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An audit of chest pain and the factors affecting it in private emergency department

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CHAPTER ONE: INTRODUCTION

Emergency Departments (ED's) form integral components of major hospitals. They provide a wide variety of services, which include:

- Treating critically ill and injured patients.
- Rapidly processing and stabilising injuries from trauma incidents.
- Treatment for medical conditions, including chronic, acute illnesses and minor injuries[1].

Patients will present to the ED with real (a true medical emergency based on the pathology found) or perceived emergencies (where the patient interprets their symptoms as an emergency, but it is not a true medical emergency), without an appointment twenty-four hours a day. Chest pain as a presenting complaint forms an important percentage of these ED presentations[2]. Weiner et al[3] reported 6.4 million annual chest pain presentations to ED's in the United States of America, which is a significant number. Contributing to the number of chest pain presentations in recent years is the increased awareness among the general public of the potential for chest pain to represent a serious life-threatening condition such as an acute myocardial infarction or pulmonary embolism[1].

The McGraw- Hill Concise dictionary of Modern Medicine[4], defines chest pain as a general term for any dull, aching pain in the thorax, usually referring to that of acute onset, which is often regarded as being myocardial in origin unless proven otherwise. This broad definition encompasses a wide variety of potential aetiologies for this symptom. Verdont et al[5] investigated the causes

of chest pain in 24 620 patients in Switzerland presenting with chest pain and found the following aetiologies: musculoskeletal chest pain (49%), cardiovascular (16%), psychogenic (11%), respiratory (10%) digestive (8%), miscellaneous (2%) and no diagnosis in 4% of patients[5].

For the doctor in the ED, chest pain, with its multitude of potential aetiologies, provides a diagnostic challenge. Many of the aetiologies are benign, but there are also various life-threatening conditions e.g. acute coronary syndrome, tension pneumothorax and aortic dissection causing chest pain. Identification of these is of is of paramount importance as early identification allows for the timeous application of life-saving treatment regimes. Failure to identify these can result in patient death or other complications.

To achieve this, a thorough history and examination are of supreme importance and various diagnostic investigations such as electrocardiograms (ECG's), laboratory investigations and radiological investigations are undertaken to assist the ED doctor in finalising a diagnosis. In spite of these efforts, there are often patients who are discharged without a diagnosis[5]. Having no formal diagnosis could represent a benign cause or a missed diagnosis and is an undesirable outcome. This is unfortunately not an uncommon phenomenon. Cayley et al[6] in a review article give a figure of 15% of patients presenting with chest pain who are discharged from ED's with no formal diagnosis.

With the above in mind, the ED doctor and nursing staff bear a significant responsibility when faced with a patient with chest pain. They are the first

patient contact and it is their evaluation that will guide the patient's medical journey during their current illness.

This study was undertaken with the aim of highlighting and investigating some important aspects of the patient presenting with chest pain such as patient age, race, and final diagnosis, amongst others. For this, an audit of ED chest pain presentations was conducted, by investigating all patients presenting with chest pain to a private ED in the northern suburbs of Johannesburg, from 01st January to 31st December 2013.

In terms of what a private ED refers to, it must be noted that a patient in the South African healthcare sector can seek medical assistance either at a public or private healthcare facility. Public sector facilities are subsidised by the government and South African patients who utilise these facilities pay a nominal fee for service. Patients utilising a private facility pay a full fee for service. To facilitate this, the majority of patients subscribe to a medical aid via a fixed monthly payment contribution. According to South African Labour law[7], medical aid is a type of insurance scheme and medical aid schemes must pay for some medical expenses such as hospital, doctor and dentist bills, medicines and other medical services like dentistry and physiotherapy.

The researcher chose to base this study in the private sector as it represents a unique environment from a socio-economic, patient demographic and resource availability point of view in the South African Health care sector.

In addition, investigating the complex details around chest pain presentations was done to facilitate a better understanding of these patients with an aim to aiding in the challenges discussed above. The literature review will discuss details of chest pain presentations and the many facets associated with this.

CHAPTER TWO: LITERATURE REVIEW

In this chapter a review will be done of some of the literature on chest pain presentations, with particular reference to the incidence, aetiology, time of presentation, mode of transportation, gender variance and triage categories associated with these patients.

2.1 Incidence of chest pain presentations

Chest pain presentations form a relatively low percentage of all presentations to the ED[8]. Calculating the incidence of chest pain in the population presenting to the ED is vital, so that medical staff have an understanding and an expectation of patient volumes they will be seeing and information to guide appropriate resource allocation. While the vast majority of chest pain patients will not have a serious underlying pathology, many are extensively assessed and investigated by ED doctors to ensure that life-threatening conditions are identified and not missed[9].

The incidence of chest pain presentations varies across studies, depending on the population that is studied. Ekelund et al[8] studied a single ED in Sweden in 2007 and 2008 identifying patients with chest pain or discomfort, in order to look at the likelihood of acute coronary syndrome (defined in their study as unstable angina or acute myocardial infarction), depending on the time of patient presentation. A total of 11 219[8] patients presented with acute chest pain or discomfort during the two year study period, in this ED which sees a total of 65 000 patients in a year. This equates to an 8.63% incidence[8] of chest pain presentations in this population. In a study done in Boston in the United States of America, Weiner et al[3] studied the mode of transportation for

patients presenting to an urban academic ED with chest pain and identified 690 chest pain presentations in an eight month period with an incidence of 4%[3].

These study populations vary and this may be related to multiple factors such as socio-economic, political or demographic variations. Ekelund et al[8] based their study in a university hospital in Sweden, while Weiner et al[3] based theirs in an academic hospital in Boston in the United States of America. Both environments share the fact that they are academic centres, but other differences in the study population e.g. average age and environment may affect the incidence.

2.2 Demographics

Gender

Ravn-Fischer et al[10] investigated men and woman presenting with chest pain. In their study, set in Sweden, they evaluated all patients presenting with chest pain, during a three month period in 2008 across three different ED's. They found 2588 visits with 1248 (48%) female and 1340 (52%) male. They also found a small discrepancy in ambulance usage with 42% of female patients arriving via ambulance as compared to the 38% of male patients. Weiner et al[3] also did not detect a significant difference in terms of gender with regards to ambulance service usage. They found 45.9% female and 54.1% male patients made up the group of ambulance arrivals in that hospital. In terms of patient presentations, from a study sample of 599 patients, 267 (44.6%) were female and 332 (55.4%) were male.

Variations in gender presentation may be related to demographics of the population studied and possibly linked to specific diagnoses associated with chest pain. With regards to acute coronary syndrome, male sex is a clear known risk factor[6] with a higher incidence in males. This can result in a higher number of ED presentations. Hess et al[11] , in a Canadian ED study evaluated sex differences in chest pain presentation as related to acute coronary syndrome in 970 patients of which 386(39.8%) were female and 584 (60.2%) male. They found a lower probability of acute coronary syndrome[11] in women than men (76.4% vs 85%, p=0.001) and also a lower frequency of typical chest pain (37.1% vs 45.7%, p=0.01). In the study, they evaluated the following criteria to determine typical chest pain for acute coronary syndrome[11]: pain worse with exertion, pain similar to previous diagnosed ischemia in patients who had had previous ischaemia, location of chest pain, description of chest pain, radiation of chest pain and associated symptoms. In the study, they found 62.9% of females presented atypically according to their criteria[11]. Milner et al[12] examined gender and age differences in patients hospitalised for acute myocardial infarction. Their study had a group with 43% female and 57% male. They found that females, in particular older females, with acute myocardial infarction diagnosed did not present with chest pain as their chief complaint[12].

This atypical presentation in females described by Hess[11] and the large group of female patients presenting without chest pain described by Milner [12] could both be major contributors to reduced female presentations to the ED, as females may not perceive their symptoms as being related to as serious condition that may cause chest pain.

In looking at gender differences in pulmonary embolism, Robert-Ebadi et al[13] investigated gender differences in terms of presentation and use of clinical decision tools. A total of 3414 (1940/57% female and 1474/43% male) outpatients with suspected pulmonary embolism were evaluated retrospectively[13]. The diagnosis of a pulmonary embolism was confirmed in 773 patients (22.6%). The gender distribution among these was 432 female (22.3%) and 341 male (23.1%) ($p = 0.55$). The clinical probability prediction scores (Geneva score and Wells score) seemed to work equally well in both genders[13]. From this, it can be seen that the significant gender differences that present in acute coronary syndrome are not applicable in pulmonary embolism.

Age of patient presentation

Age of presentation in chest pain is important as age is a well-known risk factor for acute myocardial infarction[14] amongst other causes. Zucker et al[14] evaluated patient presentations of chest pain and other symptoms suggestive of acute cardiac ischaemia in ten ED's across the United States. In their patient population they found that in the age group 30-44, there was a prevalence of acute myocardial infarction in 3% of males and 1% of females. In contrast, in the age group 65-74, there was a prevalence of acute myocardial infarction of 15% in males and 7% in females. Ekelund et al[8] looked at the likelihood of acute coronary syndrome in ED patients with chest pain and linked this to time of presentation and demographics.

In their study, they noticed the following age distributions in terms of chest pain presentations[8]: 18-39: 15%, 40-48: 13%, 50-59: 17%, 60-69: 22%, 70-79: 18%, over 80: 15%. They also correlated for acute coronary syndrome and found that in patients over the age of 65 years a higher prevalence of 11% was found as compared to patients under the age of 65 with a prevalence of 4.5%.

2.3 When do chest pain patients present?

Ekelund et al[8] in their Swedish study chose to additionally investigate time of presentation for their chest pain patients. They found the peak in chest pain presentations over the study period of two years to be between 10am and noon[8]. This peak was similar for men and women and also for patients under the age of 65 years. The peak and changes in patients over 65 were not investigated in terms of changes in chest pain presentation, as the study primarily focused on patients with acute coronary syndromes and the times at which they presented. This was additionally not discussed further in the study, as this similar pattern was not discovered in the core study groups, which were patients with acute coronary syndrome. The authors found clear time brackets when related to acute coronary syndrome and they suggest time of arrival in the day could alert physicians to the likelihood of acute coronary syndrome, but that further studies would be needed to confirm this in other populations and health care settings[8]. In this study, based on the time frames noted, it appears that chest pain presentations are more prevalent during the day[8].

With regards to weekly variation[8], some differences were noted with Mondays having the highest inflow of chest pain presentations with 18% of patients and Friday having the lowest inflow of chest pain patients at 12%[8]. This variation may not be unique to chest pain. Downing and Wilson[15] evaluated temporal and demographic variations in patient attendance at thirteen different accident and emergency departments in the United Kingdom over the period of a year. A total of 963 195 chest pain presentations were analysed. In this study, they found the highest inflow of ED patients to be on a Monday with 16 % of patients. The researchers suggest that this may be related to patients who are injured or sick over the weekend, but do not consider that they need immediate treatment, and would rather seek attention at a later stage[15]. Ekelund's[8] peak in Monday attendances, thus may not be specific to chest pain, but rather to the general increase in all ED patient attendances on a Monday.

Weiner et al[3] looked at whether patients presented during day periods, defined as 07:00am-06:59 pm or during night periods from 07:00pm-06:59 am and then correlated this to patients choice of transportation mode. They found that 70.6% of patients presented during the day, while 29.4 % presented during the night. With regards to ambulance usage[3], 65.6% of ambulance arrivals were during the day with 34.4% during the night. They also evaluated weekday and weekend presentations and found that 75% presented during weekdays and 25% during weeknights[3]. With regards to ambulance usage[3], 79.6% was during weekdays and 20.4% during weekends. No further investigation was done in this study on the reasons for this day-to-day variation, as it was not a primary objective of the study. Patient presentation

times are also affected by a variety of non-medical factors and many may not present at the time of onset of chest pain. Dracup et al[16] looked at the impact of socio-demographic, clinical, cognitive, emotional, and social factors on patient delay in seeking treatment for chest pain. They found that patients who delayed presentation after onset of chest pain usually fell into one of the following groups[16]: older patients, lower income group patients, diabetics, patients who did not appraise their symptoms as serious, patients who had symptoms that were intermittent in nature, patients who waited to see whether symptoms disappeared, patients who were worried about troubling others, patients who feared what might happen if they sought treatment and patients who did not realise the importance of their symptoms[16]. Delays in presentation, for whichever reason, can worsen the extent of the pathology and make patient care more complicated and prolonged.

2.4 Triage

Triage in this ED is done according to the South African Triage Scale (SATS)[17] (refer to Appendix 1 for the adult chart). Triage allows patients to be allocated to one of four categories: green, which represents a non-urgent case, yellow which represents an urgent case, orange which represents a very urgent case and red which represents an emergency case. This triage colour grouping is based on a rapid evaluation of the patient for specific symptoms and vital signs. Symptoms and abnormal vitals correlate to an individual score that when tallied provides a triage early warning score (TEWS)[17]. Based on this score, the final category is decided. Chest pain is one of the symptoms that automatically allocates all patients to a category of

orange, unless their TEWS score is higher and they are upgraded to a red category, or if the triage nurse, makes a clinical judgement call that the patient needs to be up or down triaged.

