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An audit of the surgical load at the Charlotte Maxeke Johannesburg Academic Hospital

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CHAPTER 1. INTRODUCTION AND LITERATURE REVIEW

1.1Historical background

The Charlotte Maxeke Johannesburg Academic Hospital (CMJAH), formerly known as the Johannesburg General Hospital, is the site of one of the world's first independently functioning trauma units.

In 1960, the Head of the Department of Surgery, Prof D J Du Plessis noted that there was a certain degree of difficulty being experienced by both staff and patients alike in the then general casualty department which was responsible for the acute management of all emergency patients. The main problem cited was that there was a relatively large population of patients who had suffered traumatic injuries and required adequate and timeous access to treatment. As such, it was decided that a dedicated area should be set aside for the management of these trauma patients. Initiated in 1962 under the leadership of Prof A E Wilkinson, this area, termed a unit at a later stage, was seen as an answer to the problems of overcrowding and difficulty in access to trauma care.[1]

1.2 Current structures

Today, the above mentioned trauma unit consists of the emergency treatment/ resuscitation area for the initial assessment and management of trauma patients, a trauma ICU for the critically injured patients who have need of intensive care and monitoring, and a trauma ward for the less severely injured and recovering patients. Associated trauma administrative offices are responsible for a large amount of data capturing on the trauma-medibank system and for the quality control of patient care. The data gleaned from this system informs the hand-over discussions and the morbidity and mortality (M&M) meetings. For the purposes of this study

although the trauma unit comprises several different areas in the hospital for ease of description it will be referred to either as area 163 or as the trauma unit.

In terms of non-trauma surgical admissions, a different management is currently in place. General and vascular surgical admissions (non-trauma) are admitted first through a general medical casualty area where they are triaged and assessed by emergency medical officers. Once an assessment is complete the relevant surgical medical officer/ junior registrar is called to go and assess the patient. Patients are then either managed and discharged in the medical emergency area or admitted for further management under the care of the surgical team on call for a given day. If an emergency operation is required patients are often sent straight to the operating theatre from the admission area and only taken to the surgical wards post-operatively.

When admitted, non-trauma, surgical patients will be cared for by one of three surgical teams.

- Ward 394 is a general surgical ward which also specialises in breast and thyroid surgery.
- Ward 395 is the vascular surgery ward
- Ward 396 is a general surgical ward which also specialises in oncology and gastro-intestinal surgery.

Ward 395 is on call for all vascular surgical emergencies 24 hours a day, 7 days per week. Wards 394 and 396 are on call for general surgical emergencies for 24 hours, each on alternate days.

Currently, the structures described necessitate at least 2 medical officers and one registrar (intermediate or senior level) on duty within the hospital for the trauma unit (163) at any given time. There is also 1 medical officer on duty in the hospital for the Trauma Intensive Care Unit (TICU.) Simultaneously there is always one medical officer or junior registrar on call within the hospital for either of wards 394 or 396 depending on which unit is on duty. In addition there is always a senior registrar for each of the above mentioned units on call (from home) every day. Ward 395 is staffed after hours by a medical officer and a senior registrar who are on call from home. In general there is one consultant who is on telephonic call from home for each of these wards every day. The exception is trauma (163) where the consultant on call is required to be on hospital premises.

The potential exists with a system such as this for unacceptably frequent rostering of doctors in terms of on call hours, and in terms of hours worked. This is exacerbated by the fact that doctors have to continue working on the days following their calls and if they have been busy during the calls, they may work as many as 36 hours at a time with little or no sleep. It would be useful to understand the actual workload in the trauma unit and the surgical wards prior to considering a possible restructuring of the surgical units or the employment of more medically qualified personnel if a problem is identified.

1.3 Literature review

By the late 1970's, the improvement in the overall care of trauma patients in dedicated units such as the unit in the Johannesburg General Hospital, had led to many similar units being successfully implemented in hospitals throughout the world.[2]Prior to the trauma unit concept, the management of severely injured patients took place in general "emergency" areas and with a wide variety of other emergency patients and specialists. Thus trauma patients were often lost in an inefficient and overburdened system where specialist care for these patients

was not optimal, in addition to which, this type of specialist care was not always easily or immediately obtained. Consequently the "golden age" of trauma began. General surgery became an extremely competitive and prestigious career choice and the trauma surgeon was regarded as the "master surgeon of the pack:" - a surgeon who could operate in virtually any area of the body in order to save a life within the so-called "golden hour" of trauma.2 Ultimately the American College of Surgeons developed a trauma centre designation system with stipulated requirements, thus reinforcing the paradigm that trauma is a surgical disease which must be managed in trauma-ratified centres, by exclusive trauma teams each of which should be overseen by an on-site trauma surgeon.

Over the next quarter of a century, however, trauma surgery started to change, particularly in the United States (US) and United Kingdom (UK) i.e. first world or developed country settings. Dramatic improvements in the quality and number of diagnostic modalities started to bring about a trauma revolution of sorts.2 There was a shift towards the non-operative management of trauma patients, which essentially left the trauma surgeons acting as interns, not doing much of the operative work themselves. They ended up "baby-sitting" patients for other specialists (such as neurosurgeons and orthopaedic surgeons) during the night and then handing them over for definitive management during the following day. At the same time, newer specialist disciplines (for example emergency medicine and interventional radiology) emerged.2 As these specialists started to become more adept and better trained at handling trauma emergencies themselves, the presence of an on-site trauma surgeon was rendered obsolete. At present the perception amongst many of the residents (registrars) is that trauma surgeons are resuscitation doctors who let other surgeons do the actual operating.[3] An example is the study by Søreide[4] which highlights that < 5 % of trauma patients are managed operatively.

Currently, emergency medical care seems to be in turmoil - access to emergency medical care is problematic in many areas of the world. Once emergency care has been accessed, patients and doctors alike are faced with the issues of overcrowding, boarding and delays in management. Average waiting times of 6.4hours have been quoted by Exadaktylos[5] (in some departments), just for surgical consultation. This would result in serious delays in the definitive management of these patients.

This type of problem has been experienced before. Prior to the dawn of the trauma unit era, as a solution to the above-mentioned problems was sought, the concept of merging trauma surgery with other surgical emergencies was explored. By using the concept of the dedicated trauma unit and applying this to all emergency surgical patients, a new type of unit could be created; one which might make for a more patient- and surgeon-friendly environment, where some of the pressure of the generalised emergency units may be alleviated by redirecting all of the surgical emergencies toward a dedicated emergency surgical unit. This concept effectively includes the disciplines of trauma, critical care and emergency surgery under one umbrella and became known as Acute Care Surgery. The author of the name "Acute Care Surgery", L D Britt[6], has seen the successful application of this new unit concept to an impressive degree, with the result that not only are these Acute Care Surgery Units now being run with success across many areas of the USA and Britain, but it also appears that the initial rationale behind such a restructuring has actually achieved its aims i.e. filling the "quality void" that exists in many emergency medical systems.

In South Africa, the problems of overcrowding and delays in generalised emergency areas appear to be just as severe if not worse than outlined above and although the discipline of trauma is not yet facing the same challenges, the solution to our own problems may lie along similar lines to some of the Acute Care Surgery models which will be described. In some instances there is great similarity between the problems experienced in the US and the

problems we are experiencing now in South Africa, particularly with regard to the working hours and remuneration of general surgeons. In one study completed by the Association of Surgeons of South Africa it was noted that general surgeons worked excessively long hours and as a result had increased levels of stress and strain placed on their families.[7]

Gamelli[8] has said: "Establishing acute care surgery as a defined speciality within a busy academic medical centre allows for more efficient management of patient care, development of educational programs, and more effective use of the surgical faculty's time." Whilst Acute Care Surgery (ACS) is a long way from becoming a separate sub-specialty in South Africa, this statement does highlight three ideals which are very important generally and particularly pertinent to the situation at CMJAH. They are:

- Efficient management of patient care.
- Academic program development.
- Efficient use of the surgical faculty's time.

Within the academic hospital environment in developed countries such as the US, traditional incentives have tended to be replaced with more corporate measures such as revenue. This has resulted in procedures becoming the main driving force for the measurement of productivity, producing a system where rapid patient turnover and high level efficiency are the norm. Time management is key and consequently scheduling plays an important role in the managerial side of such academic units. "Caring for patients with operative emergencies is inherently unexpected and inefficient and fits poorly into this contemporary academic surgical model" according to Reilly and Schwab.[9]The CMJAH is an academic hospital which faces the same problems with regard to the need for rapid patient turnover even though the

baseline reasons for that need are very different and in all likelihood due to the patient loads at this hospital.

1.3.1 Acute care surgery

Is there a general model for Acute Care Surgery? Not yet; units at present tend to be set up for specific country, area, and hospital needs.

The Santa Clara Valley Medical Centre (SCVMC) [10] in the USA and The Rotherham General Hospital in the United Kingdom[11], are two examples of hospitals which are running such acute care surgical units in very different but nonetheless effective ways.

