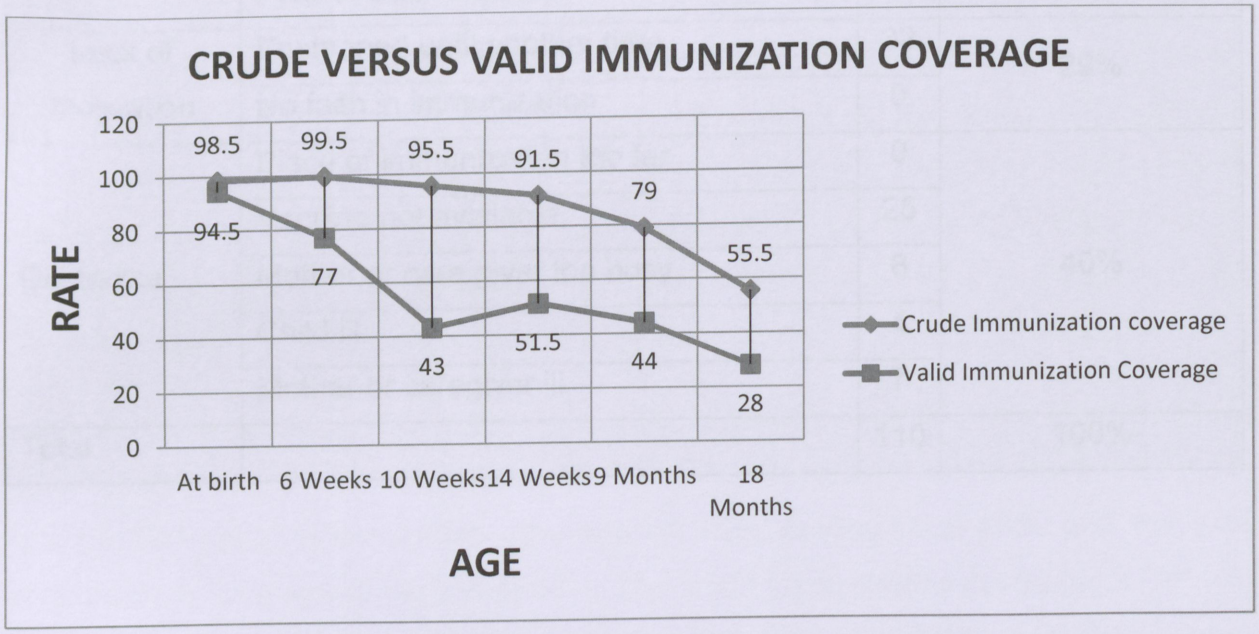


Figure 4.1: Crude versus Valid Immunization rate

4.6 Reasons for failure to immunize 0 to 24 month old children

Reasons for failure to immunize children were identified as either, lack of motivation, lack of information and obstacles. The survey revealed that 29% of the failures to immunize the children were due to lack of motivation, 31% were due to lack of information and 40% were due to obstacles. Table 4.5, below shows the classified grouping of specific reasons for failure to immunize children and their extent.

Table 4.5: Reasons for failure to immunize children

REASONS FOR IMMUNIZATION FAILURE		N	FREQUENCY (%)
Lack of information	Unaware of need for immunization	0	31%
	Unaware of need to return for second or third dose	10	
	Place and time of immunization unknown	4	
	Fear of side reactions	20	
Lack of motivation	Postponed until another time	32	29%
	No faith in immunization	0	
Obstacles	Place of immunization too far	0	40%
	Vaccine not available	25	
	Mother or care giver too busy	8	
	Child ill	4	
	Mother or caregiver ill	7	
Total		110	100%

CHAPTER 5:

DISCUSSION OF THE RESULTS

5.1 Introduction

This study was designed to evaluate the immunization coverage among 0 to 24 months old children in Dzimauli village, Limpopo Province of South Africa, and also investigate the reasons for not immunizing children. It also looked at the difference in crude and valid vaccination coverage patterns and vaccination trends against the age of children. Since there are no previous similar studies done in this area, the results of this study will be compared with the records obtained from the District Health Information system, the Health Systems Trust, as well as the National Immunization coverage statistics.

The revised childhood immunization schedule EPI (SA), April 2009 has two vaccines administered at birth, namely BCG and OPV (0) vaccines. The results of the study indicate that crude immunization coverage of BCG vaccine is at 97% and the valid immunization coverage of BCG is at 94%. The crude immunization coverage of OPV (0) vaccine is 100%, while the valid immunization coverage of OPV (0) is at 95%. These vaccines are normally administered at birth or at least before the child is discharged from the health facility in which they were delivered. This is seen in the high coverage of the two vaccines administered at birth. All children were expected to have received the BCG and OPV (0) vaccines on time since they were born in health facilities. The results reveal that 3% of the children did not receive the BCG vaccine and this could be because of the unavailability of drugs in the health care facilities.

A study in Ghana found that children who received immunization services in the same facility where they were born appeared more likely to receive the BCG vaccine on time (Laryea, Parbie, Frimpong & Ebenezer, 2014). A study in Guinea-Bissau also found that children born at a hospital or health centre were likely receive the BCG vaccination and, similarly, a study in South Africa found that birth at a health facility significantly reduced

the risk of a child going unvaccinated (Thysen, Byberg, Peresen, Rodrigues, Ravn, Martins, Benn, Aaby, Peter & Fisker, 2014); (Fadnes et al. (2011)). At 10 weeks, crude and valid immunization coverage is at 86% and 26% respectively. Although the crude immunization coverage is lower than the target of 90% set by the Department of Health, it is considerably high. At this age parents are still motivated to take the children to health facilities for booster vaccines (Mutua et al., 2011). At 14 weeks crude vaccination coverage is high, ranging from 86% DTP (3) to 94% PCV7 (2). The valid immunization coverage rates are as low as 26% DTP (3) and 53% HepB (3). The trend of high vaccination at the early stages of life is still visible and the pattern of children not getting vaccinated on time is seen from the low coverage in valid vaccination rates.

Most of the children, in the study, were born in Vhufuli Hospital, a major health facility which is about 40 to 50KM from the study area. The hospital does not have a clinic and, therefore, children have to visit different clinics in their areas of origin for further vaccination doses. Children who, for some reason, do not receive the required vaccines at birth visit local clinics for vaccination. This may result in missed opportunities for immunization, as shown by the BCG coverage of 97%.

There is a gradual decline in immunization coverage rates at 10 weeks (95.5%), 14 weeks (91.5%), 9 months (79%) and 55.5% at 18 months. The decline in immunization coverage rates reveals a problem of children not returning for booster vaccines as they grow up, hence a decrease in the immunization coverage with an increase in age of the child. These findings are consistent with Laryea *et al.* (2014), in Ghana, who revealed that, there was a high proportion of children receiving all vaccines on time. However, the proportion decreased with the increasing age of the children. Low coverage in booster vaccination could be due to the physicians and families losing interest over time in maintaining vaccine coverage (Ozcirpici, Aydin, Coskun, Hakan & Ozgur, (2014). A study in Kenya revealed high vaccination coverage for vaccines given in the early stages of life while the coverage for Measles given towards the end of the first year was poor (Mutua, Murage & Ettarh, 2011).

The high levels of immunization coverage at birth (BCG and OPV (0)) could be attributed to the fact that all children were born at a health facility and that these vaccines are

normally administered before the children are discharged. Vaccination coverage rates for vaccines administered at a later stage of life that is 9 months and 18, months are lower at 79% and 55.5% respectively compared to 98.5% at births. This is comparable with similar studies that found highest immunization coverage at birth and lowest coverage at 18 months (Corrigall *et al., 2008;* Ndirangu *et al.,* 2009). Findings of this study also revealed that most children complete the early stages of the vaccination schedule, but fail to adhere to the later stages of the schedule, (9 months and 18 months).