2.5 Mode of transportation

Being able to access the ED and its available resources is of vital importance to patients with chest pain. In terms of transportation, patients utilise medical (ambulances) or non–medical (anything other than an ambulance e.g. private vehicles, public transport systems etc.) transportation.

Weiner et al[3] investigated mode of arrival of patients presenting to an ED with chest pain over a six-month period in 2006. They compared ambulance versus alternative transportation and found that ambulance transportation had some distinct advantages for patients with chest pain. Life-saving therapy can be initiated en route[3] e.g. aspirin in the case of acute coronary syndrome or decompression of a tension pneumothorax. The ambulance crew can also forewarn the ED of their impending arrival to ensure that the ED is prepared, if needed. The crew is also able to perform resuscitation if necessary[3]. Patients travelling with non–medical transportation do not have these benefits. They cited other studies[3] e.g. National registry of myocardial infarction study[3] that demonstrated in acute coronary syndromes that use of ambulance services was associated with wider use of life-saving reperfusion therapies and cardiac catheterisation. In the Rapid early action for coronary treatment trial[3], they demonstrated that patients who arrived via non-ambulance transportation arrived more quickly than if they activated ambulance services, but did not have the benefit of pre-hospital treatment and had longer times to reperfusion

therapy. Weiner et al's[3] study recommended ambulance transportation. In investigating patient choice of transportation, Weiner et al[3] additionally referenced a telephonic patient survey done by Brown et al[3]. They found that 89% of patients reported they would utilise ambulance services with chest pain, but only 23% made actual use of the service. Risk factors found for decreased likelihood of ambulance service use included being prompted to wait after a call until ambulance services arrived and having already taken an antacid or aspirin at home[3]. Other potential variables related to ambulance use were evaluated including gender, time of day of presentation and weekday versus weekend presentations. No significant difference in use of ambulance services among these variables was identified.

2.6 Aetiology of chest pain and the diagnostic challenge

Chest pain, as a presenting complaint can stem from a wide range of aetiologies. The Tager medical dictionary[18] defines chest pain and gives a good outline of some of the varied aetiologies as follows: Pain in the upper abdomen, thorax, neck, or shoulders. Chest pain is one of the most common potentially serious complaints offered by patients in emergency departments, hospitals, outpatient settings, and physicians' offices. A broad array of diseases and conditions may cause it, including angina pectoris or myocardial infarction; anxiety and hyperventilation; aortic dissection; costochondritis or injured ribs; cough, pneumonia, pleurisy, pneumothorax, or pulmonary emboli; oesophageal diseases, such as reflux or oesophagitis; gastritis, duodenitis, or peptic ulcer; and stones in the biliary tree[18].

The responsibility lies with the ED doctor, to rapidly and systematically assess patients to differentiate among these aetiologies of chest pain[19] and to exclude life-threatening causes. There are a variety of life-threatening causes[19,20,21,22, 23].

In Opolots[19] article entitled Chest pain: An approach for Family Practice, the following life-threatening causes of chest pain are listed: Acute coronary syndromes (acute myocardial infarction, unstable angina), pulmonary embolism, aortic dissection, tension pneumothorax and ruptured aortic aneurysm. The American Heart Association lists similar causes in the advanced cardiac life support experienced provider[20] manual: acute coronary syndrome, aortic dissection, pulmonary embolism, pericardial effusion with acute tamponade and tension pneumothorax[20]. Inci et al[21] in their case study also discuss the addition of oesophageal rupture as a life-threatening cause of chest pain.

A large number of patients will present with non-acutely life-threatening causes of chest pain[19]. These can be grouped according to system and include:

- Gastro-intestinal causes e.g. reflux oesophagitis, peptic ulcer disease, pancreatitis, cholecystitis and hepatitis.
- Musculoskeletal causes e.g. costochondritis, shoulder arthritis.
- Psychiatric/ Psychogenic causes e.g. anxiety, depression.
- Neurological causes e.g. cervical radiculopathy.
- Pulmonary causes e.g. pneumonia, pleuritis.
- Other causes e.g. disorders of the breast tissue or chest wall tumours.

When looking at diagnostic groupings in more detail, the study setting has relevance on the distribution of diagnoses. Cayley[6] in his review article, lists the following diagnostic groups for ED's in the United States of America: non–specific chest pain 15%, cardiac 67%, pulmonary 12%, gastro-intestinal 3%, musculoskeletal 7%, psychosocial or psychiatric 9%. Cayley[6] also discussed the diagnostic distribution in primary care practices in the United States of America: non-specific chest pain 11%, cardiac: 26%, pulmonary 5%, gastro-intestinal 19%, musculoskeletal 36%, and psychiatric /psychological 8%. Primary care diagnostic distribution in Europe was also discussed: non-specific chest pain 11%, cardiac: 21%, pulmonary 20%, gastro-intestinal 10%, musculoskeletal 29%, and psychiatric /psychological 17%. This large variation in primary care versus ED and United States of America primary care versus European, clearly demonstrates that study setting has a clear role to play in terms of diagnostic groupings.

Buntinx et al[24] also evaluated chest pain presentations and diagnostic groupings in Belgium across a variety of primary care practices and hospital ED's. They found a strong and statistically significant relationship between type of setting and chest pain diagnosis confirming that the morbidity spectrums in general practice and in hospital are related to setting. Some of the findings in this study in terms of primary care versus ED were[24]: serious cardiovascular disease 4.8% vs. 28.1%, musculoskeletal 20.6% vs. 6.2%, oesophageal disorders 1.3% vs. 4.5%.

With information such as this, doctors in various settings can start to understand their settings unique case mix. This can potentially be used to guide diagnostic processes and the number and nature of investigations

done. In addition, while emphasis is always placed on the exclusion of the life-threatening diagnoses, doctors can also additionally ensure that an increased emphasis is placed on the non-life-threatening diagnoses in chest pain that are more specific to their setting.

For the ED doctor, the history and clinical examination guide clinical diagnosis and diagnostic processes. The examination can be equivocal and investigations may be misleading[25]. For example, in patients presenting with acute coronary syndrome, history and an ECG help to initially guide diagnosis. These can potentially be completely normal[25]. This increases the risk of missing an important diagnosis and may have major negative consequences for the patient, which can extend from worsening illness to death.

Thus ED doctor and staff need to effectively identify those with a suspicion of high risk or serious conditions, so that appropriate resource allocation, is provided to these highest risk patients, who may require timely life-saving therapy[26,27].

Sanchez et al[28] conducted a three-month study in an ED in Spain with 1518 patients. They looked primarily at differentiating chest pain into that which was ischaemic (related to acute coronary syndrome) and non-ischaemic. They found that the source of chest pain was non-ischaemic in 909 patients, undefined in 370 patients and ischaemic in 239 (15.7%)[28]. Non-ischaemic comprised a large number of cases in this population. Of note is the undefined category of patients, which comprised 25% of patients.

In Cayley's[6] review article, he reports rates of 15% of chest pain presentations where a definitive diagnosis was not found. Wilcox et al[29] looked at this phenomenon in patients who were admitted with chest pain to a coronary care unit and then discharged. They identified 662 patients and of these 89 patients (13%) were discharged from hospital with a diagnosis of "chest pain? cause ". This establishes that the diagnosis of chest pain in a significant number of cases is difficult to define, even in patients who are admitted and discharged from a coronary care unit[29]. The study then followed these patients prospectively for a year and found that six of the patients were readmitted with chest pain during the course of the year with two of these having confirmed acute myocardial infarctions[29]. From this the researchers suggested that the majority of these patients do not seem to come to harm at any time and may be rapidly discharged from medical supervision. They concluded that a clinician who discharges a patient with "chest pain? cause " after clinical evaluation by ECG and repeat measurements of cardiac enzymes, can assure the patient that all will be fine with confident assurance[29]. These results must however be viewed in light of the fact that this study was conducted in patients discharged from a coronary care unit and not an ED. In the coronary care unit a higher level of monitoring over a specific period was provided and repeat investigations were conducted. This may have reduced the number of complications and missed diagnoses, in this group, which cannot be directly correlated with discharges from an ED. The study though does illustrate the difficulty in chest pain diagnoses in a percentage of patients, even with the added evaluation in a coronary care unit.

Atypical or unusual presentations[30], particularly in cardiac cases, increase the complexity around evaluating chest pain patients. In a study done in the United Kingdom by Spalding et al[30], the authors evaluated the differential diagnoses of patients admitted with suspected atypical chest pain and their correlation to acute coronary syndromes. Patients were deemed atypical if they had initial negative troponins and normal ECG's. Troponins[22] are cardiac markers of myocardial cell injury that are released into the bloodstream after myocardial cell necrosis. The markers appear at different times after injury and levels in the blood serum decrease at different rates.

Spalding et al's[30] study encompassed 250 patients admitted over a five-week period. Researchers investigated the final diagnosis, made after their hospital stay. The following was found: An acute ischaemic event was diagnosed in 142. In the remaining 108, the pain was judged at discharge to have been musculoskeletal in 25 (23%), cardiac, but not ischaemic in 21 (19%), gastrointestinal in 12 (11%) and respiratory in 10 (9%). A total of 40 (37%) patients had no final diagnosis[30]. This study highlights the concerning fact that 57% of these patients presented atypically, and yet still had a serious condition in the form of an ischaemic event. Ischaemia and acute coronary syndrome form one of the major life-threatening causes of chest pain and diagnosing these conditions is of paramount importance. With the diagnosis of chest pain already being wide, considering a large number of atypical presentations adds to the diagnostic challenge faced by ED doctors and the risk of misdiagnosis. In addition atypical presentations may lead to serious and life-threatening conditions being missed, which can have serious consequences for the patient in terms of complications or even death[30].

2.7 Patient disposition

Luke et al[9] had looked at admission rates in their chest pain audit done in 1990 and found an admission rate of 22%. The study looked at 400 consecutive ED patients in a United Kingdom ED. Of note, is that their study was done on a population that was 35 years of age or younger. Verdont et al[5] had an admission rate of 5% in their primary care practice and this likely relates to the variation in diagnostic mix in primary care versus ED cases, as detailed by Buntinx et al[24].

In summary, the various studies and information in this literature review highlight a variety of important facets related to chest pain presentations. One the most important of these, is the wide aetiology in relation to a diagnosis and the difficulties faced by the ED doctor in evaluating these patients.

This study was conducted in the private South African context so as to better understand these facets in this specific context.

Study aim

The aim of the study is to conduct an audit regarding patients presenting with chest pain to a specific urban private ED with particular reference to ED diagnoses and patient demographics.

Objectives

1. To describe the total number of presenting chest pain patients in relation to the total number of patients seen in the ED.
2. To describe the demographics of the patient population presenting with chest pain.
3. To describe day to day variations in the number of chest pain presentations.
4. To evaluate triage categories of patients presenting with chest pain.
5. To evaluate mode of transport for patients presenting with chest pain.
6. To evaluate the range of diagnoses made in patients presenting with chest pain.
7. To evaluate patient disposition in terms of patients presenting with chest pain.

CHAPTER THREE: METHODOLOGY

3.1 Study Design

A retrospective, cross-sectional study was conducted.

3.2 Study Location

The study was conducted at a private hospital ED in the northern suburbs of Johannesburg.

This ED is located in an urban environment in Johannesburg and services a variety of different socio-economic areas. It attracts both indigent, medical aid and private paying patients with the majority of people in the area from the middle to upper class sector. As this is a private sector ED all patients need to pay for services rendered, either by means of a medical aid or direct payment. If patients who cannot afford the service fee present to the ED, they are not turned away. All patients presenting to the ED have a triage assessment and score done and are initially assessed for emergency conditions. If necessary, they are assisted with their emergency and stabilised, regardless of financial ability and transfer is then arranged to the nearest public sector hospital for further care.

This ED is jointly run by the hospital group and an outside private company. The hospital group manages the nursing staff, facility and stock in the department, while the private company manages doctor staffing in the ED and assists with day to day management.

There are approximately 2500 patient attendances a month. The hospital also has full cardiac capabilities with a team of Cardiologists and a fully equipped on-site cardiac catheterisation laboratory.

3.3 Authorisation for study

Initial permission was obtained prior to commencing this study from the following entities:

- The relevant hospital group's Research Department. Refer to Appendix 2 for this letter of authorisation.
- The relevant Hospital Manager.
- The private doctor management company.
- The relevant Radiology Department.
- The relevant laboratory.

Some letters of authorisation are not included so as to maintain the anonymity of the hospital group involved. This was a stipulation of the hospital research committee. These letters are available upon request.

3.4 Ethics clearance

Ethics Clearance was obtained from the Human Research Ethics Committee (Medical), University of the Witwatersrand. Reference number: M140464. Refer to Appendix 3 for a copy of the certificate.

3.5 Patient sample

Patients were identified by a systematic review of all the patient registers from 01 January 2013 – 31 December 2013. Patient registers are records of all

patients who have presented to the ED. These are completed by nursing staff after the patient has been discharged.

These included the following registers:

- New patients – These are patients presenting to the ED that are triaged and evaluated by the triage nurse and not categorised as high priority cases.
- Resuscitation patients – These are patients triaged and then identified by nursing staff as high priority cases. These are then treated in the resuscitation area of the ED, where resuscitation equipment and a higher level of monitoring is available. They are also seen and treated as a matter of urgency by both doctor and nursing staff in the ED.
- Follow up patients – These are patients who return for follow up after having been seen at an initial visit.

