The evaluation of the on-time immunisation rates of students entering public schools in the City of Johannesburg, Regions B and E

UNIVERSITY OF THE
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JOHANNESBURG

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April 2021

DECLARATION

I, Tah’seen Ismail, declare that all work represented in this dissertation is my own work, and has not been submitted for any other degree or examination in any other University, and that all the sources I have used or quoted have been indicated and acknowledged by complete references.

Full Name: Tah’seen Ismail Date: April 2021

Signed:

ETHICS DECLARATION

I, Tah'seen Ismail, declare that I am registered with the University of the Witwatersrand for the degree in Master of Pharmacy and have read the University's current research ethics guidelines. I accept responsibility for the conduct of the procedures in accordance with the Human Research Ethics Committee (HREC). I have obtained ethical approval from HREC (Appendix L, M180646) to conduct my research as well as approval from the relevant study sites. (Appendix C-E)

Full name: Tah'seen Ismail Date: April 2021

Signed:

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Tahseen Ismail

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LIST OF ABBREVIATIONS

AFM	Acute flaccid myelitis
BCG	Bacille Calmette-Guérin
DTP3	Diphtheria-tetanus-pertussis
EPI	Expanded programme on immunisation
EPI (SA)	Expanded programme on immunisation (South Africa)
GAVI	Global Alliance for Vaccine and Immunisation
Hep B	Hepatitis B
HPV	Human Papillomavirus (Vaccine)
HREC	Human Research and Ethics Committee
MNTE	Maternal and Neonatal tetanus elimination
MMR	Measles, Mumps and Rubella
%	Percent
PACV	Parent Attitudes about Childhood Vaccines
PCV	Pneumococcal conjugate vaccine
RV	Rotavirus
SDG	Sustainable Development Goals
Td	Tetanus-diphtheria
TOPV	Trivalent Oral Polio Vaccine
UN	United Nations
UNICEF	United Nations Children's Fund
VPDs	Vaccine Preventable Diseases
WHO	World Health Organization

ABSTRACT

Due to the rise in prevalence of vaccine preventable diseases (VPDs) in South Africa, the primary objective of this study is to determine the incidence of on-time immunisation rates among grades 1 to 3 children (ages 6 to 9) entering public schools in Region B and E of the City of Johannesburg, and to further determine the factors that affect caregiver willingness to vaccinate as a secondary objective. School-based immunisation surveys are a common tool used to establish the vaccination coverage among children. A quantitative cross-sectional study design was used to establish the knowledge, attitude and perceptions of caregivers and administrators of students in grades 1 to 3 at three public sector schools within the City of Johannesburg, district of Gauteng. For the purpose of this study a caregiver can be defined as any person whom the student has been placed in the care of. This can be further categorised as a father, mother, aunt, uncle or grandparent. The on-time immunisation rates among children in grades 1 to 3 attending these public schools were analysed by reviewing the immunisation records of the students from the respective schools. The data needed for the study was collected, using REDCap, by means of a pre-validated questionnaire.

One of the major findings concluded in this study is that around 16.44% of children are not fully immunised despite government efforts to achieve 100% coverage through the Expanded Program on Immunisation - South Africa (EPI-SA), which is implemented in most public schools. This study discovered that there are varying percentages of children who get enrolled for their first grade before they have completed their immunisation schedules (13% to 25%). These results confirm findings made by other researchers, which point to the fact that the immunisation coverage of VPDs takes a downward trajectory as children grow, signifying underlying factors that go beyond just caregiver knowledge. The study also concluded that around 19% of parents and caregivers who participated in the survey admitted that they had decided against getting their children immunised for reasons other than illness. This points to other reasons that are at play, which influence caregivers and parents in making decisions regarding the immunisation

of their children. This supports the assertion made by the World Health Organization (WHO) that there are socio-economic determinants like a family's income level and the educational status of the mother, which are associated with inequities in vaccination coverage as well.

CHAPTER 1
INTRODUCTION & LITERATURE REVIEW

1.1 INTRODUCTION

Immunisations are one of the most cost-effective ways to prevent infectious disease and associated morbidity and mortality in children. The World Health Organization (WHO) has further noted that despite the availability of immunisations, Vaccine Preventable Diseases (VPDs) continue to cause high levels of morbidity and mortality across the world. This chapter will explore the history of vaccinations and further provide a literature review.

The goals of this review were to investigate and analyze perceptions of caregivers towards childhood immunisation, the factors that shape these perceptions and how this impacts immunisation trends of children in South Africa, to determine the importance of childhood immunisations and discuss attributing factors towards vaccine hesitancy and stigma.

1.2 HISTORY OF VACCINATIONS

1.2.1 BACKGROUND INFORMATION AND DEVELOPMENT OF VACCINATIONS

The origin of the word *vaccine* is Latin and stems from *vacca* (“cow”) and the related word *vaccine* (“from cows”) (Kushinka, 2015). The practice of immunisations dates back hundreds of years with the smearing of a patient’s skin tear with a cowpox virus to confer immunity to smallpox. Another example is the drinking of snake venom that was encouraged to confer immunity to snake bites among Buddhist monks (Markel, 2004). Society has come a long way with the development of vaccines that are easily and efficiently administered, with different types of vaccines requiring different methods of manufacture. For example, the measles, mumps and rubella (MMR), oral polio virus, shingles, rotavirus (RV) and chickenpox vaccines are made using a strategy known as “weaken the virus”. This results in a weakened virus that will replicate poorly once inside

the human body while still remaining viable, thus reducing the virulence of the pathogen (Paul, 2016). Another strategy commonly used is called “inactivate the virus”. This is where the virus is completely killed (“inactivated”) using a chemical, making replication or reproduction virtually impossible (Offit, 2014). Examples of inactivated vaccines include, hepatitis A, influenza, rabies and polio vaccines. The final strategy is by removing a part of the virus and making use of that as the vaccine. Hepatitis B (Hep B) and the human papilloma virus (HPV) vaccine are made using this strategy. The figure below (Figure 1.1) illustrates the process by the body to establish immunity after the administration of a vaccine.

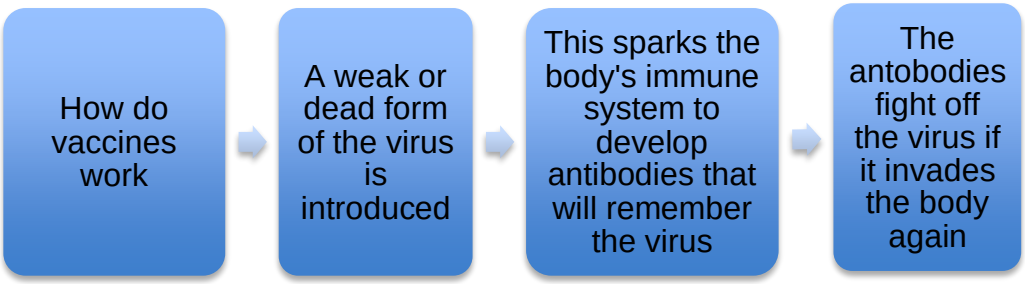


Figure 1.1: Illustration of the process of the body establishing immunity after the administration of a vaccine

The development of viral tissue culture methods led to the discovery of Salk (inactivated) polio vaccine and Sabin (live attenuated oral) polio vaccine. The discovery of the polio vaccine has now eradicated polio from a number of regions across the globe. The WHO is a partner in the Global Polio Eradication Initiative and the outcome has reduced polio by 99%. Polio now only features in the world’s poorest communities (WHO, 2017). Figure 1.2 illustrates the progress of polio elimination between 1988 and 2014 (Immunisation Advisory Centre, 2017).

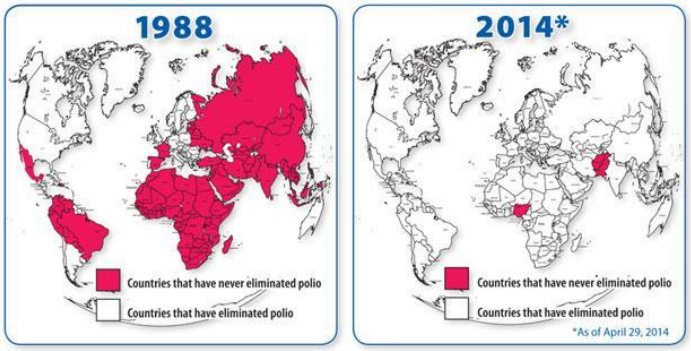


Figure 1.2: Depiction of the progress of polio elimination from 1988 to 2014 (Immunisation Advisory Centre, 2017)

1.2.2 EXPANDED PROGRAM ON IMMUNISATION

The Expanded Program on Immunisation (EPI) was established by the WHO in May 1974 with the principal objective to provide immunisations to children throughout the world (WHO, 2012). Accessibility and availability are the core aspects of the EPI. In 1984, 10 years later, the WHO established a standardized immunisation schedule and included the following vaccines: Bacillus Calmette-Guerin (BCG), diphtheria-tetanus-pertussis (DTP3), trivalent oral polio (TOPV) and measles. In each of the United Nations (UNs) member states, the national governments create and implement their policies for vaccination programs following the guidelines set by the global EPI, according to the region's level of health infrastructure. The table below (Table 1.1) depicts the generic EPI schedule as per WHO regulations (WHO, 2002).

Table 1.1: The generic EPI schedule as per WHO

Vaccine →	Schedule
BCG	Birth
DTP3 (I)	6 weeks
OPV (I)	6 weeks
DTP3 (II)	10 weeks
OPV (II)	10 weeks
DTP3 (III)	14 weeks
OPV (III)	14 weeks
Measles	9 months

The South African Department of Health has established the country's EPI, namely, EPI (SA) (Appendix B). The main objective of EPI (SA) is to reduce and eventually eradicate VPDs that affect children (Gauteng Department of Health, 2015). EPI (SA) is based on the outline provided by the WHO. There are currently 7 immunisations in the EPI (SA) schedule, administered to children aged 0-12 years. Catch up immunisations can be done up to the age of 15 years (Gauteng Department of Health, 2014). Full immunisation of a child is achieved when all doses meant for a particular age group have been administered according to the EPI (SA) schedule. It is also worth noting that immunisation services in South Africa are provided to all children and women at public health facilities at no additional cost (Health System Trust, 2014). The generic EPI schedule provides an outline to be used by countries around the world, and depicts the mandatory immunisations that must appear on the EPI schedule. Countries are at liberty to add childhood immunisations as they see fit.

The table below (Table 1.2) is a representation of EPI (SA) and depicts how the addition of the pneumococcal vaccine (PCV), rotavirus vaccine (RV) and tetanus-diphtheria (Td) immunisations differs from the generic WHO EPI. The PCV, RV and Td vaccines are important additions as pneumococcal infection, rotavirus and whooping cough mainly affect babies and children. These vaccines act as preventative measures and protect children against these VPDs. The PCV vaccine is of utmost importance because babies and very young children, whose immune systems are still strengthening, are at a higher risk for contracting dangerous infections, including pneumonia and bacterial meningitis (WHO, 2005).

Table 1.2: EPI (SA) as per South African Department of Health (differences to the generic EPI are highlighted)

Vaccine	Schedule
BCG	Birth
OPV (0)	Birth
DTP3 (I)	6 weeks
OPV (I)	6 weeks
RV (I)	6 weeks
PCV (I)	6 weeks
DTP3 (II)	10 weeks
OPV (II)	10 weeks
DTP3 (III)	14 weeks
OPV (III)	14 weeks
PCV (II)	14 weeks
RV (II)	14 weeks
Measles (I)	6 months
PCV (III)	9 months
Measles (II)	12 months
DTP3 (IV)	18 months
Td	6 years
Td	12 years

1.2.3 IMPORTANCE OF ON-TIME IMMUNISATION RATES IN SCHOOLS, HERD IMMUNITY AND ADVANTAGES OF CHILDHOOD IMMUNISATIONS

On-time immunisations can be defined as the administration of all the necessary immunisations, as per EPI (SA), at the appropriate time (Gage, 2005). On-time immunisation rates play a critical role in protecting against VPDs for school entry children (Atkinson *et al.,* 2016). For this reason, national and local immunisation requirements are strictly implemented (Seither *et al*., 2015). In South Africa, when applying for school admission, a parent must show proof that the learner has been immunised against the following VPDs: polio, measles, tuberculosis, diphtheria, tetanus, pertussis and Hep B. Public schools are permitted to request the immunisation chart records of students, which comply with EPI (SA). If a parent is unable to show proof of immunisation, the principal must advise the parent on having the learner immunised as part of the free primary health care program (Dunlop, 2015). It should be further noted that, according

to the South African Department of Education National Education Policy Act, 1996, Admission Policy for Ordinary Public Schools, should parents not have the relevant documents, the principal must assist the parents in obtaining the documents, and this may not interfere with the child's admission to the school. This could result in a further risk to herd immunity if non-immunised students, being allowed into a school, do not have their immunisations followed up on (Dunlop, 2015). Schools are expected to keep comprehensive immunisation charts of their learners, proving effective in determining immunisation coverage within communities (Rodewald *et al.*, 1993).

A form of immunity that occurs when the vaccination of a significant portion of a population (or herd) provides a measure of protection for individuals who have not developed immunity is a term commonly known as herd immunity (Bonanni *et al.*, 2015). Herd Immunity is a crucial aspect in terms of childhood vaccinations because when a higher percentage of children are vaccinated against a certain virus or bacteria, it proves challenging for that virus or bacterium to spread. This is a key concept in schools and crèches and establishes the importance of childhood immunisations. The benefits of herd immunity can be expressed using this simple statement: “once enough people are protected, they help to protect vulnerable members of their communities by reducing the spread of the disease” (Thomas *et al.*, 2015). Those in favor of childhood immunisations will argue that vaccinations are vital in terms of travelling, going to school or simply being in the company of others. On the rebutting end, anti-vaccine activists claim that if their children are not ill, why would they willingly inject a virus into their children. “Most children are protected from diseases such as measles and pertussis – but parents who opt out need to know the implications of their decision” (Finnegan, 2019).

Childhood immunisation is essential to the prevention of diseases that cause death and disability. In South Africa, the United Nations Children’s Fund (UNICEF) estimates that there are tens of thousands of children who are not fully immunised each year, a situation that exposes these children to VPDs such as measles, diarrhoea, pneumonia, meningitis, and other life-threatening conditions (UNICEF, 2011). Vaccinations are one

of the most cost-effective ways to prevent infectious diseases and their associated morbidity and mortality. Annually, as a result of immunisations, as many as three million lives are saved around the world (UNICEF, 2019). The figure below (Figure 1.3) establishes the core advantages of childhood immunisations.

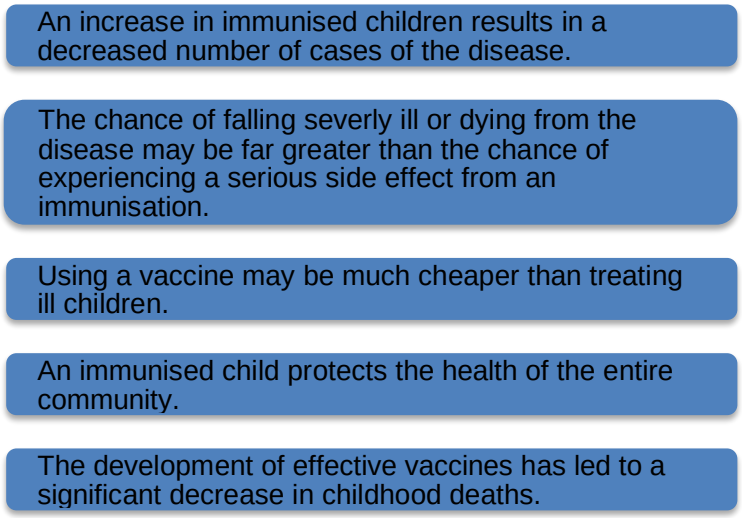


Figure 1.3: Advantages of childhood immunisations, which attribute to the importance of childhood immunisations in schools

The WHO and UNICEF both estimate that South Africa faces immense challenges in ensuring that every child receives the necessary immunisations. Research shows that it is imperative to vaccinate children and the success of adequate vaccination has been shown by the eradication of the polio virus in today's population. South Africa has experienced a shift in its vaccination coverage. Despite the remarkable progress achieved by immunisation efforts that were implemented, the country failed to meet the UNs Millennium Development Goal of reducing the mortality rate of children under 5 years by approximately two thirds in the period 1990 to 2015. WHO global trends depict the leading causes of VPD deaths in children under the age of 5 years, as can be seen in Figure 1.4 (WHO, 2003).

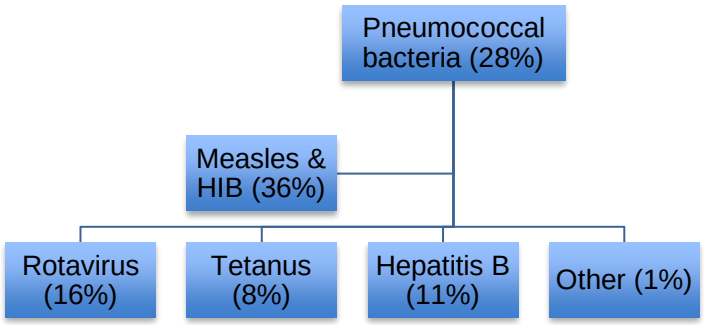


Figure 1.4: Representation of the leading causes of VPD deaths in children under the age of 5 years in order of prevalence

1.3 IMMUNISATION COVERAGE AT A GLOBAL LEVEL AND FACTORS AFFECTING THESE RATES

Since the success of the smallpox eradication campaign during the early 1970s, the WHO has supported several immunisation campaigns across the world. Smallpox was one of the deadliest diseases known to humankind and its eradication marked the first major eradication of a disease through the use of vaccines (WHO, 2019). The WHO expanded its efforts towards immunisation as a result of the success achieved in the smallpox campaign and this led to the establishment of the EPI in 1974 (Okwo-Bele & Cherian, 2011).

Despite the expansion of immunisation programs across the world since the 1970s, there has been a significant drop in the uptake of immunisation programs and new vaccines. This decline has prompted a joint effort by the public and private sectors aimed at resuscitating the decreasing momentum. The joint effort culminated in the formation of the Global Alliance for Vaccines and Immunisation (GAVI), which aimed at improving immunisation efforts across the world (CRS, 2014).

The UN developed Sustainable Development Goals (SDGs) in 2015, which were adopted by all its member states. These SDGs have an overall and common aim to eradicate poverty in the world through the achievement of the various goals that were

set. These goals include: improving health and education, reducing inequality, and spurring economic growth by 2030 (UN, 2015). In the context of immunisations, the SDG Goal 3, is important as it commits all member countries to focus on eradicating "preventable deaths of newborns and children under the age of 5 by 2030, with a targeted reduction of children under the age of 5s mortality to 25 per 1,000 live births in every country" (UN, 2015).

All international efforts to reduce the incidence of VPDs among children younger than 5 years have so far been led by international organizations such as the WHO, UNICEF, and GAVI. In essence, several efforts have been undertaken to reduce and eventually eradicate VPDs on a global scale. These efforts have continued to be of benefit in many instances. However, as previously indicated, there is a downward trend in the uptake of new vaccines, which hampers immunisation efforts. This is supported by statistics on immunisations released by the WHO in 2018, which indicate that as global uptake of childhood vaccines improves, there is an increasing proportion of child deaths. These child deaths are concentrated in sub-Saharan Africa and Southern Asia where 80% of deaths in children under the age of 5 occur in these regions (WHO, 2018).

At a global level, immunisations currently prevent between two to three million childhood-deaths every year. On the contrary, more than 1.5 million children still die from VPDs each year (Barasa,Rogo,Mwaura & Chuma, 2018). In the 18 years since its inception in 2000, GAVI reports that it has managed to support the immunisation of more than 760 million children worldwide (GAVI, 2019). It is believed that currently, approximately 100 million children are immunised each year. According to statistics presented by UNICEF (2018), overall child mortality rates due to VPDs fell from 12.7 million to 5.8 million during the period from 1990 to 2017. This drop in mortality rate is as a result of global immunisation campaigns and expanded national immunisation programs. The outcome achieved from the campaign relates to the scaled-up fight against measles from 2000 to 2017. The campaign was responsible for saving an estimated 15.6 million children from the disease (UNICEF, 2018). However, about 20 million infants and children across the

world did not get the full schedule of recommended vaccines in 2018 (WHO, 2019). An estimated 60% of these children who failed to receive the full schedule of vaccines live in low and middle-income countries including: Angola, Brazil, DRC, Ethiopia, India, Indonesia, Nigeria, Pakistan, the Philippines, and Vietnam (WHO, 2019). Even though there have been major strides across the world in terms of immunisation efforts, full global coverage is yet to be achieved. According to GAVI, full immunisation coverage could prevent one in seven deaths in children under the age of 5. Several efforts have been taken to improve global immunisation efforts by leading multilateral organizations.

An additional paradigm that points to slowed immunisation efforts relates to the immunisation campaigns against the DTP3 vaccine. According to the WHO (2019), there has been a marked decrease in the number of children vaccinated with DTP3 in recent years, even though its coverage remains higher than coverage for other required immunisations. There are reports that this recent stagnation in DTP3 coverage is a result of “acute problems that a small number of previously high performing countries have faced” (GAVI, 2019). The WHO reported that DTP3 posed a dangerous threat to neonates, new mothers, and pregnant women (WHO, 2019). On a global scale, maternal and neonatal tetanus elimination (MNTE) has reached the level where it has almost been eradicated and since 2000 newborn deaths from tetanus have been reduced by 85% (WHO, 2019).

1.4 IMMUNISATION TRENDS IN SOUTH AFRICA

Recent trends in immunisations have revealed that the levels of immunisations have dropped significantly in South Africa since 1994, signifying a downward trajectory. UNICEF (2011) estimated that as many as 105,000 infants are not fully immunised in South Africa. An estimated 400,000 children in South Africa are not fully immunised against measles. 15% of deaths in children under 5 are due to diarrhea caused by the Rotavirus and 9% are due to pneumonia, both vaccine-preventable diseases of childhood. Up to the end of February 2011, nearly 19,000 cases of measles occurred in South Africa, of which 52% were in children under 5 (UNICEF, 2011). These figures can

be accounted for by the numerous factors that influence immunisation rates including immunisation stigma, geographic location, corruption, inadequate country capacity, poverty and socioeconomic status. A UNICEF representative in South Africa, Dr. Aida Girma, reiterated the importance of protecting children against VPDs. She emphasized the importance of immunisation by citing its many successes and cost-effectiveness.

