Antibiotic Prescribing Patterns amongst Healthcare Professionals in a Paediatric Ward at Van Velden Hospital, Tzaneen - Limpopo Province

Dissertation submitted by

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2014
DECLARATION

I, Linneth Nkateko Mabila, hereby declare that the work on which this dissertation is based is original (except where acknowledgements indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for any other degree at this or any other university.

_________________  ___________________
Signature                      Date
DEDICATION

A special feeling of gratitude to my husband, Thembinkosi whose words of encouragement and push for tenacity ring in my ears. To our two children, Nsovo and Luzuko I dedicate this dissertation to you as you both had to make a lot of sacrifices during these times.

Thank you for your love, support and encouragement.
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☞ Paediatric Ward staff for their cooperation to obtain the list of patients who were admitted in the ward during the year 2011.
DISSEMINATION OF FINDINGS

BOUND COPIES OF THE RESEARCH REPORT

1. To be submitted to the Drugs and Therapeutic committee at Van Velden Hospital
2. To be submitted to the Limpopo Department of Health’s – Directorate for Monitoring, Strategic Planning and Policy

PODIUM PRESENTATIONS

Local Conferences

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<td>Antiretroviral Therapy</td>
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<td>ATC</td>
<td>Anatomical Therapeutic Chemical</td>
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<td>BPN</td>
<td>Bronchopneumonia</td>
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<td>DTC</td>
<td>Drugs and Therapeutics Committee</td>
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<td>EDL</td>
<td>Essential Drugs List</td>
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<tr>
<td>LRTI</td>
<td>Lower Respiratory Tract Infection</td>
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<tr>
<td>MDG</td>
<td>Millennium Development Goals</td>
</tr>
<tr>
<td>NDoH</td>
<td>National Department of Health</td>
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<tr>
<td>NDP</td>
<td>National Drug Policy</td>
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<td>NICHD</td>
<td>National Institute of Child Health and Human Development</td>
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<td>OTC</td>
<td>Over the Counter</td>
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<td>Paediatric Standard Treatment Guidelines</td>
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<tr>
<td>RH</td>
<td>Rifampicin and Isoniazid</td>
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<td>RHZ</td>
<td>Rifampicin Isoniazid and Pyrazinamide</td>
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<td>RTI's</td>
<td>Respiratory Tract Infections</td>
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<td>SAPC</td>
<td>South African Pharmacy Council</td>
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<tr>
<td>STGs</td>
<td>Standard Treatment Guidelines</td>
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<td>TDS</td>
<td>Three times a day</td>
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<td>URTI</td>
<td>Upper Respiratory Tract Infection</td>
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ABSTRACT

Antibiotics are among the most frequently prescribed drugs in the 21st century. The first antibiotic, penicillin, was accidentally discovered from a mold culture in 1928. Today, over 100 different antibiotics account for the treatment and cure of many bacterial infections. It is for this reason that many developing nations have come to place heavy reliance on antibiotics, a phenomena that has contributed to the spread of antibiotic resistant bacteria. Unless health workers antibiotic prescribing patterns is kept in check, this spread of resistant bacteria will definitely leave many developing countries and especially the most vulnerable such as children in the population, at risk of contracting dreadful diseases. In this study, antibiotic prescribing patterns amongst healthcare practitioners in a district hospital were investigated to determine the commonly prescribed antibiotics in the paediatric ward.

To achieve this purpose, the study set a number of objectives, namely; to determine the prevalence of antibiotics prescribing patterns in the paediatric ward; to identify the most common conditions for which antibiotics were prescribed in the paediatric ward; to identify the most common factors related to antibiotic prescribing patterns in the paediatric ward; to determine the pharmacological classes of antibiotics that were most commonly prescribed in the paediatric ward; and to compare the ward’s antibiotic prescribing patterns with the Paediatric Standard Treatment Guidelines.

The study adopted a cross-sectional research design whereby a census of 304 patients who were admitted in the paediatric ward from 1 January 2011 to 31 December 2011 was conducted. Patient admission files were used to collect data about health workers antibiotic prescribing patterns in the ward. The data collected were managed and analysed through the IBM SPSS Statistics® programme. To report on the prescribing patterns descriptive statistics was chosen. The results from the data obtained on prescribing patterns were presented through percentage and frequency tables, graphs, tables and pie charts. To test the association of various variables that were predicted to have an effect on health workers antibiotic prescribing patterns Chi-square tests were conducted.
The results show that on average, most patients in the ward received at least two antibiotics during their stay in the ward. Ampicillin was found to be the most commonly prescribed followed by gentamicin. Diarrhoea, bronchopneumonia and dehydration were amongst the most common conditions that antibiotics were prescribed for. In addition, most of the antibiotic treatment in the ward was empiric and did not depend on culture results as in most of the cases laboratory tests were not requested. The results of the Chi-square tests indicate that, there was not relationship between any of the variables (age, weight, gender or length of stay in the ward) and antibiotic prescribing.

The study therefore concluded that health workers irrational antibiotic prescribing has no relationship with, age, gender, weight or length of stay in the ward. The patterns of prescribed antibiotics in the ward were higher within patients suffering from diarrhoea, bronchopneumonia and dehydration. The findings have important policy implications for recommendations on antibiotic stewardship in small hospitals like Van Velden Hospital.

**Keywords:** Paediatrics, antibiotics, rational prescribing, prescribing patterns, treatment guidelines.
CHAPTER 1: INTRODUCTION

This introductory chapter describes the background and rationale for the study. The aim and objectives of the study are provided and this chapter ends with an outline of the dissertation.

1.1 BACKGROUND TO THE STUDY

Antibiotics are the most commonly sold drugs in developing countries. Unfortunately, their use of antibiotics has become a matter of concern, especially because of the spread of antibiotic resistant bacteria (Bukes, Ermertcan, Hosgor-Lomoncu, Ciceklioglu, & Eren, 2003). Locally, Schellack and Gous (2011) revealed that the emergence of resistance associated with antibiotic use has been recognised. If it is not addressed urgently, the risk of a post-antibiotic era is now eminent (Cars, Hedin, & Heddini, 2011). Especially, due to the realization that, infants and children are among the most vulnerable population groups that contract illnesses in South Africa, Botswana and Lesotho (Ashford, 2006).

According to (Chang, Chang, & Lai, 1999), the problem of antibiotic abuse also results from irrational prescribing patterns by medical practitioners. This problem can be compounded in South African hospitals which are largely found in rural areas where no antibiotic ward policy exists. Health care practitioners in such hospitals have to ensure that antibiotic prescribing patterns conform to the Paediatric Standard Treatment Guidelines (PSTG). There is at least some hope for rational antibiotic prescribing in hospitals where a policy exists. For example, recent studies by Erbay, Çolpan, Bodur, Çevik, Samore and Ergönül, (2003) as well as Schellack and Gous, (2011) indicate that deviations from ward antibiotic policy are often minimal and usually discussed within a multidisciplinary team.

Personal experience from the researcher in this study reveals that this problem is also prevalent at Van Velden Hospital, which is the location for this study since it does not have a paediatric ward antibiotic policy. Health care practitioners in this
hospital have to rely and conform to the guidelines offered by the PSTG. Hence, the researcher in this study believes it is necessary to assess the antibiotic prescribing patterns in the paediatric ward at Van Velden Hospital, in Tzaneen - South Africa.

1.2 RATIONALE FOR THE STUDY

A number of studies point to the importance of research in the area of antibiotic use in paediatrics. Amongst these are for example: Essack (2006), Istúriz and Carbon (2000), Schellack and Gous (2011), and Slogrove, Kunneke, Engelbrecht, Holgate, Cotton and Rabie (2010). Evidence from South Africa, Botswana and Lesotho (Ashford 2006) highlights the vulnerability of infants and children under the age of five years. In a most recent study conducted at the Neonatal Intensive Care Unit of the Dr George Mukhari Hospital, Schellack and Gous (2011) stated that prolonged use of antibiotics may contribute to the development of antimicrobial resistance.

Hence, knowledge of drug administration in children and infants is essential to the practice of paediatrics since most registered medicines do not have indications or dosing for children (Cranswick & Rechtmann, 2009). This is especially so when considering that antibiotics are one of the most frequently prescribed drugs for children's diseases. In other parts of the world, for example India it is also revealed that the “use has become so common that not much thought is given to their need for use, their side effects and precautions to be observed during the treatment” (India Parenting, 2011).

This study was motivated by the possibility of establishing an antibiotic protocol for small rural district hospitals such as Van Velden Hospital in which the project was conducted.

1.3 AIM OF THE STUDY

The aim of the study was to investigate antibiotic prescribing patterns amongst healthcare professionals in a paediatric ward at Van Velden Hospital, Tzaneen - Limpopo Province, South Africa.
1.4 OBJECTIVES OF THE STUDY

The following objectives were formulated:

▷ To determine the prevalence of antibiotic prescribing patterns in the paediatric ward

▷ To identify the most common conditions for which antibiotics are prescribed in the paediatric ward

▷ To identify the most common factors related to antibiotic prescribing patterns in the paediatric ward

▷ To determine the pharmacological classes of antibiotics that are most commonly prescribed in the paediatric ward

▷ To compare the ward’s antibiotic prescribing patterns with the PSTG

1.5 OUTLINE OF THE DISSERTATION

Chapter One introduces the reader to the study and includes the background and rationale for the study. The aim and objectives of the study are thereafter laid out.

An extensive review of the literature is covered in Chapter Two and is discussed under the following headings: Antibiotic use, rational/irrational antibiotic use, causes of irrational antibiotic use, antibiotic use in paediatrics, conditions that require their use in paediatrics, antibiotic resistance in paediatrics, factors that contribute to antibiotic resistance, the role of treatment guidelines, the need for antibiotic stewardship.

Chapter Three follows hereafter and covers the methodology of the study. The research design is discussed including a workflow figure of the data collection process to ensure clear and easy understanding thereof. In this chapter, the study site, period and population are given as well as the sampling method with some information of the patients. The Instrument used for the data collection is laid out as well as a complete explanation on the processes followed for data collection. This
chapter on methodology ends with an explanation on the data analysis and ethical considerations.

CHAPTER 2: LITERATURE REVIEW

In this chapter the literature review will focus on previous studies of authors which are relevant to the area of study. First, Section 2.1 is an overview of research conducted on antibiotic use. Second, rational/irrational antibiotic use is discussed in Section 2.2. Thereafter, an overview of the causes of irrational antibiotic use is presented in Section 2.3. Next, the impact of irrational antibiotic use is discussed in Section 2.4. This is followed by Section 2.5 on antibiotic use in paediatrics. After this, conditions that usually require the use of antibiotics in paediatrics are discussed in Section 2.6. In Section 2.7, the chapter presents a general discussion of literature on antibiotic resistance in paediatrics. Section 2.8, gives an overview of the factors that contribute to antibiotic resistance. This is followed by Section 2.9 which provides a discussion on the role of treatment guidelines. Lastly, the chapter closes with Section 2.10 which presents the need for stewardship in antibiotics.

2.1 ANTIBIOTIC USE

The use of broad-spectrum antibiotics increased considerably in the 1990’s, but often is inappropriate. For example, current antibiotic prescribing practices show that antibiotics are frequently used in settings where they may not be needed at all and where it is difficult to document a benefit (Niederman, 2005).

A number of studies in the area of antibiotic use in paediatrics have been reported in the past few years. For example, Ashford (2006) reports on evidence from South Africa, Botswana and Lesotho. In this study Ashford reveals and highlights the vulnerability of infants and children under the age of five years.

Another study conducted by Chadwick, Yogev and Shulman (1986), found that combinations of beta-lactam and aminoglycoside antibiotics which are frequently used in the treatment of paediatric infections, has potential risks associated with the
use of multiple, broad-spectrum antibiotics, including fungal or bacterial super-
infection and increased drug toxicity.

Elsewhere in the world, in 2002, a retrospective study on antibiotic use for paediatric inpatients was conducted by researchers in the University of Padua. An interesting finding of this study was that antibiotics were also used in infants with severe respiratory tract-infections (RTI’s), but without a documented bacterial aetiology. Hence, it is in view of such situations that Tünger, Dinç, Özbakkaloglu, Atman and Algün (2000) called for what they referred to as the evaluation of ‘rational antibiotic use’.

2.2 RATIONAL/IRRATIONAL ANTIBIOTIC USE

Prescribing is a complex and challenging task which must be based on accurate and objective information and not an automated action without critical thinking or a response to commercial pressure (Aronson, 2006).

The World Health Organisation’s experts on antibiotics defined that “rational use of antibiotics requires that patients receive medications appropriate to their clinical needs, in doses that meet their own individual requirements for an adequate period of time, and the lowest cost to them and their community” (WHO, 2010). In the same light, Mehta and Gogtay (2005) simplified the concept of rational antibiotic use as the five rights. That is to say, the right drug at the right dose by the right route at the right time for the right patient. Hence, according to Chaturvedi, Mathur and Anand, (2012) the requirements for rational antibiotic prescribing can be fulfilled if the prescribing process covers the following steps:

- Diagnosis;
- Drug and non-drug treatments;
- Selecting appropriate drugs, dosage and duration;
- Writing a clear prescription;
- Giving patients adequate information and counselling; and
- Planning to evaluate treatment responses
Unfortunately, it is said that ‘in the real world, prescribing patterns do not always conform to these ideals and what prevails instead is inappropriate, irrational or pathological prescribing’ (Chaturvedi, et al., 2012: 206).

The rational use of medicines in any country is said to be influenced by its national medicine policies. It is however unfortunate that the need for rational drug use is greatest in poorer communities where financial resources are scarce and pressing needs multiply. This then sacrifices the attention and resource allocation for rational drug use at the altar of policy makers resulting in continual suffering for their population because of lopsided preferences (Thawani, 2010).

Quality of antimicrobial drug usage is dependent on knowledge of many aspects of infectious diseases. This includes considering efficacy because many of the indications for antimicrobial use need critical evaluation. Antimicrobial therapy is not only based on the characteristics of a patient and a drug, but also on the characteristics of an infection (Gyssens, 2001).

A rational choice of antibiotic can only be expected if the prescriber is aware of the most likely infective agent and furthermore, by being aware of the prevailing susceptibility patterns (Struelens, 1998).

On the other hand, Kailas (2008) mentions some reasons behind the irrational use of antibiotics. These are:

- Easy availability, such as the sale of over the counter (OTC) drugs, self-medication.
- Incorrect prescribing practices.
- Rigorous marketing by pharmaceutical companies.
- Non availability/ expensive microbiological tests
- Parental unwillingness to undergo investigations
- Fear of legal actions by the doctors

In view of these, Kailas (2008) therefore warns against problems that can result from the irrational use of antibiotics. These are:
• Development of resistance,
• High cost in therapy,
• Negative influence on ecosystem,
• and the perpetuation of the culture of irrational drug use.

The irrational use of medicines is a major problem worldwide. The WHO estimates that more than half of all medicines are prescribed, dispensed or sold inappropriately, and that half of all patients fail to take them correctly. The overuse, underuse or misuse of medicines results in wastage of scarce resources and widespread health hazards (WHO, 2010).

In addition, the overuse and misuse of antibiotics lead to unnecessary side effects, costs and emergence of antibiotic resistant bacteria (Berild, Ringertz, Aabyholm, Lelek, & Fosse, 2002). Hence, irrational use should be discouraged (Gyssens, 2001).

To this effect Zaki and Kheder (2012) mentions that ‘the overuse of expensive broad-spectrum intravenous (IV) agents and the ecological impact of prescribed drugs on the hospital micro-flora have contributed to high levels of expenditure in health’.

Coming closer to home, a number of studies on rational/irrational antibiotic use are notable. Amongst these are for example Istúriz and Carbon (2000); Essack (2006); Slogrove, et al. (2010); and Schellack and Gous (2011)

Istúriz and Carbon (2000) note two important issues related to irrational use of antibiotics. First, they mention that the contribution of developing countries to the world consumption of antibiotics, and consequently to the problem of resistance, is not negligible. Specifically, they mention that a whopping 35 percent of the total health budget is spent on antimicrobials, versus 11 percent in developed nations. Secondly, they reveal that in countries like South Africa and Zimbabwe irrational use of antibiotics may result from the fact that, the prescription of such drugs can be given by unskilled physicians and practitioners, whose only source of learning may be from tactical promotional activities.
To this, Essack (2006) warns that surveillance of antibiotic efficacy should be disease-based, establishing sensitivity profiles of common causative organisms to inform the development of or amendment to standard treatment guidelines (STG) and essential drugs lists (EDL) adopted within the national drug policy.