In these registers, the patient's presenting complaint is documented. Any complaint which had the wording "chest pain" was included. From these registers, all patients who fit the inclusion criteria for the study were identified.

The follow up patients were identified as 29 patients, but these were excluded from the study as they represented a double count of existing patients already attributed to the new and resuscitation categories. In addition, the number was small and the factors influencing a repeat presentation were numerous. It was decided that this should be further evaluated in a future study. After review of the new and resuscitation registers, a total of 939 patients were

identified. From there, exclusion criteria were applied, which excluded 77 files. These files were excluded for the following reasons:

- Patients < 18 yr: 22 files
- Trauma patients: 54 files (of which two were also under 18 years)
- Patients for whom there was no data : two files
- Patients who were sent to the ED for evaluation from the ward i.e. in-hospital patients: one file.

A total of 862 files were evaluated and statistically analysed.

3.6 Inclusion Criteria

- Any patient presenting with a main complaint of chest pain.
- Age 18 and older.

3.7 Exclusion Criteria

- Chest pain secondary to trauma.

3.8 Data collection

Patient registers for 2013 were requested and obtained from the Hospital groups archives. These were reviewed by the researcher and all patients with chest pain in their presenting complaint were added to one of two master lists of names. The first list was for new patients and the second for resuscitation patients. These lists were kept on the researcher's personal laptop, which was password protected and only accessible to the researcher. Hospital and doctor group file numbers were also recorded for each patient and a new research number was allocated to each patient. The new list was marked N1,

N2, N3 etc. and the resuscitation list was marked as P1, P2, and P3 etc. Files were requested from the archive department of the hospital and from the doctor's practise. Hospital files containing nursing notes and triage scores were obtained. Doctor's notes were obtained from the private doctor management group who keep their own records of notes. Most of the relevant information was taken from the nursing notes, with doctors notes as a back-up for further information. This information was then utilised to complete the patient data sheet (see below) on each patient, which was numbered according to the N or P number only. Where information was not available, further data was sought from the laboratory and radiological departments to complete these forms. All information was stored on the researcher's laptop under password protection and patient confidentiality was strictly maintained.

Table 1: Patient data sheet

PATIENT DATA SHEET

PATIENT NUMBER:_____

DATA REQUIRED	**INFORMATION**
Arrival date	
Sticker time	
Patient age	
Under 18	
Patient Sex:	
Male	
Female	
Day	
Night	
Working Day	
Non-working day	
Medical aid	
Private	
Triage time	
Nursing Notes time	
Triage colour	
Ambulance or non-ambulance transportation	
Trauma related	
Patient ethnicity (if recorded)	
Asian	

Coloured	
White	
Black	
Indian	
ECG done?	
Sent for and angiogram from the ED?	
Final ED diagnosis	
Patient died in ED?	
Admitted?	
Transferred out?	
Referred to specialist on admission?	
Any data concerns	
Other relevant information	

Ascertaining patient arrival time was challenging, as various times were collected on each patient. The sticker time, taken from the sticker on the patient file reflected the time when the patient file was open. The triage time was automatically generated via the electronic triage software that was utilised and this was reflected on the patient triage sheet that was printed and placed into each file. Nursing staff also recorded a time on their nursing notes reflecting the start of their interaction with the patient. The order of these varied and the researcher evaluated all three for each patient and then chose the earliest recorded time to reflect the closest time to true arrival time.

In differentiating day versus night presentations, day started at 07:00 and finished at 18:59pm and night started at 7pm and finished at 06:59am.This

time frame was adopted from the Weiner et al [3] study and was additionally appropriate as this coincided with nursing staff shifts in the ED.
Patient's racial data was obtained from the electronic triage system in the department. This was a subjective parameter recorded by the nursing staff member allocated to the duty of triage on that day. This was based on the nurse's personal assessment of the patient's race.

Medical aid details were obtained from the patient sticker on the hospital file and the patient information sheet contained in the hospital file. Patients without medical aid were termed private patients. This group also included some indigent patients, who could not afford the costs of consultation, but presented for emergency help. The files did not differentiate between the two types of patients.

Triage is done electronically in this ED and follows the South African Triage Scale (SATS) [17] guidelines.

Diagnoses were grouped together according to systemic groupings. These were: Cardiac, Respiratory, Gastro-intestinal (GIT), Musculoskeletal, Neurological, Psychiatric/Psychological, Genito-urinary (GU), Haematological, Allergy, Dermatological, Endocrine, Obstetric and Neurosurgical. A separate group termed "no diagnosis" was utilised for patients where a formal diagnosis was not recorded.

For patient disposition, it was evaluated whether patients had been admitted, discharged, transferred to another facility, absconded or refused further care. Under admissions data was collected showing which specialities patients had been admitted under or whether they had been admitted under the ED

doctors overnight. Here doctors admit patients to the ward overnight under the care of the ED doctor if their condition is stable, and refer to the specialist the following morning as needed or discharge patients.

Data collection was conducted over a period four months with use of the patient data sheet. The researcher then collated all data into an Excel^{TM} spreadsheet for analysis.

3.9 Data analysis

Data analysis was undertaken with the assistance of a statistician and was carried out using the SAS^{TM} software version 9.3 for Windows.

Between-group differences were tested as follows: The X^2 test was used to assess the relationships between categorical variables. Fisher's exact test was used for 2 x 2 tables or where the requirements for the X^2 test could not be met. The strength of the associations was measured by Cramer's V and the phi coefficient respectively. The relationship between continuous and categorical variables was assessed by the t-test (or ANOVA for more than two categories). Where the data did not meet the assumptions of these tests, a non-parametric alternative, the Wilcoxon rank sum test (or the Kruskal-Wallis test for more than two categories) was used. The strength of the associations was measured by the Cohen's d for parametric tests and the r-value for the non-parametric tests.

The 5% significance level was used throughout, i.e. p-values <0.05 indicate significant results.

CHAPTER FOUR: RESULTS

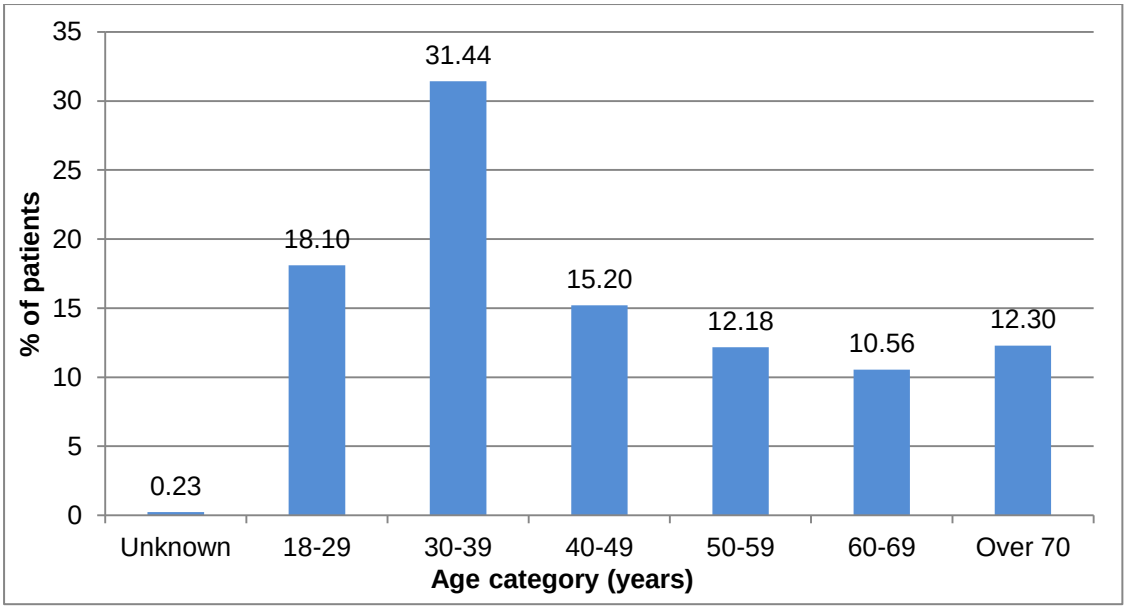
This chapter documents results obtained after investigation, based on the objectives listed in Chapter two.

Objectives: To describe the total number of presenting chest pain patients in relation to the total number of patients seen in the ED.

In the year 2013, 30 090 chest pain patient presentations were recorded. Of these, 862 chest pain presentations were included, demonstrating a 2.86% incidence of chest pain patients for the year. Of these 862 patients, 53.1% were allocated to the group of resuscitation patients, while 46.9% were allocated to the group of new patients.

Objective: To describe the demographics of the patient population presenting with chest pain.

Figure 4.1: Chest pain presentations per age category (n=862)

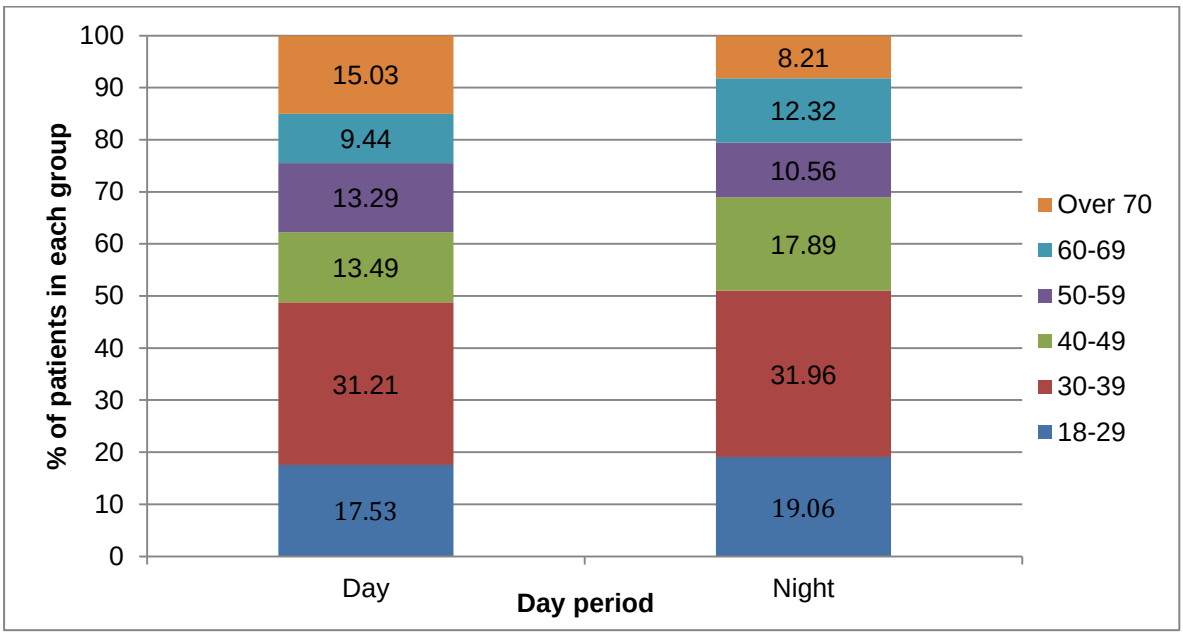


In terms of gender distribution, 55.1% of the patients in the study were male, with 44.9% female patients. Resuscitation patients had a higher proportion of

males (63.1%) compared to new patients (46.0%) (Fisher's exact test: p<0.0001; phi coefficient=0.17; weak association).

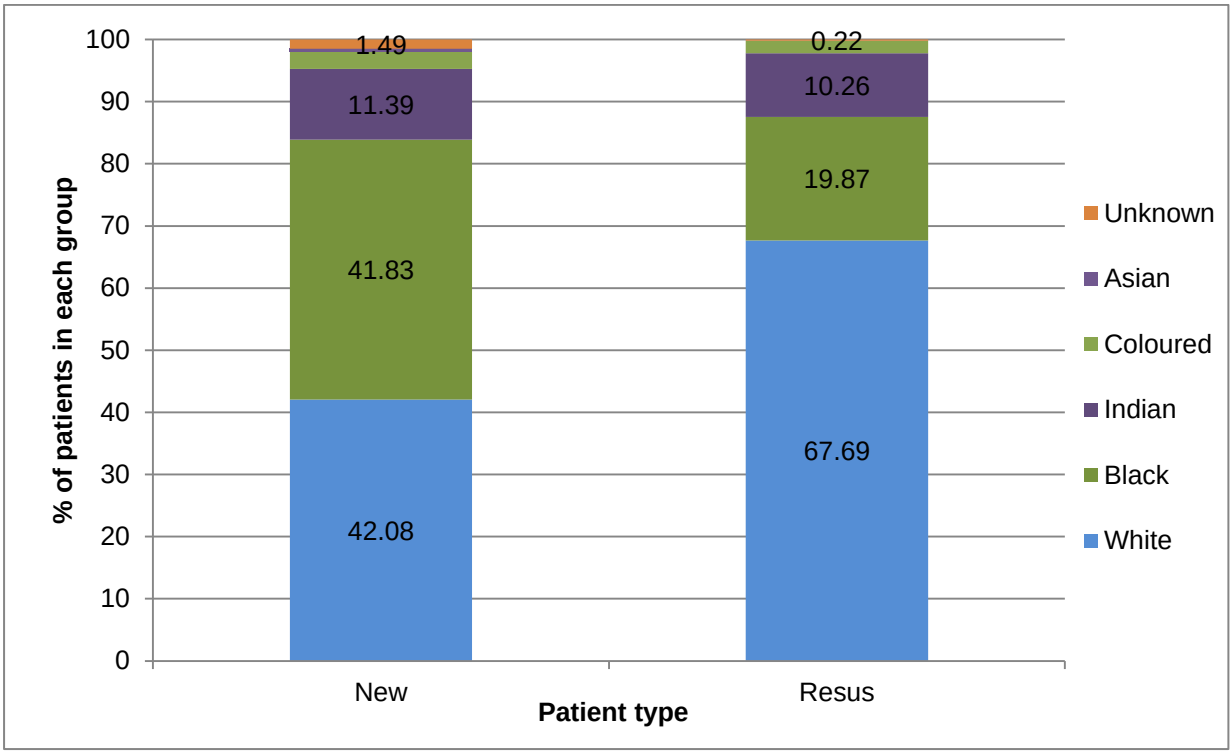
There was a significant association between age category and day/night presentation (X^2 test: p=0.019; Cramer's V=0.13; weak association): Those aged 70+ tended to present more frequently during the day (Figure 4.2).