The results of this study revealed that Measles (1) vaccination coverage is as high as 90% for crude vaccination and only 50% for valid doses. It is difficult to ascertain whether the 90% coverage is according to the EPI schedule or whether some vaccines were administered during the campaigns and during the vaccination week.

PCV7 (3) administered at the same time with Measles has its crude vaccination coverage at 68% and the valid coverage at 38%. The results for PCV7 (3) concurs with the trend of low coverage in booster vaccines, and it is contrary to the trend shown in Measles vaccinations, hence the suspicion that it may include non-schedule vaccination doses.

The road to health chart does not have a separate space to record vaccines given during campaigns and, therefore, some health workers add it to the EPI schedule. The results have shown that vaccination coverage at 18 months is far below the target of 90%, with DTP (4) having a crude rate of 68%, valid rate of 21% and Measles (2) having a crude rate of 61% and a valid rate of 27%. These results are in line with other studies that have indicated a decline in vaccination coverage as the children grow older (Mutua *et.al.*, 2011).

Similarly, Fadnes *et al.* (2011) on vaccination coverage and timeliness in three South African areas found out that vaccination coverage was lower for the vaccines given at an older age. The findings were further in agreement with those of Scott *et al.*, (2014) in which he revealed that the Gambia health system achieved high vaccine coverage in the first year of life (Scott, Odutola, Mackenzie, Fulford, Afolabi, Jallow, Jasseh, Jeffries, Dondeh, Howie & D'Alessandro, 2014).

Unlike findings in this study, research conducted by Thysen *et al.* (2014), on BCG coverage and barriers to BCG coverage in Guinea-Bissau, found out that BCG coverage during the first month of life was low. With regards to factors associated with underimmunization at 3 months of age, it was found that missed opportunities were significant barriers to vaccinations (Bardenheir, Yusuf, Rosenthal, Santoli, Shefer, Rickert, & Chu, 2004). In Guinea-Bissau, it was found that vaccine coverage was low at the age of 12 months, but continued to increase beyond 12 months of age (Hornshoj, *et al.*, 2012).

Unvaccinated children are at risk of vaccine preventable diseases such as Measles. Low immunization coverage at a later stage of life may results in low vaccination rates against Measles and Pneumococcal infections.

Based on current trends, it was concluded that the 2015 measles milestones and elimination goals will not be achieved on time (WHO, 2015). Yuan found out that adherence to routine measles vaccination for all eligible children was important to ensure appropriate coverage with a single dose (Yuan, 1994).

In Burkina Faso it was also found out that strategies to reduce missed opportunities for vaccination resulted in high vaccination coverage that prevented large measles outbreaks. This infurn resulted in a reduction in measles mortality (Kidd, Ouedraogo, Kambire, Kambou, Mclean, Kutty, Ndiaye, Fall, Alleman, Wannemehler, Masresha, Goodson, & Uzicanin, 2012). The measles out break in South Africa from 2003 -2005 and 2009 - 2011 associated with poor vaccination coverage, a high prevalence of HIV infection and a high population density (Sartorius, Cohen, Chirwa, Ntshoe, Puren, & Hofman, 2013; McMorrow, Gebremedhin, van den Heever, Harris, Nandy, Strebel, Jack & Cairns, 2009).

5.7 Overall vaccination rates

Of the 4114 crude vaccine doses expected, a total of 3638 vaccine doses were administered, while a total of 2664 valid doses were administered. The overall crude immunization coverage was at 88%, while the overall valid immunization coverage is at 56%, similarly to the results of a study in Mali that indicated only 59.9% of the children were fully immunized (Koumane et.al. (2009).

Average immunization coverage in Dzimauli village is at 72%, lower than the national immunization coverage rate in 2011 that was 98%, while Limpopo Provinces' coverage rate was at 96.7% (Health Systems Trust, 2013). The vaccine coverage for Vhembe District in 2011 was 90% and that of Mutale Local Municipality was 95% (MASSYN, *et al.*, 2014). The immunization coverage rate among the children in the study is 2% shot of the target of 90% set by the Department of Health, and is lower than what is reflected in the National, District and the local Municipality statistics.

The results show that valid immunization of all vaccines is constantly lower than the crude immunization coverage. Achieving high vaccination coverage is necessary, but is not a sufficient indicator of the quality of a vaccination programme, and, therefore, timeliness of vaccination is an important target (Lermout, Theeten, Hens, Braeckman, Roelants, Hoppenbrouwers & Va Damme, 2014).

This is consistent with many other studies. A study in Bangladesh revealed that timely or valid vaccination coverage of infants was extremely low, with only 19% of the infants receiving scheduled vaccinations on time (Vasudevan, Labrique, Mehra, Wu, Levine, Feikin, Klemm, Christian, & West, 2014). Another study revealed that some children had a delay of more than 90 days to get scheduled primary immunization (Ughade, Zodpev, Deshpande & Jain, 2000).

It has been shown that children rarely receive all vaccinations as recommended in the vaccination schedule. Therefore, there is a need to improve timeliness of administration of vaccines (Barker, McCauley, MTSC & Drews-Botsch, 2005). In India, it was found that immunization coverage had increased since the early 1990s, but complete age appropriate coverage was still as low as 50% (Corsi, Bassani, Awasthi, Jotka, Kaur & Jha, 2009). Kalies *et al.* (2006) concluded that, although combination vaccines were meant to reduce the number of injections a child gets, they can significantly improve the timeliness of immunization (Kalies, Grote, Verstraeten, Hessel, Schmitt and von Kries, 2005).

5.9 Dropout rates

The difference between crude and valid immunization rates is due to children dropping out of the immunization schedule. The results have shown that the dropout rate from DTP (1) to DTP (3) is 13% for crude immunization coverage and is as high as 74% for valid immunization. These figures are extremely high when compared to the 2010 HST records for Limpopo Province which were at 7.6% and the national, at 5.6% (MASSYN, *et al.*, 2014). Studies have shown that, although majority of children do receive vaccination in their first birthday, coverage levels at 24 months of age are low and, therefore, tracking systems need to be put in place to ensure that children do not drop out of the system once they have begun the vaccination series (Dietz *et al.*,1994).

A study in Mali revealed that the dropout rate between DTCP1 and DTCP3 was 5.5%, much lower than the rate of 37% revealed by this study. (Koumare, Abdel, Traore, Haidara, Haidara, Sissoko, Traore, Drame, Sangare, Diakite, Coulibaly, Togola, & Maiga, 2009).

5.10 Reasons for failure to immunize

The results show that 39% of the children were partially immunized; 31% of them were not immunized due to lack of information, 29% due to lack of motivation, and 40% due to obstacles. Unlike the children in Mozambique, who did not complete their vaccination programme due to lack of accessibility to the vaccination site, children in this study had access to three health facilities, as well as a mobile clinic (Jani, *et al.*, 2008).

The DHIS 2013/14 report indicated that some clinics experienced stock outs in February 2014 that lasted from one to four weeks, and this is one of the obstacles that prevented children from getting vaccinated. Other factors noted by DHIS included facilities doing immunization only on stipulated days, and not administering vaccines after hours, as well as migrations resulting in non-adherence to return dates. Our study did not explore the activities of the health facilities in the area, but migration was a common problem during data collection. A good number of children do not stay in one place for a long time.

The results revealed that the majority of children were not fully immunized as a result of obstacles, thus unavailability of vaccines, mother or care giver of the child too busy, mother or care giver being ill as well as the child illness.

CHAPTER 6:

CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

The study results reveal that the majority of parents in Dzimauli village endeavour to take their children for immunization. All children that participated in the study were in possession of a road to health chart, which enabled this research to check and confirm the vaccines given according to the EPI (SA) schedule. The biggest challenge is failure to complete the EPI schedule and adhere to the schedule timelines, especially vaccines given in the later stages of a baby's life. This is shown by high crude immunization coverage rates and lower valid immunization coverage rates.