Slogrove, et al. (2010) reported on a study which evaluated the use of antibiotics in a Western Cape secondary level hospital neonatal unit. The study found that longer duration of appropriate antibiotic treatment was associated with empiric need. It also revealed that, although the antibiotic treatment of patients based on the empiric need was appropriate, practitioners were often faced with the inability to confirm or refute infections. To this they strongly recommended that in such cases, earlier discontinuation should be practiced.

This is confirmed by Schellack and Gous (2011) that advises that the duration of antibiotic use needs to be monitored to prevent unnecessary prolonged use. In addition, they contend that an antibiotic policy may be useful to guide and measure rational antibiotic therapy.

### 2.3 CAUSES OF IRRATIONAL ANTIBIOTIC USE

Factors underlying the irrational use of drugs such as antibiotics are diverse and difficult to pinpoint (Chaturvedi, et al., 2012). However, the major forces can be categorised as those derived from patients, prescribers, workplace, supply system which includes industry influences, regulation of drug information, misinformation as well as a combination of these factors (Chaturvedi, et al., 2012; Choudhry, Stelfox, & Detsky, 2002).

Although, it is difficult to locate the causes of irrational use in paediatric wards, a number of studies describe this issue. For example, in a recent article, Navarro-San Franciscoa, C., Del Toro, M., Cobo, J., De Gea-García, J., Vañó-Galván, S., Moreno-Ramos, F., . . . Paño-Pardo, J. (2013) reveals the perceptions of resident doctors, in a multicentre survey which was conducted in five teaching hospitals.
The article quoted above reveals that participants considered amongst other issues, that their training regarding antibiotics is insufficient (Navarro-San Franciscoa, et al., 2013; Welngart, Wilson, Gibberd, & Harrison, 2000). Most junior doctors who participated in the study considered that lack of advice from for example, specialists in the fields of infectious diseases was largely related to their inability to improve their antibiotic prescribing patterns. Other issues which were pointed out in the study included the unavailability of local antibiotic guidelines, lack of specific antibiotic teaching sessions, lack of specific antimicrobial management teams and readily accessible advice from a group of doctors working in the same environment (Navarro-San Franciscoa, et al., 2013).

2.4 THE IMPACT OF IRRATIONAL ANTIBIOTIC USE

Antibiotics are the agents which are commonly used in the treatment of bacterial infections. In spite of their disadvantages in treatment, the problems that occur from the irrational use of antibiotics (IUA) have put them on the health agendas of the countries as a common issue of consideration (European Parliament Directorate General for Internal Policies of the Union, 2006; Gould & van der Meer, 2005; Holloway & van Dijk, 2011; WHO, 2001; Srinivasan, 2004).

Srinivasan, (2004) mentions that ‘the impact of irrational drug use is said to be predictable’. Hence, according to Srinivasan the ‘reduction in the quality of drug therapy leads to increased morbidity and mortality, wastage of resources leading to reduced availability of other vital drugs, increased costs, increased risk of unwanted effects and the emergence of antimicrobial drug resistance’.

The overuse of antibiotics creates a significant direct financial burden to patients and health insurers. It also increases the risk of avoidable adverse drug reactions (Karras, et al., 2003). It is also believed that the widespread overuse and inappropriate use of antibiotics are a major public concern (Mangione-Smith, Elliot, Stivers, McDonald, Heritage, & McGlynn, 2004). Again, the (WHO, 2010) when medicines are prescribed or used erroneously, they pose serious health risks to the patient and significant associated economic implications.

Moreover, the factors thought to be responsible for poor prescribing have been identified as: deficiency of training, failure to perceive the importance of the task, lack
of identifying the errors, and increasing therapeutic options (Welngart, et al., 2000; Barber, Rawlins, & Dean, 2003).

2.5 ANTIBIOTIC USE IN PAEDIATRICS

Knowledge of drug administration in children and infants is essential to the practice of paediatrics. Most registered medicines do not have indications or dosing for children (Cranswick & Rechtmann, 2009). It is obvious that this often results in irrational use of these agents. This is especially so when considering that antibiotics are one of the most frequently prescribed drugs for children's diseases. In other parts of the world, for example India it is also revealed that the “use has become so common that not much thought is given to their need for use, their side effects and precautions to be observed during the treatment” (India Parenting, 2010).

Curtis, Starr and Wolf (2009) have also seen the need for rational antimicrobial prescribing in paediatrics based on a number of reasons and is summarised as follows:

- Unnecessary antibiotic use for viral illnesses contributes to the increasing problem of antibiotic resistance. Most RIT's in children, including tonsillitis and otitis media, are self-limiting and do not require antibiotic therapy. If the diagnosis is unclear, it is preferable to repeat the clinical evaluation and simple laboratory tests, rather than use empiric antibiotic therapy ‘just in case’.
- Antibiotics do not prevent secondary bacterial infection in viral illnesses.
- The use of antibiotics may make definitive diagnosis and subsequent decisions about management more difficult.
- Empiric antibiotic therapy (that is, not based specific aetiological diagnosis) should only be prescribed when a serious bacterial infection is suspected (e.g. meningitis) and it is not safe or possible to obtain definitive culture specimens or culture results are pending.
- Empiric therapy should be based on the likely cause, local antibiotic resistance patterns and individual host factors (e.g. immunocompromised) in accordance with local guidelines.
• For mild infections, broad-spectrum agents are chosen until the pathogen and its susceptibility is identified (e.g., cefotaxime for meningitis).
• Theoretical benefits of new antibiotics based on in vitro data do not necessarily translate into greater efficacy. Newer antibiotics often offer no advantages, might be expensive with more side effects and have a greater likelihood of leading to resistance or super infection.

2.6 CONDITIONS THAT REQUIRE THE USE OF ANTIBIOTICS IN PAEDIATRICS

Curtis, et al. (2009) mention a number of common bacterial infections that require antibiotic treatment in paediatrics. These are discussed briefly in the following Sections:

• Group A streptococcus which causes a variety of diseases including pharyngotonsilitis, impetigo, cellulitis, scarlet fever, otitis media, streptococcal toxic shock syndrome, necrotising fasciitis, glomerulonephritis, and rheumatic fever.
• *Streptococcus pneumoniae* – a gram positive coccus that causes a wide variety of infections including severe, invasive disease (e.g., meningitis, septicaemia, septic arthritis, peritonitis), or mild often self-limited, invasive disease (occult bacteraemia), pneumonia, otitis media and sinusitis.
• *Neisseria meningitidis* – a gram negative diplococcus that mainly causes meningitis and septicaemia, or both. Less commonly, it may cause other infections including conjunctivitis, septic arthritis, pharyngitis, pneumonia, occult bacteria.
• *Staphylococcus aureus* – a gram positive cocci that causes a wide variety of invasive and non-invasive disease such as impetigo, boils and abscesses, cellulitis (including periorbital cellulitis), osteomyelitis, septic arthritis, endocarditis, pneumonia, food poisoning, bacteraemia, septicaemia and toxic shock syndrome.
Whether or not the data collected by the proposed study would include conditions covered in this preceding outline is discussed from the results of the study, which follows the proposed research methodology.

2.7 ANTIBIOTIC RESISTANCE IN PAEDIATRICS

Antimicrobial resistance has a significant negative impact on the outcome of therapy. It is also said that antibiotic resistance increases the risk of cross-infection in hospital environments (Kollef, 2000). Hence, it is believed that resistance leads to inappropriate empirical therapy, delay in starting effective treatment and the use of less effective, more toxic and more expensive drugs (French, 2005; Kollef, 2000).

When adjusted for other risks, mortality rates and length of hospital stay (LOS) are about twice as great for patients infected with resistant bacteria as for those infected with susceptible strains of the same species, and healthcare costs are greatly increased (French, 2010).

2.8 FACTORS THAT CONTRIBUTE TO ANTIBIOTIC RESISTANCE

Antibiotic resistance is driven by several factors, many of which are associated with inappropriate antibiotic management and consumption (Gelband & Duse, 2011). Specifically, Gelband and Duse, (2011: 552) maintain that:

The regulatory environment, knowledge of healthcare workers and patient expectations all influence antibiotic use and the resulting resistance. Furthermore, misuse is exacerbated by the impoverished living conditions characterising the majority of patients suffering from common bacterial infections, including insufficient supply of antibiotics to the public sector, the use of degraded and expired medicines, and unreliable access to diagnostic facilities and clinicians. Hence, High levels of antibiotic resistance already exist in South Africa.

Although drug resistance is usually viewed as a medical problem, but it is also revealed that the causes of resistance are also cultural and economic (Winters & Duse, 2011). Schellack, Meyer, Gous and Winters (2011) strengthen this point as they reveal a number of economic indicators that contribute to antibiotic resistance in
South Africa. In summary, the following issues are amongst others highlighted by (Schellack, et al., 2011) as contributory factors to the misuse and eventual resistance of antibiotics in South Africa:

- Absolute poverty,
- Income inequality,
- Organisation and distribution of services, and
- Human resource challenges.

Furthermore, Paruk, Richards, Scribante, Bhagwanjee, Mer and Perrie, (2012) reveal that inappropriate antibiotic prescription practices in ICUs in the public and private sectors in South Africa are common and are also associated with high levels of resistance and poor patient outcomes. Probably, this bolstered by the fact that, Patients, physicians and other health workers have little motivation to weigh up the negative impact of their use of antibiotics on others (Winters & Duse, 2011).

2.9 THE ROLE OF TREATMENT GUIDELINES

According to Essack, et al. (2011) limiting the choice of antibiotics through the use of formularies may not only reduce hospital flora to a wide spectrum of antibiotics, but can save costs to the patient, the facility and the government. Hence, the development of EDLs and STGs forms part of this strategy in the public sector. In the private sector, formularies are developed. Most importantly, the STGs and EDL form part of the country’s ‘Essential Drugs Concept’, and are viewed as critical aspects of national health policy. Compiled and periodically reviewed by expert committees under the auspices of the National Essential Drugs List Committee and implemented through the South African NDoH, these documents serve to address medicine availability and accessibility problems at primary care and hospital-level health facilities. In the case of antibiotics, they also provide standards for rational prescribing. Drugs on the EDL are generic, criterion-based and stratified by primary and hospital care, and further stratified by guidelines for adult and paediatric patients. Drugs excluded from the list may be requested in exceptional circumstances for specific patients according to a standardised process.
2.10 THE NEED FOR ANTIBIOTIC STEWARDSHIP

The era of antibiotics is coming to an end. In just a few generations, many “miracle medicines” have been beaten into ineffectiveness by the bacteria they were intended to eradicate (Boseley, 2010). It is now a battle to find antibiotics effective against certain bacterial infections.

A number of studies show that the chances of dying from pneumonia or septicaemia are twice as high if bacteria are drug resistant, rising from 20% to 40% in the case of pneumonia. This is because, the nature of bacteria is that, it quickly adapts to the presence of antibacterial agents in order to survive. The misuse of antibiotics, which is an international problem, only exacerbates this steady evolution of resistance (Best Care Always, 2011).

Globally, there is growing resistance among gram-positive and gram-negative pathogens in hospital environments (Brink, 2006). Treatment options are becoming increasingly limited and complicated due to this resistance. South African hospitals are battling with the growing emergence of micro-organism which are resistant to routine antibiotic therapy. Thus far, Best Care Always (2011) identified the following challenges which are already being faced in certain areas of South Africa:

- Vancomycin-resistant *Staphylococcus aureus* and *Enterococcus faecium*,
- Penicillin-resistant *Streptococcus pneumonia* (PRSP),
- Methicillin-resistant *Staphylococcus aureus* (MRSA),
- Third-generation cephalosporin-resistant *E.coli* and *Klebsiella pneumoniae*,
- Carbapenem-resistant *Klebsiella pneumoniae*, *Enterobacter* spp. and *Pseudomonas aeruginosa*,
- Glycopeptide-resistant Enterococci
- Multi-drug resistant *Mycobacterium tuberculosis*, *Acinetobacter baumannii*, *Escherichia coli* and *Pseudomonas aeruginosa*

If the above summary of the challenges faced by South Africa is to go by. The urgent need for antibiotic stewardship is more than necessary. In addition, antibiotic stewardship is urgently needed because of rising rates of pathogen resistance; a
limited pipeline of new antibiotics; and the morbidity and mortality burden associated with disease that is improperly treated (Best Care Always, 2011).

In specific terms, antibiotic stewardship is urgently needed because it aims to:

- Raise awareness of antibiotic prescribing issues;
- Eradicate the pathogen and prevent recurrence of the infection.

Moreover, the availability of antibiotic stewardship will help ensure that:

- Antibiotics are prescribed only where there is a clear rationale. For example, clinical signs of a bacterial or fungal infection are present,
- When empiric therapy is necessary. For example, the organism has not been identified – reasonable evidence-based prescription guidelines are followed,
- Specimens are routinely sent for culture,
- Antibiotic treatment is tailored promptly according to the laboratory results,
- The appropriate dose is prescribed at the correct frequency of administration, including continuous infusion when necessary,
- Antibiotic therapy is not prolonged unnecessarily,
- Antibiotics with overlapping spectrum of activity are avoided unless there is a clear rationale and,
- the change from IV to oral therapy is made as early as possible.

Finally, according to (Best Care Always, 2011) antibiotic stewardship also emphasises the usefulness of pharmacist ward rounds to assess the antibiotic prescribed to the patients still in the hospital. Such assessment can result in a reduction of the inappropriate use of antibiotics due to direct interaction with the prescriber.

The next chapter outlines the research methodology which was adopted in the execution of the study reported in this document.
CHAPTER 3: METHODOLOGY

This chapter describes the methodology used to investigate antibiotic prescribing patterns amongst healthcare professionals in a paediatric ward at Van Velden Hospital, Tzaneen - Limpopo Province. The first Section gives background information about the site where the study was conducted. This background is followed by the study design and a detailed description of the population and sample selection. The data collection process, which includes the data collection instruments, is discussed. The analysis of the collected data, and how reliability and validity of the data were maintained, are outlined. The chapter ends with a discussion of the ethical considerations for this study.

3.1 RESEARCH DESIGN

This study adopted a retrospective quantitative research design. In addition, the design of the study employed a non-experimental and cross-sectional research design. According to Polit and Hungler (1997) as well as Levin (2006) “cross-sectional designs are especially appropriate for describing the status of phenomena, or relationships among phenomena at a fixed point in time”. In particular, the research in this study followed a retrospective cross-sectional design. That is to say, data for this study were obtained from patient files that were admitted in the paediatric ward between the periods 1st January 2011 to 31st December 2011.

3.2 STUDY SITE

The study was conducted at Van Velden Hospital in Tzaneen, Limpopo province. The hospital is a government institution located in the rural town of Tzaneen which is situated approximately 102 kilometres north of Polokwane, the administrative capital of the Limpopo Province. The hospital has a total of sixty seven (67) beds distributed into four (4) wards as follows: The male ward with nineteen (19) beds, the female ward with twenty three (23) beds, the paediatric with eight (8) beds and the maternity ward with seventeen (17) beds. The hospital services a total of six (6) fixed as well as four (4) mobile clinics. The mobile clinics service the farms in and around Tzaneen. Four (4) of the six (6) fixed clinics are located in Bolobedu South, a cluster
of villages which surround the Tzaneen town. The other two (2) clinics are located in town near the central business district (CBD).

In addition, the hospital admits on average a total of about three hundred and seventy three (373) patients per month. Of this total about twenty (25) patients are admitted at the paediatric ward.

3.3 STUDY PERIOD

The data collection for this study took place from March 2013 to June 2013.

3.4 STUDY POPULATION

The population for this study consisted of all files of patients who were admitted in the paediatric ward between the periods 1\textsuperscript{st} of January 2011 to 31\textsuperscript{st} December 2011.

3.5 SAMPLING METHOD

In line with cross-sectional research design, the sample was a census of all files of patients who were admitted into the paediatric ward during the period specified above. Available hospital statistics revealed that on average, the paediatric ward at Van Velden admits about 25 patients per month. It was thus anticipated that approximately three hundred (300) evaluable cases would be obtained in a period of twelve (12) consecutive months beginning from 1\textsuperscript{st} of January 2011 until 31\textsuperscript{st} of December 2011.

Inclusion criteria

- Any patient admitted to the paediatric ward with or without an antibiotic prescribed.
- Only patients admitted to the paediatric ward during the period 1\textsuperscript{st} January 2011 – 31\textsuperscript{st} December 2011.