Figure 4.2 Day/ night chest pain presentations related to age group (n=862)



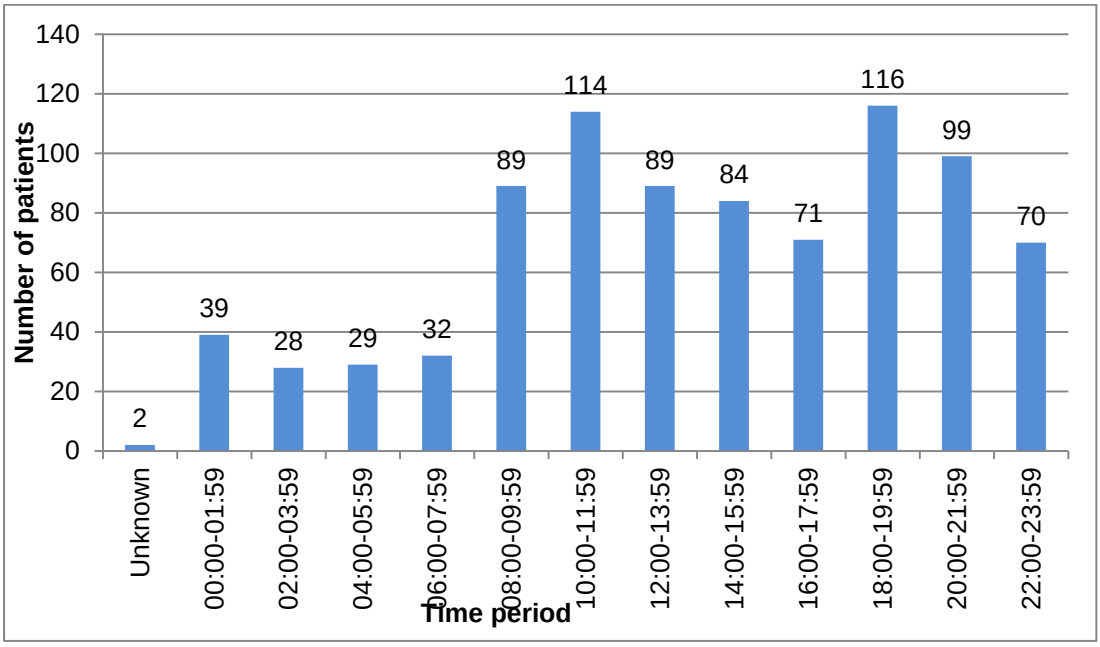
There was a significant associations between race and patient type (X^2 test: p<0.0001; Cramer's V=0.27; weak association): There were relatively more White, and fewer Black, resus patients, compared to new patients (Figure 4.3).

Figure 4.3: Race based distribution of new and resuscitation patients presenting with chest pain (n=862)



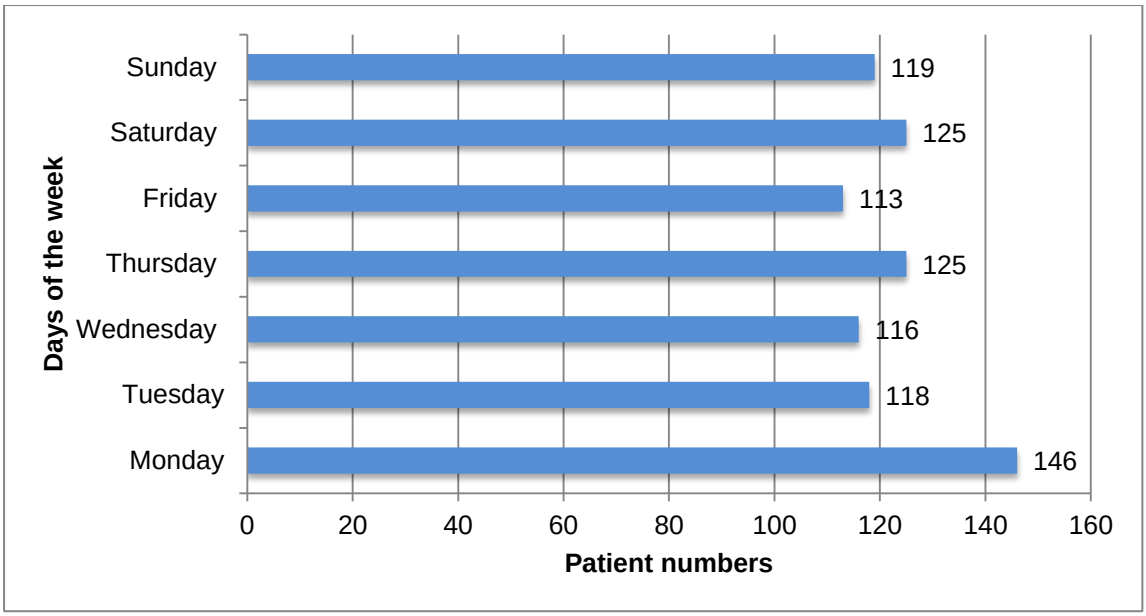
Objective: To describe day to day variations in the number of chest pain presentations.

Figure 4.4: Chest pain presentations per time period



The median number of chest pain patient presentations per day was 2 with a range of 0-8 patients per day. In terms of day versus night, 60.2% of the patients presented during the day, while 39.8% presented during the night (figure 4.4). There was no significant difference in this when correlated for months in the year.

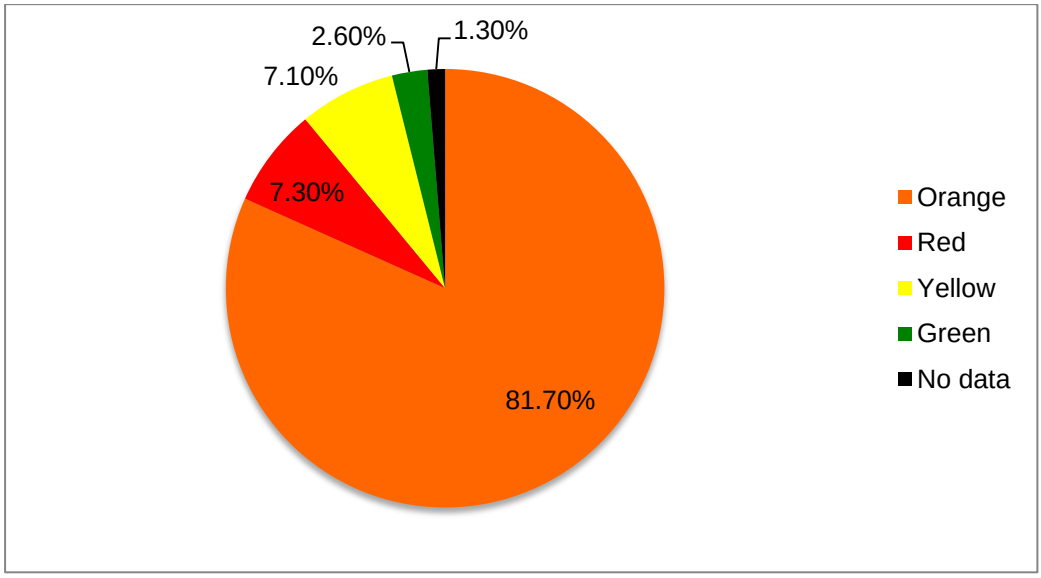
Figure 4.5: Chest pain presentations according to day of the week



Chest pain presentations on Mondays were marginally higher than the rest of the week, with 17% of presentations (Figure 4.5). This was not statistically significant.

Objective: To evaluate triage categories of patients presenting with chest pain.

Figure 4.6: Distribution of allocated triage colours of patients presenting with chest pain (n=862)



Orange triage made up the largest group of triage colours amongst all patients types (Figure 4.6).

Objective: To evaluate mode of transport for patients presenting with chest pain.

The majority (92.6%) of patients arrived by non-medical transport, while the remainder (7.4%) arrived by ambulance. A higher proportion of cases arrived by ambulance during the night (10.3%) as compared to the day (5.4%) (Fisher's exact test: p=0.011; phi coefficient=0.09; weak association). A higher proportion of resus cases arrived by ambulance (10.3%) as compared to new patients (4.0%) (Fisher's exact test: p<0.0001; phi coefficient=0.12; weak association).

Objective: To evaluate the range of diagnoses made in patients presenting with chest pain.

There was a significant association between diagnosis and patient type (Fisher's exact test: p<0.0001; phi coefficient=0.38; moderate association): A higher proportion of resuscitation cases received a cardiac diagnosis, while a higher proportion of new cases received a respiratory or musculoskeletal diagnosis (Figure 4.8).

