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INVESTIGATING THE AREAS OF DELAY ASSOCIATED WITH PROLONGED LENGTH OF STAY IN AN EMERGENCY DEPARTMENT IN A TERTIARY HOSPITAL IN GAUTENG

By

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DECLARATION

Student number: 10659979

I, Kapari Constance Mashao, hereby declare that this research study titled **Investigating the areas of delay associated with prolonged length of stay in an emergency department in a tertiary hospital in Gauteng** is my own work and that all sources consulted or quoted have been indicated and acknowledged by means of complete references and that this work has not been submitted for any other degree at any other institution.

_____ _____

KC Mashao Date

DEDICATION

I dedicate this work to **Almighty God** whose presence I felt at all times and who, I knew, held my hand with every step I took.

This dissertation is also dedicated to my son **Maropeng Mashao** and my late **dad, Ngoako Frans Alfred Mashao,** who always encouraged and believed in me.

'Thanks very much **Dad** for your **love, support and encouragement.** I love you very much and wish you were here to share this with me.'

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ABSTRACT

Background: Prolonged length of stay in an emergency department, which affects quality patient care and patient outcomes negatively, is a worldwide problem.

Aim: The aim of this study was to describe associated areas of delay in the emergency department and also to investigate factors influencing prolonged length of stay in this department. The study also would suggests recommendations to address delay in the emergency department.

Research design and methods: A quantitative, non-experimental, descriptive, retrospective study of the files of 100 patients who were managed in the emergency department of a tertiary hospital in Gauteng, South Africa from June to August 2015 was conducted. An audit tool was developed, guided by the input-throughput-output model. Patient files were sampled systematically to be audited and to collect data. During the data analysis, descriptive statistics, regression analysis, regression diagnostics, stepwise regression and Durbin-Watson statistics were used.

Results: Due to lack of capacity the relevant emergency department experienced difficulties in dealing effectively with the numbers of patients arriving at the department. This was one of the factors that led to an increase in the length of stay (the average of which was 3.04 days). The following areas of delay possibly causing an increase in length of stay were reception and triage, triage doctor, speciality referral and specialist consultation, trauma lying area, female medical area, internal medicine department, pathology department and inpatient beds.

Conclusion: Prolonged length of stay was experienced in the emergency department of the study hospital. Revising the referral system of patients to the hospital and doctors' system of referring patients to specialists, monitoring the time specialists take to consult with patients and the disposition of patients, and evaluating the availability of inpatient beds might improve the situation.

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ABBREVIATION	MEANING
ED	Emergency department
HCP	Health care providers
ICU	Intensive care unit
LOS	Length of stay
SATS	South African Triage Scale
TSSA	Trauma Society of South Africa
TLA	Trauma lying area
FMA	Female medical area

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CHAPTER 1: ORIENTATION TO THE STUDY

1.1 INTRODUCTION AND BACKGROUND

Globally, length of stay (LOS) of patients in emergency departments (EDs) remains a challenge to patient health and safety. Pitts, Pines, Handrigan and Kellermann (2012:685) described prolonged LOS of patients in the ED as a growing problem as it led to overcrowding. The duration of LOS in the ED is measured from the time a patient arrives for triage until the time the patient departs or is discharged from the ED. Huang, Thind, Dreyer and Zaric (2010:6) found that ED LOS of more than 12 hours increased inpatient LOS (12.4%), health care costs (11%) as well as mortality rates. Therefore, staying of patients in the ED for more than 12 hours can be seen as prolonged LOS.

Prolonged LOS in the ED is recognised as a main concern in many countries (developed and developing), such as Australia (Shetty, Gunja, Byth & Vakasovic 2012:375), Taiwan (Hsu, Shu, Lin, Yang, Su & Ko 2012:1), the United States of America (Wiler, Gentle, Halfpenny, Heins, Mehrotra, Mikhail, & Fite 2012:142), the Netherlands (Borghans, Kool, Lagoe & Westert 2012:222), Canada (Soong, High, Morgan & Ovens 2013:299), Brazil (Santos, Lima, Pestana, Gerlet & Erdmann 2013:142) and Ghana (Osei-Ampofo, Oduro, Oteng, Zakariah, Jacquet & Donkor 2013:53). Many of these countries have tried to reduce LOS in the ED by setting targets for the period that a patient is allowed to stay in the ED. The United Kingdom's National Health Service set a goal target referred to as the "four-hour rule" for patients in the ED (Jones & Schimanski 2010:391) which was later also implemented in Australia (Geelhoed & De Klerk 2012:122). In accordance with this target the aim was to either discharge patients home or admit them to a ward within four hours of presentation at the ED. Other countries, like New Zealand, implemented a six-hour target time in 2009 aimed at reducing LOS in the ED (Forero, McCarthy & Hillman 2011:1 of 6).

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The setting of target times led researchers like Jones and Schimanski (2010:392) to express the opinion that setting target times should be aimed at moving patients quickly from the ED without compromising quality patient care. Ding, McCarthy, Desmond, Lee, Aronsky and Zeger (2010:816) stated that quality ED care was often described and associated with the time spent in the ED and that it was crucial to document and plan actions to prevent prolonged LOS. According to Nugus, Forero, McCarthy, Mcdonnell, Travaglia, Hilman and Braithwaite (2013:3), prolonged LOS and overcrowding in the ED reduce the department's efficiency and increase the risks of medical errors, leading to adverse events. Prolonged LOS decreases patient satisfaction, quality of care and patient outcomes and affects mortality, which may lead to preventable adverse events. Prolonged LOS also depletes ED resources like human resources, equipment, infrastructure and consumables (Huang, et al 2010:1; Singer, Thode, Viccellio, and Pines 2011:1324-1326; Stauber 2013:221). Prolonged LOS increases the burden on ED health care providers, which threatens safety and quality of patient care (Cho, Jeong, Han, Yeom, Park, Kim and Hwang 2011:400; Shu, Lin, Hsu, & Ko 2011:677). Limited resources and overcrowding may in turn, reduce access for new patients who may be emergent and who has to wait to be admitted (Pitts, et al 2012:685).

Recognising that prolonged LOS and overcrowding have become a daily reality affecting the functionality of the ED, Djokovic (2012:32) stated that this phenomenon could be a symptom of hospital system problems and that further investigation into LOS was needed. In sub-Saharan Africa, consensus was reached that further investigation to try and reduce prolonged LOS in the ED was needed (Calvello, Reynolds, Hirshon, Buckle, Moresky, O'Neill & Wallis 2013:46).

Although other countries have tried to address the LOS challenge by setting definite time limits (four to six hours) for the stay of patients in the ED from admission to discharge (Jones & Schimanski 2010:391; Forero, et al 2011:1; Geelhoed & De Klerk 2012:122), in South Africa and in the ED where the study was done no such time limit or target time for LOS has been set. According to Van Wyk and Jenkins (2014:241), hospital emergency departments in South Africa are often overburdened

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by patients suffering from various conditions, resulting in overcrowding of these departments. Overcrowding increases waiting times in the ED, which potentially increase morbidity and mortality. Nortan and Hogan (2012:401) described the accident and emergency care department in a Johannesburg hospital as extremely crowded and busy, leading to prolonged LOS. In another study conducted in South Africa by Engelbrecht, Du Toit and Geyser (2015:1), overcrowding in the ED was referred to as a global and common phenomenon that was caused by an access block. Because no limit has been set relating to the ideal LOS in EDs in a South African context, the study hospital has attempted to improve prolonged LOS and overcrowding in the ED by recommending an ideal period of 12 hours or less for LOS in the ED. Based on this recommendation of the hospital where the study was conducted, the researcher decided to use a period of 12 hours or less as the ideal for LOS in the ED.

Despite the fact that the problems related to overcrowding and LOS in EDs around the world is not new, limited data exists on the sustainability of potential solutions (Shetty, et al 2012:374). The researcher, therefore, decided that the challenge of prolonged LOS in the ED needed to be investigated, which was the motivation for embarking on this study.

1.2 PROBLEM STATEMENT

The focus of treatment in the ED is the immediate treatment of life-threatening conditions, the stabilisation of patients and their discharge to appropriate facilities and/or wards. Patients who stay in the ED for a prolonged time have lower satisfaction levels as they often link quality of ED care to the time they spent in the ED (Ding et al 2010:816). As recorded in the 2014 statistics of the study hospital, prolonged LOS in the ED is a continuous challenge that results in patients waiting in the ED for up to 13 days or longer for inpatient beds to become available so that they can be admitted. This prolonged LOS results in patients being exposed to adverse events and not getting the optimal and best available care they deserve and would have received when admitted in the speciality wards.

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Prolonged LOS leads to overcrowding as the inflow (input) of patients into the ED is more than the outflow (output) of patients from the ED. Even on days when the hospital is full and has no available inpatient beds, the ED is still expected to admit patients, affecting the ability of the ED to discharge patients to the wards (output). As a result, overcrowding happens on a daily basis and it affects quality patient care, leads to inappropriate staff-to-patient ratios and increases the burden on the ED health care providers (Ding et al 2010:816). The researcher has noticed that when patients who require speciality treatment and have specific needs, such as, frequent turning, close continuous monitoring, frequent electrocardiogram (ECG) monitoring, special positions and special investigations, stay long in the ED, these specific needs end up not being met.When patients' specific needs are not effectively attended to it results in complications, for example, pressure sores development, inconsistent medication administration, increased risk of nosocomial and cross infection, deterioration of conditions with increased mortality as well as increase in preventable adverse events. ED resources such as human resources, equipment, infrastructure and consumables are depleted as patients boarding in the ED consume the remaining limited ED resources (Singer, et al 2011:1326) due to overcrowding.

When there is overcrowding, patients are placed closer to each other to create space, leaving insufficient space between beds. As a result, patient privacy is compromised, hence patients' satisfaction levels are lowered. As the ED inflow (input) is expected to continue even though no inpatient beds are available (the limited number of ED beds usually being 100% occupied), some of the very sick patients end up being admitted and nursed on chairs. Medications are given to patients and procedures and examinations are done on them while they are seated on chairs, leading to a decrease in the quality care delivered to the ED patient. In addition, this practice increases the risks of falls, complications and medico-legal adverse events.

Singer, et al (2011:1326) stated that the effect of prolonged LOS is that ED health care providers often attended to new, unstable patients and dedicate less time to patients awaiting admission to the hospital. Richardson and Mountain (2009:370)

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reported that the opposite could also be true: health care providers could spend a significant percentage of staff time on caring for patients waiting for inpatient beds rather than looking after newly admitted emergency patients. This could lead to patients suffering complications before being seen by ED health care providers, or patients leaving the ED without being seen or managed appropriately. Prolonged LOS in the ED is associated with longer inpatient LOS, increased inpatient cost and increased cost to the hospital (Huang, et al 2010:6).

The goal of this study was to investigate areas of delay contributing to LOS in the ED of a tertiary hospital in Gauteng, South Africa in order to identify the areas and also to use the information to prevent the possible negative effects of prolonged LOS.

1.3 AIM AND OBJECTIVES

The overall aim of this study was to describe associated areas of delay in the emergency department and to investigate factors influencing prolonged length of stay in this department. In order to achieve the aim of the study, the following objectives were formulated based on the open systems theory approach:

- **Objective 1:** To describe the possible areas of delay associated with prolonged length of stay during the input, throughput and output phases in the ED
- **Objective 2:** To investigate the relationship between the areas of delay and LOS
- **Objective 3:** To recommend strategies to management that could be implemented to address the areas of delay that possibly contribute to prolonged LOS in the ED

1.4 IMPORTANCE AND BENEFITS OF THE RESEARCH

The results of the study might assist in raising the awareness of the management of the relevant tertiary hospital about the areas of delay contributing to the LOS in the ED. Strategies will be recommended, which, if implemented, might decrease the LOS of patients in the ED, decrease overcrowding (Wiler, et al 2012:157), improve

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quality of care (Nugus, et al 2013:8) and improve patient satisfaction (Djokovic 2012:10). Managing prolonged LOS might control overcrowding, which might improve patient comfort in the input phase (reception and triage) as well as morbidity and mortality. In other words, patients' quality of care might be improved, resulting in positive health outcomes. Further advantages of managing prolonged LOS could include avoiding preventable adverse events in patient care and reducing the rate of patients leaving the ED without having been managed or without having completed their treatment. In addition, moving patients from the ED within a shorter period of time could improve the timely management of patients and could allow for the specialised needs of patients to be attended to in the in-hospital wards. Reducing LOS in the ED might also improve the ED health care providers' job satisfaction (Hsu, et al 2012:2), functioning (Borghans, et al 2012:230) and decrease burnout amongst the ED healthcare providers. A decrease in LOS of patients in the ED might allow the ED health care providers more time to apply their expertise in caring for emergency patients in a non-crowded ED.

1.5 DELIMITATIONS

The study was conducted in the ED of a tertiary hospital in Gauteng. It was a retrospective study and the audit was complicated because of missing data in patient files. Retrieval of files from the hospital archive was identified as a possible challenge, and this turned out to be a reality. The researcher obtained permission from the hospital to conduct the study and contacted the personnel at the records section regarding the personal retrieval of files after the permission, but challenges were still experienced during the retrieval process.

1.6 PARADIGM AND ASSUMPTIONS

The assumptions derived for the study were based on the positivist paradigm and were used to guide the research in line with the suggestions of Polit and Beck (2008:13). The positivist paradigm refers to the traditional scientific objective view of

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the world which assumes that reality can be objectively measured and observed, independent of historical, social or cultural contexts (Polit and Beck 2010:14).

The following evidence was used to prove that this study was embedded in the positivist paradigm:

- The use of a quantitative research design and statistical analysis (see sections 3.2.1 and 3.5.1)
- The use of mechanisms to control the study and minimise bias, fixed and pre-specified design (see section 3.3.7)
- The gathering of observed evidence (see section 3.3.5)
- The use of a regression analysis and a logical stepwise regression approach in the research process (see sections 3.5.2 and 3.5.4)
- The maintenance of the independence of the researcher from those being researched and the use of an audit tool to guide the collection of data (view annexure B2)

The assumptions of this study are summarised in Table 1.1.

Table 1.1: Summary of the assumptions

Philosophical question	Description: Positivism	Application in study
Ontology: What is the nature of reality?	A belief that there is an objective real world beyond the individual's body which can be known and described.	There were areas of delay in the ED contributing to prolonged LOS resulting in unpleasant effects that will be described later. The researcher could not influence the study as it was retrospective and depicted the reality in the ED.
Epistemology: Why, how and what does the researcher know about the phenomena?	Knowledge can be described in a systematic way and it consists of verified hypotheses that can be regarded as facts or laws.	No particular values were involved in the analysis as the researcher was looking for clear facts and not interpretive or fake data. The researcher used a pre-set audit tool to ensure systematic recording of the data from the accessed patient files without meeting the respondents. The researcher documented the data as it naturally occurred and did not influence the findings. The findings would be discussed with reference to findings in other parts of the world.

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Philosophical question	Description: Positivism	Application in study
Methodology: How was the evidence obtained?	Rules and procedures to guide the researcher to investigate what she believes must be known	A quantitative design ensured that empirical data was collected. The study was based on the input-throughput-output systems theory. The researcher worked with patients' files and, therefore, assumed that the files would be complete and accurate. The audit tool was used to extract facts. Statistical analysis was performed to answer the research questions.

***Source**: Adapted from Polit and Beck (2012:13)*

1.7 THEORETICAL FRAMEWORK

Anfara and Mertz (2006:xiv) defined theory as "a set of interrelated constructs, definitions and propositions that present a systematic view of a phenomena by specifying relations among variables, with the purpose of explaining or predicting the phenomena". According to De Vos, Strydom, Fouche and Delport (2005:33), theoretical frameworks are based on propositional statements resulting from existing theories. Brink, Van der Walt and Van Rensburg (2006:19) added that theories proposed the explanations and phenomena of how things worked, how parts were interconnected and how things influenced each other. Therefore, theoretical studies create new ways of understanding the world that surrounds us and bring order and give meaning to observations.

According to LoBiondo-Wood and Haber (2006:121), researchers follow either inductive or deductive reasoning when approaching a research problem. In deductive reasoning, which was used in this study, a researcher uses the conceptual or theoretical framework to approach a research problem (Polit & Beck 2010:64). Theory was described by De Vos, et al (2005:36) as an attempt to explain and/or predict a particular phenomenon, which hinted that quantitative research was supposed to be guided by a theory prior to research findings. This study was based on the open systems theory model according to which the input-throughput-output systems approach was applied.

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1.7.1 Overview of the open systems theory

Haines (2007:1) defined a system as a "set of elements or components that work together in relationship for the overall good and objective of the whole". The systems theory provides a logical basis for viewing an organisation in general. According to Nolan, Regenstein, Anthony and Siegel (2009:2) an organisation can be described as an input-throughput-output system involved in transactions within a surrounding environment. Nolan, et al (2009:2) believed that organisations consisted of patterned activities of individuals aimed at some common output or outcome. Nolan, et al (2009:3) and Wright and McMahan (1992:306) described these patterned activities as input, throughput and output activities.

- ***Input*** refers to the energy input into the system, that is, inputs of people, money and technology, or inputs of human resources, which are competencies such as skills and abilities that the individuals who work in the organisation would otherwise have had to import from its external environment.
- ***Throughput*** refers to the transformation of energies within the system, which is, putting the inputs to work together. Throughput can also be characterised by the behaviours of the individuals making up the organisational system.
- ***Output*** refers to the resulting product or energy output, that is, the product that result from the patterned activities of the input and throughput phases. Output consists of performance, such as the productivity of individuals and effective outcomes.

According to Nolan et al (2009:2), the input-throughput-output model provides a structure for examining factors that affect an organisation. The researcher used the open systems theory (input-throughput-output theory) as the framework for this study. The open systems theory provided useful guidance and structure in examining and describing the factors that affected LOS in the ED. In the application of the input-throughput-output theory in this study of LOS in the ED, the three phases identified by Von Bertalanffy were used, which were defined and interpreted as follows by Nolan et al (2009:2):

- **Input**: patients arrival at reception and/or triage to be admitted to the ED

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- **Throughput**: admission of patients to the ED and all activities implemented to manage the patient in the ED, for example, consultations with all health care providers (particularly nurses and doctors), referral to specialists and conducting of diagnostic tests
- **Output**: discharge of patients from the ED to, for example, wards, their homes or other hospitals

The input-throughput-output approach, on which the systems theory was based, was applied from operations management concepts to investigate LOS in the ED.

1.7.2 Input phase: reception and triage

Patients travel to the ED by different means, for instance, by ambulance or by private transport. The general term used for patients not brought by ambulance is walk-in patients. In the ED the input component consists of two areas of delay namely, registration at reception and triage of patients. Triage is a process used in the ED during which patients' conditions are assessed. The process starts at the reception area where the ED nurse or the ED doctor assesses the patient (if urgent), otherwise the patient is taken to the allocated triage area of the ED where the nurse does the assessment. Urgent patients brought by ambulance are admitted directly to the ED without going to the triage area. Patients who are non-urgent are sent to the triage area to be triaged by the ED nurse followed by the ED doctor.

In the triage area, patients are first seen by the ED nurse and then by the ED doctor, both of whom make a decision about the patient's condition based on observation and assessment. Waiting time to be triaged can differ as it can be influenced by the day of the week where some days are busier than others. The triage score allocated to a patient determines the urgency of the patient's condition, on the basis of which the patient is assigned to an ED area. Any of the steps mentioned in the input phase could be a source of delay and could influence the LOS of the patient in this phase (see Annexure B2, Section B for possible areas of delay that may cause prolonged LOS).

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Patients have to go through two registration points after the ED doctor has decided they need to be admitted to the ED for management. First the ED nurse at the ED counter enters the patient's name and admission diagnosis into the ED register. After that, an admission clerk of the ED admission department admits the patient electronically by entering the patient's info into the hospital system. However, if the patient is emergent (critically ill or injured) and has no escorts, the admission clerk will obtain the patient information inside the ED next to the bed, after which the electronic admission process will follow.

1.7.3 Throughput phase: admission to the emergency department

The throughput phase starts when patients register for admission to the ED. Each patient receives a patient file with stickers indicating the necessary demographic data of the patient and the official registration time. Patients are then classified as either medical or trauma depending on their conditions, and they are allocated to different areas according to their triage scores and triage colours. In the ED, patients are mostly first seen by the nurses, then the ED doctors who refer patients to specialists if warranted by the results of diagnostic tests performed on the patients, and the seriousness of their conditions. View inclusion of possible areas of delay that may contribute to LOS in the ED in the throughput phase on the audit tool (see Annexure B2, Section C).

1.7.4 Output phase: discharge time

Discharge refers to the disposition of a patient from the ED by an ED doctor or a specialist to go home or to a ward, high-care unit, intensive care unit, theatre, another hospital or the mortuary. Discharge time is the patient's departure time from the ED. Departure time and destination will be considered in this component. For areas of delay that may contribute to LOS in the ED, see Annexure B2, Section D.

Figure 1.1 shows the systems approach to LOS in the emergency department. The figure shows the process or pathway that patients coming to the emergency department are destined to follow. Patients arriving at the emergency department would report to the reception and get triaged (input phase) before entering the

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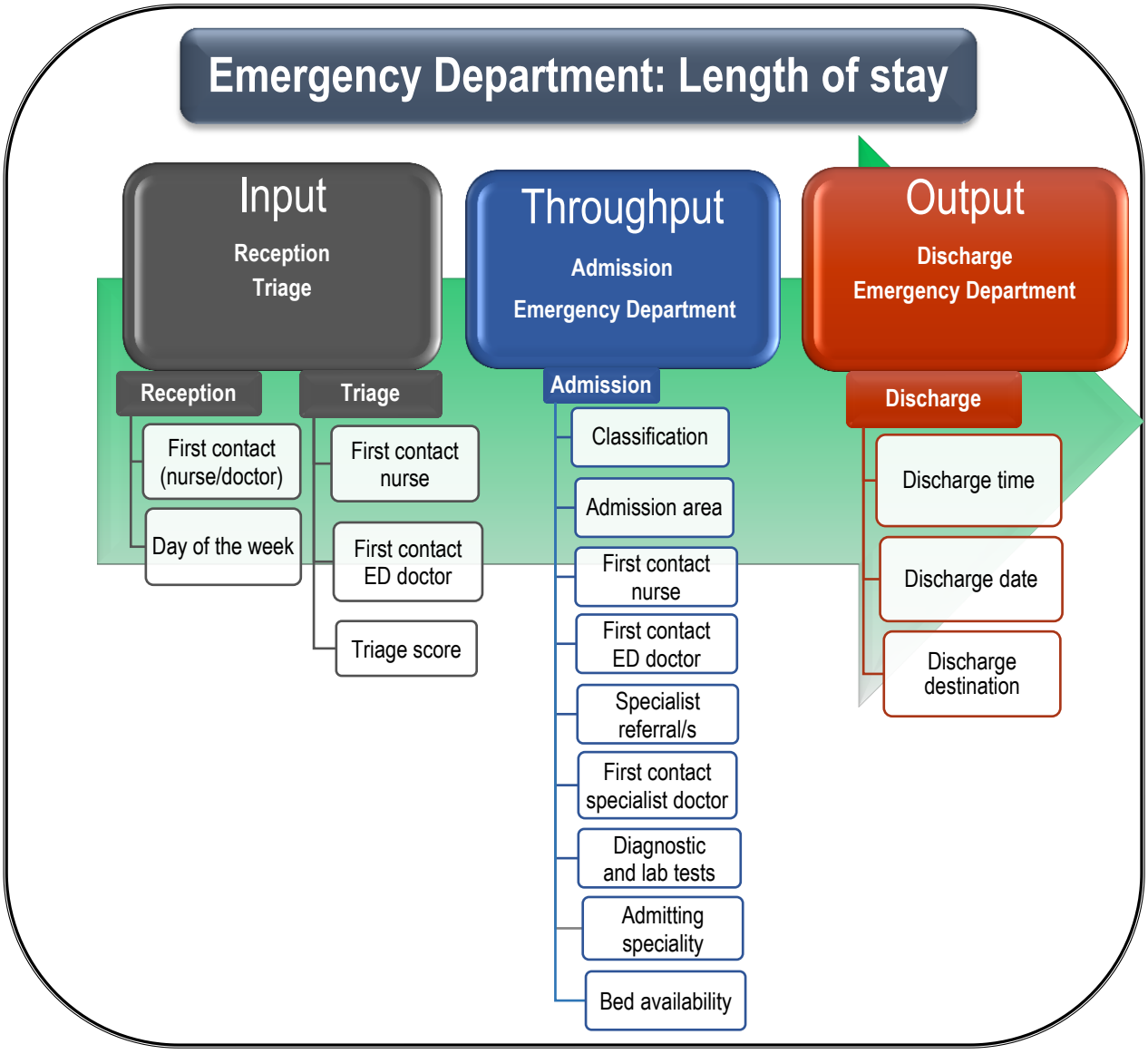

Figure 1.1: A systems approach to length of stay in the emergency department

emergency department. In the emergency department the patients are allocated to lie in a specific area (throughput phase) according to their classifications (medical or trauma), triage scores and colours (indicating degree of urgency). Consultations take place, first with the first nurse contact and then with the first ED doctor contact. The ED doctor does a few diagnostic and laboratory tests before referring the patient to a specialist/s. During the first contact, the specialist/s can sometimes order more diagnostic and laboratory tests even if the ED doctor has done some tests already. These diagnostic and laboratory tests are all done in the ED. The process ends when the patient is discharged from the ED (output phase). Patients are discharged

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from the ED to their homes or to a ward, high-care unit, intensive critical care unit, theatre, other hospitals (transfer) or to the mortuary (if the patient died in the ED). Admissions to inpatient beds depend on the admitting speciality and the availability of beds. The last step in the output phase is destination and time of discharge, which concludes the patient's LOS in the ED.

1.8 DEFINITION OF KEY TERMS

To ensure the clarity and consistency of discussions in this study, the key conceptual definitions are defined.

1.8.1 Emergency department (ED)

An emergency department is a 24-hour location serving an unscheduled patient population with anticipated needs for emergency medical care rendered by emergency medical services, (Lo, Choi, Wong, Lee, Yeung, Chan et al 2014:112) to which patients are transported or transport themselves. In this study, ED refers to a 24-hour department in a tertiary hospital serving all patients with emergency conditions. It is a short-stay department that focuses on stabilising patients and moving them to appropriate destinations.