The overall immunization coverage rate is 72% (88% for crude vaccination and 56% for valid vaccination), a trend that is also shown by individual vaccines. Crude vaccination is higher than the valid immunization coverage rates. Both the crude and valid rates are lower than the 90% target set by the Department of Health and the 95% WHO recommended immunization coverage to achieve herd immunity, as well as the targets set by WHO and UNICEF which is at least 90% vaccination coverage by 2015.

Vaccination at birth is high because the majority of children are born in health care facilities and they are administered the vaccines before being discharged from the health care facilities. The few who are not vaccinated at birth failed to get vaccinated because vaccines were out of stock at the time they were born; however they later managed to receive the vaccine in the second or third visit to the health facilities.

As the children grow older, it has been observed that their adherence to the EPI schedule is very poor; hence an average dropout rates of 37% (13% for crude vaccination and 60% for valid vaccination). There are a number of reasons why children failed to complete or adhere to the EPI schedule, and there are grouped into 3 groups, namely lack of motivation, lack of information and obstacles.

Obstacles are the highest factor leading to non-vaccination of children, hence there is need to priorities the elimination of such. Factors such as unavailability of vaccines reveal a lot about the administration of vaccines in South Africa. This needs to be avoided if the quality of the vaccination programme is to be maintained.

6.2 Recommendations

The declining coverage rates, as children grow older, sends an important message for the EPI (SA) programme managers and policymakers to improve vaccine coverage and adhere to the EPI (SA) timelines. We, therefore, recommend that the Department of Health should improve the supply of vaccine doses to health facilities that take care of the population, as well as children who do not stay in one place for a long time.

All under 24 months old children should be registered and be closely monitored so that they may get all the vaccines on time. Community health care workers should be employed and their primary duties should be to do home visits to see if children are getting all the vaccines. They will also provide education to mothers and care givers during their visits.

It is also recommend that the Department of Health should consider introducing more combination vaccines to reduce the number of injections a child receives, as well as the number of times children have to visit health care facilities, in order to get immunization vaccines.

It is also important to embark on further studies on immunization coverage in the Vhembe District so that we can come up with conclusive results. These studies may be conducted on a yearly basis to monitor improvement or decline in vaccination rates.

The Department of Health should not only focus on improving vaccination coverage, but they should also work towards improving the quality of the vaccination doses and completely adhere to the EPI (SA) schedule for better protection of the children.

REFERENCES

Aatekah Owals, Beenish Hanif, amna R Siddiqui, Ajmal Agha and Anita KM Zaidi, 2011. Does improving maternal knowledge of vaccines impact infant immunization rates? A community-based randomized-controlled trial in Karachi, Pakistan. *BMC Public Health.*

Abdel Karin Koumare, Drissa Traore, Fatouma Haidara, Filifing Sissoko, Issa Traore, Sekou Drame, Karim Sangare, Karim Diakite, Brehima Coulibaly, Birama Togola, Aguissa Maiga, 2009. Evaluation of immunization coverage within the Expanded Program on Immunization in Kita Circle, Mali: a cross-sectional survey. *BMC International Health and Human Rights.*

Abdul, R.M.A., Al-Dabbagh, S.A and Al-Habeeb, Q.S, 2013. Health education and peer leaders' role in improving low vaccination coverage in Akre district, Kurdistan Region, Iraq.. *East Mediterr Health J,* pp. 125-129.

Aboubakary Sanou, Seraphin Simboro, Bocar Kouyate, Marylene Dugas, Janice Graham and Gilles Bibeau, , 2009. Assessment of factors associated with complete immunization coverage in children aged 12-23 months: a cross-sectional study in Nouna district, Burkina Faso. *BMC International Health and Human Rights.*

Alto, W.A., Fury, D., Condo, M and Aduddell, M., 1994. Improving the immunisation coverage of children less than 7 years old in a family practice residency.. *J Am Board Fam Pract,* pp. 472-7.

Andrea Minetti, Mattew Kagoli, Agnes Katsulukuta, Helena Huerga, Amber Featherstone, Hazel Chotcha, Delphine Noel, Cameron Bopp, Laurent Sury, Renzo Fricke, Marta Iscla, Northan Hurtado, Tanya Duconmble, Sarala Nicholas, Storn Kabuluzi, Rebecca F. Grais,, 2013. *Lessons and Challenges for Measles Control from Unexpected Large Outbreak, Malawi,* s.l.: CDC.

Andrew-Chavez., Animesh, Biswas., Mervyn, Gifford., Charli, Eriksson and Koustov, Dalal, 2012. Identifying household with low immunization completion in Baglades.. *HEALTH,* 4(11), pp. 1088-1097.

Anita, Hardon., Stuart, Blume, 2005. Shifts in global immunization goals (1984-2004): unfinished agendas and mixed results. *Social Science and Medicine,* pp. 345-356.

Anna Nilsson, Fracesca Chiodi, 2011. Measles Outbreak in Africa-Is There a Link to the HIV-1 Epidemic. *PLoS Pathongens.*

Arevshatian, L; Clements, CJ; Lwanga, SK; Misore, AO; Ndumbe, P; Seward, JF and Taylor, P, 2007. L Arevshatian, CJ Clements, SK Lwanga, An evaluation of infant immunization in Africa: is a transformation in progress.. *WHO,* pp. 449-457.

Axel Antonio Bonacic Marinovic, Corien Swaan, Ole Wichmann, Jim van Steenbergen, and Mirjam Kretzschmar, 2012. Effectiveness and Timing of Vaccination during School Measles Outbreak. *Medscape Education,* pp. 1405-1410.

Ayaya, S.O., Liechty, E., Conway, J.H., Kamau, T and Esamai, F.O., 2007. Training needs for mid-levelmanagers and immunisation coverage in Western Kenya.. *East Afr Med J,* pp. 342-352.

Babalola, S., 2011. Maternal reasons for non-immunisation and partial immunization in nothern nigeria. *Journal of Paediatrics and Child Health,* 47(5), pp. 276-281.

Barbara EM,Kimberly MS, Nancy ND, Anita ML, 2008. Implications for registry-based vaccine effectiveness studies from an evaluation of an immunization registry study.. *BMC Public Health.*

Bardenheir, BH; Yusuf, HR; Rosenthal, J; Santoli, JM; Shefer, AM; Rickert, DL and Chu, SY, 2004. Factors associated with underimmunization at 3 months of age in four medicakky underserved ares. *Public health Reporters,* Volume 119, pp. 479-485.

Barker, L., Luman, E., Zhao, O., Smith, P., Linkins, R., Santoli, J., McCauely, M and Centers for Disease Control and Prevention (CDC), 2001. National, State, and urban area vaccination coverage levels among children aged 19-35 months-United States. *PubMed,* pp. 664-666.

Barker, Lawrence E; McCauley, Mary M; MTSC and Drews-Botsch, Carolyn;, 2005. Timeliness of Children Immunizations: A State-Specific Analysis. *American Journal of Publi Health,* 95(8), pp. 1367-1374.

Barker, L., 2010. The face of South Africa's expanded programme on immunisation (EPI) schedule. *SA Pharmaceutical Journal,* pp. 18-21.

Bates, A.S., Fitzgerald, J.F., Dittus, R.S and Wolinsky, F.D., 1994. Risk factors for underimmunisation in poor urban infants. *JAMA,* pp. 1105-10.

Bonita, R., Beaglehole, R., and Kjellstrom, T., 2006. *Basic epidemiology.* 2nd ed. Geneva: World Health Organization.

Burton, A., Monasch, R., Lautenbach, B., Gacic-Dobo, M., Neill, M., Karimov, R., Wolfson, L., Jones, G and Birmingham M, 2009. WHO and UNICEF estimates of national infant immunisation coverage: methods and process. *Bull World Health Organ,* pp. 535-541.

Burton, A.,Monasch, R.,Lautenbach, B., Gacia-Dobo, M., Neill, M., Karimov, R., Wolfson, L., Jones, G. and Birmingham, M, 2008. *WHO and UNICEF estimates of national infant immunization coverage: methods and processes,* Switzerland: World Health Organization.