The Santa Clara Valley Medical Centre (SCVMC) in Santa Clara County, USA is a level 1 trauma centre in which a single surgical service covers the elective patients as well as the acute surgical and trauma patients. The structuring of their particular unit has been fine-tuned over the better part of the last decade and is structured as follows: the emergency room team is comprised of surgical and emergency medicine staff. The in-house on-call surgeons work on a shift basis seeing to all emergency surgical patients who present. During day time hours the responsibility is given over to an on-call attending (consultant) of the week and his/her team of residents (registrars) and students. The residents and students of that week will then be responsible for taking over the care of the patients who present during the 7 day cycle this team will follow them up throughout their hospital stay.[10]

By comparison, the Rotherham General Hospital in the UK has developed a different emergency general surgery (EGS) system. Introduced in March 2003, there were two major changes made to existing work practices. Firstly, all emergency surgical patients were managed by all five consultant surgeons as a team rather than falling under a single consultant as had been the case previously. Secondly, each of the five consultants was

assigned a fixed on-call day each week. On this day, the on-call consultant had no elective commitments in the hospital. The net result of these two changes was that the on-call consultant would take responsibility for all the emergency patients on any given day and for the post-intake ward round the following day. On the following day he/she would hand the patients over to the rest of the consultant team who were thereafter jointly responsible for the ongoing patient care.[11]

The two models outlined above demonstrate that working within the constraints of any given situation, it is possible to restructure resources in a manner that is conducive to the improvement of patient care, academic development and the efficient use of time for the health care professionals in question, thus achieving all of the three ideals quoted previously, but specific to the needs of the actual patient and hospital environments under consideration. Before being able to consider the restructuring of these resources in a local context, it is necessary to have data which accurately reflect the trauma and the general surgical loads within the hospitals concerned.

Examples of workloads and doctor - patient ratios were sought at centres worldwide in order to try and compare local emergency workloads with those internationally. In Nottingham, England it was found, that emergency surgical admissions to one firm (surgical unit) in 1979 constituted half of the overall workload.[12] Similarly in an audit done in a District General Hospital (Whipps Cross Hospital, North East London) over the course of 1 year it was found that out of 1060 patients population, 652 (62%) required operative management.[13] Interestingly, the conclusions derived from these audits mentioned concerns for the quality of care which patients were receiving as well as the level of training provided to the surgical registrars. Only 30.2% of the patients in the Nottingham study were operated on within 48 hours leading to the assumption that surgical trainees are not gaining the experience needed in the management of emergency surgical cases.[12]Whipps Cross Hospital concluded that

management could be improved by provision of more adequate facilities. They also warned that reducing staff or bed numbers without due consideration to the suggested restructuring may lead to a significant reduction in patient care.[13] Prior to undertaking the current investigation it was anticipated that patient loads at CMJAH might be greater than those at other large hospitals internationally. A representative article was sought in the US, UK and Australia. The only suitable article found was in the Department of Surgery at the Royal Devon and Exeter Hospital (UK), where a total of 19 931 surgical emergencies were admitted in 7 study years spread over a 25 year period.[14] This will be enlarged on in the discussion chapter.

1.3.2 Objective

The objective of the current retrospective audit was to determine the total surgical load indicated by admissions and operations in the four surgical areas/ wards at CMJAH over one year.

CHAPTER 2. MATERIALS AND METHODS

2.1 Definitions

For the purposes of this study the following definitions have been used:

- **Emergency admissions**- is the term used to describe any unplanned or unbooked admission to hospital
- **Emergency operation**- would be any operative procedure which is unplanned or unbooked

Occasionally the term **"urgent"** will be used to describe a surgical procedure or admission. This usually indicates that the surgical operation or admission must happen within a few hours (usually not more than 24hrs,) but that the condition for which the patient is being admitted or operated on does not necessarily warrant immediate attention. The intervening time will allow for some degree of planning or adjunctive management prior to intervention.

- **Non-emergency admissions and operations**- these are admissions or procedures which are pre-planned/ booked for a certain time/date in the future. The waiting list for non-emergency admissions and operations is also subject to change/reshuffling on occasions when there have been so many emergencies that there is no more space to admit the non-emergency cases.
- **Unit**- this term is used to describe a particular ward or area within the hospital which has specific roles and responsibilities to perform. For example the vascular unit is ward 395 and its patients (some of whom may actually be managed in a different ward such as the intensive care unit,) the purpose of the vascular unit is to manage and oversee the hospital stay of any patients with vascular disorders which are surgical in nature. The work of the doctors within

a unit is not however restricted to one ward/ area in the hospital as they will be required to work in the emergency areas, theatres, wards etc.

2.2 Study design

This is a retrospective audit of surgical loads at the CMJAH. Prior to starting the audit, ethics clearance (no M….) was obtained from the Human Research Ethics Committee (Medical) of the University of the Witwatersrand (Appendix A). Owing to the fact that the title was changed after ethics clearance had been obtained, a notification to the ethics committee was made and accepted.

2.2.1 Source of data

In the Department of Surgery at CMJAH, statistics are captured onto computer at the weekly patient Morbidity and Mortality (M&M) meetings. Once appropriate permissions had been obtained from the department and hospital, these statistics were downloaded from the computer in the Department of Surgery.

2.2.2 Study population

All data for the period 29 December 2008- 28 December 2009 (52 calendar weeks) were captured. The study population included all patient admissions and operations captured for this period.

2.3 Data analysis

Data was initially captured onto Excel spread sheets and then analysed using the Statistical Analysis System (SAS for Windows version 9.1; SAS Institute Cary. NC, USA). Statistical tests used in SAS were the frequency, univariate, general linear models analyses and Tukey's

multiple comparison. In addition X-Y plots and linear regression analysis were done using Prism 4 (Graph Pad Inc, San Diego CA, USA). Statistical significance was set at $P < 0.05$.

2.4 Methodology

Weekly data for the year 29 Dec 2008 – 28 Dec 2009, were recorded in the Excel spread sheet under the following headings:

- Week (1 – 52)
- Ward (163, 394, 395, 396)

Then the absolute weekly totals for

- Emergency admissions
- Non – emergency admissions
- Total admissions
- Emergency operations
- Non – emergency operations
- Total operations
- Consultants
- Senior registrars
- Junior registrars /medical officers
- Total doctors

In the analysis of data, yearly trends were plotted as emergency and total admissions and operations X-Y plots. Thereafter a seasonal trends analysis was done to compare emergency, non-emergency and total admissions and operations. For ease of comparison all three tables per heading are shown. However parametric tests were applied only to the emergency data so that it would be in keeping with the main theme of this report.

CHAPTER 3. RESULTS: ADMISSIONS- YEARLY TRENDS

3.1 Introduction

An intention of this study was to record the number of doctors working in the units on a weekly basis so that doctor - patient ratios could be calculated. It was found, however, that the departmental data recorded the number of doctors assigned to each unit but did not indicate the number of doctors actually on duty and working in the unit on a daily basis. Thus the analysis of the number of working doctors and the calculation of doctor - patient ratios proved impossible, and this objective was eliminated.

3.2 Area 163 (Trauma unit)

This is the admissions area for the trauma unit at the CMJAH.

The following figure (Figure3.1) is a plot of all admissions to area 163 during the 52 week study period together with the linear regression line. In this area all admissions are emergencies.

For most of the year the admissions were approximately 200 – 220 per week varying throughout the year. The lowest recorded minimum one week was 160 admissions and the highest was 371 around the New Year. The plot shows irregular variations and a secular trend of a slight increase from beginning to end of the year. The linear regression analysis was not statistically significant.