According to UNICEF (2011), poor and remote areas need to have easy access to immunisation services so as to reduce both maternal and infant mortality rates, as this plays a crucial role towards improving the health and economic status of South Africa. Sudfeld, Navar, and Halsey (2010) also supported this view by stating that most deaths from diseases were preventable with available vaccines, and diseases such as measles and polio could be eliminated with immunisation. This, however, requires a high immunisation coverage rate. Towards the end of 2019, health officials reported a measles outbreak in the Bojanala Platinum district in North West province. This poses a serious threat to all the children in that area as herd immunity is now compromised. According to a study conducted globally, the minimum threshold for measles herd immunity is 93-95%, which is a number much higher than anticipated (Funk et al., 2017).

In the South African context, immunisations have played a very important role in safeguarding individual health. The country has made remarkable progress in childhood immunisations and according to a countrywide survey conducted by the Department of Health of South Africa, immunisation coverage of routine vaccines in children 12 – 23 months of age ranged from 62% for measles immunisation to 81% for BCG immunisation in 2003 (Department of Health, 2007). There has been a significant decline in child mortality, owing to immunisations in South Africa (Bärnighausen, Bloom, Canning, O'Brien, 2008)**.** Despite the remarkable progress achieved by immunisation efforts that were implemented, the country failed to meet the UN's Millennium Development Goal of reducing children under the age of 5's mortality by about two thirds in the period from 1990 to 2015 (UNICEF, 2016). Recent trends in immunisations have revealed that the

levels of immunisations have dropped significantly in South Africa since 1994 (Health Systems Trust, 2014).

South Africa still remains behind other countries in terms of vaccine coverage. A study conducted by Hamid *et al*. (2012) revealed that while South Africa's national percentage on immunisation coverage fluctuated between 80% and 84%, India's immunisation coverage was higher. The study concluded that India's dropout rate was lower than that of South Africa due to women in India understanding the importance of childhood immunisations (Hamid *et al*., 2012).

As previously discussed, there is a significant lack of research surrounding immunisation rates in South Africa and emphasis should be placed on the importance of conducting childhood immunisation research in South Africa. South Africa faces a downward trajectory of immunisation rates, which contributes towards the economic and health statuses of the country. Vaccine experts have also noted that there is no data on anti-vaxxers in South Africa nor the extent of their contribution to the rise in VPDs such as measles. The scale of vaccine hesitancy in South Africa can only be known and understood after a nationwide survey has been conducted (Logan *et al*., 2018).

1.4.1 THE UNIQUE CHALLENGES FACED BY SOUTH AFRICA IN THE FIGHT FOR IMMUNISATIONS

Immunisation in South Africa has recently shown a downward trend despite having registered impressive growth in the last 5 to 8 years. According to the EPI (SA), immunisation coverage increased from 83.6% during the 2012/13 period to 89.8% during the 2014/15 period. Immunisation coverage then dropped to 82.3%, which marked a 6.9% reduction, putting our coverage rate at almost 10% below the set national target of 92%. This is also lower than the target set by the WHO Global Vaccine Action plan 2011-2020, which is at 90% national coverage of all primary series vaccines.

Explanations for this reduction include the fact that there was an equal distribution of vaccines to all areas without factoring in the different population targets and demand, which gave a false impression of heterogeneity in coverage. This can also be attributed to the shortage of Hexavalent for a period of nine months, which was only rectified at the end of October in 2016. As a result of this reduction in vaccine coverage at a national level, the Department of Health introduced South Africa's first national household immunisation coverage survey in March of 2019. This initiative is meant to investigate immunisation figures and trends and to rectify any anomalies that are affecting national coverage.

1.5 DETERMINANTS OF LOW IMMUNISATION UPTAKE

Apart from vaccine hesitancy and poor access to treatment, lowered rates of immunisation uptake are still evident due to the influence of caregivers. A qualitative evidence synthesis study conducted by Cooper *et al*. (2019) concludes that a growing number of caregivers are: questioning childhood immunisations, seeking alternative preventative measures, and deciding to delay or refuse immunisations for their children, both in high- and low-income settings. These factors are further elaborated on below.

1.5.1 CAREGIVER KNOWLEDGE AND ATTITUDES TOWARDS IMMUNISATION COVERAGE

Caregivers play a very significant role in the immunisation of children. As a result, their cooperation is pertinent to ensuring that children are fully immunised against VPDs (AbdulRaheem *et al*., 2011). Mphaka, Moshime, and Reddy (2018), conducted a cross-sectional study on the knowledge, attitudes, and practices of caregivers and how this impacted on immunisation coverage rates in Tshwane, South Africa. The authors found that 13% of the caregivers interviewed had no knowledge about any immunisations, while 29% had knowledge about 3 out of the 18 immunisations, as per EPI (SA). Findings from this study indicated that 82% of children were recorded as fully immunised regardless of the caregivers' knowledge relating to immunisations. The attitudes of

caregivers were positive and the importance of immunisations in preventing their children from contracting VPDs was understood. According to Mphaka *et al*. (2015), poor caregiver knowledge on immunisation was a minor contributor to the low levels of immunisation coverage. When participants with children who had not been fully immunised were asked why they did not complete the immunisation schedule of their children, factors such as vaccine stock outs, long queues at healthcare centers, and the negative treatment received from healthcare workers were common answers.

A study conducted in the North West province by Sehume (2011) to investigate the reasons for the low uptake of vaccines, showed that caregiver knowledge was not linked to low vaccine coverage. This study revealed that factors such as: low-income status of the family, education level of mothers, and certain cultural beliefs, were more strongly correlated to poor immunisation coverage. In essence, its results were similar to the results from the study by Mphaka *et al*. (2015), which failed to establish a connection between low immunisation coverage and caregiver knowledge.

The results of these studies are in sharp contrast to those of similar studies held elsewhere. These include a study held by Odusanya *et al*. (2008), which analyzed how caregiver knowledge was connected to low immunisation rates in rural Nigeria. Another study carried out in Pakistan by Owais *et al*. (2011), investigated whether maternal knowledge could improve immunisation coverage in Pakistan. Both studies concluded that there was a strong correlation between caregiver knowledge and immunisation rates.

There seems to be no consensus on the issue of whether or not caregiver knowledge influences the rate of immunisation coverage. However, it is important to note that there are other factors at play that affect immunisation coverage rates – even in cases where caregivers were well informed regarding vaccines, some caregivers still failed to fully immunise their children.

A survey that specifically assessed attitudes towards vaccines among fathers in Istanbul showed that about 18.6% of fathers were of the view that vaccines were not good for their children and therefore they would not allow it (Torun and Bakirci, 2006). It has been well documented in different parts of the world that a negative attitude towards vaccines results in poor immunisation coverage thereby reducing the progress made against VPDs. For example, Hamid *et al*. (2012) reported on the positive attitudes of women in India towards immunisation having resulted in higher percentage coverage of immunisation in that country.

Research conducted by Corrigal *et al*. (2008), in the Western Cape province, showed that 13.5% of the parents who participated in the study were not motivated to immunise their children. A literature review that was conducted on vaccine hesitancy amongst parents in the United States revealed some of the reasons that motivate parents to adopt a negative view of immunisation, these include: religious beliefs, personal beliefs, and safety concerns (McKee and Bohannon, 2016). Research has revealed that beliefs can lead to misconceptions about immunisation, including beliefs that any vaccine contributes to the general immunity of people rather than protecting against specific diseases, or that sick individuals cannot be immunised (Nichter, 1995). There is a strong conviction among some of these caregivers that VPDs can be remedied by maintaining healthy diets and lifestyles. According to McKee and Bohannon (2016), the only way to shift such mindsets is through intensive programs to educate caregivers about vaccine safety and the dangers of not immunising their children.

1.5.1.1 THE INFLUENCE OF CAREGIVER AND ADMINISTRATOR PRACTICES ON IMMUNISATION COVERAGE

Caregiver and administrator attitudes towards childhood immunisations are essential in determining the likelihood of on-time immunisation rates. There are a number of caregiver practices that impact vaccine coverage, which range from religious beliefs to a lack of verified information on the importance of vaccines and their safety – often peddled on social media platforms. These factors have a great impact on immunisation

coverage and the uptake of new vaccines, the most common factor being incorrect immunisation return dates and the distance between patient's homes and their clinics (Fonn *et al*., 2006). A study conducted in 2008 in the Western Cape, indicates that 19.2% of clinic factors were caused by missed opportunities by healthcare providers themselves (Corrigal *et al*., 2008). If the healthcare facility is poorly staffed and caregivers experience difficulties in accessing services, the likelihood of their return is severely curtailed.

As further noted in the various articles reviewed, immunisation differs across different countries and also within countries across different districts. In terms of South Africa, despite having achieved significant strides in immunisation coverage across the country, there are still disparities in immunisation coverage across its various provinces. Several reasons have been cited for the recent decline in immunisation rates. These range from socio-economic factors to those relating to the practices and attitudes of the caregivers themselves. It is also worth noting that the downward trend experienced in South Africa is experienced in other countries as well, including high-income countries. Even though there is a direct link between caregiver and administrator knowledge and immunisation coverage rates in other jurisdictions, the results for South Africa are not conclusive which echoes the need for more research relating to the effects of caregiver knowledge on childhood immunisation rates.

1.6 VACCINE HESITANCY

Despite having knowledge on the importance of these scientific discoveries to prevent childhood mortality, there still remains a social pull against the use of immunisations as a result of a surge in vaccine hesitancy.

Vaccine hesitancy refers to the delay in acceptance of vaccines or the refusal of vaccines, despite the availability of immunisation services (Hussey, 2009). In South Africa, vaccine hesitancy is largely attributed to false beliefs and conspiracy theories led by anti-vaccine activists (Cooper, 2018). The net effect of this anti vaccine movement can be illustrated by the rising number of global childhood deaths resulting from VPDs

such as measles. Vaccine experts have noted a lack of data on the extent of anti-vaccine sentiment in South Africa. The scale of vaccine hesitancy in South Africa can only be known and understood after a nationwide survey has been conducted (Logan *et al*., 2018).

The fairly recent outbreak of measles in South Africa can be seen as an example of VPD occurrence due to the influence of social media and anti-vaxxers. In 2017, there had been an outbreak of measles thought to have started in Gauteng and spread to all the major cities in South Africa. Dr. Yogan Pillay, the Deputy Director General for the National Department of Health said that 85% of children in South Africa are fully immunised by the age of 1 year, but the most recent data from the country's Medical Research Council suggests this figure is now closer to 70% (Green, 2016). The figure below (Figure 1.5) illustrates how MMR coverage (%) in the United Kingdom has decreased significantly during the period 1997 to 2004, shortly after anti-vaccine activist Andrew Wakefield published a paper surrounding the harms of the MMR vaccine and the side effect of autism in 1998. There has been a sharp and steady increase in the number of reported and confirmed measles cases from 2001 to 2007. Due to the contagious nature of measles, even the slightest breach in immunity could cause a worldwide outbreak (WHO, 2017).

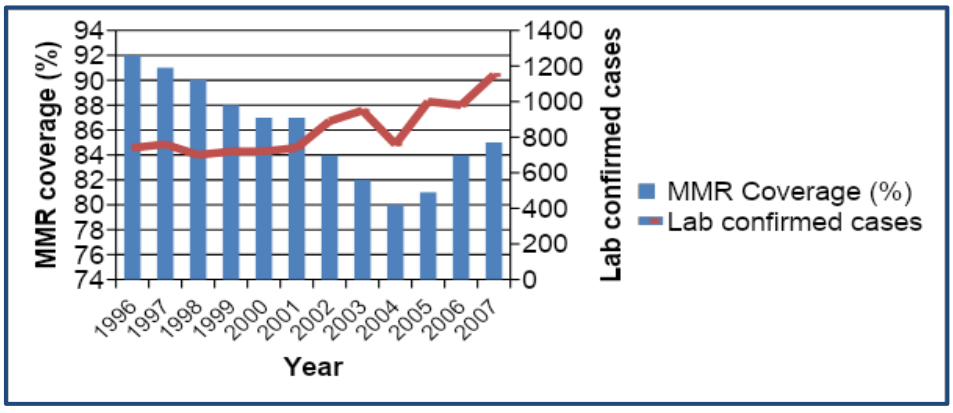


Figure 1.5: Bar graph representing MMR vaccine coverage and laboratory confirmed measles cases (all ages) in the United Kingdom from 1996-2007

Vaccine hesitancy is thought to be the main contributing factor to decreasing immunisation coverage and an increase in the risk of VPD outbreaks throughout Africa (Dube *et al*., 2013). A large number of parents in Africa are delaying or refusing recommended immunisations for their children. This can be attributed to a number of factors that are illustrated in the figure below (Figure 1.6). As a result, many communities are prone to infections, which results in disease outbreaks and eventually fatalities (MacDonald, 2015). The figure below (Figure 1.6) provides a graphic illustration of the factors attributing to vaccine hesitancy.

Figure 1.6: Factors affecting vaccine hesitancy

As a result of the resurgence of certain VPDs, which had previously been brought under control, the WHO has recently identified vaccine hesitancy as one of the ten biggest threats to public health on a global scale (WHO, 2019). Many public health officials, the world over, have continued to raise grave concern over the challenges posed by vaccine hesitancy and stigma that is being spread around the issue of vaccines. It was envisaged that by now the world could have achieved total eradication of polio, but this has not happened (GAVI, 2019; WHO, 2019). The health fraternity has also witnessed a spike in measles cases in some middle- and high-income countries, directly attributed to the effects of vaccine hesitancy (WHO, 2019). The WHO presented a report that confirmed

a rise of 300% in measles cases in America, Europe, and the Middle East in 2019 as compared to the figures in 2018 (WHO, 2019).

Vaccine hesitancy is an intensifying concern in South Africa. According to Wiysonge (2019), a brief survey of social media platforms has shown that about one-fifth of social media users in South Africa are vaccine hesitant. This was confirmed when the Western Cape Provincial Department of Health posted a notice on their Facebook page about a school-based immunisation campaign to administer the first dose of the HPV vaccine to 9-year-old, fourth-grade girls in public schools in the province in February of 2019. The response to this notice from social media users revealed that a third of the people who commented were vaccine hesitant (Wiysonge, 2019). A recent survey of private schools in South Africa revealed that only about 19.4% of girls receive the HPV vaccine and 65% of those who refused immunisations were vaccine hesitant (Wiysonge, 2019). According to a survey conducted by Wellcome Trust, which is based in the United Kingdom (UK), only 82% of South Africans expressed their trust in the safety of vaccines compared to 91% in Nigeria and 94% in Rwanda (Khan, 2019). South Africans have shown a greater distrust in vaccines and public healthcare institutions than other countries in Africa (Kahn, 2019).

Nigeria is an example where immunisation campaigns have failed and this resulted in the country's failure to eliminate polio for many years after it had already been eliminated in other countries (Kahn, 2019). According to the WHO, immunisation campaign efforts in Nigeria were hampered in part by conspiracy theories, "vaccine stigma", as well as by ethical concerns about government regulations and pharmaceutical industry practices (WHO, 2019).

The WHO (2019) has further noted that the uptake of new vaccines by low- and middle-income countries, which often have the highest disease burdens, has slowed down considerably when compared with high-income countries. Children, especially those that are under the age of 5 are more vulnerable to VPDs when compared to adults, therefore

early administration of immunisations for all children not only protects them but also decreases the spread of related diseases, thus improving child survival.

1.6.1 VACCINE STIGMA

A landmark study published 12 years ago by Dr. Andrew Wakefield and 12 co-authors associated childhood autism with the MMR vaccine. Wakefield affirmed that there was a clear correlation between the MMR vaccine and the occurrence of autism in children. This paper has since been retracted due to incorrect evidence and claims contrary to the findings of an earlier investigation (Eggertson, 2010). Furthermore, the sample size was much too small (n=12) to be recognized (Taylor, 2011). The main contributing factors to the stigma associated with childhood immunisations are the spread of misinformation and the rise of anti-vaxxers (Walter *et al*., 2009). This stigma creates misconceptions and steers caregivers away from fulfilling their children's recommended immunisation schedules. Research in South Africa indicates that caregivers show reservations towards the recommended immunisation schedule in South Africa due to religious objections while others see the immunisation schedule as an imposition by the government when this is meant to be a personal choice (S Ali *et al*., 2010). Most caregivers have concerns about the safety and efficacy of immunisations and are led to believe that VPDs do not pose a serious health risk (AbdulRahman *et al*., 2013). Both of the above are reasonable concerns, but due to the spread of false information, caregivers are encouraged to display these concerns without rectification.

1.6.2 CORRUPTION

Corruption is a difficult and complicated issue in South Africa and all around the world. These offenses range from minor bribes being taken by nurses and hospital staff members to falsify information on immunisation chart records to more severe acts at hospital administrator level or governance, when a person in power would obtain money or redirect resources for their own benefit (Transparency International, 2006).

Access to immunisations for children in the public sector is dependent on the state of the facility. Corruption and misuse of funds by governing bodies poses a great risk to

immunisation rates. Political instability poses a risk to immunisation rates in the same way that corruption and fraud contribute. Political stability is a necessary component to ensure that the health care system of a country runs efficiently (Vian, 2002), and this warrants that caregivers are given adequate access to healthcare facilities to allow for the administration of immunisations.

In Uganda, a study conducted in 2012, noted corruption as one of the largest barriers to providing good care to patients (Bouchard *et al*., 2012). Corruption and poor governance as well as political instability, leads to fewer resources being available to purchase necessary immunisations and medications, hire capable healthcare workers to administer immunisations, or make improvements to healthcare facilities, which all ultimately impact patient care and treatment outcomes (Gupta, 2000). The key findings from a study conducted in the United States (US) explain that globally 1.6% of yearly deaths in children can be accounted for by corruption, as a lack of healthcare services (Mackey, 2012).

Research suggests that an individual's political and moral outlook have a role in vaccine uptake, but this may differ from country to country (Dube *et al*., 2013). For example, in America, Trump supporters are politically influenced by his view that the MMR vaccine attributes toward autism. South Africa has not had the influence of an extremist leader on the practice of childhood immunisations, however moral and religious outlooks by caregivers play a role. A study by Kahn (2017), conducted in Lenasia, South Africa, a predominantly Indian Muslim populated area, concludes that more than half of the participants reasoned religious beliefs and cultural viewpoints as an exemption for childhood immunisations.

1.6.3 GEOGRAPHIC LOCATION

There are many areas in developing countries that are located far away from health facilities, further affecting immunisation coverage. According to Utazi *et al*. (2019), geographical distance from health centers has the potential to hinder the progress of vaccine campaigns. Often in poor countries, some populations live in remote and poorly resourced areas, which bear the burden of disease because they lack access to proper health facilities. Utazi *et al*. (2019) notes that it is common across the world that there are major differences in terms of vaccine coverage between children in urban and rural areas, resulting in an increase in the spread of VPDs in rural areas. The WHO reports that in certain countries like Nigeria and Indonesia, coverage of the measles vaccine in rural areas is 33.0% lower than in urban areas (Utazi *et al*., 2019).

In 2009, the health department of South Africa added the PCV, which initially covered seven strains and was thereafter increased to 13 strains of the pneumococcus by 2011 (Corrigal *et al*., 2011). Studies indicate that in the Western Cape, immunisation coverage of PCV was as low as 7.3% in 2007 followed by a sharp increase to 89% in 2012 (Madhi *et al*., 2014). This can be attributed to an increase in childhood immunisation awareness and knowledge, as well as access to healthcare services. Low percentage coverage during the initial phase was caused by vaccine stock shortages due to the geographical location of the study sites.

In South Africa, the geographic location of the different provinces plays a role in immunisation rates. For example, major cities within larger provinces are likely to have increased access to healthcare services as well as additional availability and resources. There are also disparities in immunisation coverage between the provinces with Gauteng at 91%, Western Cape at 84.9%, and Limpopo at 70.3%, which can be attributed to geographic location as Gauteng has more service providers per capita than other provinces in South Africa (Health Systems Trust, 2014).

1.6.4 FRAGILE AND CONFLICT ENVIRONMENTS

According to a report by UNICEF, 40% of children who fail to access vaccines are found in countries that are affected by armed conflict or other humanitarian challenges (UNICEF, 2019). Healthcare systems in such countries are often broken down and healthcare workers cannot reach certain areas to carry out immunisation administration. Armed conflict is a barrier to the treatment of VPDs and the containment of these diseases. Armed conflict displaced individuals into overcrowded and unsanitary settings where infectious diseases spread rapidly (Chimeremma *et al*., 2017). As of 2015, countries affected by armed conflict or other humanitarian emergencies, such as Somalia, South Sudan, Central African Republic, Ukraine, and Syria, reported that immunisation coverage of DTP3 was below 50% (Mast *et al*., 2017). The University of Minnesota further noted that VPD cases in conflict-affected countries have expanded with the Democratic Republic of Congo experiencing a surge in measles cases in 2019, killing more people than the Ebola epidemic (University of Minnesota, 2019). In 2017, it was reported that South Africa experienced three measles outbreaks in the Western Cape, Gauteng and KwaZulu-Natal provinces, largely attributed to low immunisation coverage. A total of 6256 cases were suspected and the incidence rate per million increased from 0.3 in 2016 to 3.7 in 2017 (Hong, 2017).

1.6.5 POVERTY, SOCIOECONOMIC STATUS, AND SOCIAL DETERMINANTS OF HEALTH

Casey, Dumolard, and Danovaro-Holliday (2015) stated, “immunisation coverage in low-income countries (41%) are far behind coverage in high-income countries (90%).” For instance, in South Africa, immunisation coverage has declined from 89.8% in the 2014/15 periods to 82.3% in the 2016/17 periods (WHO, 2018). This is driven by the fact that there are limited investments in the public health sector in low-income countries, with private medical care out of reach for the majority of the citizens. This puts low-income countries in a position where they are unable to vaccinate enough children to stop a virus’s spread, even with donor aid. Furthermore, there are socio-economic determinants like a family’s income level and the educational status of the caregiver,

which are all associated with inequities in immunisation coverage (WHO, 2019). UNICEF (2016) also noted that in certain countries, vaccine coverage for the richest fifth of the population is up to 58% higher than for the poorest fifth.