Centers for Disease Control and Prevention, 2009. *Morbidity Weekly Report (MMWR): Global Routine Vaccination Coverage,* Washington DC: U.S. Government Printing Office.

Chubilleau C, Comte J, Robin C, Cassel AM, Randirmaherison, Bouffard R, Purbert, Pascouau N and Ingrand P,, 2011. *What are knowledge, attitude and practice on vaccination and infectious diseases of 17 years-old persons of the Poitou-Charentes?,* Stockholm: ECDC Eurovaccine .

Clark, A and Sanderson C, 2009. Timing of children's vaccinations in 45 low-income and middle. *Lancet,* pp. 1543-1548.

Corsi, Daniel J; Bassani, Diego G; Awasthi, Shally; Jotka, Raju; Kaur Navkiran and Jha, Prabhat , 2009. Gender inequality and age -appropriate immunization coverage in India from 1992 to 2006. *BMC International Health and Human Rights.*

David W. Brown, Anthony Burton, Marta Gacia-Dobo, and Rouslan Karimov, 2011. A summary of global routine immunisation coverage through 2010. *The Open Infectious Disease Journal,* pp. 115-117.

David W. Brown, Anthony H. Burton, Martha Gacic-Dobo, Rouslan I Karimov, 2012. Data Update: A summary of global immunization coverage through 2011. *The Open Infectious Disease Journal,* pp. 71-75.

Dhadwal, D., Sood, R., Gupta, A.K., Ahluwalia, S.K., Vatsayan, A and Sharma, R., 1997. immunisation coverage among urban and rural children in Shimla hills.. *J Commun Dis,* pp. 127-130.

Dharan, P. V., 2011. Immunisation coverage and the effect of martenal knowledge and attitude towards it. *New Indian Journal of Surgery,* 2(4), p. 325.

Dietz, V.J., Stevenson, J., Zell, E.R., Cochi, S., Hadler, S and Eddins, D., 1994. Potential impact on vaccination coverage levels by administrating vaccines simultaneously and reducing dropout rates.. *Arch Pediatr Adolesc Med,* pp. 943-949.

DISH II Project, 2002. *Childhood immunization in Uganda: A report on qualitative research,* s.l.: K2 - Research Uganda Ltd.

DOH, 2009. *Department of Health.* [Online]
Available at: http://www.doh.gov.za/docs/reports

Dr. Robin Biellik, Simon Madema, Anne Taole, Agnes Kutsulukuta, Ernestina Allies, Rudi Eggers, Ntombenhle Ngcobo, Mavis Nvumalo, Adelaide Shearley, Egleah Mabuzane, Jean-Marie Okwo-Bele, 2002. First 5 years of measles eliminationin in Southern Africa: 1996-2000. *The Lancet,* pp. 1564-1568.

Eduard Bos and Amie Batson, 2000. *Using Immunization Covergae Rates for Monitoring Health Sector Perfomance,* Washington DC: The World Bank.

Eskola, J., 1998. Childhood immunization day. *Drugs,* 55(6), pp. 759-766.

Fadnes et, al. , 2011. vaccination coverage and timeliness in three South African areas: a prospective study.. *BMC Public Health.*

Fadnes, L.T., Nankabirwa, V., Sommerfelt, H., Tylleskar, T., Tumwine, J.K., Engbrestesen, I.M and PROMISE_EBF Study Group., 2011. Is vaccination coverage a good indicator of age-appropriate vaccination? A prospective study from Uganad.. *PubMed,* pp. 3564-70.

Fassin, D & Jeanee., E, 1989. Immunization coverage and social differentiation in urban Senegal. *Am J Public Health,* pp. 509-511.

Fell, G., David, C and Reintjes, R., 2005. Vaccinations in early infancy - results of an epidemiological cross-sectional study in Hamburg.. *Gesundheitswesen,* pp. 27-32.

Foundation, T. H. K. F., 2012. *Globalhealthfacts.org..* [Online]
Available at: http://www.Globalhealthfact.org
[Accessed 29 May 2012].

Gentile, A., Bakir, J., Firpo, V., Caruso, M., Lucion, M.F., Abate, H.J., Chiossone, A and Debbag, R., 2011. Delayed vaccine schedule and missed opportunities for vaccination in children up to 24 months. Amulticentre study. *PubMed,* pp. 219-225.

Heever, J. v. d., 2012. *What is the South African Immunisation coverage?,* Pretoria: Department of Health.

Hornshoj, L. et al., 2012. Vaccination coverage and out-of-sequence vaccinations in rural Guinea-Bissau: an observational cohort study. *BMJ open,* p. http://bmjopen.bmj.com.

HST, 2013. *Health Systems Trust.* [Online]
Available at: http://indicators.hst.org.za/healthstats/210/data
[Accessed 31 March 2013].

HST, 2013. *Health Systems Trust.* [Online]
Available at: http://indicators.hst.org.za/healthstats/216/data
[Accessed 22 May 2013].

Jagrati V Jani, Caroline De Schacht,Ilesh V Jani and Gunnar Bjune, 2008. Risk factors for incomplete vaccination and missed opportunity for immunization in rural Mozambique. *BMC Public Health.*

Jellis, S., 2001. *ENCARTA THESAURUS (Choose the right word from over 350, 000 alternatives).* London: Bloomsbury Publishing Plc.

Joan, Costa-Font., Alistair, McGuire., Christina Hernandez-Quevedo, 2010. *Persistence despite Action: Measuring the patterns of Health Inequality inn England,* London: The ondon chool of Economics and Political Science.

Johnson, D.R., Nichol, K.L and Liczynski, K, 2008. Barriers to adult immunisation. *The american journal of medicine,* pp. S28-S35.

Kalies H; Grote V; Verstraeten T; Hessel L; Schmitt HJ and von Kries R, 2006. The use of combination vaccines has improved timeliness of vaccination in children. *PubMed,* Issue 6, pp. 507-12.

Khan, M.N., Rahman, M.L., Awal, M.A., Islam, M.S., Musa, S.A., and Tofail, F. , 2005. Vaccination coverage survey in Dhaka District.. *Bangladesh Med Res Counc Bull.,* pp. 46-53.

Kidd, S; Ouedraogo, B; Kambire, C; Kambou, JL; Mclean, H; Kutty, PK; Ndiaye, S; Fall, A; Alleman, M; Wannemehler, K; Masresha, B; Goodson, JL and Uzicanin, A, 2012.

Measles outbreak in Burkina Faso, 2009:a case-control study to determine risk factors and estimate vaccine effectiveness. *PubMed.*

Koumare, Abdel K; Traore, Drissa; Haidara, Fatouma; Haidara, Karim; Sissoko, Filifing; Traore, Issa; Drame, Sekou; Sangare, Karim; Diakite, Karim; Coulibaly, Brehima; Togola, Birama; Maiga, aguissa, 2009. Evaluation of immunization coverage within the expanded program on immunization in Kita Circle, Mali: a cross-sectional survel. *BMCInternational Health and Human Rights,* pp. http://biomedcentral.com/1472-698X/9/SI/S13.

Laryea, Odai L; Parbie, Emmanuel A; Frimpong, Ebenezer, 2014. Timeliness of childhood vaccine uptake among children attending a tertary health service facility-based immunisation clinic in Ghana. *BMC Public Health,* pp. http:www.biomedcentral.com/1471-2458/14/90.

Leonard Foum, S. H. P. F. a. R. G., 2009. Determinants of parents' reticence toward vaccination in urban areas in Benin (West Africa). *BMC International Health and Human Rights.*

Leonard fourn, Slim Haddad, Pierre Fournier, Romeo Gansey, 2009. Determinants of parents' reticence toward vaccination in urban areas in Benin. *BMC International Health and Human Rights.*

Lermout T; Theeten H; Hens N; Braeckman T; Roelants M; Hoppenbrouwers Kand Va Damme, P, 2014. Timelines of infant vaccination and factors related with delay in Flanders, Belgium.. *PubMed,* pp. 284-9.