1.8.2 Health care provider

Under the federal regulations of the United States government, a health care provider is defined as a doctor of medicine, osteopath, podiatrist, dentist, chiropractor, clinical psychologist, optometrist, nurse practitioner, nurse midwife, or clinical social worker who is authorised to practise by the state and who performs within the scope of their practice as defined by the state of law, or who is a Christian science practitioner (University of California, Berkeley Human Resource). A health care provider in this study refers to personnel authorised to provide health care to patients and these personnel include different categories of nurses, doctors and other allied health workers in the ED.

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1.8.3 Length of stay (LOS)

Length of stay is defined as the time between a patient's arrival at the ED and the patient's discharge from the ED (Cimona-Malua 2010:28). In this study, LOS encompasses the duration of time a patient spends in the ED from the time of arrival for triage until departure.

1.8.4 Prolonged length of stay

According to Djokovic (2012:19), prolonged length of stay is the stay of patients in the ED for more than eight hours. The study hospital regards a period of 12 hours or less as the ideal length of stay in the emergency department (the hospital); therefore, prolonged LOS in this study refers to the stay of patients in the ED for more than 12 hours.

1.8.5 Triage

Triage refers to the sorting of patients for priority of treatment in emergency departments, multi-casualty incidents, disasters and battlefield settings (Ganley & Gloster 2011:49). In this study, triage is the process of assessment by the ED nurse and doctor in a specific, allocated area before admission to the ED or referral to another health institution.

1.9 THE RESEARCH SETTING

This study was conducted over a period of three months at a tertiary hospital, which is also an academic hospital, in Gauteng, South Africa. This hospital was chosen because it is one of the biggest tertiary, academic and a referral hospital in the Tshwane region. The hospital has a capacity of 832 beds (among which, 53 beds in intensive care and 21 beds in high care), 80 consultation rooms, 22 operating theatres and more than 50 departments and clinics. The ED has 34 beds, of which four are for paediatric cases and 30 for adult patients. Only adult patients will be investigated in this study and therefore the adult beds available are divided into areas, and the division and set out in Table 1.2.

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Table 1.2: Adult beds in the emergency department

Type of bed	Number of beds
Resuscitation beds:	
• Trauma resuscitation	4
• Medical resuscitation	2
Observation beds:	
• Trauma	10
• Male medical	6
• Female medical	8
Total	**30**

The ED of the study hospital has the capacity to increase the number of beds to 60 in a disaster situation. Patients in the ED are primarily cared for by ED doctors and can be referred to specialists who are on call. In some specialities, patients are first seen by a student intern, after which they see the registrar or a specialist who takes the final decision about patients' destination.

1.10 RESEARCH DESIGN AND METHODS

Brink, et al (2006:92) described a research design as the overall approach to the research, which incorporates aims, methods and the predicted outcomes. A research design is the plan that designates when, where and how data will be collected and analysed. A quantitative, non-experimental, descriptive, retrospective design was used in this study to describe the possible areas of delay in the ED and to investigate factors influencing prolonged LOS in the ED.

Quantitative design was defined by Polit and Beck (2012:17) as a set of orderly and disciplined procedures aimed at acquiring knowledge. The descriptive design used in this study allowed the researcher to produce a descriptive knowledge of areas of delay that contributed to LOS in the ED, of contributing areas of delay and of the relationship between areas contributing to delay and LOS. The research methods and application used in this study are summarised in Table 1.3.

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Table 1.3: Summary of the research methods used

Research methods	Applied to study
Population / Unit of analysis:	Unit of analysis was used – patients' files and not patients themselves served as data sources. Accessible unit of analysis: files of all patients managed in the ED Target unit of analysis: files of patients managed in the ED from 1 June 2015 to 31 August 2015 Inclusion criteria • Files of patients who were 18 years and older • Files of adult patients managed in the ED during the period of 1 June 2015 to 31 August 2015 • Files of adult patients who remained in the ED for 12 hours or more • Files of both males and females Exclusion criteria • Files of patients who left the ED without being seen by a doctor • Files of patients who signed refusal of treatment forms or discharged themselves from the ED against the doctor's decision • Files of patients who were dead on arrival at the ED • Files of patients whose data on length of stay in ED was missing • Files of patients who were admitted for a prescription (that is, who were managed in the triage area and not in the ED)
Sample method	Systematic sampling (a probability sampling method) was used in terms of which samples were selected from a larger population according to a random starting point and a fixed periodic interval (Polit & Beck 2012:282).
Sample plan	In order to ensure the sample represented the population, a sample frame was developed, comprising the unit of analysis, sampling frame, selection of the study sample and completion of the audit tool for the files that met the criteria.
Sampling frame	Patients' files were systematically selected in that a list of all adult patients admitted to the ED during the study period was obtained from the records department of the study hospital. Random lists of all patients managed in the ED from 1 June 2015 to 31 August 2015 were used in the order in which the patients were admitted to the ED and all these files were selected for the audit. Files that met the unit of analysis inclusion criteria were then sampled. To achieve the sampling interval the total number of target unit of analysis, which was 1 300, was divided by 100 (the suggested sample). Having decided on an nth term of eight, the researcher and the supervisor determined a random starting point and selected every 13th file until a total of 100 files had been obtained. Files with complete LOS data were audited with an pre-set audit tool.

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Research methods	Applied to study (continued)
Sample size	A sample size of at least 100 patient files was used to estimate with a 95% confidence the expected proportion of 50% prolonged length of stay to an accuracy of within 10%. An expected proportion of 50% was assumed since this was the conservative scenario associated with the maximum sample size. A sample of 100 files that met the inclusion criteria and had complete LOS information was audited.
Data collection	Taking the patient's journey through the ED into consideration, the researcher developed an audit tool to suit the type of data required. The open systems theory model and inputs from experts currently working in the study ED with experience of risk areas of delay that might influence LOS in the ED were used to guide the development of the tool (see Annexure B2). The audit tool consisted of four sections, namely: • Section A: Demographic information • Section B: Input (reception / triage) • Section C: Throughput (admission emergency department) • Section D: Output (discharge)
Variables	Independent variables are variables that cause change or influence other variables. Independent variables are also called treatment or experimental variables (Brink, et al 2006:85). These variables were: • Five (5) independent variables at input phase (reception (2), triage (3)) • Seven (7) independent variables in the throughput phase (admission) • Three (3) variables in the output phase (discharge)
Validity	Content validity: The measuring tool provided an adequate or representative sample of all content or elements or instances of the phenomenon (LOS in ED) being measured (De Vos, et al (2005:160). Improvements of questions, the format and the scale were enhanced by pilot testing the audit tool. Face validity: The clinical audit tool covered all the aspects required to answer the research question (De Vos, et al 2005:161). Construct validity: Construct validity was enhanced by ensuring that the clinical audit tool was developed in such a way that the aspects to be answered were clear. Experts were asked to review the clinical audit tool, and the audit tool was piloted with a sample of ten (10%) of the unit of analysis.
Reliability	Cronbach's alpha coefficient, being useful for establishing reliability in a structured quantitative data collection instrument, was used to establish internal consistency (Brink, et al 2006:164). Reliability of the instrument was also enhanced when piloted.

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Research methods	Applied to study (continued)
Data analysis	Descriptive statistics were used to describe areas of delay that contributed to prolonged LOS in the ED. The proportion of prolonged LOS was expressed as a percentage along with a confidence interval. Areas of delay were expressed as categories of time and summarised as a proportion with a 95% confidence interval. A more sophisticated analysis might involve logistic regression, provided the reference categories were large enough. According to convention, an expected 11 areas of delay would require a sample of 110 files. The sample size tied in with convention according to which 10 files per area of delay were required, as well as with the events-per-variable (EPV) approach, which in the case of this study equalled five (5). In collaboration with the statistician it was decided that any testing that might take place would be at the 0.05 level of significance.

A more in-depth discussion of the research design and methods will follow in Chapter 3.

1.11 ETHICAL CONSIDERATIONS

Brink, Van der Walt and Van Rensburg (2006:66) stated that research ethics provided researchers with a code of moral guidelines on how to conduct research in a morally acceptable way. Hence ethics is regarded as a system of morals or rules of behaviour that is concerned with the degree to which research procedures adhere to professional, legal and social obligations (Polit & Beck 2012:727). Babbie and Mouton (2004:53) and Burns and Grove (2005:181) indicated that research ethics involved protecting the rights of the respondents participating in the research and the rights of the institution where the research was done. Adherence to ethical principles was also important to maintain scientific integrity.

In view of the importance of adhering to ethical principles, the researcher obtained ethical approval from the Research Ethics Committee of the Faculty of Health Sciences of the University of Pretoria and the study hospital prior to collecting data. Permission to get access to patients' files was obtained from the management of the study hospital. To maintain confidentiality, the researcher did not document any names or hospital numbers of patients during the clinical audit. To ensure safe

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keeping of collected data, names and medical records or patients' file numbers were removed and stored in an encrypted, password protected file prior to analysis of data. Brink, et al (2006:31) identified the three fundamental ethical principles that should guide the researcher, namely, respect for persons, beneficence and justice. The right to self-determination was ensured as only patients' files were used in the study and the names and numbers of patients were not documented.

The principle of beneficence requires that attention should be paid to the wellbeing of respondents. In this study, the researcher used patients' files to collect data and, therefore, the wellbeing of the study subjects was not violated. Moreover, the patients whose files were used were not identified. Thus no physical, emotional, spiritual, economic, social or legal harm was inflicted (Brink, et al 2006:33). With regard to the statement of Brink, et al (2006:33) that "The principle of justice includes the subjects' right to fair selection and treatment", the researcher ensured fairness in selecting the unit of analysis by using a systematic, random sampling method.

The respondents' right to privacy was respected and confidentiality and anonymity were maintained as no identifiable data was recorded in the audit tool. The infliction of physical or mental suffering was not applicable as only files and not people were used for the research.

1.12 LAYOUT OF THE STUDY

The layout of the chapters in this study is presented in Table 1.4.

Table 1.4: Layout of chapters

Chapter	Chapter title	Chapter description
Chapter 1	Orientation to the study	This chapter presents an orientation to the entire study. It gives a brief introduction to the research design and methods that were utilised.
Chapter 2	Theoretical underpinning	An in-depth literature discussion that supports the introduction and background as well as the findings on the areas of delay associated with prolonged length of stay in the ED is presented in this chapter.

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Chapter	Chapter title	Chapter description
Chapter 3	Research design and methods	This chapter contains an in-depth discussion of the research methodology utilised with specific reference to the research design, research method and process, actions taken to enhance validity and reliability of the study and the specific ethical considerations adhered to during the study.
Chapter 4	Research findings and discussion	An in-depth discussion of the research results is presented.
Chapter 5	Conclusions, recommendations and limitations	This chapter presents the conclusions drawn from the research findings. Additionally, recommendations are made to improve length of stay in the ED, and mention is made of the limitations of the study.

1.13 SUMMARY

In Chapter 1 an orientation to the study was presented. The background and introduction to the research problem, the problem statement, aim and objectives, the delimitations and an overview of the layout of the study were described. In the following chapter, Chapter 2, an in-depth literature discussion that supports the background to and the introduction of the study will be provided.

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2. THEORETICAL UNDERPINNING

2.1 INTRODUCTION

Chapter 1 provided an orientation to the study which included the introduction, background and research problem, the aim and objectives of the study, the research paradigm used to guide the study as well as a summary of the research design and methods used. Chapter 2 provides an in-depth discussion of current literature relating to areas in the emergency department that can cause prolonged length of as well as the effects of prolonged length of stay.

2.2 EMERGENCY CARE

Emergency care, “one of the most sensitive areas of health care” (Aacharya, Gastmans and Denier 2011:1), should be delivered within the first few hours of the onset of an acute medical condition or traumatic event (Periyanayagam, Dreifuss, Hammerstedt, Chamberlain, Nelson, Bosco, Pellone and Bisanzo 2012:153). The emergency department (ED) is a unit in a hospital that delivers a 24-hour service to an unscheduled patient population with anticipated needs for emergency care (Paul, Reddy and Deflitch 2010:559). The ED renders a very important service as the clinical focus of the ED is to provide initial resuscitation, stabilisation and treatment to non-acute and acutely ill and/or injured patients, and transfer these patients to the best available care units (Calvello, et al 2013:48).

The ED is regarded as the core clinical department of hospitals and is considered to be the crucial interface between emergency medical services (pre-hospital) and the hospital (Christ, Grossmann, Winter, Bingisser and Platz 2010:892; AL-Reshidi 2013:33). Effective emergency care can reduce morbidity and mortality associated with serious illness and/or injury (Calvello, et al 2013:48). In the ED, healthcare providers (HCP) triage patients presenting with a variety of critical, urgent and semi-

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urgent conditions, irrespective of the mode of transport the patients used to come to the hospital. The HCP stabilise the patient by providing life-saving emergency management and make decisions relating to the appropriate referral of these patients (AL-Reshidi 2013:33). Although healthcare providers in the ED deliver a 24-hour service, the level of care delivered in the ED differs depending on the ED's capacity and capabilities (Cullinan 2006:7).

Different countries categorise hospitals according to different principles. In China, for example, hospitals are divided into three levels (levels 1 to 3) based on the capability of care delivered which is determined by the level of sophistication, the equipment available, the available staff and the number of beds available (Eggleston, Lu, Li, Wang, Yang, Zhang & Quan 2010:5). Level 1 is considered the lowest, whereas level 3 is the highest level based on the specialised services the relevant hospitals are required to provide (Mohapi & Basu 2012:79).

In South Africa, hospitals EDs are classified by the Ministry of Health and by the Trauma Society of South Africa. This is stated in the white paper for the transformation of the health system in South Africa (Department of Health, notice 667, Department of Health 1997:2). Hospitals are categorised into three categories: Level 1 refers to district hospitals, level 2 to regional hospitals and level 3 to tertiary hospitals. Level 3 tertiary hospitals are further divided into three classes, namely, provincial tertiary hospitals, national referral tertiary hospitals and central referral tertiary hospital hospitals (Cullinan 2006:10). A district hospital (level 1) is a facility that offers a range of outpatient and inpatient services and has a bed capacity of 30 to 200. The ED of a district hospital offers a 24-hour emergency care, treats common injuries and emergencies and refers patients to a regional hospital (level 2) if they need care that the district facility cannot deliver (Cullinan 2006:10). Regional hospitals (level 2) ED's provide care rendered by general practitioners and some specialists and refer patients to a tertiary hospital (level 3) if patients' health needs exceed their capabilities. Tertiary hospitals (level 3), of which there are three classes, provide specialist and sub-specialist care. Tertiary 1 hospitals (provincial hospitals) receive patients from and provide specialist support to regional hospitals.

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Tertiary 2 (national referral hospitals) provides specialist support to provincial hospitals. Lastly, tertiary 3 (central referral hospitals) have highly specialised national referral units providing for multi-speciality clinical services, improvement and research. All these hospitals have EDs that provide care to ill and injured patients according to their capability and capacity (Cullinan 2006:13).

In South Africa and also worldwide, trauma is the leading cause of death and disability mostly affecting the active population group, and because of this a trauma bank project was launched by the Trauma Society of South Africa (TSSA) in 2007. This project involved the introduction of a trauma care system which is a network of facilities that provides a full range of trauma care for all injured patients that differs from the care provided by an emergency centre or department (Hardcastle, Steyn, Boffard, Goosen, Toubkin, Loubser, Allard, Moeng, Muckart, Brysiewicz & Wallis 2011:190; Nicol, Knowlton, Schuurman, Matzopoulos, Zargaran, Cinnamon, Fawcett, Taulu & Hameed 2014:550). The TSSA distinguishes between different EDs that provide trauma care to injured patients. However, the TSSA only evaluates emergency care delivered to patients involved in trauma and not in medical emergencies.

Trauma Centres in the South African context are divided into level 1 to 3 centres. Hardcastle, et al (2011:190) described these trauma centres as follows: a level 1 trauma centre facility refers to a regional resource trauma centre that is usually a tertiary care facility central to the trauma care system. Furthermore, most level 1 trauma centres are university-based teaching hospitals that must have adequate depth of resources as well as a 24-hour availability of all major specialities. A level 2 trauma centre is expected to provide initial trauma care regardless of the severity of injury, and refers patients to a level 1 trauma centre when needed. Level 3 trauma centres serve communities, provide assessments, resuscitation, basic emergency operations, stabilisation and transfer patients to either to level 1 trauma centres or a level 2 trauma centres according to their specific need. It is clear that no matter what the level of the ED is, there is a chronological flow process followed to manage patients from arrival to discharge in the ED.

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2.3 FLOW PROCESS

Wiler, et al (2010:142) described a flow process as steps which, although they vary from one ED to another, typically included: initial presentation or arrival of the patient at the ED, triage, registration, bed or treatment space placement and medical evaluation. In a study conducted by Beck, Balasubramanian and Henneman (2009:1887), the ED flow process was described as sequential steps which included: arrival, triage, registration, bed placement, nurse assessment, medical doctor assessment, tests, nurse procedures, medical doctor procedures, medical doctor discharge, nurse discharge, discharge from the ED or admission to a unit in the hospital.

The input-throughput-output systems theory has become an accepted model that is used to understand the flow process involved in an ED (Paul, et al 2010:560). The input-throughput-output model can represent the ED flow process in the following manner: ED input includes reception and triage, ED throughput includes evaluation by HCPs (nurses and doctors) and diagnostic tests, and ED output focuses on the timely disposition (discharge or admission) of patients (Mumma, McCue, Li & Holmes 2014:505). In the study hospital the input-throughput-output model was applied (see figure 1.1), and each section of the model will be discussed in sections 2.3.1 to 2.3.3.

2.3.1 Input: reception and triage

Arrival time at the ED refers to the time that the patients arrive at the ED to request emergency care (Morris, Boyle, Beniuk & Robinson 2012:461). According to Welch, Stone-Griffith, Asplin, Davidson, Augustine and Schuur (2011:3), arrival time (also referred to as initial presentation) of the patient at the ED denotes the actual first contact with the ED healthcare providers and not necessarily registration time or triage. The arrival time of a patient is when the patient presents himself or herself at the ED and is evaluated (Farrohknia, Castren, Ehrenberg, Lind, Oredsson, Jonsson, Asplund & Göransson 2011:4). The arrival mode of patients differs: some come by

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helicopter (air ambulance), others by road ambulances, whereas some are walk-in patients (patients who come by themselves or are brought by family members, and others who come after having been referred by their general practitioners).

Upon arrival in the ED reception area, whether by ambulance or own transport, a quick assessment is done by the ED nurse and/or doctor to decide if the patient is an emergency patient or not. Patients with low acuity levels remain in the ED waiting room to be triaged (Abo-Hamed & Arisha 2013:24), whereas patients who might be critically sick or injured and have high acuity levels are admitted directly to the ED where the most appropriate areas for them are selected and immediate treatment is initiated (Eatock, Clarke, Picton & Young 2010:4). A quick triage can be done at reception by the first healthcare providers contact in order to identify a critical patient. The practice described is the practice followed in the ED of the study hospital.

2.3.1.1 Triage and acuity level

Eatock, et al (2010:4) indicated that when walk-in patients arrived in the ED they saw the receptionist or an ED healthcare providers at the reception that recorded their arrival time, their details and sent them for triage. Welch, et al (2011:541) defined triage as “the process of assessing patients who present for care by prioritizing access to providers and space according to the urgency of the patient’s need and the complexity of the services required”. In the emergency department, triage refers to the methods implemented in assessing patients’ medical and surgical urgencies immediately on their arrival and, based on the assessment priorities assigned to patients, they transfer them to appropriate areas for treatment (Christ, et al 2010:892). Therefore, by means of triage, patients’ levels of urgency and treatment needs are identified, and the aim is to optimise the waiting time of patients according to the severity of the condition, in other words, to complete the process in the shortest period of time possible (Farrohknia, et al 2011:1). To triage simply means to select or sort (Rosedale, Smith, Davies & Wood 2011:537) and it is an important tool in the ED as it enables nurses to prioritise patients according to the urgency of their need and to ensure that patients receive the appropriate care based on their needs

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(Janssen, Van Achterberg, Adriaansen, Kampshoff, Schalk & Mintjes-de Groot 2011:438).

According to Ding, McCarthy, Desmond, Lee, Aronsky and Zeger (2010:819), waiting time, treatment time and length of stay (LOS) in the ED are mostly determined by the acuity levels of patients. Patients in the ED are classified as medical (medical illness) or trauma (injuries), and as low acuity or high acuity patients (Sharma, Mulcare, Graetz, Greenwald, Mustalish and Flomenbaum 2012:406). Different acuity levels and diagnoses require different management and treatment depending on the urgency and complexity of a condition. High-acuity-level patients are seen as emergencies and are prioritised in the ED, while low-acuity-level patients are non-urgent patients that can be attended to later (Christ, et al 2010:894). Therefore, patients who present themselves at an ED are seen in order of priority based on their needs and not in order of arrival time so as to ensure that the most critically ill or injured patients are attended to first (AL-Reshidi 2013:33). Patients arriving at the ED are triaged and classified according to acuity level, namely, emergency, urgency and non-urgency. There are several triage systems that can be employed in EDs to determine patients' acuity levels, such as the Australian Triage Scale or the Canadian Triage and Acuity scale to name two options (Patel, Rose, O'Brien & Rosamond 2011:2266). All triage systems classify patients according to their urgency levels, which guide their treatment.

According to Hing and Bhuiya (2012:4), emergent patients need to be seen within one minute to 14 minutes, urgent patients need to be seen within 15 to 60 minutes, semi-urgent patients need to be seen within one to two hours and non-urgent patients need to be seen within two to 24 hours. These different classes of patients are all treated differently. Upon arrival in the ED, an emergent patient is rushed to the resuscitation room immediately and the bed registration and the initial evaluation by a nurse and a medical doctor begin simultaneously (Wiler, et al 2012:143). These patients usually arrive by ambulance and they are rushed to the resuscitation room where treatment is initiated immediately (Kuo, Rado, Benedetta, Leung & Graham 2014:1). According to Squire, Tamayo and Tamayo-Sarver (2010:341), ambulances

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often transport older patients and patients that are emergent or very urgent. On the other hand, patients classified as semi-urgent or non-urgent or who are self-referrals usually arrive by their own means. The latter group of patients follow the triage process whereas patients arriving by ambulance are triaged first to free the ambulance staff as soon as possible (Patel, et al 2011:2267).

As indicated, a patient who has a low acuity level will be referred to the triage area for assessment by a nurse and/or a doctor on the basis of which the patient's acuity level is calculated and treatment is started accordingly (AL-Reshidi 2013:33). The first initial contact with the triage nurse and/or doctor includes the taking of vital signs, doing a simple assessment and estimating the acuity of illness by means of a triage tool (Beck, et al 2009:1890). In a study conducted by Sharma, et al (2012:409), it was shown that patients with low acuity scores often waited for a long time to be evaluated and treated and as a result experienced prolonged LOS in the ED. Patients with a high acuity score were seen immediately (Storm-Versloot, Ubbink, Kappelhof & Luitse 2011:822) and did not experience prolonged LOS.

As mentioned earlier, several triage instruments have been developed and implemented with the goal to sort patients according to their clinical urgency (Christ, et al 2010:893). Some of these instruments are the Australasian Triage Scale, the Canadian Triage and Acuity Scale, the Manchester Triage System, the Emergency Severity Index, the Gruppo Formazione Triage System, the Taiwan Triage Scale, the Geneva Emergency Triage Scale and the South African Triage Scale. The South African Triage Scale, which is currently used in South Africa and in sub-Saharan countries (Christ, et al 2010:893-894), was developed and derived from the Cape Triage Scale. The Cape Triage Scale was the first national triage system implemented in South Africa in January 2006 and proved to reduce the waiting time of patients in EDs significantly (Rosedale, et al 2011:537). Rosedale, et al (2011:540) stated that the Cape Triage Scale had been effective in triaging both medical and trauma patients in the ED. The use of the South African Triage Scale, enhances care delivered by emergency centres in South Africa as it allows nurses

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and medical doctors in the ED to assess and prioritise patients and manage them accordingly (Augustyn 2011:29).

The triage process is used in many different ways to attempt to decrease overcrowding and LOS in the ED. Some of the methods that EDs worldwide have implemented to optimise triage systems are: physician triage, supplemented triage and rapid treatment (START), and physician-nurse supplementary triage assistance team (White, Brown, Sinclair, Chang, Carignan, McIntyre & Biddinger 2012:322); Burke, Hines, Ahn, Walters, Young, Anderson, Tom, Clark, Obita & Nelson 2013:303; Cheng, Lee, Mittmann, Tyberg, Ramagnano, Kiss, Schull, Kerr & Zwarenstein 2013:10). The use of these triage strategies has been associated with a decrease in ambulance diversions, a decrease in the proportion of patients leaving the ED without being seen, and an overall decrease in LOS (White, et al 2012:323; Burke, et al 2014:303). These declines were recorded despite an increase in patient volumes and despite the fact that no compromises were made in the quality of patient care (White, et al 2012:322; Burke, et al 2014:303; Cheng, et al 2013:10).

Due to the quadruple burden of disease in South Africa, namely, communicable diseases, non-communicable chronic diseases, injuries and HIV/AIDS, the rate of patients who fall in the higher triage categories when admitted to an ED is high when compared to the rate in developed countries. In developed countries many patients tend to seek medical attention early and the situation in SA could not be established in available literature (Rosedale, et al 2011:540). In South Africa the quadruple burden of disease, coupled with poorly resourced, overcrowded, understaffed and underfunded EDs, increases the pressure under which the HCPs working in EDs in South Africa have to function (Rosedale, et al 2011:537). Triage can facilitate the rapid identification and transfer of low-acuity patients to pre-designated low-acuity areas and/or hospitals like for instance, level 2 and level 3 hospitals (See section 2.3) (Sharieff, Burnell, Cantonis, Norton, Tovar, Roberts, VanWyk, Saucier & Russe 2013:427). After being triaged, patients are usually registered before being admitted to the ED.