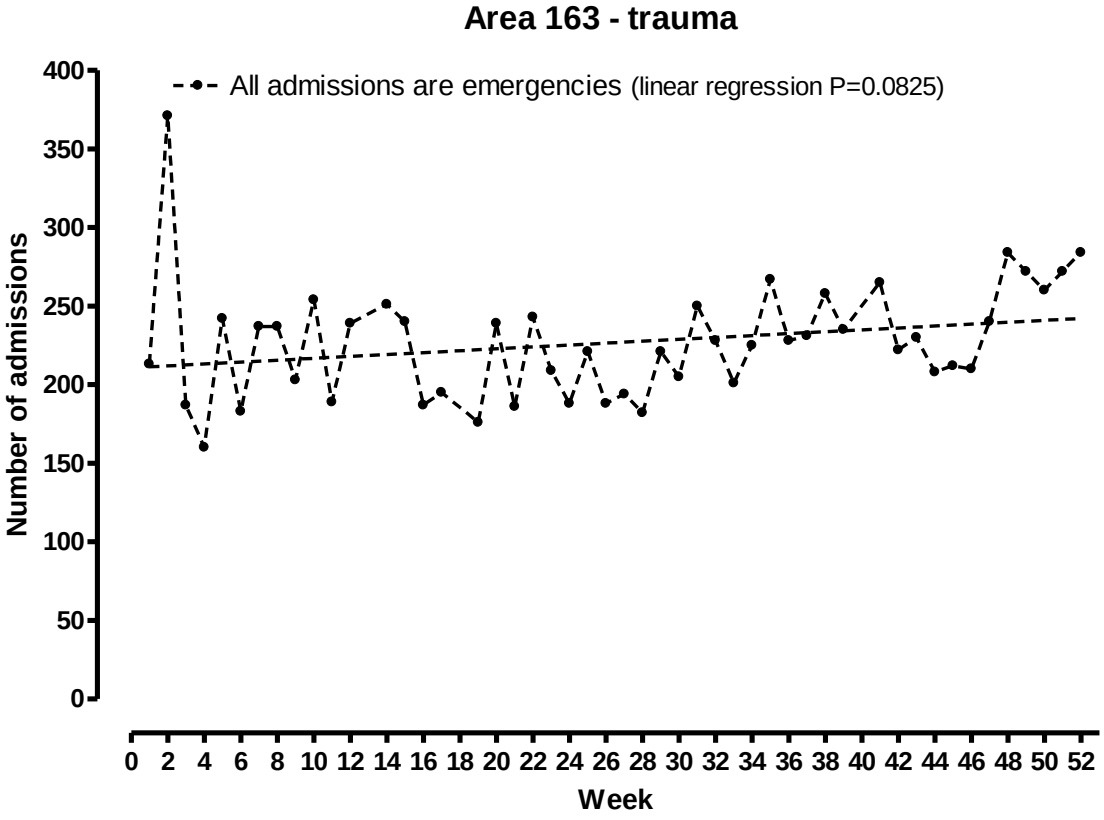


Figure 3.1 Admissions for area 163 by week

3.3 Ward 394 (General surgery)

As this is a general surgical ward, some of the admissions are emergencies and some are pre-planned admissions (non-emergencies.) Total admissions for ward 394 are shown on the upper plot of Figure3.2.

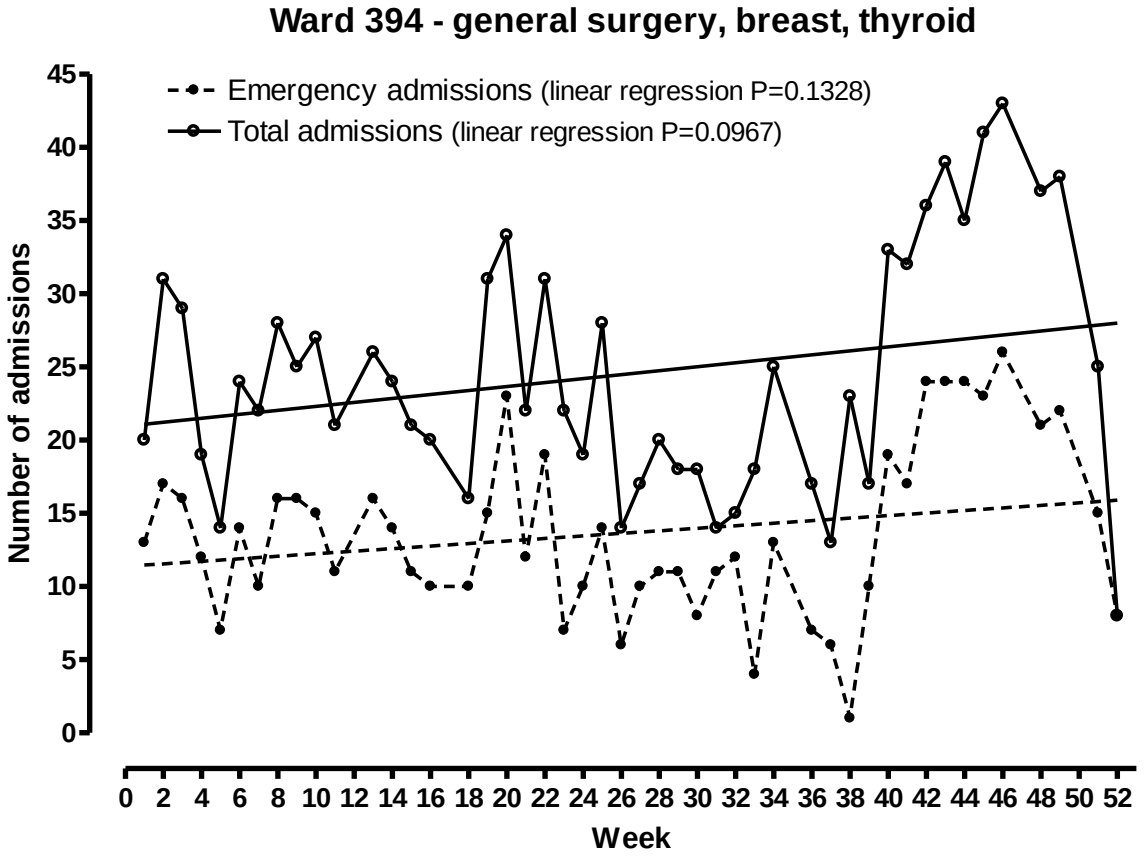


Figure 3.2 Total and emergency admissions for ward 394 by week

The total admissions vary between 7 and 43 with a rounded mean of 23 admissions per week. Visually the rates are lowest between weeks 26 and 38 and highest between weeks 40 and 50. There is a slight secular trend increase over the study period which is not statistically significant

Emergency admissions 394 are shown as the lower plot in Figure3.2.They vary between 0 and 26 admissions with a mean of approximately 13 per week. The variations follow the total admission patterns. Distances between the two plots are due to the non-emergency admissions. The general yearly secular trend follows that of the total admissions, and is not statistically significant.

3.4 Ward 395 (Vascular surgery)

This ward is a specialist facility for vascular surgery patients. Total admissions are shown in Figure 3.3(upper plot). There are two peak periods; weeks 1 – 12 and 32 – 38. The secular trend during the year is downwards but was not statistically significant.

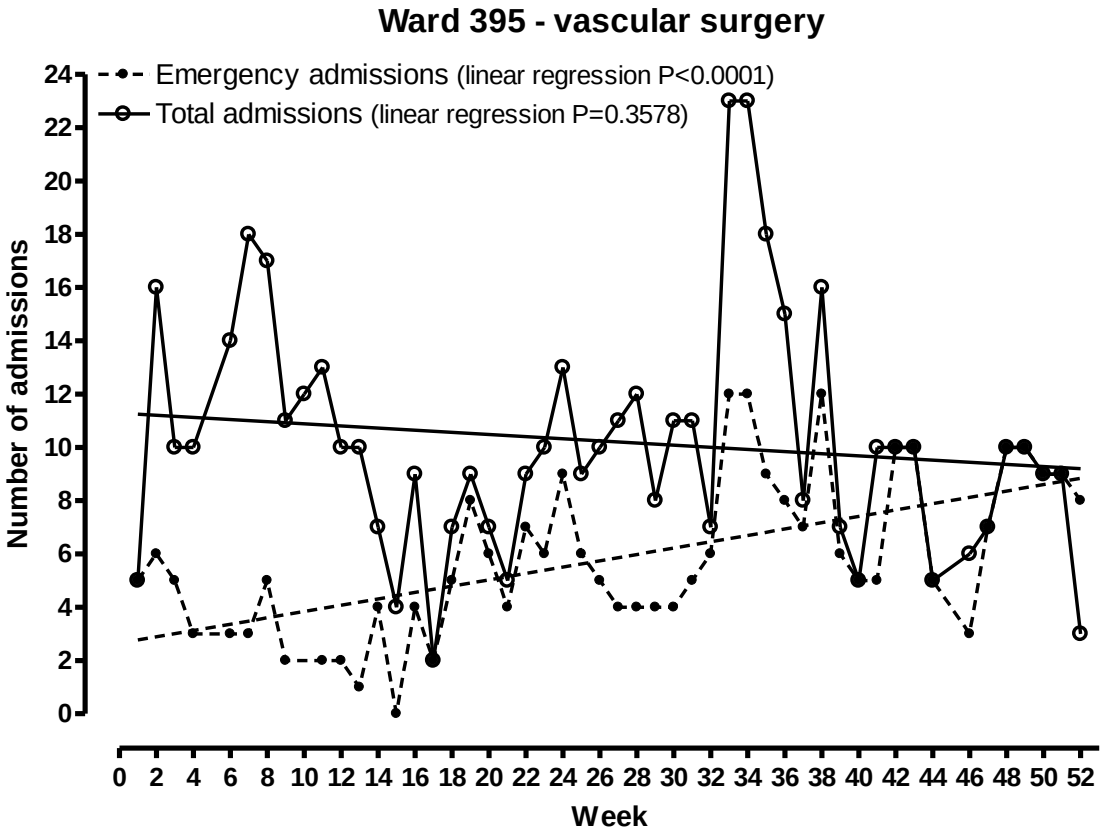


Figure 3.3 Total and emergency admissions for ward 395 by week.

Emergency admissions for ward 395 are shown in the lower plot in Figure3.3. There is an increase in the secular trend over the year of study which ranges from a weekly intake of about 3 patients at the beginning of the year to about 9 patients at the end. The variations in weeks 1 – 14 do not resemble the total admissions plots for the same period. The linear regression shows a highly statistically significant trend ($p < 0.0001$).

3.5 Ward 396 (General surgery)

This is the second of the 2 general surgical wards which is responsible for the management of both emergency and non-emergency admissions. Total admissions are in Figure3.4 below indicated by the unbroken line plot. Variations are lowest between weeks 19 and 26; there are two peaks at weeks 34 – 38 and 45 – 47. During the study period a slight increase in the secular trend of the total number of admissions was noted. Although this was not statistically significant, it should be mentioned that in the last 20 weeks of the study period the total number of admissions to this ward are closely aligned with the number of emergency admissions, indicating that very few non-emergency admissions were managed during this time.