LoBiondo-Wood and Haber, J., 2006. *Nursing Research Methods and Critical Appraisal fot Evidence-Based Practice..* St Louis: Mosby.

Luman, E.T., Barker, L.E., Shaw, K.M., McCauley, M.M., Buehler, J.W and Pickering, L.K., 2005. Timeliness of childhood vaccinations in the Un ited States: days undervaccinated and number of vaccines delayed.. *JAMA,* pp. 1204-11.

Mabrouka, A., 2011. Knowledge, attitude and practices of mothers regarding immunization of infants and preschool children at Al-Beida City, Libya 2008.. *Egypt J Pediatr Immunol,* pp. 29-34.

Manjunath, U and Pareek, R.P., 2003. Marternal Knowledge and perceptions about the routine immun ization programme - a study in a semiurban area in Rajasthan.. *Indian J Med Sci,* pp. 158-163.

Mapatano MA, Kayembe K,Piripri L, Nyandwe K, 2008. Immunisation-related knowledge, attitudes and practices of mothers in Kinshasa, Democratic Republic of the Congo. *South African Family Practice.*

Marie Tarrant & Neil Thomson, 2008. Secrets to success: A qualitative study of perceptions of childhood immunization in a highly immunised population. *Journal of Paediatrics and child health,* Issue 44, pp. 541-547.

Massyn, N., Day, C., Peer, N., Padarath, A., Barron, P and English, R., , 2014. *District Health Barometer,* Durban: Health Systems Trust.

McMorrow, ML; Gebremedhin, G; van den Heever, J; Harris, BN; Nandy, R; Strebel, P; Jack A and Cairns, KL, 2009. Measles outbreak in South Africa, 2003-2005. *S Afr Med J,* pp. 314-319.

Meredith L McMorrow, Goitom Gebremedhin, Johann van den Heever, Robert Kezaala, Bernice N Harris, Robin Nandy, Peter Strebel, Abdoulie Jack, K Lisa Cairns, 2009. Measles outbreak in South Africa, 2003-2005. *South African Medical Journal,* pp. 314-319.

Mukherjee, B., Ray, S.K., Kar, M., Mandal, A., Mitra, J and Biswas, R., 1990. Coverage evaluation surveys amongst children in some blocks os West Bengal.. *Indian J Public Health,* pp. 209-214.

Mutua, Martin K; Murage, Elizabeth K and Ettarh Remare, 2011. Childhood vaccination in informal urban settlements in Nairobi, Kenya: Whongets vaccinated?. *BMC Public Health,* pp. http:www.biomedcentral.com/1471-2458/11/6.

Nath, B., Singh, JV., Awasthi, S., Bhushan, V., Kumar, V., Singh, Sk., , 2008. KAP Study on Immunization of children in a City of North India - A 30 cluster survey. *Online Journal of Health and Allied Sciences,* 7(1).

Nazish Siddiqi, Azfar-e-Alam Siddiqi, Nighat Nisar, Altaf Khan, 2010. Mothers' Knowledge about EPI and its relation with age appropriate vaccination of infants in peri-urban Karachi. *J Pak Med Assoc,* pp. 940-944.

Nobuo Mori, Yasushi ohkusa, Takaaki Ohyama, Keiko Tanaka-Taya, Kiyosu Taniguchi, John M. Kobayashi, Mikio Doy and Nobuhiko Okkabe, 2008. Estimation of measles vaccine coverage needed to prevent transmission in schools. *Japan Pediatric Society,* pp. 464-468.

Odyssey, A. S., 1980. *World Health Organization declares smallpox eradicated 1980,* Geneva: s.n.

Olumuyiwa O Odusanya, Ewan F Alufohai, Francois P Meurice and Vicent I Ahonkhai, 2008. Determinants of vaccination coverage in rural Nigeria. *BMC Public Health.*

Ozcirpici, Birgul; Aydin, Neriman; Coskun, Hakan and Ozgur, Servet), 2014. Vaccination coverage of children aged 12-23 months in Gaziantep, Turkey: comparative results of two studies carried out by lot quality technique: what changed after family medicine?. *BMC Public Health,* pp. http://www.biomedcentral.com/1471-2458/14/217.

Philippe Duclos, Jean-Marie Okwo-Bele, Marta Gacic-Dobo Thomas Cherian, 2009. Global immunization: status, progress, challenges and future. *BMC International Health and Human Rights.*

Pilay, V.K and Conaway, M., 1992. Immunisation coverage in Lusaka, Zambia; implications of the social setting.. *J Biosoc Sci,* pp. 201-209.

Pinaki, Sensarma., Subhasis, Bhandari and V Raman, Kutty, 2012. Immunization status and its predictors among children of HIV-infected people in Kolkata. *Health and Social Care in the Community,* 20(6), pp. 645-652.

Rainey, J.J., Lacapere, F., Danovaro-Holiday, M.C., Mung, K., Magloire, R., Kananda, G., Cadet, J.R., Lee, C.E., Chamouillet, H and Luman, E.T., 2012. Vaccination coverage in Haiti: results from the 2009 national survey.. *Vaccine,* pp. 1746-51.

Ray, S.K., Das, G.S and Saha, I., 1998. A report of diphtheria survillance from a rural medical college hospital.. *J Indian Med Assoc,* pp. 236-8.

Roberts, JR., Thompson, D., Rogacki, B., Hale, JJ., Jacobson, RM., Opel, DJ and Darden, PM, 2015. Vaccine hesitancy among parents of adolescents and its association with vaccine uptake. *PubMed.*

Sartorius, B; Cohen, C; Chirwa, T; Ntshoe, G; Puren, A and Hofman, K, 2013. Identifying high-risk areas for sporadic measles outbreaks: lessons from South Africa. *PubMed,* pp. 174-183.

Satcher, D., 1999. *Statement on Risk vs Benifits of Vaccination.* [Online] Available at: http://www.hhs.gov/asl/testify/t990803a.html [Accessed 23 February 2015].

Scott, S; Odutola, A; Mackenzie, G; Fulford, T; Afolabi, Muhammed O; Jallow, Yamundow L; Jasseh, M; Jeffries, D; Dondeh, Bai L; Howie, Stephen RC; D'Alessandro, U , 2014. Coverage and timing of childrens vaccination: An evaluation of the expanded programme on immunization in Gambia. *PLoS ONE* , p. http://dx.doi.org/101371/journal.pone0107280.

Stephane Verguet, Waasila Jassat, Calle Hedberg, Stephen Tollman, Dean T. Jamison, Karen J. Hofman, 2012. Measles control in Sub-Saharan Africa: South Africa as a case study. *Vaccine.*

Surender N Gupta, Naveen gupta, Nirankar Sropical Neki, 2012. German measl;es outbreak bursts i two unvaccinated border hilly districts of Northern Himachai Pradesh, India. *Annals of Tropical Medicine and Public Health,* pp. 219-224.

Sylvia E, Caingles MD, Joanne J, Lobo MD of Davao Doctors Hospital in Davao City, 2011. Survey on the knowledge, attitudes and practices of parents in Barangay 8A, district!, Davao city regarding their children's immunization. *PIDSP Journal,* pp. 46-52.

Talani, P., Nzabn, P., Bolanda, D., Ongouo, H., Mayanda, H.F and Yala, F., 2004. A immunisation coverage survey in the Kouilou area of Congo-Brazzaville. *Sante,* pp. 121-124.

Thom, Anso, n.d. *Health-e.* [Online] Available at: http://www.health-e.org.za/news/easy_print.php?uid=20033118 [Accessed 11 March 2013].

Thysen, Sanne M; Byberg, Stine; Peresen, Marie; Rodrigues, Amabelia; Ravn, Henrik; Martins, Cesario; Benn, Christine S; Aaby, Peter and Fisker Ane B, 2014. BCG coverage and barriers to BCG vaccination in Guinea-Bissau: an observational study. *BMC Public Health,* pp. http:www.biocentral.com/1471-2458/14/1037.