Exclusion criteria

- Patients who were not admitted in the paediatric ward.
- Patients admitted in the paediatric ward before and after the inclusion period.
- Patients admitted to the paediatric ward with antibiotics prescribed prior to surgery

3.6 DATA COLLECTION INSTRUMENT

A data collection form (Appendix 1: Adapted from Tünger, et al., 2000) was used. In accordance with the objectives of the study, the form was divided into two sections as follows. First, Section A which largely collect data on file numbers, demographics of patients, disease condition(s), number of antibiotic prescriptions, etc.

Secondly, Section B of the form collected data on prescribing patterns of healthcare workers in the paediatric ward at Van Velden Hospital. For example, whether or not healthcare professionals' prescription of antibiotics took into account the history of drug allergy or reaction, etc.

3.7 DATA COLLECTION

The data collection process was carried out as outlined in the following diagrammatic expression presented in Figure 3.1 which follows here below:
Similar to the Turkish study conducted by Tünгер, et al. (2000), indications for antibiotic use were grouped into three categories:

- First, it was empirical, that is to say it was based on clinical evidence of the infection, and not depending on culture results.
- Second, it was prophylactic, that is to say it was based on administration of antibiotics without evidence of infection.
- Third, it was based on specific uses, that is to say it was based on culture results.
The study did not include patients receiving preoperative prophylactic antibiotics. This is simply because prophylactic antibiotics are usually administered to the patient within 1 hour prior to surgical procedures. They are also supposed to be discontinued within 24 hours from the end of surgery.

In accordance with the method applied by Tünger, et al. (2000), data that were collected included the diagnosis of the patients, laboratory findings, and the details of antibiotic administration, that is to say the type of antibiotic, dosage, and duration of treatment. In addition, the appropriateness of antibiotic use was evaluated according to the indications for use, the choice of antimicrobial agent, and the pharmacokinetic considerations.

3.8 DATA ANALYSIS

The data collected for this study were managed and analysed using the IBM SPSS Statistics® programme. A chi square test was employed to test for association between the dependant and independent variable. A chi square is a statistical test used to compare observed data with data that a researcher would expect to obtain according to a specific hypothesis. For the purpose of this study, Pearson chi-square test was used to establish if there is an association between the prescription of antibiotics and explanatory factors. The factors considered are gender, age, weight, diagnosed condition and patient’s length of stay in the ward.

In addition, the data analysis for this study was informed by the following considerations:

After the data on all patients who were admitted in the paediatric ward between the periods 1st of January 2011 to 31st December 2011 were established, the appropriateness of prescribed antibiotic treatment was determined by a comparative analysis of the procedures followed by health practitioners in accordance with the PSTG.

In addition, the following criteria established in a previous study by Erbay, et al. (2003) was employed in the analysis of the data for this study: That is, where necessary, the researcher made an attempt to communicate and seek clarity about particular antibiotic prescriptions which were not be clear according the PSTG.
Disagreements between the researcher and other health officials were solved through discussion and review of the PSTG and EDL.

Secondly, the appropriateness of each and every prescribed antibiotic was assessed according to a classic criteria established by Kunin, Tupasi and Craig (1973). Although, this criterion seems a bit outdated, it is still well endeared and relied upon by a number of established researchers in this area. For example, van Bijnen, et al. (2011); Bisharal, Hershkovits, Paul, Rotenberg and Pitlik (2007) as well as Dailey and Martin (2001) all conducted their studies assessing the prescribing patterns of antibiotics following Kunin, et al. (1973). According to this criterion, the following categories may be used to classify, analyse data, and describe in/appropriateness of antibiotic use:

- Agree or disagree with choice of antibiotic, with reference to literature (e.g., PSTG and EDL)
- Agree or disagree with choice of antibiotics, with reference to the spectrum of the antibiotics. For example, a researcher may disagree with choice of antibiotic if the spectrum of the antibiotics were overlapped.
- Disagree with choice of antibiotic if the spectrum was not broad enough
- Disagree with choice of antibiotic if the spectrum was overly broad
- Disagree with choice of antibiotic if an equally effective drug was available at a lower cost

During the analysis, antibiotics were judged unnecessary when the patient had no evidence of infection or indication for prophylaxis. Broad-spectrum antibiotic coverage was considered appropriate if there were no available culture and susceptibility results. If a more effective antibiotic was available based on either culture and susceptibility result of the isolated pathogen or identity of the expected pathogen, the antibiotic given was judged inappropriate.

The results of this study are henceforth presented in the next chapter through descriptive statistics which allow for illustrations through tables, graphs and charts from which summaries and conclusions were drawn.
3.9 ETHICAL CONSIDERATIONS

In order to ensure research integrity, the researcher in this study had an obligation to ensure that the research was conducted in an environment which reflected the code of ethics for the profession of a pharmacist as guided by the South African Pharmacy Council (SAPC). Hence, it was ensured that the research site chosen for this study had the necessary SAPC accreditation as an approved location in compliance to minimum requirements for Good Pharmacy Practice (see appendix 2: Approval of Premises certificate). In addition, all patient related information, which was accessed as a part of the data collection process for the study was handled according to the stipulations of the privacy rule as per the professional code of ethics for pharmacists and health care professionals.

Further, permission was sought and obtained for access to the research site (See Appendix 3: Head of Department’s permission letter). Permission to access patient files was also sought from the hospital authorities (see Appendix 3: Hospital Superintendent signed letter of permission). In addition, permission to conduct the study and an evaluation of the ethical considerations was sought from the Medunsa Research and Ethics Committee (MREC) prior to the commencement of the study (see Appendix 4: MREC Certificate).

Prior to the commencement of the study, the researcher ensured that an information session was conducted for all relevant stakeholders (for instance: Executive Committee (EXCO) of the Hospital; Patient records staff and Paediatric ward as well as Pharmacy staff) – (see appendices 5, 6 & 7: Study Summary, PowerPoint presentation, and List of signatures for members who attended the information session, respectively). In addition, the researcher ensured that a poster of the summary of the study was displayed in the pharmacy at all times during the period of this study (see Appendix 8 – Evidence of poster display)

Only data relevant to the objectives of this study were documented. A coding system was used to protect the identity of the patients - confidentiality.
CHAPTER 4: RESULTS AND DISCUSSION

This chapter describes the analysis of data, followed by a discussion of the research findings. The findings relate to the research aim, and objectives that guided the study.

After permission was granted by the hospital authorities, it was established that a total of 423 patients were admitted in the hospital ward between 1 January and 31 December 2011 according to the ward register. Since the cross-sectional study adopted the form of a census, all 423 patient files were expected to be subjected to evaluation. However, due to a number of reasons, for instance; missing files, issuing of duplicate files, readmissions, and wrongfully entered patient information, only 304 (72%) evaluable cases were obtained from the records and administration section where files are kept. This means that a total of 304 paediatric patient files were collected for data collection in this study. Figure 4.1 below illustrates the study population from which a cross-sectional census of antibiotic prescribing patterns in the paediatric ward was conducted.

Figure 4.1: Illustration of the Study Population and Sample

<table>
<thead>
<tr>
<th>Total of 423 expected cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>28.1%, (n=119) unavailable files</td>
</tr>
<tr>
<td>71.9% 304 evaluable</td>
</tr>
<tr>
<td>83.8%, (n=255) Received antibiotic(s)</td>
</tr>
<tr>
<td>1.7%, (n=5) No information of treatment</td>
</tr>
<tr>
<td>14.5%, (n=44) Did not receive antibiotic(s)</td>
</tr>
</tbody>
</table>
Since the study followed a cross-sectional design which adopted the format of a census, all cases (with or without antibiotic prescription) were included in the data collection stage. The data which were obtained from the patient files are presented in this chapter as follows:

- Section 4.1: Patient demographics and characteristics
- Section 4.2: Prevalence of antibiotic prescriptions with discussions on the most commonly prescribed drugs
- Section 4.3: The most common conditions for which antibiotics were prescribed
- Section 4.4: The most common factors related to antibiotic prescribing patterns
- Section 4.5: The pharmacological classes of antibiotics that are most commonly prescribed in the paediatric ward
- Section 4.6: Comparison of the wards antibiotic prescribing patterns with the Paediatric Standard Treatment Guidelines (PSTG)
- Section 4.7: Measure of association between antibiotic prescribing patterns and independent variables such as patient’s age, weight, gender, diagnosed condition, length of stay in the ward, as well as between the diagnosed condition and type of antibiotic therapy, as well as number of antibiotics prescribed. While the choice of antibiotic therapy was measured against the antibiotic protocol as outlined by the PSTG.
- Section 4.8: Conclusion on prescribing patterns

4.1 PATIENT DEMOGRAPHICS AND CHARACTERISTICS

The demographic data of the 304 evaluable patient case files in the study sample were analysed. In this section, they are presented and discussed taking into consideration their possible influence on the findings of this study. The demographic data included the following variables which are discussed sequentially: Patient’s Gender, Age, Nationality, Race and Home Language.

Demographic details such as age and gender are amongst the major determining factors for consideration in rational prescribing (Fernández, Modamio, Catalán, Lastra, Rodríguez, & Mariño, 2008). Table 4.1 below presents the summary of the analysis of the data collected on these and other variables.
Table 4.1: Demographic data

<table>
<thead>
<tr>
<th>Variable</th>
<th>Number (n=304)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>158</td>
<td>52.0</td>
</tr>
<tr>
<td>Female</td>
<td>144</td>
<td>47.3</td>
</tr>
<tr>
<td>Information not found</td>
<td>2</td>
<td>.7</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-1 yr (Infants)</td>
<td>116</td>
<td>38.2</td>
</tr>
<tr>
<td>2-3 yrs (Toddlers)</td>
<td>83</td>
<td>27.3</td>
</tr>
<tr>
<td>4-9 yrs (Early Children)</td>
<td>76</td>
<td>25.0</td>
</tr>
<tr>
<td>10-13 yrs (Middle Childhood)</td>
<td>27</td>
<td>8.9</td>
</tr>
<tr>
<td>Information not found</td>
<td>2</td>
<td>.7</td>
</tr>
<tr>
<td>Nationality</td>
<td></td>
<td></td>
</tr>
<tr>
<td>South African</td>
<td>284</td>
<td>93.4</td>
</tr>
<tr>
<td>Zimbabwean</td>
<td>6</td>
<td>2.0</td>
</tr>
<tr>
<td>Somalian</td>
<td>4</td>
<td>1.3</td>
</tr>
<tr>
<td>Information not found</td>
<td>10</td>
<td>3.3</td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
</tr>
<tr>
<td>African</td>
<td>277</td>
<td>91.1</td>
</tr>
<tr>
<td>White</td>
<td>15</td>
<td>4.9</td>
</tr>
<tr>
<td>Indian</td>
<td>2</td>
<td>.7</td>
</tr>
<tr>
<td>Information not found</td>
<td>10</td>
<td>3.3</td>
</tr>
<tr>
<td>Home Language</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sepedi</td>
<td>208</td>
<td>68.4</td>
</tr>
<tr>
<td>Xitsonga</td>
<td>52</td>
<td>17.1</td>
</tr>
<tr>
<td>English</td>
<td>10</td>
<td>3.3</td>
</tr>
<tr>
<td>Shona</td>
<td>7</td>
<td>2.3</td>
</tr>
<tr>
<td>Afrikaans</td>
<td>6</td>
<td>2.0</td>
</tr>
<tr>
<td>Tshivenda</td>
<td>5</td>
<td>1.6</td>
</tr>
<tr>
<td>SiSwati</td>
<td>3</td>
<td>1.0</td>
</tr>
<tr>
<td>IsiZulu</td>
<td>2</td>
<td>.7</td>
</tr>
<tr>
<td>Somali</td>
<td>2</td>
<td>.7</td>
</tr>
<tr>
<td>IsiXhosa</td>
<td>1</td>
<td>.3</td>
</tr>
<tr>
<td>Information not found</td>
<td>8</td>
<td>2.6</td>
</tr>
</tbody>
</table>

4.1.1 Patient’s Gender and Age

The sample (N = 304) included (158; 52.0%) male and (144; 47.3%) female patients who were admitted to the paediatric ward during the period under study (January to December 2011). In addition, there were two (2; 0.7%) patients whose gender was not identified as information from the patient files was not found. It was therefore noted that in terms of gender, the two groups of patients (male and female) were almost equal.
On the other hand, the patients’ age stages were categorised and adapted for this study according to NICHD (2011) Paediatric Terminology developed by the Eunice Kennedy Shriver National Institute of Child Health and Human Development in the United States as follows: Stage 1, consisted of infant cases, which are cases of patients who upon admission were aged between zero and one year. Stage 2, consisted of toddler cases, which are those that upon admission were aged between two to three years. Stage 3, comprised of early children cases, who were admitted by the age four to nine years. Stage 4, included all middle childhood patient cases who were between 10 and 13 years old upon their admission in the paediatric ward. Therefore, the results of the analysis in this study indicated that there were (116; 38.2%; N= 304) infant cases, (83; 27.3%) toddler cases, (76; 25.0%) early children cases and (27; 8.9%) middle childhood cases. Similar to the data on gender, there were two patient cases whose age was not found from their files.

A cross-sectional study by Fernández, et al. (2008) sought to determine the prevalence and usage patterns of prescription drugs according to patients’ age and gender in a primary health care facility found that the prevalence of drug prescriptions was higher in females than males. This was especially so within a group of 0-4 year-olds. The study concluded that age and gender are the principal determining factors of cost variability in relation to patient therapy. Similarly, in this study age and gender were afforded the attention deserved. The next section provides a discussion on the results of the patient’s nationality.

### 4.1.2 Patient's Nationality

According to the International Organization for Migration (IOM) (2010), South Africa has attracted many migrants because of relatively higher rates of economic growth and the consequences of political and economic crisis in neighbouring countries, especially Zimbabwe and Somalia. The demographic results in Table 4.1 show that there were three nationalities from which the patient cases emanated. These were South Africa, Zimbabwe and Somalia. Hence, as the Table illustrates, the majority (284; 93.4%; N = 304) of patients were of South African origin. Six (6; 2.0%) cases were of patients who were of Zimbabwean origin. The other four (4; 1.3%) cases...
were of Somalian origin. There were also ten (10; 3.3%) patient files from which information about the patient's nationality was not found. From these findings, it is observed that a total of 10 patients were immigrants (that is 6 from Zimbabwe and 4 from Somalia). This important in view of the fact that “nobody knows the number of immigrants now living in South Africa” (Smith, 2009). This is evident from the conflicting reports which purport for example that “South Africa is home to an estimated five million immigrants”, most of them from neighbouring countries such as Zimbabwe (Bearak, 2008). On the other hand Smith (2009) reports that “At one stage there was even talk of a ‘Mugabe-Tsunami’ in which more than 10,000 Zimbabweans a day were streaming across the borders” into South Africa. The next section presents a discussion on results of the study’s analysis of race within the sample understudy.

4.1.3 Patient’s Race

Table 4.1 above shows that in terms of race, the analysis conducted on the evaluable cases in this study found that the majority of (277; 91.1%; N = 304) patients were of black African origin who were admitted to the paediatric ward in the period under study. (15; 4.9%; N = 304) were white. Further, a total of (2; 0.7%) cases were found to be of Indian origin. As was the case with the patient's nationality, (10; 3.3%) cases did not reveal the race of the patients. According to a study conducted by Eng, et al. (2003) previous studies found no significant differences in antibiotic use among groups defined by race. This study also did not expect any differences in this regard. The next section provides details on the evaluable cases home language background.

4.1.4 Patient’s Home Language

The analysis conducted in this study sample revealed that the following languages were indicated as home languages of the patients whose files were examined: Sepedi, Xitsonga, English, Shona, Afrikaans, SiSwati, Tshivenda, IsiZulu, Somali, and IsiXhosa. Of these languages, (208; 68.4%; N = 304) cases were of Sepedi origin. While (52; 17.1%) were from a Xitsonga background. A further (10; 3.3%) cases included patients whose language background was English. Whilst (6; 2.0%)
were from the Afrikaans background. These four languages are the main languages of the area where the hospital from which the research study was conducted is located. The other language backgrounds in the cases for this study included Shona which had (7; 2.3%) cases; Tshivenda which had (5; 1.6%) cases; SiSwati which had (3; 1.0%) cases; IsiZulu and Somali both of which had (2; 0.7%) cases respectively. The least represented language background was IsiXhosa which had (1; 0.3%) case in this study. This is obviously so because in the Limpopo province where this study was conducted “the principal home language is Sesotho, spoken by more than half the population, followed by Xitsonga and Tshivenda” (SAinfo reporter, 2012). IsiXhosa is spoken by almost 80% of people in the Eastern Cape (SAinfo reporter, 2012), and to some extent it is also the most common home language in the Western Cape and Gauteng. Hence, the occurrence of the language in Limpopo could be due to movements such as seasonal visits or as a result of employment opportunities.