Emergency admissions for ward 396 are plotted on Figure 3.4 (the broken line). There is quite a wide variation in actual numbers of emergency admissions in this ward from a minimum of 0 per week to a maximum of 35 in one week. Despite this variation, the slight general upward trend shown is not statistically significant.

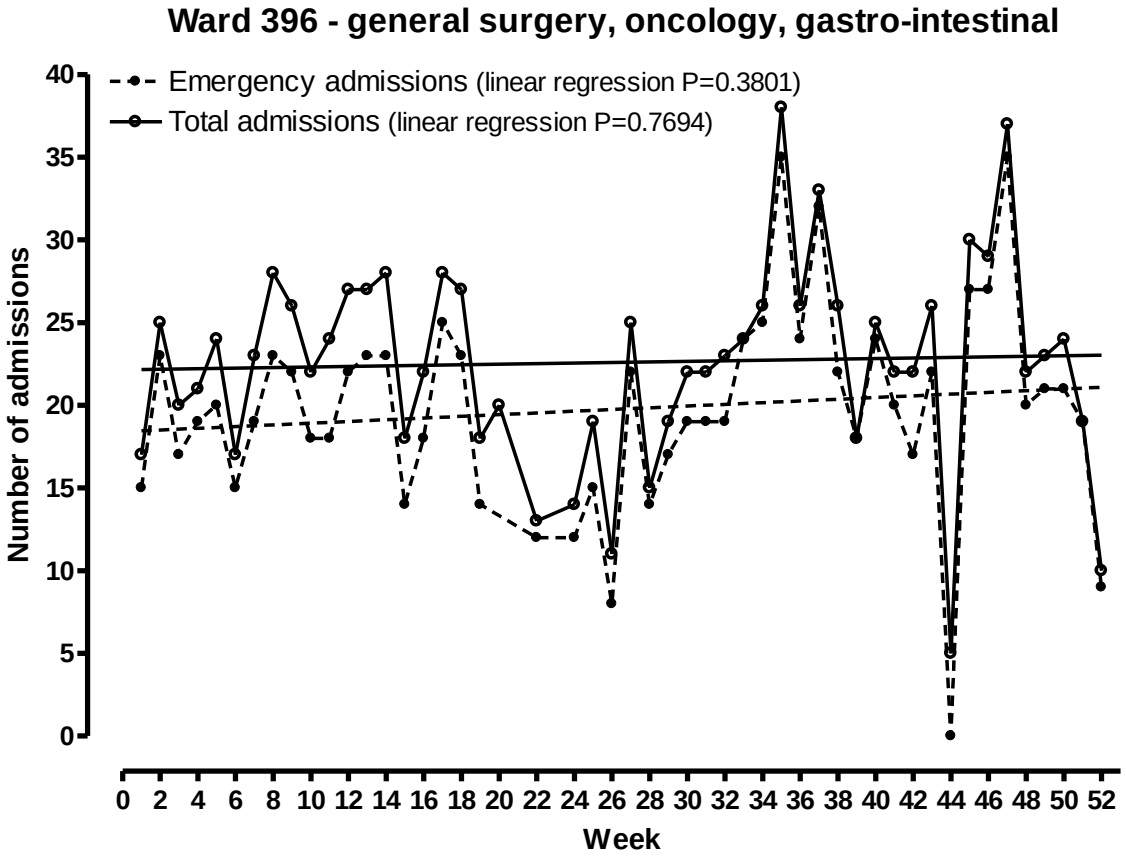


Figure3.4 Total and emergency admissions for ward 396 by week

CHAPTER 4. RESULTS: ADMISSIONS- SEASONAL TRENDS

4.1 Introduction

It is anecdotal that certain emergencies, particularly trauma, show seasonal variations. In chapter 3 the secular trends for emergency admissions increased, one of which was statistically significant. While this increase was towards the end of the year suggesting that Summer is the busiest time, the first few weeks of the year are also Summer. Thus, the data for the current study has been stratified into seasons to examine whether certain seasons are busier than others.

4.2 Materials and methods

Subdividing a year into seasons is complicated, many methods exist. The conventional seasonal calendar dates suggested on the website of the South African Weather Service was used.[15] The dates were corrected into the weeks of the study using a standard South African diary; all South African diaries use the same week numbering system.

Table 4.1 Calendar weeks by season used in this study.

SEASON	CALENDAR WEEKS
Spring	Weeks 36 – 48 (total 13 weeks)
Summer	Weeks 1 – 8 and 49 – 52 (total 12 weeks)
Autumn	Weeks 9 – 21 (total 13 weeks)
Winter	Weeks 22 – 35 (total 14 weeks)

There were occasional weeks where data was not recorded by the Department of Surgery during the M&M meeting, thus the number of weeks in sections of the study does not always add up to 52.

Statistical evaluation for the effect of season was applied to emergency admissions. First a Shapiro-Wilk test for normality was applied. This showed that the emergency admissions had a Gaussian distribution, so parametric statistics could be used. The two parametric tests used used were the general linear models analysis followed by Tukey's multiple comparison test. The level of statistical significance was set at $P<0.05$.

4.3 Area 163 Admissions

Table 4.2 below shows the admissions for area 163 by season. This is the total admissions for this area because all admissions are emergencies in the trauma unit.

Table 4.2 Seasonal trends for all admissions to area 163 (trauma)

	No of weeks	mean	SD	Median	Minimum	Maximum
Spring	12	235	23.4	231	208	284
Summer	12	243	56.1	240	160	371
Autumn	11	215	29.9	203	176	254
Winter	14	216	25.4	215	182	267

Spring and summer were the busiest seasons with an extra 20 – 30 admissions per week than in autumn and winter but the general linear models analysis showed no statistical effect for season ($F=1.92$; $P=0.1397$.)

4.4 Ward 394 Admissions

The three groupings of admissions are shown for emergency (Table 4.3), non-emergency (Table 4.4), and total admissions (Table 4.5).

Table 4.3 Seasonal trends emergency admissions ward 394 (general surgery)

	No of weeks	mean	SD	Median	Minimum	Maximum
SPRING	12	18	7.3	20	6	26
SUMMER	12	13	5.7	14	0	22
AUTUMN	11	14	3.8	14	10	23
WINTER	13	10	3.8	11	4	19

Table 4.4 Seasonal trends non-emergency admissions ward 394 (general surgery)

	No of weeks	mean	SD	Median	Minimum	Maximum
SPRING	12	13	3.6	13	7	18
SUMMER	12	9	5.1	10	0	16
AUTUMN	11	10	2.4	10	6	16
WINTER	13	9	3.9	9	3	15

Table 4.5 Seasonal trends total admissions ward 394 (general surgery)

	No of weeks	mean	SD	Median	Minimum	Maximum
SPRING	12	31	10.3	34	13	43
SUMMER	12	22	10.4	23	0	38
AUTUMN	11	24	5.1	24	16	34
WINTER	13	20	5.3	18	14	31

Emergency admissions per week were low with little change between the seasons. No statistically significant effect for season was noted. In this case the general linear models analysis showed a statistically significant effect for season (F = ; P =). Forward 394 each season differed significantly at $P < 0.05$ from the other in the following descending order Spring – Winter; Spring – Summer ;Spring – Autumn; Autumn – Winter; Summer – Winter; Autumn – Summer. Thus, Spring was significantly busier than other seasons, a similar trend to Autumn.

4.5 Ward 395 Admissions

The following three tables show the seasonal admissions to ward 395 (vascular surgery). Table 4.6 shows the seasonal trends in the emergency admissions, Table 4.7 shows the seasonal trends in the non-emergency admissions, and Table 4.8 shows the seasonal trend for the total admissions.

Table 4.6 Seasonal trends emergency admissions ward 395 (vascular surgery)

	No of weeks	mean	SD	Median	Minimum	Maximum
SPRING	12	7	2.7	7	3	12
SUMMER	11	6	2.7	5	3	10
AUTUMN	12	3	2.3	3	0	8
WINTER	14	7	2.8	6	4	12

Table 4.7 Seasonal trends non-emergency admissions ward 395 (vascular surgery)

	No of weeks	mean	SD	Median	Minimum	Maximum
SPRING	12	2	2.4	1	0	7
SUMMER	11	6	5.8	5	0	15
AUTUMN	13	5	4.0	4	0	11
WINTER	14	6	3.3	6	1	11

Table 4.8 Seasonal trends total admissions ward 395 (vascular surgery)

	No of weeks	mean	SD	Median	Minimum	Maximum
SPRING	12	9	3.6	9	5	16
SUMMER	11	11	4.8	10	3	18
AUTUMN	13	8	3.2	9	2	13
WINTER	14	13	5.2	11	7	23

The overall admissions for this ward were low.

The general linear models analysis showed a statistical effect for season. For ward 395 each season differed significantly from the other in the following descending order: Spring – Autumn; Winter – Autumn; Summer – Autumn; Spring – Summer; Winter – Summer; Spring – Winter. The pattern was irregular.