A study conducted by Fadness *et al*. (2011) at three different sites in South Africa, revealed that there is a strong correlation between socioeconomic factors such as low levels of education and low immunisation coverage (Fadness *et al*., 2011). The study covered three geographic areas, located in two provinces: Paarl in the Western Cape Province, and Umlazi and Rietvlei in KwaZulu-Natal. The areas were also different in terms of socio-economic status. The study specifically looked at immunisation timeliness and immunisation coverage for the first 8 vaccines of the EPI in South Africa. This included BCG, four doses of oral polio vaccines, and three doses of the pentavalent vaccine protecting against DTP3, Hep B and Haemophilus influenza type B disease. According to this study, there were significant differences between the different South African sites in terms of immunisation coverage and timeliness, with the poorer areas of Rietvlei performing worse than the economically better areas in Paarl (Fadnes *et al*., 2011).

In 2008 a study conducted in Italy (Bertoncello *et al*., 2008) titled “The association between socioeconomic determinants and hesitancy/refusal” was investigated with a logistic-regression model. A clear correlation between increasing economic hardship and hesitancy to childhood immunisations was noted. A lower parental education level was associated with refusal to childhood immunisations (Bertoncello *et al*., 2008). Despite differences in coverage, compared with the overall Sub Saharan African

childhood immunisation coverage, South Africa is anticipated to depict the lowest coverage (Bloom, 2011). Corrigal *et al*. (2008), Harris *et al*. (2013) and UNICEF (2016) convey similar conclusions as can be seen in Figure 1.7. Figure 1.7 depicts a column graph indicating coverage for two childhood immunisations in three differing geographic locations in Africa.

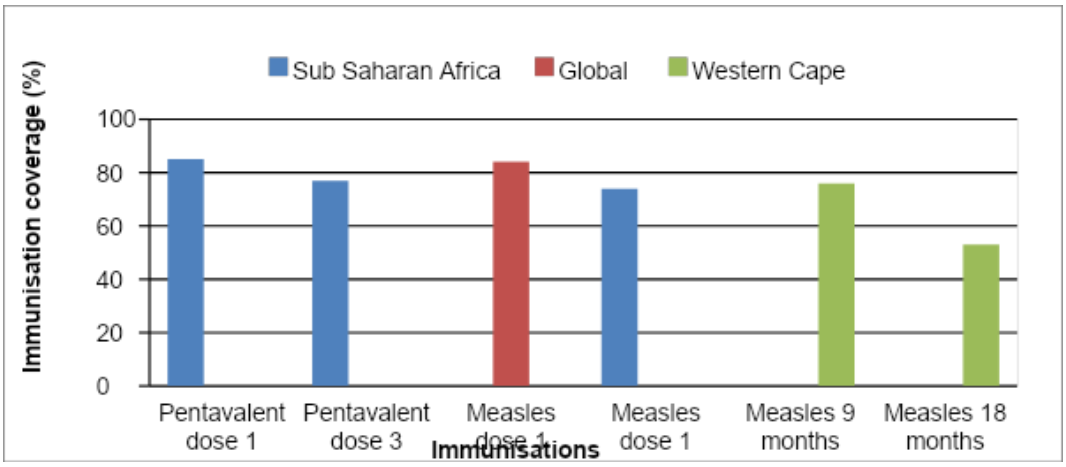


Figure 1.7: Column graph indicating the immunisation coverage for two childhood immunisations in three different geographic locations

It is clearly depicted that the global coverage for the first measles dose is higher globally (84%) in comparison to Sub Saharan Africa (74.3%) and the Western Cape (76.4%). The immunisation coverage for measles at 18 months lends to a sharp decline at 53.2% in the Western Cape.

1.7 PURPOSE OF THE STUDY

With a massive rise in anti-immunisation practices across the globe, a threat is posed to the integrity of herd immunity, on-time immunisation rates and to the health of individuals. Research shows that due to this anti-vaccine movement, parents who once favoured having their children immunised are now beginning to doubt whether or not it causes more harm than value (Godlee, 2011).

It is crucial that caregivers verify any and all information regarding risks associated with immunisations. False information should be substantiated before it eliminates the integrity of research based evidence regarding immunisations (Deer, 2004). In order to counteract the anti-immunisation movement it is important to develop a strong relationship and ensure trust between health care professionals and their patients (Hussain *et al*., 2018). Patients are more likely to vaccinate their children if they trust the health care professional advising them. This study will therefore determine the incidence

of on-time immunisation rates among grade 1 to 3 children (ages 6-9) entering public schools in Region B and E of the City of Johannesburg and further determine the factors that affect caregiver willingness to vaccinate.

1.8 STUDY AIMS AND OBJECTIVES

1.8.1 STUDY AIMS

The aim of this study is to establish the on-time immunisation rates among children who enter grades 1 to 3 within three public sector primary schools in Regions B and E of the City of Johannesburg. This study further aims to determine the thoughts, attitudes and perceptions of the caregivers of the enrolled students as well as the school administrators regarding immunisations and how these may influence on-time immunisation rates and management of VPDs.

1.8.2 OBJECTIVES

The objectives to this study include:

1. To determine the incidence of on-time immunisation rates among grade 1 to 3 children who enter three primary public schools in Region B and E of the City of Johannesburg.
2. To determine the knowledge, attitudes and perceptions of caregivers with regard to the practice of immunisation and the benefits thereof.
3. To establish the knowledge, attitudes and perceptions of public-school administrators regarding the need for learner immunisations.

1.9 SUMMARY OF CHAPTERS

Chapter 1 introduces the importance of the study by providing the reasons why further research surrounding this topic is required. Chapter 1 introduces the background importance of the study as well as provides a literature review related to factors affecting immunisation rates and the importance of on-time immunisations in schools in order to ensure the integrity of herd immunity. In Chapter 2, details of the methodology used in

the study are presented. It includes details on the study design, study sites, sampling methods, study participants, data collection methods and instruments, and lastly data analysis methods. The chapter also highlights and explains the reliability and validity of the data collection instruments and ethical considerations employed in the study. Chapter 3 presents the findings of the research conducted and the interpretation and discussion of the data that was collected. Chapter 4 draws recommendations and concludes this study as well as provides areas for future study.

CHAPTER 2
METHODOLOGY

2.1 INTRODUCTION

This chapter details the methodology used in the study. It includes details on the study design, study sites, sampling methods, study participants, data collection methods and instruments, and lastly data analysis methods. The chapter also highlights and explains the reliability and validity of the data collection instruments and ethical considerations employed in the study. In this chapter, the methods have been divided per study objective, outlined in Chapter 2.

2.2 ETHICAL CONSIDERATIONS

2.2.1 PERMISSIONS AND INFORMED CONSENT

A formal application of proposed research protocol was submitted to the Human Research Ethics Committee (HREC) at the University of the Witwatersrand, where ethics clearance was granted with ethics clearance number M190415 (Appendix L).

For objective 1, formal applications were submitted to the three selected schools to gain permission for use of these schools as study sites (Appendix C-E), as well as to the National Department of Education (NdoE) where approval was granted (Appendix M). Consent to access the records of the learners was not sought for this study because their information was used in a retrospective review and the parents had willingly submitted the records to the school upon enrolment. No identifying factors were used throughout the study and hence caregiver consent was not needed.

For objectives 2 and 3, a newsletter was sent with all the relevant details of the study to inform the prospective participants. Attached to this newsletter was a link directing the caregivers to the survey, on REDCap, which was completed by those interested.

Completion of the survey was considered as an informed consent, in accordance with HREC guidelines.

2.2.2 RIGHTS OF PARTICIPANTS

For objectives 2 and 3, by means of the participant information leaflet, the respondents were made aware that their participation in the survey was strictly voluntary. Therefore, they were free to stop their participation at any point if they felt they no longer wanted to participate.

2.2.3 CONFIDENTIALITY

All the data collected for this study was treated with the utmost confidentiality and was not divulged to any third parties. For objectives 2 and 3, the data was uploaded to REDCap, which is secure because only the researcher and supervisors have access to this data. Research participants were given assurances that the surveys were conducted only for academic purposes and nothing more. No actual names or identifiable information of any of the participants were used in the write up of the dissertation. Their right to anonymity was maintained throughout the study, as explained to the participants in the participant information leaflet and in accordance with ethical guidelines set out by the HREC.

2.3 STUDY DESIGN

This study employed a cross-sectional research design with a retrospective review of patient data, as well as a knowledge, attitude and perception (KAP) study being conducted. These methods were deemed the most suitable in fulfilling the research objectives of the study outlined in Chapter 1. This chapter elaborates on the nature of the research design for the study. It includes a detailed description of, and a rationale for, the specific design for the study and describes how it aligns to the selected methodology indicated. Additionally, it describes why the selected design is the best option to collect the data needed for the study. It explains exactly how the selected design will be used to collect data for each and every variable, for a quantitative study,

and how the selected design will be used to collect data to describe the nature of the phenomena in detail, for a qualitative study. It identifies the specific instruments and data sources to be used to collect all of the different data required for the study. Arguments are supported by citations from articles and books on research methodology and design.

2.4 OBJECTIVE 1: A RETROSPECTIVE REVIEW OF LEARNERS IMMUNISATION RECORDS

A retrospective review, also known as a historic study, was undertaken to determine the on-time immunisation rates amongst grade 1 to 3 learners, at three public primary schools, in Region B and E of the City of Johannesburg. The immunisation charts were reviewed and assessed (Appendix A) to determine the on-time immunisation rates amongst grade 1 to 3 learners, in accordance with the EPI (SA) (Appendix B).

2.4.1 STUDY SITE AND SAMPLE SIZE

The study site for the retrospective review of learner immunisation records included three public primary schools in Region B and E of the City of Johannesburg district of Gauteng, South Africa. For the purpose of this study and to maintain confidentiality the schools will be coded as 1, 2 and 3. Permissions to conduct research and access information at these sites was obtained from both the school principals and governing bodies (Appendix C – E).

These three particular public schools were selected as the study sites, due to their willingness to participate in the study. A further justification for the use of these particular schools as a study site, is that research indicates a relationship between socio-economic status and vaccine hesitancy (Wakefield, 1998). The learners enrolled in these selected schools are assumed to be from families of middle to high-income demographics, where vaccine hesitancy is considered most prevalent. Based on the number of grade 1 to 3 learners at these study sites, it was decided that three study sites would allow for the

collection of a sufficient data set to represent the broader population, in correspondence with the calculated sample size indicated below (Equation 2.1).

Equation 2.1: Sample size determinant equation for the purpose of conducting this study (Daniel, 1999).

$$n = \frac{z^2 P(1-P)}{d^2}$$

n = sample size

z = stats for CI (CI = zd) (Where CI is the confidence level and zd is the standard normal distribution

P = expected prevalence (in proportion to 1)

d = precision d = 0.5 x (1 - P)

The population size of grade 1 to grade 3 learners, from the three public primary schools selected, amounted to 756 learners. The specific population size per school is highlighted in Appendix F. The sample size calculated amounted to a total of 464 learners, or 61.35% per study site. This resulted in the sampling of 164 learner immunisation records from School 1, 136 learner immunisation records from School 2, and 164 learner immunisation records from School 3. This calculated sample size allowed for data collection to reach an appropriately large target population necessary for this study type to be of a suitable scientific reflection of specific population immunisation traits.

2.4.2 STUDY PARTICIPANTS AND SAMPLING TECHNIQUE

The retrospective on-time immunisation review was undertaken by making use of immunisation records of grade 1 to 3 learners at the three selected study sites. The immunisation charts that were provided by the respective schools were selected through a process of random sampling to maintain confidentiality and eliminate bias. The respective school administrators randomly supplied the required number of learner immunisation records per age group under review.

2.4.3 INCLUSION AND EXCLUSION CRITERIA

Learners in grades 1 to 3 were selected to form part of the retrospective review. The inclusion criteria used, determined that only male and female learners from the three participating schools whose immunisation records were submitted upon their entry into grade 1 as per EPI (SA) guidelines, were selected for the study. For the purpose of this study, no other gender specifications were considered. These participants were selected as the South African Department of Education National Education Policy Act, 1996, Admission Policy for Ordinary Public Schools states that in South Africa children are assumed to be fully immunised by the age of 1 year. Therefore, the expectation is that learners in grade 1 should have received full immunisation cover. This study further included grade 2 and 3 learners on the basis that the current EPI (SA) program extends to 9 years of age (the normal age for learners in grade 3). Since a retrospective design was used for this process, no parental consent was necessary to access the immunisation records.

The exclusion criteria employed excluded children who had conditions that would not allow them to be vaccinated. These would include transplant patients, patients with autoimmune conditions, patients with cancer or any other exclusionary medical conditions where immunisations are contraindicated.

2.4.4 RESEARCH INSTRUMENTS

The research instrument used to collect data for this objective was developed from the EPI (SA). The EPI (SA) schedule was adapted to provide a relevant data collection sheet, by including space for data collection pertinent to the student immunisation chart, relating only to the date of birth of the student and the dates associated with vaccine administration (Appendix A). Student codes were randomly assigned per data collection sheet to facilitate the gathering of data and to ensure that confidentiality was maintained. No learner specific identifiers were used during data collection.

2.4.5 DATA COLLECTION AND ANALYSIS

The immunisation charts were reviewed on-site, at the respective schools in a designated office space, hence there was no need to remove the records from the schools property. The first step in collecting the data from the charts was to redact all information that was identifiable. The data was then stored on REDCap using a data collection sheet tool. REDCap is a web-based application developed by Vanderbilt University to capture data mainly for clinical studies. It is a secure application for building and managing online surveys and databases and hence the chosen means for disseminating the survey for data collection purposes. The data collection sheets were stored in chronological order and each student's sheet was assigned a code, facilitating their collection and analysis. This was also done to ensure the integrity of the data while protecting the confidentiality of the learners. The data collection sheets were kept for record purposes and were only accessible to the researcher and research supervisors of the study. The immunisation chart records were then assessed and the necessary data was extracted from the records and recorded on the data collection sheet (Appendix A). The date of immunisation was compared to the student's date of birth to confirm compliance to guidelines associated with vaccine administration per age. Compliance was determined by comparing the date of student immunisation to the EPI (SA) schedule (Appendix B). Compliance was defined as immunisations that met the dosage intervals according to the EPI (SA) guidelines, while non-compliance was defined as immunisations that were outside of this range.

Overall, four categories of analysis were created: fully compliant, mainly compliant, partially compliant and non-compliant learners. A fully compliant learner was defined as having received on-time immunisations for all 18 expected administrations, as per EPI (SA). Mainly compliant was defined as immunisations received on-time for 12 to 17 immunisations, partially compliant for 3 to 12 vaccines received on-time, while non-compliant referred to less than 3 immunisations received on-time, as per EPI (SA).This study defined mainly compliant and partially compliant as late immunisations.

Furthermore, a record of the errors that occurred during the collection of data on the data collection sheet (Appendix A) were kept.

2.5 OBJECTIVE 2: SURVEY ON THE KNOWLEDGE, ATTITUDES AND PERCEPTIONS OF CAREGIVERS REGARDING CHILDHOOD IMMUNISATIONS

In order to address objective 2, a quantitative cross-sectional survey was employed to determine the knowledge, attitudes and perceptions (KAP) of learner caregivers. These were caregivers of the learners whose records were reviewed for the first objective in the retrospective study, from the three selected primary schools (1, 2 & 3). The cross-sectional study design was most suitable for this particular objective, as the aim was to describe and analyse particular features of a selected population. The objective is concerned with the current attitudes and how these impact immunisation coverage rates. The study made use of a pre-validated survey by Opel *et al*. (2013). Approval for use of the pre-validated survey tool was sought from the respective authors and it was granted (Appendix G). The approved survey is found under Appendix H.

2.5.1 STUDY SITE AND SAMPLE SIZE

The study sites for the caregiver KAP study remained the same as for the retrospective review conducted. The sample size for this objective of the study was determined as per calculations detailed in section 3.3.1. The population of learner caregivers, from the three public primary schools selected, amounted to 1 156 caregivers (associated with grade 1 to 3 learners). This population size allowed for data collection to reach an appropriately large target population, necessary for this study type. The specific population size of the caregivers per school is highlighted in Appendix F. The calculated sample size for the KAP study amounted to a total of 711 caregivers, including both mother and father, or 61.46% per study site. This resulted in 219 caregivers sampled from School 1, 273 caregivers sampled from School 2, and 219 caregivers sampled from School 3.

2.5.2 STUDY PARTICIPANTS AND SAMPLING TECHNIQUE

A cross-sectional analytical study design was undertaken, using systematic sampling methods. The study participants selected for KAP analysis were the grade 1 to 3 learner caregivers. The caregivers of all the learners, whose immunisation charts were reviewed in the retrospective study, were selected for the KAP study. The caregivers were invited to participate in this study through a newsletter that was sent out by the school administrators via the schools' databases. This newsletter outlined the study information and allowed the caregivers to gain insight into the research. Attached to the newsletter was a link directing the caregivers to the survey that was hosted on REDCap.

2.5.3 INCLUSION AND EXCLUSION CRITERIA

The inclusion criteria used for the selection of caregivers determined that only primary caregivers of the learners, whose immunisation charts were reviewed in the retrospective study, would be selected for the study. This was mainly because the primary caregivers were the ones with the responsibility to ensure that the required vaccines were administered at the appropriate times. In cases where both parents were the primary caregivers, their responses were treated as separate responses as opposed to joint responses.

2.5.4 RESEARCH INSTRUMENT

The study made use of a pre-validated survey tool, namely the Parent Attitudes about Childhood Vaccines (PACV) survey, developed by Opel *et al*. (2013), for which approval of use was granted (Appendix H). The survey had a total of 15 Likert scale type questions that were divided into five themes. Questions were based on themes relating to contextual influences such as community, media and the environment, as well as religious, cultural and socio-economic influences. Questions 1 to 5 emphasised the group and individual influences surrounding childhood immunisation controversies.

The PACV survey was first used to describe factors associated with immunisation prevalence and measuring caregiver knowledge, attitudes and practices, which may have influenced immunisation prevalence in the Delft community. The cross-sectional

approach was used to establish the knowledge, attitudes and perceptions of public-school administrators on the need for student immunisations. The cross-sectional design was chosen for this study because it allowed researchers to observe several characteristics and in this case perceptions, beliefs, knowledge and attitudes of caregivers towards vaccines and the immunisation of their children.

The PACV survey tool has been previously tested in pilot studies for construct validity and predictive validity. In order to obtain international validation, the PACV survey tool was distributed to investigators, clinicians, and public health experts in seven countries (Opel *et al*., 2013). Additionally, the PACV survey tool was used for comparative analysis against the five categories of vaccine acceptance identified by Gust *et al*. (2008). The correlation between the two measures using the Spearman correlation coefficient, and the association between the two measures using the Cochran-Mantel-Haentszel test of association were previously assessed (Oladejo, 2016). The conclusion to this study was that the ability of the PACV survey tool to identify and classify parental vaccine hesitancy is similar to classification using Gust *et al*. (2008) vaccine acceptance categories, and both measure linear entities. Therefore, this validated survey was deemed reliable for this study as it was a means of a public health surveillance tool that has been commonly used in many parts of the world. Approval for use of this tool was granted (Appendix H). Due to the tool being pre-validated, no pilot study was necessary for this study.

2.5.5 DATA COLLECTION AND ANALYSIS

The survey was sent to all selected caregiver participants via email. The email contained a newsletter with details about the study in order to provide information to the participants (Appendix K). Attached to the newsletter was a link directing the caregivers to the survey on REDCap. Completion of the survey was considered as an informed consent, in accordance with Human Research Ethics Committee (HREC) guidelines. The researcher remained in constant contact with the respective administrators of the schools, bimonthly, sharing developments in the study's progress as well as attending to any questions or concerns the schools or caregivers had about the study. Upon

completion of the surveys, the results were used to draw conclusions pertaining to the knowledge, attitudes, perceptions and thoughts of childhood immunisations amongst caregivers.

All data collected was sent to REDcap where it was securely stored and could be accessed by the researcher and supervisors only. Statistical analysis was conducted, which was both illustrative and inferential using IBM SPSS (Statistical Package for Social Science) analytical tools. The quantitative data was presented in tables and graphs in order to identify variations as well as similarities within the data and present the data in a comprehensible manner. Furthermore, frequency and percentages were used to measure prevalence. A logistic regression was employed to determine the relationships and correlations. The help of a bio-statistician at the University of the Witwatersrand (Phillip V Tobias Building) was adopted in order to correctly complete the logistic regression and draw accurate conclusions from the data collected.

2.6 OBJECTIVE 3: SURVEY ON THE KNOWLEDGE, ATTITUDES AND PERCEPTIONS OF SCHOOL ADMINISTRATORS REGARDING CHILDHOOD IMMUNISATIONS

A quantitative cross-sectional study design was used to establish the knowledge, attitudes and perceptions of public-school administrators on the need for student immunisations. A pre-validated survey by Larson *et al*. (2015), was adapted for this study. Approval for use of the established survey tool was obtained from the respective authors (Appendix I). The survey was emailed to the administrators of the respective schools.

2.6.1. STUDY SITE AND SAMPLE SIZE

The study sites for the administrative KAP study remained the same as for objective 1 and 2. The sample size for this objective of the study was determined as per calculations

detailed in section 2.4.1. The calculated sample size for the KAP study amounted to a total of 3 administrators from the respective schools.

2.6.2 STUDY PARTICIPANTS AND SAMPLING TECHNIQUE

The school administrators associated with the study sites were selected and invited to participate in this study, through a study information document. This study information document outlined crucial details of the study and enabled the administrators to gain insight into the research. Completion of the survey was considered as an informed consent.

2.6.3 INCLUSION AND EXCLUSION CRITERIA

Only school administrators associated with the study sites were invited to participate in the study. The respective administrators of the public primary schools are responsible for student enrolment and ensuring that the correct documents are presented upon enrolment. Administrators play a critical role in the ongoing monitoring of on-time immunisation rates as they are in charge of making sure that all immunisation charts of learners are up to date. In the event of missing information, these administrators are meant to follow up with caregivers and obtain the necessary information. Factors made their views pertinent to this study and their perceptions, knowledge and attitudes were also deemed necessary.

2.6.4 RESEARCH INSTRUMENTS

Data was collected through the use of a quantitative survey. This survey tool, by Larson *et al*. (2015), was tested for construct validity and predictive validity. Since the study used a pre-validated instrument, there was no need to conduct a pilot study for this study. The necessary permission to use this instrument was sought from the originators and it was granted (Appendix I). The survey has Likert scale type questions. This scale, like many others, measures attitudes to set statements put by the survey. "The respondent is provided with a scale of possible responses (usually five) to the question – ranging from the attitude measure, strongly agree, to the exact opposite measure of strongly disagree”

(Wilkinson & Birmingham, 2003). The questions for the administrative participants were divided into five themes comprising of 15 questions in total, with similar types of questions as in the caregiver survey developed by Opel *et al*. (2013). This pre- validated survey (Appendix J) was considered suitable and reliable for this study's setting as it was a means to a public health surveillance tool that is commonly used in many parts of the world.