Figure 4.7: Percentage of chest pain patients in the various diagnostic groups

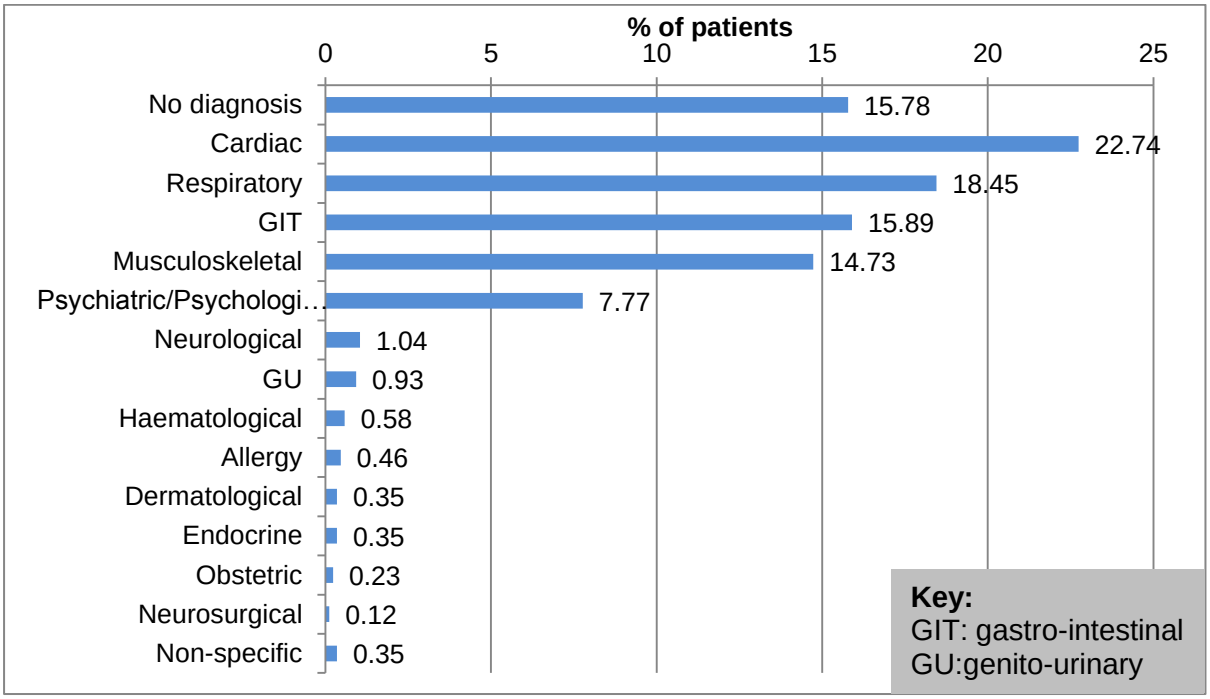
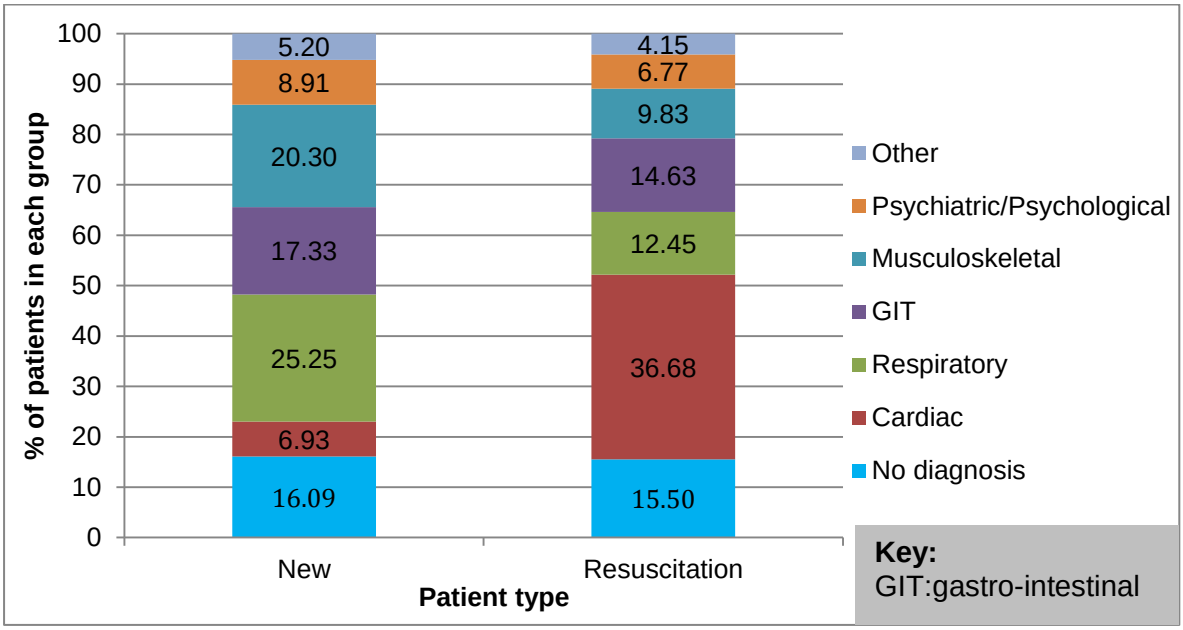
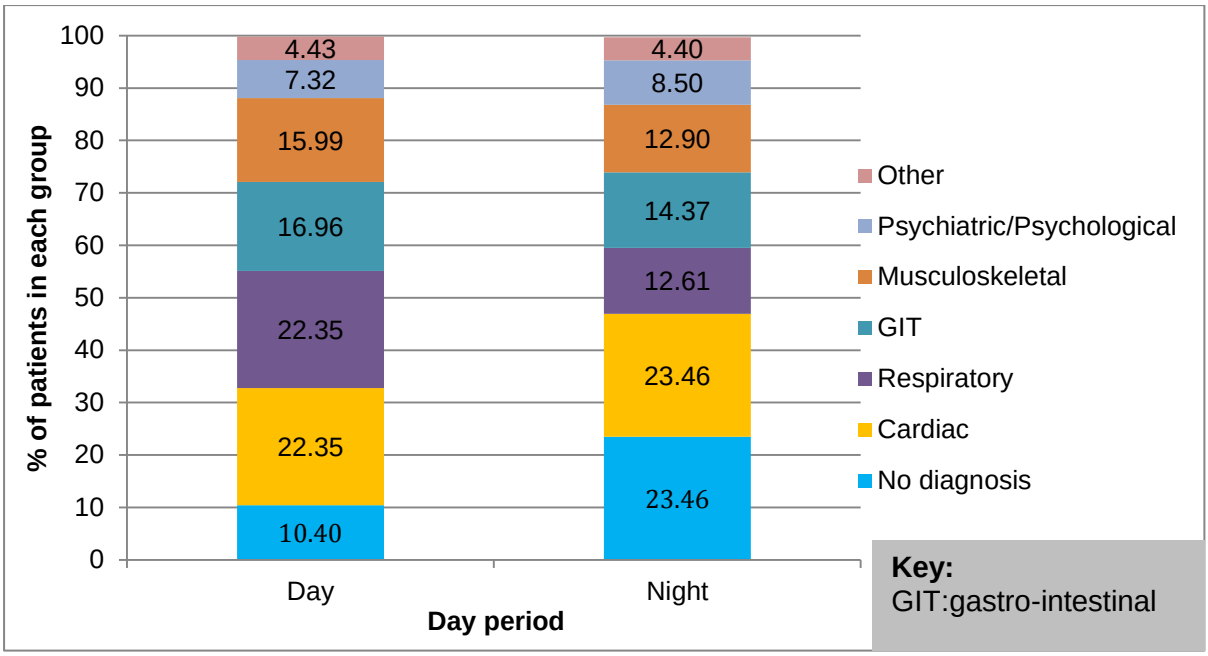


Figure 4.8: Chest pain diagnoses correlated to new versus resuscitation patient allocation.



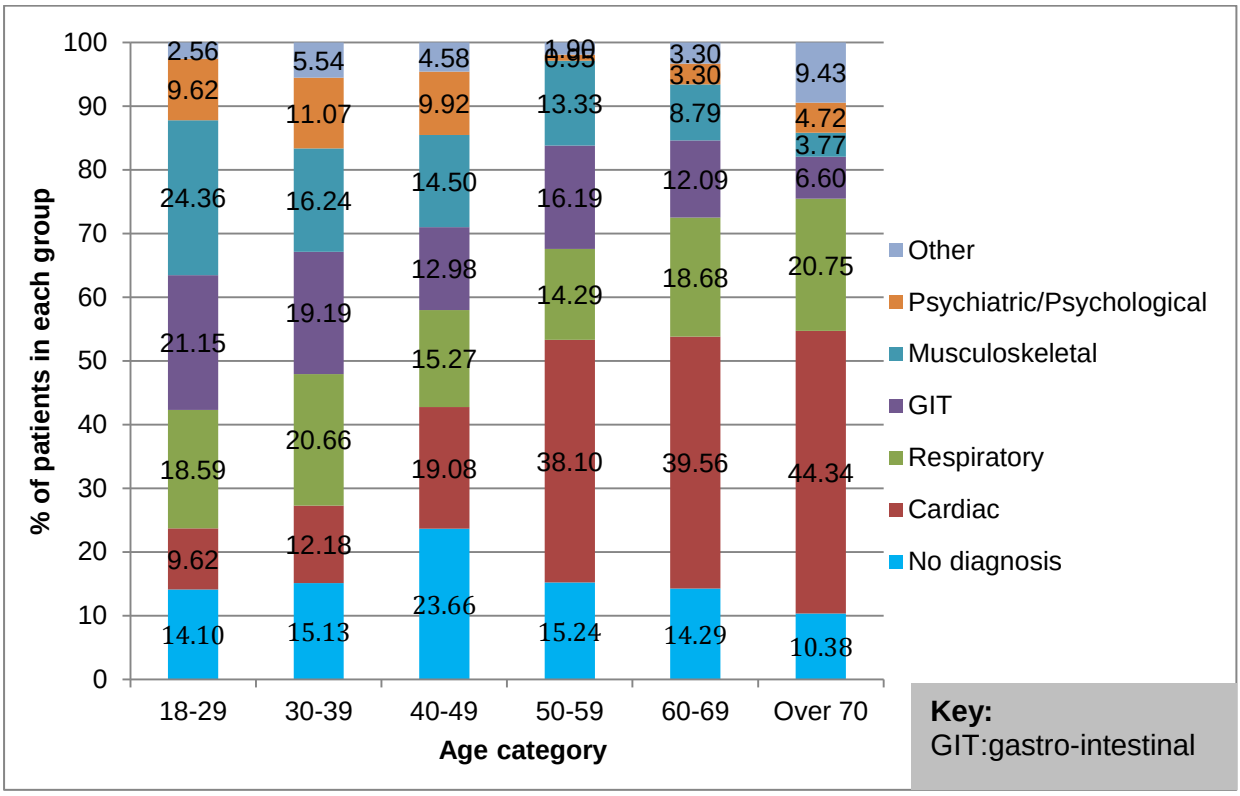
There was a significant association between diagnosis and day period (Fisher's exact test: $p<0.0001$; phi coefficient=0.21; weak association): More patients were given a 'no diagnosis' at night, and fewer a respiratory diagnosis, compared to the daytime results (Figure 4.9).

Figure 4.9: Chest pain diagnoses correlated to day and night chest pain presentations.



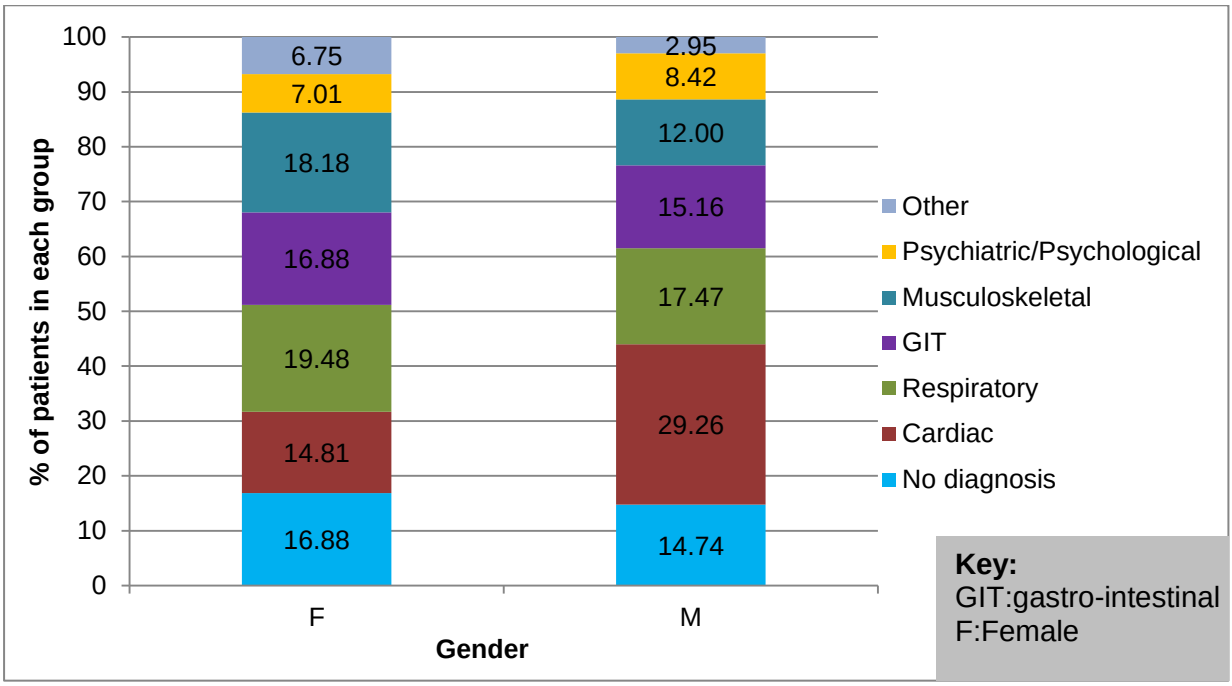
Age category and diagnosis were significantly associated (X^2 test: $p<0.0001$; Cramer's V=0.18; weak association): Cardiac diagnoses increased with increasing age (Figure 4.10).

Figure 4.10: Diagnostic groupings related to patient age



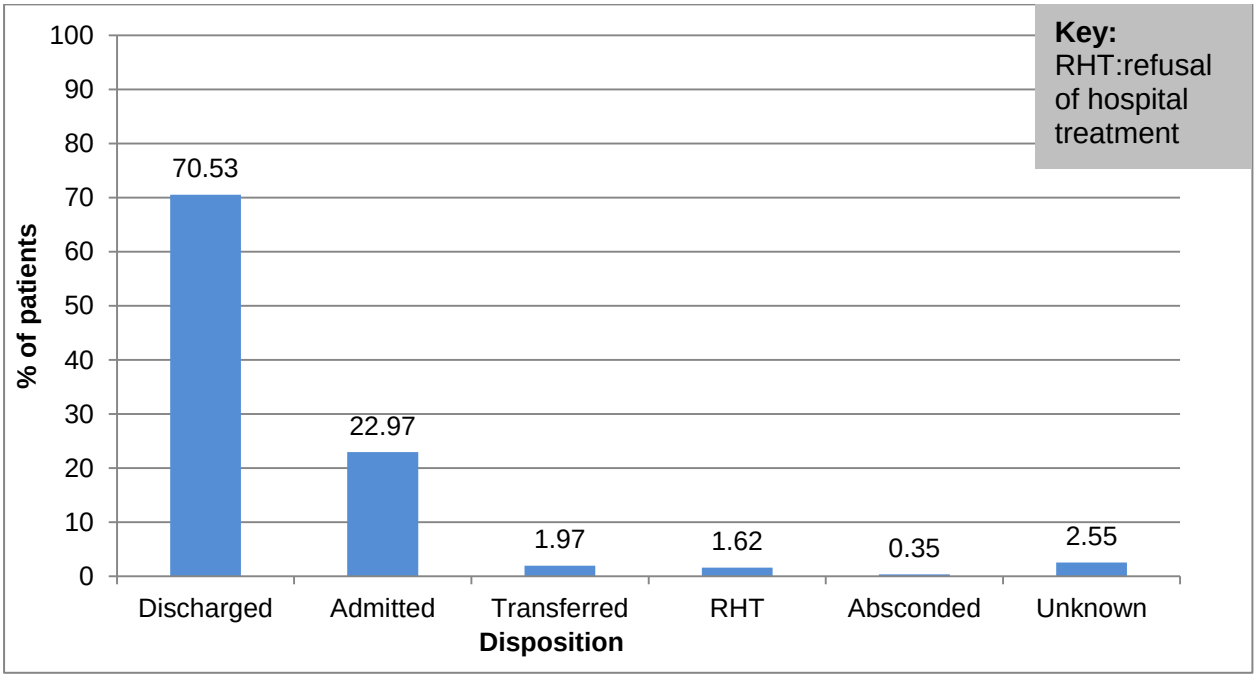
Gender and diagnosis were significantly associated (X^2 test: $p<0.0001$; Cramer's V=0.18; weak association): Cardiac diagnoses were more prevalent amongst males than females, while musculoskeletal diagnoses were more prevalent amongst women than men (Figure 4.11).