4.6 Ward 396 Admissions

The three groupings of admissions to ward 396 (general surgery) are shown for emergency admissions (Table 4.9), non-emergency admissions (Table 4.10), and total admissions (Table 4.11).

Table 4.9 Seasonal trends emergency admissions ward 396 (general surgery)

	No of weeks	mean	SD	Median	Minimum	Maximum
SPRING	13	22	8.5	22	0	35
SUMMER	12	18	4.0	19	9	23
AUTUMN	12	19	5.6	20	5	25
WINTER	13	19	7.0	19	8	35

Table 4.10 Seasonal trends non- emergency admissions ward 396 (general surgery)

	No of weeks	mean	SD	Median	Minimum	Maximum
SPRING	13	3	1.6	2	0	5
SUMMER	12	3	1.4	2	0	5
AUTUMN	12	5	3.2	4	3	15
WINTER	13	2	1.3	3	0	4

Table 4.11 Seasonal trends total admissions ward 396 (general surgery)

	No of weeks	mean	SD	Median	Minimum	Maximum
SPRING	13	25	7.8	26	5	37
SUMMER	12	21	4.8	22	10	28
AUTUMN	12	24	3.8	25	18	28
WINTER	13	21	7.1	22	11	38

The admissions for ward 396 tended to be slightly higher than those of 394 and 395. There were also relatively more emergency admissions to this ward. The general linear models analysis showed no statistical effect for season (F= 0.97; P= 0.4158). It should also be noted that the mean number of non-emergency admissions to this ward was less than 1 per 24 hours, whereas there were, comparatively, many more emergency admissions on a weekly basis.

CHAPTER 5. RESULTS: OPERATIONS- YEARLY TRENDS

5.1 Introduction

As was done for the annual trends for admissions, the emergency and total operations were recorded and plotted together with a linear regression analysis.

5.2 Area 163 (Trauma unit)

Although admissions to the trauma unit are all emergencies, many of the operations which are performed are “relook” procedures which follow after the initial emergency “damage control” type operation. For this reason, there will be a certain number of operations which are considered as pre-booked/planned operations despite the ‘emergency’ nature of the trauma unit setting. Therefore in this analysis two x-y plots will be shown on the graph instead of the single plot shown for the admissions analysis.

Figure 5.1 depicts all operations performed in the trauma unit during the 52 week study period.

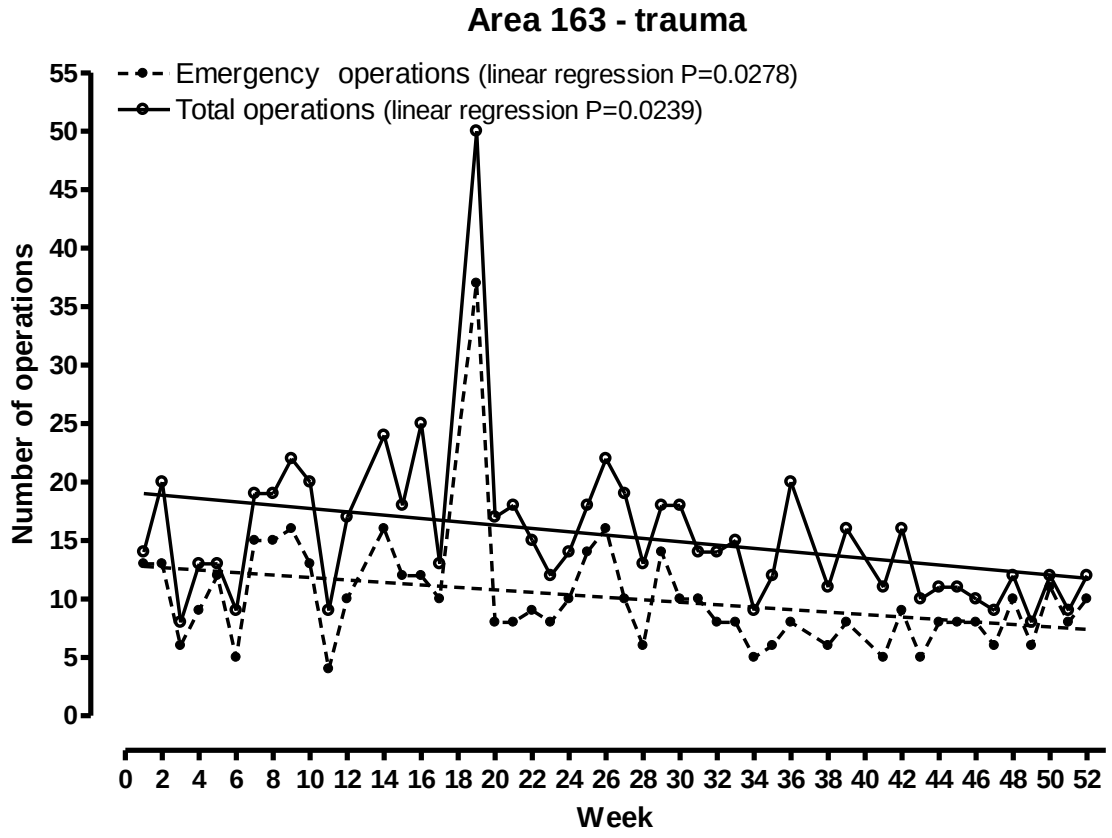


Figure 5.1 Total and emergency operations for Area 163 by week

The upper line in this Figure shows the total numbers of operations done during the study period; there was a decline from just less than 20 at week 2 to approximately 10 operations per week which was statistically significant.

The emergency operations for the trauma unit are shown in the lower plot of Figure 5.1 (above). The number of emergency operations for this period ranged from a minimum of 4 to a maximum of 37 operations per week. The secular trend is also statistically significant. The variations in the two plots follow each other.

5.3 Ward 394 (General surgery)

Total operations for ward 394 are shown on the upper plot of Figure 5.2.

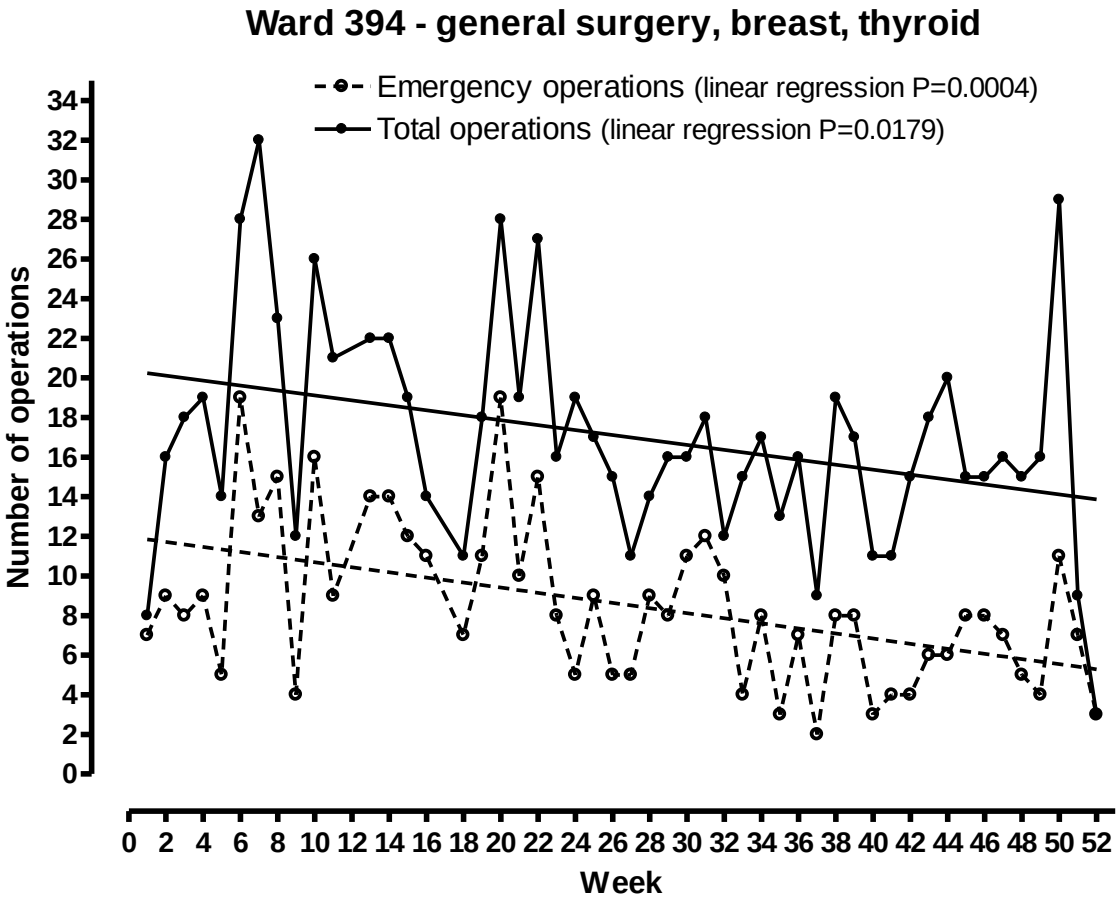


Figure 5.2 Total and emergency operations for ward 394 by week

Many high peaks can be seen during the course of the year of study with a statistically significant downward trend during the study period.