2.6.5 DATA COLLECTION AND ANALYSIS

Data needed for this part of the study was collected by using a quantitative survey and it was stored using a tool called REDcap. The administrators voluntarily completed the surveys and completion of the survey was considered as an informed consent, in accordance with HREC guidelines. All data collected was sent to REDcap where it was securely stored and could be accessed easily. Statistical analysis was conducted which was both illustrative and inferential using IBM SPSS (Statistical Package for Social Science) analytical tools. The quantitative data was presented in tables and graphs in order to identify variations as well as similarities within the data and present the data in a comprehensible manner. Furthermore, frequency and percentages were used to measure prevalence. A logistic regression was employed to determine the relationships and correlations. The researcher adopted the help of a bio-statistician at the University of the Witwatersrand (Phillip V Tobias Building) in order to correctly complete the logistic regression and draw accurate conclusions from the data collected.

CHAPTER 3
RESULTS AND DISCUSSION

3.1 INTRODUCTION

This chapter presents findings of the research conducted and the interpretation of the data that was collected. The study used a retrospective analysis to fulfill the requirements of the first objective. This entailed a retrospective review of immunisation charts found in the three schools that were chosen for this study. The second analysis was quantitative and this was used to respond to objectives 2 and 3, which focused on the attitudes, knowledge, and perceptions of caregivers and school officials. For the purpose of this study a caregiver can be defined as any person whom the student has been placed in the care of. This can be further categorised as a father, mother, aunt, uncle or grandparent. A survey was conducted using a questionnaire as the main data instrument, which consisted of Lickert type questions. After collection, the data was organized, cleaned and prepared for analysis. The success of all research largely depends on the data cleaning process (Pallat, 2001). The data was uploaded on REDCap and stored for analysis. In this chapter results are presented in the form of graphs and frequency tables depicting %, which were the preferred method of presenting the results after the process of data analysis was conducted. For the purpose of this study, only public schools were considered however the effect of the private medical aid schemes, on childhood immunisation outcome rates, were explored and it was concluded that vaccinations among the section of the population that had private insurance were quite low at below 5% (Solanki, Cornell & Lalloo, 2018). This could be attributed to the costing of private immunisations. Even though there was a higher prioritisation of groups that had major health risks like young children, pregnant women and the elderly, vaccination coverage still remained quite low among this group as well. Other reasons for this low coverage are still not known and are subject to further research (Solanki, Cornell & Lalloo, 2018). This means that vaccination coverage is better under the EPI programme.

3.2 OBJECTIVE 1: ON-TIME IMMUNISATION RATES OF LEARNERS

3.2.1 GRADE 1 COMPLIANCE

Across all three schools reviewed, an average of 17.2% of Grade 1 learners had been fully immunised by the time they had entered school, and an average of 17.9% were non-compliant. Learners who were partially compliant with their immunisation schedules were 16.5% and a greater percentage of learners were discovered to be mainly compliant at an average of 49.1%. The figure below (Figure 3.1) represents a summary of the results of the retrospective review of the immunisation charts of grade 1 learners, from the three respective schools.

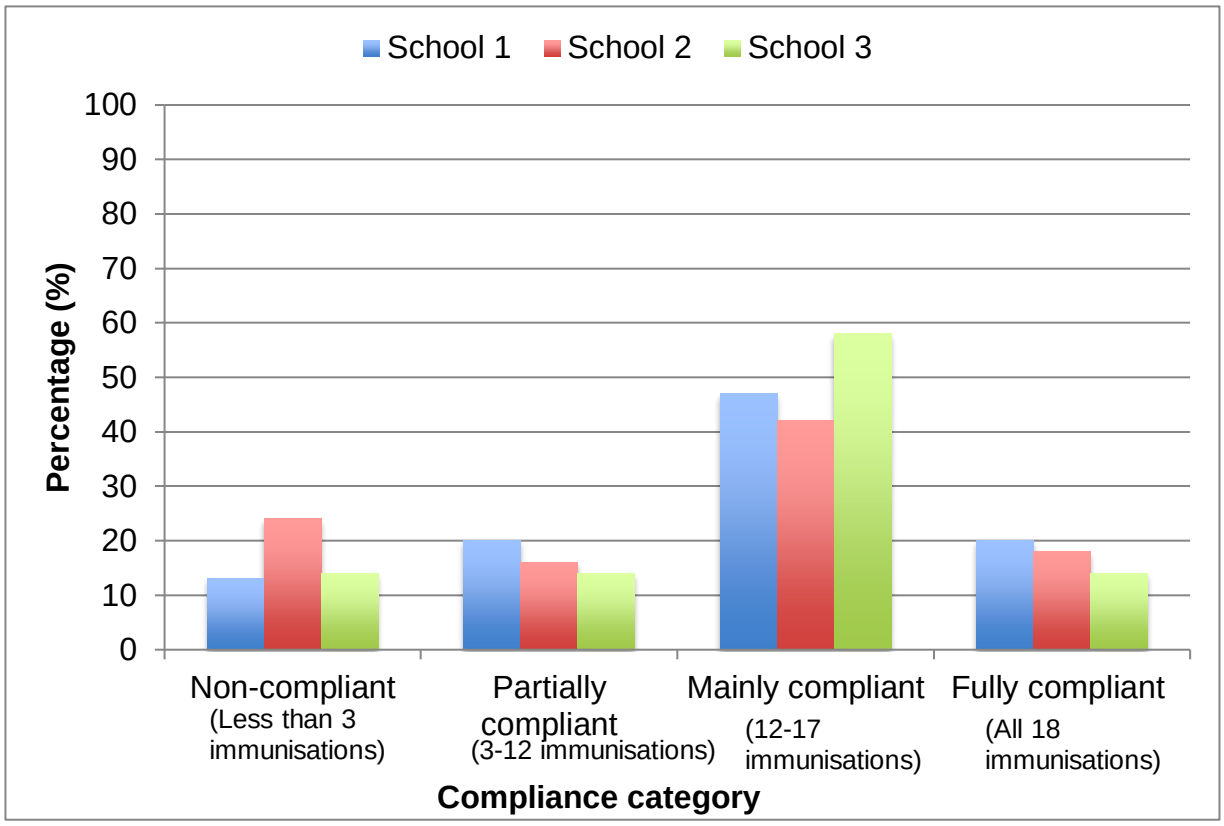


Figure 3.1: Graphic representation depicting the compliance levels of grade 1 learners

The percentage for full compliance (17.2%) is low in comparison to previous studies by Green (2016), Daniel *et al*. (1999), and Waldorf *et al*. (2014). The studies mentioned consisted of retrospective reviews of immunisation charts of learners entering schools around the globe and concluded that a majority of learners (average of 65%) would be fully (66% - 100%) immunised by the time they enter school, as per government regulations. This is relevant as the participants for objective 1 consisted of learners entering schools and the data shows grade 1 fully compliant learners comprise of less than half of the average suggested by the studies mentioned above. Luman (2013) suggests that children entering schools within the past 10 years are less likely to be vaccinated as opposed to children who entered school 10 to 15 years ago. Reasons for this are attributed to the age of their caregivers. The age of a parent of a child entering school is averaged at 30 to 35 years. There is a greater influence of social media and social pressure on caregivers currently, as opposed to 15 years ago. Caregivers are more likely to be influenced by anti-vaxxers and are more likely to question the safety of childhood immunisations in this day and age (Chu, 2016). This may be a contributing factor to the figures seen above, which depicts a 17.9% and 16.5% coverage for non-compliance and partial compliance respectively.

It should be further noted that learners who were mainly compliant had the highest percentage (49.1%) and for purposes of this study, this category was made up of learners who had received anything from 12 to 17 (66%-94%) of their immunisations on time. This number is significantly high and indicates that there are still caregivers who are fully supportive of childhood immunisations, as shown in a study by Lin,,Zeng,Mehrotra,Corey and Gilbert (2020). An elevated figure of 49.1% depicted in the mainly compliant category is in line with literature, which suggests that 86% of children worldwide receive vaccination coverage of at least 3 out of the recommended 4 (75%) childhood vaccines every year (Children’s Hospital of Philadelphia, 2020).

3.2.2 GRADE 2 AND 3 COMPLIANCE

The percentage of learners who were non-compliant among grade 2 and 3 learners in all schools were an average of 17.9% and this was the same percentage of learners who were non-compliant for grade 1 learners. The partially compliant group represented as an average of 14.7% is a slight decrease when compared with the percentage for the same category in grade 1. Learners who were mainly compliant remained high at an average of 48.8% while those fully compliant showed a slight increase at an average of 18.3%. The figure below (Figure 3.2) depicts a summary of the results after a retrospective review of the immunisation charts of the grade 2 and 3 learners was conducted.

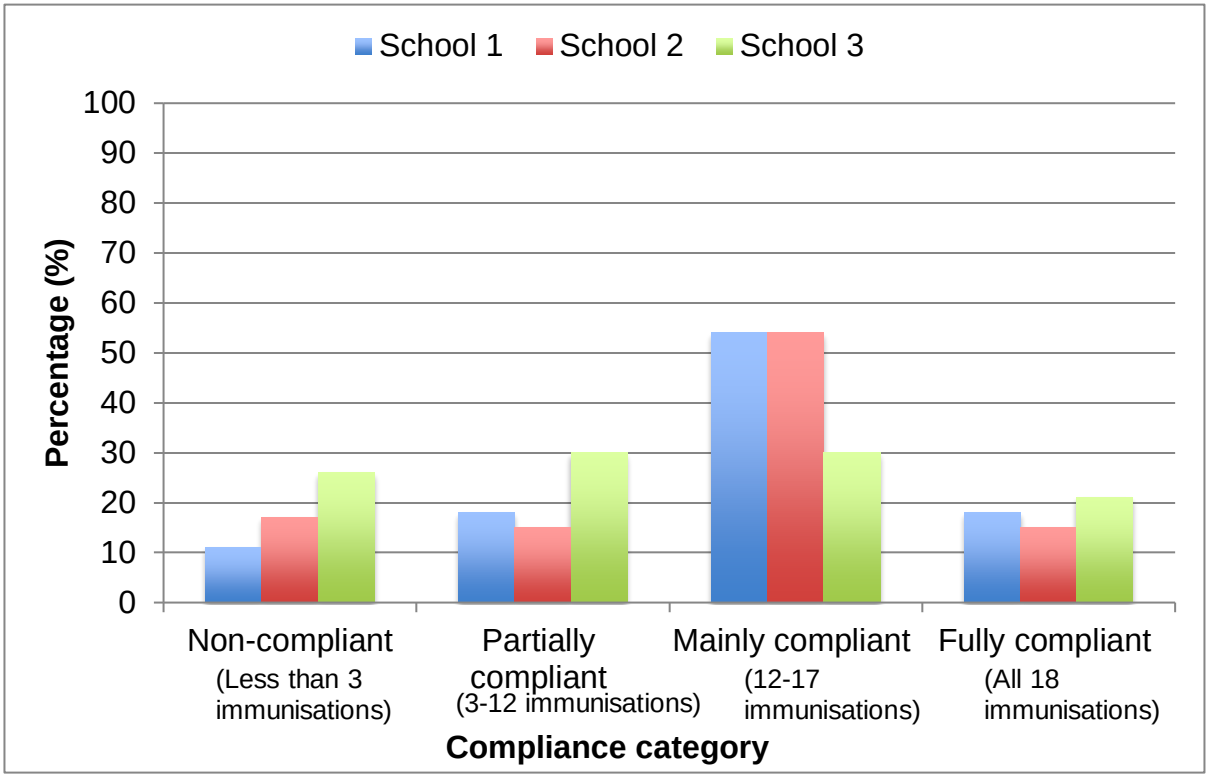


Figure 3.2: Graphic representation depicting the compliance levels of grade 2 and 3 learners

These percentages show very little movement, which is contrary to expectations that compliance should improve, once learners are enrolled at school (Findley *et al*., 2011). In relation, previous studies by Seither (2015) and Roberts (2011) suggest that immunisation rates would steadily increase with age for most of the recommended vaccines. Reasons for these expectations could be attributed to follow up programs and educational initiatives in schools, or the role that administrators play in ensuring full compliance of their students. This study gathered that all schools (1, 2 and 3) displayed no follow up initiatives despite favourable responses by the administrators regarding the follow up question. The persistent low percentages of 17.9% and 14.7% for the non-compliant and partially compliant categories are indicative of this. There is no pressure from administrators to encourage caregivers to immunise their children. Should follow up programs be implemented, an increase in immunisation coverage may be expected, as literature suggests (Calhoun, 2014). The study conducted in North Carolina by Calhoun (2014), showed an increase of 46.1% full compliance following the implementation of follow up campaigns.

The trend revealed by the results shows that a majority of learners fell under the mainly compliant category across all grades. The data also shows that there are learners who go past the cut off point for immunisation without full compliance, in turn, dismissing the national immunisation catch up schedule. This statement challenges a study conducted in India with the principle objective being to evaluate the impact of catch up campaigns through estimation of immunisation coverage. The study concluded that immunisation coverage significantly increased after catch up campaigns were introduced (Farid *et al*., 2012).

Overall, the results from all the grades depicts that not all learners receive full immunisation coverage by the age of nine or when they enter grade 3. In some cases, the data shows slightly higher percentages of non-compliance in the higher grades, depicting a downward trajectory with an increase in age.The reasons for this are varied but can be attributed to the perceptions and attitudes of caregivers and administrators.

Research conducted previously by Cotter *et al*. (2002) and Duffell (2001), points to the fact that caregiver attitudes have a significant effect on immunisation uptake rates as they play a vital role in whether or not caregivers are inclined to immunise their children. In Cotter's study, a group discussion was conducted and an average of 55% of caregivers expressed a fear of immunisation side effects, mistrust of health services and felt poorly informed on childhood immunisations. Duffell (2001) concludes that 43.8% of parents consider the MMR vaccine to be a greater threat to their child's health than measles itself. In a cross-sectional study conducted by Montasser *et al*. (2014), it was established that a caregiver's view on the importance of immunisation had a direct bearing on the uptake of vaccines. This was also in line with the submissions made by Wilson *et al*. (2008), which supported the same perspective – that positive attitudes among caregivers did have a positive impact on general immunisation trends.

3.3 OBJECTIVE 2: CAREGIVERS INFLUENCE ON THE PRACTICE OF CHILDHOOD VACCINATIONS

A total of 1958 questionnaires were sent out to caregivers. Quantitative data was analyzed and presented in the form of tables. The results for this objective were categorized according to the PACV domains, namely: immunisation behaviour (comprising of questions 1 to 5 and 12 of the caregiver survey), beliefs about vaccine safety (comprising of questions 6 to 11 of the caregiver survey) and efficacy and general attitudes and trust (comprising of questions 13 to 15 of the caregiver survey).

A simple regression analysis (Appendix N) was conducted to measure the relationship between immunisation hesitancy and the belief by caregivers on the severity of VPDs. According to the regression square, the belief in the severity of VPDs and the importance of full immunisation have very little effect on immunisation hesitancy, with a 0.1% influence on the tendency not to immunise children. The significant F also showed that this regression was not very strong because it is higher than 0.05. This points to the insignificance of any links between the variables in comparison. The P values are also

above 0.05 and the coefficients lacked strength. This points to the fact that this regression analysis does not reveal much about the relationship among the variables in comparison.

3.3.1 IMMUNISATION BEHAVIOUR OF CAREGIVERS

The behaviours discussed in this section are classified into 3 personality types namely, optimistic, pessimistic and trusting. The table below (Table 3.1) depicts the combined immunisation behaviours of caregivers from the three respective schools.

Table 3.1: Distribution of caregivers by immunisation behaviour

Immunisation behaviour items	**Yes**	**No**	**Don't know or maybe**
Delaying the immunisation for reasons other than illness	58.8	25.2	18.9
Deciding not to give the immunisation for reasons other than illness of allergy	19	52.5	28.5
Second child fully immunised	19.5	50	30.5
	Not sure	**Moderately sure**	**Completely sure**
Following the recommended immunisation schedule is a good idea	38.6	42	19.4
	Strongly agree or agree	**Strongly disagree or disagree**	**Not sure**
Children get more immunisations than are good for them	14.3	46.2	39.5
	Somewhat or very hesitant	**Not too or not at all hesitant**	**Not sure**
The caregivers are hesitant about childhood immunisations	33.3	25	41.5

From the caregiver responses it can be concluded that 58.8% of caregivers delayed the immunisations for reasons other than illness or allergy, while 25.2% of caregivers immunised their children on time. Approximately one third of caregivers (38.6%) were not sure whether following the recommended immunisation schedule is protective for the children and only 19.4% were completely sure. This behaviour on the part of the caregivers explains why non-compliance to childhood immunisations at the three schools presents as an average of 17%. In general, this level of uncertainty has a negative impact on the wellbeing of children (Kempe *et al*., 2019). According to the WHO (2020) the number of children receiving immunisations has decreased in a number of countries including South Africa, suggesting pessimistic behavioural patterns being adopted by caregivers around the world. Freedman (2018) and Baleta (2020) provide evidence to support this statement. Freedman (2018) conducted a survey in Italy on the behavioural patterns of parents towards childhood immunisations and concluded that from 414 parents surveyed, only 36% displayed optimism towards the recommended childhood immunisations and a majority of the 36% were caregivers with a tertiary level of education. Baleta (2020) concluded from his study conducted in South Africa, that due to the COVID-19 pandemic, there has been a significant decrease (39.2%) in the DTP3 immunisation rate after almost three decades. This is attributed to factors such as access to clinics and the hesitancy of parents to immunise their children with the fear of contracting COVID-19. The most concerning figure is the sharp decline in the coverage rate of the second dose of measles vaccine from 77% in April 2019 to 55% in April 2020. It is interesting to note that there is a potential risk that COVID-19 fears may transform into skepticism among caregivers about medical treatment and childhood immunisations in general, further decreasing immunisation rates (Baleta, 2020).

When asked about whether or not caregivers would immunise their second child, half (50%) of the caregivers answered no and less than a fifth answered yes (19.5%). A quarter (25%) of caregivers considered themselves non-hesitant regarding immunisations, 33.3% were hesitant and 41.5% not sure. The difference between the hesitant caregivers and the non-hesitant caregivers was significant in respect to

immunisation behaviour items when the mean was compared. The higher number of caregivers who indicated that they had decided not to immunise their children is supported by previous research on caregiver's negative attitudes and pessimist behaviours (Aitken, 2003; Simone *et al*., 2015). A study conducted by Corrigal *et al.* (2008) in the Western Cape province, explains that about 13.5% of parents were very reluctant to take their children to the clinic for immunisations. This can be attributed to factors such as pessimistic behaviour from caregivers towards childhood immunisations, pressures from social media, inaccurate and unsubstantiated claims (which will be discussed in section 3.3.4), difficulty in accessing healthcare facilities, and the unwillingness of health care workers to assist caregivers (Olatunbosun, Esterhuizen & Wiysonge, 2017).

A majority of caregivers (52%) indicated that they would not immunise their children for reasons other than illness or allergies, while 28.5% indicated that they might have done so. This indicated a positive trend and showed that a majority of caregivers immunised their children despite a negative attitude towards childhood immunisations amongst the caregivers. This positive trend contributes to the national coverage in various provinces, which was above 70%. The District health barometer (2014) reported that during the 2013/14 period Limpopo province had the lowest coverage at 70.3%, Gauteng was at 90%, while the Western Cape province had a coverage of 84%. An explanation for this is the differing geographic location of the provinces, the socioeconomic status of the caregivers in these provinces as well as the access to clinics and immunisations (Reuben, 2016).

A response of disagreement was given by 46.2% of caregivers regarding the assertion that children get more immunisations than are good for them. However, a significant number of the respondents were not sure whether this was true or not (39.5%). Only 14.3% of caregivers agreed that children received more immunisations than were good for them. This attitude is one that convinces caregivers against fully immunising their children Olatunbosun,Esterhuizen,Wiysonge,2017. The response to this question gave

the impression that caregivers would be more inclined to fully immunise their children, however the retrospective review of their children's immunisation charts in objective 1 concluded otherwise.

On the question of willingness to get their children fully immunised, 33.5% of the participants indicated that they were hesitant about immunising their children, while 25% indicated that they were non-hesitant and the remaining 41.5% indicated that they were unsure on their willingness to immunise their children. This is consistent with previous literature by Omar (2011) which indicates that an average of 18% of South Africans strongly believe that immunisations are not safe for their children for reasons such as misinformation on immunisations and pessimist behaviour by caregivers towards childhood immunisations. According to Wiysonge (2019), a new phenomenon is emerging in well-served urban settings in South Africa known as immunisation hesitancy, which prevents or delays parents from immunising their children. This confirms that immunisation hesitancy is slowly gaining ground in South Africa and is negatively impacting the efforts towards improved immunisation coverage (Omar, 2011).

3.3.2 IMMUNISATION KNOWLEDGE OF CAREGIVERS

The knowledge of caregivers was assessed with regards to the safety and efficacy of childhood immunisations. The table below (Table 3.2) indicates the findings of this.

Table 3.2: Distribution of caregivers by knowledge about childhood immunisation safety and efficacy

Beliefs about childhood immunisation safety and efficacy	Somewhat to very concerned	Not too to not at all concerned	Not sure
Childhood immunisations might cause serious side effects	33.2	31.8	35

Table 3.2: (continued) Distribution of caregivers by knowledge about childhood immunisation safety and efficacy

Concerned about the safety of childhood immunisations	35	27.6	37.4
Concerned that the immunisation might not prevent the disease	34.3	22.8	42.9
	Agree to strongly agree	**Disagree to strongly disagree**	**Not sure**
It is better for children to receive more than one immunisation at the same time	20.1	43	36.6
It is better to develop immunity by getting sick rather than receiving an immunisation	16.4	45.9	37.7
The diseases that immunisations prevent are severe	17.8	47.7	34.5

Table 3.2 depicts that from the 1958 caregivers who answered the survey, an average of 34.2% displayed concerns about the safety and efficacy of childhood immunisations. A study conducted by Burnett (2015) attributed the low immunisation coverage in South Africa to anti-immunisation rumours on many platforms. According to Kahn (2019), only 18% of South Africans living in Johannesburg believed that childhood immunisations were safe, resulting in 82% who strongly felt that they were unsafe. This relates to the responses given for this question by the caregivers in this study, residing in Johannesburg, where a large proportion (34%) were concerned about the safety of childhood immunisations. Gust *et al*. (2006) reaffirms this theory of parental concern towards childhood immunisations in his study conducted in America, when he concludes that 46% of the participants agreed that delaying childhood immunisations for reasons associated with safety and effectiveness were reasonable.