In this category of the demographic details, there were also (8; 2.6%) cases whose files did not reveal the home language background of the patients in the ward. The next section provides a discussion of the results of patient characteristics in the evaluable sample.

The ensuing discussion of the data on patient characteristics included the following variables: Patient’s Weight, Type of Admission, Month of Admission and Length of Stay in the Hospital. Table 4.2 below presents the summary of the analysis of the data collected on these variables.
Table 4.2: Patient Characteristics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Number (n=304)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-9 Kg</td>
<td>94</td>
<td>30.9</td>
</tr>
<tr>
<td>9.1-14 Kg</td>
<td>58</td>
<td>19.1</td>
</tr>
<tr>
<td>14.1-17.5 Kg</td>
<td>30</td>
<td>9.9</td>
</tr>
<tr>
<td>17.6-35 Kg</td>
<td>32</td>
<td>10.5</td>
</tr>
<tr>
<td>35.1-55 Kg</td>
<td>7</td>
<td>2.3</td>
</tr>
<tr>
<td>Not Stated</td>
<td>83</td>
<td>27.3</td>
</tr>
<tr>
<td>Type of Admission</td>
<td></td>
<td></td>
</tr>
<tr>
<td>New Admission</td>
<td>282</td>
<td>92.8</td>
</tr>
<tr>
<td>Re-Admission</td>
<td>14</td>
<td>4.6</td>
</tr>
<tr>
<td>Information not found</td>
<td>8</td>
<td>2.6</td>
</tr>
<tr>
<td>Month of Admission</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jan 2011</td>
<td>29</td>
<td>9.5</td>
</tr>
<tr>
<td>Feb 2011</td>
<td>19</td>
<td>6.3</td>
</tr>
<tr>
<td>Mar 2011</td>
<td>27</td>
<td>8.9</td>
</tr>
<tr>
<td>Apr 2011</td>
<td>17</td>
<td>5.6</td>
</tr>
<tr>
<td>May 2011</td>
<td>28</td>
<td>9.2</td>
</tr>
<tr>
<td>Jun 2011</td>
<td>24</td>
<td>7.9</td>
</tr>
<tr>
<td>Jul 2011</td>
<td>24</td>
<td>7.9</td>
</tr>
<tr>
<td>Aug 2011</td>
<td>24</td>
<td>7.9</td>
</tr>
<tr>
<td>Sep 2011</td>
<td>30</td>
<td>9.9</td>
</tr>
<tr>
<td>Oct 2011</td>
<td>26</td>
<td>8.6</td>
</tr>
<tr>
<td>Nov 2011</td>
<td>34</td>
<td>11.2</td>
</tr>
<tr>
<td>Dec 2011</td>
<td>18</td>
<td>5.9</td>
</tr>
<tr>
<td>No Information found</td>
<td>4</td>
<td>1.3</td>
</tr>
<tr>
<td>Length of Stay in the Ward</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-5 Days</td>
<td>228</td>
<td>75.0</td>
</tr>
<tr>
<td>6-10 Days</td>
<td>52</td>
<td>17.1</td>
</tr>
<tr>
<td>11-15 Days</td>
<td>6</td>
<td>2.0</td>
</tr>
<tr>
<td>16-20 Days</td>
<td>2</td>
<td>.7</td>
</tr>
<tr>
<td>21-25 Days</td>
<td>3</td>
<td>1.0</td>
</tr>
<tr>
<td>26-30 Days</td>
<td>2</td>
<td>.7</td>
</tr>
<tr>
<td>&gt; 30 Days</td>
<td>1</td>
<td>.3</td>
</tr>
<tr>
<td>Information not found</td>
<td>10</td>
<td>3.3</td>
</tr>
</tbody>
</table>

4.1.5 Patient's Weight

Since, the PSTG does not have information of paediatric weight bands. In order to effectively deal with this variable, the patient’s weight in this study was divided into five categories adapted from the 2008 Standard Treatment Guidelines and Essential Medicines List in the Primary Health Care (PHC) (National Department of Health, 2008). As a result, the following five categories emerged: Category 1 included patients whose weight was within the range 1 – 9 Kg. Category 2 included patients
whose weight was within the range 9.1 – 14 Kg. Category 3 included patients whose weight was 14.1 – 17.5 Kg. Category 4 included patients who were 17.6 – 35 Kg. The fifth and last category was that of patients within the range 35.1 – 55 Kg. The analysis yielded the following results: There was a majority of (94; 30.9%; N = 304) patient cases who belonged to the weight category 1. (58; 19.1%) patient cases fell under weight category 2. This was followed by category 4 which had (32; 10.5%) evaluable cases. Category 3 had (30; 9.9%) cases. The fifth category had only (7; 2.3%) cases in this study. The results of the analysis showed that there was a high number of patient files (83; 27.3%) where information on weight was not found. Hence, this study indicates that a high percentage (27.3%) of patients in the paediatric ward were treated with no knowledge of their weight. Weight is an important factor in the treatment of paediatric patients (Wong, Ghaleb, Franklin, & Barber, 2004; Aina & Egbehor, 2013). There are increased opportunities for, and relatively high risk of, dosing errors in this setting. In view of this important consideration, a recent Nigerian study (Aina & Egbehor, 2013) conducted in a paediatric emergency section of tertiary hospital recommended that patient body weight should always be included as an element in all prescriptions for paediatric patients.

The next section provides a discussion of the results on the type of admission of patients who comprised the sample for this study.

4.1.6 Admission Diagnoses

In this variable, there were just two categories. Patients whose files were included in the cross-sectional study were either classified as new-admissions or re-admissions. Analysis of this variable showed that new admissions constituted the majority of admissions (282; 92.8%) whilst readmissions comprised (14; 4.6%) cases. There were also (8; 2.6%) cases where information on admission type was not found. In the next section, the study presents the distribution of patient cases according to the month of admission.

4.1.7 Month of Admission
The results of the analysis show that the number of cases in the sample for this study was fairly evenly distributed during the period under study. The monthly analysis reveal that the highest admissions were in November where there were (34; 11.2%; N = 304) patients admitted. This was followed by 30 admissions (9.9%) admitted in September. Next, followed the month of January with (29; 9.5%). The other admissions were as follows: May with (28; 9.2%) patients, March with (27; 8.9%) patients, October with (26; 8.6%) patients, followed by June, July and August with (24; 7.9%) patients admitted in each month. Then, February where there were (19; 6.3%) admissions, followed by December with (18; 5.9%) admissions. Lastly, the month which saw the least admissions was April with (17; 5.6%). The finding that admissions were highest in November is consistent with a previous study conducted in the Caribbean Island of Trinidad (Gyan, et al., 2005). Looking at the admissions according to South Africa’s four seasons, the study found that the most admissions (90; 29.6%) occurred in spring (which is, September, October, November) (See figure 4.2 which follows here below). It should be noted that this, according South Africa’s seasons is the onset of the warm period of the year which extend until the end of the summer season (February 28/9). This is consistent with (Barnett, et al., 2005) who report that in their study, admissions were higher in the warm season.

![Patient's admission per season (n = 304)](image)

Figure 4.2: Patient's admission per season (n = 304)
The next section discusses the distribution of patient cases according to their length of stay in hospital.

4.1.9 Length of Hospital Stay

A large number of patient cases (288; 75%; N = 304) were admitted in the ward for at least 1 – 5 days during the period understudy. The second largest number (52; 17.1%; N = 304) of patients were admitted for a period between 6 – 10 days. Six (6; 2.0%) patients stayed in the hospital ward for a period 11 – 15 days. There were only two (2; 0.7%) patients who stayed in the ward for 16 – 20 days. Equally, two (2; 0.7%) patients were admitted for 26 – 30 days in the ward. Three patients (3; 1%) were admitted for a period between 21 – 25 days. Only one patient (1; 0.3%) was admitted in the paediatric ward for more than 30 days.

A number of studies namely; Zwi, Pettifor and Soderlund (1999); Richardson (2002); Stephen and Berger (2003) and Rotter, et al. (2010) have looked into the length of stay in hospital amongst paediatrics. For example, Zwi, et.al. (1999) report that HIV-infected children had a longer length of stay compared to HIV-negative and untested children. Further, Richardson (2002) established in a study conducted in Canberra Hospital, Australia that the length of stay was longer in patients across a wide range of diagnoses although the trend reached significance only for respiratory and renal diagnosis. The results from this study point to several cases where the length of stay in the ward was longer, exposing most of the admitted patients to more than the minimum period of antibiotic use.

In the cases were the paediatric patients had a lengthy period in the hospital, patients had multiple diagnoses. For example, there was a patient who was in the ward for 22 days treated for jaundice (ICD10 Code - R17.0) and acute abdomen (R10.0), another patient who stayed for 24 days treated for gastro-enteritis (A09); malnutrition (E45); URTI (J06.9); and poisoning of unspecified substance (T65.9). Another patient was in the ward for 27 days being treated for pulmonary TB (A15.0); bronchopneumonia (J18.0), HIV (B24) and protein energy malnutrition (E43). One patient stayed for 29 days being treated for midshaft femur fracture (S52.20). The patient with the longest period in the ward stayed for 38 days being treated for burns.
These findings are consistent with both the observations of Zwi, et al. (1999) and that of Richardson (2002) reflected in the preceding paragraph above. The next section presents the findings and discussion on the prevalence of antibiotic use in the paediatric ward.

4.2 PREVALENCE OF ANTIBIOTIC USE IN THE PAEDIATRIC WARD

This section presents the results of the analysis which was conducted to determine the prevalence of antibiotics in the paediatric ward. A summary of the analysis of the data for this objective is first presented in Table 4.3 which follows next.

Table 4.3: Antibiotic Prescriptions

<table>
<thead>
<tr>
<th>Variable</th>
<th>Number (N=304)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Antibiotic Prescription</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>255</td>
<td>83.9</td>
</tr>
<tr>
<td>No</td>
<td>44</td>
<td>14.5</td>
</tr>
<tr>
<td>Information not found</td>
<td>5</td>
<td>1.6</td>
</tr>
<tr>
<td><strong>Number of Antibiotics prescribed during admission</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No Antibiotic Prescribed</td>
<td>39</td>
<td>12.8</td>
</tr>
<tr>
<td>One Antibiotic</td>
<td>70</td>
<td>23.0</td>
</tr>
<tr>
<td>Two Antibiotics</td>
<td>96</td>
<td>31.6</td>
</tr>
<tr>
<td>Three Antibiotics</td>
<td>53</td>
<td>17.4</td>
</tr>
<tr>
<td>Four Antibiotics</td>
<td>22</td>
<td>7.2</td>
</tr>
<tr>
<td>Five Antibiotics</td>
<td>8</td>
<td>2.6</td>
</tr>
<tr>
<td>Information not found</td>
<td>10</td>
<td>3.3</td>
</tr>
<tr>
<td>Six Antibiotics</td>
<td>1</td>
<td>.3</td>
</tr>
<tr>
<td>Seven Antibiotics</td>
<td>4</td>
<td>1.3</td>
</tr>
<tr>
<td>Eight Antibiotics</td>
<td>1</td>
<td>.3</td>
</tr>
</tbody>
</table>

In total, 1159 drugs were prescribed during the patients’ admission period. Out of all drugs prescribed, 585 were antibiotics. Therefore, it was observed that antibiotics made about 50.5% of the total drugs prescribed in this cross-sectional study. Some of the drugs which were prescribed were analgesics (15.19%), Vitamins (11.8%), anti-inflammatory drugs (2%), and others, (20.1%). Antibiotics were the highest (50.5%) prescribed drugs in this census study. Hence, antibiotic use and the number of antibiotics prescribed are explained through the following pie charts labelled Figures 4.3 and 4.4 respectively. Figure 4.3 which follow next, illustrates the percentages of cases which received antibiotics (Yes) and those which did not receive antibiotics (No).
Figure 4.3: Antibiotic Prescriptions

From the above Figure 4.3, it can be deduced that the majority of patients (255; 83.9%; N = 304) in the cases evaluated for this study received antibiotics. Less than a quarter of the evaluable cases (44; 14.5%) did not receive any antibiotic during their period of admission in the ward. A negligible percentage (5; 1.6%) of files of the evaluable cases did not show whether or not the patients received any antibiotics during their stay in the paediatric ward. Next, from those that received antibiotics (n=255) the study sought to establish the number of antibiotics per case. Figure 4.4 below presents the results of this evaluation.

Figure 4.4: Distribution of patients according to number of antibiotics prescribed
From the total number of cases which received antibiotics (N=255), the majority of the patient cases (96; 32%; n = 255) received two antibiotics during their admission in the ward as they were switched from one treatment to another. This was followed by (70; 23 %; n = 255) of patients who received only one antibiotic; 18 % (53; 18%; n = 255) of patients received three antibiotics. Then, there were 7 % of the patients (22; 7 %; n = 255) who received four antibiotics during their admission, 3 % had received five antibiotics (8; 3%); a minute number (4; 1.3%) of these patients received seven antibiotics, Eight antibiotics (1; 0.3%) and six antibiotics (1; 0.3%) were respectively prescribed to one patient.

A number of previous studies in this field have indicated the number of antibiotic treatment given to patients. For example, Wiström, et al. (2001) conducted a study on the frequency of antibiotic-associated diarrhoea in 2462 antibiotic-treated hospitalised patients. On the other hand, Mollahaliloglu, Alkan, Donertas, Ozgulcu and Akici (2013) conducted a study which was aimed to investigate the utilisation of antibiotics at various health care facilities. The study indicates that 1250 prescriptions contained antibiotics. Further, Katende-Kyenda, Lubbe, Serfontein andTruter (2007) indicate the number of antibiotic treatment given to patients in a group of private primary health care in South Africa. In all the cited studies it was observed that the high number of antibiotics prescribed, in most cases were neither necessary nor appropriate. In the present study, most patients were prescribed up to six drugs per prescription. Such a number is larger than the optimal WHO figure of two drugs per patient encounter (Ibrahim & El-Sharif, 2012).

The South African report on antibiotic stewardship in the hospital environment (Best Care Always, 2011) revealed that prescribing more than three microbial agents at a time amounts to inappropriate agent combinations and subsequently inappropriate antibiotic use. To this Leekha, Terrell and Edson (2011) concurred that although single-agent antimicrobial therapy is generally preferred, a combination of two or more antimicrobial agents is recommended in a few scenarios. This view is also supported by Stocker, Ferrao, Banya, Cheong, Macrae and Furck (2012) who recommend that antibiotic surveillance on hospitalised new-borns, infants and children is mandatory to optimise antibiotic therapy and to prevent antimicrobial resistance.
Thereafter, the study sought to establish the most commonly prescribed antibiotics. Table 4.4 and Figure 4.5 which follow provide summaries of the results of the analysis of the data on the most commonly prescribed antibiotics in all the cases which were evaluable.

Table 4.4: Most commonly prescribed antibiotics

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>ATC Classification</th>
<th>Number (N = 255)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ampicillin</td>
<td>Penicillins with extended spectrum</td>
<td>165</td>
</tr>
<tr>
<td>Gentamicin</td>
<td>Aminoglycoside antibacterials</td>
<td>121</td>
</tr>
<tr>
<td>Ceftriaxone</td>
<td>3rd Generation cephalosporins</td>
<td>56</td>
</tr>
<tr>
<td>Co-Trimoxazole</td>
<td>Sulphonamides and Trimethoprim</td>
<td>45</td>
</tr>
<tr>
<td>Amoxicillin</td>
<td>Penicillins with extended spectrum</td>
<td>38</td>
</tr>
<tr>
<td>Metronidazole</td>
<td>Antiprotozoal</td>
<td>37</td>
</tr>
<tr>
<td>Cloxacillin</td>
<td>Beta-lactamase resistant penicillin</td>
<td>24</td>
</tr>
<tr>
<td>Quinine</td>
<td>Antimalarial</td>
<td>13</td>
</tr>
<tr>
<td>Co-Amoxiclav</td>
<td>Combination of Penicillins including β-Lactamase inhibitors</td>
<td>11</td>
</tr>
<tr>
<td>Pen G</td>
<td>Penicillins with extended spectrum</td>
<td>8</td>
</tr>
</tbody>
</table>

Table 4.4 shows the distribution of the antibiotic type, ATC classification and a number of the ten most frequently prescribed antibiotics in the cases that presented in the paediatric ward and analysed in this study. The antibiotics are listed according from the most to the least commonly prescribed. The overall indication of the most commonly prescribed antibiotics is illustrated graphically in Figure 4.5 which is presented hereunder.
The most commonly prescribed antibiotics were discovered to be ampicillin, gentamicin, ceftriaxone, co-trimoxazole, amoxicillin, metronidazole, cloxacillin, quinine, co-amoxiclav and penicillin G. Of all the patients who received antibiotics, the majority (165; 64.7 %; n=255) received ampicillin. Overall the second highest number of patients (121; 47.4 %; n=255) received gentamicin. This was followed by those (56; 21.9 %; n=255) who received ceftriaxone, co-trimoxazole (45; 17.6 %; n=255), amoxicillin (38; 14.9 %; n=255), metronidazole (37; 14.5 %; n=255), cloxacillin (24; 9.4 %; n=255), quinine (13; 5.0 %; n=255), co-amoxiclav (11; 4.3 %; n=255) and penicillin G (8; 3.1 %; n=255).