Emergency operations for ward 394 are shown as the lower plot in Figure 5.2.The maximum recorded emergency operations in one week were 19, with a minimum of 3. The linear regression analysis for the downward secular trend is also statistically significant.

5.4 Ward 395 (Vascular Surgery)

This ward is a specialist facility for the management of vascular surgery patients. Total operations are shown in Figure 5.3 in the upper plot.

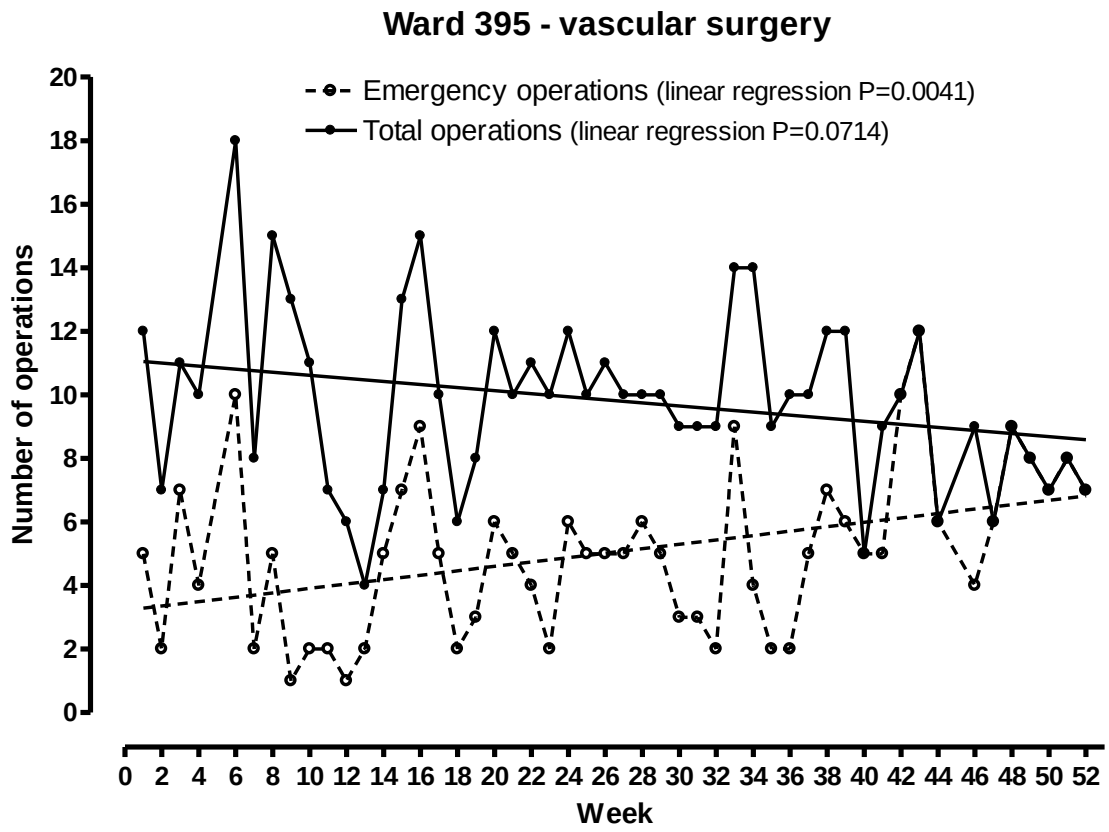


Figure 5.3 Total and Emergency Operations for ward 395 by week

There is a decline in the total operations done over the course of the year, however, this is not statistically significant.

The emergency vascular surgical operations are shown in the lower plot in Figure 5.3 above. There is a noticeable upward trend over the study year which is statistically significant. The variations in the two plots only partly follow each other.

5.5 Ward 396 (General surgery)

The total numbers of operations done in ward 396 are depicted by the upper plot in Figure 5.4.

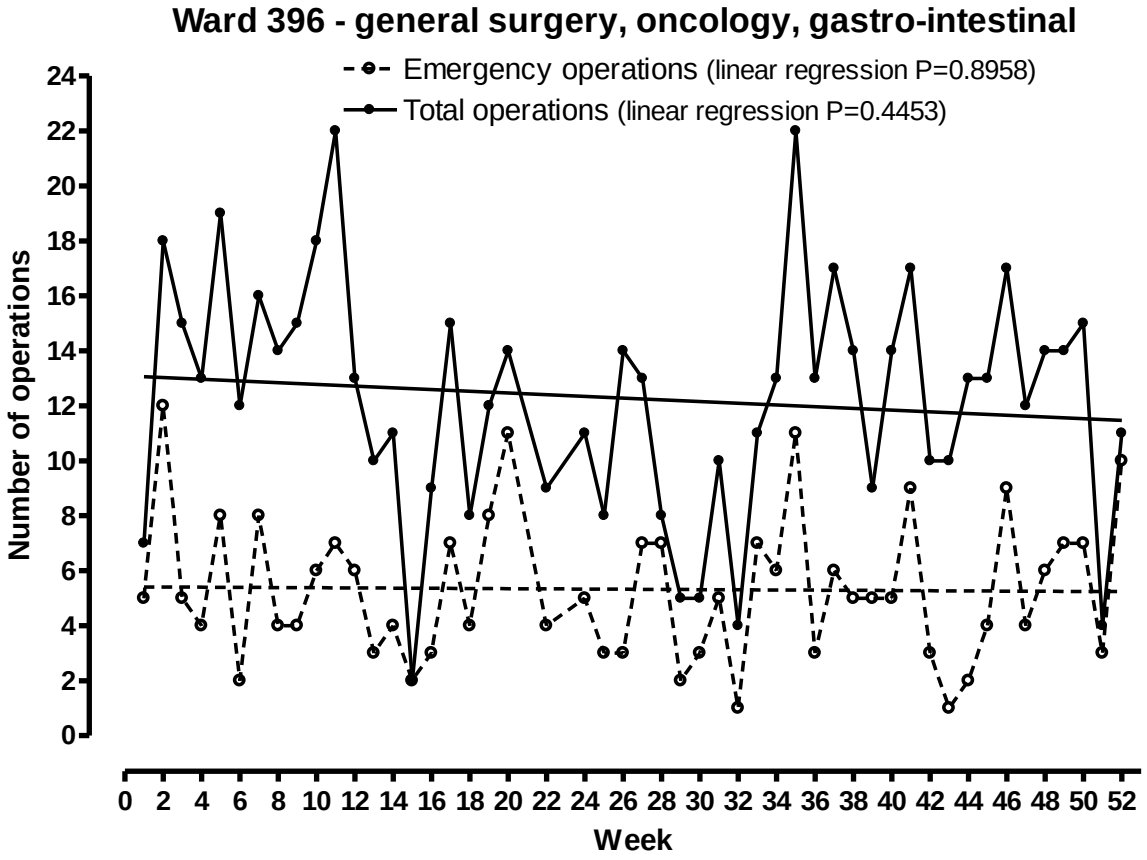


Figure 5.4 Total and emergency operations for ward 396 by week

There is a wide variation in the total numbers of operations – an obvious drop is from week 12 through 32. The downward linear regression shows no statistical significance.

The emergency operations are the lower plot in Figure 5.4.The week to week variation is quite noticeable in that there is a lowest recorded minimum of 0 operations and a maximum recorded on more than one occasion of 35 emergency operations performed in one week. The trend is horizontal and also not statistically significant.

CHAPTER 6. RESULTS: OPERATIONS- SEASONAL TRENDS

6.1 Introduction

In order to analyse whether seasonal operation rates mirror the admission rates, a seasonal analysis of the operative data was done. Often the number of operations done will seem far fewer than the number of admissions. The main reason for this is that not all emergency admissions require operative intervention and some of those that do will only require operation at a later stage and will therefore be classified as a planned / non-emergency procedure.

6.2 Materials and methods

The operative data was categorised according to the seasonal calendar in the same manner as in section 4.2.The data for the seasonal operations was analysed first with a Shapiro-Wilk test for normality. This showed a Gaussian distribution so was followed by the general linear models analysis and Tukey's multiple comparison test. The level of statistical significance was set at $P<0.05$. In keeping with the emergency medicine theme of this report, the result comments given at the end of each ward sub-section are relevant only to the emergency operation results, the non-emergency and total operation results are given for the sake of comparison.