On the question of VPDs, a majority of the caregivers (47.7%) did not believe that these were severe, with only 17.8% of all the respondents agreeing that these diseases are

severe. It was concluded that 22.8% of caregivers displayed no concern or a slight concern towards the idea that childhood immunisations might not prevent the disease. Corrigal *et al*. (2011), concludes that a significant number of parents (64%) in the Western Cape province had indicated a lack of knowledge on the efficacy of vaccinations, and this contributed to low immunisation uptake. UNICEF (2011) has noted that an estimated 400 000 children in South Africa are not fully immunised against measles, 15% of deaths in children under the age of five are due to diarrhoea and 9% are due to pneumonia, both of which are VPDs of childhood. This is related to objective 2 as 47.7% of caregivers displayed a lack of knowledge regarding the severity of VPDs by answering that VPDs were not severe. This lack of knowledge or misinformation is a contributing factor to the low immunisation coverage as seen in their childrens' immunisation chart records in objective 1. The figure of 47.7% suggests that caregivers do not see the need to immunise their children as they believe that VPDs are not severe. It is interesting to note that although a majority of the caregivers indicated their concerns towards the safety and effectiveness of childhood immunisations, a majority of them also indicated that VPDs are not severe. This information gap is substantiated by Muscaro (2009) in his study, conducted in the United Kingdom, where he concluded that knowledge does have an impact on caregivers' decisions to immunise their children. Of the participants in his study, 79% indicated that knowledge and the information received on childhood immunisations was a deciding factor as to whether or not their children received immunisations. Previous literature by Odasunya *et al*. (2008) and Owais *et al*. (2011) also established that caregiver knowledge had a greater potential to improve immunisation rates as there appears to be a direct correlation between caregiver knowledge and immunisation rates.

In a study carried out in the Gauteng province, it was discovered that only 13% of caregivers interviewed knew nothing about VPDs, while 29% knew only 3 VPDs (Mphaka *et al*., 2018). However, 82% of children were recorded as fully immunised despite there being no difference in the knowledge scores of the caregivers who had fully immunised their children and those who had only partially immunised their children (Mphaka *et al*.,

2018). It was their attitudes that had a greater impact on caregivers' decision making with regards to immunising their children (Bangura, Xiao, Qiu *et al.,* 2020). All caregivers and parents of the children who had been fully immunised had a positive attitude and they knew the importance of vaccinating their children.

According to Montasser *et al*. (2014) caregivers who had better knowledge regarding immunisations kept up to date with their children's immunisation schedules as compared to caregivers who delayed their child's immunisations. A study conducted in 2014 by Allison *et al*. discovered that a caregiver's view on the importance of immunisation had a direct bearing on the uptake of vaccines. The data depicted in the table above (Table 3.2) substantiates these studies, as the caregivers displayed a lack of concern on the severity of VPDs yet displayed concerns towards the safety and effectiveness of childhood immunisations, hence the significantly low immunisation rates gathered from objective 1. This theory was supported by Wilson *et al*. (2008), as well as several other researchers, that a lack of knowledge regarding the importance of immunisations posed the biggest threat to childhood immunisation rates (De Courval *et al*., 2003; Joseph *et al*., 2011).

From the caregiver responses, 20.7% agreed that children should get fewer immunisations at a time while most caregivers (43%) disagreed with this assertion and 36.3% were not sure. Once again, these figures can be attributed to a lack of knowledge and misinformation. Research has shown that the administration of several immunisations concurrently has certain advantages for children and is not harmful (CDC, 2020). Numerous studies have been conducted to assess registered immunisations to conclude if the effect is altered by combination administration as opposed to indiviudal administration. These studies have shown no alteration and no adverse effects when administered in combination (CDC, 2020). The WHO (2020) has further noted that scientific data depicts simultaneous vaccination with multiple immunisations has no adverse effect on the normal childhood immune system. Howevere, it should be noted that the single administration of the measles vaccine is recommended (WHO, 2020).

Most caregivers (45.9%) did not believe that it would be better to develop immunity by contracting the disease as opposed to receiving an immunisation, however, 37.7% of caregivers were unsure, and the remaining 16.4% did agree that contracting the disease would be a better way to develop immunity. The belief that natural alternatives are superior to immunisations is being encouraged by the growing anti immunisation sentiment in the country (Baleta, 2020). According to Green (2016), there are many websites in South Africa that contain advertisements and articles from caregivers who promote natural alternatives. The main debate on these websites is that children develop a stronger immunity by fighting off the illness, hence advocating for the avoidance of childhood immunisations and further contributing towards low immunisation rates in South Africa (Burnett, 2015).

3.3.3 THE ATTITUDES OF CAREGIVERS

The general attitude and trust of caregivers towards childhood immunisations was assessed. The data is depicted in the table below (Table 3.3).

Table 3.3: Distribution of caregivers by general attitude and trust

General attitude and trust	Strongly agree / Agree	Strongly disagree / Disagree	Not sure
Trusting the information received about childhood immunisations	27.9	26.1	46

Table 3.3: (continued) Distribution of caregivers by general attitude and trust

Able to openly discuss concerns about childhood immunisations with doctor	26.8	29.2	44
	Complete trust	**Trust**	**Don't trust at all**
How much trust do you have in your child's doctor	24.3	30.8	44.9

On the question of trust in the information that was disseminated about immunisations, 27.9% of the respondents agreed that they trusted the information regarding childhood immunisations; while 26.1% of the respondents claimed that they did not. A majority of the participants (46%) indicated that they were unsure about the information they received on childhood immunisations. The source of information is vital because it accounts for the difference between substantiated and unsubstantiated claims, which ultimately contributes towards the increase or decrease of childhood immunisation rates by influencing decisions made by caregivers on whether or not to immunise their children (De Bruin, Panday-Soobrayan, 2017). This is of relevance to objective 2 because 46% of caregivers indicated that they were unsure about the information received and this attributes to their willingness to immunise their children. The low immunisation rates seen in objective 1 can be accounted for by this figure.

The issues of the ineffectiveness of immunisations can be attributed to the sudden wave of anti-immunisation sentiment (Wolfe, 2002). This is of importance to the South African setting and objective 2 as the anti-vaccine movement is gaining ground, as previously mentioned (Baleta, 2020; Green, 2016). According to the WHO (2020), there is a rise in concerns from caregivers, which can be attributed to strong misconceptions surrounding side effects associated with childhood immunisations. These misconceptions are unsubstantiated and not evidence based (WHO, 2020). When reputable journals publish inaccurate and unsubstantiated articles relating to childhood immunisations, a sense of confusion and anxiety is created amongst caregivers, which leads them to reject the

notion of immunising their children, as may be the case with the participants of objective 2 (Ozkaya *et al*., 2010; Ritvo *et al*., 2003).

Only 26.8% of participants indicated that they took the time to talk to healthcare workers about their children's immunisations to get clarity on their concerns regarding immunisation safety and importance, while 29.2% indicated that they did not. This can be attributed to any number of reasons ranging from the accessibility of healthcare workers or waiting times at clinics to the attitudes that caregivers and healthcare workers may have. In a study conducted by Omar (2011) in South Africa, it was discovered that 68% of South Africans trusted the advice they received from healthcare workers, which leaves 32% who did not trust healthcare workers.

From the table above (Table 3.3) it can be concluded that a majority of the caregivers are either unsure or completely disagree with the statement that they trust the information received from doctors, as well as the statement that they are able to openly converse with their children's doctor. This is a major concern that is supported by a statement made by Kahn (2019) which emphasises that healthcare workers are well versed in issues relating to immunisations and a lack of trust in them puts children's lives at risk. This lack of trust ultimately leads to a decline in childhood immunisation rates, as seen in objective 1. Healthcare workers provide a positive influence on caregivers, including caregivers who are under the impression that childhood immunisations are unsafe, to vaccinate their children (Omar, 2011). Healthcare workers should increase their efforts to build direct and respectful relationships with caregivers, especially when caregivers display concerns about immunisation safety or have misconceptions about the benefits and risks of childhood immunisations, in order to contribute towards increasing childhood immunisation rates in South Africa (Smith, 2006).

On the follow up question as to whether caregivers trusted their children's doctors, a majority of the participants (44.9%) indicated that they had no trust in their children's doctors, 30.8% were moderately trusting and only 24.3% responded that they completely

trusted their children's doctors. This helps to explain why fewer caregivers from objective 2 took the time to talk to healthcare workers about their children's immunisations. A recent survey conducted at the University of Michigan concludes that 76% of parents reported trusting their children's doctors 'not a lot' (Gary, 2015). A direct line of communication and trust between healthcare workers and caregivers is needed to increase immunisation rates. Nearly half (44.9%) of the participants from objective 2 displayed a distrust towards their children's doctor, which further contributes towards low immunisation rates. Corrigal *et al*. (2008), carried out a study in the Western Cape, which found that direct communication and encouragement by healthcare workers is crucial in dismissing parental anxiety and assuring the positive benefits of childhood immunisations.

A literature review, conducted on vaccine hesitancy amongst parents in the United States, revealed that there are a number of reasons which motivate parents to adopt a negative view of immunisation coverage and these include: religious beliefs, personal beliefs, and safety concerns (McKee, 2016). These factors contribute towards a distrust between healthcare workers and caregivers, impart negative attitudes among caregivers, and result in them not willing to immunise their children against VPDs, as can be seen with the data in the table above (Table 3.3).

3.4 OBJECTIVE 3: ADMINISTRATORS INFLUENCE ON THE PRACTICE OF CHILDHOOD VACCINATIONS.

Data was gathered from the school administrators of the three selected schools using a quantitative questionnaire. This data was then analyzed using statistical packages and presented in the form of tables, which are explained below. In a similar way to objective 2, the results for this objective are categorized according to the PACV domains, namely: immunisation behaviour (comprising of questions 8, 10 and 11 of the administrator survey), beliefs about vaccine safety (comprising of questions 9, 12 and 13 of the

administrator survey) and efficacy and general attitudes and trust (comprising of questions 1 to 7, 14 and 15 of the administrator survey).

3.4.1 General attitudes and trust of administrators towards childhood immunisations

The following section explains the assessment of the general attitudes and trust of administrators towards childhood immunisations. The table below (Table 3.4) indicates these findings.

Table 3.4: Distribution of administrators by general attitude and trust

General attitude and trust	Yes	No
Childhood immunisations should be compulsory in order to enter schools	100	0
	Agree	**Disagree**
Trusting the information received about childhood immunisations	66.6	33.3
Maintaining herd immunity is a must in schools	100	0
It is pertinent to follow up with learners who are not fully immunised	100	0

From the data collated, it can be concluded that all respondents agree to the statement: immunisations should be compulsory in order to enter schools. Administrators understand the importance of childhood immunisations in safeguarding lives and protecting children against VPDs. Despite the myths and falsehoods that are peddled in some circles, immunisations are a very important shield against VPDs and it is because of these immunisations that some diseases like polio have been eradicated (CDC, 2020). A requirement to enter most public and private schools in South Africa is to show proof of immunisations (SAVIC, 2013). This is in line with the respondent's agreement as 100% answered that childhood immunisations should be compulsory in order to enter schools.

All of the administrators (100%) agree that immunisations are safe for both the children in their schools and the community. Two thirds (66.6%) agree that the information received regarding immunisations is credible. This was expected as the administrators responded that they depend on reliable sources of information, and are more likely to be influenced by factual data. A study conducted in Turkey concludes that the rate of immunisation coverage is directly proportional to the knowledge, attitudes, trust and behaviours of administrators. Of the participants in that study, 55.7% displayed a positive attitude towards childhood immunisations while only 18% displayed some concerns (Munoz, 2015).

The impact of the knowledge, attitudes, trust and behaviours of administrators from objective 3 is of vital importance in the school setting because administrators are responsible for ensuring up to date immunisation chart records of their students by conducting follow ups. It is important that the administrators from objective 3 maintain a positive attitude, display optimistic behaviour and are well versed on issues relating to childhood immunisations in order to encourage caregivers to immunise their children.
All respondents (100%), from objective 3, confirmed the importance of maintaining on-time immunisation rates in schools. Responses from the administrators were in line with literature (Ricco, 2017; Moser, 2019; Zeyer, 2010). However, the low immunisation rates in objective 1 from the three respective schools suggests a lack of initiative by the administrators to conduct follow ups on immunisation chart records. An absence of pressure from schools allows caregivers to be excused from fully immunising their children. A study conducted by Ricco (2017) explains the importance of administrator intervention towards childhood immunisation, which may ultimately increase the immunisation acceptance amongst caregivers and immunisation rates in the school setting.

It is expected that administrators should display positive attitudes towards immunisations and be a reliable source of information for caregivers (Moser, 2019). A study conducted

in Mexico concluded that the willingness of teachers to immunise their own children inclines parents of their students to do the same (Zeyer, 2010). From the favourable administrator responses towards immunising their own children in objective 3, high immunisation rates in the three selected schools would be expected. However the caregivers, from objective 2, displayed negative attitudes and constant hesitancy towards childhood immunisations, suggesting that there is a lack of encouragement and information exchange from schools to motivate caregivers to immunise their children. Previous literature by Signorelli (2004), would suggest that caregivers are more inclined to trust administrators of their children's school, as opposed to healthcare workers, and this further emphasises the importance of a trusting relationship between the two parties.

The attitude exhibited by the school administrators in objective 3 is in line with the expectations of the EPI (SA) program, which is to prevent death and reduce suffering from diseases of childhood that can be prevented by immunisation of children and women (EPI-SA, 2012). Respondents were unanimous in their response to the question of the importance of on-time immunisations in maintaining the health and safety of children in their schools. Respondents agreed that on-time immunisations were important to maintain acceptable herd immunity rates among their learners. It was therefore important for these records to be kept up to date and accurate. However, as can be seen from the low immunisation rates in objective 1, these records are not up to date and there is no follow up process in place at any of the three selected schools. The impact of this is that children remain in the school system maintaining incomplete immunisation chart records and prove a risk to herd immunity and the safety of their fellow classmates.

Health workers involved in immunisation administration are in a privileged position to ensure immunisation protection (EPI (SA), 2012). Even though the administrators are not healthcare workers, they play a crucial role in supporting the improvement of immunisation coverage in the country by encouraging caregivers to immunise their children and conducting follow ups on the immunisation chart records of the students in

their schools. A study conducted by Odone (2009), in Northern Italy, suggests that 82% of the participants agreed that they would rather converse with school teachers as opposed to medical professionals on the topic of their children's immunisation status. From this study and the 44.9% of caregivers in objective 2 who do not trust their children's doctor, the researcher concluded that the role played by administrators towards improving childhood immunisation rates may be superior to that of healthcare workers. This can be attributed to the fact that administrators are at the forefront of the issue in the school setting and are in direct contact with caregivers. As mentioned above, the influence of administrators, the relationship between caregivers and administrators and the implementation of follow up initiatives are the three main contributing factors towards improving and increasing childhood immunisation rates.

All respondents, from objective 3, indicated that it was important to conduct follow ups on learners whose immunisation chart records showed that they were not up to date. However, this was not done and no follow up initiatives have been implemented in any of the three selected schools. The results might not reflect their personal opinions and feelings on the issue but they are duty bound. In her article, Dr Claire McCarthy, from Harvard Medical School, emphasises the importance of following up with under immunised children for the benefit of all. When enough of the community is vaccinated, the spread of the disease as well as the risk of exposure to VPDs decreases significantly (McCarthy, 2020). The impact of the lack of following up on under-immunised children proves risky to herd immunity and to the safety of other students in the school setting as well as contributes to the spread of VPDs, as mentioned above.

3.4.2 IMMUNISATION BEHAVIOURS OF ADMINISTRATORS TOWARDS CHILDHOOD IMMUNISATIONS

The behaviours discussed in this section are classified into 3 personality types namely, optimistic, pessimistic and trusting. The table below (Table 3.5) depicts the combined immunisation behaviours of administrators from the three respective schools.

Table 3.5: Distribution of administrators by immunisation behaviour

Immunisation behaviour items	Yes	No	
Have you ever been hesitant regarding childhood immunisations	33.3	66.6	
	Strongly agree / Agree	**Neither agree nor disagree**	**Strongly disagree / Disagree**
Following the recommended immunisation schedule is a good idea	33.3	49.9	16.6

From the data recorded in the table above (Table 3.5), there was an indication that 33.3% of the respondents had been reluctant at some point to get their children vaccinated. However, the majority (66.7%) indicated they had not been hesitant at any point about immunisations for their children.

It is surprising that not all the respondents fully agreed that immunisations were important for children's health. The administrators' response was unanimous on the safety of immunisations as well as their stance against community groupings and individuals who were against immunisation. The expectation on this question would have been for all respondents to strongly agree that immunisations were important for children's health. Only 66.7% of the respondents agreed that immunisations were important for children's health. This gives credence to the researcher's opinion that the responses are mechanical and they are not a true reflection of how the respondents felt about immunisations. It gives the impression that the responses were given according to what is expected of them due to the requirements of their jobs. This then presents problems on the strength of the data collected. A qualitative analysis would have been able to expose these contradictions. In this context, it is essential to know the attitude of

administrators towards childhood immunisations. A small quantitative study, conducted in Switzerland, revealed that despite the well-known reluctance of parents having their children immunised, more than half of the teachers interviewed also questioned immunisations and the importance of childhood immunisations in particular (Zeyer, 2019). This is relevant to objective 3 as it may account for the low immunisation rates in objective 1 and the hesitancy of caregivers in objective 2, as there is no pressure from schools to motivate caregivers to immunise their children and no follow up initiatives implemented by the schools, due to possible pessimistic behavioural patterns displayed by administrator.

In sharp contradiction to the administrators' unanimous agreement about the safety of immunisations and its importance, when asked about their opinion on adhering to the recommended immunisation schedule, an average of 49.9% of the responses were unsure, while 16.6% disagreed that there were any benefits from the recommended government program. This is in line with a study by Blanchard (2020), which reviewed the responses of 272 teachers surrounding an immunisation debate (pro versus contra). He concluded that 58% of teachers displayed a negative attitude towards immunisations while only 23% of the participants displayed a positive attitude. The responses from 52 participants (19%) were excluded. Blanchard's study categorised the results into three groups. The acceptors, rejectors and hesitators. As mentioned above, the behaviour and attitudes of administrators towards childhood immunisations are main determining factors of immunisation rates in the school setting. Responses from administrators in objective 3 are contradictory and the researcher concludes that results might be based on their professional duty as opposed to their personal opinions regarding childhood immunisations.

3.4.3 ADMINISTRATORS KNOWLEDGE CHILDHOOD ON IMMUNISATION SAFETY AND EFFICACY

The knowledge of administrators was assessed with regards to the safety and efficacy of childhood immunisations. The table below (Table 3.6) indicates the findings of this.

Table 3.6: Distribution of administrators by knowledge about childhood immunisation safety and efficacy

Beliefs about childhood immunisation safety and efficacy	**Multiple**	**Individual**	
It is better for children to receive more than one immunisation at the same time	0	100	
	Strongly agree / Agree	**Neither agree nor disagree**	**Strongly disagree / Disagree**
Children do not require immunisations for diseases that are no longer common	0	33.3	66.6
New immunisations carry more risks than older immunisations	33.3	33.3	33.3

A response of 100% was presented by the administrators when asked if children should receive only one immunisation at a time. There are falsehoods that have been peddled by anti vaxxers, that allude to the fact that multiple immunisations are harmful. This is not based on any scientific evidence and immunisations work the same individually or in combination with others (CDC, 2020). Several studies have shown that the administration of multiple immunisations at the same time improves compliance as fewer clinic visits are required (Delany-Moretlwe et al., 2018). Multiple immunisations administered at the same time also reduces trauma experienced by the child (Wang, 2018).

The data collected from the statement: children do not require immunisations for diseases that are no longer common, demonstrates that none of the respondents believed that the administration of immunisations was no longer necessary for diseases that are no longer common. Two thirds of the respondents disagreed with the statement indicating their stance for the continued administration of immunisations for diseases that are no longer common. In 1974, Japan achieved success against whooping cough

(pertussis) with an average of 80% of children vaccinated. Due to the spread of false information that the immunisation was unsafe, many children remained unvaccinated (CDC, 2020). In 1979, the disease was resurgent in the country, with an outbreak that claimed 13 000 lives, forcing the government to reintroduce vaccinations against whooping cough, which then resulted in a decline in the number of cases (CDC, 2020). This affirms the importance of the acquisition of accurate information by administrators, as they are a great influence over caregivers, regarding childhood immunisations, and in determining childhood immunisation rates in schools. Administrators from objective 3 revealed that their information sources were credible and it is to be expected that they be well versed on issues relating to childhood immunisations.

Acute flaccid myelitis (AFM), a rare but severe illness seen in children around the age of 5 years, is another example of the importance of persistent adherence to the childhood immunisation schedule. AFM causes sudden polio-like symptoms such as weak muscles and paralysis. Polio, a disease thought to be eradicated in 1979, has resurfaced in 2014 in the form of AFM (CDC, 2015).

The above examples suggest that because a disease has become less common, does not mean it has been completely eradicated. The respondents seemed unsure about the latest immunisations as a majority of their split responses revealed that they were unsure about the safety and reliability of new immunisations versus older immunisations. One third (33.3%) of the respondents disagreed that new immunisations carried more risks than older immunisations, while the same percentage of respondents agreed or were unsure. This gives the impression that there seems to be an information gap that leaves administrators unsure, including administrators who are at the forefront of encouraging caregivers to immunise their children (Chang, 2017). Studies reveal that the development of new immunisations poses a lower risk to patients, as a result of increased safety considerations and decreased incidence of side effects, as well as improved development and innovation over the years (Janz *et al*., 2018). Additional

emphasis has been placed on the safety of childhood immunisations to improve compliance and adherence to the recommended immunisation schedule (Chang, 2017).

As mentioned above, administrators need to be well versed on issues relating to childhood immunisations as they are a source of information for other school teachers and caregivers of the students in their schools. The administrators from objective 3 reveal that they consult accurate sources of information in relation to childhood immunisations, however their contradictory responses reveal that their answers could be based on their professional duty as administrators and do not reveal their personal thoughts on the matter.