Trochim, W. M., 2006. *Research Methods Knowledge Base.* [Online] Available at: www.socialresearchmethods.net/kb/intreval.php [Accessed 29 October 2013].

Ughade SN;Zodpev SP; Deshpande Sg and Jain D, 2000. Factors responsible for delaye immunisation among children under 5 years of age. *PubMed,* pp. 4-5.

UNICEF, 2008. *Immunisation coverage survey,* s.l.: UNICEF.

UNICEF, 2008. *Somaliland Immunization Coverage Survey,* s.l.: UNICEF.

Vaahtera, M., Kulmala, T., Maleta, K., Cullinan, T., Salin, M.L and Ashorn, P., 2000. Childhood immunisation in Rural Malawi: time of administration and predictors of non-compliance.. *PubMed,* pp. 305-12.

Vasudevan L; Labrique AB; Mehra S; Wu L; Levine O; Feikin O; Klemm R; Christian P; and West KP Jr, 2014. Martenal determinants of timely vaccination coverage among infants in rural Bangladesh. *PubMed,* p. http://www.ncbi.nlm.nih.gov/pubmed/25132336.

vid M le Roux, Stanzi M le Roux, James J Nuttall, Brian S Eley, 2012. South Africa measles oubreakk 2009-2010 as experienced by a paediatric hospital. *South African Medical Journal,* pp. 760-764.

Weller, B., 2000. *Nurses Dictionary 23rd Edition.* London: Bailliere Tindall.

WHO, 2012. *Global measles and rubella strategic plan,* Switzerland: World Health Organisation.

WHO, 2012. *Weekly epidemiological record,* Geneva: World Health Organization.

WHO, 2013. *World Health Organisation.* [Online] Available at: http://www.who.int/topics/millennium_development_goals/en/index.html [Accessed 10 June 2013].

WHO, 2015. *Global Alliance for Vaccines and Immunization (GAVI).* [Online] Available at: http://www.who.int/mediacentre/factsheets/fs169/en [Accessed 23 February 2015].

WHO, 2015. *Measles.* [Online] Available at: http://www.who.int/mediacentre/factsheets/fs286/en/ [Accessed 19 February 2015].

Xavier, Bosch-Capblanck., Banerjee, K and Burton, 2012. Unvaccinated children in years of increasing coverage: how many and who are they? Evidence from 96 low and middle-income countries. *Tropical Medicine & International Health,* pp. 697-710.

Yokokura, A.V., da Silva, A.A., Bernardes, A.C., Lamy, F.F., Alves, M.T., Cabra, N.A and Alves, R.F., 2013. Vaccination coverage and factors associated with incomplete basic vaccination schedule in 12-month-old children, Sao Luis, Maranhao state, Brazil, 2006.. *Cad Saude Publica,* pp. 522-34.

Yuan, L., 1994. Measles outbreak in 31 schools: risk factors for vaccine failure and evaluation of a selective revaccination strategy. *PubMed,* pp. 1093-1098.

ANNEXURES

ANNEXURE A: Revised EPI-SA schedule

health

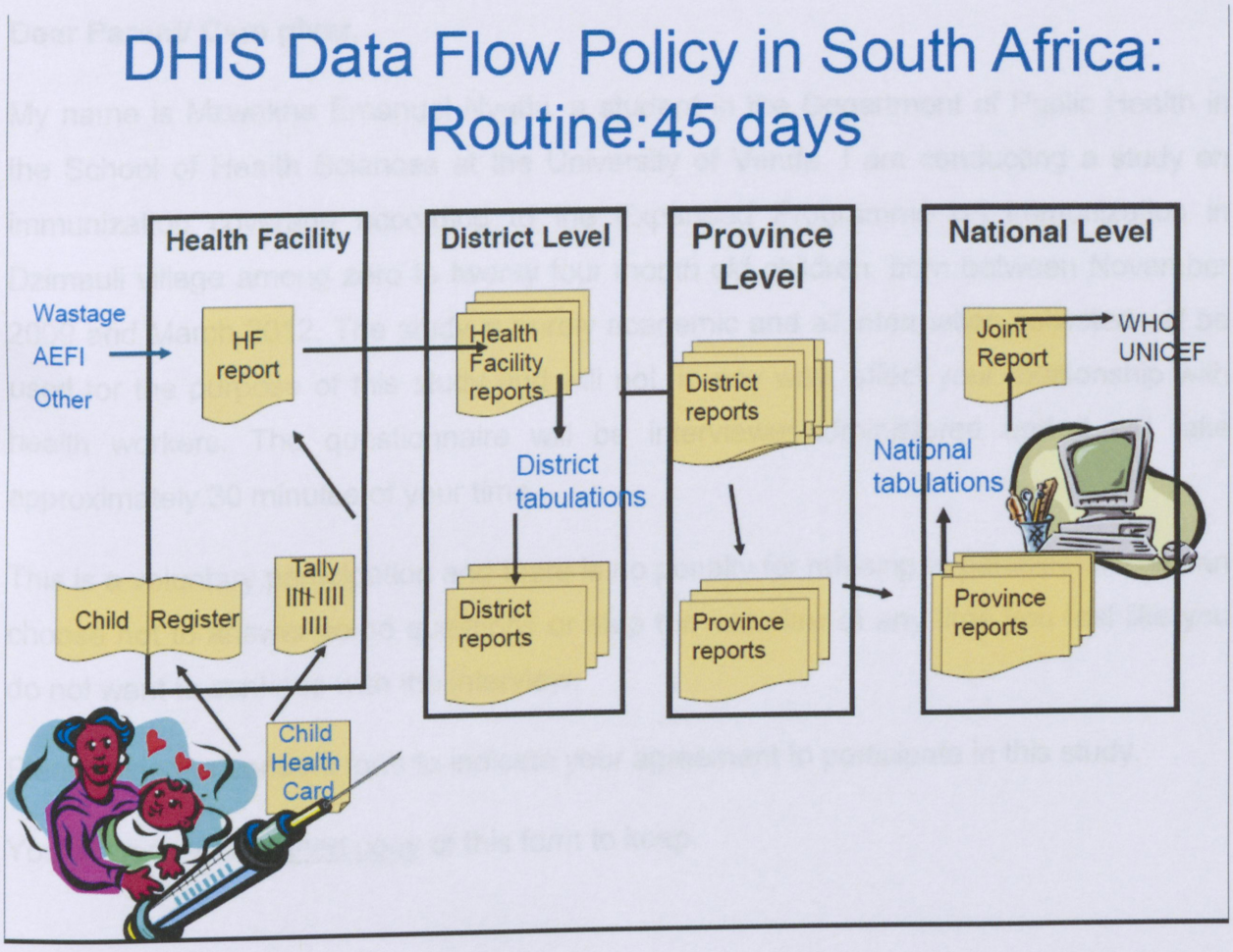
Department:
Health
REPUBLIC OF SOUTH AFRICA

Expanded Programme on Immunisation – EPI (SA)
Revised Childhood Immunisation Schedule from April 2009