Similar studies conducted in South Africa and Egypt recently (for example, Katende-Kyenda, et al., 2007 and Ibrahim & El-Sharif, 2012) found that amoxicillin was the most frequently prescribed antibiotic in the treatment of diseases. On the contrary, in this study ampicillin was found to be the most often prescribed antibiotic for most diagnosed conditions. However, elsewhere in Croatia (Vojvodić, 2010) amoxicillin, co-amoxiclav and co-trimoxazole as the most commonly prescribed antibiotics. On the other hand, (Baktygul, Marat, Ashirali, Harun-Or-rashid, & Sakamoto, 2011) reported that penicillin G, gentamicin and metronidazole where the most commonly used antibiotics. Similar to the studies cited above, in this study gentamicin, co-
trimoxazole, amoxicillin, metronidazole, co-amoxiclav and penicillin G were most commonly prescribed in the ward.

Another objective concerning for this study was to identify the most common conditions for which antibiotics were prescribed in the paediatric ward. The next section presents the results of this investigation.

4.3 COMMON CONDITIONS FOR WHICH ANTIBIOTICS WERE PRESCRIBED

The data collected in this study revealed that most patients were diagnosed with at least one (1) condition during their admission in the paediatric ward. Although, some of the patients within the study sample were diagnosed with up to four conditions. The results of the analysis presented in Figure 4.6 below show that, from the sample (n=304) a total of (295; 97%) patients were diagnosed with only one condition. No information was found regarding diagnosis in some (9; 3%) cases.

![Figure 4.6: Distribution of patients according to number of diagnosed conditions](image)

Within the group of patients who had only one diagnosis, a further group of patients (88; 29%; n = 295) had a second concomitant condition diagnosed, whereas some (24; 8%; n = 295) had a third concomitant diagnosis and others (7; 2%; n = 295) had a fourth condition diagnosed. Table 4.5 which follow below presents the distribution of diagnosed conditions in all four categories.

38
Table 4.5: Distribution of the most commonly diagnosed conditions

<table>
<thead>
<tr>
<th>Patients with one Diagnosis</th>
<th>Patients with two Diagnoses</th>
<th>Patients with three Diagnoses</th>
<th>Patients with four Diagnoses</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Disease</strong></td>
<td><strong>ICD10</strong></td>
<td><strong>Number</strong></td>
<td><strong>Percent</strong></td>
</tr>
<tr>
<td>Diarrhoea</td>
<td>A09</td>
<td>63</td>
<td>20.8</td>
</tr>
<tr>
<td>BPN</td>
<td>J18.0</td>
<td>38</td>
<td>12.5</td>
</tr>
<tr>
<td>Poisoning</td>
<td>T65.9</td>
<td>19</td>
<td>6.3</td>
</tr>
<tr>
<td>LRTI</td>
<td>J22</td>
<td>17</td>
<td>5.6</td>
</tr>
<tr>
<td>Febrile Convulsions</td>
<td>R56.0</td>
<td>15</td>
<td>4.9</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>J18.9</td>
<td>14</td>
<td>4.6</td>
</tr>
<tr>
<td>Adeno-tonsillectomy</td>
<td>J35.3</td>
<td>8</td>
<td>2.6</td>
</tr>
<tr>
<td>Burns</td>
<td>M61.30</td>
<td>8</td>
<td>2.6</td>
</tr>
<tr>
<td>URTI</td>
<td>J06.9</td>
<td>8</td>
<td>2.6</td>
</tr>
<tr>
<td>Bronchiolitis</td>
<td>J21.9</td>
<td>6</td>
<td>2.0</td>
</tr>
<tr>
<td>Others</td>
<td>99</td>
<td>32.6</td>
<td></td>
</tr>
<tr>
<td>Lodger</td>
<td>2</td>
<td>0.7</td>
<td></td>
</tr>
<tr>
<td>INF</td>
<td>7</td>
<td>2.3</td>
<td></td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>304</strong></td>
<td><strong>100</strong></td>
<td></td>
</tr>
</tbody>
</table>
All in all, the analysis in the study revealed that, in total, there were 65 diagnosed conditions in this cross-sectional study. The preceding Table 4.5 presents the distribution of the most commonly diagnosed conditions in the paediatric ward. In line with the categories already established and presented in Figure 4.6 the diagnosed conditions are categorised into four classes, namely; Patients with one diagnosis, Patients with two diagnosis, etc. For each and every category presented, the ten most commonly diagnosed conditions are presented.

The analysis revealed that in all cases diagnosed, diarrhoea was the most commonly diagnosed - occurring (63; 20.8 %; n = 295). The other conditions which dominated diagnosis 1 within the sample admitted in the ward are broncho-pulmonary pneumonia (BPN) (38;12.5 %; n = 295), poisoning (19; 6.3 %; n = 295), lower respiratory tract infections (LRTI) (17; 5.6 %; n = 295), febrile convulsions (15; 4.9 %; n = 295), pneumonia (14; 4.6 %; n = 295), adeno-tonsillectomy (8; 2.6 %; n = 295), burns (8; 2.6 %; n = 295), upper respiratory tract infections (URTI) (8; 2.6 %; n = 295) and bronchiolitis (6; 2.0 %; n = 295).

The other patients (99; 32.6 %; n = 295), in the sample where diagnosed with several conditions which occurred minimally. A further group (2; 0.7 %; n = 295) of patients in the sample were lodgers, hence their prescribed treatment was not for consideration in this study. There was also those (7; 2.3 %; n = 295) whose information regarding the diagnosed condition could not be found in the file.

In addition to the conditions already identified, diagnosis 2 revealed the following as the most commonly diagnosed conditions in this category: dehydration (16; 5.3 %; n = 295), pulmonary TB (8; 2.6 %; n = 295), and malnutrition (4; 0.3%; n = 295).

In the category diagnosis 3 additional conditions were as follows: HIV (4; 1.3%), diabetes mellitus (3; 1.0%; n = 295), protein energy malnutrition (PEM) (2; 0.7%; n = 295) and Pneumocystis jirovecii pneumonia (PCP) (1; 0.3%; n = 295). Whereas oral thrush was noticed as one of the most occurring (1; 0.3 %; n = 295) in diagnosis 4.

Rotavirus diarrhoeal disease ranks among the top three killers of paediatric patients in the developing world (Chavan, Agarkhedkar, Chavan, Nagdawane, & Singhania, 2013). For example, it has been reported that in Kenya rotavirus diarrhoea
accounted for the majority of hospitalisations for most paediatric patients (Tomheim, Manya, Oyando, Kabaka, O’Reilly, Breiman, & Feikin, 2010). Although in this study it was not confirmed whether or not cases of diarrhoea resulted from such infections due to absence laboratory tests and culture results, the researcher also reported that diarrhoea was responsible for most of the hospitalisations of patients in the paediatric ward during the study period. Hence, it is no surprise that this study also found diarrhoea at the top of the most commonly diagnosed conditions.

The next Figure 4.7 illustrates a summary of the ten most commonly occurring conditions in the sample.

![Figure 4.7: Most common conditions for which antibiotics were prescribed](image)

Figure 4.7 shows that, all in all diarrhoea was the most common condition for which antibiotics were prescribed in the ward (78; 26.4 %; n = 295). This was followed by BPN which occurred (43; 14.5%; n = 295) times, dehydration (26; 8.8 %; n = 295) times, LRTI (25; 8.4 %; n = 295) occurrences, pneumonia (24; 8.1 %; n = 295) times, poisoning (21; 7.1 %; n = 295) times, febrile convulsions (20; 6.7 %; n = 295) times, URTI (17; 5.7 %; n = 295) times, malnutrition (11; 3.7 %; n = 295) times, as well as
pulmonary TB which occurred (11; 3.7 %; n = 295) times. Section 4.5 which follows below discusses the factors related to antibiotic prescribing patterns in the study.

4.4 FACTORS RELATED TO ANTIBIOTIC PRESCRIBING PATTERNS

In this study, the factors related to antibiotic prescribing patterns needed to be identified in order to establish and discuss rational or irrational antibiotic prescribing in the hospital paediatric ward. Studies have revealed a number of factors that need to be considered when prescribing antibiotic treatment. For example Leekha, et al. (2011) discussed the general principles of antimicrobial therapy. Zolaly and Hanafi (2011) reveal that parents are a major factor in the prescription of antibiotics in general paediatric clinics. They add that the use of antibiotics is also determined by physicians’ experience, mothers’ educational level and work status. Another study by Struelens (1998), points to the prescribers awareness of the most likely infective agent as well as being aware of prevailing susceptibility patterns (Struelens, 1998).

Similarly, in the analysis conducted for this study there emerged several factors. The most notable of these factors were knowledge of the infective organism, sensitivity or culture results as well as the type of antibiotic treatment for given conditions. These factors are similar to those recommended by Essack, et al. (2011) as well as (Quintana, Deniz, Ortega, Ramírez, Pita, & Castro, 2007). Figure 4.8 below provide a summary of the factors which were related to the antibiotic prescribing patterns.
Figure 4.8 above provides a summary of the analysis of the factors related to antibiotic prescribing patterns. With regard to these factors, the study sought to establish whether or not the health workers prescribing patterns were related to the knowledge of the infective organism upon the patients presentation of the prescribed conditions. Second, it sought to establish if treatment was prescribed based on sensitivity or culture results. Third, it sought to establish the type of antibiotic treatment. The figure therefore shows that in some cases there was ‘no sign of infection’ as the conditions on admission were those that were not related to infections (for example; jaundice, poisoning, and snake bite). Hence such patients did not receive antibiotics. As in previous cases where data are presented in this study – INF means that ‘No information was found’ from the patient’s file during the data collection.

4.4.1 Infective organism known

As already indicated, after establishing the most common conditions for which antibiotics were prescribed, the study sought to also investigate if treatment was prescribed based on the knowledge of the infective organism. The result for this analysis as Figure 4.8 above shows, is that, with regard to the infective organism, in most of the conditions for which antibiotics were prescribed (243; 79.9 %; n = 255),
there was no evidence of the infective organism – meaning that the patient admission files did not have any evidence of lab tests to determine the nature of the infection. This then means that antibiotic treatment was prescribed without the confirmation of infective organism by means of laboratory results. Only in a few cases (27; 8.9%; n = 255) did health practitioners indicate the causative infective organism. In addition, some cases (19; 6.3%; n = 255) revealed that patients did not receive antibiotics because there was ‘no sign of infection’ upon admission. Out of the total number of cases considered (N = 255), only in a minimal (15; 4.9%) patient cases was the information about this category not found – meaning that the patient file did not have any information at all.

Next, the study sought to establish if antibiotic prescriptions followed the availability of sensitivity or culture results.

4.4.2 Sensitivity or culture results

The options for analysis in this item were ‘yes’ or ‘no’ meaning yes or no sensitivity or culture results provided. The results of the analysis summarised in Figure 4.8 show that on the one hand, only in a few (21; 6.9%) cases was the prescribing of antibiotics related to interpretation of sensitivity or culture results. On the other hand, the prescribing of antibiotics was not related to the interpretation of sensitivity or culture results as the results show that in some (37; 12.2%) cases there was no consideration for this. In most (212; 69.7%) of the cases laboratory tests were not requested at all. With regards to this variable there were some cases (17; 5.6%) which were found indicating that patients did not receive antibiotics because there was no sign of infection upon admission. This means that, a majority (69.7%) of the patients in the sample received antibiotic prescriptions during their period of admission to the ward with no interpretation of sensitivity or culture tests.

4.4.3 Type of antibiotic treatment

There were three types of antibiotic treatment to consider for each and every prescription, empiric, prophylactic or specific purposes. In Figure 4.8 above, the results of the analysis are presented. The figure indicates that most indications (201;
66.1%) for antibiotic prescriptions were empiric. In some cases, the treatment was specific (56; 18.4%), and prophylactic (8; 2.6%). Only in a few cases (19; 6.3%) was the question respectively not applicable to the patients. In some cases and (20; 6.6%) information of treatment was not found in the patient’s files. This shows that, in this study most antibiotic prescriptions were based on clinical presentation of infections, and did not depend on culture results. Only a small percentage (about 18%) of the study sample received antibiotic treatment based on culture results. Khan, Shehzad, Shehzad and Al-Suhaimi (2013) have demonstrated that prescribing antibiotics based on patients clinical presentation accounts for approximately 60 % of irrational antibiotic use.

In a similar study, Leekha, et al. (2011) pointed out that one of the most important considerations when prescribing antibiotic therapy include obtaining an accurate diagnosis of infection; understanding the difference between empiric, prophylactic and specific therapy. Next, the study sought to analyse data on the most commonly prescribed antibiotic classes.

4.5 CLASSES OF MOST COMMONLY PRESCRIBED ANTIBIOTICS

In this study, the classes of the most commonly prescribed antibiotics were ranked from the most frequently prescribed to the least frequently prescribed. As already indicated in Section 4.2, a total of 585 antibiotics were prescribed in this study. When the analysis was conducted in accordance with antibiotic classes, it emerged that a total of 19 antibiotic classes were prescribed in this study. Figure 4.9 below present the data summary of the ten antibiotic classes which were most commonly prescribed.
Figure 4.9: Illustration of the most commonly prescribed ATC Classes

From Figure 4.9 above, it is evident that the most frequently prescribed antibiotic class was penicillins with extended spectrum (213; 36 %; n = 585). More specifically, these were ampicillin, amoxicillin and PenG. This was followed by aminoglycosides (125; 21.3 %; n = 585) for example, gentamicin. Next was 3rd generation cephalosporins (61; 10.4 %; n = 585) such as example ceftriaxone. This was followed by antiprotozoals (47; 8.0 %; n = 585), for example metronidazole. Then it was sulphonamides & trimethoprim (45; 7.6 %; n = 585) for example co-trimoxazole. This preceded beta-lactamase resistant penicillins (25; 4.2 %; n = 585) such as flucloxacillin, which was followed by drugs for TB treatment (21; 3.5 %; n = 585) such as RHZ (that is; a combination of rifampicin, isoniazid, and pyrazinamide) and RH (that is; a combination of rifampicin, isoniazid). The least prescribed antibiotic classes included antimalarials (15; 2.5%; n = 585) such as quinine and doxycycline. This was followed by direct acting antivirals (13; 2.2%; n = 585), which for example include drugs such as acyclovir & ART drugs. Then the combination of penicillins including β-lactamase inhibitor (11; 1.8 %; n = 585) such as for example co-amoxiclav.
In a study conducted by Ibrahim and El-Sharif (2012) penicillins were the most commonly prescribed antibiotic class with amoxicillin as the most commonly prescribed of all. Similarly, in the current study, penicillins were the most commonly prescribed antibiotic class with ampicillin being the most commonly prescribed in the group. Further, Mollahaliloglu, et al. (2013) reported that penicillins and macrolides were commonly used antibiotics for paediatric patients as most doctors prescribed penicillins followed by macrolides. The next section provides the results of the comparison of the antibiotic prescribing patterns with the PSTG.