6.3 Area 163 Operations

The three groupings of tables show the emergency (Table 6.1), non-emergency (Table 6.2), and total operations (Table 6.3) for area 163 (Trauma unit)

Table 6.1 Seasonal trends emergency operations area 163 (trauma)

	No of weeks	mean	SD	Median	Minimum	Maximum
SPRING	12	7	2.6	8	0	10
SUMMER	12	10	3.5	11	5	15
AUTUMN	11	13	8.6	12	4	37
WINTER	14	10	3.2	10	5	16

Table 6.2 Seasonal trends non-emergency operations ward 163 (trauma)

	No of weeks	mean	SD	Median	Minimum	Maximum
SPRING	12	5	3.3	4	0	12
SUMMER	12	3	1.9	2	1	7
AUTUMN	11	8	3.1	7	3	13
WINTER	14	6	1.7	6	4	9

Table 6.3 Seasonal trends total operations ward 163 (trauma)

	No of weeks	mean	SD	Median	Minimum	Maximum
SPRING	12	11	4.8	11	0	20
SUMMER	12	13	4.3	13	8	20
AUTUMN	11	21	10.6	18	9	50
WINTER	14	15	3.4	15	9	22

As can be seen from theses tables the numbers of operations occurring within the trauma environment are far fewer than the numbers of admissions to the trauma unit on a weekly basis. The general linear models analysis showed a statistical effect for season (F = ; P =). Each season differed significantly from the other in the following descending order: Autumn – Spring; Autumn – Winter; Summer – Spring; Autumn – Summer; Winter – Spring; Summer – Winter. Autumn is therefore the busiest season.

6.4 Ward 394 Operations

Table 6.4 Seasonal trends emergency operations ward 394 (general surgery)

	No of weeks	mean	SD	Median	Minimum	Maximum
SPRING	13	6	2.1	6	2	8
SUMMER	12	9	4.7	9	3	19
AUTUMN	11	12	4.2	11	4	19
WINTER	14	8	3.4	8	3	15

Table 6.5 Seasonal trends non-emergency operations ward 394 (general surgery)

	No of weeks	mean	SD	Median	Minimum	Maximum
SPRING	13	9	2.2	9	7	14
SUMMER	12	8	5.0	9	0	18
AUTUMN	11	8	2.5	8	3	12
WINTER	14	8	3.1	8	2	14

Table 6.6 Seasonal trends total operations 394 (general surgery)

	No of weeks	mean	SD	Median	Minimum	Maximum
SPRING	13	15	3.2	15	9	20
SUMMER	12	18	8.9	17	3	32
AUTUMN	11	19	5.4	19	11	28
WINTER	14	16	3.8	16	11	27

The mean numbers of total operations done in 394 appear to be higher than those done in 163, however this can largely be accounted for by the non-emergency cases. General linear models analysis showed a statistical effect for season in ward 394. The seasons differed significantly from each other in the following descending order: Autumn – Spring; Autumn – Winter; Summer – Spring; Autumn – Summer; Winter – Spring; Summer – Winter. Spring was the least busy period.

6.5 Ward 395 Operations

The following three tables show the emergency (Table 6.7), the non-emergency (Table 6.8), and the total (Table 6.9) operations

Table 6.7 Seasonal trends emergency operations ward 395 (vascular surgery)

	No of weeks	mean	SD	Median	Minimum	Maximum
SPRING	12	6	2.7	6	2	12
SUMMER	11	6	2.5	7	2	10
AUTUMN	13	4	2.5	3	1	9
WINTER	14	4	1.9	5	2	9

Table 6.8 Seasonal trends non-emergency operations ward 395 (vascular surgery)

	No of weeks	mean	SD	Median	Minimum	Maximum
SPRING	12	3	3.0	2	0	8
SUMMER	11	4	3.7	5	0	10
AUTUMN	13	6	2.6	5	2	12
WINTER	14	6	1.5	6	4	10

Table 6.9 Seasonal trends total operations ward 395 (vascular surgery)

	No of weeks	mean	SD	Median	Minimum	Maximum
SPRING	12	9	2.4	1	5	12
SUMMER	11	10	3.6	8	7	18
AUTUMN	13	9	3.3	10	4	15
WINTER	14	11	1.7	10	9	14

Once again in ward 395 the mean numbers of operations tend to be lower than in the other three wards studied. In ward 395 the general linear models analysis also showed a statistical effect for season. Each season differed significantly from the other in the following descending order: Spring – Autumn; Summer – Autumn; Spring – Winter; Summer – Winter; Winter – Autumn; Spring – Summer.

6.6 Ward 396 Operations

The three groupings of tables are shown for emergency (Table 6.10), non-emergency (Table 6.11), and total admissions (Table 6.12) in ward 396.

Table 6.10 Seasonal trends emergency operations ward 396 (general surgery)

	No of weeks	mean	SD	Median	Minimum	Maximum
SPRING	13	22	8.5	22	0	35
SUMMER	12	18	4.0	19	9	23
AUTUMN	12	19	5.6	20	5	25
WINTER	13	19	7.0	19	8	35

Table 6.11 Seasonal trends non- emergency operations ward 396 (general surgery)

	No of weeks	mean	SD	Median	Minimum	Maximum
SPRING	13	3	1.6	2	0	5
SUMMER	12	3	1.4	2	0	5
AUTUMN	12	5	3.2	4	3	15
WINTER	13	2	1.3	3	0	4

Table 6.12 Seasonal trends total operations ward 396 (general surgery)

	No of weeks	mean	SD	Median	Minimum	Maximum
SPRING	13	25	7.8	26	5	37
SUMMER	12	21	4.8	22	10	28
AUTUMN	12	24	3.8	25	18	28
WINTER	13	21	7.1	22	11	38

In ward 396 the emergency operations and total operations were high compared to the other wards however there appeared to be far fewer no-emergency cases in this ward. General linear models analysis showed no statistical effect for season (F= 0.78; P= 0.5117.)

CHAPTER 7. DISCUSSION

7.1Principal Findings

South Africa is well known for having high levels of trauma particularly interpersonal violence and road traffic accidents – approximately 1 million annual trauma cases reported by 68 % of hospital responding to headcount questionnaires. 75 % of these cases were treated in State hospitals.[16]The findings of the current investigation indicate that there is certainly a very high trauma admission load at CMJAH which is one of the large State hospitals and is classified as a quaternary hospital. Relatively, the non-trauma emergency surgical cases were not as high but did show that they form a substantial number of the overall vascular and general surgery admissions. For this reason it would be useful to have some guidance in terms of the recommended number of doctors allocated to the trauma unit and other general surgical wards.

Norms and standards for the doctor patient ratios have been taken from the Department of Health website – Modernisation of tertiary services document appendix 4 of framework 06[17]

Norms described in the above mentioned document are as follows:

- Vascular surgery – 2 vascular surgeons and 2 registrars for a unit which does 400 operations p.a. with the addition of 2 vascular surgery fellows for a unit which does 1000 operations p.a.

- General surgery – for tertiary general surgery the recommended norm is one specialist per 12 beds. There are no norms for the numbers of registrars provided in this document; however the point is made that we should be developing our own norms appropriate for the South African context.

- Trauma is considered as a branch of general surgery and therefore whilst there have been no separate norms and standards listed, the same norms and standards can be applied to the trauma unit as to the general surgery units.

- The norms set down for Intensive care unit (ICU) are set out in terms of bed numbers. An ideal ICU in a Provincial tertiary hospital should have 12 beds.

The trauma ICU at CMJAH has 8 beds and very often extra beds have to be sought in other ICU's in the hospital because the trauma ICU is full. General surgical patients who require ICU care are usually sent to the general ICU in block 5 of the hospital. This ICU has 12 beds but as it is a general ICU and as such is not dedicated to surgical patients only. There is frequently a scenario where the all ICU beds are full and therefore trauma patientshave to be hospitalised in the emergency resuscitation area in area 163. Should this be the case, ordinary emergency trolleys are used as patient beds which can cause serious difficulties in nursing care, limited access to the patients in terms of space constraints and medical problems such as the development of pressure sores.

Other surgical loads were sought for the purposes of comparing the data collected at CMJAH to other countries. The difficulties encountered were that very few areas recorded only the surgical loads. Many places recorded general emergency department loads and yet others recorded loads which were symptom or diagnosis related. Some examples of surgical loads in other countries will be included later on in the discussion.

7.1.1 Admissions

The total emergency admissions shown in chapter 3 for all four wards combined were 13032 for 2009 of which 11221 (86.1%) were trauma admissions, indicating how large the trauma

load component is in comparison to the emergency surgical admissions in the other 3 wards combined (1811; 13.9%).

The burden of trauma on the hospital is known to be extremely heavy and is one of the reasons why a dedicated trauma unit has been developed. This allows for round the clock on-site medical officer, registrar and consultant cover which at this stage is something that the other 3 units cannot feasibly provide. Space is however a big problem for the trauma unit. Once the ICU beds are all full, the emergency area is taken over by the ICU patients for whom there are no beds. This in turn limits the space available for resuscitation of trauma patients. Often the trauma ward is also fully occupied and the trauma patients have to be "outlied" to other wards in the hospital.

The total numbers of admissions in the 3 non-trauma wards are closely aligned with the number of emergency admissions in these wards indicating that many if not all of the total admissions for a particular week are in fact emergency admissions. This can have an important impact on the quality of care delivered to the emergency patients who may have to wait several hours before being attended to by the doctor on duty. It also affects the care of the booked patients whose planned admissions and subsequent operations may have to be delayed if the emergency cases admitted take up all of the ward space and operative time. This might be indicative that a new system needs to be implemented; one in which a restructuring of the existing units and staff can be considered in order to try and alleviate the surgical burden placed on the facilities and the staff members.