Age of Child	Vaccines needed	How and where is it given?
At Birth	BCG Bacilles Calmette Guerin	Right arm
	OPV (0) Oral Polio Vaccine	Drops by mouth
6 Weeks	OPV (1) Oral Polio Vaccine	Drops by mouth
	RV (1) Rotavirus Vaccine	Liquid by mouth
	DTaP-IPV//Hib (1) Diphtheria, Tetanus, acellular Pertussis, Inactivated Polio Vaccine and *Haemophilus influenzae* type b Combined	Intramuscular / Left thigh
	Hep B (1) Hepatitis B Vaccine	Intramuscular / Right thigh
	PCV_7 (1) Pneumococcal Conjugated Vaccine	Intramuscular / Right thigh
10 Weeks	DTaP-IPV//Hib (2) Diphtheria, Tetanus, acellular Pertussis, Inactivated Polio Vaccine and *Haemophilus influenzae* type b Combined	Intramuscular / Left thigh
	Hep B (2) Hepatitis B Vaccine	Intramuscular / Right thigh
14 Weeks	RV (2) Rotavirus Vaccine*	Liquid by mouth
	DTaP-IPV//Hib (3) Diphtheria, Tetanus, acellular Pertussis, Inactivated Polio Vaccine and *Haemophilus influenzae* type b Combined	Intramuscular / Left thigh
	Hep B (3) Hepatitis B Vaccine	Intramuscular / Right thigh
	PCV_7 (2) Pneumococcal Conjugated Vaccine	Intramuscular / Right thigh
9 Months	Measles Vaccine (1)	Intramuscular / Left thigh
	PCV_7 (3) Pneumococcal Conjugated Vaccine	Intramuscular / Right thigh
18 Months	DTaP-IPV//Hib (4) Diphtheria, Tetanus, acellular Pertussis, Inactivated Polio Vaccine and *Haemophilus influenzae* type b Combined	Intramuscular / Left arm
	Measles Vaccine (2)	Intramuscular / Right arm
6 Years (Both boys and girls)	Td Vaccine Tetanus and reduced strength of diphtheria Vaccine	Intramuscular / Left arm
12 Years (Both boys and girls)	Td Vaccine Tetanus and reduced strength of diphtheria Vaccine	Intramuscular / Left arm

* Rotavirus Vaccine should NOT be administered after 24 weeks.

ANNEXURE B: DHIS data flow policy



Massyn, at el., 2014

ANNEXURE C: Information letter

Dear Parent/ Care giver,

My name is Mzwakhe Emanuel Nyathi, a student in the Department of Public Health in the School of Health Sciences at the University of Venda. I am conducting a study on immunization coverage according to the Expanded Programme on Immunization in Dzimauli village among zero to twenty four month old children, born between November 2009 and March 2012. The study is purely academic and all information collected will be used for the purpose of this study and will not, in any way, affect your relationship with health workers. The questionnaire will be interviewer-administered and it will take approximately 30 minutes of your time.

This is a voluntary participation and there is no penalty for refusing to participate. You can choose not to answer some questions or stop the interview at any time you feel like you do not want to continue with the interview.

Please sign the consent form to indicate your agreement to participate in this study.

You will receive a signed copy of this form to keep.

Thank you.

_____

Signature

ANNEXURE D: Data collection sheet

TOPIC: EVALUATION OF IMMUNIZATION COVERAGE ACCORDING TO THE EXPANDED PROGRAMME ON IMMUNIZATION AMONG 0 TO 24 MONTH OLD CHILDREN IN DZIMAULI VILLAGE IN VHEMBE DISTRICT LIMPOPO PROVINCE OF SOUTH AFRICA.

Sheet number: _____ Date: _____/_____/2014

SECTION A: DEMOGRAPHIC DATA			
1	What is your age?	15 – 45 years	☐☐
2	Marital status	Never Married = 01 Married = 02 Divorced = 03 Widowed = 04	☐☐
3	Level of education	Never attended school = 01 Primary = 02 Secondary = 03 Tertiary = 04	☐☐
4	Are you younger than 25 years?	Yes = 01 No = 02	☐☐
5	If yes are you currently attending school or college?	Yes = 01 No = 02	☐☐

SECTION B: IMMUNIZATION DATA

Mal-ed Participant	Yes	1	No	2	
Sex	Male	1	Female	2	
Age Group	Date Of Birth	Vaccine	Date Given	Valid Dose = 1	Invalid Dose 2
Birth		BCG			
		OPV0			
6 Weeks		OPV1			
		RV1			
		Dtap-IPV-Hib1			
		Hep B1			
		PCV1			
10 Weeks		Dtap-IPV-Hib2			
		Hep B2			
14 Weeks		Dtap-IPV-Hib3			
		Hep B3			
		PCV2			
		RV2			
9 Months		Measles 1			
		PCV3			
18 Months		Dtap-IPV-Hib4			
		Measles 2			
Immunization Status	Partially immunized	1	F - immunised	2	

SECTION C: REASONS FOR IMMUNIZATION FAILURE		
Lack of information	Unaware of need for immunization	
	Unaware of need to return for second or third dose	
	Place and time of immunization unknown	
	Fear of side reactions	
	Other:	
Lack of motivation	Postponed until another time	
	No faith in immunization	
	Other:	
Obstacles	Place of immunization too far	
	Vaccine not available	
	Mother or care giver too busy	
	Child ill	
	Mother or caregiver ill	
	Other:	

ANNEXURE E: Screening form (SCR)

SCR/SAR/v1.8/21DEC09

Child ID: ☐☐☐☐☐☐☐☐

MAL-ED

SCREENING FORM (SCR)

If no response for any question, write NA as response.

#	Question	Code	Response
01	Study researcher/Nurse/Fieldworker ID		☐☐☐
02	Today's date (DD/MMM/YY)		☐☐/☐☐☐/☐☐
03	Are there plans to move outside of the community within six months?	Yes = 01 No = 00	☐☐
04	Is the mother <16 years of age?	Yes = 01 No = 00	☐☐
05	Does the mother have another child in the MAL-ED study?	Yes = 01 No = 00	☐☐
06	Was this a multiple pregnancy?	Yes = 01 No = 00	☐☐
07	Is the child healthy? (does not have congenital diseases / severe neonatal disease requiring prolonged hospitalization)	Yes = 01 No = 00	☐☐
08	Is the mother able to give informed consent?	Yes = 01 No = 00	☐☐

The child is eligible to participate in the study if:

1) The answer to questions 3, 4, 5, and 6 is No, &
2) The answer to questions 7 and 8 is Yes.

If the child is eligible to participate, continue on to the consent form, or if consent has already been obtained, continue to the Child Assessment Form (CAF).

If the child is **not** eligible to participate (answer to question 3, 4, 5, or 6 is Yes, or answer to question 7 or 8 is No) or if the caregiver is unwilling to answer any of the screening questions, the child **cannot** be enrolled in the study and the Non-Participation Form (NPF) should be filled out with the caregiver.

ANNEXURE F: Baseline demographic questionnaire (DAF)

DAF/SRP/v5/21MAR11

Participant ID: ☐☐☐☐☐☐☐☐☐

MAL-ED

BASELINE DEMOGRAPHIC QUESTIONNAIRE (DAF)

If no response for any question, write NA as response.

#	Question	Code	Response
Questions for head of household (If mother of child is the head of household skip to question 11)			
1	Fieldworker ID		☐☐☐
2	Date (DD/MMM/YY)		☐☐/☐☐☐/☐☐
3	What is your age?	10-99 *(years)*	☐☐
4	*(Record sex)*	Male = 01; Female = 02	☐☐
5	What is your relationship to [CHILD'S NAME]?	Father = 01; Mother =02; Grandmother = 03; Grandfather = 04; Sibling = 05; Other = 06	☐☐
6	Are you currently married, divorced, widowed, or never married? *If never married, skip to question 8.*	Never married = 01; Married = 02 Divorced = 03; Widowed = 04	☐☐
7	How old were you when you got married for the first time?	08-50 *(years)*	☐☐
8	Have you ever attended school? *If no, skip to question 11.*	Yes = 01; No = 00	☐☐
9	How many years of schooling have you completed?	00-20	☐☐
10	*If younger than 25 years old:* Are you currently attending school or college?	Yes = 01; No = 00	☐☐
The remaining questions are for the mother of the child. If the mother is living but unavailable, return to the home at a later time to complete this questionnaire.			
11	How old are you?	10-70 *(years)*	☐☐
12	Are you currently married, divorced, widowed, or never married? *If never married, skip to question 14.*	Never married = 01; Married – only wife = 02; Married – first wife = 03; Married – second or higher wife = 04; Divorced = 05; Widowed = 06	☐☐
13	How old were you when you got married for the first time?	08-50 *(years)*	☐☐
14	What is your relationship to [NAME OF HEAD OF HOUSEHOLD]?	Wife/partner = 01; Daughter = 02; Daughter-in-law = 03; Niece = 04; Mother-in-law = 05; Sister = 06; Aunt = 07; Cousin = 08; Granddaughter = 09; Step-daughter or Adopted daughter= 10; Self = 11; Other = 12	☐☐