4.6 COMPARISON OF ANTIBIOTIC PRESCRIBING PATTERNS WITH PSTG

4.6.1 Adherence to Guidelines

As stated in Section 4.3, some patients in the study sample were diagnosed with more than one condition during their period of admission in the ward. Hence, even the antibiotic prescriptions they received depended upon the condition(s) treated for each and every patient. In all the patient cases evaluated for this study, the patients prescriptions ranged from between one to a maximum of six items prescribed. This was guided by two considerations: (1.) that the study was a census. (2.) that antibiotic prescribing patterns also includes not prescribing antibiotics (Burnett, 2012). So, the study did not only concentrate on prescribed antibiotics but all prescribed treatment during the admission period. For example, six items prescribed might mean five antibiotics and a vitamin supplement or three antibiotics, an analgesic and a vitamin supplement prescribed. Hence Table 4.6 below refers to treatment 1 to 6. In all the cases where treatment was administered, the guiding question was: ‘Is the treatment according to the PSTG?”. Patients with more than one infection, the prescribed antibiotic(s) was analysed looking at the treatment guidelines for all the diagnosed conditions with consideration of the spectrum of drug activity in all treatment prescribed. Table 4.6 below provides a summary of the comparison of the antibiotic prescribing patterns according to PSTG.
Table 4.6: Comparison of antibiotic prescribing according to PSTG

<table>
<thead>
<tr>
<th>Treatment 1 per Guideline?</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>210</td>
<td>69.1</td>
</tr>
<tr>
<td>No</td>
<td>75</td>
<td>24.7</td>
</tr>
<tr>
<td>Information not found from patient file</td>
<td>19</td>
<td>6.3</td>
</tr>
<tr>
<td>Total</td>
<td>304</td>
<td>100.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Treatment 2 per Guideline?</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>209</td>
<td>68.8</td>
</tr>
<tr>
<td>No</td>
<td>52</td>
<td>17.1</td>
</tr>
<tr>
<td>No treatment 2 prescribed</td>
<td>26</td>
<td>8.6</td>
</tr>
<tr>
<td>Information not found from patient file</td>
<td>17</td>
<td>5.6</td>
</tr>
<tr>
<td>Total</td>
<td>304</td>
<td>100.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Treatment 3 per Guideline?</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>179</td>
<td>58.9</td>
</tr>
<tr>
<td>No</td>
<td>48</td>
<td>15.8</td>
</tr>
<tr>
<td>No treatment 3 prescribed</td>
<td>60</td>
<td>19.7</td>
</tr>
<tr>
<td>Information not found from patient file</td>
<td>17</td>
<td>5.6</td>
</tr>
<tr>
<td>Total</td>
<td>304</td>
<td>100.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Treatment 4 per Guideline?</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>136</td>
<td>44.7</td>
</tr>
<tr>
<td>No</td>
<td>34</td>
<td>11.2</td>
</tr>
<tr>
<td>No treatment 4 prescribed</td>
<td>117</td>
<td>38.5</td>
</tr>
<tr>
<td>Information not found from patient file</td>
<td>17</td>
<td>5.6</td>
</tr>
<tr>
<td>Total</td>
<td>304</td>
<td>100.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Treatment 5 per Guideline?</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>106</td>
<td>34.9</td>
</tr>
<tr>
<td>No</td>
<td>20</td>
<td>6.6</td>
</tr>
<tr>
<td>No treatment 5 prescribed</td>
<td>161</td>
<td>53.0</td>
</tr>
<tr>
<td>Information not found from patient file</td>
<td>17</td>
<td>5.6</td>
</tr>
<tr>
<td>Total</td>
<td>304</td>
<td>100.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Treatment 6 per Guideline?</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>71</td>
<td>23.4</td>
</tr>
<tr>
<td>No</td>
<td>15</td>
<td>4.9</td>
</tr>
<tr>
<td>No treatment 6 prescribed</td>
<td>201</td>
<td>66.1</td>
</tr>
<tr>
<td>Information not found from patient file</td>
<td>17</td>
<td>5.6</td>
</tr>
<tr>
<td>Total</td>
<td>304</td>
<td>100.0</td>
</tr>
</tbody>
</table>
From the Table 4.6 above, **Yes** indicates the cases where prescribed treatment was according to PSTG, **No** means that treatment was not according to the PSTG, **Information not found** means that the patient files did not have treatment information, **No treatment prescribed** as reflected under the categories on treatment 2, 3, 4, 5 and 6 means that the particular number of patients did not have a successive treatment prescribed. Hence, from Table 4.6 above, it can be deduced that in a large number of cases, treatment was in accordance with the PSTG (2006). This is shown in the number of occasions where the choice of antibiotic is said to have been in accordance with the PSTG. For example, Table 4.6 indicates that in the majority of cases (210; 69.1%) antibiotic treatment 1 was found to be according to guidelines. This was also the case with treatments 2 (209; 68.8%), 3 (179; 58.9%), 4 (136; 44.7%), 5 (106; 34.9%), and 6 (71; 23.4%).

However, there were some cases where prescription patterns did not adhere to the PSTG. A number (75; 24.7%) of antibiotic prescriptions in the treatment of patients with one condition did not adhere to the PSTG. This was also true for a number of antibiotic treatment prescriptions in the treatment of the various conditions with treatment 2 (52; 17.1%), treatment 3 (48; 15.8%), treatment 4 (34; 11.2%), treatment 5 (20; 6.6%), and treatment 6 (15; 4.9%).

A further investigation of the cases from which there was no adherence to the PSTG revealed a number areas in which some notable irrational prescribing was observed. These were identified and categorised into four categories, namely; treatment overdose, inappropriate antibiotic choice, inappropriate administration of antibiotic, inappropriate dosing frequency, and treatment under dose. The observed medication errors are presented in table 4.7 and discussed in the section which follows below.
Table 4.7: Observed areas of irrational antibiotic prescribing

<table>
<thead>
<tr>
<th>Variable</th>
<th>Number (n = 54)</th>
<th>Variable</th>
<th>Number (n = 15)</th>
<th>Variable</th>
<th>Number (n = 28)</th>
<th>Variable</th>
<th>Number (n = 56)</th>
<th>Variable</th>
<th>Number (n = 108)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antiprotozoals</td>
<td>1</td>
<td>Antibiotic used for viral infection</td>
<td>1</td>
<td>Concurrent oral &amp; Parenteral</td>
<td>1</td>
<td>Daily dosing frequency needed</td>
<td>12</td>
<td>Antiprotozoals</td>
<td>2</td>
</tr>
<tr>
<td>Cephalosporins</td>
<td>9</td>
<td>Clindamycin use needed</td>
<td>1</td>
<td>Dose(s) skip in ward</td>
<td>11</td>
<td>Loading dose needed 1st</td>
<td>4</td>
<td>Cephalosporins</td>
<td>12</td>
</tr>
<tr>
<td>Macrolides</td>
<td>2</td>
<td>Antibiotic used for a condition which required the use of diazepam &amp; lorazepam</td>
<td>1</td>
<td>Long treatment duration</td>
<td>4</td>
<td>Wrong dosing frequency</td>
<td>40</td>
<td>Aminoglycoside</td>
<td>73</td>
</tr>
<tr>
<td>Aminoglycoside</td>
<td>25</td>
<td>Pen &amp; aminoglycosides synergy needed</td>
<td>11</td>
<td>Strength of drug not stated</td>
<td>12</td>
<td>Penicillin</td>
<td>18</td>
<td>Penicillin</td>
<td>18</td>
</tr>
<tr>
<td>Penicillin</td>
<td>17</td>
<td>PenG use needed</td>
<td>1</td>
<td></td>
<td></td>
<td>Sulphonamides</td>
<td>3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4.6.2 Medication Errors

In this category of the analysis, the researcher looked into a number of medication errors resulting from irrational prescribing in the paediatric ward. As Table 4.7 shows, from the analysis of this study, the following medication errors were resultant from the observed irrational prescribing: Overdosing, inappropriate choice of antibiotics, wrong administration of antibiotic treatment, inappropriate dosing frequency and treatment undosage.

4.6.2.1 Overdosing of antibiotic treatment

The PSTG provides guidelines for the appropriate dosing of drugs including antibiotics for all conditions. In most cases, the patient’s weight is a key factor in the determination of the correct dose of treatment (Miller, Johnson, Harrison, & Hagemann, 2010). In order to determine if prescribed antibiotic treatment adhered to the recommended dose for each and every evaluable case in this study, all prescriptions were evaluated against the PSTG. Similar to the study by Miller, et al. (2010), in this study, an overdose was defined as: the total mg/kg/day or mg/kg/dose greater than or equal to 110% of the maximum recommended paediatric dose and or greater than the recommended number of doses per day. The results of the analysis indicate that, of all the prescribed antibiotics in the paediatric ward, aminoglycosides were the drug class in which dosages were most frequently overdosed (25; 46.2 %; N = 54). This was followed by penicillins (17; 31.4 %; n = 54), then cephalosporins (9; 16.6 %; n = 54) macrolides (2; 3.7 %; n = 54) and antiprotozoals (1; 1.8 %; n = 54). According to Best, Gazarian, Cohn, Wilkinson and Palasanthiran (2011) although aminoglycosides are widely used antibiotics for Gram-negative infections, they are associated with potential for nephrotoxicity and ototoxicity. Hence, Benedik and Wendler (2014) warn that therapy in cases of an overdose of aminoglycoside can be complex and potentially dangerous.

4.6.2.2 Underdosing of antibiotic treatment

Similar to the category where antibiotics were overdosed, an underdose was defined as: the total mg/kg/day or mg/kg/dose less than or equal to 90% of the minimum recommended pediatric dose, or fewer than the recommended number of doses per
Aminoglycosides were found to be at the top of the list (73; 68%; n = 108) when it came to cases of antibiotic under dosing. These cases were seen to be prevalent mostly in instances where the weight of the patient was not stated. To determine the appropriateness of dosing in this category of patients, the researcher was aided by the National Department of Health’s Primary Health Care: Standard Treatment Guidelines and Essential Medicines List (2008) which provides tables from which the ideal weight of a patient can be determined if age is known and vice versa. So, for the patients whose files did not show age, the records on age were used to determine the ideal weight and compare that with what treatment guidelines prescribe is the appropriate dosage for that particular weight/age range. The other antibiotics which were similarly under dosed were penicillin (18; 16.6%; n = 108) and cephalosporin’s (12; 11.1%; n = 108). Also in this category were sulphonamides (3; 2.7%; n = 108) and antiprotozoals (2; 1.8%; n = 108).

According to Halczli (2013) under dosing of antibiotics can contribute to poor treatment outcomes. In general, medication under dosing occurs when a health practitioner fails to prescribe and optimise medication dosing regimens based on indication and patient-specific characteristics. One common example of under dosing is when an inadequate weight-based dose is given due to an inaccurate or outdated weight in the medical record. This can be particularly problematic for paediatric patients. Under dosing may also occur when healthcare providers lower a dosage to minimize adverse effects but do not appreciate the consequences of sub-therapeutic dosing and potential loss of efficacy.

4.6.2.3 Inappropriate choice of antibiotic

As earlier indicated in section 2.1, the appropriateness of the antibiotic prescriptions was determined against the standards prescribed by the PSTG. Hence, in this category, it was found that some prescriptions involved the use of wrong antibiotics in treating certain conditions. For example, in a total of (n = 15) cases, it was found that antibiotics such as ceftriaxone and ampicillin synergy were used (11 times; 73.3%; n = 15) in cases where penicillin and aminoglycoside synergy were needed. In other cases, although very minimal, wrong antibiotics were prescribed in the treatment of conditions such as pneumonia where ampicillin and gentamicin synergy was combined with metronidazole instead of penicillin G (1; 6.6%; n = 15), and
doxycycline was used (1; 6.6%; n = 15), for the treatment of malaria in children under the age of eight years instead of the recommended antibiotic clindamycin. In another case, antibiotic therapy was used (1; 6.6%; n = 15) to treat chicken pox, a viral infection. This is despite the fact that there are clear PSTG guidelines on the use of this antibiotic, namely; that “doxycycline should be used with extreme caution in children younger than 10 years old who have diarrhoea or an infection of the stomach or bowel, and most importantly that doxycycline should not be used in children younger than 8 years old as permanent yellow-grey-brown tooth discoloration may occur” (Drugs.com, 2014). There was also a case where an antibiotic was used to treat a viral infection witnessed with the use of ampicillin and ceftriaxone in the treatment of chicken pox. The findings in this study are similar to Kotwani and Holloway’s (2014) which clearly shows inappropriate choice of antibiotics for the treatment of acute, uncomplicated RTIs which are mainly due to a virus and do not require antibiotic treatment

4.6.2.4 Inappropriate administration of antibiotic treatment

In terms of the administration of the prescribed antibiotic treatment, in a number of cases where there was no adherence to the PSTG, Inappropriate administration of antibiotic treatment was also observed during the analysis. For example, the four most frequent areas of non-compliance included: not stating the strength of the antibiotic treatment (12; 42.8%; n =28); skipping doses during the patient’s stay in the ward (11; 39.2 %; n =28) as shown by the absence of a health professional’s signature on the spaces provided in the treatment chart. This error was also observed in Manias, Kinney, Cranswick and Williams (2014) where the most common types of medication errors included dose omission. There were also cases where there was a long duration of treatment (4; 14.2%; n = 28), as well as concurrent oral and parenteral administration of treatment (1; 3.5%; n = 28). The latter was beheld with the concurrent administration of ampicillin and amoxicillin. Thus Manias, Kinney, Cranswick and Williams (2014) attributes the most common cause of inappropriate administration of antibiotic treatment to misreading or not reading medication orders.
4.6.2.5 Inappropriate dosing frequency

All in all, there was a substantial number (40; 71.4%; n = 56) of cases of inappropriate dosing frequency in the sample of patients in this study. A number of cases were found to have not adhered to the PSTG’s recommendation for daily dosing frequency observed with cases wherein gentamicin was prescribed for use three times daily (Tds) instead of a once daily dose according to guidelines. In other findings, it was revealed that four cases (4; 7.1%; n = 56) the PSTG which recommends that a loading dose be administered first was ignored. These four cases included for example, twice the use of quinine, doxycycline and artemether/lumefantrine (coartem) in the treatment of malaria which according to the PSTG a loading dose should be given first and thereafter followed up with a maintenance dose.

With regards to dosing frequency, Harbarth, Samore, Lichtenberg, and Carmeli (2000) indicate that prolonged antibiotic exposure has a direct effect on antimicrobial resistance. For example, the emergence of resistant bacterial strains during β-lactam therapy is associated with the intensity of β-lactam use and with prolonged antibiotic exposure (Harbarth, Samore, Lichtenberg, & Carmeli, 2000).

4.7 MEASURE OF ASSOCIATION

In order to identify the most common factors related to antibiotic prescribing patterns in the paediatric ward, the study measured the association between variables such as age, weight, gender, diagnosed condition, length of stay in the ward, type of antibiotic therapy, number of antibiotics prescribed, and PSTG protocol. In particular, Pearson Chi-square tests were performed to establish if association exists between antibiotic prescriptions (dependant variable) and the independent variables.

Hence, the following results were obtained from the Pearson chi-square statistic test, where df means degrees of freedom, used to determine whether a particular null hypothesis can be rejected and Asymp.Sig (2 – sided) means a significance level in which when p is less than .05, it can be concluded that there is a relationship between the variables based on a 95 percent level of confidence. The first test which
was performed was to measure the relationship/association between antibiotic prescription and the patient’s age.
4.7.1 Antibiotic prescription and age

H₀ – There is no statistically significant association between antibiotic prescriptions and the age of the patients.

Table 4.8: Antibiotic prescription and Age

<table>
<thead>
<tr>
<th>Chi-Square Tests</th>
<th>Value</th>
<th>df</th>
<th>Asymp. Sig. (2-sided)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Chi-Square</td>
<td>94.336*</td>
<td>117</td>
<td>.939</td>
</tr>
<tr>
<td>Likelihood Ratio</td>
<td>104.182</td>
<td>117</td>
<td>.796</td>
</tr>
<tr>
<td>Linear-by-Linear Association</td>
<td>.056</td>
<td>1</td>
<td>.812</td>
</tr>
</tbody>
</table>

N of Valid Cases 285

a. 150 cells (93.8%) have expected count less than 5. The minimum expected count is .09.

Based on the findings reflected in the above table, this study did not find adequate evidence to reject the null hypothesis and therefore cannot conclude that there is an association between antibiotic prescriptions and the age of the patients admitted to the paediatric ward (p=0.939; p > 0.05). This finding goes against the results of the cross-sectional study by Fernández, et.al. (2008) who concluded that age among other factors is certainly a principal determining factor to patient therapy.