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2.3.2 Throughput: admission to emergency department

According to Welch, et al (2011:542), registration is "the process of identifying and recording information to generate a patient-specific record that includes information on financial responsibility as well as socio-demographic statistics for billing", making it distinct from patient identification. The admission area of the ED deals with registering a patient on the hospital's system and creating and assigning a hospital file for each patient. At registration, the time of registration is recorded on the hospital's computer system (Henneman, Nathanson, Li, Smithline, Blank, Santoro, Maynard, Provost and Henneman 2010:106). In a study conducted by Wiler, et al (2010:154) it was found that the implementation of bedside registration by clerks in a non-full-capacity ED could have a positive effect on the ED and could reduce waiting time as well as LOS in the ED. However, if registration was done immediately after triage inside the ED, it could improve ED throughput, but only when ED beds were available. As a result, bedside registration could only be performed when the ED had beds available and bedside registration should be avoided in overcrowded EDs and on busy days (Beck, et al 2009:1892). Consequently, patient registration has been cited as a major delay in care as the traditional registration after triage requires that all patients (urgent and non-urgent) be registered after triage before being evaluated in the ED (Eitel, Rudkin, Malvehy, Killeen & Pines 2010:74). Patients are then admitted to the ED according to their triage classification.

2.3.2.1 Classification

Emergency departments are generally divided into different treatment areas, which include a resuscitation area, a high-dependency unit, a trolley bay, a minor injuries area and a paediatric area (Baboolal, Griffiths, Knight, Nelson, Voake & Williams 2012:972). Patients presenting themselves at the ED are classified to be placed in the above-mentioned areas according to their acuity level determined during triage. Critically ill or injured patients arriving by ambulance or brought by relatives, friends or any other person are rushed to the resuscitation area and treated immediately (Kuo, et al 2014:2). Patients in the ED are assessed and classified according to the level of urgency as assigned to them during triage to identify priorities for receiving treatments. Kuo, et al (2014:2) further classified patients in five categories: critical,

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emergency, urgent, standard and non-urgent. In many EDs the classification is further influenced by whether the patient is a medical or a trauma case (Calvello, et al 2013:43) and is also used to place patients in different areas in the ED.

2.3.2.2 Bed placement

According to Stone-Griffith, Engelbrecht, Cheung, Korwek & Perlin (2012:170), bed placement refers to placing a patient in a space in the ED treatment area, such as on a bed, a stretcher or a chair, where a medical examination can be initiated even if that space is not permanent. The first step after triage and registration is bed placement in the ED or treatment area. Patients in the ED are placed in different treatment areas according to their level of acuity as confirmed by triage or by a doctor's assessment. Patients' are generally ranked according to their conditions as emergent, urgent non-urgent or routine (Storm-Versloot, et al 2011:822). It is, therefore, crucial to place patients in the ED treatment room according to their classification and acuity level to enable appropriate treatment and early discharge or transfer of patients out of the ED.

As patients arrive in an ED without appointments it is sometimes a challenge to have adequate treatment areas/beds for the volume of patients in the ED (Anderson, Butcher & Moreno 2010:1). The number of patients admitted to the ED increases the workload of the ED healthcare providers and the volume and/or high acuity levels of patients might ultimately lead to the patient ratio in the ED being out of balance (Morris, et al 2012:461). In a study conducted by Henneman, et al (2010:109) it was found that patients in the ED were placed on chairs approximately 50% of the time as there were not enough beds or stretchers or other spaces commonly used as treatment spaces. According to Harris and Sharma (2010:511), the numbers of nurses, doctors and beds have a direct effect on LOS.

2.3.2.3 Management

Staffing an ED, which is a 24-hour, seven-days-a-week unit, requires significant human resources and expense (Soong, et al 2013:303). The staffing in the ED will affect the management of the patient by the ED nurse, the ED doctor and specialists.

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The management of patients during the throughput phase is discussed in terms of the management by the emergency nurse, the emergency doctor, specialists and diagnostic and laboratory tests.

⇨ **First contact ED nurse**

The ED nurse, who is a patient's first contact, plays an important role as this nurse will stay at the patient's bedside at all times. The efficient functioning of the ED depends on the adjustment of resources, specifically the ED nursing staff, to accommodate bed space and patient volume (Sharieff, et al 2013:431). It is vital to have adequate numbers of healthcare providers, including ED nurses, to staff the ED as understaffing can place a burden on ED healthcare providers and reduce the quality of patient care (Pham, Story, Hicks, Shore, Morlock, Cheung, Kelen & Pronovost 2011:489). According to Singer, et al (2011:1326), patients that have been seen by the healthcare providers and wait to be admitted to a ward tend to place an increased burden on ED healthcare providers who are busy evaluating and treating new and potentially higher priority and unstable patients. In California in the United States of America there is a mandatory nurse-patient ratio of 1:4, which has led to reduced waiting times in the ED (Rathlev, Obendorfer, White, Rebholz, Magauran, Baker, Ulrich, Fisher and Olshaker 2011:164).

⇨ **First contact ED doctor**

Emergency department patients are treated primarily by an ED doctor, and LOS is directly linked to the number of patients in the ED that the ED doctor must see (Cho, et al 2011:399). The number of patients in the ED, the acuity levels of patients and the number of ED doctors available are associated with LOS in the ED (Henneman, et al 2010:110). Emergency department doctors might delay the treatment and management of patients and other therapeutic interventions as well as the re-evaluation of patients already in the ED, owing to the increased burden of unstable, high-acuity patients coming in (Singer, et al 2011:1326). Prolonged LOS and delayed care by emergency doctors could compromise six dimensions of care, namely, safety, effectiveness, patient-centredness, efficiency, timeliness and equity (AL-Reshidi 2013:34). The ED doctor is ultimately responsible to discharges the patients

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from the ED or refers the patients to specialists after his or her initial assessment and treatment for definitive care and possible admission to the hospital.

⇨ **First contact specialist**

After being seen by the ED doctors, patients in the ED are referred to the specialists if and as required. Speciality consultation is an important aspect of the throughput process and patients are likely to stay in the ED until the consultation with the specialist is finished (Cho, et al 2011:399). Consultations with specialists in the ED affect patients' LOS as these specialists are tasked with admitting, transferring or discharging patients (Cho, et al 2011:399). As patients are likely to stay in the ED until the consultation process is completed, their LOS will be directly affected by the specialist care (Cho, et al 2011:399). Many of the first-line-on-call specialists in the ED are junior residents or doctors who are tasked with assessing the patient first before contacting a senior specialist in their department (Cho, et al 2011:400). The hierarchical decision-making approach causes a delay as the decisions made by junior doctors must be discussed with senior doctors before the senior doctors make a final decision, which prolongs the patients' LOS (Vegting, Nanayakkara, Van Dongen, Vandewalle, Van Galen, Kramer, Bonjer, Koole and Visser 2011:397). In academic or training hospitals most specialists work with medical doctor students who need supervision and education and require time to formulate plans and conduct initial presentations, which prolong LOS even further (Paul, et al 2010:566; Soong, et al 2013:299).

According to Vegting, et al (2011:397), consecutive consultations by different specialists regarding patients with complex pathology also lead to prolonged LOS. Some patients with poor prognoses or do-not-resuscitate orders also tend to stay longer in the ED as specialists are reluctant to admit these patients to the limited amount of available beds that can be used for patients with better prognoses (Hsu, et al 2012:4). Specialists' admissions orders are also affected by inpatient bed availability (Cho, et al 2011:400). As patients cannot be admitted to a department (ward) if no bed is available, patients are sometimes left in the ED until a bed becomes available. Most of the time patients stay in the ED awaiting results of all the

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diagnostic and laboratory tests done on them which also prolong their LOS in the ED.

⇨ **Diagnostic and laboratory tests**

Patients admitted to the ED are managed, but also require diagnostic procedures to enable the healthcare providers to make a diagnosis and treat the patient appropriately. The number of patients in the ED is directly associated with the waiting time for specific procedures required and for diagnostic and laboratory results (Beck, et al 2009:1891). Some tests are ordered by the ED doctor before referring the patient to the specialists and sometimes the specialists will add tests after being consulted. As a result, the EDs are dealing with boarding of patients and overcrowding, which impact on fast and efficient radiology and pathology services (Forero, et al 2011:4 of 6). It takes time before test results are available and these results are required as they are used to guide the treatment of patients and aid in the decision whether the patient should be admitted to the hospital or discharged to their homes (Vegting, et al 2011:397). One specific and important diagnostic procedure which is being used increasingly in the ED and which is associated with an increase in the LOS of the patient in the ED is computed tomography (Cimona-Malua 2010:63; Kocher, Meurer, Desmond & Nallamothu 2011:533). The elapsed time between receiving all diagnostic results and admitting/discharging a patient has the biggest influence on the LOS in the ED (Vegting, et al 2011:397).

2.3.3 Output: Discharge

Once patients have been assessed and treated in the ED by the healthcare provider and, if appropriate, the specialists, patients are usually discharged from the ED by either being admitted to the hospital (ward), transferred to another hospital or sent home (AL-Reshidi 2013:33). The healthcare providers in the ED usually have limited control over the discharge of a patient to a ward in the hospital, but they have more control over patients who are discharged home (Henneman, et al 2010:109). In a study done by Sharma, et al (2012:411), the establishment of a discharge facilitator team, consisting of an attending emergency physician, a physician assistant and a nurse, proved to reduce LOS for all low-acuity patients in the ED. The reason for the

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success of this discharge facilitator team is because the team is able to triage, treat, quickly manage and discharge a group of patients, thereby decreasing the number of patients in the ED.

AL-Reshidi, et al (2013:34) found that the inability to admit critically ill or injured patients to an appropriate treatment space when required can lead to overcrowding and prolonged LOS. Hsu, et al (2012:3) found that patients with more complex conditions remained in the ED for longer periods while awaiting discharge to a critical care unit in the hospital. Discharge of patients from the ED and their admission to the hospital is done only when the specialist consultations and tests in the ED are finished and as a result the time between receiving all diagnostic results and admission or discharge affects patients' LOS in the ED (Cho, et al 2011:401). The inability to discharge patients from the ED for a long period of time results in overcrowding, prolonged LOS and an ineffective flow of patients (Henneman, et al 2010:108). When resources like inpatient beds and staff are available the LOS of the patients in the ED is positively affected, but when the resources are not available, the LOS is negatively affected.

The availability of inpatient beds is the major factor contributing to prolonged LOS in the ED. Admission of low-risk patients in the ED and the hospital leads to high-risk patients staying longer in the ED as the healthcare providers Santos, Lima, Pestana, Gerlet & Erdmann 2013:142' time is shared among all patients (Asha, Titmuss & Black 2011:36). In the study hospital, the shortage of staff has forced management to close some inpatient and ED beds. According to Hsu, et al (2012:3), another factor effecting the LOS in the ED are patients with more complex co-morbidities and those with "do-not-resuscitate" orders, as they are more likely to be left in the ED even though there are inpatient beds (Hsu, et al 2012:4).

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2.4 LENGTH OF STAY

Length of stay in the ED is defined as the time between a patient's arrival at the ED and the patient's discharge from the ED (Cimona-Malua 2010:28; Stauber 2013:222). The LOS in the ED is further explained by Brick, Lowes, Lovstrom, Kokotilo, Villa-Roel, Lee, Lang and Rowe (2012:135) as the time a patient arrives for triage in the ED until the patient's departure from the ED. Length of stay in the ED includes waiting time. Stauber (2013:221) defined waiting time as the time between arrival in the ED and the time a patient was seen by a provider.

In an attempt to monitor LOS, the centres for Medicaid and Medicare services released new regulatory standards for EDs in January 2012, while in South Africa literature concerned could not be established. These require EDs to report arrival time at the ED, triage time, the time of the decision to admit and the transfer time from the ED (Sharieff, et al 2013:427). Hence many EDs, including South African EDs, measure and monitor completion time to identify delays in the EDs (Ding et al 2010:814; Cimona-Malua 2010:63).

2.5 EFFECTS OF PROLONGED LENGTH OF STAY

Prolonged length of stay can have an effect on the quality of patient care, healthcare providers, EDs, ED resources and the whole organisation (the hospital). The effects of prolonged LOS are discussed below.

2.5.1 Effects on quality of care

Prolonged length of stay affects the quality of patient care; therefore, it is important to try and identify potential areas of delay that could lead to prolonged LOS in the ED so as to address these delays and improve the quality of ED care. Prolonged LOS of patients in the ED, threatens patient safety as well as public health (Soong, et al 2013:229). Prolonged LOS adversely affects the functionality of the ED, for instance, research indicated that in large EDs approximately 40% of staff time was spent on

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caring for patients waiting to be admitted to wards rather than caring for new emergency patients (Forero, et al 2011:6; Shetty, et al 2012:374). Singer, et al (2011:1326) posited that prolonged LOS was associated with increased hospital LOS and inpatient mortality rates.

A manifestation of the quick management of patients in the ED has been poor health outcomes, which result in patient dissatisfaction due to quality of patient care being compromised by prioritising on quantity and focussing in time (Jones & Schimanski 2010:396; Vegting, et al 2011:392). Patients are less frequently re-evaluated, and workups as well as other therapeutic interventions may be delayed (Singer, et al 2011:1328). Delay in care due to prolonged LOS in the ED can prolong pain and suffering and result in increased mortality and morbidity for patients, longer hospital LOS and delay of transfer to the critical care unit (Beck, et al 2009:1887; Singer, et al 2011:1328; Djokovic 2012:5). According to Djokovic (2012:5), critical care patients who had prolonged LOS in the ED were at an increased risk for prolonged hospital stay, deterioration in condition, and death.

In the triage area or the waiting room, prolonged LOS limits the healthcare providers' ability to evaluate newly admitted patients within the recommended time, resulting in other patients leaving the ED without being seen (Henneman, et al 2010:111). Some patients leave without being evaluated as they become tired of waiting for ED services (Rogg, White, Biddinger, Chang & Brown 2013:379).

In the case of prolonged LOS, the quality of care is affected and patient safety may be endangered owing to a shortage of resources, such as beds, leading to patients being treated in hallways or on chairs without monitors (Mosely, Dickerson, Kasey, Key, Moore, Vagarali & Rund 2010:456; Henneman, et al 2010:111). A delay in patient care, for instance when patients wait for evaluation and treatment is a significant issue. Prolonged LOS can delay the appropriate treatment of patients, lead to overcrowding and compromise patients' privacy and confidentiality (Henneman, et al 2010:111). Prolonged LOS of patients in the ED also prevents boarders from receiving the same level of care they would have received in inpatient

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beds if they had been admitted in their appropriate departments (Singer, et al 2011:1324). Thus, patients with prolonged LOS in the ED have an increased risk of poor patient outcomes and compromised care.

2.5.2 Effects on healthcare providers

Prolonged LOS in the ED resulted in overcrowding, which led to a delay in treatment and a consequent reduction in the quality of care with an increase in the potential for adverse events (Stauber 2013:221). As a result of prolonged LOS in the ED, the burden on ED healthcare providers increase, which, in turn, affects the quality of patient care. ED healthcare providers (both nurses and doctors) become stressed about high volumes of patients, which are the result of overcrowding due to prolonged LOS (Al-Reshidi 2013:40). Due to the high volumes of patients that stay in the ED for longer, healthcare providers are under constant strain to cope and to attempt to evaluate, diagnose and treat patients in less time (Crawford, Morphet, Jones, Innes, Griffiths & Williams 2013:2). This phenomenon reduces efficiency and quality of care and increases the risk of medical errors and the potential for adverse events, all of which put the healthcare providers at risk (Horwitz, Green & Bradley 2010:1; Nugus, et al 2013:3; Stauber 2013:221).

Healthcare providers become overwhelmed by the huge amount of work to be done and run the risk of making mistakes, for instance with monitoring and medication (Mosely, et al 2010:453). Due to the strain to cope with the increasing demand, healthcare providers attempt to assess, diagnose and treat patients in less time, resulting in higher levels of stress in healthcare providers, increased medical errors, poor patient outcomes, decreased nurse and doctor productivity and decreased morale among healthcare providers (Crawford, et al 2013:2; Al-Reshidi 2013:40). It is, therefore, clear that prolonged LOS and overcrowding have a negative effect on the ED healthcare providers.

2.5.3 Effects on the emergency department and resources

As a result of prolonged length of stay, resources (like staff, space and equipment) become limited, which in turn leads to an increase in the cost of care and the

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lowering of staff morale (Aacharya, et al 2011:1). Prolonged LOS of patients in the ED results in overcrowding (Singer, et al 2011:1324). Overcrowding is associated with the following: negative patient outcomes (such as increased morbidity and mortality), lower quality of care, depleted resources and an increased burden on the staff and the healthcare system. Overcrowding leads to boarding of patients and to depletion of resources in the ED. Patients who are boarding in the ED tend to consume the limited resources of the ED while new patients are kept waiting for assessment and treatment (Ye, Zhou, He, Shen, Gan & Zhang 2012:635). In addition, patients who board in the ED and deplete its resources prevent other patients from being treated in a timely manner (Huang, et al 2010:1; Beck, et al 2009:1889).

As a result of prolonged LOS, time spent on patient care is ineffective. Singer, et al (2011:1326) found that less time was dedicated to patients in the ED as new admissions were focussed on, whereas Richardson and Mountain (2009:378) indicated that less time was spent on new admissions as the focus was on patients already in the ED. Either way, LOS affects all patients in the ED and may have negative effects on the organisation as a whole.

2.5.4 Effects on the organisation

Prolonged length of stay can increase the percentage of time the ED is on ambulance diversion, which impairs access to emergency care and compromises clinical care in the hospital (Henneman 2010:111; Prabath, et al 2010; Forero, et al 2011:1). As a result of prolonged LOS the ED's capacity to respond to disasters decreases (Al-Reshidi 2013:33). In academic hospitals, prolonged LOS results in negative effects on teaching and it also results in miscommunication (Paul, et al 2010:560) which can lead to several adverse effects.

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2.6 STRATEGIES TO ADDRESS LENGTH OF STAY

The building blocks of quality and operational performance of an ED depend on the design, implementation and assessment of innovative solutions (Wiler, et al 2010:142). For over 20 years researchers have developed models and proposed decision-making strategies and policies for the management of prolonged LOS in EDs (Kuo, et al 2014:3). Some of the solutions were directed at the input phase, some at the throughput phase and some at the output phase. Recognising these efforts and strategies, there are still gaps and new strategies will have to be planned and implemented in the future.

In a study conducted by Oredsson, et al (2011:7) it was found that team triage and implementation of fast track for patients with less severe symptoms resulted in shorter LOS in the ED. This fact was confirmed by Wiler, et al (2010:157) who stated that proficiency in processing patients at the ED front end could minimise length of stay and improve patient satisfaction.

The throughput phase in the ED is managed by decisions related to having a non-pooling system in the ED, optimising existing resources and processes, doing simulations, introducing advanced nursing interventions and implementing computerised consultations, in particular in an academic hospital (Song, Tucker and Murrell 2013:22; Baboolal, et al 2012:560,401 Stauber, Cho, Jeong, Han, Yeom, Park, Kim & Hwang 2011:224). Improving ED throughput waiting times and LOS, which would improve patient safety and satisfaction, should be considered (Rogg, et al 2013:375) at all time. The non-pooling work system mentioned earlier refers to assigning patients to a doctor and nurse team immediately on arrival at an ED, a system that is said to improve functioning of an ED (Song, et al 2013:22). Furthermore, emergency department efficiency can be improved by introducing advanced nursing interventions in the ED (Stauber 2013:224). Existing resources and processes can be maximised by improving ED services and the support provided by radiology, laboratory and consultation services. At the same time

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transfers to other departments (wards) can be speeded up when the ED is busy (Baboolal, et al 2012:560).

Strategies to address LOS in the ED during the output phase include improving discharge processes, increasing ED capacity and implementing human and physical resources (Baboolal, et al 2012:560). However, Mumma, et al (2014:507) found that increasing ED capacity had no significant effect on LOS but that it led to the ED becoming a boarding area rather than a treatment area. Sharma, et al (2012:406) stated that creating a discharge facilitator team consisting of a nurse and a physician could improve LOS in the ED in respect of low-acuity patients. The implementation of computerised management systems in an academic hospital also proved to reduce LOS (Cho, et al 2011:401).

The introduction of an emergency medical wards service and an observational unit is regarded as a proposed solution for reducing LOS in the ED (Henneman, et al 2010:111; Lo, et al 2013:119). Another solution for the output phase is simulation. According to Paul, et al (2010:568), simulation can be used as a systems analysis tool to provide insight into ED LOS and overcrowding by investigating and exploring solutions (Paul, et al 2010:568). For testing policies, hypotheses, scenarios and re-engineering ideas in health care settings, simulation is the recommended tool to use (Paul, et al 2010:560).

In an effort to reduce the LOS in EDs, some countries are enforcing access targets. In 2000, the United Kingdom launched the National Health Service Plan to reach the four-hour rule target by the year 2004 (Crawford, et al 2013:3). The target rule indicates that no patient should wait longer than four hours in the ED from arrival to admission or discharge. A similar target was introduced in 2008 in Western Australia, and the Australian government introduced a national emergency access target in 2010 (to be reached by 2015) which requires patients in the ED to be reviewed and transferred or discharged from the ED within four hours. The New Zealand government aimed to reduce LOS in the ED by implementing a longer six-hour target in 2009 (Forero, et al 2011:1). However, in a study conducted by Richardson and

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Mountain (2009:371) the duration of LOS in an ED was found to be more than eight hours.

2.7 SUMMARY

In this chapter the focus was on a review of the literature on length of stay in an ED and specifically the studies done on the flow process of patients in the ED and the effects of the ineffective flow processes in the ED. In the investigation the open systems theory model was used according to which input, throughput and output phases were compared to reception and triage, admission to the emergency department and discharge. The possible challenges that might be experienced by patients, healthcare providors and the organisation (hospital) were discussed. Despite implementing all the proposed solutions to reduce LOS in the ED, EDs globally are still struggling to improve LOS (Paul, et al 2010:560; Wiler, et al 2010:142; Ye, et al 2012:634; Hsu, et al 2012:1) and the reality of this challenge is on-going in the world.

In Chapter 3 an in-depth discussion of the research design used for this study as well as of the ethical principles that were heeded in this study will follow.

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CHAPTER 3: RESEARCH DESIGN AND METHODS

3.1 INTRODUCTION

Chapter 2 provided an in-depth literature review on topics relevant to the study, namely, the flow of patients in the emergency department, different levels of care in the emergency department, length of stay in the emergency department and the causes of ineffective flow of patients in the emergency department. Chapter 3 will provide a detailed discussion of the research design, research methodology used for this study as well as of the ethical principles that were applied in this study.

3.2 RESEARCH DESIGN

A research design according to Grove, Burns and Gray (2013:195), is a blueprint for conducting research that maximises control over factors that could interfere with the validity of the findings and also guides the researcher in planning and implementing the study in a way that will most likely ensure the achievement of the intended goal. Brink, et al (2006:92) described a research design as the overall approach which incorporates aims, methods and predicted outcomes. Thus, a research design is the plan according to which data is collected to investigate the research question in the most economical manner. In addition, Brink, et al (2006:92) defined research design as a set of logical steps taken by the researcher to answer the research question and as the plan that served to designate when, where and how data would be collected and analysed. According to Parahoo (2006:182), the design is coupled with the methods and procedures and together they are the mechanisms for finding solutions to the research question(s). In addition, Parahoo (2006:183) described research design as the planning and designing of strategies for the collection and analysis of data: therefore, a research design is a plan that describes how, when and where data is to be collected and analysed, specifies the steps and actions to be

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taken and represents the thinking, beliefs and strategies of the researcher and the logic of the enquiry.

Brink, et al (2006:92) stated that a research design determined the methodology used by the researcher to obtain sources of information (such as subjects, elements and units of analysis) to collect and analyse the data and to interpret the results. The type of design directs the selection of a population, sampling procedure, methods of measurement and a plan for data collection and analysis (Grove, et al 2013:43). The choice of a research design depends on the researcher's expertise, the problem, the compatibility of resources available (such as time and money), the purpose of the study and the desire to generalise findings (Grove, et al 2013:43). The selection of the design, as mentioned by Parahoo (2006:184), depends on the beliefs and values of the researcher, the resources available and the accessibility of respondents. According to Hek, Judd and Moule (2005:25), a research design offers a plan of how the research will proceed and it includes consideration of the research approach to be taken, the research methods, data collection tools and methods of data analysis to be employed. The purpose of a design is to achieve greater control and thus improve the validity of the study in examining the research problem and increase the probability that the study results are accurate reflections of reality (Grove, et al 2013:36).

A quantitative, non-experimental, descriptive, retrospective design was used in this study to determine the LOS in the ED and the factors contributing to LOS. The purpose of using this design was to provide a description of the situations as they naturally occurred and it was chosen since it allowed for the effective collection of a large amount of data on a problem in a retrospective manner.

3.2.1 Quantitative design

Quantitative research refers to the formal objective and systematic process of generating information about the world (Burns & Grove 2009:26). Quantitative design is also defined by Polit and Beck (2012:17) as a set of orderly and disciplined procedures aimed at acquiring knowledge. Therefore, a researcher gathers data

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using a specified plan and formal instruments to collect the required information. Rigorous control is crucial to identify and limit the effects of extraneous variables not under study (Burns & Grove 2005:26). Thus, the researcher must adhere to detail, be disciplined and be accurate (Burns & Grove 2005:39).

According to Parahoo (2006:48), quantitative research has its roots in positivism and is derived from a philosophical paradigm that views human phenomena as being amenable to objective study, particularly to measurement. In quantitative research, the researcher is able to state in advance the research questions or hypotheses, operationalize the concepts and devise or select the methods of data collection (Parahoo 2006:48). The analysis and the findings are presented in numerical and/or statistical language. When using quantitative research, the larger samples that are obtained can provide valuable data within a short period of time at relatively low cost (Parahoo 2006:58). The ways in which data are collected and analysed in quantitative research are expected to be free from bias on the part of the researcher and the participants in the study (Parahoo 2006:51). In effect, in quantitative research it is the tool that does the measurement and not the researcher. Quantitative research will be conducted in this study as it involves rigour which will enable the researcher to strive for excellence.