DAF/SRP/v5/21MAR11

Participant ID: ☐☐☐☐☐☐☐☐☐

15	Have you ever attended school? *If no, skip to question 18.*	Yes = 01; No = 00	☐☐
16	How many years of schooling have you completed?	00-20	☐☐
17	*If younger than 25 years old:* Are you currently attending school or college?	Yes = 01; No = 00	☐☐
18	What is the last name of the father of your child?	Open-ended up to 18 characters	*Write response below*
☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐			
19	Does your household pay any domestic workers?	Yes = 01; No = 00	☐☐
20	How old were you when you first became pregnant?	10-50 (years)	☐☐
21	How many pregnancies have you had in your lifetime?	00-20	☐☐
22	How many live births have you had in your lifetime?	00-20	☐☐
23	Are all of these children still alive? *If yes, skip the next question.*	Yes = 01; No = 00	☐☐
24	How many children have died?	01-20	☐☐

ANNEXURE G: Monthly form b form (MOB)

MOB/SR/v1.6/ 31OCT2011
Child ID: ☐☐☐☐☐☐☐☐☐☐

MONTHLY FORM B (MOB)

If no response for any question, write NA as response.

#	Question	Code	Response
01	Study researcher/Nurse/Fieldworker ID		☐☐☐
02	Today's date	DD/MMM/YY	☐☐/☐☐☐/☐☐
Vaccines administered since last visit			
03	BCG date	DD/MMM/YY	☐☐/☐☐☐/☐☐
04	Diphtheria, Pertussis, Tetanus (DPT) date	DD/MMM/YY	☐☐/☐☐☐/☐☐
05	Hepatitis B date	DD/MMM/YY	☐☐/☐☐☐/☐☐
06	Oral Polio Vaccine (OPV) date	DD/MMM/YY	☐☐/☐☐☐/☐☐
07	Measles date	DD/MMM/YY	☐☐/☐☐☐/☐☐
08	Rotavirus date	DD/MMM/YY	☐☐/☐☐☐/☐☐
09	Hib date	DD/MMM/YY	☐☐/☐☐☐/☐☐
10	Measles, Mumps, and Rubella (MMR) date	DD/MMM/YY	☐☐/☐☐☐/☐☐
11	Japanese Encephalitis date	DD/MMM/YY	☐☐/☐☐☐/☐☐
12	Pneumococcal conjugate vaccine (PCV) date	DD/MMM/YY	☐☐/☐☐☐/☐☐
13	Inactivated polio vaccine (IPV) date	DD/MMM/YY	☐☐/☐☐☐/☐☐
14	Yellow fever vaccine date	DD/MMM/YY	☐☐/☐☐☐/☐☐
15	Other:	DD/MMM/YY	16 ☐☐/☐☐☐/☐☐
17	Other:	DD/MMM/YY	18 ☐☐/☐☐☐/☐☐
19	Other:	DD/MMM/YY	20 ☐☐/☐☐☐/☐☐
21	Other:	DD/MMM/YY	22 ☐☐/☐☐☐/☐☐
Anthropometry			
23	Weight (kg)		☐☐.☐☐
24	Length / height (cm)		☐☐☐.☐
25	Head circumference (cm)		☐☐.☐
Monthly stool sample collection			
26	Monthly stool sample collected?	Yes = 01 No = 00	☐☐
27	Does the child have bipedal edema?	Yes = 01 No = 00	☐☐

ANNEXURE H: Vaccine information form (VIF)

VIF/VD/v3/25JAN11

Participant ID: ☐☐☐☐☐☐☐☐

Date: ☐☐/☐☐☐/☐☐ Fieldworker ID: ☐☐☐

MAL-ED

VACCINE INFORMATION FORM (VIF)

Instructions: *Record information regarding childhood vaccination for each study participant. Please write down all vaccines given since the last VIF form was administered. "***Source***" refers to the source of the information regarding vaccinations. Vaccination information from vaccination cards or clinic records are STRONGLY preferred.*

*Options for "***Source***": **1.** From vaccination card, **2.** From clinic record, **3.** From verbal source (e.g. mother, guardian etc.), **4.** Other.*

#	Vaccine Name:	Date of Administration:	Source:
1		☐☐/☐☐☐/☐☐	☐
2		☐☐/☐☐☐/☐☐	☐
3		☐☐/☐☐☐/☐☐	☐
4		☐☐/☐☐☐/☐☐	☐
5		☐☐/☐☐☐/☐☐	☐
6		☐☐/☐☐☐/☐☐	☐
7		☐☐/☐☐☐/☐☐	☐
8		☐☐/☐☐☐/☐☐	☐
9		☐☐/☐☐☐/☐☐	☐
10		☐☐/☐☐☐/☐☐	☐
11		☐☐/☐☐☐/☐☐	☐
12		☐☐/☐☐☐/☐☐	☐
13		☐☐/☐☐☐/☐☐	☐
14		☐☐/☐☐☐/☐☐	☐
15		☐☐/☐☐☐/☐☐	☐
16		☐☐/☐☐☐/☐☐	☐
17		☐☐/☐☐☐/☐☐	☐
18		☐☐/☐☐☐/☐☐	☐

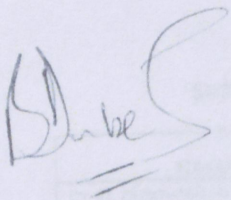
VIF Page 1 of 1

72

ANNEXURE I: Editorial letter

EDITORIAL LETTER

I, Dr. Bevelyn Dube, of the Communication and applied language Studies Department at the University of Venda declare that I edited and proofread the Masters of Public Health dissertation *"Evaluation of Immunization coverage among 0-24 month old children in Dzimauli village, Vhembe District, South Africa"* written by Nyathi, E.M. (Student: 11543178)



Dr B. Dube: BA, Grad CE, BA Hons (English), MA (English) University of Zimbabwe, DPhil (SU)
University of Venda
Department of Communication and Applied Language Studies
P.B. X5050
Thohoyandou
O950
RSA
Phone: (B) +27 (0) 15 962 8420
Mobile: + 27 (0) 847565524
Email: Bevelyn.dube@univen.ac.za

ANNEXURE J: Ethics approval

RESEARCH AND INNOVATION
OFFICE OF THE DIRECTOR

NAME OF RESEARCHER/INVESTIGATOR:
Mr ME Nyathi

Student No:
11543178

PROJECT TITLE: **Evaluation of immunization coverage among 0 to 24 month old children in Dzimauli village, Limpopo Province, South Africa.**

PROJECT NO: SHS/14/PH/10/2807

SUPERVISORS/ CO-RESEARCHERS/ CO-INVESTIGATORS

NAME	INSTITUTION & DEPARTMENT	ROLE
Dr RL Mamabolo	University of Venda	Supervisor
Ms TG Tshitangano	University of Venda	Co-Supervisor
Mr ME Nyathi	University of Venda	Investigator - Student

ISSUED BY:
UNIVERSITY OF VENDA, RESEARCH ETHICS COMMITTEE

Date Considered: July 2014
Decision by Ethical Clearance Committee Granted
Signature of Chairperson of the Committee: .....
Name of the Chairperson of the Committee: Prof. G.E. Ekosse

University of Venda
PRIVATE BAG X5050, THOHOYANDOU, 0950, LIMPOPO PROVINCE, SOUTH AFRICA
TELEPHONE (015) 962 8816/8313 FAX (015) 962 9060
"A quality driven financially sustainable, rural-based Comprehensive University"