4.7.2 Antibiotic prescription and patient weight

H₀ – There is no statistically significant association between antibiotic prescriptions and the weight of the patients.
Table 4.9: Antibiotic prescription and patient weight

<table>
<thead>
<tr>
<th>Chi-Square Tests</th>
<th>Value</th>
<th>df</th>
<th>Asymp. Sig. (2-sided)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Chi-Square</td>
<td>95.207a</td>
<td>132</td>
<td>.993</td>
</tr>
<tr>
<td>Likelihood Ratio</td>
<td>92.495</td>
<td>132</td>
<td>.996</td>
</tr>
<tr>
<td>Linear-by-Linear Association</td>
<td>1.465</td>
<td>1</td>
<td>.226</td>
</tr>
<tr>
<td>N of Valid Cases</td>
<td>209</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The findings reflected in the above Table show that, this study did not find adequate evidence to reject the null hypothesis and therefore cannot conclude that there is an association between antibiotic prescriptions and the weight of the patients admitted to the paediatric ward (p=0.993; p > 0.05). This result is consistent with the researcher's observation that most of the files evaluated in this study indicated that the weight of the patients was not taken on admission and throughout the patient stay in the ward. This finding also goes against Miller, et al. (2010) study which notes that the patient's weight is a key factor in the determination of paediatric patient's treatment. It also goes against the recommendations of a Nigerian study which proclaims the importance of weight in the treatment of paediatric patients (Aina & Egbehor, 2013).

The next section presents the results of the chi square test on the association between antibiotic prescriptions and patient gender

4.7.3 Antibiotic prescription and gender

H₀ – There is no statistically significant association between antibiotic prescriptions and the gender of the patients.
Table 4.10: Antibiotic prescription and patient gender

<table>
<thead>
<tr>
<th>Chi-Square Tests</th>
<th>Value</th>
<th>df</th>
<th>Asymp. Sig. (2-sided)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Chi-Square</td>
<td>41.822a</td>
<td>39</td>
<td>.349</td>
</tr>
<tr>
<td>Likelihood Ratio</td>
<td>52.526</td>
<td>39</td>
<td>.073</td>
</tr>
<tr>
<td>Linear-by-Linear Association</td>
<td>.300</td>
<td>1</td>
<td>.584</td>
</tr>
<tr>
<td>N of Valid Cases</td>
<td>285</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. 71 cells (88.8%) have expected count less than 5. The minimum expected count is .48.

In this category of the chi-square tests, the findings reflected in the above table, also show that this study did not find adequate evidence to reject the null hypothesis and therefore cannot conclude that there is an association between antibiotic prescriptions and the gender of the patients admitted to the paediatric ward (p=0.349; p > 0.05). The finding show no significant association between the variables of gender and antibiotic prescribing, gender is not a factor for consideration in the prescription of antimicrobials. Although, this is so, the finding goes against the results of the cross-sectional study by Fernández, et.al. (2008) which reflected that a higher prevalence of antibiotic prescription in a primary health care was associated with gender as drug usage was higher in females than males.

The next section deals with the results of the chi square tests for antibiotic prescriptions and diagnosed conditions.

4.7.4 Antibiotic prescription and diagnosed condition

H₀ – There is no statistically significant association between antibiotic prescriptions and the diagnosed condition of the patients.
Table 4.11: Antibiotic prescription and diagnosed condition

<table>
<thead>
<tr>
<th>Chi-Square Tests</th>
<th>Value</th>
<th>df</th>
<th>Asymp. Sig. (2-sided)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Chi-Square</td>
<td>2102.212(^a)</td>
<td>2262</td>
<td>.992</td>
</tr>
<tr>
<td>Likelihood Ratio</td>
<td>579.783</td>
<td>2262</td>
<td>1.000</td>
</tr>
<tr>
<td>Linear-by-Linear Association</td>
<td>.842</td>
<td>1</td>
<td>.359</td>
</tr>
<tr>
<td>N of Valid Cases</td>
<td>280</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^a\) 2353 cells (99.7%) have expected count less than 5. The minimum expected count is .00.

Based on the findings reflected in the above table, this study also did not find adequate evidence to reject the null hypothesis and therefore cannot conclude that there is an association between antibiotic prescriptions and the diagnosed condition of the patients admitted in the paediatric ward \((p=0.992; \ p > 0.05)\). This result is consistent with the researcher’s observation that the health worker’s prescribing patterns did not follow the guidelines as according to the PSTG. The prescribing patterns relied more on literature than the PSTG. In view of the fact that the findings of this study revealed in Table 4.5 that diarrhoea, febrile convulsions, poisoning, and dehydration are amongst the most commonly prescribed conditions in the paediatric ward, this finding is not surprising since these conditions are normally not associated with antibiotic therapy.

4.7.5 Antibiotic prescription and length of stay in the hospital

It is believed that the appropriate use of antibiotics shortens length of stay in hospital (Geerlings, Hulscher, & Prins, 2014). Hence in this study, the following hypothesis was tested:

\(H_0\) – There is no statistically significant association between antibiotic prescriptions and the patient’s length of stay in the hospital.
Table 4.12: Antibiotic prescription and length of stay in the hospital

<table>
<thead>
<tr>
<th>Chi-Square Tests</th>
<th>Value</th>
<th>df</th>
<th>Asymp. Sig. (2-sided)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Chi-Square</td>
<td>216.383a</td>
<td>234</td>
<td>.790</td>
</tr>
<tr>
<td>Likelihood Ratio</td>
<td>95.917</td>
<td>234</td>
<td>1.000</td>
</tr>
<tr>
<td>Linear-by-Linear Association</td>
<td>1.306</td>
<td>1</td>
<td>.253</td>
</tr>
</tbody>
</table>

N of Valid Cases

a. 272 cells (97.1%) have expected count less than 5. The minimum expected count is .00.

Based on the findings reflected in the above table, this study also did not find adequate evidence to reject the null hypothesis and therefore cannot conclude that there is an association between antibiotic prescriptions and the length of stay in the hospital (p=0.790; p > 0.05). This result could be consistent with the researcher’s observation that most patients had multiple diagnoses which could have an impact in their length of stay. Similarly, Richardson (2002) concurs with this finding as he states that the length of stay in the paediatric ward is longer in patients across a wide range of diagnosis.

4.7.6 Diagnosed condition and the type of antibiotic therapy

It was also revealed in the literature review that the type of antibiotic therapy can be empirical, prophylactic and specific (see, section 3.7). Hence, the chi-square test was also employed to establish if there is a statistically significant association between the diagnosed condition and the type of antibiotic therapy. For this reason, the following hypothesis was also tested:

\[ H_0 \] – There is no statistically significant association between the diagnosed condition and the type of antibiotic therapy.

The following results were obtained from the chi-square test:
Table 4.13: Diagnosed condition and the type of antibiotic therapy

<table>
<thead>
<tr>
<th>Chi-Square Tests</th>
<th>Value</th>
<th>df</th>
<th>Asymp. Sig. (2-sided)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Chi-Square</td>
<td>212.944&lt;sup&gt;a&lt;/sup&gt;</td>
<td>174</td>
<td>.024</td>
</tr>
<tr>
<td>Likelihood Ratio</td>
<td>129.192</td>
<td>174</td>
<td>.995</td>
</tr>
<tr>
<td>Linear-by-Linear Association</td>
<td>.087</td>
<td>1</td>
<td>.768</td>
</tr>
<tr>
<td>N of Valid Cases</td>
<td>277</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup>. 227 cells (96.2%) have expected count less than 5. The minimum expected count is .03.

The table above shows that there is a statistically significant association between the diagnosed condition and the type of antibiotic therapy as shown by the p value (p = 0.024). Therefore the null hypothesis is rejected (p < 0.05). If one considers that the findings of the study earlier indicated that in most patient cases, the infective organism was not known since culture results were not requested, and that in most cases treatment was empirical and associated with longer duration of antibiotic treatment, this finding goes against, Leekha, et al. (2011) study which pointed out that understanding the difference between empiric, prophylactic and specific therapy (in other words, obtaining an accurate diagnosis of infection) is the most important consideration when prescribing antibiotic therapy.

4.7.7 Diagnosed condition and the number of antibiotics prescribed

The study also sought to establish if there is a statistically significant association between the patient’s diagnosed condition and the number of antibiotics prescribed. For this reason, the following hypothesis was tested:

\[ H_0 \] – There is no statistically significant association between the number of antibiotics prescribed and the diagnosed condition.

The results of the chi-square test are as follows:
Table 4.14: Diagnosed condition and the number of antibiotics prescribed

<table>
<thead>
<tr>
<th></th>
<th>Value</th>
<th>df</th>
<th>Asymp. Sig. (2-sided)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Chi-Square</td>
<td>784.164&lt;sup&gt;a&lt;/sup&gt;</td>
<td>531</td>
<td>.000</td>
</tr>
<tr>
<td>Likelihood Ratio</td>
<td>454.036</td>
<td>531</td>
<td>.993</td>
</tr>
<tr>
<td>N of Valid Cases</td>
<td>297</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup> 591 cells (98.5%) have expected count less than 5. The minimum expected count is .00.

The table above shows that there is a statistically significant association between the number of antibiotics prescribed and the diagnosed condition as shown by the significance of the p value. Therefore the null hypothesis is rejected since p < 0.05 (in fact p < 0.001). In view of the fact that the findings of this study revealed that diarrhoea, BPN and dehydration were amongst the most commonly prescribed conditions in this study, this finding raises a concern since a substantial number of patients (89; 34.9 %; n = 255) received more than three antibiotics. This practice goes against a warning by a report which directs that prescribing more than three microbial agents at a time amounts to inappropriate agent combinations and subsequently inappropriate antibiotic (Best Care Always, 2011).

### 4.7.8 Choice of antibiotic therapy and protocol

The study also sought to establish if there is a statistically significant association between the choice of antibiotic therapy and following protocol by health care professionals:

\[ H_0 \] – There is no statistically significant association between the choice of antibiotic therapy and protocol.

The results of the chi-square test are presented in table 4.15 below as follows:
Table 4.15: Choice of antibiotic therapy and protocol

<table>
<thead>
<tr>
<th>Chi-Square Tests</th>
<th>Value</th>
<th>df</th>
<th>Asymp. Sig. (2-sided)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Chi-Square</td>
<td>6.423</td>
<td>3</td>
<td>.093</td>
</tr>
<tr>
<td>Likelihood Ratio</td>
<td>8.640</td>
<td>3</td>
<td>.034</td>
</tr>
<tr>
<td>Linear-by-Linear Association</td>
<td>3.405</td>
<td>1</td>
<td>.065</td>
</tr>
<tr>
<td>N of Valid Cases</td>
<td>272</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. 2 cells (25.0%) have expected count less than 5. The minimum expected count is 2.21.

Based on the findings reflected in the above table, this study did not find adequate evidence to reject the null hypothesis at 5% level of significance. So, this study therefore can conclude that there is no significant relationship between the choice of antibiotic therapy and protocol. The finding of this study is not surprising since the ward where the current study was conducted is in a districts hospital, and also that most of the prescribing health workers are not specialist but inexperienced junior medical officers mostly in their year of community service. In relation to this finding, studies (for example, Geerlings, et al., 2014 and Hulscher, Grol, & van der Meer, 2010) highlight the association of better clinical responses with adherence to protocol, in hospital wards were specialists can be found. For example, Menéndez, et al. (2005) found that adherence to protocol was high, although with significant differences between hospital and physicians. The factors related to higher adherence were hospital, physician characteristics and initial high risk class of fine, whereas admission to ICU decreased adherence. Therefore Menéndez, et al. (2005) concluded that adherence to protocol mainly depends on the hospital and the specialty and training status of the prescribing health worker.

4.8 CONCLUSION ON PRESCRIBING PATTERNS

This chapter presented the results and discussion of the study which aimed at investigating antibiotic prescribing patterns amongst healthcare professionals in a paediatric ward. First, the study presented and discussed the results of the analysis on patient demographics and characteristics (see, Section 4.1). The results in this
section showed amongst others that in terms of gender, there was an almost equal number of male and female patient admissions during the period under study. Most of the admitted patients in the ward were infants followed by toddlers in the ward. Despite the fact that in this study the results of the chi-square show no statistically significant association between antibiotic prescriptions and the patient’s age and gender, it can still be concluded that age and gender are the key determining factors to paediatric patient therapy. Age for example, as the (National Department of Health, 2008) prescribes is always a considered factor when treatment is administered to paediatric patients. This conclusion is supported by literature from authors such as (Fernández, et al., 2008). In terms of origin, three nationalities (namely, South Africa, Zimbabwe and Somali) were represented in the group of patients that were admitted to the ward. Most of the admitted patients were black Africans, followed by whites and Indians. In terms of language background, the study found that the group of patients admitted to the ward represented the multilingual and multicultural nature of South Africa. Therefore to these the study concludes that the population of patients whose therapy was understudy was representative of South Africa’s diverse population as well as Smith’s (2009) assertion that South Africa is flooded by foreign nationals, which contributes to the burden of the health budget. The results of the analysis on the weight of admitted patients revealed that for a high number of patients, the health worker did not record the weight of the patients. To this, the study concludes that since weight is a crucial determinant of paediatric patient treatment according to Wong, et al. (2004) this oversight has a potential for detrimental consequences such as antibiotic resistance, long duration of stay in the hospital, and high costs of patient therapy. The study also found that most patients were admitted during the spring season. This was closely followed by the winter season. Therefore with regards to the period, the study concludes in line with (Barnett, et al., 2005) that these seasons have the highest infection rates. Especially if one considers the fact that this study was conducted in Tzaneen, Limpopo province - where the climate is sub-tropical. Although, a majority of patients stayed in the ward for a period less than a week, there was a number of patients whose stay in the ward was between 1 week up to 38 days. From this result, the study therefore concludes that paediatric patients with multiple diagnosis usually stay in the hospital longer that those with just 1 diagnosis.
Next, the chapter presented the results of the study on the prevalence of antibiotic use in the paediatric ward (see, Section 4.2). The results indicated that from the population of 304 patients in the ward, a total 255 (83.9 %) received antibiotic therapy whilst on admission in the hospital ward. To this the study concludes that antibiotics are profoundly used in paediatric patient care. In this issue, the study also found that patients received up to eight antibiotics during their admission, leading to the study concluding that health care workers in this ward clearly do not have the required knowledge in antibiotic stewardship.

Section 4.3 presented the results of the investigation on the most common conditions for which antibiotics were prescribed in the paediatric ward. The results and discussion indicated that in total, there were 65 diagnosed conditions in the study. Of all the diagnosed conditions, diarrhoea was the most commonly diagnosed occurring (63; 20.8 %; n = 295) than others. Unfortunately, the study could not confirm the exact cause of this diarrhoea as culture tests were not performed in most treated cases. Therefore in this case, the study concludes that health workers in this study empirically used antibiotics without evidence of the cause of disease. Another factor which could lead to resistance and longer period of stay in the ward.

Further, Section 4.4 was a presentation and discussion of the most common factors that were related to antibiotic prescribing patterns in the hospital ward understudy. The resultant discussion indicated that the most notable factors were: knowledge of the infective organism, sensitivity or culture results as well as the type of antibiotic treatment. The results in this study indicated the following: (1) that in most of the conditions for which antibiotics were prescribed, there was no evidence of the infective organism; (2) that only in a few cases was the prescribing of antibiotics related to interpretation of sensitivity or culture results; (3) that most conditions for which antibiotics were prescribed were based on empiric decisions. Therefore, the study concludes that for the health workers in this study, antibiotic prescribing was irrational and did not follow protocol set by the PSTG.

Next, was section 4.5 which presented results and discussion into the pharmacological classes of antibiotics that were most commonly prescribed in the paediatric ward. The study found that a total of 585 antibiotics were prescribed
during the period understudy. The mostly prescribed antibiotic class was penicillins with extended spectrum followed by aminoglycosides such as gentamicin. Although there was no clear rationale as suggested by Best Care Always (2011) the health care workers in this study used antibiotics with overlapping spectrum of activity. The study concludes that the health workers in this study relied on broad spectrum antibiotics since they could not ascertain (through lab tests) the cause of the infection for a number of conditions. This is indicative of medical personnel preoccupation with broad spectrum antibiotic (Lam & Lam, 2003), a fact which could also result in antibiotic resistance in later occurrences of certain conditions where narrow spectrum antibiotics can be used effectively.

The results on the comparison of the ward’s antibiotic prescribing patterns with the PSTG was discussed in Section 4.6. It was shown from the discussion which followed in this section of the study that the treatment regimens implemented in the treatment of infectious diseases among admitted paediatrics were found to be in accordance with literature and not according to the PSTG. Treatment protocols did not fully abide to the PSTG guidelines since culture and sensitivity tests were not carried out for most cases. The most common problem which was found in this study was the non-specific terms used in diagnosis such as lower and upper respiratory tract infections. Lower respiratory tract infection could be bronchitis, bronchiolitis or pneumonia, while upper respiratory tract infection could be otitis media, sinusitis, tonsillitis, pharyngitis or laryngitis. Medication errors such as overdosing, underdosing and wrong choice of antibiotic resulted from amongst others: (1) lack of culture and sensitivity results, (2) not recording the weight of the patients, and (3) not being specific in diagnostic terminology. Hence, the study concludes that health professionals in a paediatric ward need to be more specific in their diagnostic terminology, and culture and sensitivity tests must be done despite budgetary constraints or time constraints. In other cases, the study found that antibiotics were used for both bacterial and viral infection.

Lastly, in Section 4.7 the study presented the results of chi-square tests to measure the association between antibiotic prescribing patterns and independent variables such as patient’s age, weight, gender, diagnosed condition, length of stay in the
ward, as well as between the diagnosed condition and type of antibiotic therapy, as well as number of antibiotics prescribed. While the choice of antibiotic therapy was measured against the antibiotic protocol as outlined by the PSTG. From the results in this section, the following could be highlighted: that the chi-square test results indicated that there is no statistically significant association between antibiotic prescriptions and the patient’s age, weight, gender, diagnosed condition and length of stay in the hospital. Further chi-square tests revealed no statistically significant association between the diagnosed condition and the type of antibiotic therapy. In sight of this finding and the earlier discussions, the researcher in this study points to the absence of lab tests as it means that health workers relied on the use especially of broad antibiotics to treat conditions for which the causes they did not have certainty. Interestingly, the study found that there was a statistically significant association between the number of antibiotics prescribed and the diagnosed condition. However, it was also found that there was no statistically significant association between the choice of antibiotic therapy and protocol. This finding was not surprising since the study was conducted in a district hospital where the paediatric ward is staffed by health workers who have not specialised in the field of paediatrics, but general medical practitioners.
CHAPTER 5: LIMITATIONS, RECOMMENDATIONS AND CONCLUSION

During the course of this study certain limitations were encountered. These are presented in this chapter. Recommendations are made where possible. This chapter ends of with a conclusion to the study.

5.1 LIMITATIONS AND RECOMMENDATIONS

5.1.1 Delays in obtaining patient files: during the data collection period it was important performing to retrieve and evaluate patient files timeously. Unfortunately, this depended on the availability of the filing department’s staff. In some instances, when the researcher had planned to secure and evaluate patient files, this became dependant on how busy the staff in the section would be. In some cases, delays resulted from shift changes. This would sometimes be an inconvenience to the researcher.

5.1.2 No permission to take patient files home: due to the hospitals’ strict rule on patient’s file movement, the researcher was not allowed to take evaluable patient files home, even after hours. This means that the researcher had to spend long hours paging through bulky files to evaluate cases. This is one of the main reasons why the duration of the study was lengthy.

Recommendation: each person involved in a study should ensure that they adhere to time limits and be committed. A good understanding of the process is always important as well as a good working relationship between colleagues and staff from different disciplines.

5.1.3 Census cross-sectional study: during the approval stage of the research project, one of the recommendations of the research committee was that the study should adopt and conduct a census of the paediatric ward. Although the census approach has the ability to ensure a large sample of evaluable cases, it however has its limitations. As it was observed in this study, conducting a census limited the main focus of the study in a sense that antibiotics could not be examined in depth as
initially planned. In addition, the researcher could not only focus on a limited number of antibiotics, for example as prescribed for dominant conditions in the ward as she had to consider all treatment prescribed to the population in the ward.

**Recommendation:** it is important that studies of this nature be limited in scope to ensure effective focus and depth in evaluating specific guidelines related to antibiotic prescriptions.

5.1.4 **Lengthy data collection form:** the data collection form had at least 33 questions which upon evaluating a patient file, they had to rotate between the patient file, PSTG and the form itself. On average, evaluating each case ended up taking about 45 minutes to an hour. In view of the fact that this was a cross-sectional study which took the form of a census, this meant that for the 304 patient files which were evaluable cases in this study it roughly took about 228 hours for the researcher to collect all the data needed before the analysis could take place. This process was not only lengthy, but also tedious and exhaustive.

**Recommendation:** it is important that studies of this nature be limited in scope to ensure effective and timeous data collection and analysis.

5.1.5 **No prescribers perspective on antibiotic choice:** due to its design, focus and scope, the study was only limited to the researchers analysis of prescribers antibiotic choice. The paediatric ward staff were not given a voice to share their experiences and knowledge on antibiotic prescribing in the ward.

**Recommendation:** it is important that future researchers look into a mix of quantitative and qualitative methodologies, which will allow for the authentic views from the prescribers themselves.

5.2 **CONCLUSION TO THE STUDY**

The aim of the study was to investigate antibiotic prescribing patterns amongst healthcare professionals in a paediatric ward at Van Velden Hospital. Knowledge of prescription patterns is an important tool in rational prescribing (Fernández, et al., 2008).
One of the important considerations for this study was to look at the factors related to antibiotic prescribing patterns. This study therefore looked into whether or not antibiotic prescriptions in the paediatric ward took into consideration key factors such as knowledge of infective organism, sensitivity or culture results, as well as type of antibiotic prescribed. With regards to knowledge of infective organism, it was found that most prescriptions took place without the knowledge of the infective organism. Culture results were not requested from the lab. In addition, most antibiotic treatment was empiric without laboratory confirmation.

Hence, in this study the prevalence of antibiotic prescriptions in the paediatric ward was determined, the most prevalent antibiotics were classified according to the ATC classification system. In addition, the most prevalent conditions for which antibiotics were prescribed were also determined and tabulated.

When comparing the different results presented in the preceding sections, it becomes evident that ampicillin and gentamicin were the most frequently prescribed antibiotics in this study. There is evidence even in studies across Africa and America (for instance, Gwimile, Shekalaghe, Kapanda, & Kisanga, 2012; Oshikoya, Chukwura, & Ojo, 2006; as well as Onubogu & Anochie, 2014) that ampicillin, although it is a broad spectrum penicillin, its use alone, can only be limited to a bacteriostatic effect. The high use of ceftriaxone, a broad spectrum cephalosporin in this study indicates a growing pattern of prescribers choosing more expensive and broader spectrum antibiotics in the paediatric ward. This raises a serious concern about the overuse of broad spectrum antibiotics, particularly for patients whom their infective organism is not known.

Due to a number of irrational practices in the health workers antibiotic prescriptions in the paediatric ward in this study, there is enough proof to the fact that there is minimal use of the PSTG amongst practitioners. Hence, this study calls for the development and strict administration of ward protocols. Since, “the goal of the antibiotic policy in hospitals is a correct and restrictive use of antimicrobial agents” (Peetermans, 1997). Hence, the guidelines on antibiotic use should aim to improve the quality of care, to reduce costs and to prevent the emergence of (multi-) resistant microorganisms in a hospital. Where necessary, strategic options and methods to
reach the objectives of rational antibiotic use should be developed by consensus of committees in a health care organisation. In the case of hospital wards such as paediatrics, local guidelines must be based upon standard principles of prophylactic, empiric and therapeutic use of antibiotics. They should also take into account local epidemiology of infectious diseases, microbiology and resistance patterns as well as the local clinical experience.

The introduction of a clinical pharmacist in the paediatric ward will be very beneficial, to assess antibiotics prescribed to patients still in the hospital and to monitor the patient’s response to treatment. These assessments can result in the lessening of inappropriate use of antibiotics and thus reduce long days of stay in ward, due to the direct interaction with the prescriber and the ward staff. Hospitals also should consider the adoption of Antibiotic stewardship, a programme which when efficiently combined with the role of infections control committee in the hospital can help to limit the emergence and transmission of antibiotic resistant bacteria. Antibiotic stewardship promotes awareness of antibiotic prescribing issues; both inappropriate use and misuse (Best care always, 2011).

Irrational use of antibiotics in the paediatric ward was observed in a number of levels. These included for example; treatment overdose, where aminoglycosides were the most overdosed; wrong antibiotic choice, where ceftriaxone and ampicillin synergy was prescribed instead of penicillin and aminoglycoside synergy. There was also an observation of irrational prescribing when it came to treatment administration, for example the concurrent oral and parenteral administration of treatment such as ampicillin and amoxicillin. Wrong dosing frequency, as well as treatment under dose were also observed.

Variables such as gender, age, length of stay in hospital were measured and their relationship commented upon. A major finding for this study was that there was no relationship between the main variables (age, weight and length of stay in the ward) and the antibiotic prescribing pattern in the paediatric ward.

This study should be the basis for more specific research in the future. Improving the availability of rapid diagnostic methods to differentiate between viral and bacterial
infections is suggested to reduce the high volume of empiric therapy by antimicrobial agents so as to decrease the ever expanding chances for drug resistance.
REFERENCES


Berild, D., Ringertz, S., Aabyholm, G., Lelek, M., & Fosse, B. (2002). Impact of an antibiotic policy on antibiotic use in a paediatric department. Individual based follow-up shows that antibiotics were chosen according to diagnoses and bacterial findings. *International Journal of Antimicrobial Agents, 20*, 333-338.


Burnett, R. (2012). Protocol Feedback: A cross-sectional study assessing the prescribing patterns of antibiotics amongst healthcare professionals in a paediatric ward at the Van Velden Hospital, Tzaneen Limpopo Province. Medunsa Campus: School Research Committee for the School of Health Sciences, University of Limpopo.


### Appendix 1: Data Collection Form

**PUT A TICK (✓) WHERE APPROPRIATE**

#### Section A

**Biographical Details**

1. **Antibiotic Prescribed:**
   - Yes
   - No
2. **Number of antibiotics prescribed:**
3. **Admission date in the ward:**
   - DD
   - MM
   - YYYY
4. **Date discharged:**
5. **New Admission:**
   - Yes
   - No

#### Section B

**Prescribing Patterns**

6. **Inference for prescribed antibiotic:**
   - Yes
   - No
7. **Effective or ineffective?:**
   - Yes
   - No
8. **Drug allergy or reaction?**
   - Yes
   - No
9. **Sensitivity or culture data available?**
   - Yes
   - No

#### Section C

**Prescribing actions:**

10. **Prescribed Antibiotic:**
11. **Class of Antibiotic:**
12. **Strength and Dose:**
13. **Duration of Treatment:**
14. **Treatment as per protocol?**
   - Yes
   - No

#### Section D

**Inferences:**

15. **Infer what the ward protocol or treatment guidelines suggest:**
   - (Specify)
16. **Is the duration of treatment within the ward treatment guidelines as prescribed?**
   - Yes
   - No
17. **During the patient's stay in the ward, was there a switch from one antibiotic to another?**
   - Yes
   - No
18. **Was there a valid reason for the switch?**
   - Yes
   - No

#### Section E

**Answers:**

19. **New Antibiotic Prescribed:**
20. **Strength and Dose:**
21. **Duration of Treatment:**
22. **Reason for switch:**

#### Section F

**Other Reasons:**

23. **Does the patient have a history of drug allergy or reaction?**
24. **Is the switch as per protocol or PISTG?**
25. **Does the protocol or PISTG suggest?**
26. **Are these laboratory data or relevant information to support such a switch?**

#### Section G

**Data Collection Form**

- **Drug Reaction**
- **Allergic Reaction**
- **Drug Interaction**
- **Drug Resistance**
- **Any Other (Specify)**

Adapted from Tongren T (2010)
**Appendix 2: MREC Approval Certificate**

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**UNIVERSITY OF LIMPOPO**

**Medunsa Campus**

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**MEDUNSA RESEARCH & ETHICS COMMITTEE**

**CLEARANCE CERTIFICATE**

**MEETING:** 09/2012  
**PROJECT NUMBER:** MREC/H/262/2012: PG

**PROJECT:**

**Title:** Antibiotic prescribing patterns amongst healthcare professionals in a paediatric ward at the Van Velden Hospital, Tzaneen – Limpopo Province.

**Researcher:** Mrs LN Mabila  
**Supervisor:** Dr NS Schellack  
**Co-supervisor:** Prof AGS Gous  
**Hospital Superintendent:** Dr CN Omile (Van Velden Hospital)  
**Other Involved MOD:** Mr B Mohale (Pharmacy Manager - Van Velden Hospital)  
**Department:** Pharmacy  
**School:** Health Care Sciences  
**Degree:** MSc (Med) Pharmacy

**DECISION OF THE COMMITTEE:**

MREC approved the project.

**DATE:** 08 November 2012

---

**PROF GA OUNBANJO**  
**CHAIRPERSON MREC**

---

*Note:*

1. Should any departure be contemplated from the research procedure as approved, the researcher(s) must re-submit the protocol to the committee.
2. The budget for the research will be considered separately from the protocol. PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES.
Appendix 3: Limpopo Department of Health Approval letter

DEPARTMENT OF HEALTH

Enquiries: Selamolela Donald

Ref:4/2/2

Mabila LN
P O Box 218
Medunsa
0240

Dear Mrs Mabila LN

Re: Permission to conduct the study titled: Antibiotic prescribing patterns amongst healthcare professionals in a paediatric ward at Van Velden hospital, Tzaneen-Limpopo Province.

1. The above matter refers.
2. Permission to conduct the above mentioned study is hereby granted.
3. Kindly be informed that:-
   - Further arrangement should be made with the targeted institutions.
   - In the course of your study there should be no action that disrupts the services.
   - After completion of the study, a copy should be submitted to the Department to serve as a resource.
   - The researcher should be prepared to assist in the interpretation and implementation of the study recommendation where possible.

Your cooperation will be highly appreciated.

General Manager: Strategic Planning, Policy and Monitoring

Date: 12/2012

18 College Street, Polokwane, 0700, Private Bag v0302, POLOLOwand, 0700
Tel: (015) 293 6900, Fax: (015) 293 6211/20 Website: http://www.limpopo.gov.za

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Appendix 4: Hospital Superintendent’s Consent

Enquiries: Selamorela Donald

Mabla LN
P O Box 218
Medunsa
0240

Dear Mrs Mabla LN

Re: Permission to conduct the study titled: Antibiotic prescribing patterns amongst healthcare professionals in a paediatric ward at Van Velden Hospital, Tzaneen-Limpopo Province.

1. The above matter refers.
2. Permission to conduct the above mentioned study is hereby granted.
3. Kindly be informed that:-
   - Further arrangement should be made with the targeted institutions.
   - In the course of your study there should be no action that disrupts the services.
   - After completion of the study, a copy should be submitted to the Department to serve as a resource.
   - The researcher should be prepared to assist in the interpretation and implementation of the study recommendation where possible.

Your cooperation will be highly appreciated.

[Signature]

General Manager: Strategic Planning, Policy and Monitoring

[Date]

18 College Street, Polokwane, 0701. Private Bag 63392, POLOKWANE, 0700
Tel: (015) 233 8000, Fax: (015) 239 9211/22 Website: http://www.limpopo.gov.za

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<tr>
<th>Name</th>
<th>Position</th>
<th>Email Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mike</td>
<td>Manager</td>
<td><a href="mailto:mike@hospital.com">mike@hospital.com</a></td>
</tr>
<tr>
<td>Jane</td>
<td>Nurse</td>
<td><a href="mailto:jane@hospital.com">jane@hospital.com</a></td>
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<tr>
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<tr>
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<td>Engineering</td>
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<tr>
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<tr>
<td>Lisa</td>
<td>IT</td>
<td><a href="mailto:lisa@hospital.com">lisa@hospital.com</a></td>
</tr>
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**Date:** 28th April 2023

**Venue:** The Ayer Helen Hospital, Izaneer, Limpopo Province

**Attendance Register for Study Presentation Title:** Antibiotic Prescribing Patterns Amongst Healthcare Professionals in a Paediatric Setting
Appendix 6: Study Information Chart
Appendix 7: Editor’s Letter

EDITOR’S CONFIRMATION LETTER

TO WHOM IT MAY CONCERN

I hereby state that I have edited the document:

Antibiotic Prescribing Patterns amongst Healthcare Professionals in a Paediatric Ward at Van Velden Hospital, Tzaneen - Limpopo Province

DISSERTATION

submitted in partial fulfilment of the requirements for the degree of

Master of Science (Medical) in Pharmacy

of the

UNIVERSITY OF LIMPOPO, SOUTH AFRICA

Department of Pharmacy
School of Health Care Sciences
Faculty of Health Sciences
UNIVERSITY OF LIMPOPO, Medunsa Campus
Supervisors: Dr N Schellack
Prof AGS Gous

October 2014

Disclaimer

At time of submission to student, language editing and technical care was attended to as requested by student and supervisor. Any corrections and technical care required after submission is the sole responsibility of the student.

Kind Regards

Mr TN Manganye
MA English Studies (University of Limpopo)

Email: noel.manganye@ul.ac.za

DATE: 27 October 2014