3.5 CONCLUSION

- Despite government efforts to ensure that each child is fully immunised through the EPI (SA) program and immunisation charts in all primary schools, there is still a significant percentage of children who do not get fully immunised.
- There is also evidence to support the view that some caregivers fail to get their children immunised on time according to the schedules set by the government. The school immunisation charts conclude that around 16.44% of the children who go through the primary school system do not get fully immunised despite being encouraged to do so by school authorities, as per government regulations.
- School administrators play a vital role in encouraging caregivers to immunise their children and administrators' knowledge, attitudes and perceptions regarding childhood immunisations are of utmost importance. However, data from objective 3 reveals that there are no initiatives in place to conduct follow ups on immunisation chart records in the school setting.
- There are around 19% of parents and caregivers who do not immunise their children for reasons other than illness or allergy. This supports the view that there are many reasons contributing to parents failing to immunise their children.

- Of the caregiver respondents, 33% indicated that they were concerned about the safety of childhood immunisations and 35% believed that side effects posed health problems to their children.
- Socio-economic factors have a significant impact on caregiver understanding when it comes to the issues of immunisations and the importance of childhood immunisations.
- Qualitative research and analysis are required to get more in-depth information on the reasons why some caregivers do not support the immunisation of their children.

CHAPTER 4
GENERAL DISCUSSIONS AND CONCLUSIONS

4.1 INTRODUCTION

The primary objective of this study was to establish the on-time immunisation rates among children who enter grades 1 to 3 within three public sector primary schools in Region B and E of the City of Johannesburg. It further aimed to determine the knowledge, attitudes and perceptions of the caregivers and school administrators of the enrolled learners, regarding immunisations, and how these attitudes and perceptions influence on-time immunisation rates.

This chapter discusses the results that were presented in the previous chapter, draws recommendations and concludes this study. The major objectives of this study were as follows: to review school vaccination charts and assess the level of compliance with immunisation schedules; to investigate the attitudes, knowledge, and perceptions of caregivers; and to investigate the attitudes and perceptions of school administrators, with regard to the vaccination of children.

From the data collected and analyzed by this researcher, trends were identified, which support what previous literature established, and new insights were drawn as well. Firstly, this chapter discusses the findings; then presents recommendations that can be used by policymakers, healthcare practitioners, and caregivers themselves to work towards full compliance with on-time immunisation schedules. Finally, this chapter concludes the study.

4.2 THESIS SUMMARY

One of the major findings made in this research is that around 16.4% of children do not get fully immunised, despite government efforts to achieve 100% coverage through the EPI (SA) program, which is implemented in most public schools. This study discovered that there are varying percentages of children, who get enrolled for their first grade of school, before they have completed their immunisation schedules (13% to 25%).

The results from the different grades depict that not all learners receive full immunisation by the age of 9 or when they enter grade 3. In some cases, the data shows slightly higher percentages of non-compliance in the higher grades. These results confirm findings established by other researchers, which points to the fact that the immunisation coverage of VPDs takes a downward trajectory as children grow, signifying underlying factors that go beyond just caregiver knowledge.

A cross-sectional study conducted in the Western Cape in 2007 to determine immunisation coverage of VPDs in the Western Cape province indicated that there was immunisation coverage of 76.8% at 9 months and 53.2% at 18 months (Corrigal *et al.*, 2008).

The study found that around 19% of parents and caregivers interviewed, admitted to deciding against getting their children immunised for reasons other than illness. This points to other reasons that are at play that influence caregivers and parents in making decisions regarding the immunisation of their children. This supports the assertion made by the WHO that there are socio-economic determinants like a family's income level and the educational status of the mother, which are all associated with inequities in vaccination coverage (WHO, 2019). In other instances, factors like the distance traveled to the nearest healthcare facility and incorrect dates set for immunisation also come into play. These factors sometimes discourage caregivers from having their children immunised. It also suggests that some of these caregivers do not see VPDs as serious threats to the lives of their children.

It is important for parents and other caregivers to understand the importance of vaccinations. One study compared immunisation rates in India to South African rates and it established that India had better rates of immunisation coverage when compared to the same rates in South Africa. This has been attributed to the fact that the majority of Indian women understood how important vaccines were in safeguarding the lives of their children, when compared to South African women (Hamid *et al*., 2012). Other researchers have suggested different reasons for low immunisation coverage and high dropout rates that range from vaccine shortages, parents' lack of knowledge on the importance of getting their children immunised, and negative attitudes towards immunisations in general.

The study discovered that there are a significant number of parents and caregivers who are concerned about the safety of vaccines, and others who believe that vaccines have side effects that can pose health risks to their children. This has the potential of discouraging parents and caregivers from sticking to immunisation schedules or dropping out altogether from the program. Between 33% and 35% of parents and caregivers interviewed, indicated that they believed that vaccines had side effects that were harmful to their children. This led them to be more concerned about the safety of these vaccines for their children.

The issue of side effects has also been raised in previous studies. The fear of side effects is thought to create a greater sense of anxiety among caregivers, which eventually leads them to reject the notion of immunising their children if it's strong enough (Ozkaya *et al*., 2010; Ritvo *et al*., 2003). According to Mckee (2016), studies have shown that parents are increasingly sensitive to the perceived harms and benefits of vaccinating their children, which results in differences in their overall perceptions regarding the benefits of vaccinations. This has the net effect of parents either delaying vaccinations or avoiding them entirely. Unfortunately, this has led to a spike in some VPDs that had been eradicated or nearly eradicated, like diphtheria, whooping cough, and measles (Betsch

& Sachse, 2012). There is a great need for parents to be reassured by the health authorities on the safety of vaccines.

Another important finding made by this study relates to the dissemination of information about the importance of vaccines. The study discovered that there was a significant percentage (40%) of caregivers who were unsure about the importance of vaccines and who were unaware that they were vaccine-hesitant. The study found that a large proportion of caregivers and parents (46%) indicated that they were unsure about the reliability of the information they had on childhood immunisations. There was a lack of trust in the information even though it was not clear which sources of information they had access to. Only 27% indicated that they trusted the information they had on vaccines. A lack of access to proper information leaves a gap that is normally filled by falsehoods, often peddled on social media platforms, in turn fueling vaccine hesitancy.

Vaccine hesitancy is a growing threat to immunisation coverage in South Africa. Wiysonge (2019) concludes that according to a recent survey conducted in private schools in South Africa, "only about one in five (19.4%) girls had received HPV vaccines, with 65% of the reasons for not accepting vaccination being related to vaccine hesitancy." Vaccine hesitancy is usually caused by inaccurate information that eventually leads parents to develop an anti-vaccine attitude.

Related to the issue of information is the finding made by the study regarding the lack of trust that exists between caregivers and healthcare workers. Most caregivers who participated in this study indicated that they do not trust the doctors who treat their children. It is not clear why this situation exists, but this contributes to lower rates of vaccination uptake.

Lastly, the study uncovered that the school-based program to encourage parents and caregivers to fulfill their children's vaccination schedules is a great program. Most school administrators are very supportive of the program and their interaction with parents and caregivers makes them important sources of information relating to on-time

immunisation . The researcher concluded that education does play an important role in understanding the importance of complete immunisation for all children. School administrators strongly believe that vaccines are important in protecting all children from VPDs and they see the school program as a necessary initiative.

What is certain is the finding that despite vaccines being offered at no cost by the government, and with the follow ups that are made in schools, some children still do not get fully immunised. This confirms the presence of other underlying factors that lead caregivers to defy this noble initiative which is meant to safeguard the lives of all children in South Africa.

4.3 LIMITATIONS TO STUDY

The following limitations were encountered during the study and are in line with limitations frequently occurring in literature that was reviewed on this particular field of research.

4.3.1 Limited access to data - The assessment only of public school learners from grades 1 to 3 and not private school learners

The main reason for this limitation is the barrier put up by private schools to access their data records. It is difficult to obtain approval from private schools to access their students' data records. Hence, the decision was taken to conduct the retrospective review of learners data in public schools in the City of Johannesburg, Regions B and E. It would have been ideal to compare the immunisation records of public and private school learners, as this would have allowed the researcher to gain insight into other socio-economic factors that influence on-time immunisation rates and would have allowed for a larger sample size.

4.3.2 Issues with sample and selection

Sampling errors occur when a probability sampling method is used to select a sample, but that sample does not reflect the general population or appropriate population concerned (Chiu *et al*., 2017). This results in limitations for your study known as **"**sample

bias**”** or **“**selection bias**.”** This is why we use a calculation to be as accurate of a reflection as possible. In this study, caregivers and school administrators were asked to answer survey questions. The researcher did not have face-to-face access with any of the participants and hence could not make assumptions regarding their ethnicity and socio-economic status. The selection of participants was purely random.

4.3.3 Insufficient sample size for statistical measurement

The larger the sample, the more precise the results. The sample sizes for objectives 1 and 2 were sufficient, however the sample size for objective 3 was limited and in future it would be interesting to gain insight into the perspectives of more school administrators, regarding childhood vaccinations. The researcher found it difficult to draw substantial relationships from the data for objective 3.

4.3.4 Lack of previous research studies on the topic

As mentioned in earlier chapters, there is a lack of research regarding on-time childhood immunisation rates in South Africa. It is important to make use of prior studies as these provide theoretical foundations for comparing, investigating and drawing meaningful conclusions.

4.4 FUTURE RECOMMENDATIONS

The following recommendations were made from the combination of the respondent’s own perceptions and attitudes towards vaccines as well as the views of school authorities that were part of the study. Additionally, the study also adopts recommendations from the literature that was reviewed.

4.4.1 There is a need for trust and effective communication between health care professionals and caregivers

The relationship between caregivers and nurses and doctors is crucial in improving immunisation coverage. The way caregivers are treated at a healthcare center has a significant impact on whether or not they would return to get further vaccinations for their

children. Initiatives should be implemented to train healthcare practitioners on how to effectively communicate with parents and caregivers.

Dissemination of accurate and correct information to caregivers and parents is essential in ensuring that parents adhere to the recommended vaccination schedules. With the proliferation of social media platforms, there is a greater need for the authorities to counter negative information by providing better sources of information that reiterates the importance of early childhood vaccinations. This can be addressed by the introduction of free education campaigns in healthcare centers offering immunisations as well as maternal clinics. An interesting study conducted by Dudley (2020) in Georgia and Colorado, concludes that maternal vaccine hesitancy decreased in the first 2 years of a child's life, contributing to improved confidence in the safety and efficacy of childhood immunisations. This finding suggests that pregnancy and soon after birth may be the perfect time to educate parents on the importance of childhood immunisations. Although interventions during pregnancy focus mainly on maternal immunisations (influenza and DTP3), maternal immunisation acceptance during pregnancy is associated with increased early childhood immunisation rates (Omer, 2019). These free education campaigns should also take place, on a regular basis, in low-income areas such as squatter camps and residents should be urged to attend. Healthcare workers should be approachable and encourage residents to attend these free campaigns.

4.4.2 School authorities should be proactive in the dissemination of information on immunisations and ensuring up to date immunisation chart records of their students

By virtue of their position, schools have the capacity to educate caregivers on the importance of vaccines and counter the false information that is peddled on social media and the internet. Schools should implement annual follow up campaigns to address the issue of low immunisation coverage and to educate caregivers on the importance of childhood immunisations. Schools should promote the advantages of childhood immunisations by displaying pro immunisation banners around the school and by

engaging with caregivers on online platforms. Research has revealed that parental vaccine-related decision making is influenced by the effectiveness of administrators' communication regarding childhood vaccinations (Henrikson *et al*., 2015). Furthermore, good communication from schools regarding vaccinations is normally associated with parents adhering to the prescribed childhood vaccination schedule (Opel *et al*., 2015). In essence, research has established that poor communication skills and distrust are barriers in timely vaccinations. There might be a number of reasons why parents would choose not to communicate with administrators, chief among these being bad attitudes from administrators themselves. Administrators should urge caregivers to immunise their children and emphasise the importance of herd immunity. It has since been established that an effective and efficient communicator should provide information that is necessary, non-ambiguous, and evidence-based (Mckee, 2016).

4.4.3 The EPI (SA) program in schools should be assessed and improved

There is a need to develop a tracking system for each and every group of children from the time they enter school up to the time they complete the third grade. This is important in order to monitor the effectiveness of the EPI program and plug any weaknesses that may become apparent. This method of a follow up strategy will prove beneficial to increasing immunisation rates amongst children in schools. The current immunisation chart records are proving inefficient and a solution for this could be a free online tracking system conducted by schools to ensure the on time immunisations of their students. This free online system will prove to be a less tedious and more efficient method of storage as physical immunisation chart records take up a lot of space and are easily misplaced. The free online system should work as an application on phones and send notifications to caregivers and administrators when the immunisation date is approaching and give deadlines as to when the catch up immunisation should be administered. The Department of Health should have access to these records.

4.4.4 Vaccination schedules need to be accurate

Many caregivers and parents are frustrated by being turned away from healthcare facilities because they presented on the wrong date. This decreases the chance of them following up and adhering to their children's vaccination schedules. In remote areas where there are considerable distances to the nearest clinics, an accurate vaccination schedule can be the difference between low immunisation uptake and a strict adherence to the immunisation program. Healthcare centres need to implement accurate and reliable methods of ensuring that clerical errors are avoided. This can be avoided by training healthcare workers on the importance of the immunisation records, preventing overloading the healthcare workers by ensuring a sufficient number of employees are present in the healthcare facility and encouraging healthcare workers to prioritise accuracy over speed when interacting with caregivers and handling immunisation records.

4.5 AREAS FOR FUTURE STUDY

This study was quantitative but there are many underlying issues that were left out, especially because the online survey was the preferred method of data collection. The researcher feels strongly that qualitative interviews would have exposed these underlying issues that affect caregivers' attitudes towards vaccines. Two such issues would be: the sources they use in order to get their information and the reasons why many do not trust doctors and other medical professionals. The researcher recommends future studies, on the same issues, to adopt the qualitative or mixed-method research design to extract deep-seated issues that cannot be revealed through quantitative analysis alone.

4.6 CONCLUSION OF THE STUDY

This study set out to investigate the impact of caregiver and school administrators' perceptions, knowledge, and attitudes on vaccination coverage and on-time

immunisation rates. The study employed a retrospective review and quantitative analysis to achieve these objectives.

The study confirmed some of the findings that have already been established by previous research and drew new insights as well. The study proposed recommendations, with a particular emphasis on the importance of good and effective communication between caregivers and health care workers. The study found that there was a serious lack of trust with a large proportion of respondents admitting that they did not trust their children's doctors. This had the effect of shifting the attitudes of most caregivers against vaccinations. There was a substantial number of parents and caregivers who indicated that they were unsure about a number of issues relating to vaccines, revealing the fact that there is a considerable number of parents and caregivers who do not have sufficient information about immunisations and vaccines. It was established that there was a greater need for awareness programs to educate caregivers on the importance of getting their children immunised on time in accordance with the set vaccination schedules. Overall, there are still many factors that prevent full immunisation coverage in South Africa, and these serve to shift caregiver attitudes and perceptions against childhood immunisations.

REFERENCES

AbdulRaheem, I., Onajole, A. and Jimoh, A. (2011) Reasons for incomplete vaccination and factors for missed opportunities among rural Nigerian children, *Journal of Public Health and Epidemiology*, **3:(4)**, 194-203.

AbdulRahman, M.A., Al-Dabbagh, S. and Al-Habeeb, Q. (2013) Health education and peer leaders' role in improving low vaccination coverage in Akre district, Kurdistan Region, Iraq, *(Eastern Mediterranean* Health Journal) EMHJ, **19:(2)**, 125-129.

Allison, M. (2014) Under immunisation Among Children: Effects of Vaccine Safety Concerns on Immunisation Status, *International Journal of Recent Innovations in Medicine and Clinical Research*, **12:(31)**, 1021-1118.

Atkinson, T., Kline, P.M. and Kohlmann, T. (2016) Perceived barriers to childhood immunisation among rural populations, *Journal of Community Health Nursing*, **12:(2),** 65-72.

Babbie, E., Mouton, J. and Prozesky, B. (2001) The practice of social research, *The* Journal *of the American Medical Association*, **279:(5),** 943-948.

Baleta, A. (2020) Corona virus effect on SA immunisation rates, *The Lancet Global Health Journal*, **8:(7)**, 901-908.

Bangura, J.B., Xiao, S., Qiu, D. *et al. (*2020) Barriers to childhood immunization in sub-Saharan Africa: A systematic review. *BMC Public Health,* **20:(9),** 1108.

Barasa, L. (2018) Practical sampling, *SAGE Publication*, 128-182.

Bärnighausen, T, Bloom DE, Canning D, O'Brien J, (2008) Accounting for the full benefits of childhood vaccination in South Africa, *SAMJ*, **98:(11)**, 842- 844.

Bertoncello, C., Ferro, A., Fonzo, M., Zanovello, S., Napoletano, G., Russo, F., Baldo, V. and Cocchio S. (2008) Socioeconomic Determinants in Vaccine Hesitancy and Vaccine Refusal in Italy, *Vaccines Basel*, **8:(2)**, 276.

Betsch, C. and Sachse, K. (2012) How the internet influences vaccination decisions: Recent evidence and tentative guidelines for online vaccine communication, *Vaccine Journal and books*, **30:(25)**, 3723-3726.

Blanchard, S. (2020) Sharp rise in vaccine hesitancy in a large and representative sample of the French population: reasons for vaccine hesitancy, *Journal of Clincal Outcomes Management,* **8:(14**), 321-480.

Bloom, P. (2011) Adverse events associated with childhood vaccines: Evidence bearing on causality. Washington, DC: *National Academy Press,* **11:(1),** 112-154.

Bonnani, J., George, K. Jvilar, G.M., Lhler, E., Mafigiri, D., Pabugo, M. and Sugisha, E. (2015) Knowledge about vaccine trials and willingness to participate in an HIV/AIDS vaccine study in the Ugandan military, *Clinical Trial*, **27:(4),** 381-388.

Bornstein, M.H., Jager, J. and Patrick, D. (2017) Sampling in Developmental Science: Situations, Shortcomings, Solutions, and Standards, *Development Review Journal*, **33:(4)**, 357–370.

Bouchard, M., Kohler, J.C., Orbinski, J. and Howard, A. (2012) Corruption in the health care sector: A barrier to access of orthopedic care and medical devices in Uganda, *BMC International Health and Human*, **12:(1)**, 832-912.

Burnett, J. (2015) A profile of anti-vaccination lobbying on the South African internet, *SAMJ*, **05:(11),** 922-926.

Calhoun, K. (2014) Vaccination Coverage Among Children in Kindergarten, *(Morbidity and Mortality Weekly Report) MMWR*, **63:(41)**, 913-920.

Casey, R., Dumolard, L. and Danovaro, H. (2015) Global Routine Vaccination Coverage, *MMWR*, **65:(45)**, 1270–1273.

Center for Disease Control and prevention. (2015) Early Estimates of Seasonal Influenza Vaccine Effectiveness, *Emerging infectious diseases*, **35:(17),** 1100-1221.

Center for Disease Control and prevention (CDC), 2020. Multiple immunisations and the immune system, *Emerging infectious diseases*, **26:(12)**, 912-923.

Chang, M. and Nguyen, M. (2017) Epidemiology of hepatitis B and the role of vaccination, *Best practice and research clinical gastro*, **31:(3),** 239-247.

Children's hospital of Philadelphia. (2020) *Autism and MMR Vaccine Journal*, **2:(1),** 18.

Chimeremma, N., Etsano, A. and Uba, B. (2017) Approaches to Vaccination Among Populations in Areas of Conflict, *The Journal of Infectious Diseases*, **216:(1)**, 1003-1010.

Chiu, K., Grundy, Q. and Bero, L. (2017) Spin in published biomedical literature: a methodological systematic review, *PLOS Biology Journal*, **15:(9)**, 2173-2178.

Chu, S. (2016) Children who have received no vaccines: who are they and where do they live? *American Journal of paediatrics*, **114:(1)**, 187-195.

Congressional Research Services. (CRS) (2014) Hedging in scientific research articles, *John B Publication*, 72-91.

Congressional Research Services. (CRS) (2019) Global vaccination trends and US role, *CRS Report*, **2:(1)**, 821-930.

Cooper, S., Betsch, C., Sambala, Z., Mchiza, N. and Wiysonge, C.S. (2018) Immunisation hesitancy – a potential threat to the achievements of vaccination programmes in Africa, *Human Vaccines & Immunotherapeutics Journal*, **14:(10)**, 2355-2357.

Cooper, S., Schmidt, B.M., Sambala, Z., Swartz, A., Colvin, C.J., Leon, N., Betsch, C. and Wiysonge, C.S. *et al*. (2019) Factors that influence parents' and informal caregivers' acceptance of routine childhood vaccination: a qualitative evidence synthesis. *Cochrane Database of Systematic Reviews*, **19:(2)**, 1890-2003.

Corrigal, J., Coetzee, D. and Cameron, N. (2008) Is the Western Cape at risk of an outbreak of preventable childhood diseases? Lessons from an evaluation of routine immunisation coverage, *SAMJ*, **98:(1)**, 41-45.

Cotter, S. (2002) The views of parents and health professionals. Department of public health, *BMC Med* **5:(11),** 1741-1982.

Daniel, W.W. (1999) Biostatistics: A Foundation for analysis in the health sciences, *Wiley Online Journal*, **20:(2)**, 324-326.

De Bruin, W.E. and Panday-Soobrayan, S. (2017) Learners' perspectives on the provision of condoms in South African public schools. *AIDS Care*. **29:(12),** 1529–1532.

De Courval, F.P., De Serres, G. and Duval, B. (2003) Varicella vaccine: Factors influencing uptake, *Canadian Journal of Public Health*, **94:(4)**, 268-271.

Deer, T. (2014) Comparing the health and social protection effects of measles vaccination strategies in Ethiopia: an extended cost-effectiveness analysis, *Social Science Medical Journal*, **139:(11),** 115–122.

Delany-Moretlwe, S., Kelley, K.F., James, S., Scorgie, F., Subedar, H., Dlamini, N.R., Pillay, Y., Naidoo, N., Chikandiwa, A. and Rees, H. (2018) Human Papillomavirus Vaccine Introduction in South Africa: Implementation Lessons From an Evaluation of the National School-Based Vaccination Campaign*. Global Health: Science and Practice* **, 6:(3),** 425-438.

Department of Health (2007) *South Africa Demographic and Health Survey*, 308-315.

Devan, T. (2020) Progress on impoverishing health spending in 122 countries: a retrospective observational study. *Lancet Global Health Journal*, **6:(9),** 180–192.

Dubé, E., Laberge, C., Guay, M., Bramadat, P., Roy, R. and Bettinger J. (2013) Vaccine hesitancy: An overview, Human Vaccines and Immunotherapeutic Journal, **9:(8)**, 1763-1773.