Graph 4.11: Diagnostic groupings related to gender



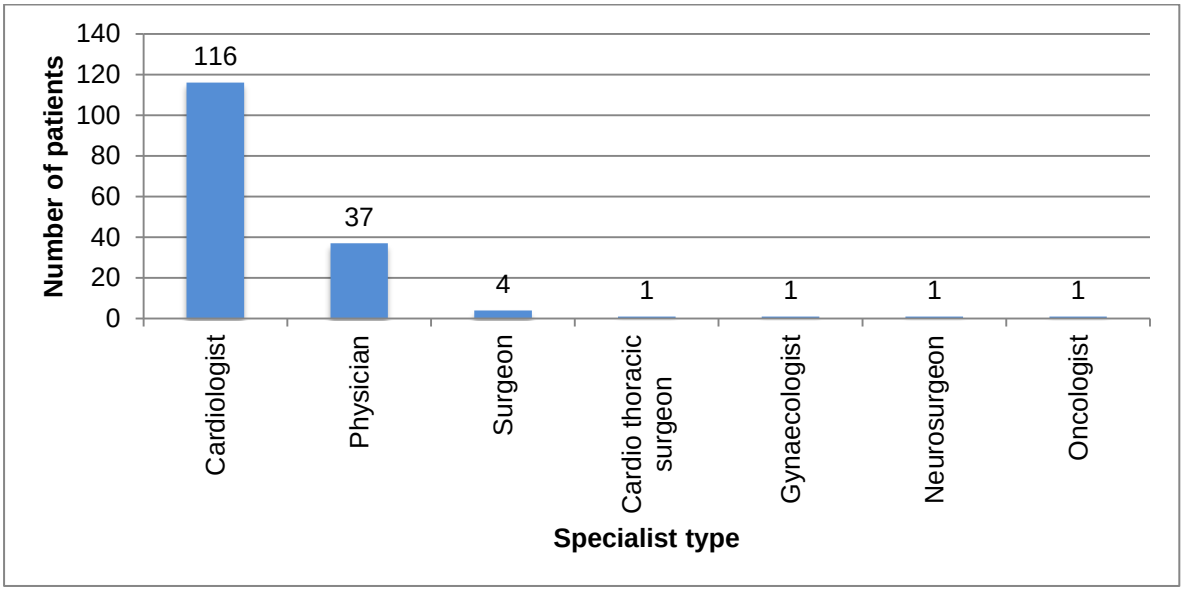
Objective: to evaluate patient disposition with patients presenting with chest pain.

Figure 4.12: Patient disposition



Of the admissions in Figure 4.12, 17% (34) were admitted under the ED and specialist referrals are differentiated in Figure 4.13 with Cardiology referrals being the highest.

Figure 4.13 Specialist referrals



CHAPTER FIVE: DISCUSSION

This chapter will elaborate on and discuss the results presented in the previous chapter as well as the most relevant findings in the study on the basis of the defined objectives.

5.1 First objective: To describe the total number of presenting chest pain patients in relation to the total number of patients seen in the ED.

In the year 2013 that was evaluated in this particular ED, a total of 30 090 patient presentations were recorded for the year. Of these, 862 chest pain presentations were identified, which equates to a 2.86% incidence of chest pain patients for the year. An incidence of 2.86% of chest pain patients is low in relation to total ED presentations, but this is in keeping with some of the other reviewed studies, where chest pain also forms a small percentage of ED patients presenting. Ekelund et al[8] described an incidence of 8.63% in their Swedish study. This study was set in a university hospital, where the ED sees 65 000 patients a year, which is a little over double the numbers in this study. However, when correlated to incidence, the Ekelund et al[8] incidence is far more than double the current study. This may be related to the Ekelund et al[8] study being based in a university hospital, which may see more chest pain patients as they may see a higher acuity of overall patient presentations as compared to the current study. In addition, the area where the Ekelund et al[8] ED is based has a catchment area with 300 000 inhabitants. The study ED is based in a densely populated urban area, but is also surrounded by a multitude of other private hospitals in the vicinity, where patients may present to or ambulance services may take patients to. In a 20 km radius, there are

nine other private hospitals. Of these nine, six have full cardiac catheterisation laboratories as well. Thus the competition for patients in this area is likely larger than in the Ekelund et al[8] study, which translates to lower numbers of chest pain presentations.

Weiner et al[3] had a relatively closer incidence to the study incidence of 4%. This study was conducted in a tertiary care urban hospital seeing a total of 39 000 patients a month, which is similar to the monthly figures in the studied population. Similarities in the studies, include patient numbers and the urban settings, but they are different in that Weiner et al[3] was based in a tertiary institution which may affect the type of patients and numbers presenting.

Of these 862 patients that presented with chest pain in 2013, 53.1% (458 patients) were allocated to the group of resuscitation patients, while 46.9% (404 patients) were allocated to the group of new patients. This difference is minimal and indicates an even spread between potentially serious and benign presentations of chest pain upon arrival, as defined by nursing staff evaluation and triage processes. For the ED doctor, this highlights the fact that each patient that arrives at the ED has a 50% chance of being allocated to the resuscitation group in this patient population. Aspects of triage and diagnoses related to these groups will be discussed further.

5.2 Second objective: To describe the demographics of the patient population presenting with chest pain.

In terms of patient age, the largest number of chest pain presentations in the study group occurred in the age group 30-39years. Patients in the 30-39 year age group made up 31.44% of total chest pain presentations. The other age groups were as follows: 18-29: 18.10%, 40-49: 15.20%, 50-59: 12.18%, 60-69: 10.56%, over 70: 12.30%. When investigated in terms of when patients presented, the 30-39 year group was the largest group during both day (31.21%) and night (31.96%) presentations.

This is younger than the age when compared to the Ekelund et al[8] study whose largest presenting group was in the 60-69 year age group, consisting of 22% of their patients. Other percentages were: 18-39: 15%, 40-48: 13%, 50-59: 17%, 60-69: 22%, 70-79: 18%, over 80: 15%. Ekelund et al[8] had 15% in the age group 18-39, while the current study had 41.44%, which is a major difference. This correlates with the mean age of presentations, which was 60 years for Ekelund et al[8] and 44 years for the current study, indicating a younger population group presenting with chest pain. In addition, the studied population saw the greatest number of patients in the under 50 year group at 64%, while Ekelund et al[8] saw the largest number of patients in the over 50 year age group at 72%. Comparisons are appropriate as inclusion criteria for both studies in terms of age was age greater than or equal to 18 years of age. The large proportion of younger patients is likely related to the area studied, which is established, but expanding at a high rate with young professionals and families moving in as development occurs.

In terms of the differing age groups, one of the areas this could affect would be in terms of patient diagnoses. Ekelund et al[8] focused primarily on the diagnosis of acute coronary syndrome in their patient population and found a total of 1 745 cardiac related chest pain diagnoses with an incidence of 15.6%, while the current study identified 196 cardiac related chest pain diagnoses, with an incidence of 22.73%. Of these, 834 patients In Ekelund et al[8] were diagnosed with acute coronary syndrome, which represents a 7.48% incidence. In the current study 99 cases of acute coronary syndrome were recorded which represents an incidence of 11.48%. This finding is surprising as one of the risk factors for cardiac disease and acute coronary syndrome is age greater than 60[6]. Age is also a factor in myocardial infarction decisions rules e.g. The Rouan decision rule for myocardial infarction[6] which gives age greater than 60 a full point in their score, which is out of six maximal points. Thus, in comparing these two studies, the assumption would be that Ekelund[8] would have a higher incidence of chest pain and acute coronary syndromes, due to the largest part of their population being in the age group over 50 years of age at 72%. This surprising result suggests possible other population specific variables which may have reduced this figure. The current study showed a higher rate of cardiac diagnoses (not limited to acute coronary syndrome) over the age of 50 in keeping with older age, with 64% of cases in this age group. A significant portion still occurred under 50 and this suggests that while the younger patient is thought to be less at risk for acute coronary syndrome that efforts must be taken to look at other risk factors and actively exclude cardiac pathology in the studied population.

In evaluating age in other studies, Burman et al[31] investigated the management of chest pain patients in four different ED's (termed casualty clinics in the study) in Norway. They had 100 patients included in their study across these ED's chosen to represent a variety of settings – urban, rural and suburban. In the study, the largest age group for presentation was between 36-50 years of age, at 33% of patients[31]. To compare this to the current study, all chest pain presentations under the age of 50 were combined. Burman et al[30] had 56% of patients in this group, while the current study had 64.74%. Burman et al[32] noted a total of 50 patients with a diagnosis of ischaemic heart disease, with an incidence of 50%. In the current study, 99 patients had acute coronary syndrome with an incidence of 11.48%. While incidence of chest pain presentations under 50 was similar, the high diagnosis of ischaemic chest pain was unusual[30]. The researchers also cite this as being unusual and attributed this to their smaller number of study participants, which may have limited the range of diagnoses. Participants were included in the study on the basis of being the first hundred patients to arrive and patients where the doctor involved could be contacted shortly after the patient consultation was completed[30]. This may have affected the types of presentations seen.

While age is an important factor, this demonstrates that a variety of other factors influence patient presentation with chest pain. These may include but not be limited to socio-economic status, study population and inclusion criteria.

In comparing age, between the resuscitation (53.1%) and new (46.9%) patient groups in the current study the following was found: patients in the

resuscitation group were older than in those in the new group. The resuscitation group of patients had a larger number of patients over the age of 50 years at 228 (49.7%), while the new patient group had 74 (18.3%). The difference was 154 patients. This would indicate that a larger number of older patients were deemed potentially more serious at initial evaluation and triage after presentation. This was likely appropriate from medical evaluation, but there is the possibility that a selection bias may be employed for older patients presenting with chest pain.

If this is correlated to diagnosis at the end of consultation, the following is found: In the resuscitation group, the highest number of diagnoses were seen in the cardiac group (36.68%) as compared to the new group (6.93%). In the new group, the highest number of diagnoses was seen in the musculoskeletal group (20.3%) as compared to the resuscitation group (9.83%). This is in keeping with traditional trends for cardiac diagnoses presenting more consistently in older patient groups as discussed above[6]. Further aspects of diagnoses are discussed at a later stage in this report.

Racial distribution of patients was evaluated in this study. Of the total patients, 55.7% were white, 30.1% were black, 10.8% indian, 2.3% coloured and 0.23% asian. If we compare this to the 2011 South African census[30], the numbers are very different and the ED does not reflect the racial distribution of the city of Johannesburg as a whole. The census[31] calculated a total population of 4.4 million of which 76.4% are black, 12.3% are white, 5.6% are coloured and 4.9% are indian/asian. The differences in this ED distribution may be explained by the unique nature of the South African context. The area in which the ED is situated was previously a predominantly white racial area

during the Apartheid era, when the population was grouped in areas according to race. While the Apartheid regime ended 20 years ago and the area's demographics have changed, it still remains a predominantly white area. In terms of race in other aspects of this study, when compared to time of presentation, mode of presentation, diagnosis and triage categorisation, no significant differences were found.

With regards to funding type, 87.0% of the patients presenting to this ED were on medical aid, while 12.8% were privately (including indigent patients) funded. The ED is a private ED and significant costs are associated with evaluation, treatment and investigations. Thus, patients with a medical aid will be able to more easily access and pay for the services rendered. The 2011 census[30] found that only 20% of the South African population is covered by a medical aid, which makes medical aid the exception, rather than the rule. This is often due to the high monthly costs attached to maintaining a medical aid. In addition, the area the ED is based in, is also a more affluent suburb, with a larger population of patients being able to afford the monthly costs of a medical aid, hence the high rate of 87% patients utilising medical aid.

In looking at patient gender in chest pain presentations, 55.1% of patients in this study were male, while 44.0% were female. A small percentage had no recorded gender. This seems similar to the Ravn-Fischer et al[10] figures of 48% female vs. 52% male. Weiner et al [3] had figures of 44.6% female vs. 55.4% male. This similarity is interesting as each study had distinct differences. Ravn-Fischer et al's[10] study was based in Sweden across three different ED's over a space of three months in 2008 with the study aim to identify inequalities in the treatment of men and women with acute chest pain.