Quantitative research is often used for studies where the researcher wishes to construct a picture of a phenomenon or give an account of events as they naturally occur (LoBiondo-Wood & Haber 2010:232). In quantitative research the researcher explores relationships and do not manipulate them as independent variables (Grove, et al 2013:36), which was the case in the current study as the researcher investigated events that had already occurred. Quantitative research was used in this study as it is highly useful in generating knowledge in a variety of situations in which it is difficult, unethical or even impossible to employ an experimental approach. According to Brink, et al (2006:92), quantitative design can be divided into experimental and non-experimental designs.

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3.2.2 Non-experimental design

A non-experimental design was used in this study: non-experimental research is when the researcher does not intervene by influencing the independent variable (Polit & Beck 2012:234). A non-experimental design could be described according to the time sequence in which data was collected (Brink, et al 2006:102). Non-experimental designs are mostly used in nursing research due to the fact that most human attributes are not subject to change and do not allow for experimentation to occur (Brink, et al 2006:102). In this study, the data collected did not involve contact with humans nor did it influence treatment provided to patients in the ED as only patients' files were used to collect retrospective data.

In accordance with a description by Brink, et al (2006:102), the design of this study was non-experimental as the research was carried out in a natural setting and phenomena were observed as they occurred with no manipulation, no intervention of the independent variable nor control of the setting by the researcher. The major purpose of non-experimental research is to describe phenomena and explore and explain the relationships between variables without the researchers' interference to manipulate and influencing them as independent variables (Polit & Beck 2012:234). Non-experimental designs require a clear, concise problem statement that is based on a theoretical framework and the researcher needs to consider the extraneous variables that might threaten validity (LoBiondo-Wood & Haber 2010:232).

3.2.3 Descriptive design

A descriptive design was selected for the current study as it provides an account of characteristics about particular individuals, situations or groups (Burns & Grove 2009:24) and describes the variables in order to answer the research question with no intention of establishing a cause-effect relationship (Brink, et al 2006:104). According to Polit and Beck (2012:194), descriptive design is aimed at observing, exploring, describing and documenting aspects of a situation as it naturally occurs.

A descriptive study in a quantitative research is considered the initial investigation of a research problem and the researcher tries to describe accurately the findings

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derived from careful systematic collection and recording of information or data (Ogier 1999:39; Burns & Grove 2009:104). Descriptive studies are used when more information is required in a particular field through the provision of a picture of the phenomenon as it occurs naturally (Brink, et al 2006:102). Hence concepts are described and relationships are identified that provide a basis for further quantitative research and theory testing (Burns & Grove 2009:51).

Descriptive research can be used to generate new knowledge about concepts or topics on which limited or no research has been done. Furthermore, a descriptive design can be used to explore and describe phenomena in real-life situations (Burns & Grove 2009:45). In descriptive research a researcher examines variables in natural environments without manipulating variables or imposing treatments (Burns & Grove 2009:287-293). As a result, protection against bias is achieved through linkages between conceptual and operational definitions of variables, sample selection and size, valid and reliable instruments and data collection procedures that achieve some environmental control (Burns & Grove 2009:292).

Descriptive research is designed to gain more information about characteristics within a particular field of study and provide a picture of situations as they naturally happen (Burns & Grove 2009:292). This kind of design may be used for the purpose of developing theory, identifying problems with current practice, justifying current practice, making judgments or determining what others in similar situations are doing (Burns & Grove 2009:293). Descriptive design is usually conducted when little is known about a phenomenon; it provides the knowledge base and potential hypotheses to direct the conduct of correlational, quasi-experimental and experimental studies (Burns & Grove 2009:293). Thus, it is a means of discovering new meaning, describing what exists, determining the frequency with which something occurs and categorising information.

When using a descriptive design, a great deal of information can be obtained from a large population in a fairly economical manner, as was done in this study. Furthermore, if a sample is representative of the population, a relatively small

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number of respondents can provide an accurate picture of the target population (LoBiondo-Wood & Haber 2010:234). However, the information obtained tends to be superficial and it can be time-consuming to obtain (LoBiondo-Wood & Haber 2010:235).

In descriptive design the emphasis in the collection of data is on structured observation, questionnaires, interviews or survey studies. In the current study the descriptive design was used as it enabled the researcher to observe, describe and document aspects of a situation as it naturally occurred (Brink, et al 2006:103). A descriptive design can also serve as a starting point for hypothesis generation or theory development and can be further described according to the time sequence in which data is collected (Polit & Beck 2012:226), as was the case in this study where retrospective data was collected.

3.2.4 Retrospective design

Parahoo (2006:192) stated that “a wealth of valuable information resides in people and documents which can be helpful to shed some light on many current issues or concerns” and as a result, records are kept for the purpose of describing and accounting for what people do. Thus, patients’ notes are not collected for the purpose of research but can be used retrospectively to explain and inform current phenomena. Hek, et al (2005:48) described retrospective design as ex-post facto, which means after the effect, because it allows an investigation about a relationship between two or more variables to be done but after the events have been allowed to happen in the natural course of events without any interference. In the case of retrospective designs, a researcher wants to study an effect and will search for some causative factor of that effect.

Polit and Beck (2012:735) defined retrospective design as “a study design that begins with the manifestation of the dependent variable in the present and then searches for the presumed cause occurring in the past”. In addition, retrospective design was described by Burns and Grove (2005:235) as a part-of-the-time dimensional design in terms of which the cause and the effect that was proposed

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had already taken place. A retrospective design was chosen for the current study because it enabled the researcher to measure variables that had occurred in the past. The researcher obtained data from patients' medical records retrospectively; once the patient had been transferred from the ED and the file was available making the data unaffected.

Retrospective study refers to the study of a current phenomenon based on information from the past with the aim to explain the current phenomenon by examining factors that are associated with it or have given rise to it (Brink, et al 2006:10). In retrospective studies the dependent variable has already been affected by the independent variable, and the researcher attempts to link present events to events that occurred in the past (LoBiondo-Wood & Haber 2010:241). Thus, when using a retrospective design, the researcher starts with an effect and works backwards to determine what was associated with this effect in the past (Brink, et al 2006:105). Both the proposed cause and the proposed effect have already occurred and, therefore, the researcher relies on information from the past in order to understand the current problem. In this study, the research problem was to identify areas of delay that could lead to prolonged LOS in the ED (Parahoo 2006:471).

Retrospective design is inexpensive and can be done quickly: a large sample from a given population can provide meaningful information about how variables function in relation to one another (Brink, et al 2006:106). Drawbacks that can be encountered when conducting a retrospective study are incomplete records (as was the case in this study) or difficulty in making sense of records (Brink, et al 2006:193). In addition, the researcher relies on existing data that was most probably not collected for research purposes and are, therefore, lacking the rigour with which research is carried out (Parahoo 2006:193).

3.3 RESEARCH METHODS

According to Botma, Greeff, Mulaudzi and Wright (2010:311), research methodology refers to "the general approach the researcher takes in carrying out the research

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project: to some extent, this approach dictates the particular tools the researcher selects". Polit and Beck (2012:12) further defined research methodology as techniques used during the research investigation to structure the study and gather and analyse data relevant to the research question. Thus, research methodology involves a set of orderly disciplined procedures to acquire information. Holloway and Wheeler (2010:287) described research methodology as the framework of theories and principles on which the design and method were based.

3.3.1 Study population / Unit of analysis

According to Brink, et al (2006:123), population comprises all the members or units of a clearly defined group of people, objects or events. In this study, unit of analysis was used in place of population as patients' files (a unit) were used and not patients. Polit and Beck (2012:745) defined a unit of analysis as the object of study that researchers observed, described and explained with the intention of drawing conclusions from it. Polit and Beck (2012:739) defined population as the whole set of individuals or objects that had some characteristics in common.

According to Terre Blanche, Durrheim and Painter (2006:133), population is the larger pool from which a researcher draws sampling elements and to which the researcher wants to generalise the findings of the study. A population is also referred to as the entire set of individuals or objects that have some common characteristics and represent the entire aggregation of cases in which a researcher is interested (Polit & Beck 2012:738). Population includes all the individuals or objects with common defining characteristics and is not restricted to humans (Polit & Beck 2012:273,738), as was the case in this study. According to Grove, et al (2013:44), the population is all the elements (individuals, objects or substances) that meet certain criteria for inclusion in a given universe. De Vos, et al (2011:93) referred to units of analysis as the specific objects or elements whose characteristics a researcher wished to describe or explain and about which data would be collected. Therefore, a unit of analysis is also known as the basic unit or focus of a researcher's analysis (Polit & Beck 2012:745).

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Grove, et al (2013:391) defined the target unit of analysis as the entire set of individuals or elements who met the sampling criteria. Polit and Beck (2012:274) referred to the target unit of analysis as the aggregate of cases about which the researcher would like to generalise.

According to Grove, et al (2013:351), an accessible unit of analysis is the portion of the target unit of analysis to which a researcher has reasonable access. Polit and Beck (2012:274) further defined an accessible unit of analysis as the aggregate of cases that conformed to designated criteria and that were accessible for the study. In this study, the accessible unit of analysis was the files of all patients who had been managed in the ED of the study hospital, and the target unit of analysis was the files of all patients who had been managed in the ED of the study hospital during the period 1 June 2015 to 31 August 2015. This time period was chosen due to the seasonal nature of the study ED as many patients were seen at this time.

The inclusion criteria stipulated for the unit of analysis were as follows:

- Files of adult patients managed in the ED during the period of 1 June 2015 to 31 August 2015
- Files of adult patients who remained in the ED for 12 hours or more
- Files of patients who were 18 years and older
- Files of both males and females

The exclusion criteria used in this study were as follows:

- Files of patients who left the ED without being seen by a doctor
- Files of patients who signed refusal of treatment forms or discharged themselves from the ED against a doctor's decision before a decision about a discharge destination had been made
- Files of patients who were declared dead on arrival at the ED
- Files of patients with missing data on length of stay in the ED
- Files of patients who were admitted for a prescription, that is, who were managed only in the triage area and not in the ED

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3.3.2 Sampling plan

A sampling plan involves the process of describing the strategies that will be used to obtain a sample for the study and of making the sample selection (Grove, et al 2013:351,357). According to De Vos, Strydom, Fouche and Delport (2011:222), a sampling plan is developed to enhance representativeness, reduce systematic bias and decrease sampling error. Polit and Beck (2012:742) described a sampling plan as a formal plan specifying a sampling method, a sample size and procedures for recruiting subjects. According to Polit and Beck (2012:59), in quantitative research a sample's adequacy is assessed by its size and representativeness. The sampling plan specifies in advance how the sample will be selected and recruited and it also specifies the number of subjects (Polit & Beck 2012:273).

In the current study, a sample plan was used to select the sample and to ensure that the sample selected would be representative of the population a sample frame was developed. The sample plan used for this study comprised of a unit of analysis, sampling frame, selection of the study sample and completion of the audit tool for the files that met the inclusion criteria.

3.3.2.1 Sampling

Sampling refers to "the process by which elements are drawn from the population" (Fox & Bayat 2007:54). Doordan (1998:111) defined sampling as the process of selecting a group or a sample of subjects from the entire population for participation in a research study. Sampling involves selecting a group of people, events, behaviours or other elements (in this study, files of patients) with which to conduct the study as well as selecting cases to represent an entire population (Polit & Beck 2012:742; Grove, et al 2013:351;). According to Botma, et al (2010:124), sampling is the process of sampling a portion of the population to represent the accessible population.

During the sampling process, research participants are selected from an entire population based on decisions about which people, setting, events, behaviours and/or social process to observe (Terre Blanche, et al 2006:49). The main concern in

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sampling is representativeness and the aim is to select a sample that will be representative of the population about which the researcher claims to draw conclusions (Terre Blanche, et al 2006:49). In the current study the researcher endeavoured to achieve representativeness by drawing random samples. Systematic sampling, a probability sampling method, was used in this study. Systematic sampling involves selecting samples from a larger population according to a random starting point and a fixed periodic interval (Struwig & Stead 2004:114).

Systematic sampling was implemented in that a list of the files of all adult patients admitted to the ED during the study period was obtained from the records department of the study hospital. To avoid bias, the list was compiled following the order in which patients presented to the ED as documented by the ED nurse on the register. The sample size of the target population of the study hospital was calculated at a 95% confidence limit and a 0.05% standard error. All the files that met the inclusion criteria where selected and a new list was compiled. To achieve the sampling interval, the total number of patients' files that met the criteria was divided by the size of the sample required. A random starting point from the list was determined by the researcher and the supervisors (see 3.3.2.4). The total number of patients who had been attended to in the emergency department of the study hospital from 1 June 2015 to 31 August 2015 and met the inclusion criteria was 1 300.

3.3.2.2 Sample

Polit and Beck (2012:275) referred to a sample as a subset of population elements and the most basic units about which data was collected. In addition, Doordan (1998:111) defined a sample as a subset of the entire population selected for the study to represent the entire population. A sample is a selected group of people or elements included in the study or a group of individuals taken from a larger population to make up a sample that is representative of the population (Polit & Beck 2012:275; Grove, et al 2013:351) The sample size that was used in this study to be representative of the study population/unit of analysis was a sample that consisted of 100 files.

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3.3.2.3 Sampling frame

Brink, et al (2006:124) defined a sampling frame as the "comprehensive list of the sampling elements in the target unit of analysis". In addition, Botma, et al (2010:127) described sampling frame as the numbered list of all the elements in the unit of analysis from which the sample was drawn. Doordan (1998:111), Greenfield (2002:197) and Polit and Beck (2012:742) called a sampling frame a listing of all elements in the population from which the sample was selected. Grove, et al (2013:357) stated that a sampling frame was a list of every member of the population that the researcher had to acquire through the use of sampling criteria to define membership. These authors explained that the researcher selected subjects from the sampling frame using a sampling plan and described the strategies that would be used to obtain a sample for the study.

In this study, a systematic selection of the files of all patients admitted to the ED from 1 June 2015 to 31 August 2015 was used as the unit of analysis and this selection served as the sampling frame in this study. The researcher obtained a random list of all patients managed in the ED on a monthly basis from the ED clerk responsible for the statistics of the ED, upon which the researcher compiled a list of all the patients who had stayed in the ED for more than 12 hours after the time registered as their time of arrival. Struwig and Stead (2004:109) defined a sampling frame as a list of all the sampling units in the population and stated that it might be a class list or a list of registered patients. During the systematic sampling of patients' files that met the inclusion criteria of the unit of analysis, a red sticker was attached to each of the patients' files that contained complete LOS data and the audit tool on these files was completed.

According to Burns and Grove (2005:232), retrospective design can protect the study from bias by linkages between conceptual and operational definitions of variables, sample selection and sample size, the use of valid and reliable instruments and data collection procedures that achieve some environmental control.

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3.3.2.4 Sampling method

Probability sampling, which is the sampling method that a quantitative paradigm relies on (De Vos, et al 2011:228) and which was used in this study, refers to a sample design where units are selected by a probability mechanism that allows no scope for the influence of subjectivity (Greenfield 2002:189). Also known as random sampling, probability sampling refers to the fact that each member of the population has a probability higher than zero of being selected for the sample (Struwig & Stead 2004:112; Grove, et al 2013:357).

Grove, et al (2013:361) suggested the use of systematic sampling when an ordered list of all members of a population was available and the process involved selecting every n^{th} individual on the list using a starting point selected randomly. Grove, et al (2013:358) stated that to obtain a probability sample the researcher had to develop a sampling frame that included every element in the population and had to randomly select the sample from the sampling frame. Doordan (1998:121) explained a random sampling procedure as sampling in which members of the population or sampling frame were selected for the study at fixed intervals. Polit and Beck (2012:275) placed great confidence in the representativeness of probability samples and believed that random sampling was the key to achieving good representation of the population (Polit & Beck (2012:135).

In the current study, the total number of patients' files that met the unit of analysis inclusion criteria were 1 300 from which a 100 files were needed for a representative sample. To get the n^{th} interval, 1 300 (N) was divided by 100 (the sample/n) and the n^{th} interval was 13. The first file was selected randomly after which each 13^{th} file was selected. Polit and Beck (2012:358) believed that to leave the selection to chance would decrease the sampling error and increase the validity of the study. Grove, et al (2013:358) indicated that there was less opportunity for systematic bias if subjects were selected randomly although it was possible for a systematic bias to occur by chance. Terre Blanche (2006:135) pointed out that the most important source of bias the researcher had to be aware of when doing systematic sampling was that the list functioning as a sampling frame might be ordered according to a particular pattern or

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principle. The sample list in this study was compiled according to the order in which patients visited the ED, and not in alphabetical order or any other pattern.

3.3.2.5 Sample size

After discussion with the statistician involved in the current study a sample size of a minimum 100 patients' files was derived with 95% confidence and 10% margin of error. For this study, the data was collected from 100 files of adult patients who had been admitted to the ED during the study period in order to achieve the study objectives presented in Chapter 1 of this report. (See 1.3).

3.3.3 Data collection

Data collection or data gathering is the process of gathering information relevant to the purpose of the study (Doordan 1998:52). In this study, a structured plan was used to collect data as it enhanced objectivity of data and eliminated bias (Botma, et al 2010:131). By means of a structured plan the same information was gathered from all participants or units of analysis in a comparable, pre-specified way (Polit & Beck 2012:29). To ensure that the same information was gathered the researcher made use of a newly developed audit tool used for all 100 files.

3.3.4 Measurement tools

A newly developed audit tool was utilised to collect data. The audit tool, developed by the researcher and the supervisors, took the setting into consideration, suited the type of data required and was guided by literature review. The researcher used the open systems theory model to guide the development of the tool and drew on the inputs of experts (currently working in the hospital's ED) who had knowledge of risk factors that might influence LOS in the ED.

The audit tool consisted of four sections, namely:

- Section A: Demographic data
- Section B: Input (reception / triage)
- Section C: Throughput (admission to emergency department)

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- Section D: Output (discharge)

The audit tool was completed according to the journey patients followed when visiting the ED, in other words, from initial presentation to departure from the ED.

3.3.4.1 Section A: Demographic data

The anonymity of patients was ensured by not documenting any names or hospital numbers on the audit tool. The demographic information collected comprised the following: age, sex, mode of arrival to the emergency department and patient mobility. These factors were selected because they could influence LOS. According to Brink, et al (2012:38), being elderly is associated with prolonged LOS and older adults with complex medical conditions (which could make the patient bedridden) tend to stay longer in the ED than other patients (Lo, et al 2013:118). In a study done by Soria-Aledo, Carrillo-Alcaraz, Campillo-Soto, Florez-Pastor, Leal-Llopis, Fernandez-Martin, Carrasco-Prats and Aguayo-Albasini (2009:328) it was found that women had slightly more inappropriate stays in the ED than men. The mode of arrival at the ED can shorten the LOS in the ED in the input phase because the patients brought by ambulances get triaged before walk-in patients to free the ambulances to leave to attend to new cases.

3.3.4.2 Section B: Input (reception / triage)

In the input phase a patient first reports to the ED reception area where an initial quick assessment is done by an ED nurse or ED doctor (using the history and chief complaint) to decide if the patient is critically ill or injured. A patient who is critical or emergent is admitted to the ED immediately and would have a shorter input phase. A patient who is not critically or emergent is sent to the triage area where a triage nurse assesses the patient, takes vital data and records the findings on the triage tool. After that the patient at triage is assessed by an ED doctor who uses the findings of the nurse's assessment recorded on the triage form as well as his/her own findings to allocate a triage score to the patient. Based on the triage score, the patient is sent either to the admissions department for admission to the ED (where

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the time and date are recorded) or is discharged from the hospital to go to another hospital or home.

3.3.4.3 Section C: Throughput (admission to emergency department)

When a patient register at admissions and enters the ED, the throughput phase starts. The patient gets classified as a medical or a trauma patient and is sent to a specific area inside the ED that is appropriate according to the classification, triage score and acuity of the patient. The first contact of a patient with a healthcare professional in the ED is mostly with the ED nurse who admits the patient and completes a second set of vital data as well as other official paperwork in the form of the nursing record tool. The second contact with a healthcare professional is with the ED doctor who assesses the patient, orders diagnostic tests and sends samples to the laboratory for testing to help with diagnosing, and decides whether the patient must be referred to a specialist doctor (for further treatment) or can be discharged. A specialist doctor who is consulted to see the patient may order more investigations (diagnostic or laboratory tests) before discharging the patient from the ED. The discharge destination (for instance, ward, home, etc.) will be influenced by the patient's condition and by the availability of in-patient beds in the appropriate speciality wards. All consultation times and dates of consultation were recorded in the audit tool to be used to identify possible areas of delay.

3.3.4.4 Section D: Output (discharge from emergency department)

In this phase the time and date the patient is discharged from the ED as well as the patient's destination is documented. This phase concludes the patient's journey (flow process) in the ED.

3.3.5 Measurement methods/technique

Data was collected by the researcher using an audit tool and documenting all the files of patients managed in the ED during the study period on a list. The researcher used the list compiled by the ED clerk of the patients who had visited the ED to compile a random list and retrieve patient files. The numbers of the files of patients who had visited the ED during the study period were recorded on a list and codes

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were assigned to the patients' files to ensure anonymity. The files were then checked to select those that met the inclusion criteria after which the audit tool was completed in respect of the 100 files of patients who met the inclusion criteria.

3.3.6 Variables

Brink, et al (2006:85) defined independent variables as variables that caused change or influenced other variables, also called treatment or experimental variables. Thus, independent variables are presumed to cause or determine dependent variables (Botma, et al 2010:103). A dependent variable was defined by Polit and Beck (2012:103) as the variable assumed to be dependent on or caused by another variable. In this sense, length of stay (dependent variable) in the ED depends on the different activities taking place in the ED (independent variable).

The following five independent variables were identified as part of the flow process of the patient managed in the ED:

- In the input phase (reception and triage) five independent variables were identified: At reception (two variables) the first contact by the healthcare professional and the day of the week. At triage the first ED nurse, the first ED doctor contact, the triage score and colour (three variables).
- In the throughput phase, nine independent variables were identified: The patient's classification, area patient was admitted to, first nurse contact, first ED doctor contact, number of specialist referrals, first specialist contact, number and nature of diagnostic and laboratory tests done, admitting speciality as well as bed availability in that speciality department.
- In the output phase (discharge), two independent variables were identified namely the time and date of discharge and the discharge destination.

3.3.7 Quality control

Quality control will be discussed in terms of validity and reliability.

Validity refers to the degree to which an instrument measures accurately what it is supposed to be measuring (Babbie & Mouton 2004:143; Polit & Beck 2012:377).

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According to Polit and Beck (2012:416), validity and reliability are the major criteria for assessing an instrument's quality and adequacy. To ensure that the quality and adequacy of the instrument were enhanced, the following aspects related to measuring the validity of the instrument (in this study the clinical audit tool) as identified by De Vos, et al (2005:160) were adhered to:

- Content validity was ensured by making sure that all the aspects included in the clinical audit tool covered all the objectives of the study. To ensure content validity the measuring tool must provide an adequate or representative sample of all content or elements or instances of the phenomenon being measured (De Vos, et al (2005:160). In this study the content validity of the clinical audit tool was enhanced by pilot testing the audit tool so as to improve the questions, format and scale.
- Face validity is not scientific but based on subjective assessment. It is concerned with the superficial appearance of a measurement procedure (De Vos, et al 2005:161). The clinical audit tool appeared to cover all the aspects required to answer the research question.
- Construct validity measures the relationship between the instrument and the related theory (Brink, et al 2006:162). In this study, the construct validity was enhanced by ensuring that the clinical audit tool was developed in such a way that the aspects to be answered were clear. Experts were asked to review the clinical audit tool. The experts that were asked to review the tool in this study included the statistician, the head of department in the ED of the study hospital, experienced health care workers (nurses and doctors) working in the ED and the two supervisors of this study. Construct validity was also enhanced by pilot testing the clinical audit tool with 10% of the unit of analysis.

Reliability was described by Botma, et al (2010:177) as the degree of consistency or accuracy with which an instrument measured the attribute it was designed to measure. To ensure that data in the current study was collected with care and precision, reliability of the measuring instrument was considered. Reliability was further defined by Brink, et al (2006:162) as "the degree to which the instrument can be depended upon to yield consistent results if used repeatedly over time by the

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same person, or if used by two researchers". The audit tool in this study was used for all 100 files.

Cronbach's alpha coefficient, which is useful for establishing reliability in a highly structured quantitative data collection instrument, was used in this study to establish internal consistency (see section 4.3.1). Reliability was also assured by sticking to reaching the research findings only based on the gathered data. To help ensure a high reliability of the data used in this quantitative study, random selection of the sample took place, a good representative sample of the target population was taken and the sample size (which was assumed to be a true representation of the target population) was calculated. Cronbach's alpha was used to confirm the reliability of the data. If Cronbach's alpha is > 0.7 then the variable can be said to produce reliable results (Brink, et al 2006:164). Reliability of the instrument was also enhanced by pilot testing.

3.3.8 Pilot testing

A pilot testing is also called a pre-test by Polit and Beck (2012:763) and is defined as the collection of data prior to the commencement of the research. A pilot test is, therefore, regarded as testing a newly developed instrument beforehand to prevent flaws, especially in a large study. In the current study, pilot testing was done with 10% of the total number of units of analysis, and the unit of analysis used in the pilot test did not form part of the study. The aim of the pilot testing was to test the practicality of the audit tool. Any ambiguities that existed in the questionnaire were pointed out and corrected and the order of the questions was revised so that the audit tool collected information relevant to the study and helped the researcher meet the research objectives.

3.4 DATA MANAGEMENT

Polit and Beck (2012:725) explained data management as the systematic organisation and synthesis of research data to answer the research question of the

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study. Brink, et al (2006:171) stated that statistics were the most powerful tool for a researcher in analysing quantitative data. Descriptive statistics were used in this study to describe, summarise and synthesise data (Struwig & Stead 2004:158; Botma, et al 2010:148), which allowed the data to be sorted, arranged, collected and presented in a scientific manner (Struwig & Stead 2004:158).

Statistics were used in the current study to analyse the data obtained. The proportion of prolonged LOS was expressed as a percentage along with a confidence interval. For the descriptive part of the study, areas of delay were expressed as categories of time and summarised as a proportion with a 95% confidence interval. A more sophisticated analysis involved regression analysis as the reference categories were large enough. Any testing that might take place would be at the 0.05 level of significance.

3.5 DATA ANALYSIS

Quantitative data analysis techniques were applied in this study to analyse and interpret the data obtained. Firstly, to describe the findings of the study population, descriptive statistics were applied through tables and graphs expressed as frequencies. Since the data was collected and captured from 100 files, the frequency and percentage were the same. Proportions were expressed as percentages and 95% confidence was also presented for results attained.

Quantitative data analysis was used to answer the research questions of this study and descriptive statistics were used to describe the possible areas of delay associated with prolonged length of stay during the input, throughput and output phases in the ED. Regression analysis was applied to estimate the proportion of patients that was not discharged from the ED within 12 hours after admission.

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3.5.1 Descriptive statistics

Descriptive statistics is the term that refers to the analysis of data that helps describe, show or summarise data in a meaningful way. Descriptive statistics do not, however, allow one to make conclusions beyond the data analysed or reach conclusions regarding any hypotheses that might have been made. Descriptive statistics are simply ways to describe the data set at hand. Therefore, descriptive statistics enable one to present the data in a more meaningful way, which allows simpler interpretation of the data. Descriptive statistics determine the distribution or spread of the data points and allow one to properly describe data through statistics and graphs. Two general types of statistics that are used to describe data are:

- Measures of central tendency: These are ways used to describe the central position of a frequency distribution for a group of data. Measures of central tendency include the mode, median, and mean.
- Measures of spread: These are ways that help to summarise a group of data by describing how the scores are spread out. The spread is described by means of the range, quartiles, absolute deviation, variance, standard deviation, skewness and kurtosis. The importance of measures of spread of the data values is due to the relationship it holds with measures of central tendency. The measures of spread inform the researcher on how well the mean, for example, represents the data. If the data spread value is large, the mean is seen as not being as representative of the data as if the spread of values is small, indicating large differences between individual scores.

In this study the group of data collected was summarised by means of descriptive statistics using a combination of tabulated descriptions (tables), graphical descriptions (graphs and charts) and statistical commentary (a discussion of the results).

3.5.2 Regression analysis

In this study regression analysis was used to investigate the relationship between patients that were not discharged from the ED within 12 hours after admission and

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possible areas of delay associated with prolonged length of stay during the input, throughput and output phases in the ED as determined in the study.

The multiple regression model is represented by the following equation:

$$y_i = b_0 + b_1x_1 + b_2x_2 + \cdots + b_nx_n + e_i \ldots\ldots\ldots\ldots equation\ (1)$$

In this equation x_n is the value of the n^{th} predictor (independent), b_o is the regression constant, b_n is the coefficient on the n^{th} predictor, 1….n is the total number of predictors, y is the dependent variable and e_i is the error term.

3.5.3 Regression diagnostics (model checks)

In regression diagnostics, it is important to confirm the goodness of fit of the model and the statistical significance of the estimated parameters. Commonly, evaluation of goodness of fit includes the (R-square) R2, analyses of the pattern of residuals and hypothesis testing. Statistical significance can be checked by an F-test of the overall fit, followed by T-tests of individual parameters.

Interpretations of these diagnostic tests depend heavily on the model assumptions. Although examination of the residuals can be used to invalidate a model, the results of a T-test or an F-test are sometimes more difficult to interpret if assumptions of the model are violated.

The following are the regression diagnostics that needs to be checked for the goodness of fit of the model:

- Assumptions: The normality assumption was carried out by testing for skewness and kurtosis. The study assumed intervals of (-2, 2) to assess both skewness and kurtosis. Data is not normal if skewness and kurtosis fall outside (-2, 2).
- Significance testing: One of the most common diagnostic checks in regression analysis is the dynamic inference which signifies the interpretation that the dependent variable changes units because the independent variable changes one unit.

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- T-test: T-tests are used to assess whether the means of two groups are statistically different from each other by testing the null hypothesis that the regression coefficient is zero. A common rule of thumb is to drop from the equation all variables not significant at the 0.05 level or better.
- F-test: The F-test is used to test the significance of R, which is the same as testing the significance of R2, which is the same as testing the significance of the regression model as a whole. If probability (F) < 0.05, then the model is considered significantly better than would be expected by chance and the null hypothesis of no linear relationship of y to the independent variables is rejected. F is a function of R2, the number of independent variables, and the number of cases. Thus, F is computed with k and (n - k - 1) degrees of freedom, where k is the number of terms in the equation, excluding the constant.

F is given by:

$$F = \frac{\left[\frac{R^2}{k}\right]}{\left[\frac{1-R^2}{n-k-1}\right]} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(Equation 2)}$$

- Correlation: Pearson's R2 is the percentage of variance in the dependent variable explained by the given independent variable when all other independent variables are allowed to vary. The result is that the magnitude of R2 reflects not only the unique covariance it shares with the dependent variable, but uncontrolled effects on the dependent variable attributable to covariance the given independent variable shares with other independent variables in the model.
- R2: R2 is the multiple correlations or the coefficient of multiple determinations, and it is the percentage of the variance in the dependent variable explained uniquely or jointly by the independent variables. R2 can also be interpreted as the proportionate reduction in error in estimating the dependent variable when knowing the independent variables. That is, R2 reflects the number of errors made when using the regression model to guess the value of the dependent variable, in ratio to the total errors made when using only the mean of the dependent variable as the basis for estimating all cases. Mathematically,

$$R^2 = \left(1 - \left(\frac{SSE}{SST}\right)\right) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots equation\ (3)$$

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$$SSE = \sum \left(\left(Y_i - \hat{Y}_i \right)^2 \right) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \ldots equation\ (4)$$

3.5.4 Stepwise regression

Stepwise regression includes regression models in which the choice of predictive variables is carried out by an automatic procedure (Efroymson 1960; Hocking 1976; Draper & Smith 1981). Efroymson (1960) explained stepwise regression as an automatic procedure for statistical model selection in cases where there were large numbers of potential explanatory variables and no underlying theory on which to base the model selection. The procedure is used primarily in regression analysis, though the basic approach is applicable in many forms of model selection. This is a variation on forward selection. At each stage in the process, after a new variable is added, a test is made to check if some variables can be deleted without appreciably increasing the residual sum of squares (RSS). The procedure terminates when the measure is (locally) maximised, or when the available improvement falls below some critical value.

The main approaches in stepwise regression are:

- Forward selection, which involves starting with no variables in the model, testing the addition of each variable using a chosen model comparison criterion, adding the variable (if any) that improves the model the most, and repeating this process until none improves the model.
- Backward elimination, which involves starting with all candidate variables, testing the deletion of each variable using a chosen model comparison criterion, deleting the variable (if any) that improves the model the most by being deleted, and repeating this process until no further improvement is possible.
- Bidirectional elimination, which is a combination of the forward and backward selection, tests each step for variables to be included or excluded.

In this study, forward selection was applied to test all variables uniformly to see which variable did not improve the model once added.

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3.5.5 Durbin-Watson statistic

The Durbin-Watson statistic is a test statistic used to detect the presence of autocorrelation (a relationship between values separated from each other by a given time lag) in the residuals (prediction errors) from a regression analysis. In this study, the Durbin-Watson statistic was applied to the residuals from least squares regressions to test the null hypothesis that the errors on a regression model follow a process with a unit root against the alternative hypothesis that the errors follow a stationary first-order autoregression (Sargan & Bhargava 1983).

From mathematical terms, d = 2 indicates no autocorrelation. The value of d always lies between 0 and 4. If the Durbin-Watson statistic is substantially less than 2, there is evidence of positive serial correlation. As a rough rule of thumb, if the Durbin-Watson is less than 1.0, there may be cause for alarm. Small values of d indicate successive error terms that are, on average, close in value to one another, or positively correlated. If d > 2, successive error terms are, on average, much different in value from one another, that is, negatively correlated. In regressions, this can imply an underestimation of the level of statistical significance.

3.6 ETHICAL AND LEGAL CONSIDERATIONS

Brink, et al (2006:66) stated that research ethics provided researchers with a code of moral guidelines on how to conduct research in a morally acceptable way. Hence ethics is regarded as a system of morals or rules of behaviour by Schartz (as cited in Nolan, et al 2009:2). To protect the rights of subjects in a research study, guidelines in this respect were drawn up in the form of the Nuremberg Code of 1947. Babbie and Mouton (2004:53) and Burns and Grove (2005:181) indicated that research ethics involved protecting the rights of the respondents and of the institution where the research was done as well as maintaining scientific integrity.

Ethical approval for the study conducted was obtained from the Research Ethics Committee of the Faculty of Health Sciences of the University of Pretoria and from the study hospital prior to the collection of data. Permission to get access to patients'

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files was requested from the study hospital management and ED management. The researcher avoided documenting any names or hospital numbers of patients during the clinical audit to maintain anonymity, privacy and confidentiality.

Brink, et al (2006:31) mentioned that the three fundamental ethical principles that should guide a researcher were respect for persons, beneficence and justice. As far as this study was concerned, the right to self-determination was considered as only patients' files were used and the names and numbers of patients were not documented for research.

The principle of beneficence was ensured by securing the wellbeing of the respondents. In this study, the researcher used patients' files to collect data and no identification took place; therefore, the right to protection from discomfort could not be violated, and no physical, emotional, spiritual, economic, social or legal harm was done to the respondents (Brink, et al 2006:33). According to Brink, et al (2006:33), "The principle of justice includes the subjects' right to fair selection and treatment". The researcher ensured fairness in selecting the unit of analysis by adhering to all steps of the chosen design.

The respondents' right to privacy was respected by ensuring confidentiality and anonymity when collecting data. Physical or mental suffering was avoided because no planned harmful interventions or activities were involved in this study and no risk or harm to people was perceived. Results from the literature review conducted justified the study.

3.7 SUMMARY

In Chapter 3 the quantitative approach to the study's research design and methodology was discussed. Reference was made to the study sample that consisted of 100 files, which were selected using systematic random sampling, and to the data collection that was done using an audit tool. There was a detailed

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discussion of the analysis of the data set by means of quantitative data analysis techniques, namely, descriptive statistics and regression analysis.

In Chapter 4 the data analysis and the interpretation of the results will be discussed in detail.

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CHAPTER 4: RESEARCH RESULTS AND DISCUSSION

4.1 INTRODUCTION

Chapter 3 focussed on a discussion of the study's research and methods. In Chapter 4 the research results related to identifying the areas of delay in the ED that could lead to prolonged LOS are presented. These results were based on the data collection carried out in three phases, namely the input, throughput and output phases (see Figure 1.1).

The input phase covered two different areas, namely, the reception and triage areas, each with their own activities. Reception in the input phase included the independent variables of first nurse/doctor contact and the day of the week that the patient presented himself or herself at the reception area. In the triage area the variables were the first ED nurse contact, the first ED doctor contact as well as the triage score calculated for each patient.

The throughput phase concerned the processes subsequent to the decision about the admission of the patient to the ED. There were seven independent variables in this phase, namely, the patient's classification, area of admission, first nurse contact, first ED doctor contact, specialist referrals, first specialist contact and the number and nature of all diagnostic and laboratory tests done in the ED. Two more variables were added, namely, the admitting speciality and the bed availability in that speciality's wards.

Lastly, the variables identified in the output phase were discharge time, discharge date and discharge destination.

A hundred patient files were included in the audit, and data was collected by means of an audit tool (see Annexure B2) that consisted of four sections, namely:

- Section A: Demographic information

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- Section B: Input (reception / triage)
- Section C: Throughput (admission to ED)
- Section D: Output (discharge)

Section A included the demographic results of the patients; however, these were not part of the open systems theory (input, throughput and output) that was used to guide the development of the audit tool in order to sectionalise the possible areas of delay. Therefore, this section will be discussed separately followed by discussions of the descriptive statistical results of sections B to D (see Annexure B2). Cronbach's alpha for reliability was used to confirm the reliability of the data. Regression analysis was used to investigate the relationship between LOS of patients who were not discharged from the ED within 12 hours after admission and all the independent variables chosen for the study, and to describe possible areas of delay associated with prolonged length of stay during the input, throughput and output phases in the ED.

4.2 RESULTS

For clarity and flow the results of the data collection will be discussed in accordance with the relevant sections of the audit tool. Theses sections were:
Section A: Demographic information
Section B: Input (reception / triage)
Section C: Throughput (admission to emergency department)
Section D: Output (discharge)

4.2.1 Section A: Demographic information

An overview of the results of the data collected relating to the demographic information of the patients in the patients' files (Section A of the audit tool) is given in Table 4.1.

4.2.1.1 Age

Section A relates to the demographic information contained in the audited patient's files. Table 4.1 gives an overview of the summary of results relating to the

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demographic information collected. The age ranges were established by determining the difference between the highest and the lowest age and by dividing the difference by the number of ranges relevant to the data set collected. The results indicated that of the 100 patients seen at the ED, the majority (33) were between the ages of 31 and 45 years, followed by 22 who were between the ages of 46 and 60. Of the 100 patients, 21 were between the ages of 61 and 75 whereas 14 patients were between the ages of 18 and 30. Only nine of the 100 patients were aged between 76 and 90 and only one patient was between 91 and 105 years of age. Of the 100 patients who had been admitted to the ED during the period of this study and had stayed in the ED for longer than 12 hours until being discharged, none were younger than 18 years of age (as this was part of the exclusion criteria) and no patients were older than 105 years (see Table 4.1).

Table 4.1: Section A: Demographic information – results

Variable		Frequency (n=100)
Patients' age range in years	18–30	14
	31–45	33
	46–60	22
	61–75	21
	76–90	9
	91–105	1
	>105	0
	Average age	50.59
Gender	Male	49
	Female	51
Mode of arrival at ED	Ambulance	24
	Private transport	76
Patient mobility	Ambulant	62
	Non-ambulant	37

Discussion: The emergency departments attend to a large number of patients, but many of these patients are also critically ill and elderly. Beck, et al (2009:1887) stated in their study that visits to the ED of elderly patients that were 65 years of age or older were increasing and that ED visit of patients in the age range 31 to 45 years were increasing more than those of any other age group. According to Foo, Siu, Tan,

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Ding and Seow (2012:45), older adults use ED services more often than any other age group and according to Fealy, Treacy, Drennan, Naughton, Butler and Lyons (2011:1004), the use of EDs increases with age. In addition Bjornsen, Uleberg and Dale (2013:463) in their study found that almost 50% of the ED were patients older than 65 years.

Due to complex medical problems, multiple co-morbidities, impaired functionality and impaired immunologic response, elderly patients' ED visits often have a greater level of urgency. These patients are also more likely to be admitted to the hospital or to have a longer length of stay (Chang, Tsai, Chen and Liu 2010:S30; Lo, et al 2013:119). Increasing age is also associated with a greater need for diagnostic tests, such as x-rays, electrocardiograms and blood tests, hence elderly patients' ED visits to the ED are high (Foo, et al 2012:44). In contrast, visits of younger adult patients to EDs are mostly characterised by surgical complaints and accidents (Gruneir, Silver and Rochon 2011:20). In comparison with younger adult patients who visit the ED, older adult patients who visit the ED use emergency services at a higher rate (Knapman and Bonner 2010:311). The findings of this study that the number of ED visits of patients in the age ranges of 31 to 45, 46 to 60 and 61 to 75 years were more than that of patients aged 18 years to 30 years supported the finding in the existing literature that older patients visited the ED more often than younger patients.

4.2.1.2 Gender (sex)

The results showed that 51 of the 100 files were of female patients and 49 of male patients; therefore, the spread was almost even.

Discussion: According to Philips, Remmen, De Paepe, Buylaert and Van Royen (2010:6), men visit EDs more than women and often with minor trauma. In addition, Perez-Carceles, Gironda, Osuna, Falcon and Luna (2010:460) described the main users of EDs as male patients over 65 years and with low education. The results of the current study did not show a significant difference in the numbers of ED visits by male and female patients. The findings of this study also did not support the findings of other studies that ED visits by male patients were more, and the education level of

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the patients were not measured in this study. Moreover, Bjornsen, et al (2013:463) added an evenly spread distribution visits between genders with a slightly more frequent in females younger than 45 years and 65 years and older.

4.2.1.3 Mode of arrival at ED

Of the 100 patients, 76 arrived at the ED by means of private transport and only 24 arrived by ambulance. As this study was done in an academic, referral, tertiary hospital it was expected that more patients would be referral cases from other health care facilities. Table 4.1 shows that 76 patients referred themselves to academic, referral, tertiary, hospital, whereas only 24 arrived by ambulance. The fact that the self-referrals were more than referrals from other health care facilities was contrary to what was expected for a tertiary referral hospital.

Discussion: Different modes of arrival of patients at EDs include arriving by helicopter (air ambulance) or ambulance whereas some patients (walk-in or self-referral patients) transport themselves (Paul, et al 2010:563). In a study done by Ding, et al (2010:822) the mode of arrival of patients at the ED influenced the waiting room time. The authors found that patients who arrived at the ED by ambulance waited for shorter times to be placed in a room compared to patients who did not arrive by ambulance. From this study 72% of visits arrived using their own transport which contradicts the 5% of ED patients with the same mode of arrival in a study conducted in Sweden by Bjornsen (2013:463). In the Sweden study more patients arrived by ambulances and as referrals. According to Janssen, et al (2011:2459), self-referral patients in the ED contribute to the increasing number of patients arriving at the ED, which results in overcrowding and longer length of stay.

Most self-referral patients are non-urgent patients who seek non-urgent medical treatment causing EDs to become congested to the disadvantage of other ED patients and the ED staff (Chmiel, Huber, Rosemann, Zoller, Eichler, Sidler & Senn 2011:2). Several studies also showed that EDs were inappropriately visited by walk-in patients that could be treated in an outpatient setting (Wang, Wild, Hilfiker, Chmiel, Sidler, Eichler, Rosemann & Senn 2013:5). As EDs attend to patients according to

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their illness and acuity levels, and not according to the order in which they arrive, critical patients arriving by ambulance are rushed into resuscitation rooms and treated immediately (Kuo, et al 2014:2). This leaves the walk-in or self-referral non-urgent patients to wait longer as the health care providers in the ED will prioritise and manage the critically ill or injured patients first.

4.2.1.4 Patient mobility

Mobility in the ED environment refers to the ability of patients to walk or ambulate. In the study it was found that of the 100 patients who had reported to the reception area, 63 patients were ambulant whereas 37 were non-ambulant. This would imply that the 63 patients who visited the ED during the time of the study were ambulant and could walk, whereas 37 patients could not walk and arrived in a wheelchair or on a trolley.

Discussion: The mobility of patients who present themselves at the ED can be influenced by personal, organisational, environmental or care-related factors (Zisberg and Hershko 2016:98). Patients who cannot walk are non-ambulant whereas those who can walk are ambulant.

4.2.2 Section B: Input (reception / triage)

Section B was divided into two areas (reception and triage) and the results relating to both these areas will be discussed.

4.2.2.1 Reception

The results of the study indicated that 100 patients had reported to the reception area during the period of study (1 June 2015 to 31 August 2015). In June, 30 patients who had reported to reception stayed in the ED for longer than 12 hours whereas the number was 27 in July and 43 (the majority of patients) in August (see Table 4.2). Of the 100 patients that had reported to the reception area, 61 patients were sent to the triage area while 39 were admitted directly to the ED. Of the 61 patients sent to triage, the majority of patients visited the hospital in August. Furthermore, of the 39 patients that were directly admitted to the ED from reception,

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the majority also visited the hospital in August (see Table 4.2). By implication the month of August was the busiest, and generally more patients were sent to the triage area before being admitted to the ED.

Discussion: At reception the ED nurse or ED doctor would do a quick assessment of the patient reporting at the reception area to decide whether to admit the patient to the ED directly (if critically ill or injured) or send the patient to the triage area. The overview of the outcome of patients being seen at reception presented in Table 4.2 indicates that the majority of the patients who visited the ED each month during the study period were sent for triage. This implied that most of the patients attended to in the ED of the study hospital were self-referrals and mostly not emergent or urgent patients. As emergency departments prioritise and organise the emergency care they deliver to patients according to their acuity levels (Paul, et al 2010:563), these departments (and also the ED of the study hospital) use a triage system called the South African Triage Score (SATS) to sort patients and to check their acuity levels (Rosedale, Smith, Davies & Wood 2011:537).

⇨ **Outcome of being seen at reception**

After the patient had arrived at the ED and reported to the reception area, the patient would either be sent to the triage area or, if in a serious condition, be directly admitted to the ED. Table 4.2 gives a summary of the number of patients from the sample of 100 who were seen at reception and of the outcome of their being seen at reception (either sent to the triage area or directly admitted to the ED).

Table 4.2: Outcome of being seen at reception

Variable	June	July	August	Total
Patients received at reception	30	27	43	100
Sent to triage area	20	14	27	61
Sent directly from reception to admissions	10	13	16	39

Discussion: Under the green paper on the National Health Insurance policy, a hospital is expected to provide a service to patients based on its category; therefore, a tertiary hospital is expected to provide service on a specialised level and should

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admit referrals from regional hospitals (Mohapi and Basu 2012:79). The provision of basic services in a tertiary hospital ED creates problems not only for the ED but also for the entire health care system in the hospital as it can increase overcrowding and LOS and result in poor quality of care and high expenditure (Mohapi and Basu 2012:79). Self-referrals of patients to the EDs partly contribute to the increased number of patients arriving at the EDs, which results in overcrowding and prolonged LOS (Janssen, Van Achterberg, Adriaansen, Kampshoff & Mintjes-de Groot 2010:2459). ED nurses prioritise patients depending on their need, therefore, when patients arrive at the ED reception an assessment is done to determine if the patients must be seen by a doctor immediately upon arrival or if they must be sent to triage (Janssen, et al 2011:438; Farrokhnia & Göransson 2011:1). Of the 100 files used in the current study, 61% of the patients were sent to triage, and SATS was used to reduce under-triage as well as to improve patient safety in terms of inappropriate discharge from the hospital (Rosedale, et al 2011:537). Only 39% of the patients were emergent enough to be admitted to the ED immediately upon arrival.

In the literature, it was reported that the day on which the patient visited the ED could also play a role in the LOS in the ED. Therefore, this factor had to be taken into account in the audit of the current study.

⇨ **Day of the week**

Figure 4.1 shows the results of this study pertaining to the day of the week, and it is clear that on a Thursday the majority (17) of the patients reported to the ED reception. On a Wednesday 16 patients reported to reception, on a Monday and Friday there were 14 and on a Tuesday, Saturday and Sunday there were 13. The difference was not large and the reason for the increased visits on a Thursday was not clear. The day of the week was taken into account as it was one of the independent variables under the area of reception in the input phase. Figure 4.1 depicts and summarises the days of the week on which patients reported to the ED reception. These findings are too limited to draw a conclusion as the study was done

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over a relative short period of time and only 100 files used, but the study does provide a glimpse that should be further investigated.

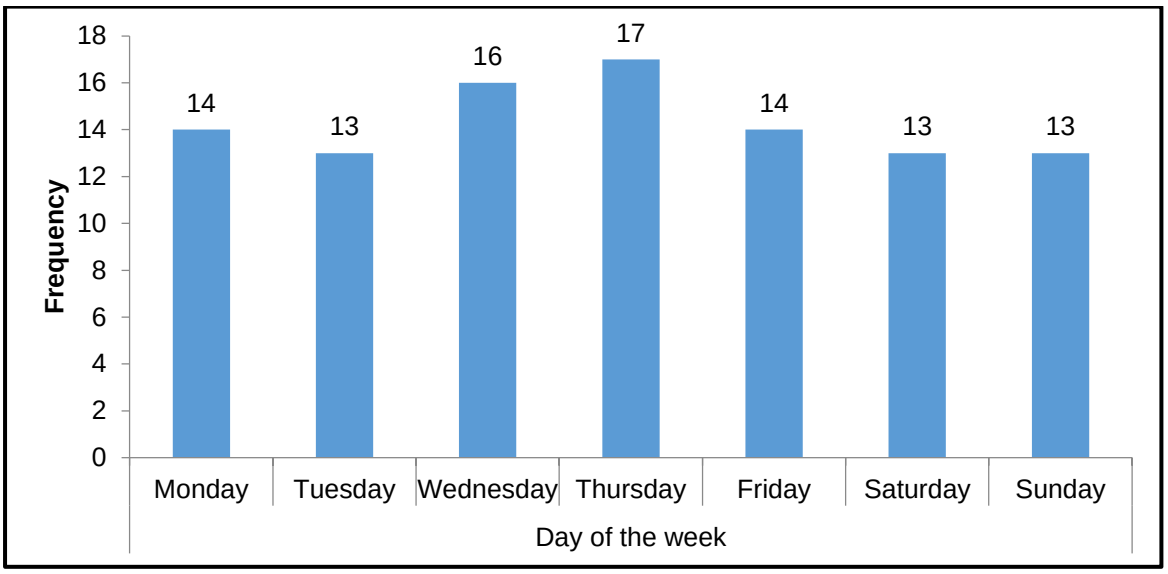

Figure 4.1: Day of the week patients reported to reception

Discussion: According to Ding, et al (2010:819), the waiting time of patients in the ED is influenced by factors like the day of the week, time of day, acuity levels of patients and the demand for ED services. These authors found that the demand for ED services was highest in the late morning and afternoon hours and lowest at night and in the early morning hours (Ding, et al 2010:822). Hence, patients presenting themselves to the ED during the day shift had a shorter LOS (Ye, et al 2012:638). In a study conducted by Rathlev et al (2012:167), it was found that the time doctors used to decide to admit, transfer or discharge patients was shorter on weekends and holidays. The demand for inpatient beds was found to often exceed 100% during the late morning and early afternoon hours on weekdays. In a Swiss study it was found that at night or over weekends ED care was often used as a substitute for primary care, as a result of which there was an increase in the number of walk-in patients, which placed a burden on hospital EDs (Chmiel, et al 2011:2). However, Metcalfe, Perry, Bouamra, Salim, Lecky, Woodford, Edwards and Costa (2016:839) found that the LOS was the same during day shifts on weekdays as during the day over weekends.

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Although EDs provide health care 24 hours a day, staffing levels, staffing seniority, access to diagnostic and therapeutic modalities and access to intensive care and hospital beds can vary considerably depending on the time of the day (Asha, et al 2011:33). The time of the day might affect the quality of care that critically ill or injured patients receive during the first few hours following presentation to the ED due to factors like staffing and access to diagnostics and beds (Asha, et al 2011:33). The importance of the time of day is further emphasised in a study by Kim (2010:2769) in which it was found that patients with head injuries arriving at the ED at night had to wait longer for surgery (despite their injuries being more severe) than those arriving during the day as more resources were available during the day than at night.

According to this study finding, the differences between the days patients visited the ED was not significant even though Thursdays showed more visits. The average number of patients (from the 100 file sample) who visited the ED on different days of the week was between 13 and 17.

4.2.2.2 Triage

The finding of the study was that the majority of patients were sent for triage before the decision of admission to the ED was made. As reported in Table 4.2, 61 of the 100 patients that had reported to the reception area went to the triage area where they were triaged by the ED nurse and then by the ED doctor. The patients would then be allocated scores and colours according to SATS (Rosedale, et al 2011:538), which was used in the study hospital, based on which the decision was made by the ED doctor whether to admit them to the ED or discharge them. This process would conclude the input phase of their journey.

Discussion: Triage acuity is defined as “the classification of patient acuity that characterizes the degree to which the patient’s condition is life threatening and whether immediate treatment is needed to alleviate symptoms” (Janssen, et al 2011:2459). Patients in the ED are categorised into three levels according to their acuity: emergency, urgency and non-urgency (Paul, et al 2010:563). SATS makes

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provision for the following four colour categories to indicate the level of acuity: red (emergency), orange (very urgent), yellow (urgent) and green (routine) (Rosedale, et al 2011:539). The care of patients in the ED is prioritised and sorted according to triage score and colour to facilitate the appropriate, timely and effective care of each patient (Kuo, et al 2014:2). After a quick assessment at reception, critical patients, also called emergency patients, who arrive at the ED are rushed to the resuscitation rooms and treated immediately (Kuo, et al 2014:2). The remaining categories of patients are sent to the triage area first for a proper triage.

In the study hospital the first contact in the triage area was with the ED nurse responsible for triaging the patient.

⇨ **First contact ED nurse**

The ED nurse will be the first contact that the patient sent for triage will have. The ED nurse will take a short history, obtain vital data (mobility, respiratory rate, heart rate, blood pressure, temperature, level of consciousness) and calculate the Triage Early Warning Score (Sun, Twomey, Tran & Wallis 2011:4). In this study it was found that the input phase took an average of 3 hours 17 minutes. Of this time, 55 minutes were attributable to the period from the patients' arrival at reception to the first contact with the ED nurse in triage, whereas 2 hours 22 minutes were attributable to the time that elapsed between the first contact with the ED nurse and the first contact with the ED doctor in triage.

Discussion: In the emergency department, all patients in need of emergency care must be triaged and prioritised to ensure that they receive optimal and timely treatment (FitzGerald, Jelinek, Scott and Gerdtz 2010:86). After registration, patients who are not emergent are assessed by a ED nurse at triage and classified according to their acuity levels for prioritising treatment delivery (Kuo, et al 2014:2). The first person that a patient who arrives in the ED encounters is the triage nurse who performs the first activity, namely to triage the patient (Janssen, et al 2011:2459; Aloyce, Leshabari & Brysiewicz 2014:14).

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The SATS tool was designed for use by enrolled nursing assistants to alleviate the shortages of doctors and professional nurses in South Africa (Twomey, Wallis, Thompson & Myers 2012:5). On arrival at the ED, patients are assessed by enrolled nursing assistant whose assessment consists of collecting information about the patients' main complaints, doing quick physical examinations, taking vital signs and assigning acuity ratings according to the SATS tool (Möller, Fridlund & Göransson 2010:746). The assigned acuity level will indicate the time patients can safely wait before being attended to by the ED doctor, giving the ED doctor time to decide how urgent the problem is and how soon treatment is required (AL-Reshidi 2013:40). A study conducted in Australia by Hitchcock, Gillespie, Crilly and Chaboyer (2014:1539) found that the inexperience or the decreased level of competence of the person doing the triage was one of the disadvantages of triage.

⇨ **First contact ED doctor**

The ED doctor does a separate assessment of the patient depending on the data received from the ED nurse, which include the triage score and colour. Table 4.3 depicts the average time taken by the triage doctor to see a patient after the patient was triaged by the nurse. The finding was that the average time taken was 2 hours 22 minutes.

Discussion: After the nurse has assessed the patients and assigned them acuity levels, they wait to be seen by the triage doctor (Aloyce, et al 2014:15). In South Africa, triage doctors use the SATS tool which has been proven to have good performance characteristics and to be a valid scale for South African conditions (Twomey, et al 2012:4). According to Han, France, Levin, Jones, Storrow and Aronsky (2010:231) as well as Nestler, Fratzke, Church, Scanlan-Hanson, Sadosty, Halasy, Finley, Boggust and Hess (2012:228), the availability of the triage doctor who is providing and initiating care in the triage is associated with decreased ambulance diversion, decreased numbers of patients who are left without being seen and decreased LOS in the ED.

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The triage doctor sees patients as they arrive and can discharge the patient or order appropriate diagnostic and laboratory testing, allowing workups of patients to be started even if there is overcrowding in the ED (Rogg, et al 2013:378). However, in a study conducted by Russ, Jones, Aronsky, Dittus and Slovis (2010:27) these authors disapprove of the use of a triage doctor because of the complexity it can add by involving a second doctor when admitting the patient to the ED and by involving an additional handoff in the patient's care. In several studies the use of the doctor in triage is supported as it reduces the waiting time significantly for initial evaluation by a doctor in the ED (Russ, et al 2010:32; Han, et al 2010:231; FitzGerald, et al 2010:228; Imperato, Morris, Binder, Fischer, Patrick, Sanchez & Setnik 2012:462). The ED doctor in triage can serve as a possible solution to poor ED flow as this can accelerate the flow of patients through the ED. This can be established when the ED doctor in triage initiate early patient assessment, appropriate diagnostic testing, early treatment, identification of definite discharges and safer discharge of patients from triage area (Jarvis 2016:64).

After completion of the triage by the ED nurse and doctor the patient is allocated a final triage score and colour indicating the acuity level of the patient.

⇨ **Triage score and colour**

The findings of the study were that of the 100 patients admitted to the ED during the period of study, 61 patients had been sent to triage, of which 28 were classified as urgent (yellow), 21 as routine non-urgent (green) and 12 as very urgent (orange), with none being classified as an emergency (as per exclusion criteria of this study). Figure 4.2 depicts an overview of the triage score and colour of the patients who had been assessed in the triage area by both the ED nurse and doctor. The research results showed that among the self-referral patients there were no emergency patients and only a few were very urgent cases.

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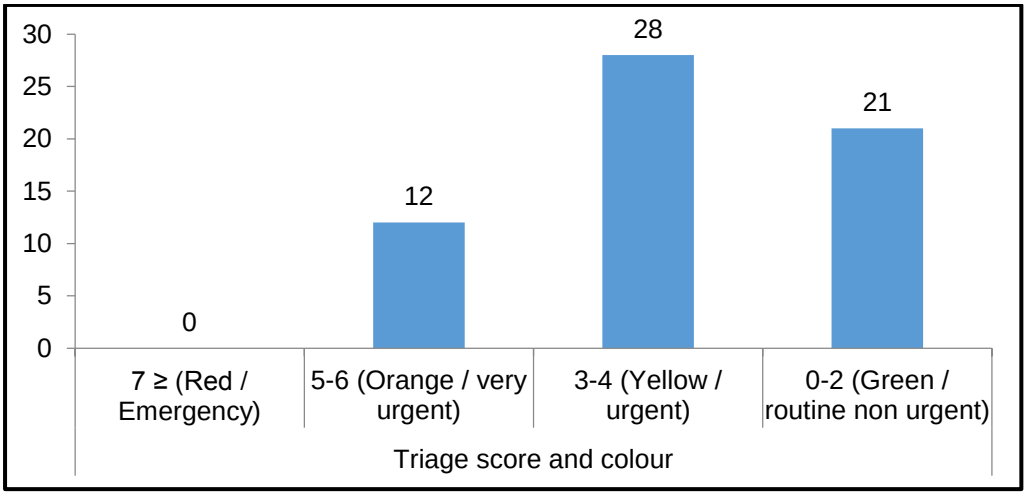

Figure 4.2: Triage score and colour

Discussion: Janssen, et al (2011:2459) defined triage acuity as the "classification of patient acuity that characterizes the degree to which the patient's condition is life threatening and whether immediate treatment is needed to alleviate symptoms". Paul, et al (2010:563) found that acuity level was one of the strongest predictors of a patient's treatment time in the ED, and, therefore, triage played an important role in the ED. The triage nurse follows the triage process, which is to collect a patient's information, do a quick physical examination, take vital data and assign a score and colour to the patient that indicate the patient's acuity level (Janssen, et al 2011:2459). Different triage scales are used by EDs around the world. In South Africa, and more specifically in the hospital where the study was done, the SATS is the preferred scale. As reported by Twomey, et al (2012:5), the acuity levels of and target times for patients indicated in SATS are as follows:

- Red (emergency) – should be seen immediately
- Orange (very urgent) – should be seen in less than ten minutes
- Yellow (urgent) – should be seen in less than 60 minutes
- Green (routine) – should be seen in less than four hours

The findings of this study correlated with the findings of several previous studies regarding an increased use of hospital EDs by patients with non-urgent problems that could be treated in clinics in the community (Clement, Businger, Martinolli,

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Zimmermann & Exadaktylos 2010:3; Tsai, Liang & Pearson 2010:537; Weinick, Burns & Mehrotra 2010:1635; Browne, Smye, Rodney, Tang, Mussell & O'Neil 2010:13; Wang, et al 2013:2;). In addition, Al-Reshidi (2013:33) cited that 50.9% of cases in EDs were not emergency cases and could be treated at primary care centres.

The use of hospital EDs for non-emergent conditions is a challenge faced in both developing and developed countries and overcrowding in many EDs is ascribed to this use (Gentile, Vignally, Durand, Gainotti, Sambuc, and Gerbeaux 2010:4; Tsai, Chen & Liang 2011:193). In a study conducted by Browne, et al (2010:14) in Canada, it was found that an estimated 33% to 55% of non-urgent patients visited the ED. Ekwall (2013:534) and Penson, Coleman, Mason and Nicholl (2011:1) argued that patients sought emergency care because they considered their medical condition urgent enough to seek emergency care. Penson, et al (2011:1) added that that non-urgent use of hospital EDs by patients might be caused by patients' perceptions of the urgency of their treatment need as well as by the accessibility, availability and capacity of alternative services. The result of admitting low-risk or non-urgent patients to the ED is that high-risk or urgent patients tend to stay in the EDs longer because of overcrowding, which contributes to prolonged LOS (Singer, et al 2011:1326).

After the patient has been allocated a triage score and colour, the input phase is completed and the throughput phase begins.

4.2.3 Section C: Throughput (admission to emergency department)

The results of this study showed that the throughput phase was by far the most complicated and longest phase of the patient's journey. It was found that the throughput phase took an average of 16 hours 25 minutes (see Table 4.3). It took 27 minutes for the patient to be admitted to the ED after being triaged by the doctor. It then took 28 minutes from admission until the patient saw the first contact nurse in the ED, after which it took another 1 hour 43 minutes for the patient to see the ED doctor. The ED doctor took 2 hours 25 minutes to do assessments and

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diagnostic/laboratory tests before referring the patient to the specialist, and 5 hours 15 minutes elapsed before the specialist had the first contact with the patient. The specialist took on average 6 hours 7 minutes to do an assessment and additional diagnostic/laboratory tests before discharging the patient from the ED. It is clear from the results that on average a specialist took longer than an ED doctor to see a patient, and that an ED doctor took longer than an ED nurse to see a patient. For the period of study the average length of stay of patients from reporting to the reception area to being discharged from the ED was approximately 3.06 days (see Table 4.3). This translates as prolonged LOS in the ED.

It took the input phase an average of 3hours 17 minutes to be completed, a further average of 16 hours 25 minutes for the throughput phase to be completed and lastly an average of 54 hours 7 minutes for the output phase to be completed. As a result, a total average of 73 hours 49 minutes was taken to manage patients in the ED.

Table 4.3: Areas of delay according to phases of LOS (input, throughput and output)

Areas of delay according to phases	Length of stay (LOS) average (hours and minutes)
Phase 1: Input – from reception to triage	
From reception to first contact by triage nurse	00:55
From 1st contact by triage nurse to 1st contact by triage doctor	02:22
Total Input LOS	03:17
Phase 2: Throughput – from triage to specialist	
From triage by doctor to admission to ED	00:27
From admission to ED to 1st contact by nurse	00:28
From 1st contact by nurse to 1st contact by ED doctor	01:43
From 1st contact by ED doctor to referral to specialist	02:25
From specialist referral to 1st contact by specialist	05:15
From 1st contact by specialist to discharge from ED	06:07
Total Throughput LOS	16:25
Phase 3 Output – Discharge	
From specialist to discharge from ED	54:07
Total Output LOS	54:07
Total LOS from reception to discharge	**73:49**

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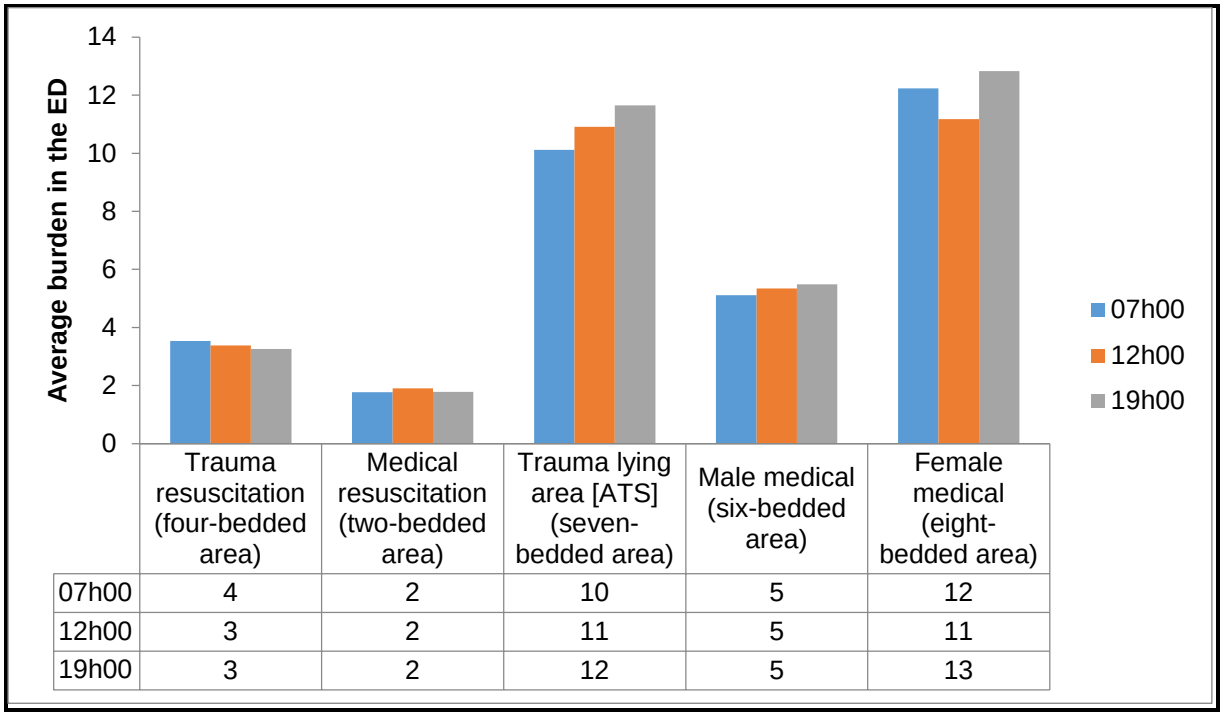
4.2.3.1 Burden on the emergency department

Figure 4.3 depicts the number of patients occupying the five different areas in the ED at specific times of the day during the study period when the 100 patients of the study were admitted to the ED. Each area contains a certain number of beds under normal conditions, and from the table it is clear that the number of patients in the ED during the study period placed a burden on the ED and affected the admission of new patients to the ED due to overcrowding.



	Trauma resuscitation (four-bedded area)	Medical resuscitation (two-bedded area)	Trauma lying area [ATS] (seven-bedded area)	Male medical (six-bedded area)	Female medical (eight-bedded area)
07h00	4	2	10	5	12
12h00	3	2	11	5	11
19h00	3	2	12	5	13

Figure 4.3: Burden on the ED

Figure 4.3 provides evidence that the ED where the study was done experienced overcrowding in four of the five areas at 07h00, 12h00 and 19h00 during the period of the study. In the female medical area (an eight-bed area) there were 12 patients at 07h00, 11 patients at 12h00 and 13 patients at 19h00. This indicates that the area was overcrowded for the duration of the study period. Overcrowding was also found in the trauma lying area (a seven-bed area) where there were 10 patients at 07h00, 11 patients at 12h00 and 12 patients at 19h00. The medical resuscitation area for critically ill or injured patients (a two-bed area) had two patients at 07h00, 12h00 and 19h00, indicating that it was a 100% occupied at all times. In the trauma

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resuscitation area for critically ill or injured patients area (a four-bed area) there were four patients at 07h00 and three patients at 12h00 and 19h00, which meant that no beds were available in this area at 07h00 and that only one bed was available for critically ill or injured patients at 12h00 and at 19h00. The male medical area (a six-bed area) had five patients at 07h00, 12h00 and 19h00 indicating that only one bed was available during the period of the study. The results showed that the female medical and the trauma lying areas were the most overloaded areas in the study ED.

Discussion: Emergency departments have good control over throughput factors, that is, how to treat and manage patients in the ED, but have less control over input (ED intake) and output factors (Morris, et al 2012:464). The most important resource in the ED is the treatment spaces and these are defined in terms of beds or rooms (Paul, et al 2010:563). Due to the inability of the ED to control intake of patients, many patients can present themselves at the ED, get admitted to the ED, and as a result the rate of admission is more than the rate of discharged, leading to crowding or overcapacity. Rabin, Kocher, McClelland, Pines, Hwang, Rathlev, Asplin, Trueger and Weber (2012:1757) defined crowding as the situation that occurred when the number of patients in the ED exceeded the capacity of the ED treatment space. If patients spend more time in the ED it results in boarding, which diminishes the capacity of the ED as the number of beds available for the evaluation and treatment of new patients is reduced (Rabin, et al 2012:1757). The resultant situation is called overcapacity and it is defined by Welch, et al (20114) as “having more patients than treatment spaces in the ED”.

Therefore, the study results indicated that the study hospital’s ED experienced overcapacity most of the time and that this contributed to overcrowding and prolonged LOS in the ED.

4.2.3.2 Patient classification

When patients are admitted to the ED they are classified as either medical or trauma patients and this, together with their triage score and colour, determines the area in

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the ED they are admitted to. Figure 4.4 depicts the classification of the 100 patients used in this study as either medical or trauma patients.

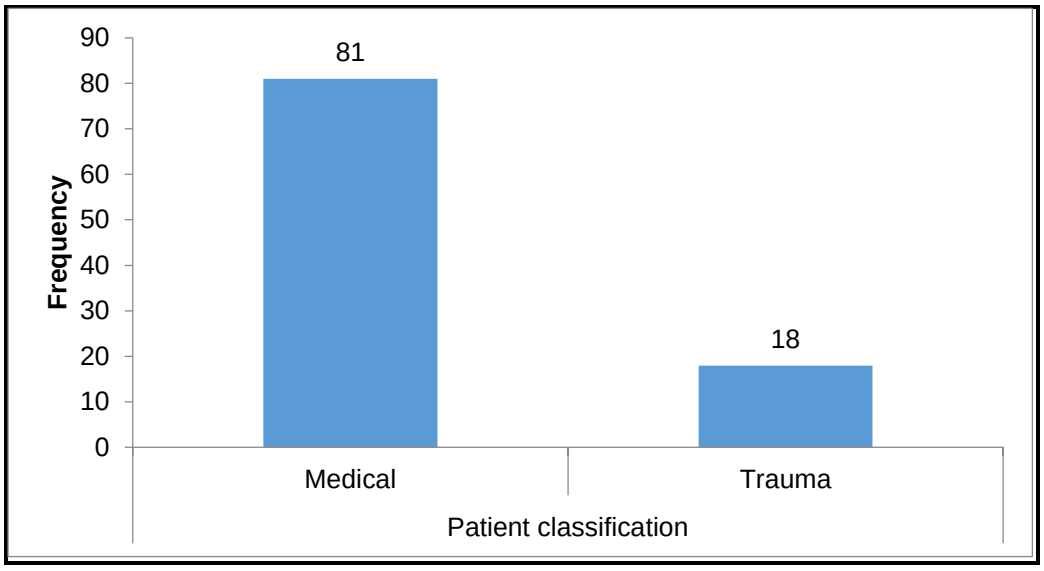

Figure 4.4: Patient classification

The study results shown in Figure 4.4 indicate that of the 100 patients received during the period June to August 2015 the majority were classified as medical patients (82) and only 18 were classified as trauma patients.

Discussion: Lo, et al (2014:118) found that during a national survey of observation units in the United States, 96.9% of patients treated suffered from medical illnesses. In South Africa, which has a quadruple burden of disease (communicable, non-communicable and chronic diseases, such as HIV and AIDS) a large proportion of medically and chronically unwell patients are seen in EDs (Rosedale, et al 2011:537). This was also the case in the study hospital.

4.2.3.3 Area patient was admitted to

Figure 4.5 depicts the five possible areas in the ED where patients were admitted to. These areas are named after the type of patient that is usually managed in the area. During overcrowding the patients would overflow into any open area, changing the dynamics of the area to a general ED.

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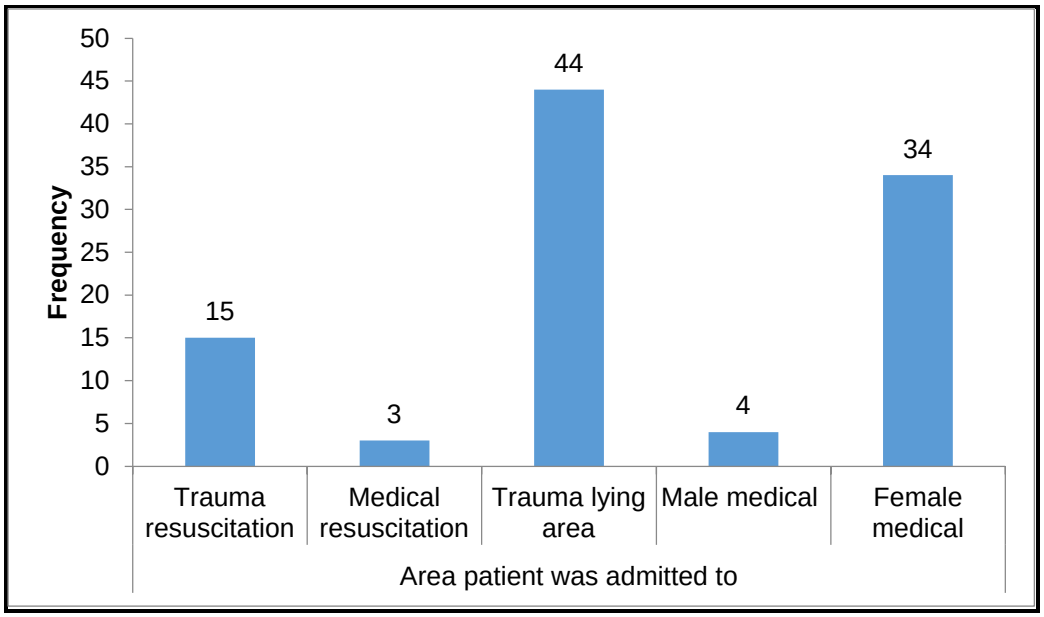

Figure 4.5: Area patient was admitted to

The results in Figure 4.5 show that 44 of the 100 patients whose files were used in the study had been admitted to the trauma lying area, 34 patients to the female medical area, 15 patients to the trauma resuscitation area, four patients to the male medical area and three patients to the medical resuscitation area. Once again the trauma lying area and female medical areas were the areas where the majority of patients were showing that these areas are the busiest areas in the study ED.

Discussion: Ye, et al (2012:638) stated that the area to which patients were transferred after treatment in the resuscitation area of the ED was associated with the LOS of patients in the ED. In a study conducted by Paul and Lin (2012:1123) in New York it was found that most of the ED beds were fully occupied during the entire day and that the ED was particularly busy in the evening. In addition, Ding, et al (2010:822) suggested that LOS in the ED varied and was influenced by the time of the day as well as the day of the week. The findings of Paul and Lin (2012) and Ding, et al (2010) could be explained by the fact that the demand for inpatient beds by ED patients and patients from other wards, hospitals and other health centres peaked at predictable times of the day and days of the week (Ding, et al 2010:822).

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4.2.3.4 First contact ED nurse

The results depicted in Table 4.3 show that the average time it took for the ED nurse to see the patient after being admitted to the ED was 27 minutes. In the ED where the study was done it is practice for the nurse to admit the patients to the ED before the ED doctor sees the patients, except in the case of emergency patients. There are other cases in which the ED doctors will see patients before the ED nurses, especially when the influx of patients is high. The ED nurses do a baseline history and quick assessment and get a set of vital data for all patients admitted to the ED.

Discussion: Emergency nurses play an essential role in the ED operations and spend more time with individual patients than any other ED personnel (Khanna, Boyle, Good & Lind 2012:511). Nurses working in the ED are expected to have the necessary skills, knowledge and experience to effectively manage everyday emergencies and chaotic situations (Hammad, Arbon & Gebbie 2011:87). These nurses must be knowledgeable about general and specific health issues because of the range of patients and the variety of medical conditions they encounter that may require urgent treatment and managed care in the ED (Hammad, et al 2011:90). Essential roles expected from a nurse in the ED include assessing, intervening and stabilising a variety of ill or injured patients with decisive actions (Hammad, et al 2011:91). The ED doctor usually sees the patient after the patient has been assessed by the ED nurse.

4.2.3.5 First contact ED doctor

The results in Table 4.3 show that an ED doctor saw a patient in the ED on average 1 hour 43 minutes after the nurse had had first contact with the patient. This proves that nurses play an essential role in ED operations as they are not only the first contact of the patient in the ED, but also has to manage the patient until the ED doctor is available to assess the patient. On the other hand, the ED doctor is the link between the patient being discharged after receiving emergency treatment or being referred to a specialist for further management.

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Discussion: Emergency doctors in the ED manage and treat patients in a one-directional flow wherein patients are attended to, moved through the ED process and discharged from the ED by being admitted to hospital wards, transferred to other hospitals or sent home (Nugus, Carroll, Hewett, Short, Forero & Braithwaite 2010:1998). Patients follow a specific journey in the ED which is assessment by ED nurses and diagnosis of conditions with specific treatment plans to stabilise patients by ED doctors (Nugus, et al 2010:1998). Another important role of the ED doctor is executing the treatment plan in coordination with relevant professionals and services involved with the care of ED patients and their admission, transfer and discharge (Nugus, et al 2010:1998). This task of the ED doctor could be complicated by the burden on the unit, in particular the burden caused by overcrowding as it prolongs the time that the patient waits before being seen by or referred by the ED doctor. For the ED doctor to coordinate with relevant professionals all the results from the required investigations (such as a CT scan and laboratory tests) should be available, unless the patient is critically ill or injured. Knowing about all these processes gives a better understanding of the reason why the average time a patient has to wait to see a specialist after referral by an ED doctor is between 2 hours 25 minutes and 5 hours 15 minutes.

4.2.3.6 Specialist's referral(s) and first contact specialist

Table 4.4 indicates the numbers of patients (out of 100 patients' files used in this study) that were referred to which speciality areas. These referrals are usually done by the ED doctor as part of coordinating the care of ED patients.

According to the results depicted in Table 4.4, the majority of patients were referred to internal medicine (53), followed by general surgery (21) and orthopaedics (17). Fewer patients were referred to neurology and cardiology (5), followed by neurosurgery and thoracic surgery (3). Of the 100 patients in this study there was only one referral each to gynaecology, intensive care and vascular surgery. In confirmation of the earlier observation that South Africa has a quadruple burden of disease (communicable, non-communicable and chronic, such as the human immunodeficiency virus (HIV) and acquired immune deficiency syndrome (AIDS)

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(Rosedale, et al 2011:537), the results in Table 4.4 indicate that a large number of patients in the study ED were medical patients who then was referred to internal medicine doctors (specialists).

Table 4.4: Specialist referrals

Specialist referrals	Frequency
Neurology	5
Neurosurgery	3
Cardiology	5
Thoracic surgery	3
Internal medicine	53
General surgery	21
Orthopaedics	17
Gynaecology	1
Intensive care	1
High care	0
Vascular surgery	1

As indicated in Table 4.3, an ED patient waited on average 5 hours 15 minutes before having the first contact with a specialist. The specialist assesses the patient and does additional diagnostic and laboratory tests before discharging the patient from the ED. In the current study this process took an average of 6 hours 7 minutes. Table 4.3 shows that on average a specialist takes longer than a triage nurse and doctor as well as an ED doctor and nurse to see a patient.

Discussion: Coordination of the ED doctor with other professionals consists of specialist referrals and consultations and these processes form an important aspect of the throughput process as patients are likely to stay in the ED until consultations are completed (Cho, et al 2011:399). Hence, all the required specialists' consultations and tests are done in the ED before any decision is taken about a patient's discharge from the ED to a ward, a hospital or home. As depicted in Table 4.3, it takes hours for ED patients to be seen by specialists and these patients might face prolonged waiting times to see specialists (Rao, Lerro & Gross 2010:1375), which could lead to prolonged LOS in the ED. According to Brick, et al (2012:137), emergency consultations increase patients' LOS in the ED. Patients with complex pathologies who have consultations with multiple specialities and consecutive

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consultations with different specialists are two of the reasons identified for prolonged LOS in the ED (Vegting, et al 2011:396). Specialists work independently and different specialists take different times to make decisions about and treat patients. Multiple consultations result in fragmentation of patient care and eventually in the increased LOS of patients in the ED.

A lack of coordination of care that is sometimes caused by different specialities who tend to work individually and not as a team when attending to patients can lead to prolonged LOS (Vegting, et al 2011:397). The occurrence of multiple specialist referrals in Taiwan was also identified in a study conducted by Hsu, et al (2012:3) who found that patients with complex medical and surgical co-morbidities were usually managed by more than one specialist. In a study conducted by Vegting, et al (2011:397), 37% of ED patients were treated by internal medicine and 29% by neurology, and these patients experienced prolonged LOS in the ED. This finding is significant in respect of the ED where the study was done as the majority (53) of the 100 patients in the study ended up being referred to the internal medicine speciality and five to neurology.

4.2.3.7 Diagnostic and laboratory tests

In Table 4.5 the five most common tests done in the ED are summarised and the tests ordered for the 100 patients in this study are shown: X-rays were conducted for all 100 patients, blood tests were conducted for 98 of the 100 patients. CT scans were done for 17 patients and sonars were done for five patients. None of the 100 patients in this study received an MRI scan.

Table 4.5: Diagnostic and laboratory tests

Diagnostic and laboratory tests done	Frequency
X-rays	100
CT scan	17
MRI scan	0
Sonar	5
Blood tests	98

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Discussion: Diagnostic testing and treatment are an integral and essential aspect of ED evaluation. However, they often influence doctors' decision-making regarding admissions and care delivery and as a result may contribute to longer ED LOS (Kocher, Meurer, Desmond and Nallamothu 2012:532). In the hospital where the study was done, specialist consultation is requested by the ED doctor after diagnostic and laboratory tests have been ordered. This is because in most cases the results of these investigations are used as the basis of referrals. Specialists will also request additional diagnostic or laboratory tests after they have been consulted and before they decide whether to discharge the patients from the ED. In the hospital where the study was done it has become practice for most specialists to wait for the results of diagnostic and laboratory tests before discharging the patient from the ED. This practice, and also the amount of diagnostic and laboratory tests done in the ED, leads to an increase in patients' LOS in the ED. According to Javis (2016:66), effective use of point-of care testing (POCT) can reduce delays in the disposition decisions, increase timely patient discharge rates and reduce the overall total patient journey time as it provides clinicians with rapid results and reduction in turnaround times for investigation in the ED results.

In a study conducted by Forero, et al (2011:4) it was found that EDs and inpatient units faced challenges associated with the impact of overcrowding and prolonged LOS due to delays in the availability of radiology and pathology results. It was further reported in the same study that there was an increased demand for imaging, which could result in delays in receiving these services, errors in producing the results as well as errors in processing the radiology orders (Forero, et al 2011:4). Furthermore, the health care system in general is experiencing an increase in the usage of diagnostic tests such as computed tomography (CT) scans in the ED, tests which involve many specialities (Larson, Johnson, Schnell, Salisbury & Forman 2011:172). The increased use of CT scans is associated with prolonged LOS (Vegting, et al 2011:397). The elapsed time between receiving diagnostic results and the making of a decision by either the ED doctor or specialists might be ascribed to the fact that results take time to become available. It could also be ascribed to the repetition of diagnostic tests when doctors are not aware that tests have already been performed

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(Vegting, et al 2011:397). On the other hand, results might be delayed because of a backlog due to overcrowding of patients in the ED and tests being done on all or almost all patients coming to the ED.

4.2.3.8 Admitting speciality and bed availability at the time of admission

Table 4.6 depicts how many of the 100 patients in this study were admitted per speciality as well as the number of in-hospital beds available in the speciality wards at the time of admission of these patients. Statistics on the availability of beds in the study hospital at specific times (07h00, 12h00 and 19h00) are collected by the hospital's central patient care office every day shortly before the times indicated so that these statistics are at hand when required for possible bed identification for patient admissions to the hospital.

Table 4.6: Admitting specialities' bed availability at the time of admission

			Admitting speciality bed availability at the time of admission			
Speciality	**Admitting speciality**	**No. of patients admitted**	**07h00**	**12h00**	**19h00**	**Total no. of beds available**
Neurology	3	3	n/a	n/a	1	1
Neurosurgery	2	2	n/a	n/a	3	3
Cardiology	5	5	0	0	1	1
Thoracic surgery	1	1	n/a	n/a	0	0
Internal medicine	55	55	2	2	2	6
General surgery	18	18	2	1	0	3
Orthopaedics	16	16	2	5	3	10
Gynaecology	0	0	2	n/a	n/a	2
Intensive care	0	0	n/a	n/a	1	1
High care	0	0	n/a	n/a	n/a	0

Table 4.6 depicts the in-hospital beds available after the specialist had first contact with the patient in the ED and decided to discharge the patient from the ED to a hospital ward. The results of Table 4.6 show that out of the 100 patients in the study, internal medicine needed to admit 55 ED patients, general surgery needed to admit 18, orthopaedics needed to admit 16, cardiology needed to admit five, neurology

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needed to admit three, neurosurgery needed to admit two and thoracic surgery needed to admit one patient.

The results illustrate clearly that the number of patients needing admission did not equate to the number of in-hospital beds available at the time of admission. Although internal medicine had to admit 55 patients they only had six in-hospital beds available in their speciality wards at the time. General surgery had to admit 18 patients but had only three speciality beds available, while orthopaedics had to admit 16 patients but had only 10 speciality beds available. Although cardiology had to admit five patients, they only had one bed available and neurology had to face the same challenge as this ward had to admit five patients but had only one bed available. Thoracic surgery had the lowest number of patients to admit (one) but had no available in-hospital beds in their speciality wards at the time of the study. Other specialities, for instance gynaecology, intensive care and high care, had beds available but did not need to admit any patients at the time. Table 4.6 indicates that an overall shortage of beds was experienced by different specialities, resulting in boarding of patients in the ED and prolonged LOS.

Discussion: According to Soong, et al (2013:299), a large proportion of inpatients in many hospitals are admitted to general wards like internal medicine. In addition, Rathlev, et al (2011:167) remarked that the demand for inpatient beds often exceeded the capacity as the hospitals were often 100% full especially during the late morning and early afternoon hours on weekdays. Hsu, et al (2012:4) found that patients with sub-speciality diseases in the ED were usually outnumbered by those with general medical or internal medicine needs, which caused a shortage of general medical beds most of the time. This is also true for the hospital where the study was done as 55 of the 100 patients in the study needed to be admitted to the internal medicine area (see Table 4.6). This was also the case in a study done in Sweden where 66% of patients who required admissions were medical patients (Bjornsen 2013:464). Internal medicine in the study hospital has three speciality wards: one 35-bed male ward, one 30-bed female ward and a short-stay ward for both male and female patients with 17 beds (therefore, a total of 82 beds). More than often the

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internal medicine wards ended up borrowing beds from other specialities when their need exceeded their capacity (see Table 4.6). When all efforts failed to find an in-hospital bed for a patient needing admission, the patient ended up staying in the ED, which led to prolonged LOS of up to 3.04 days (see Table 4.3). This chain of challenges led to overcrowding and a decrease in the quality of care these patients received in the ED.

4.2.4 Section D: Output (discharge)

Table 4.3 indicates the duration of time from when the patient is seen by a specialist to when the patient is discharged from the ED as well as the overall time taken from admission to the ED to discharge from the ED. From the patient's first contact with a specialist to the patient's discharge from the ED took 54 hours 7 minutes. The overall time it took a patient from reporting to reception to being discharged from the ED was 73 hours 49 minutes, which is equivalent to 3.04 days.

4.2.4.1 Discharge date, time and destination

Figure 4.6 depicts the discharge destination of the 100 patients whose files were used in the study to six possible destinations, namely home, a ward, high care, intensive care, other hospitals and an operating theatre.

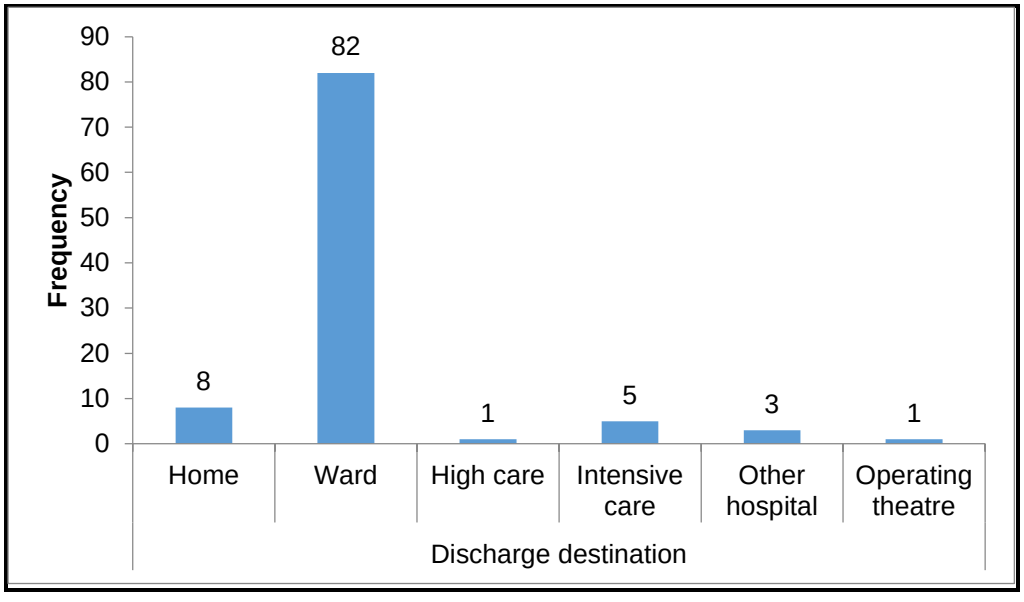

Figure 4.6: Discharge destination

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The results of this study show that the majority of patients (82) were discharged to the wards, eight were discharged to their respective homes, five were discharged to an intensive care unit, three to other hospitals, one to high care and one to an operating theatre. To summarise, 89 patients needed an in-hospital bed in a hospital that had little available capacity at the time. Thus the patients all experienced prolonged LOS in the ED.

Discussion: The last phase of the ED process that patients go through is their admission to wards, transferral to other hospitals or other health care facilities or being discharged to their home (Magee 2015:132). The inefficiency of this stage of the ED process can lead to the boarding and prolonged LOS of patients who remain in the ED after the decision to admit or transfer them has been taken (Hing & Bhuiya 2012:7). Various reasons for boarding in the ED are cited by various authors. In a study conducted by Cho, et al (2011:401) it was found that many doctors had a tendency to order admission only when they were sure they had inpatient beds available. Most of the time, patients with more complex co-morbidities as well as patients with ”do-not-resuscitate” orders have prolonged LOS in the ED, which suggests that the complexity of a patient’s condition or the patient’s advanced disease stage may obstruct access to beds (Hsu, et al 2012:4). Some patients who are seeking emergency care during the night are often allowed to stay in the ED for the night and are held there until morning when the family can pick them up or when transport is available (Rathlev, et al 2011:167). As a result, the patient’s stay in the ED is prolonged. These above explanations are true also for the study hospital, resulting in increased boarding, overcrowding and prolonged LOS in the ED. As far as the study hospital was concerned, boarding was caused by the fact that more beds were needed to admit patients than what was available. Most of the doctors in the ED only admitted patients when an inpatient bed became available and other doctors who were unsure about patients’ prognoses preferred to leave them in the ED for monitoring. Interestingly, the study conducted by Bjornsen (2013:464) revealed that 89% of ED visits resulted in admission which shows that a high rate of patients that visits the ED requires admissions owing to the reason for boarding of patients in the ED.

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4.3 RELIABILITY AND VALIDITY ANALYSIS

Chronbach's alpha and correlation analysis was used to test the reliability and validity of the study.

4.3.1 Cronbach's alpha

In order to test the reliability of the variables to be used in the regression analysis, Cronbach's alpha was applied. Cronbach's alpha measures the internal consistency through correlating responses of a questionnaire across a sub-group or the entire questionnaire (De Vos, Strydom, Fouche & Delport 2011:177). Table 4.7 presents Cronbach's alpha coefficient ranges and their significance for this study. The variables of interest showed an average Cronbach's alpha of 0.87, which falls within the acceptable value of 0.7. A summary of the results is provided in Table 4.8.

Table 4.7: Cronbach's alpha values

Alpha coefficient range	Strength of association
< 0.6	Poor
0.6 to < 0.7	Moderate
0.7 to < 0.8	Good
0.8 to < 0.9	Very good
0.9	Excellent

Source: Hair, et al (2003:172)

Table 4.8: Summary of Cronbach's alpha results

Summary for scale: Mean = 295516 Standard deviation = 195.904 Valid sample size(N) = 60 Cronbach's alpha: 0.871681 Standardised alpha: 0.657681 Average inter-item correlation: 184402

The reliability test using Cronbach's alpha was conducted to ensure construct validity and to ensure that questions appeared logically and reflected accurately what they were intended to measure.

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Table 4.9: Cronbach's alpha for study

Variable	Cronbach's alpha
Input	0.872177
Throughput	0.872320
Output	0.872225
LOS	0.872214

Cronbach's alpha was calculated for all the variables applied in the study. Table 4.9 shows all the variables with scores above 0.70. These indicated that the variables were within the acceptable range and that the results produced might be reliable in accordance with the guidelines given in Table 4.7.

4.3.2 Correlation analysis

(Only correlations above 50% that had a *p*-value with a level of significance less than 0.05 are presented in this section.)

Correlation analysis was done between variables to assess the extent to which two or more variables fluctuated together where a positive correlation indicated the extent to which those variables increased or decreased in parallel, and a negative correlation indicated the extent to which one variable increased as the other one decreased. The following correlation results were obtained:

- Gender – Gender was positively correlated with the area the patient was admitted to (59%).
- Mode of arrival to emergency department – There was a positive correlation of 68% between modes or arrival and the dates patients were triaged by a nurse and a doctor whereas a negative correlation of -68% existed between the modes of arrival and the times patients were triaged by a nurse and a doctor (including triage score and colour).
- Time reported to reception – There was a positive correlation of 66% between the dates and times patients reported to reception and the date and time of admission to the emergency department.
- Patient classification was positively correlated with the outcome of being seen at reception (60%), time triaged by nurse, date triaged by doctor, time triaged by

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doctor and triage score and colour, whereas it correlated negatively with the date triaged by the nurse (60%).

- Admission to ED was positively correlated with burden related to bed availability in the trauma resuscitation area at 07h00 (62%), burden related to bed availability in the trauma lying area (TLA) at 07h00 (62%), burden in the bed in the medical resuscitation area at 07h00 (62%), burden in the bed in the male medical area at 07h00 (62%), burden in the bed in the female medical area at 07h00 (62%), whereas admission to ED correlated negatively with burden in the bed in the trauma resuscitation area at 19h00 (57%), burden in the bed in the medical resuscitation area at 19h00 (52%), burden in the bed in the trauma lying area at 19h00 (53%), burden in the bed in the male medical area at 19h00 (52%) and burden in the bed in the female medical area at 19h00 (54%). The date the patient was discharged correlated positively with the date the patient was seen by the nurse.

4.4 DATA ANALYSIS

4.4.1 Regression analysis: results

In order to assess the relationship between the independent and dependent variables, stepwise regression with forward selection was applied.

The dependent variable, namely the patient LOS, was calculated by subtracting the date and time the patient was discharged from the date and time the patient was received at the reception of the hospital's ED. The independent variables were indicated in Chapter 3 of this study.

The results indicated that 98% of the data set had been explained and that there was a strong relationship between the variable of length of stay and the variable of time taken between being seen by the specialist until being discharged. The *p*-value of the variable being seen by the specialist showed a level of significance of less than

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0.05, indicating a strong relationship between the variable of being seen by the specialist and the variable of length of stay.

A summary of the regression analysis showing the relationship between the dependent and independent variables is presented in Table 4.10.

Table 4.10: Regression analysis between LOS and independent variables

	Summary of regression analysis: Dependent variable *Correlation coefficient (R)* = 0.98436346 *R- Square* = 0.96897141 Adjusted *R- Square* = 0.96864820, *F – test calculated* (1,96) = 2997.9 p value<0.0000 Standard error of estimate: 0.41173					
	Beta	**Std error of beta**	**B**	**Std error of beta**	**t(96)**	**p-level**
Intercept			0.537693	0.058517	9.18862	0.000000
Difference between being seen by a specialist and being discharged	0.984363	0.017978	0.990933	0.018098	54.75327	0.000000

Discussion: This study results indicated a strong relationship between the variable of being seen by a specialist and length of stay. This implies that the length of stay was influenced by how long the specialist took to see the patient. The results of this study conducted supported the indication in the literature that many of the first-line-on-call specialists in the ED who see patients are junior residents or doctors who are tasked with assessing patients first before notifying the senior specialist in their department about the findings and Cho, et al (2011:400) had similar results in their study. The study conducted by Cho, et al (2011:399) confirmed that a patient's consultation with a specialist in the ED affected the patient's LOS as this specialist was tasked with making a decision about admitting, transferring or discharging the patient and because the patient was likely to stay in the ED until the consultation process had been completed. In a study conducted by Vegting, et al (2011:397) similar results indicated that the hierarchical decision-making approach practiced by letting junior doctors see patients and first discuss the patients with senior doctors

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before a final decision can be made contribute to the LOS. This hierarchical decision-making was the practice in the study hospital as well.

Table 4.11: Goodness of fit of the regression model – analysis of variance

	Sums of squares	*Degree of freedom*	Mean squares	*F test*	*p*-level
Regress	508.2189	1	508.2189	2997.921	0.00
Residual	16.2743	96	0.1695		
Total	524.4932				

The results in Table 4.11 depict the goodness of fit of the regression model. The results of the study according to Table 4.11 found that the *p*-value was less than 0.05 and *F* was larger than expected, indicating that the model, when the dependent variable was LOS and the independent variable was the time taken by the specialist to see the patient, depicted a strong relationship with patient LOS. These results showed that the aspect of the time it took for a specialist to see a patient had to be addressed.

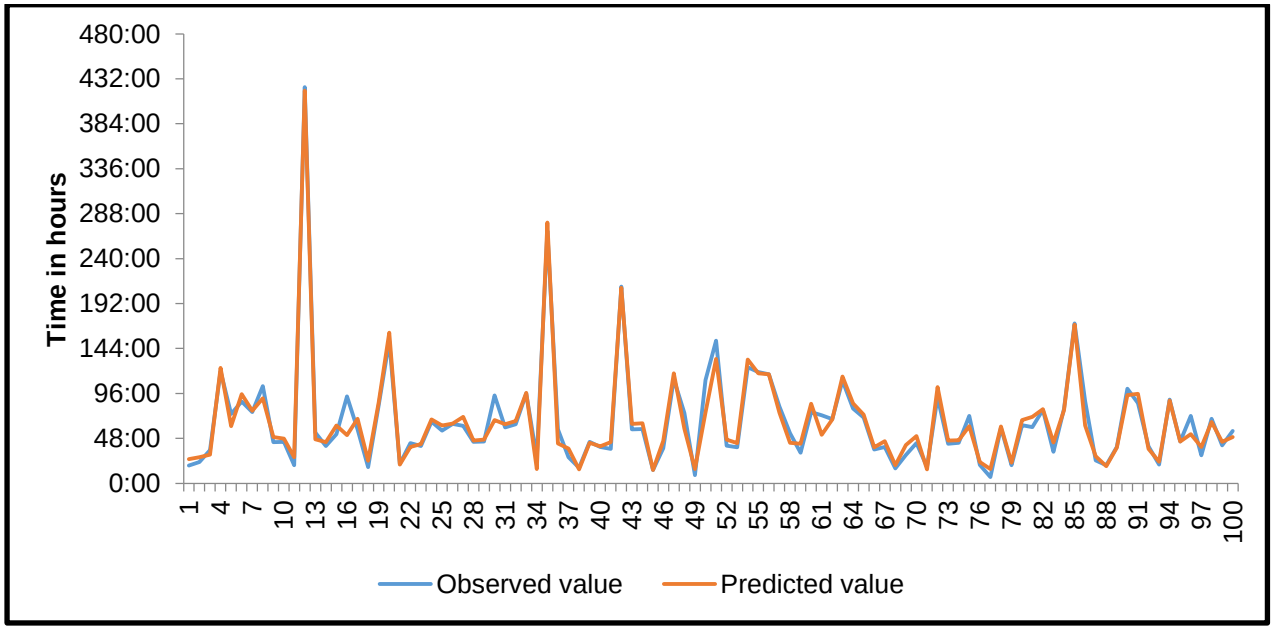

Figure 4.7: Predicted values for patients' length of stay

Future length of stay prediction based on time it takes for specialist to see patients.

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Figure 4.7 presents an outlook regarding the time specialists are more likely to take in future to see patients, which may potentially affect patients' length of stay. This is in line with results presented in Table 4.12 where specialists are more likely to spend between 2.31 days and 3.23 days compared to the expected 12 hours.

In Table 4.12 a summary is given of the predicted results of time taken by specialists to see patients

Table 4.12: Summary of predicted results (time taken by specialists to see patients)

	Observed value (time in hours and minutes)	Predicted value (time in hours and minutes)
Minimum	6:41	14:13
Maximum	422:59	419:21
Mean	66:28	66:31
Median	56:55	51:42
95% Lower confidence interval	2.29	
95% Upper confidence interval	3.21	

The results show that minimum time taken to see patients by a specialist was 6 hours 41 minutes and predicted time increased from 6 hours 41 minutes to 14 hours 13 minutes while maximum observed was 422 hours 59 minutes equivalent to 17 days and predicted maximum is less by one day. The average time sits at 2.77 days. When 95% confidence limit was assessed the results indicate that the true value will be between 2.31 days and 3.23 days for specialist to see a patient. Refer to Figure 4.7 and Table 4.12.

An outlier of 17 days was recorded as resulting in the high maximum time it might take for a specialist to see a patient. Therefore, the results confirmed that it would take patients more than 12 hours of stay at the hospital if the throughput area (in terms of the time a specialist took to see a patient) did not improve. However, if this area improved the length of time a specialist took to see a patient could range between only 14 hours and two days.

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4.4.2 Stepwise regression (forward selection): summary

Forward selection was applied to eliminate variables that, when selected, did not improve the model. When adding the variables that improved the model, the following results were obtained:

Table 4.13: Stepwise regression: application of forward selection

	Step +in /- out	Multiple *R* (*correlation coefficient*)	Multiple *R*-square	*R*-square change	*F* - to entr/rem	*p*-level	Variables included
Difference between the time seen by a specialist and discharged	1	0.982120	0.964559	0.964559	1605.730	0.000000	1

Table 4.13 depicts the step-by-step implementation of stepwise regression. The results showed that the time it took for a specialist to see a patient had the highest correlation with patient LOS. The *R*-square of 98% indicated that 98% of the data for these variables had been explained and that the coefficients fit the model significantly since the *p*-values were below the 0.05 level of significance. Whereas all the other variables showed a drop in significance in relation to the time taken by a specialist to see a patient, the *R*-square showed a constant high, indicating that this was the area where the challenges in LOS lay.

4.4.3 Autocorrelation

To test the null hypothesis that the errors on the regression model were constant against the alternative hypothesis that the errors followed a stationary first-order auto regression, the Durbin-Watson statistic was applied to the residuals from least square regressions. It should be noted that the distribution of this test statistic did not depend on the estimated regression coefficients and the variance of the errors. In this study, the Durbin-Watson statistic found was 2.3, indicating that there was no autocorrelation between the residual values and that the errors followed a stationary first-order auto regression, which improved the ability to conduct valid statistical tests.

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4.5 DISCUSSION OF LENGTH OF STAY: FUTURE PREDICTIONS

The following challenges, among others, were identified:

- Consecutive consultations with different specialists by patients with complex pathology led to prolonged LOS (Vegting, et al 2011:397).
- Some patients with poor prognoses or do-not-resuscitate orders tended to be kept longer in the ED as specialists were reluctant to admit these patients (Hsu, et al 2012:4).
- In most cases, specialists worked with medical doctor students who needed supervision and education and required time to formulate plans and conduct initial presentations, which prolonged LOS (Paul, et al 2010:566; Soong, et al 2013:299). LOS was also prolonged because specialists only gave admission orders when they were sure they had inpatient beds available (Cho, et al 2011:400).

The above-mentioned instances may all lead to prolonged length of stay. When the regression model was fitted, the results showed that there was a confidence percentage of 95% that the true value would be between 2.31 days and 3.23 days for a specialist to see a patient. This showed that since the actual average was 3.04 days and the predicted average was 2.77 days, there was a probability that the time that a specialist took to see a patient might be reduced.

4.6 SUMMARY OF RESULTS AND DISCUSSION

It was found that the majority of the 100 patients who had visited the ED during the study period and stayed longer than 12 hours after admission were females, although the difference between females and males was huge. Of the100 patients in the study, majority of patients who stayed longer than 12 hours in the ED were aged between 31 and 45 years, and one patient was older than 91 years. The majority of patients, including those who used private transport to get to the hospital, were ambulant. The results also showed that the majority of the patients during the period

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of study had been sent to the triage area whereas fewer of them were sent directly to the admission department (being urgent and needing emergency care). On Thursdays slightly more patients were seen at the ED than on other days of the week. One of the main results was that specialists took longer times with patients than any other group of health care professionals (nurses and doctors). Although the time that nurses spent at patients' bedsides was not calculated (because it was too fragmented to measure), it is known that they spend longer than any other health care professionals at patients' bedsides. For example, if a nurse stays in the same room as a patient to continue monitoring it can count as being at the patient's bedside.

The study results showed that the majority of the patients managed in the ED were medical patients. Furthermore, the majority of the patients were admitted to the trauma lying area and the female medical area, where the numbers of beds available were less than the numbers of patients admitted. In the hospital where the study was done, additional beds and chairs were always taken to these areas to accommodate the number of patients admitted. The majority of the patients were referred to the internal medicine area although substantial numbers of them were referred to the general surgery and orthopaedic areas. Concerning the diagnostic and laboratory tests, the one that was ordered and used most often for the 100 patients in the study was X-rays. This was closely followed by blood tests and CT scans whereas sonars were not used as often and MRI scans were not asked for at all. In the output phase most of the 100 patients were discharged to in-hospital wards and fewer to their respective homes, ICU, other hospitals, a theatre and high care. The average LOS in the ED was 3.04 days (which can be regarded as prolonged LOS).

4.6.1 Objective 1

Objective one was to describe the possible areas of delay associated with prolonged length of stay during the input, throughput and output phases in the emergency department. In the study the possible area of delay associated with prolonged length of stay during the throughput phase was found to be the difference between the time taken to be seen by a specialist and the time of discharge. Other factors also

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showed a strong and significant correlation and level of association with LOS. The following factors may need to be looked at since they were a cause for alarm: patient classification; outcome of being seen at reception; time triaged by nurse; date triaged by doctor; time triaged by doctor and triage score/colour and date triaged by nurse; admission to ED; burden related to bed availability in trauma resuscitation area at 07h00 and 19h00; burden related to bed availability in trauma lying area at 07h00 and 19h00; burden related to bed availability in medical resuscitation area at 07h00 and 19h00; burden related to bed availability in male medical area at 07h00 and 19h00; and burden related to bed availability in female medical area at 07h00 and 19h00.

4.6.2 Objective 2

In the study, a correlation was established between the gender of the patient and the area the patient was admitted to. The patient's mode of arrival at the emergency department was correlated with the date/time the patient was triaged by the nurse, the date/time the patient was triaged by the doctor and the patient's triage score and colour. A correlation was also established between the time the patient reported to reception and the time the patient was admitted to the emergency department. Patient classification and outcome of being seen at reception, time triaged by nurse, date triaged by doctor, time triaged by doctor, triage score/colour and date triaged by nurse were correlated. Furthermore, admission to the ED correlated with the burden experienced in the ED pertaining to beds available in the trauma resuscitation area at 07h00 and 19h00, the beds available in the trauma lying area at 07h00 and at 19h00, the beds available in the medical resuscitation area at 07h00 and at 19h00, the beds available in the male medical area at 07h00 and at 19h00, and the beds available in the female medical area at 07h00 and at 19h00 (see section 4.3).

According to the results, the variable with a strong relationship to the length of stay was the time taken by a specialist to see a patient. However, the indication was that factors with a strong correlation of below 0.05 the level of significance ought to be addressed equally to prevent increased length of stay and its challenges. These factors were: patient classification and outcome of being seen at reception; time

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triaged by nurse; date triaged by doctor; time triaged by doctor and triage score/colour and date triaged by nurse; admission to ED; burden of beds available in the trauma resuscitation area at 07h00 and 19h00; burden of beds available in the trauma lying area at 07h00 and 19h00; burden of beds available in the medical resuscitation area at 07h00 and 19h00; burden of beds available in the male medical area at 07h00 and 19h00, and burden of beds available in the female medical area at 07h00 and 19h00.

4.6.3 Objective 3

Objective 3 will be discussed in Chapter 5 (see Section 5.3.3).

4.7 SUMMARY

Chapter 4 presented an analysis and a discussion of this study results, and the discussion was accompanied by references to relevant literature. The results of this study supported the findings reported on in the literature (see section 4.2). Furthermore, this chapter presented a discussion of the demographics of the 100 patients whose files were selected (using systematic sampling) for the specified period of this study, a discussion of the demographic analysis using descriptive statistics as well as an explanation of the stepwise regression applied to investigate the relationship between length of stay and the different phases (input, throughput and output phases) in the ED. The diagnostic checking that was carried out for the study was reported on and a summary of the findings related to the objectives and to answering the research questions were presented in detail. In conclusion, the results were discussed.

Chapter 5 concludes the study by summarising the findings that were presented statistically using graphs and tables. The chapter also presents a discussion of recommendations that could lay the foundation for future research and a discussion of the limitations of the study.

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CHAPTER 5: CONCLUSIONS, RECOMMENDATIONS AND LIMITATIONS

5.1 INTRODUCTION

In Chapter 4 the research results were presented and the findings were discussed. In Chapter 5 the conclusions reached and the recommendations made based on the research results will be provided and reference will be made to the limitations of the study. The research objectives will guide these discussions.

5.2 RESEARCH AIM AND OBJECTIVES

The overall aim of this study was to describe associated areas of delay in the emergency department and also to investigate factors influencing prolonged length of stay in this department.

In order to attain the aim of the study, objectives were formulated based on the open systems theory model. An audit tool was developed according to the set objectives to achieve the research aim. The objectives set for this study were as follows:

- **Objective 1:** To describe the possible areas of delay associated with prolonged length of stay during the input, throughput and output phases in the ED
- **Objective 2:** To investigate the relationship between the areas of delay and LOS
- **Objective 3:** To recommend to management that strategies be implemented to address the areas of delay that possibly contribute to prolonged LOS in the ED

To address the aim and objectives of the research, a quantitative, non-experimental, descriptive and retrospective design was used. Ethical approval was obtained from the University of Pretoria's Faculty of Health Sciences (see Annexure A1) and the relevant hospital (see Annexure A2). Based on the input-throughput-output model (see Figure 1.1) and in collaboration with a statistician (see Annexure C) an audit tool (see Annexure B2) was designed, which was used to collect data from the files

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of 100 patients. During June 2015, 30% of the patients who were managed in the ED stayed in the ED for more than 12 hours. In July of the same year, 27% of the patients and in August 43% of the patients who were managed in the ED stayed there for more than 12 hours (see section 4.2.2.1 and Table 4.2.). Systematic sampling was used to select the files of the 100 patients who met the inclusion criteria (see section 3.4.1 and Table 1.3). The sample was selected from all patients who had been attended to and managed in the ED of the study hospital for more than 12 hours from 1 June 2015 to 31 August 2015.

5.3 CONCLUSIONS AND RECOMMENDATIONS

The discussion of the conclusions reached is based on the results of the study (see Chapter 4) and will be guided by the research objectives (see section 1.3).

5.3.1 Possible areas of delay

Objective 1: To describe the possible areas of delay associated with prolonged length of stay during the input, throughput and output phases in the ED

In order to describe the possible areas of delay associated with prolonged LOS, the audit tool that was used to collect data was sub-divided into the following four sections (also see Annexure B2):

- Section A: Demographic information
- Section B: Input (reception / triage)
- Section C: Throughput (admission to emergency department)
- Section D: Output (discharge)

A concluding discussion of each section is presented in sections 5.3.1.1 to 5.3.1.4.

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5.3.1.1 Section A: Demographic information

Data in respect of demographic information related to the patients' age, gender, mode of arrival at the ED and mobility. In this section the descriptive data relating to these aspects will be discussed.

⇨ **Patients' age**

The largest group of patients managed in the ED was found to be patients between the ages of 31 to 45 years (33%), and the smallest group was found to be between the ages of 91 to 105 years (1%). The data is inconsistent with the literature which states that the highest percentages of patients attended to in EDs are patients above 65 years of age (see Table 4.1). Research indicates that the majority of patients who visit the ED are 65 years or older. In the study sample the majority of patients (69%) were 60 years or younger.

⇨ **Patients' gender**

The research results showed an almost even spread of male (49%) and female (51%) patients who were attended to in the ED, which is contrary to the findings in the literature that more male patients than female patients visit the ED (see section 4.2.1.2).

⇨ **Mode of arrival**

The study found that 76% of patients who arrived at the ED used their own transport and only 24% arrived by ambulance (see Table 4.1). The findings indicated a higher rate of walk-in patients (76%) who used their own transport to visit the ED. As the study was conducted in a tertiary hospital delivering definitive care to referral patients, one would expect that the majority of patients' mode of arrival would be by ambulance. The findings are consistent with the literature indicating that patients bypass clinics and arrive at the ED using their own transport to be managed in the ED as walk-in patients.

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⇨ **Patients' mobility**

The study showed that 62% of the patients in the sample were ambulant (able to walk) while only 37% were non-ambulant (see Table 4.1). These non-ambulant patients included both unconscious patients and conscious patients who could not walk because of their conditions (for instance, a patient presenting with fractures of the lower limbs, such femur fractures). The majority of ambulant patients arrived by own transport (76%), which is in line with other studies (see section 2.2).

5.3.1.2 Section B: Input (reception / triage)

The data in respect of the input phase related to the patient being seen at the reception and triage areas before being admitted to the ED. In this section the relevant descriptive data will be discussed.

⇨ **Reception**

The first contact of a patient who wishes to be managed in the ED is between the ED nurse and the patient who reports to reception. Based on the acuity level of the patient a decision is made by the ED nurse whether to have the patient admitted to the ED immediately, or whether to send the patient to the triage area. In total, 39 of the patients in this study were directly admitted to the ED based on their acuity level. As they were managed immediately their input phase was shortened. A total of 61 patients were sent to the triage area, where it took an average of 55 minutes (see Table 4.3) to be seen by the ED nurse in triage. A possible reason for this delay could be that patients register to be issued with a file before reporting to the triage area. Once the ED doctor in triage has made the decision that a patient may enter the ED, the patient is required to return to the ED admissions section to re-register for admission to the ED. The time patients spend to re-register may also contribute to patients' prolonged total waiting time (55 minutes) during the input phase.

The result of this study showed minor differences in the number of patients visiting the ED on different days of the week, which was consistent with related literature. Thursday was the day on which the majority of patients (17%) visited the ED,

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followed by Wednesday (16%), Monday and Friday (14%), Tuesday, Saturday and Sunday (13%).

Of the 100 patients who reported to the reception area, 61 were sent to triage. These patients were triaged using the SATS tool (see section 2.3.1.1), and of them 46% (n = 28) were found to be urgent, 34% (n = 21) were non-urgent and 20% (n = 12) were very urgent (see Figure 4.2). These figures are consistent with findings in the existing literature.

⇨ **Triage**

It took patients about 55 minutes after reporting to reception to be seen by the ED nurse in triage, and about 2 hours 22 minutes more to be seen by the ED doctor in triage (see Table 4.3). Therefore, the total LOS in the input phase was on average 3 hours 17 minutes (see Table 4.3), delaying patients' admissions to the ED. The findings of the current study are inconsistent with those in other studies in which an emphasis is placed on the importance that patients who present themselves to the ED should be triaged immediately to determine the urgency of their conditions and should not wait and register for a file prior to being triaged. Waiting an average of 55 minutes to be triaged is too long and might affect a patient's outcome negatively. Emergency doctors in triage took an average of 2 hours 22 minutes to see patients after they had been triaged by the ED nurse in triage. This prolonged LOS and should be addressed urgently.

5.3.1.3 Section C: Throughput (admission to emergency department)

The data in respect of the throughput phase related to the patient being admitted to the ED and managed by different health care professionals. In this section the descriptive data relating to the throughput phase will be discussed.

⇨ **Time admitted to the ED**

The average time it took a patient to be admitted to the ED after being triaged by a ED doctor in triage was 27 minutes. The system used in the study hospital was that the patient, after having been triaged, would report to the ED reception again to be

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entered into the ED register, and would then return to the ED admission to register for a file. In this study, it was observed that the total average time a patient had to wait to be admitted to the ED was 1 hour 22 minutes, which is quite high when compared to findings from other similar studies (see Table 4.3).

⇨ **Burden on the emergency department**

The study findings provided evidence that two areas in the ED, namely the trauma lying area and the female medical area experienced an overcapacity of patients in terms of the number of beds available (see Figure 4.3). Overcapacity leads to overcrowding, which impacts negatively on patients' LOS in the ED. The medical resuscitation area where critically ill patients are managed was 100% occupied during the study period.

⇨ **Patient classification**

The study showed that 82% of patients admitted to the ED during the study period were classified as medical and 18% were classified as trauma (see Figure 4.4). These results are consistent with reports in the literature and confirm that the quadruple burden of disease (communicable, non-communicable and chronic diseases for instance, HIV and AIDS) that South Africa suffers from contributes to the fact that a large proportion of the patients in EDs are medically and chronically unwell.

⇨ **Area patient was admitted to**

Patients were managed in allocated areas based on their classification (medical or trauma) and acuity level (triage score/colour). However, due to the overcrowding experienced (see Figure 4.3) patients were allocated to any open bed available, changing the dynamics of the area. As evident from Figure 4.3 and Figure 4.5 patients regularly are overcrowded in the trauma lying area and the female medical area.

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⇨ **First contact with the ED nurse in the emergency department**

The average time it took for a patient to be admitted to the ED after the ED doctor in the triage area had taken the decision to admit the patient, was 27 minutes. Once the patient had been admitted to the ED, the average time it took the ED nurse to have first contact with the patient in the ED was 28 minutes (see Table 4.3). Once the patient had been triaged, it took an average of 55 minutes before the first contact with the nurse in the ED. Thus, from the time the patient first reported to the ED reception area, it took an average of 4 hours 20 minutes before the patient was managed by the nurse in the ED (see Table 4.3).

⇨ **First contact with the ED doctor in the emergency department**

Once the patient had been admitted to the ED and managed by the ED nurse, it took an average of 1 hour 43 minutes before the patient was managed by the ED doctor. Emergency doctors assessed, had diagnostic as well as laboratory tests done and managed patients and, if appropriate, consulted specialists. It was found that the total average time it took a patient from first reporting to the reception area to being assessed and managed by an ED doctor was an astonishing 6 hours 3 minutes.

⇨ **Specialist referrals, first contact with the specialist**

Once an ED doctor had referred a patient to a specialist it took an average time of 5 hours 15 minutes for the patient to be seen by the specialist. A further average time of 6 hours 7 minutes was taken by the specialist to decide on the disposition of the patient (see Table 4.3). This time taken may be due to the time it took to carry out and receive results of the additional diagnostic and laboratory tests requested by the specialist to confirm a final diagnosis (see Section 4.2.3.7). On average, specialists took 6 hours 7 minutes to make a decision about the patient's disposition. The total time that patients waited for specialists to manage them and make a decision about their discharge amounted to 11 hours 22 minutes. Thus the results showed that, on average, specialists took longer to see patients (11 hours 22 minutes) than ED doctors (2 hours 25 minutes).

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⇨ **Diagnostic and laboratory tests**

The results from the study indicated that X-rays were performed on all the patients in the study, blood tests were performed on 98 patients and 17 patients were sent for CT scans. The practice in the study hospital was for the ED doctors to refer patients to the specialists when all the results of the diagnostic and laboratory tests were available, which might have impacted on the LOS. A further delay might be caused if the specialists ordered additional diagnostic and laboratory tests.

⇨ **Admitting speciality and bed availability**

The results indicated that the specialists from the internal medicine section (n = 55), the general surgery section (n = 18) and the orthopaedic surgery section (n = 16) decided to admit the majority of the patients (89%) (see Table 4.6). In similar studies reviewed, specialists from internal medicine were the ones who admitted the majority of the ED patients to the hospital. In the study hospital, the number of patients who required admission by specialists exceeded the number of available beds (see Table 4.6), which might have contributed to the prolonged LOS in the ED. Patients who remained in the ED due to a shortage of beds led to patients overcrowding to different areas in the ED as well as to overcrowding, which might impact on patient outcomes. In addition, the literature confirms that large numbers of patients admitted to the ED and waiting for admission to the hospital caused overcrowding, a situation that caused health care providers to become overwhelmed.

5.3.1.4 Section D: Output

The data in respect of the output phase related to the discharge of the patient from the ED. In this section the descriptive data relating to the output phase will be discussed.

According to the results it took an average of 54 hours 7 minutes for patients to be discharged from the ED once the decision for discharge had been made by the specialist. The total average of LOS was 73 hours 49 minutes, which is equivalent to 3.04 days. Furthermore, the results showed that the majority of patients (82%) were discharged to wards. A further 8% of patients were discharged to their respective

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homes, 5% to an intensive care unit (ICU), whereas three patients were discharged to other hospitals, one patient to a high care unit and one to an operating theatre (see Figure 4.6).

5.3.2 Relationship between the areas of delay and length of stay

Objective 2: To investigate the relationship between the areas of delay and LOS

The results indicated that a correlation existed between the gender of a patient and the area the patient was admitted to. A correlation also existed between the patient's mode of arrival at the ED and the date/time of triage by the ED nurse, the date/time of triage by the ED doctor and the triage score and colour. A correlation was also detected between the time the patient reported to reception and the time the patient was admitted to the ED. Patient classification and outcome of being seen at reception, the time of triage by the ED nurse, the date of triage by the ED doctor, the time of triage by the ED doctor, triage score/colour and date of triage by the ED nurse were also correlated. Admission to the ED correlated with the burden the ED experienced in respect of beds available in the trauma resuscitation area, the trauma lying area, the medical resuscitation area and the male medical and female medical areas at 07h00 and 19h00.

5.3.3 Recommendations

Objective 3: To recommend to management that strategies be implemented to address the areas of delay that possibly contribute to prolonged LOS in the ED

As the third objective of the study was to make recommendations related to addressing prolonged LOS in the ED, this objective will be discussed in this section. The strategies recommended to decrease the LOS of patients admitted to the ED will be discussed in terms of the input-throughput-output model, and general strategies that may further decrease LOS in the ED will also be referred to.

5.3.3.1 Strategies relating to input

The recommended strategies relating to input are the following:

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- The nurses at ED reception should refer patients directly for immediate triage and assessment by the ED nurses in the triage area.
- Patients should not be requested to open a file before being triaged.
- Patients should only be requested to open a file once the ED doctor in triage has made a decision that the patient can be admitted to the ED.
- The number of ED nurses in triage should be increased to decrease the time the first contact with the ED nurse in triage is established so that this nurse can identify the patient's acuity level earlier, in which case patient outcomes may be improved.
- An ED doctor should be allocated and dedicated to the triage area. This doctor should not be involved in the management of patients in the ED.
- Bedside registration, which involves an initial quick registration by capturing the patient's basic demographic information for opening a file, could be done in the ED so as not to delay patient management.

5.3.3.2 Strategies relating to throughput

The recommended strategies relating to throughput are the following:

- The nurse-patient ratio should be investigated and the number of nurses should be adjusted accordingly to ensure that patients who are admitted to the ED are assessed immediately.
- The doctor-patient ratio should be investigated and the number of emergency doctors available per shift should be adjusted accordingly to ensure that patients who are admitted to the ED are assessed immediately.
- Emergency doctors should refer patients to specialists based on a differential diagnosis and referral should not be done only once the diagnostic and laboratory tests are available.
- Specialists should assess patients before diagnoses are confirmed by diagnostic and laboratory tests.
- Specialists should be involved earlier when ordering diagnostic and laboratory tests to ensure these tests are appropriate and to prevent additional diagnostic

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and laboratory tests being required. If additional test are ordered, LOS in the ED is prolonged.

- The departments of radiology and pathology should prioritise the processing of diagnostic and laboratory tests of ED patients.
- A communication system (such as text messaging) could be used to alert the emergency doctor and/or specialist immediately when the diagnostic and laboratory results are available.

5.3.3.3 Strategies relating to output

The recommended strategies relating to output are the following:

- The level of care needed by a patient should be assessed and, if appropriate, the patient should be down referred to a hospital that renders a lower level of care.
- The number of beds allocated to different specialists, specifically internal medicine, general surgery and orthopaedics, should be re-evaluated.
- Available beds in all wards should be utilised for patients admitted from the ED.
- A computerised 24-hour system should be used to identify all available beds.

5.3.3.4 General strategies

The following general strategies are recommended:

- LOS should be monitored and evaluated continuously.
- Health care professionals should reflect on the factors that contribute to increase LOS and should collaborate to address the challenges.
- The study hospital should revise its ED policies concerning the maximum number of patients that can be admitted to the ED.
- There should be protocols for catering for elderly medical patients in the ED.

5.4 LIMITATIONS

As with any research, this study had certain limitations, and these limitations were noted and considered when interpreting the results. This was a retrospective study in which an audit tool was used to audit patients' files that had not been compiled

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having research purposes in mind; therefore, the documentation was not done in accordance with research requirements. The collection of data was based on a chart or a file review and the correctness of the data extracted was dependent on whether the correct data had been entered by the relevant health care providers. Missing data in several patients' files limited accurate retrieval of aspects such as specialist assessment times and referral times to specialists by ED doctors. Most of the patients' files did not have time written by specialists on first contact with the patient and therefore the researcher relied on the nurses' notes to complete data. Furthermore, the study was done in the ED of a single tertiary, academic hospital in Gauteng, South Africa, and the results obtained might not be generalizable to or representative of other EDs that differ in respect of geographic location, resources and staffing.

5.5 FUTURE RESEARCH

Based on the results of the current study, the recommendations for future research relating to an emergency department could include the following:

- Factors contributing to the high rate of walk-in, non-urgent patients who visit an ED should be investigated.
- The number of nurses and doctors required to manage patients admitted to an ED based on patients' acuity levels should be investigated.
- The LOS of patients triaged as red, orange, green and yellow should be differentiated.
- The public's knowledge and understanding about the referral systems used in South Africa should be explored.
- Exploring the proposed strategies by discussing them with the ED staff.

5.6 CONCLUSION

To conclude, some of the major findings of this study, which was conducted at the ED of a tertiary, academic hospital in Gauteng, South Africa, are highlighted. It was

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revealed that the majority of the patients reporting to the ED were walk-in patients aged between 31 and 45 years, followed by patients aged between 46 and 60 years and then patients aged between 61 and 75 years. The majority of the patients (n = 61) were referred for triage, only 12 of whom were very urgent and 21 of whom had non-urgent conditions that required routine treatment. A concern indicated by the results was the prolonged time it took for a patient to be managed for the first time by a nurse (4 hours and 20 minutes) and by a doctor in the ED (6 hours and 3 minutes). After the ED doctor had referred the patient to a specialist it took an average of 5 hours and 15 minutes before the specialist assessed the patient. The majority of the patients managed in the ED were medical patients (82%), hence increasing the number of patients referred to internal medicine specialists. These patients required to be admitted and because the medical area had only five beds available it led to overcapacity and overcrowding in the ED. X-rays were done on all patients and the majority of patients (98%) had additional laboratory and diagnostic tests done to confirm diagnoses, which might have caused an increase in the LOS. The majority of the patients were admitted to the hospital (92%) – most of them to wards and a few to ICU, high care and the operating theatre. The total average LOS in the ED was 3.04 days, which can be regarded as prolonged LOS, and this aspect requires urgent attention as the prescribed length of stay is 12 hours. The areas of delay identified in the relevant ED were reception / triage, ED doctor in triage, speciality referral by ED doctor waiting for test results, speciality consultation by a specialist, trauma lying area, female medical area and internal medicine department.

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ANNEXURE A

Approval letters:

A1: Ethical Approval University of Pretoria

A2: Hospital permission

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ANNEXURE B

Audit tool:

B1: Audit tool – Pilot

B2: Audit tool – Final

B3: Audit tool – Completed example

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ANNEXURE C

Clearance letters:

C: Letter of clearance from the biostatician

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ANNEXURE D

Letter from the editor