Dudley, Z. (2020) Latent class analysis of maternal vaccine attitudes and beliefs. *American Health Education & Behavior Journal*, **29:(1)**, 89-92.

Duffell, E. (2001) Attitudes of parents towards measles and immunisation after an outbreak, *Journal of Epidemiology and Community Health*, **55:(9)**, 685-686.

Dunlop, J. (2015) Making Paradigms Meaningful in Mixed Methods Research,

Journal of Mixed Methods Research, **10:(4),** 319–334.

Eggertson, K. (2010) How does the cross-sectional study work? *Methodology series,* **3:(1),** 18-32.

Expanded Program on Immunisation in South Africa (EPI-SA) (2012) Vaccinators' manual: Immunisation that works, *Vaccine Journal*, **30:(3)**, 208-230.

Fadnes, L.T., Jackson, D. and Engebretsen, I.M. (2011) Vaccination coverage and timeliness in three South African areas: a prospective study, *BMC Public Health Journal*, **11:(404)**, 1471-2314.

Farid, R. Li, R. Liu, L. and Mo, Z. (2012) An inactivated enterovirus 71 vaccine in healthy children. *English Journal of Medicine*, **370:(9),** 829-837.

Findley, J. Ma, Y., Li, XF., Zhao, J. (2011) Relationships between the diameters of Bacille Calmette-Guerin scars and asthma, atopy in urban and rural Beijing children, *Zhonghua Jie He He Hu Xi Za Zhi,* **26:(9),** 526-527.

Finnagan, R. (2019) Realism as a stance for mixed methods

research. *Journal of Mixed Methods Research*, **10:(6),** 145-167.

Fonn, R., Hristensen, J., Kurke, J. and Larry, E. (2006) Educational research: quantitative, qualitative, and mixed approaches, *Mixed Methods Research Journal*, **5:(2),** 341-350.

Freedman, J. (2018) Parental hesitancy on the safety of childhood vaccines. A survey, *PLOS Journal*, **15:(9)**, 1340-1371.

Funk, S. (2017) Dialectics and pragmatism: Being of consequence,

Sage handbook of mixed methods in social and behavioral research, **2:(1**),134-145.

Gage, X. (2005) Scalable Simple Random Sampling and Stratified Sampling, *Proceeds of Machine Learning Research*, **28:(3),** 531-539.

Gary, E. (2015) Early priming with inactivated IPV, *Vaccine development and therapy journal*, **33:(48),** 6816-6822.

Gauteng Department of Health (2014) Addressing low immunisation coverage. A plan for addressing low immunisation coverage and expanded Programme on Immunisation (EPI), *Global Health Science and practice*, **2:(4)**, 381-394.

GAVI. (2019) Facts and Figures, *Past progress reports*, **4:(5)**, 821.

Godlee, E. (2011) A comparative evaluation of the effects of MMR immunization and mercury doses from thimerosal-containing childhood vaccines on the population prevalence of autism, *Medical Science Monitor*, **10:(10),** 133–139.

Green, A. (2016) Anti-vaxxers in South Africa: risking children's lives, *Daily Maverick*, **1:(1)**, 89.

Gupta, S. (2000) Corruption and the Provision of Health Care and Education Services, *Working paper*, 32 (Accessed 13 April 2020).

Gust, Y., Hammitt, J.K. and Robinson, L.A. (2008) Valuing mortality risk reductions in global benefit-cost analysis. *J Ben Cost Analysis*, **10:(18),** 15–50.

Hamid, S., Andrabi, S., Fazli, A. and Jabeen, R. (2012) Immunisation of children in a rural area of North Kashmir, India: A KAP study, *Online Journal of Health Allied Sciences*, **11:(1)**, 123-134.

Harris, J.B., Gacic-Dobo, M., Eggers, R., Brown, D.W. and Sodha, S.V. (2013) Global immunisation coverage, *MMWR*, **63:(46)**, 1055-1058**.**

Health Systems Trust. (2014) When to use the odds ratio or the relative risk?

International Journal of Public Health, **53:(3),** 165–167.

Henrikson, N.B., Opel, D.J., Grothaus, L., Nelson, J., Scroll, A., Dunn, J., Faubion, T., Roberts, M., Marcuse, E.K. and Grossman, D.C. (2015) Physician communication training and parental vaccine hesitancy: A randomized trial, *Paediatrics Journal*, **136:(1)**, 70-79.

Hong, R. (2017) Infant vaccinations and childhood asthma among full-term infants. *Pharmacoepidemiology and Drug Safety Journal*, **13:(1),** 1–9.

Hussain, R., Kevin, C.E., Olson, Z. and Verguet, S. (2018) An extended cost-effectiveness analysis of publicly financed HPV vaccination to prevent cervical cancer in China, *Vaccine Journal*, **33:(8),** 2830–2841.

Hussey, P. (2009) Quantitative data analysis in education: A critical introduction

using SPSS, *CRC Press*, **1:(1),** 280-325.

Janz, J. Letuenhaus, R and Martine, B. (2019) Mapping the Dutch vaccination debate on Twitter: Identifying communities, narratives, and interactions, *Vaccine X*, **1:(9)**, 88-110.

Joseph, N., Subba, S., Nelliyanil, M., Kotian, S.M., Haridath, A.C., Kishor, N., Attavar, S., Poornima, P., Rane, D.V., Chaithali, H. and Husain, J. (2011) A study of the knowledge and attitude towards pulse polio immunisation in semi-urban areas of South India, *Australas Med Journal*, **4:(2)**, 81-86.

Kahn, T. (2019) Almost a fifth of South Africans fear immunisations are unsafe, *National Health Journal*, 121.

Kempe, T. (2019) Virology, epidemiology, pathogenesis, and control of enterovirus 71, *Lancet Infect Dis*ease, **10:(11),** 778-790.

Kushinka, R. (2015) On Pragmatist Institutional Economics, I*DEAS Working Paper Series-Economic Review Foundation*, **10:(1),** 44-65.

Larson, J., Park, M. and Wu. J.T. (2015) Cost-benefit analysis of vaccination: a comparative analysis of eight approaches for valuing changes to mortality and morbidity risks. *BMC Med*, **16:(8),** 139.

Logan, J., Nederhoff, D., Koch, B., Griffith, B., Wolfson, J., Awan, F.A. and Basta, N.E. (2018) What have you HEARD about the HERD?' Does education about local influenza vaccination coverage and herd immunity affect willingness to vaccinate? *Vaccine Journal*, **36:(28)**, 4118-4125.

Luman, T. (2013) Timelessness of childhood vaccinations in the United States, *JAMA Journal*, **293:(10)**, 1204-1211.

MacDonald, N.E. (2015) Vaccine hesitancy: Definition, scope and determinants, *Vaccine Journal*, **33:(34)**, 4161-4164.

Mackey, K. (2012) Combating healthcare corruption and fraud with improved global health governance, *BMC International Human and Health Rights*, **12:(23)**, 862-891.

Madhi, S.A., Bamford, L. and Ngocobo, N. (2014) Effectiveness of pneumococcal conjugate vaccine and rotavirus vaccine introduction into the South African public immunisation program, *SAMJ*, **104:(3)**, 228-234.

Mast, E.E., Cochi, S.L. and Kew, O.M. (2017) Fifty Years of Global Immunisation at CDC, *Public Health Reports*, **132:(1)**, 18-26.

McCarthy, C. (2020) Why we need to make it harder for parents to refuse vaccines, *Harvard medical blog*, **3:(2)**, 11.

McKee, C. and Bohannon, K. (2016) Exploring the Reasons Behind Parental Refusal of Vaccines, *Journal of Pediatric Pharmacology and Therapeutics*, **21:(2)**, 104-109.

Mertens, D.M. (2007) Transformative paradigm: Mixed methods and social justice. *Journal of Mixed Methods Research*, **1:(3)**, 212-225.

Montasser, N. and Helal, R. (2014) Knowledge, Attitude and Beliefs of Caregivers of Children below 2 Years of Age towards Immunisation, *British Journal of Medicine and Medical Research*, **4:(14)**, 2757-2767.

Morkel, E. (2004) Outbreaks of rubella indicate epidemiological shift in age. *Indian Pediatric Journal,.* **52:(11**), 169.

Moser, M. (2019) Single replication vaccine immunity against influenza B, *Vaccine journal*, **37:(32),** 4533-4542.

Mphaka, M.R., Moshime, M. and Reddy, C. (2015) A Cross-Sectional Study On Caregivers' Knowledge, Attitudes, and Practices about the Routine Immunisation Program in Tshwane Sub-District 2, Gauteng, South Africa. *Journal of Environmental Science and Public Health*, **2:(18)**, 221-231.

Munoz, F. (2015) Pertussis vaccine in pregnant women, *Vaccine development and therapy journal*, **6:(5),** 1-8.

Muscaro, J. (2009) Vaccinatin crisis in Japan. *Lancet journal,* **385:(2**), 571.

Nichter, M. (1995) Vaccinations in the third world: A consideration of community demand, *Journal of Social Science & Medicine*, **41:(5)**, 617-632.

Odone, A. (2009) Effectiveness of interventions that apply new media to improve vaccine uptake and vaccine coverage, *Human vaccine and immunotherpeutics*, **11:(1),** 73-82.

Odusanya, O., Alufohai, E.F., Meurice, F.P. and Ahonkhai, V. (2008) Determinants of vaccination coverage in rural Nigeria, *BMC Public Health Journal*, **8:(381)**, 3412-3415 (Accessed 05 September 2019).

Offit, I. (2014) Mounting a good offense against measles. *English Journal of Medicine**,*** **371:(1)**, 1661–1663.

Oladejo, R. (2016) Economic evaluation of the routine childhood immunization program in the United States, *Pediatrics Journal*, **133:(11),** 577–585.

Okwo-Bele, J.M. and Cherian, T. (2011) The expanded program on immunisation: A lasting legacy of smallpox eradication, *Vaccine Journal*, **29:(4)**, 74-79.

Omar, K. (2011) Acceptance of and attitudes towards human papillomavirus vaccination in Japanese mothers of adolescent girls. *Vaccine journal of therapeutics,* **30:(1),** 5740–5747.

Omer, S.B. (2019) Enhancing uptake of influenza maternal vaccine, *Expert Review of Vaccines journal*, **18:(2),** 191-20.

Olatunbosun, O.D., Esterhuizen, T.M.,Wiysonge, C.S. (2017). A cross sectional survey to evaluate knowledge, attitudes and practices regarding seasonal influenza and influenza vaccination among diabetics in Pretoria, South Africa. *Vaccine*. **35:(47),** 6375–6386.

Opel, D.J., Mangione-Smith, R., Robinson, J.D., Heritage, J., DeVere, V., Salas, H.S., Zhous, C. and Taylor, J.A. (2015) The influence of provider communication behaviors on parental vaccine acceptance and visit experience, *Journal of Public Health*, **105:(10)**, 1998–2004.

Opel, D.J., Padarette, D. and Sullivan, J. (2013) Moving beyond traditional valuation of vaccination: needs and opportunities, *Vaccine Journal*, **35:(12),** 29–35.

Owais, A., Hanif, B., Siddiqui, A.R., Agha, A. and Zaidi, A. (2011) Does improving maternal knowledge of vaccines impact infant immunisation rates? A community-based randomized-controlled trial in Karachi, Pakistan*, BMC Public Health*, **11:(239)**, 1471-2458.

Ozkaya, E., Eker, H.H., Aycan, N. and Samanci, N. (2010) Impact of maternal anxiety level on the childhood vaccination coverage, *Pediatric Journal*, **169:(11)**, 1397-1401.

Pallat, W. (2001) The equity impact vaccines may have on averting deaths and medical impoverishment in developing countries. *Health Affinity Journal*, **37:(1),** 316–324.

Reuben, I. (2016) Towards the eradication of HPV infection through universal specific vaccination. *BMC Public HealtH*; **13:(642),** 884-892.

Ricco, M. (2017) Knowledge, attitudes and perceptions (KAP) towards vaccinations in the school setting: an explorative survey, *Journal of preventative medicine and hygiene*, **58:(2)**, 266-278.

Ritvo, P. (2003) A Canadian national survey of attitudes and knowledge regarding preventive vaccines. *Journal of Immune Based Therapies and Vaccines*, **1:(1)**, 3.

Roberts, K. (2011) Cost-effectiveness and economic benefits of vaccines in low- and middle-income countries: *a systematic review*, **31:(96),** 88-108.

Rodewald, H., Sohnson, R.B., Stefurak, T., and Turner, R. (1993) Considering the evidence-and-credibility discussion in evaluation through the lens of dialectical pluralism, *New Directions for Evaluation*, **138:(2),** 37-48.

SAVIC. (2013) Benefits of vaacines- myths and facts, *Medunsa Blog*, **4:(1),** 13.

S Ali, F., Manzoor, N. and Sahi, S. (2010) Vaccine refusal: an obstacle to a polio free world. *Prof Med Journal*, **17:(1)**, 145-150.

Sehume, W. (2011) Designing and Conducting Mixed Methods Research, *SAGE Publications*, **2:(1),** 153-161.

Seither, Y. (2015) Does childhood immunization against infectious diseases protect from the development of atopic disease?, *Pediatric Allergy Immunology Journal,* **16:(7),** 193-200.

Signorelli, C. (2004) Measles vaccine in the school setting: a cross-sectional study about knowledge, personal beliefs, attitudes and practices of school teachers in Northern Italy, *Minerva Paediatrica Journal*, **10:(26)**, 4940-4946.

Smith, H. (2006) Association Between Health Care Providers' Influence on Parents Who Have Concerns About Vaccine Safety and Vaccination Coverage, *Paediatrics Journal*, **118:(5)**, 1287-1292.

Solanki, G., Cornell, M., & Lalloo, R. (2018). Uptake and cost of influenza vaccines in a private health insured South African population. *Southern African journal of infectious diseases*, **33:(5),**138-190.

Sudfeld, C.T., Navarre, A.M, and Halsey, N. (2010) Effectiveness of measles vaccination and vitamin A treatment, *Internal Journal Epidemiol*, **39:(1)**, 48-55.

Taylor, B. (2011) Qualitative Research Methods for the Social Sciences, Boston MA:

*Pearson Education Inc***, 7:(4),** 366-371.

The District Health Barometer. (2014) Durban: Health Systems Trust.

Thomas, K., Turner, N., Urant, C.G., Yetousis-Harris, H. and Werse, N. (2015) Primary care practice and health professional determinants of immunisation coverage, *Journal of Paediatrics and Child Health*, **4:(3**),189–198.

Torun, E. and Bakirci, J. (2006) Research design: qualitative, quantitative, and mixed methods approaches*, SAGE Publications*, **4:(1),** 232-268.

Transparency International Global corruptions report. (2006) *Global Corruption Report*, 209-217 (Accessed 10 August 2020).

UNICEF. (2011) Discovery and UNICEF helping to close the gap in access to childhood vaccination, *South Africa Annual Report*, 91-110 (Accessed on 01 April 2020).

UNICEF. (2016) Handbook of Qualitative Research, *Surgical Research Journal*, **2:(36**), 235-241.

UNICEF. (2018) Under-five mortality, *UNICEF DATA*, **38:(18)**, 335-372 (Accessed 03 April 2020).

UNICEF. (2019) Observational research methods. Research design II: cohort, cross-sectional, and case-control studies, *BMJ Journals***, 20:(1)**, 821-822.

United Nations. (2015) Goal 3: Ensure healthy lives and promote well-being for all at all ages, *Sustainable Development Goals,* 114-128 (Accessed 29 March 2020).

University of Minnesota. (2019) Does childhood immunization against infectious diseases protect from the development of atopic disease. *Pediatric Allergy and Immunology*, **16:(3),** 193–200.

Utazi, C.E., Thorley, J. and Alegana, V.A. (2019) Mapping vaccination coverage to explore the effects of delivery mechanisms and inform vaccination strategies, *Nature Communications*, **10:(1633)**, 229-238.

Vian, T. (2002) Sectoral perspectives on corruption. Corruption and the health care sector, *Health Policy and Planning*, **23:(2)**, 83-94.

Waldorf, B., Gill, C. and Crosby, S.S. (2014) Assessing adherence to accepted national guidelines for Immigrant and refugee screen and vaccine in an urban primary care practice, a retrospective review, *Journal of Immigrant and Minority Health*, **16:(5)**, 839-845.

Walter, E.B., Hellkamp, A.S., Goldberg, K.C., Montgomery, D., Patterson, B. and Dolor, R.J. (2009) Improving influenza vaccine coverage among asthmatics: a practice-based research network study, *Journal of Clincal Outcomes Management,* **15:(5)**, 227-234.

Wang, T., Wang, D., and Yu, H. (2018) A cancer vaccine-mediated postoperative immunotherapy for recurrent and metastatic tumors. *Nat Commun,* **9:(11),** 1532.

Wilson, J. and Zhang, X. (2008) Efficacy, safety, and immunogenicity of an enterovirus 71 vaccine in China. *English Journal of Medicine*, **37:(9),** 818-828.

World Health Organization. (WHO) (2002) Vaccine epidemiology: A review. *Journal of Family Medicine Primary Care*. **5:(1),** 7-15.

World Health Organisation. (WHO) (2003) Parental attitudes on childhood immunisations, *BMC Paediatrics*, **12:(12),** 154.

World Health Organization. (WHO) (2005) Progress towards global immunization goals,Geneva. Available at:

http://who.int/entity/immunization/monitoring_surveillance/SlidesGlobalImmunization.pptx?ua=1

World Health Organization. (WHO) (2012) Antimicrobial resistance: global report on surveillance, Geneva. Available at: https://www.who.int/drugresistance/documents/surveillancereport/

World Health Organization. (WHO) (2017) Strategic advisory group of experts on immunisation, *Assessment Report of the Global Vaccine Action Plan*, 81-95 Available at: http://www.who.int/immunisation/web_2017_sage_gvap_assessment_report_en.pdf

World Health Organization. (WHO) (2018) Introduction to the Philosophy of Methodology, *AbE Publications*, 310-312.

World Health Organization. (WHO) (2019) Global Measles and Rubella Update, *Disease Outbreak News*, 1210-1416 Available at: https://www.who.int/news-room/ (Accessed 01 April 2020).

World Health Organization. (WHO) (2020) Routine childhood immunisations during a pandemic, *Lancet global health articles*, **8:(10**), 1264-1272.

Wiysonge, C.S. (2019) Vaccine hesitancy, and escalating danger in Africa, *BMC Public Health Journal*, **20:(1108)**, 1186-1187.

Wolfe, R.M. and Sharp, L.K. (2002) Anti-vaccinationists past and present, *BMJ*, **28:(5)**, 325-430.

Zeyer, K. (2010) Vaccine attitudes and concerns amongst parents of young children, *Paediatrics health survey*, **9:(1),** 92-99.

APPENDICES

APPENDIX A: DATA COLLECTION SHEET FOR VACCINATION CHARTS OF STUDENTS

Name of school (1, 2 or 3):

Number of students:

Student code:

Age	Vaccine		Administration date	Late vaccination[1]	Compliant (Y/N)
Birth	TOPV 1	(Trivalent) Oral polio			
Birth	BCG	Bacillus Calmette Guerin			
6 weeks	TOPV 2	(Trivalent) Oral polio			
6 weeks	RV 1	Rotarix			
6 weeks	PCV 1	Pneumococcal conjugate			
6 weeks	DTap-IPV//Hib 1	Pentaxim (5-in-one)			
6 weeks	Hep B 1	Hepatitis B			
10 weeks	DTap-IPV//Hib 2	Pentaxim			
10 weeks	Hep B 2	Hepatitis B			
14 weeks	RV 2	Rotarix			
14 weeks	PCV 2	Pneumococcal conjugate			
14 weeks	DTap-IPV//Hib 3	Pentaxim			
14 weeks	Hep B 3	Hepatitis B			
6/9 months	Measles 1	Measles			
9 months	PCV 3	Pneumococcal conjugate			
12/18 months	Measles 2	Measles			
18 months	DTap-IPV//Hib 4	Pentaxim			
6 years	Td 1	Diftavax			

[1] Late vaccination will be determined based on the EPI schedule interval guidelines (Appendix B)

APPENDIX B: EPI (SA) IMMUNISATION SCHEDULE INTERVAL GUIDELINES

Immunisation	Minimum age at first dose	Catch up immunisation [1]	Minimum interval between dose 1 and 2	Minimum interval between dose 2 and 3	Minimum interval between dose 3 and 4
TOPV	Birth	< 6 weeks	4 weeks	4 weeks	4 weeks
		> 2 years	4 weeks		
BCG	Birth	<1 year Do not give after the age of 1 year			
Hepatitis B	6 weeks	Up to 5 years	4 weeks	4 weeks	
Rotavirus	6 weeks	< 20 weeks	4 weeks		
		20-24 weeks (give only one final dose. Do not give vaccine after age of 24 weeks.			
Pneumococcal	6 weeks	< 6 months	4 weeks	Give 3rd dose at age of 3 months	
		6-9 months	4 weeks	8 weeks (final dose)	
		>9-12 months	4 weeks (final dose)	Give final dose when child is greater than 1 year.	
		12-24 months	Give only one dose at presentation		
DTap	6 weeks	<2 years	4 weeks	4 weeks	At 18 months of age
		2-6 years	4 weeks	4 weeks	After 12 months
Mealses	9 months	17 months or younger	At 18 months age		
		>17 months	4 weeks		
Td	6 years	> 6 years	2nd dose at age 12 years.		

[1]Check the age at presentation give the first dose and follow dose interval if another is indicated

APPENDIX C: PERMISSION TO REVIEW STUDENT VACCINATION CHART RECORDS FROM SCHOOL 1

HOUGHTON SCHOOL

FIRST AVENUE
LOWER HOUGHTON
JOHANNESBURG
2196

P.O. BOX 95012
GRANT PARK
2051

TELEPHONE
483-1450, 483-2550
483-3308
FAX: 728-6987
E-MAIL:
houghtonschool@webmail.co.za

2 April 2019

I hereby give permission for Tah'seen Ismail to conduct a survey and view vaccination chart records for Houghton primary school.