Weiner at al's [3] study was conducted in an urban tertiary hospital in the United States of America over a six month period in 2006 with the study aim to evaluate if mode of arrival of chest pain patients predicted myocardial infarction in patients who present to the ED with chest pain. The current study was conducted in an urban ED over a period of 12 months in 2013. In spite of these differences, the three studies found similar results, which suggest a possible consistency in gender presentations for chest pain, which may transcend environmental and patient population factors.

Gender distribution in Johannesburg according to the 2011 census[32] show a distribution of 49.8% females and 50.1% males, which is similar to the study results. From this, it seems that while race distribution in the area the ED is in, may be unique and vastly different to greater Johannesburg, that the gender distribution is similar to overall figures.

5.3 Third objective: To describe day-to-day variations in the number of chest pain presentations.

The increased prevalence of day time presentations is in keeping with the Ekelund et al[8] and Weiner et al[3] studies. Both studies do not primarily discuss reasons for this preference. Potential reasons for this could be that patients are more physically aware of chest pain during the day, than at night during sleep. Day presentations may also be more convenient in terms of transportation and patient access to the ED. Considerations suggested in Dracup et al [16] such as cognitive and emotional responses to chest pain, could also contribute to patient delay to presentation if the chest pain occurs at night.

In keeping with the higher prevalence of day time chest pain presentations, the current study had the least amount of presentations between 00h00 and 07h59 (14.84%). Downing and Wilson[15] in their ED attendance study, investigating all patient attendances, found similar trends with the proportion of patient attendances being low after midnight and decreasing through the early hours of the morning. This may indicate a prevalence that has little to do with chest pain specifically, but rather to do with general ED trends as a whole. Two peaks in chest pain presentation were noted, one from 10:00-10:59 (13.23%) and another from 18:00 – 19:59 (13.46%). Ekelund et al's[8] peak presentation for chest pain was between 10am and noon. The evening peak was however not noted. Downing and Wilson[23] found similar peaks in early evening patient attendances, in their population groups 25-44, 45-64 and 65-74. The magnitude of this peak decreased as age increased. This further suggests that these peaks may not be entirely related to chest pain, but rather to ED patterns of patient attendance, which do increase after working hours are over.

In terms of days of the week, chest pain presentation numbers were relatively similar. Chest pain presentations on Mondays were marginally higher than the rest of the week, with 17% of presentations. Sunday's came thereafter with 15% of the presentations. This was not a statistically significant figure. The increased presentations on a Monday was similar to both the Ekelund et al[8] and Downing and Wilson [23] studies, but it is again unclear if this is specific to chest pain or as a result of general weekly ED trends.

5.4 Fourth objective: To evaluate triage categories of patients presenting with chest pain.

With the application of the South African Triage Scale (SATS)[17] to all chest pain presentations, the following was found: orange triaged patients made up 81.7%. Red triaged patients made up 7.3%. Yellow triaged patients made up 7.1% and green triaged patients made up 2.6%. 1.3% of patients had no recorded triage colour.

The South African Triage Scale (SATS)[17] automatically allocates all chest pain patients to a category of orange. However, this category can be adjusted if the TEWS score is higher than an orange category and thus upgrades the patient to a red category. The triage nurse can also make a clinical judgement call that the patient needs to be up or down triaged, based on their initial assessment. This is why some of the patients are triaged green, which is not common for a chest pain patient. It must be noted that patients with any and all complaints of chest pain were included in the study. This thus will include patients with chest pain as one of a variety of symptoms, where it may not be the primary complaint e.g. a patient with cough, runny nose, sore throat and chest pain. These may have been down triaged by the triage nurse on the basis of a lower TEWS score and the triage nurse's clinical discretion.

The score of 81.7% orange patients would seem to indicate a higher acuity of patients, but this did not translate into a similar rate of admissions, as only 23% of patients were admitted. This raises the concern that triage may be overestimating the severity of these patients and this should be investigated in future studies. From a clinical point of view, potential overestimation of

severity may have its advantages in chest pain presentations, as medical staff may respond quicker to assess and treat patients with an orange or higher triage category. In addition, with the diagnostic challenge that chest pain is, potentially treating all as orange patients i.e. serious until otherwise proven may ensure that fewer serious conditions are missed.

The initial allocation of patients to the new or resuscitation group was correlated with triage category and produced noteworthy results. New patients were categorised as follows for triage: 315 orange (78%), 57 yellow (14%) and 22 green (5.4%) patients. No triage category was recorded for 2.6% of new patients. Resuscitation patients were categorised as follows for triage: 63 red (14%), 389 orange (85%) and 4 yellow (0.87%) patients. No triage category was recorded for 0.13% of resuscitation patients.

Of note is that both groups had a large number of orange triages and this suggests that the differentiation between new and resuscitation patients was not based on triage alone, but that nursing discretion played a major factor. Nursing discretion refers to the nurse utilising his/her experience and clinical judgement to overrule the outcome of the TEWS and SATS. In new patients, 315 patients were triaged as orange, but not seen as resuscitation cases. This also suggests that the triage scale may overestimate acuity for chest pain patients in a large percentage of patients, which nurses use their discretion to overrule. It must be remembered that patients after initial assessment, can be up or down graded in triage categories during the course of treatment. This was not evaluated in this study and gathering data on this, would be useful in

understanding if initial evaluation and triage categorisation was accurate for the clinical condition diagnosed on each patient.

5.5 Fifth objective: To evaluate mode of transport for patients presenting with chest pain.

The majority of patients in the study (92.6%) arrived via non-medical transportation, rather than via ambulance (7.31%). In Canto at al's [14] study done in the 1990's 53.4% of patients arrived by ambulance, whereas the Weiner[3] study showed a rate of 31.4% in their population in 2009. This reflects the patient survey data in Weiner et al[3] where 89% of patients stated they would use an ambulance service, but only 23% utilised this service when needed. Another aspect that could explain is, is that the ED is set in a large residential area, which is easily accessible and a short distance away for patients living there. Many will chose to transport themselves to the hospital, as the perceived quicker route, rather than waiting for an ambulance to arrive. The population in the study is also made up of a middle to higher economic class community, where most patients have access to private transportation.

In addition, use of non-medical transportation is not likely to be related to funding concerns as 87% of the patients in the population seen had access to a medical aid. Most medical aids have contracts with ambulance services which can be utilised for emergency cases. In spite of this, it seems that private transportation is preferable in this population. A lack of awareness of this benefit in terms of medical aid may also contribute to this.

Another contributor to this may be lack of awareness amongst ambulance services and patients in the community of the cardiac facilities available at this

hospital. This may result in preferential presentations to other hospitals in the area. One solution to this may be in a targeted marketing and an educational program in the community served by the ED.

Ambulance use in the current study was higher at night with 10.3% of patients as compared to day time usage of 5.4%. In Weiner et al[3], the opposite held true with 34.4% of patients presenting via ambulance at night and 65.5% during the day. In terms of higher night presentations, in most ED's, patient numbers taper off from late evening till morning[23] as this is an inconvenient time for presentation, unless with a true emergency. Thus, patients who present at night, instead of waiting for day time, will usually do so as they perceive their symptoms as being more serious and a true emergency. As a result of this, many may be more inclined to contact an ambulance service. Access to transportation at night, may also be limited and contribute to increased ambulance usage. The difference with regards to Weiner et al's[3] day presentations, may be related to a variety of population or environment specific factors such as patient access to private transportation and availability of ambulance services.

5.6 Sixth objective: To evaluate the range of diagnoses made in patients presenting with chest pain.

In the overall evaluation of diagnostic groupings, the largest groups were no diagnosis (15.78%), cardiac (22.74%), respiratory (18.45%), gastro-intestinal (15.89%), musculoskeletal (14.73%) and psychiatric/psychological (7.77%).

In comparison to Cayley et al's[6] case mix for ED's in the United States of America (non–specific chest pain 15%, cardiac 67%, pulmonary 12%, gastro-

intestinal 3%, musculoskeletal 7%, psychosocial or psychiatric 9%), these results are significantly different. This further highlights the variation in case mix based on setting[16]. This diagnostic grouping seems more similar to the primary care distribution Cayley at al[6] described: non-specific chest pain 11%, cardiac: 26%, pulmonary 5%, gastro-intestinal 19%, musculoskeletal 36%, psychiatric /psychological 8%. This suggests a difference in ED usage by patients in the current study, where many may be utilising the ED for primary care presentations and not true emergencies.

In the current study, in Cayley et al [6] and in Buntinx et al [24] large groups of patient consultations across all settings had no diagnosis or a non-specific diagnosis. The figure in this study was 15.8%. These were patients in which no definitive diagnosis was made and patients were either diagnosed as "chest pain" or the diagnosis was left blank. While this is a common diagnosis across a multitude of studies, it raises concerns about potential missed diagnoses in these patients and future complications or life-threatening events. Wilcox et al [21] specifically evaluated patients admitted to a coronary care unit and discharged as "chest pain? Cause". Even in this setting, 13% of patients had no clear diagnosis. This illustrates that even with further monitoring and investigation in a coronary care unit that the final diagnosis in a chest pain patient may be elusive. In their year-long follow up with these patients, Wilcox et al [21] found that a small percentage had further events with six being re-admitted and two of these having acute myocardial infarctions. This study should be replicated in ED patients to see if rates of complications or further events are similar.

Of the no diagnoses, a larger percentage was found at night (23.46%) as compared to the day (22.35%). Potential reasons for this include reduced accessibility of specialists at night, the higher use of locum doctors in the ED and reduced access to special investigations at night as well.

In terms of life-threatening diagnosis, the two that were found in this study were acute coronary syndrome and pulmonary emboli. Cardiac diagnoses form the second largest group and of these 99 patients were diagnosed with acute coronary syndrome, which made up 50% of total cardiac diagnoses. There were 16 cases of pulmonary embolism and this made up made up 10% of the total respiratory cases. In the patient group as a whole, life- threatening conditions occurred 13% of the time, with 87% of cases being less serious. With an understanding of this, ED doctors can tailor evaluation of the chest pain patient to exclude the common life-threatening conditions and also ensure that adequate focus is given to the less serious causes.

If this is correlated with triage colour, it indicates that of the 81.7% of cases triaged orange and the 7.3% triaged red and highlighted as serious cases, very few were life-threatening. As discussed earlier, the higher triage categories also did not correlate to a higher admission rate. A further study evaluating triage should be done to understand if this categorisation was appropriate beyond the life –threatening conditions and patients who were admitted.

In comparing diagnostic categories in males versus females, rates of psychiatric or psychological (8.42% vs. 7.01%), gastro-intestinal (15.16% vs. 16.88%) and respiratory (17.47% vs. 19.88%) diagnoses were relatively similar. The greatest difference was seen in cardiac cases, where the

incidence in male patients was 29.26% versus 14.81% in females. This concurs with Hess et al[11] and Cayley et al[6] with regards to male sex being a risk factor for cardiac disease and more specifically acute coronary syndrome.

5.7 Seventh objective: To evaluate patient disposition in terms of patients presenting with chest pain.

The majority of patients (70.53%) were discharged from the ED, while 22.97% were admitted. A small percentage (1.98%) was transferred to another facility for further treatment. The remainder signed a refusal of hospital treatment form (RHT) (1.62%) or absconded (0.35%). A small percentage (2.55%) had an unknown disposition. If a patient signs an RHT form, it indicates that the patient was given medical advice for admission, further evaluation or further investigation, but chose to go against this. The signing of the form represents that the patient choses to take full responsibility for his/her decision and the consequences this may have in terms of worsening of pathology or complications. Patients who absconded are those, who in the process of treatment chose to leave the hospital of their own accord without discussion with the treating staff.

In this study, the chest pain admission rate of 22.97% is significantly higher than the average overall ED admission rate of 10%, thus indicating the increased severity of pathology in the chest pain patients as a whole, as compared to the general ED population. Still, the majority of patients was discharged and did not require further assessment or investigation in hospital. Admissions were higher amongst orange and red patients, which suggest that while triage categorisation may overestimate severity of illness and have a

high sensitivity, it does seem to pick up those patients with high risk and have a fair specificity.

Specialist admissions were primarily made under the Cardiologist (116 patients/ 72.05%). Physician referrals made up 23% of other admissions. This correlates with diagnostic groupings, where cardiac diagnoses were the largest group. Of note is that admissions under specialists were higher during the day than at night. This may be attributed to the increased accessibility of specialists during the day.

Another contribution is the system of ED admission, where doctors admit patients overnight under the care of the ED doctor if their condition is stable, and refer to the specialist the following morning. This system may add to the day specialist referrals and reduce the night specialist referrals. An example of this is the ED practice admission for a patient who needs repeat cardiac enzymes to fully exclude acute coronary syndrome. If the repeat results show worsening cardiac enzymes, the patient is then referred to a cardiologist and if not, the patient can be discharged directly for an outpatient cardiologist appointment.

Of note is that the ED is currently covered by a group of five cardiologists and when we look at actual figures, there are an average of 78 patients presenting with chest pain every month, with an average of three Cardiology admissions per month. This suggests that the ED provides few of the cardiac admissions to the hospital each month, which is surprising in light of the full cardiac catheterisation laboratory on site. A further study could be done to evaluate if more patients are presenting to the Cardiologist as direct referrals and

bypassing the ED entirely or if ambulance services and patients are unaware of the potential a high level of cardiac care in this ED and hospital.