The highest number of admissions recorded in the trauma unit happened around the time of the New Year celebrations with a drastic fall to the lowest number of admissions two weeks later. This was then followed by a steady linear increase in admission numbers towards the end of the study period.

Conversely, the two general surgical wards (394 and 396) showed peaks in the number of admissions in late winter and early spring with a much quieter time during the festive season. This is probably due to the fact that elective (planned) operative lists do not run over the festive season and only emergency patients and cancer patients are admitted and operated on during this time.

The vascular surgery unit (ward 395) showed a marked spike in the total number of admissions in the third quarter of the year. This may be seasonally related but also may be due to closure of one of the feeder hospitals resulting in the unit having to take on many extra patients. It should be noted that there are several feeder hospitals and that many of the vascular surgery admissions are referrals from these hospitals.

Although the seasonal analysis of the data shows that trauma admissions are highest in summer and lowest in winter with slightly more admissions in spring than in autumn, the mean values are all over two hundred trauma admissions per week in all seasons indicating a very high work load for the doctors in the trauma unit. Surgical admissions show a different trend. Given that the total patient admissions for the 3 surgical wards are still less than those for the trauma unit, there is an overall extra burden of patient numbers in the summer.

7.1.2 Operations

With regard to the operative trends shown, for the trauma unit, these were fairly consistent throughout the year (about 15 patients per week on average) with one week (week 19) showing a huge increase in the total (50) and emergency operations (37) . No reason was apparent for this sudden spike but may also be due to closure of one of the associated feeder hospitals as this is an occurrence which occurs quite frequently in the trauma context. It was also noted that this spike coincided with the Easter holidays and this was thought to have contributed to the increase in trauma related operations during this period. There was a

statistically significant decline in both the total and emergency operations performed over the study period for the trauma unit. It should also be mentioned that the total numbers of operations performed in the trauma unit is low in comparison to the numbers of admissions seen in this unit. This is in keeping with a more conservative philosophy which has resulted in a worldwide trend towards the non-operative management of trauma patients as previously commented on in the literature review.

Ward 394 showed some examples of substantial week to week variation in operative trends. The quietest operative period was revealed to be between weeks 24 and 38. This indicated a correlation with the admission trends which were also at their quietest in the same week period. The downward trend shown for the emergency operations in ward 394 was shown to be statistically significant. Although an explanation for this was sought no definitive answer was found. Possibilities include more operations being performed at feeder hospitals or staff issues and available theatre time at CMJAH (which occur on an ongoing basis.)

In ward 395 there was a linear increase in the number of emergency operations performed as the year progressed, whereas the total number of operations decreased over the same period. This is an interesting occurrence which echoes the admission trends in the vascular ward but the reason for this is unclear at this stage and is postulated to be due to difficulties with transfer of patients from feeder hospitals.

Although total operations and emergency operations were fairly constant throughout the year, in ward 396, there were 2 peaks in the total operations during the year. The first peak in week 12 did not show a corresponding increase in the number of emergency operations so this was probably due to an increase in the booked cases. The second peak was mirrored by a peak in the emergency operations in week 36 and was shown to be the week in which the highest number of emergency cases was admitted. Reasons such as changeover of staff and registrar

exams may also account for spikes such as this. The overall downward trend in total operations and the horizontal trend in emergency operations were not statistically significant.

In terms of seasonal analysis, there was very little consistency shown between the 4 wards. The highest seasonal emergency operation rates for trauma were found to be during the autumn, for 394 during summer and autumn, for 395 during spring and for 396 during winter and spring. The small number of emergency operations for each ward would probably account for these findings appearing to be somewhat random. It is interesting to note that whilst the weekly trauma admissions are far higher than those in any of the other three wards, the numbers of operations are not proportionally as high in comparison to the general surgical wards, thus showing that there are a lot of trauma patients who do not proceed to operation once they have been admitted. This could indicate a move towards the more conservative management of trauma cases in keeping with the move towards the non-operative management cited in the literature review.[2]

7.2 Strengths and Weaknesses

7.2.1 Strengths of the current study

This study has given a good indication of the overall burden of surgical disease in the CMJAH. In particular it has outlined how extensive the burden of trauma is in this context.

It has also shown that the burden of surgical emergencies constitutes a fair proportion of the total surgical workload in the hospital.

The seasonal analysis of surgical trends has helped to illustrate when the busiest times of the year are for each of the four units analysed in this study and has outlined that the emergency surgical workload has an important impact on both the operative responsibilities and the non-emergent/booked cases in each of the four units.

7.2.2 Weaknesses of current study

As regards the weaknesses of this study, an accurate reflection of the exact surgical diagnosis cannot be given and as such, the reasons for seasonal variations in disease type cannot be identified. This means that trends - for example a seasonal increase in burns injuries during the winter- cannot be confirmed or denied.

Another weakness of the study is that while there is good data capturing in terms of the number of doctors assigned to each unit, this data did not reflect the actual number of doctors on duty in the hospital at any given time. In addition to this, there was no data to show the number of interns either allocated to or working in the units at any given time.

Lastly, it is very difficult to compare the different workloads of the doctors working in different units. This is largely because of the differences in timetabling and shift work across the different units. For example, in area 163 the medical officers work on a shift basis whereas the medical officers in the general surgical wards work every day and do their afterhours duties according to a call roster system.

7.3 Strengths and Weaknesses in relation to other studies

7.3.1 Strengths of current study

This study confirms that the burden of trauma on South African hospitals is extremely high and in keeping with the info contained in the SA info website.[16] In fact the article on this website estimated that there were 1 million new trauma cases countrywide per year which would mean that in 2009, CMJAH admitted 1 % of these cases.

By way of comparison other examples of surgical loads were sought. Mount Sinai Hospital (Toronto) recorded an annual emergency department volume of 38000, 20% (7 600) of which were trauma related and 10% (3 800) of which were surgical (non-trauma.)[18]This gives a total

number of 11 400 cases seen in the emergency department, not all of which would have been admitted to the hospital. The total number of cases seen in this emergency department (ED) approximates the number of emergency admissions from only the trauma unit at CMJAH, highlighting once again the high numbers of patients seen in the trauma unit at CMJAH. The numbers of non-trauma surgical patients are slightly lower than the quoted number for Mount Sinai, however the numbers quoted for Mount Sinai account for the total number of patients seen in the ED whereas the patient population quoted in this study are admissions to the hospital.

7.3.2 Weaknesses of current study

When attempting to compare this study to other studies, the main problem encountered was that other seasonal analysis studies include medical emergencies together with the surgical emergencies. Such examples include North New York General Hospital ED, with a quoted annual ED patient volume of 63 000. This includes all specialities with no breakdown given for surgical or trauma patients.[18]Other audits and surgical loads were sought but very often audits were done pertaining only to a given diagnosis or presenting complaint. This prevented comparison with the current study.

7.4 Implications of the study

The main messages arising from this study are that while there are good systems in place, particularly for the management of trauma patients at the CMJAH, there are also systems for the management non-trauma patients which appear to be slightly cumbersome and do not use their resources to optimal efficiency. An important suggestion therefore would be to look at restructuring the existing resources into a more organised system of practice such as the type of Acute Care Surgery Unit described in the literature review. This would allow for the more efficient utilisation and deployment of staff within the units, thus reducing the burden placed

on the staff in terms of working hours and patient loads. The Royal Infirmary (Edinburgh) demonstrated this through a retrospective study on operative activity following the separation of elective and emergency surgical activity. This study showed that despite an increase in emergency operations from 941 in 1994 to 1351 in 1999, there was a twofold reduction in operations carried out after hours thus allowing a more optimal usage of staff resources.[19]This would also allow for better access to emergency surgical facilities and definitive emergency surgical intervention, which would be more beneficial to both the patients requiring emergency surgical care as well as those requiring non-emergent surgical care. Presently the latter often have to wait weeks or even months due to the overcrowding of hospitals with emergency cases. The implementation of Acute Care Surgery units or Surgical admission units has also been shown to improve bed management[20], which would benefit not only the patients with surgical emergencies but would allow for the improvement of the use of physical resources thus indirectly benefitting the non-emergent patients as well.

One suggestion would be to remodel the existing trauma unit and redeploy some of the staff from the other 3 wards (394,395 and 396) to the trauma unit, therefore allowing it to absorb the burden of emergency surgical disease. Ideally one of the general surgical wards could be reallocated to this Acute Care Unit to increase the bed allocation for the new unit.

The other three units could then potentially amalgamate to become one general surgical and vascular unit, thus relatively speaking, increasing the staff allocation but without having the responsibility of managing any of the emergency surgical cases- all of which would be managed by the Acute Care Unit. This general surgical/vascular unit would then be solely responsible for managing all non-emergent vascular and general surgical cases.

7.5 Unanswered questions and future research

The main question still unanswered by this particular study, is that of the exact doctor patient ratios. In order to accurately record and analyse these statistics, a prospective data collection would need to be undertaken, in which somebody would have to manually record the numbers of doctors and patients present in each unit on every day.

Other future research could include feasibility studies into whether a unit such as the one proposed above would be achievable given the current staffing structures and budgetary constraints within the hospital system.

More research could then be done on how best to achieve the aim of creating a new Acute Care Surgical Unit and follow up auditing of the newly implemented models.

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