Yours sincerely

A. J. MORRIS
Principal

APPENDIX D: PERMISSION TO REVIEW STUDENT VACCINATION CHART RECORDS FROM SCHOOL 2

Rosebank School

TEL: 011 788-1120
FAX: 011 447-5897
EMAIL: roseps@iafrica.com

13 Jellicoe Ave
Rosebank
Johannesburg
2196

Founded 1906

2019/04/08

To Whom it may Concern,

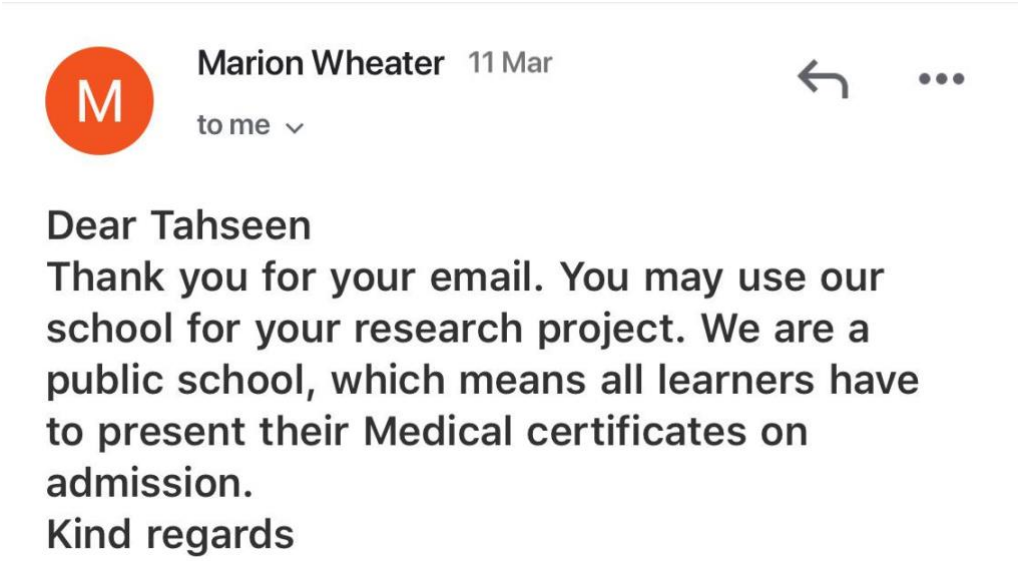
We as Rosebank Primary School, give Tah'seen Ismail (071 3436794), permission to conduct his survey and view vaccination chart records of the Grade 1 pupils.

Regards,

Debbie Barnard

HOD Junior Primary

APPENDIX E: PERMISSION TO REVIEW STUDENT VACCINATION CHART RECORDS FROM SCHOOL 3



Marion Wheater 11 Mar

to me

Dear Tahseen
Thank you for your email. You may use our school for your research project. We are a public school, which means all learners have to present their Medical certificates on admission.
Kind regards

APPENDIX F: POPULATION SIZE PER SCHOOL

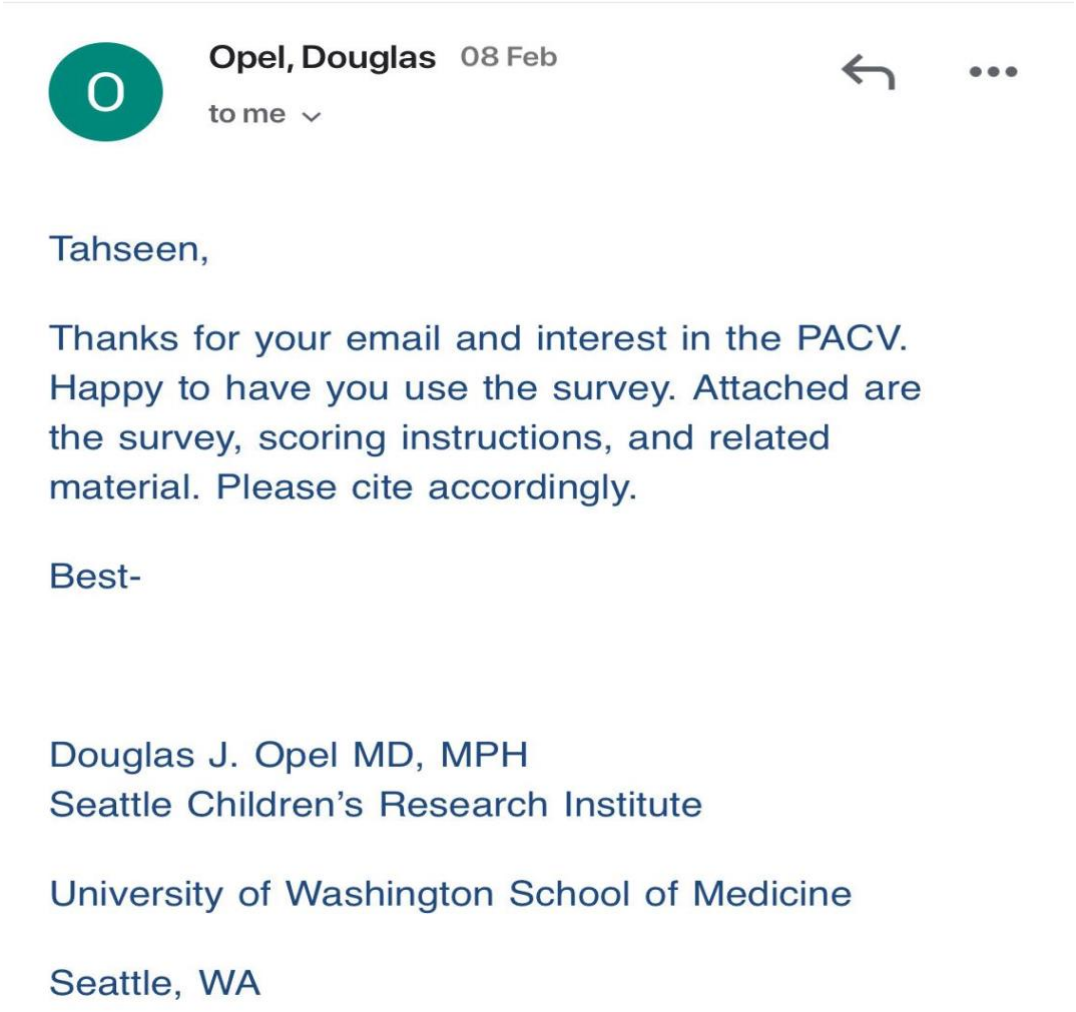
Table: Population size of student demographic per selected school

Schools associated to the study	**Number of students (n)**
School 1	267
School 2	222
School 3	267
Total number of students	**756**

Table: Population size of caregiver demographic per selected school

Schools associated to the study	**Number of caregivers (n)**
School 1	356
School 2	444
School 3	356
Total number of participants	**1 156**

APPENDIX G: PERMISSION TO MAKE USE OF APPROVED SURVEY TOOL BY OPEL *ET AL.* (2013)



Opel, Douglas 08 Feb

to me

Tahseen,

Thanks for your email and interest in the PACV. Happy to have you use the survey. Attached are the survey, scoring instructions, and related material. Please cite accordingly.

Best-

Douglas J. Opel MD, MPH
Seattle Children's Research Institute

University of Washington School of Medicine

Seattle, WA

APPENDIX H: QUESTIONNAIRE ON THE KNOWLEDGE, ATTITUDES AND PERCEPTIONS OF CAREGIVERS TOWARDS CHILDHOOD VACCINATIONS.

1. Have you ever delayed having your child get a vaccination for reasons other than illness or allergy?

- Yes
- No
- Don't know

2. Have you ever decided not to have your child get a vaccination for reasons other than illness or allergy?

- Yes
- No
- Don't know

3. If you had another infant today, would you want him/her to get all the recommended vaccinations?

- Yes
- No
- Don't know

4. How sure are you that following the recommended vaccination schedule is a good idea for your child?

0 TO 5= Not sure	**6 TO 7= Moderately sure**	**8 TO 10= Completely sure**

- 0-5
- 6-7
- 8-10

5. Children get more vaccinations than are good for them?

- Agree
- Disagree
- Not sure

6. I believe that many of the vaccine preventable illnesses are severe.

- Agree
- Disagree
- Not sure

7. It is better for my child to develop immunity by getting sick than to get a vaccination.

- Agree
- Disagree
- Not sure

8. It is better for children to get fewer vaccines at the same time.

- Agree
- Disagree
- Not sure

9. How concerned are you that your child might have a serious side effect from a vaccination?

- Concerned
- Not concerned
- Not sure

10. How concerned are you that any one of the childhood vaccinations might not be safe?

- Concerned
- Not concerned
- Not sure

11. How concerned are you that a vaccination might not prevent the disease?

- Concerned
- Not concerned
- Not sure

12. Overall, how hesitant about childhood vaccinations would you consider yourself to be?

- Hesitant
- Not hesitant
- Not sure

13. I trust the information I receive about vaccinations.

- Agree
- Disagree
- Not sure

14. I am able to openly discuss my concerns about vaccinations with my child's doctor.

- Agree
- Disagree
- Not sure

15. All things considered, how much do you trust your child's doctor?

0 TO 5= Don't trust at all	**6 TO 7= Trust**	**8 TO 10= Complete trust**

- 0-5
- 6-7
- 8-10

APPENDIX I: PERMISSION TO MAKE USE OF APPROVED SURVEY TOOL BY LARSON *ET AL.* (2015)

Dear Tah'seen,

I assume you mean our Vaccine Confidence Index™ which our Vaccine Confidence Project developed and did a global study as well as follow up studies in the EU and the Philippines to measure change in vaccine confidence over time?

Please see our attached studies which explain the questions and the methodologies.

It is fine to use the Vaccine Confidence Index™ as long as you reference the attached papers.

Best regards,

Heidi

Heidi J Larson, PhD

Professor of Anthropology, Risk and Decision Science

Director, The Vaccine Confidence Project

APPENDIX J: QUESTIONNAIRE ON THE KNOWLEDGE, ATTITUDE PERCEPTIONS OF ADMINISTRATORS TOWARDS CHILDHOOD VACCINATIONS

1. What is the most common source of information you turn to for information on vaccines?

- Social media
- Pediatricians
- Friends and family
- Media
- Journals
- Books

2. Do you know the recommended vaccine schedule?

- Yes
- No

3. Do you think it is important to maintain on-time immunisation rates in public schools?

- Yes
- No

4. Some group or leaders do not agree to vaccination for different reasons. Do you know any of these groups or individuals?

- Yes
- No

5. In general do you agree or disagree with these groups?

- Agree
- Disagree
- Not sure

6. Do you think childhood vaccinations should be compulsory or not?

- Yes
- No

7. Do you think vaccinations are safe for yourself/ children/ those in the community?

- Yes
- No

8. Have you ever been reluctant or hesitant to get a vaccine for your child?

- Yes
- No

9. In your opinion, is it better for a child to receive multiple vaccines in one vaccination with fewer injections or to have individual vaccines?

- Multiple
- Individual

10. Childhood vaccines are important for children's health?

- Strongly agree
- Agree
- Neither agree or disagree
- Disagree
- Strongly disagree

11. All the childhood vaccinations offered by the government program are beneficial?

- Strongly agree
- Agree
- Neither agree or disagree
- Disagree
- Strongly disagree

12. Children do not require vaccines for diseases that are no longer common?

- Strongly agree
- Agree
- Neither agree or disagree
- Disagree

- Strongly disagree

13. New vaccines carry more risks than older vaccines?

- Strongly agree
- Agree
- Neither agree or disagree
- Disagree
- Strongly disagree

14. Having the children in my school vaccinated and up to date is important for maintaining herd immunity, on-time immunisation rates and for the safety of other students.

- Strongly agree
- Agree
- Neither agree or disagree
- Disagree
- Strongly disagree

15. It is important to follow up the vaccination records of a student who is not up to date?

- Strongly agree
- Agree
- Neither agree or disagree
- Disagree
- Strongly disagree

16. How can pharmacists participate and promote on-time vaccinations for children entering schools? (More than one option may be chosen)

- Improving both the quality and quantity of the delivery of vaccination services
- Minimizing financial burdens for needy persons
- Increasing community awareness, participation, education, and partnership
- Improving disease monitoring and vaccination coverage
- Developing new or improved vaccines and improving the use of vaccines

APPENDIX K: STUDY INFORMATION DOCUMENT

Study title: The evaluation of the on-time immunisation rates of students entering public schools In the City of Johannesburg, Regions B and E of Johannesburg and how the thoughts, attitudes and perceptions of their caregivers and administrators influence these rates.

Dear Sir/Madam

As part of my Master's research dissertation I, Tah'seen Ismail, am conducting a research project on the assessment of the on-time immunisation rates among Grade 1 to 3 children who enter public schools in Region B and E of the City of Johannesburg. I invite you to complete the survey, which can be found by clicking on the link below: (Link will be inserted once survey has been created on REDCap)

Completion should take you approximately 10 minutes.

Your participation in this survey is *voluntary* and all your answers will be kept *anonymous*. You have the right to refuse participation or withdraw at any time during the survey. The survey will run from 01 June 2019 and will close on 01 October 2019. Thank you for your time and I hope you consider being a part of this masters research study.
Please note that the survey questions being asked are from globally approved and commonly used tools and consent has been given by the authors for use. A 5-point Likert scale is used to gather the information for questions 10-15, where administrators' will answer questions using the following scale shown below:

1 = strongly disagree	**2 = disagree**	**3 = neither agree nor disagree**	**4 = agree**	**5 = strongly agree**

Introduction:

I, Tahseen Ismail, am doing a Master's research project on the evaluation of on-time immunisation rates among Grade 1 to 3 students who enter public schools in Region B and E of City of Johannesburg and how the thoughts, attitudes and perceptions of their caregivers and administrators influence these rates.

There is a rising concern amongst new parents regarding the use of and administration of childhood vaccinations. This concern is lending to the distressing health issue of a rise in vaccine preventable disease occurrence. School based immunisation surveys are a common tool used to establish the vaccination coverage among children. It proves an easy method in gathering information surrounding on-time vaccination rates. The on-time rates for children entering schools plays a vital role in preserving the integriry of the vaccines and ensuring its effectiveness. A survey will be used to establish the knowledge, attitude, perceptions and utilization of childhood vaccinations amongst public school administrators and the caregivers of Grade 1 to 3 students as well as the on-time immunisation rates among children who enter these public schools. This research study will analyse the immunisation cards of the students from the respective schools and gather information on the on- time immunisation rates. The data needed for the study will be collected using REDCap by means of a questionnaire.

Invitation to Participate: Participation in this study is entirely voluntary. I would like to invite you to participate in this research study.

What is involved in the study?

Questionnaires

The researcher will send surveys to caregivers and administrators, which will determine their knowledge, attitudes and perceptions surrounding childhood vaccinations. The questionnaire will be prepared using REDcap. The survey consists of short multiple-choice questions and the questionnaire will take approximately 10 mins of your time to complete. All completed surveys will be analyzed using the tools on REDcap and

Microsoft Excel. The researcher will analyze the vaccination chart records of the student in primary schools in Region B and E of the City of Johannesburg and will draw conclusions on the on-time vaccination rates in these schools.

Risks

There are no risks in participating in this study.

Participation is voluntary

Your participation in this survey is completely voluntary, and all your opinions will be kept anonymous. You have the right not to participate in this survey. Completing the survey will be regarded as informed consent to participate in this study.

Confidentially

Confidentiality will be maintained in this study. The questionnaire does not require any personal identifying information to be divulged.

Who has reviewed the study and given Ethical approval for this study?

This study has been sent to the Wits University Human Research Ethics Committee for approval.

Approximate time that the study will be completed in

June 2020

For more information or questions regarding the study, or if you would like to report any problems, please contact:

Researcher: Tahseen Ismail
0713436794
Tahseendaawson@gmail.com

Supervisor: Stephanie De Rapper
0823104898
Stephanie.derapper@wits.ac.za

If you have any concern over the way the study is being conducted, please contact the Chairperson of this Committee who is Professor Clement Penny, who may be contacted on telephone number 011 717 2301, or by e-mail on Clement.Penny@wits.ac.za. The telephone numbers for the Committee secretariat are 011 717 2700/1234 and the e-mail addresses are Zanele.Ndlovu@wits.ac.za and Rhulani.Mukansi@wits.ac.za

Thank you for reading this Study Information Sheet.

APPENDIX L: ETHICS CLEARANCE CERTIFICATE (M180646)

UNIVERSITY OF THE WITWATERSRAND JOHANNESBURG

R14/49 Ms Tah'seen Ismail

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M180646

NAME: (Principal Investigator)	Ms Tah'seen Ismail
DEPARTMENT:	Pharmacy and Pharmacology Health Sciences Campus University of the Witwatersrand
PROJECT TITLE:	The prevalence of use, knowledge and attitude towards Complementary and Alternative Medicine (CAM) among pharmacy students at the University of the Witwatersrand
DATE CONSIDERED:	29/06/2018
DECISION:	Approved uncoditionally
CONDITIONS:	
SUPERVISOR:	Ms Stephanie de Rapper
APPROVED BY:	Professor CB Penny, Chairperson, HREC (Medical)
DATE OF APPROVAL:	20/08/2018

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office Secretary on the Third Floor, Faculty of Health Sciences, Phillip Tobias Building, 29 Princess of Wales Terrace, Parktown, 2193, University of the Witwatersrand. I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report**. The date for annual re-certification will be one year after the date of convened meeting where the study was initially reviewed. In this case, the study was initially reviewed in **June** and will therefore be due in the month of **June** each year. Unreported changes to the application may invalidate the clearance given by the HREC (Medical).

Principal Investigator Signature Date

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

APPENDIX M: RESEARCH APPROVAL FROM GAUTENG DEPARTMENT OF EDUCATION

GAUTENG PROVINCE
Department: Education
REPUBLIC OF SOUTH AFRICA

8/4/4/1/2

GDE RESEARCH APPROVAL LETTER

Date:	20 June 2019
Validity of Research Approval:	04 February 2019 – 30 September 2019 2019/94
Name of Researcher:	Ismail T
Address of Researcher:	26 3rd Street
	Houghton
	Johannesburg, 2198
Telephone Number:	011 728 2585/ 071 343 6794
Email address:	tahseendawson@gmail.com
Research Topic:	The evaluation of the on-time immunisation rates if students entering public schools in the city of Johannesburg, Regions B and E.
Type of qualification	Masters of Pharmacy
Number and type of schools:	Three Primary Schools
District/s/HO	Johannesburg East and Johannesburg South

Re: Approval in Respect of Request to Conduct Research

This letter serves to indicate that approval is hereby granted to the above-mentioned researcher to proceed with research in respect of the study indicated above. The onus rests with the researcher to negotiate appropriate and relevant time schedules with the school/s and/or offices involved to conduct the research. A separate copy of this letter must be presented to both the School (both Principal and SGB) and the District/Head Office Senior Manager confirming that permission has been granted for the research to be conducted.

24/06/2019

The following conditions apply to GDE research. The researcher may proceed with the above study subject to the conditions listed below being met. Approval may be withdrawn should any of the conditions listed below be flouted:

1

Making education a societal priority

Office of the Director: Education Research and Knowledge Management
7th Floor, 17 Simmonds Street, Johannesburg, 2001
Tel: (011) 355 0488
Email: Faith.Tshabalala@gauteng.gov.za
Website: www.education.gpg.gov.za

1. *The District/Head Office Senior Manager/s concerned must be presented with a copy of this letter that would indicate that the said researcher/s has/have been granted permission from the Gauteng Department of Education to conduct the research study.*
2. *The District/Head Office Senior Manager/s must be approached separately, and in writing, for permission to involve District/Head Office Officials in the project.*
3. *A copy of this letter must be forwarded to the school principal and the chairperson of the School Governing Body (SGB) that would indicate that the researcher/s have been granted permission from the Gauteng Department of Education to conduct the research study.*
4. *A letter / document that outline the purpose of the research and the anticipated outcomes of such research must be made available to the principals, SGBs and District/Head Office Senior Managers of the schools and districts/offices concerned, respectively.*
5. *The Researcher will make every effort obtain the goodwill and co-operation of all the GDE officials, principals, and chairpersons of the SGBs, teachers and learners involved. Persons who offer their co-operation will not receive additional remuneration from the Department while those that opt not to participate will not be penalised in any way.*
6. *Research may only be conducted after school hours so that the normal school programme is not interrupted. The Principal (if at a school) and/or Director (if at a district/head office) must be consulted about an appropriate time when the researcher/s may carry out their research at the sites that they manage.*
7. *Research may only commence from the second week of February and must be concluded before the beginning of the last quarter of the academic year. If incomplete, an amended Research Approval letter may be requested to conduct research in the following year.*
8. *Items 6 and 7 will not apply to any research effort being undertaken on behalf of the GDE. Such research will have been commissioned and be paid for by the Gauteng Department of Education.*
9. *It is the researcher's responsibility to obtain written parental consent of all learners that are expected to participate in the study.*
10. *The researcher is responsible for supplying and utilising his/her own research resources, such as stationery, photocopies, transport, faxes and telephones and should not depend on the goodwill of the institutions and/or the offices visited for supplying such resources.*
11. *The names of the GDE officials, schools, principals, parents, teachers and learners that participate in the study may not appear in the research report without the written consent of each of these individuals and/or organisations.*
12. *On completion of the study the researcher/s must supply the Director: Knowledge Management & Research with one Hard Cover bound and an electronic copy of the research.*
13. *The researcher may be expected to provide short presentations on the purpose, findings and recommendations of his/her research to both GDE officials and the schools concerned.*
14. *Should the researcher have been involved with research at a school and/or a district/head office level, the Director concerned must also be supplied with a brief summary of the purpose, findings and recommendations of the research study.*

The Gauteng Department of Education wishes you well in this important undertaking and looks forward to examining the findings of your research study.

Kind regards

.....

Mrs Faith Tshabalala
Acting Director: Education Research and Knowledge Management

DATE: 24/06/2019

Office of the Director: Education Research and Knowledge Management
7th Floor, 17 Simmonds Street, Johannesburg, 2001
Tel: (011) 355 0488
Email: Faith.Tshabalala@gauteng.gov.za
Website: www.education.gpg.gov.za

APPENDIX N: SIMPLE REGRESSION ANALYSIS

SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0.295745							
R Square	0.087465							
Adjusted F	0.04779							
Standard E	0.792672							
Observatic	49							
ANOVA								
	df	SS	MS	F	Significance F			
Regressior	2	2.770329	1.385165	2.204521	0.121825			
Residual	46	28.90314	0.628329					
Total	48	31.67347						
	Coefficient	Standard E	t Stat	P-value	Lower 95%	Upper 95%	Lower 95%	Upper 95%
Intercept	1.076888	0.418806	2.571329	0.013429	0.233875	1.9199	0.233875	1.9199
Belief in se	0.129993	0.168412	0.771876	0.444136	-0.209	0.468989	-0.209	0.468989
full immur	0.335604	0.209489	1.602008	0.116	-0.08608	0.757284	-0.08608	0.757284