With regards to ambulance arrivals, the proportion of admissions was higher for patients who arrived by ambulance (52.4%) compared to non-ambulance arrivals (20.7%). This would seem to indicate an increased acuity in ambulance patients in this study. Wiener et al[3] investigated a similar concept in terms of acute myocardial infarction. The aim was to see if mode of transportation alone could predict myocardial infarction. For the 157 identified ambulance arrivals, 62.4% were admitted with 37.6% discharged, as compared to 51.4% of patients admitted who arrived with alternate transportation. This seems to agree with the current study. With further analysis, Weiner et al[3] looked at patients with a diagnosis of acute myocardial infarction and found that 7% of patients arriving via ambulance and 5.4% of patients arriving via alternate transportation were diagnosed with an acute myocardial infarction. This was not statistically significant and the researchers suggested that ED doctors need to give equal consideration and urgency to all patients in terms of acute myocardial infarction, regardless of mode of transportation.

CONCLUSION

Chest pain as a presenting complaint may form a small percentage of presentations to the ED, but the evaluation of these patients is no small task. Due to the wide range of aetiologies and the life-threatening nature of many of these, the ED doctor is tasked with a diagnostic challenge and directs most of his/her efforts at excluding the life-threatening causes of chest pain. This however, forms a small percentage of chest patients. Of the 862 patients included in this study only 13% had life threatening conditions. Triage is also directed at identifying these patients, with all chest pain patients automatically orange triages at the outset, unless adjusted by the triage nurse.

This search for the life-threatening causes additionally occupies huge resource in terms of doctor and nursing time, investigations and treatment. A study allocating rand value to this would be of great interest.

On the basis of this study and the high figures of non-life threatening causes, the question arises of whether on not this active management of these causes, with a small yield of positive results, is justifiable in terms of cost and time spent. On the other hand, the consequences of aortic dissection, traumatic pneumothorax or acute coronary syndrome can also have devastating consequences for the patient and possible medico-legal consequences for the doctor involved if the diagnosis is missed.

One potential way to limit costs and also limit missed diagnoses, is in the adoption of an evidence based population-specific guideline for the evaluation of a chest pain patient.

Limitations

The researcher also acknowledges and appreciates the following limitations in undertaking this study:

- Variations in note keeping. While both the nursing and doctor staff in this unit utilise template notes for record keeping, there were variations to this, with some completing all aspects diligently and others omitting certain fields. Thus some data fields were incomplete.
- Most of the files were intact, but in a small percentage, some documentation was loss or misplaced, as can be expected in a busy ED. This also contributed to the incomplete data in some fields.
- This was a retrospective audit, with the only access to information from a written record
- A small amount of follow up patients (29) were identified, but these were excluded from the study, due to a lack of information available on them.

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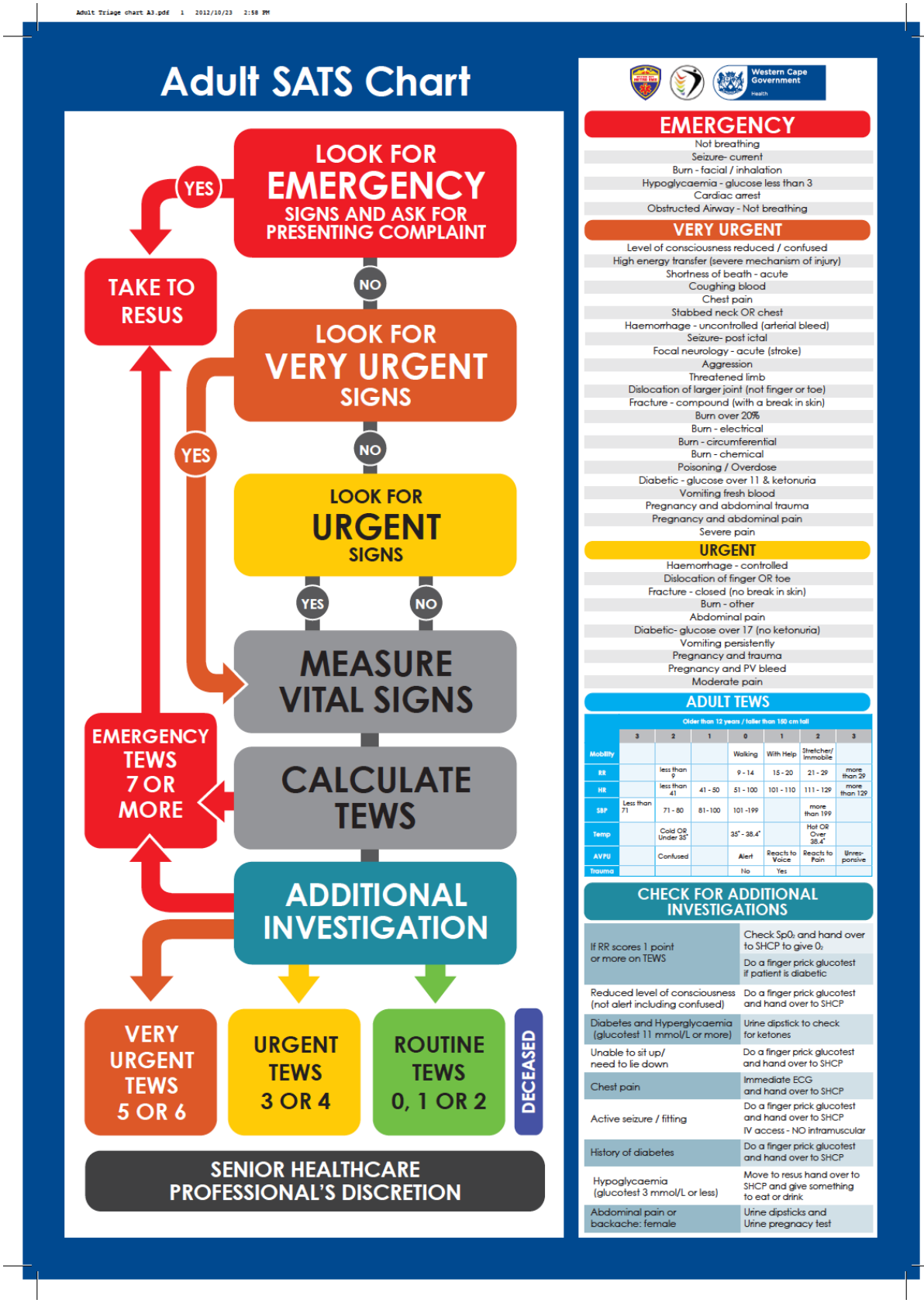
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APPENDIX 1


Adult Triage chart A3.pdf 1 2012/10/23 2:58 PM
Adult SATS Chart
LOOK FOR EMERGENCY SIGNS AND ASK FOR PRESENTING COMPLAINT
YES
TAKE TO RESUS
NO
LOOK FOR VERY URGENT SIGNS
YES
NO
LOOK FOR URGENT SIGNS
YES
NO
MEASURE VITAL SIGNS
CALCULATE TEWS
EMERGENCY TEWS 7 OR MORE
ADDITIONAL INVESTIGATION
VERY URGENT TEWS 5 OR 6
URGENT TEWS 3 OR 4
ROUTINE TEWS 0, 1 OR 2
DECEASED
SENIOR HEALTHCARE PROFESSIONAL'S DISCRETION
Western Cape Government
Health
EMERGENCY
Not breathing
Seizure- current
Burn - facial / inhalation
Hypoglycaemia - glucose less than 3
Cardiac arrest
Obstructed Airway - Not breathing
VERY URGENT
Level of consciousness reduced / confused
High energy transfer (severe mechanism of injury)
Shortness of beath - acute
Coughing blood
Chest pain
Stabbed neck OR chest
Haemorrhage - uncontrolled (arterial bleed)
Seizure- post ictal
Focal neurology - acute (stroke)
Aggression
Threatened limb
Dislocation of larger joint (not finger or toe)
Fracture - compound (with a break in skin)
Burn over 20%
Burn - electrical
Burn - circumferential
Burn - chemical
Poisoning / Overdose
Diabetic - glucose over 11 & ketonuria
Vomiting fresh blood
Pregnancy and abdominal trauma
Pregnancy and abdominal pain
Severe pain
URGENT
Haemorrhage - controlled
Dislocation of finger OR toe
Fracture - closed (no break in skin)
Burn - other
Abdominal pain
Diabetic- glucose over 17 (no ketonuria)
Vomiting persistently
Pregnancy and trauma
Pregnancy and PV bleed
Moderate pain
ADULT TEWS
Older than 12 years / taller than 150 cm tall
3 2 1 0 1 2 3
Mobility: Walking | With Help | Stretcher/ Immobile
RR: less than 9 | 9 - 14 | 15 - 20 | 21 - 29 | more than 29
HR: less than 41 | 41 - 50 | 51 - 100 | 101 - 110 | 111 - 129 | more than 129
SBP: Less than 71 | 71 - 80 | 81-100 | 101 -199 | more than 199
Temp: Cold OR Under 35° | 35° - 38.4° | Hot OR Over 38.4°
AVPU: Confused | Alert | Reacts to Voice | Reacts to Pain | Unresponsive
Trauma: No | Yes
CHECK FOR ADDITIONAL INVESTIGATIONS
If RR scores 1 point or more on TEWS: Check Sp0₂ and hand over to SHCP to give O₂; Do a finger prick glucotest if patient is diabetic
Reduced level of consciousness (not alert including confused): Do a finger prick glucotest and hand over to SHCP
Diabetes and Hyperglycaemia (glucotest 11 mmol/L or more): Urine dipstick to check for ketones
Unable to sit up/ need to lie down: Do a finger prick glucotest and hand over to SHCP
Chest pain: Immediate ECG and hand over to SHCP
Active seizure / fitting: Do a finger prick glucotest and hand over to SHCP; IV access - NO intramuscular
History of diabetes: Do a finger prick glucotest and hand over to SHCP
Hypoglycaemia (glucotest 3 mmol/L or less): Move to resus hand over to SHCP and give something to eat or drink
Abdominal pain or backache: female: Urine dipsticks and Urine pregnacy test

APPENDIX 2

RESEARCH OPERATIONAL COMMITTEE FINAL APPROVAL OF RESEARCH

Approval number: UNIV-2014-0018

Dr Urvashi Pather

E mail: urvaship@erconsulting.co.za

Dear Dr Pather

RE: AN AUDIT OF CHEST PAIN AND THE FACTORS AFFECTING IT IN A PRIVATE EMERGENCY DEPARTMENT

The above-mentioned research was reviewed by the Research Operational Committee's delegated members and it is with pleasure that we inform you that your application to conduct this research at Private Hospital, has been approved, subject to the following:

i) Research may now commence with this FINAL APPROVAL from the Committee.

ii) All information with regards to Company will be treated as confidential.

iii) Company's name will not be mentioned without written consent from the Committee.

iv) All legal requirements with regards to patient rights and confidentiality will be complied with.

v) Insurance will be provided and maintained for the duration of the research. This cover provided to the researcher must also protect both the staff and the hospital facility from potential liability

vi) In accordance with MCC approval, that medicine will be administered by or under direction of the authorised Trialist

vii) The research will be conducted in compliance with the GUIDELINES FOR GOOD PRACTICE IN THE CONDUCT OF CLINICAL TRIALS IN HUMAN PARTICIPANTS IN SOUTH AFRICA (2000)

viii) Company must be furnished with a STATUS REPORT on the progress of the study at least annually on 30th September irrespective of the date of approval from as well as a FINAL REPORT with reference to intention to publish and probable journals for publication, on completion of the study.

Anonymous

ix) A copy of the research report will be provided to Company once it is finally approved by the tertiary institution, or once complete.

x) Company has the right to implement any Best Practice recommendations from the research.

xi) Company reserves the right to withdraw the approval for research at any time during the process, should the research prove to be detrimental to the subjects/Netcare or should the researcher not comply with the conditions of approval.

xii) APPROVAL IS VALID FOR A PERIOD OF 36 MONTHS FROM DATE OF THIS LETTER.

We wish you success in your research.

Yours faithfully

Prof Dion du Plessis
Full member: Research Operational Committee & Medical Practitioner evaluating research applications as per Company Policy

Shannon Nell
Chairperson: Research Operational Committee
Date: 13/5/2014

This letter has been anonymised to ensure confidentiality in the research report.
The original letter is available with author of research

Anonymous

APPENDIX 3

R14/49 Dr Urvashi Pather

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M140464

NAME: (Principal Investigator)	Dr Urvashi Pather
DEPARTMENT:	Emergency Medicine [redacted]
PROJECT TITLE:	An Audit of Chest Pain and the Factors Affecting it in a Private Emergency Department
DATE CONSIDERED:	25/04/2014
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Prof Efraim Kramer
APPROVED BY:	Professor PE Cleaton-Jones, Chairperson, HREC (Medical)
DATE OF APPROVAL:	29/04/2014

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

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Secretary in Room 10004, 10th floor, Senate House, University.

I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report.**

Principal Investigator Signature _____ Date _____

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES