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Pattern and Outcomes of Admissions to the Medical Acute Care Unit of a Tertiary Teaching Hospital in South Africa

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A research report submitted to the University of the Witwatersrand, in fulfilment for the requirements of the degree of Master of Medicine in the branch of Internal Medicine

Johannesburg 2018

DECLARATION

I, Uzma Nasir Khan, declare that this research report is my own work which is being submitted for the degree Master of Medicine (in the submissable format with my protocol and an extended literature review) in the branch of Internal Medicine at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other University

……

……day of ……2018

ACKNOWLEDGMENTS:

Heartfelt thanks go to my two supervisors.

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Last, but not the least, my husband Nasir, and my wonderful daughter, Fatima.

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OUTCOMES FROM THIS STUDY

Oral presentations

Khan U. Patterns and outcomes of admissions to the Medical Acute Care Unit of a Tertiary Teaching Hospital in South Africa

1) Academic Meeting: Department of Medicine, Chris Hani Baragwanath Academic Hospital, May 2016.
2) Academic Meeting: Department of Medicine, Helen Joseph Hospital, June 2017

Submissable Article (According to the Instructions of the South African Medical Journal)

Khan U. Menezes C. Govind N. Patterns and outcomes of admissions to the Medical Acute Care Unit of a Tertiary Teaching Hospital in South Africa

ABSTRACT

Background

A Medical Acute Care Unit (MACU) was established at Chris Hani Baragwanath Academic Hospital (CHBAH) to provide comprehensive medical specialist care to the patients presenting with acute medical emergencies. Improved standards of health care delivery systems at the MACU may result in shorter hospital stay, better outcomes and less mortality.

Objectives

The objective of the study was to describe the demographics, diagnoses, pattern of diseases and the outcomes, including mortality of patients admitted to the MACU at the Chris Hani Baragwanath Academic Hospital (CHBAH).

Methods

A record review of 200 patients admitted to the MACU at CHBAH was performed from March 2015 to August 2015. The records were analysed for patient demographics, diagnosis at admission and duration of stay in MACU. The outcome was defined as transfer to the medical ward, Intensive Care Unit (ICU) or discharged home. The main causes of mortality were also recorded.

Results

Of the 200 patients, 59% were females. The mean age of the patients was 46 ± 17.2 years and the mean duration of stay at the MACU was 1.45 ± 1.25 days. Non-communicable diseases accounted for 76% of admissions. The most frequently diagnosed conditions included: diabetic ketoacidosis acidosis (DKA) and hyperosmolar non-ketotic (HONK) (17.5%), non-accidental self-poisoning (16%), hypertensive emergencies (9.5%), decompensated cardiac failure (8%) and ischemic

heart disease (7%). Infectious diseases comprised 14% of the diagnoses of which pneumonias were the most common (5%). Most patients (77.5%) were transferred to medical wards, 12% to ICU, while 10% demised at the MACU. The main causes of death included sepsis (25%), DKA/HONK (20%), non-accidental self-poisoning (10%) and cardiac failure (10%).

Conclusion

Non-communicable diseases particularly diabetic emergencies were the main causes of admission to the MACU at CHBAH. During the study period, high rates of case improvement, patient discharge, shorter hospital stay, and less mortality were observed. The main cause of mortality was sepsis related.

LIST OF FIGURES

Figure 1: Duration of stay of patients at MACU, Chris Hani Baragwanath Academic Hospital, South Africa (n=200) 31

Figure 2: Causes of death of study patients who demised in MACU presented as percentages (n-20) 32

LIST OF TABLES

Chapter 1:

Table 1.1: Common reasons for admission to MACUs in international hospitals. 11

Table 1.2: Comparison of causes of mortality in MACUs between developed and developing countries 13

Table 1.3: Time frame to conduct the research 17

Chapter 2

Table1: Demographics of patients admitted to the MACU at Chris Hani Baragwanath Academic Hospital, South Africa (n=200). 28

Table 2: Reasons of admission by organ system affected, mean age and gender distribution of study population at MACU, Chris Hani Baragwanath Academic Hospital, South Africa (n=200). 29

Table 3: Frequency of the Diagnoses of patients admitted to the MACU at Chris Hani Baragwanath Academic Hospital, South Africa (n=200). 30

Table 4: Patterns of diseases at the MACU, Chris Hani Baragwanath Academic Hospital, South Africa in comparison with other international units. 33

ABBREVIATIONS

CHBAH	Chris Hani Baragwanath Academic Hospital
COPD	Chronic Obstructive Pulmonary Disease
CVA	Cerebrovascular Accident
DKA	Diabetic ketoacidosis
HONK	Hyperosmolar non ketotic
ED	Emergency Department
HAART	Highly Active Anti-Retroviral Treatment
ICU	Intensive Care Unit
IMSANZ	Internal Medicine Society of the Australia and New Zealand
MACU	Medical Acute Care Unit
PE	Pulmonary embolism
SA	South Africa
SAM	Society of Acute Medicine
RCOP	Royal Colleges of Physicians
UK	United Kingdom
USA	United States of America

TABLE OF CONTENTS

DECLARATION ii

ACKNOWLEDGEMENTS iii

PRESENTATIONS ARISING FROM THIS PROJECT iv

ABSTRACT v

LIST OF FIGURES vii

LIST OF TABLES viii

ABBREVIATIONS xi

CHAPTER 1: PROTOCOL WITH EXTENDED LITERATURE REVIEW 1

1.0.0 Introduction 1

1.1.1 Background 2

1.1.2 Medical Acute Care Unit 3

1.1.2.1 History of Acute Medicine: International 4

1.1.2.2 History of Acute Medicine: South Africa 5

1.2.0 Description of Acute Medical Care 5

1.2.1 Provision of acute Focussed Care 5

1.2.2 Provision of Comprehensive Specialist Care 6

1.2.3 Facilitation of flow of patients and bed management 7

1.2.4 Prompt access to diagnostics and therapeutics 7

1.2.5 Acute versus Intensive Care 9

1.2.6 Acute versus Emergency Care 8

1.2.7 Summary of Acute Medical Care 9

1.3.0 Patterns of disease in Acute Medical Patients 10

1.3.1 Patterns of disease in acute medical patients: International 11

1.3.2 Patterns of disease in acute medical patients: South Africa 12

1.4.0 Demographics of patients at the MACU 13

1.5.0 Outcomes of admissions to the MACU 14

1.6.0 Mortality patterns at the MACU 14

1.7.0 Justification for the study 15

1.8.0 Objectives 15

1.9.0 Methods 15

1.9.1 Study setting 15

1.9.2 Study population 16

1.9.3 Study design 16

1.9.4 Statistical analysis 18

1.9.5 Limitation 18

1.9.6 Ethics permission 18

1.9.7 Funding 18

1.9.8 Time frame 19

1.9.9 References 20

CHAPTER 2: SUBMISSABLE ARTICLE 22

APPENDICES 42

Data Collection Form Appendix A

Ethics Clearance Certificate Appendix B

CHAPTER 1: PROTOCOL WITH EXTENDED LITERATURE REVIEW

1.0 Introduction

Worldwide, medical diseases have been the foremost cause of hospitalisation, disability and death.(1) Patients with medical diseases account for most of the healthcare provided by hospitals. The increasing prevalence of these conditions has greatly affected the acute healthcare systems of hospitals.

A wide range of medical conditions presented as acute emergencies and admitted to the medical wards through the Emergency Departments (ED), leading to overcrowding and congestion in EDs. Recently, there has been a growing concern about the quality of care offered to acutely ill medical patients when admitted from EDs to the medical wards.(2)

Subsequently, in the developed world, the process of acute care has undergone a substantial change with the introduction of the Medical Acute Care Unit (MACU). Acute medicine has emerged as a sub-specialty of internal medicine in the United Kingdom.(3) This model of health care was also implemented in Australia and New Zealand, even though it is not a formally recognised specialty in these countries.(4,5) In developing countries, like South Africa (SA), this novel approach is not widely implemented. However, a MACU was recently established at Chris Hani Baragwanath Academic Hospital (CHBAH). The information regarding the operation of the MACU, the pattern of diseases observed, the comorbidities and outcomes is immensely important. It provides essential information for developing and modifying the therapeutic guidelines for the MACU. It also provides data for formulation of plans to improve service delivery in a health care facility. This literature review will

serve as a background to our research on the patterns and outcomes of admissions to the MACU at the CHBAH.

1.1.1 Background

The increasing number of acute medical admissions to major tertiary hospitals over the past few years has become a significant problem globally.(6) The increase in acute medical admissions has been affected by the lower threshold for admissions due to increased patient and general practitioner expectations for admission to hospital.(6) Another contributing factor is an increased survival of elderly patients with multiple comorbid illnesses and their repeated emergency visits for acute decompensation of chronic conditions.(7) The EDs of hospitals are the predominant route of admission to medical wards,(8) this leads to overcrowding and congestion in EDs.(9) The increased demand by patients for emergency services exceeds the ability for the ED to provide the necessary care for patients in an acceptable amount of time. In addition, due to unavailability of hospital beds, this results in the delayed transfer of patients from the ED to the medical wards.(10) The overcrowding in EDs results in inefficiencies in service delivery.(11) The long waiting periods in the ED are associated with prolonged hospital stays, which negatively affect the economic structures of health systems. The increased waiting period in the ED is also considered an independent risk factor for mortality.(12)

Moreover, it has been noted that most of the emergency patients were treated for prolonged periods by relatively inexperienced doctors, without early involvement by specialists.(13) Specialist physicians were only involved in care and resuscitation of patients after many hours, or the next day on a post-intake ward round.(14) Junior doctors who were involved in the management of acute medical emergencies,

showed a lack of knowledge with regard to early resuscitation of acutely ill patients. This resulted in a greater risk of medical errors and complications.(15)

During admission, acutely sick patients were transferred to the medical wards, and at times were dispersed widely around the hospital due to a shortage of beds in the admitting ward. This resulted in the compromised coordination of treatments and investigations. The therapeutic response to treatment was not effectively observed and the distance from main facilities delayed the making of diagnoses.(16)

To solve these problems, hospitals globally, sought structural reforms to optimise the initial evaluation, treatment and subsequent transfer of patients. There was a need for change in how the system for emergency admissions to internal medicine was organised. In the developed world, the entire process of acute care was revolutionised with introduction of MACUs.(16)

The MACU provides a place where internal medicine specialists provide an immediate assessment, diagnosis and treatment to acutely ill medical patients.

1.1.2 Medical Acute Care Unit

According to the Royal College of Physicians, Acute Medicine is “the part of General Internal Medicine concerned with the immediate and early specialist management of adult patients with a wide range of medical conditions who present in hospital as emergencies.” (17) The MACU is known by several names, including: The Acute Medical Admission Unit, the Medical Assessment Unit and the Acute Assessment Unit, to name a few.

Despite the many synonyms, a MACU may be described as a specifically staffed and equipped medical ward that receives patients presenting with acute medical illnesses from the ED and/or community. In the MACU, patients receive expedited medical,

multidisciplinary and specialist assessment. The patients are provided with care and treatment for an initial period (24 to 72 hours), before being transferred to medical wards or discharged home. The acute medical patients require increased staff time and expertise as well as prioritised access to diagnostic tests during the initial 48 hours. It allows for focussed care in the initial hours of treatment.(17)

1.1.2.1 History of Acute Medicine: International

The move towards the establishment of the MACU started in the United Kingdom (UK). The Royal College of Physicians initiated a discussion in 1997, focusing on the organisation of emergency care for internal medicine patients.(3) Subsequently, the need for change in the system of care provided to acutely ill medical patients was highlighted by many. This resulted in the emergence of Acute Internal Medicine in the UK.

Acute medicine has become a speciality in Internal Medicine with its own curriculum and certificate examinations in the UK since 2004 (3) and The Society of Acute Medicine was established.(3) The Royal College of Physicians and the Society of Acute Medicine has issued the guidelines for the MACU's operation, and audits were performed to assess the quality of services given at the MACU's.(18) However, it is not a uniquely British phenomenon, and has been implemented in several other countries such as Australia and New Zealand where individual dedicated MACUs are established in different hospitals.(4) The Internal Medicine Society of the Australia and New Zealand (IMSANZ) has promoted the concept of a MACU by releasing guidelines and issuing a position statement on the standards required for MACUs throughout the region.(5)

In Europe, acute medical units are in operation, even though acute medicine is not a recognised specialty.(19) In the United States of America (USA) acute medical physicians are known as Hospitalists (20) Hospitalists are responsible for the management of patients throughout their hospital stay. They are comparable to the general medical physicians in SA.

There are variations regarding operational policies and mechanisms of health care delivery at MACUs in the UK and USA. However, the rationale behind the acute medical programme is same: provision of high quality specialist care to acutely ill medical patients.

1.1.2.2 History of Acute Medicine: South Africa

South Africa has started to adopt this approach to enhance the quality of care for acute medical patients. The MACU health care model is new in SA with most of the hospitals using traditional models of care. Patients with acute medical emergencies are seen at EDs and sent to general medical ward where they are managed by medical generalists. This system experiences overcrowding and exit congestion at ED which raises concerns regarding health care delivery. Locally, acute medicine is not a formally recognised specialty of internal medicine, yet it has become a speciality, however, a MACU was established at Chris Hani Baragwanath Academic Hospital (CHBAH), which is a tertiary institution located in Soweto, SA.

1.2.0 Description of Acute Medical Care

1.2.1 Provision of acute focussed care

The provision of focussed care during the initial hours of presentation to the hospital is fundamental to the MACU health model. This is similar to the generally accepted time-sensitive care e.g. revascularisation strategies for acute myocardial infarction

and stroke and early antibiotic therapy in severe sepsis. Similarly, the MACU model of care provides the same benefit to general medicine patients as the acute coronary care unit for cardiac patients or stroke units for acute cerebrovascular accident (CVA) patients. Here, the MACU consultants provide specialist medical care in a time-sensitive manner.(3)

Emergency medical patients should be immediately identified on presentation to the hospital, with early referral to the MACU. Patients with acute reversible conditions, with good prognosis should be admitted immediately. The care should be patient-centred, and the patient should not be moved to different wards unnecessarily. The MACU model of healthcare provides improved and sustainable standards of care.

1.2.2 Provision of comprehensive specialist care

The increasing presence of specialists in the early hours of treatment, resulted in better patient outcomes in other reports.(13) MACUs are staffed with internal medicine trainees and specialists as a part of a multidisciplinary team. (21) Internal medical specialists have the knowledge and training to ensure comprehensive care. They can coordinate the sub-specialties efficiently and can ensure the appropriate use of advanced investigations. The MACU consultants also have the ability to decide the composition of the multidisciplinary team determined by patient's health conditions.

MACU specialists are also involved in teaching and training junior doctors and medical students. Teaching on the management of acute medical conditions is fundamental to the internal medicine curriculum.

1.2.3 Facilitation of flow of patients and bed management

The flow of patients within the hospital is necessary for effective inpatient bed management. The standardised admission and discharge criteria at the MACU allow rapid turnover of patients. Those patients able to be managed within a short period of time are benefited most by this model. Those requiring a longer hospital stay will need to be transferred to the medical wards in an appropriate manner. This maintains a smooth flow of the patients and effective utilisation of hospital beds.(22) Moreover, a MACU should be situated on the same floor as the emergency department where the critical care facilities and diagnostics are co-located. This allows rapid transfer of patients between these departments. This concentration of emergency admissions in a specific location of a large hospital assists in the facilitation of urgent health care delivery systems.(22)

1.2.4 Prompt access to diagnostics and therapeutics

The acute care programme maintains the necessity for same day diagnostics. Diagnostic support underpins competent medical decisions for MACU patients. Prompt access to diagnostics will reduce the delay to treatment and prevent unnecessary prolonged inpatient stays.(18) Access to diagnostics includes the need for priority diagnostic radiology and pathology tests with immediate reporting and effective communication to senior decision-makers promptly.

1.2.5 Acute versus Intensive Care

There is an overlap between areas of acute and intensive care medicine. Most of the patients are acutely sick on arrival at the hospital, however, the degree of illness is relative. Many of the patients will improve with focussed specialist resuscitation, without the need for intensive care unit (ICU) monitoring or organ support. While the MACU provides early focussed care during the initial hours of treatment, invasive

hemodynamic monitoring is not a feature of MACU care. The criteria for admission to most of the MACUs excludes patients with haemodynamic instability, requiring intensive care monitoring.(3) In poor resource settings, where there are a limited number of ICU/high care beds in hospitals, the MACU model of care provides effective way of observation and management but it does not work as an alternative to ICU care.

1.2.6 Acute versus Emergency Care

It should be stressed that acute medicine is not the same as emergency medicine, although the two specialities work closely together. Most health systems will have EDs where interdisciplinary services are provided. The assessment and treatment surgical, medical or gynaecological emergencies occurs within the same team in the same location. Whereas, a MACU is a place for specialist medical treatment is provided by specialist physician

The concept of the MACU care is different from short stay observation wards, which are operated by ED doctors in hospitals. The patients of different specialities are assessed and observed in the emergency short stay ward. Further, the decision regarding admission to the hospital or discharge home is done by ED doctors.

1.2.7 Summary of acute medical care

Acute medical care is designed to serve the following objectives: (3)

- Rapid and comprehensive assessment of patients by the Internal Medicine team.
- Recognition of time-sensitive process in the practice of medicine.
- Early specialist input toward the management of the patient.

- Location adjacent to pathology, radiology and other investigative services.
- Standardised admission and discharge policies.
- Smooth flow of patients from ED to internal medicine wards.
- Effective use of hospital resources.

1.3.0 Patterns of disease in acute medical patients

The knowledge regarding the pattern of diseases in acute medical patients is important for several reasons. It reflects the common diseases in the surrounding communities, which the institution serves. However, the admissions to a hospital may be influenced by several factors in the health care system. For example, the availability of staff, medication, equipment and diagnostic facilities in an institution will contribute towards the patterns of admissions. The level of care of the facility and referral pathways can also influence the admission patterns. The demographics and disease patterns can vary from one hospital to another. The general disease burden is inclined to have changes in disease patterns and there may be an interaction of diseases.

Therapeutic protocols are established more readily for frequently encountered diseases and conditions in facilities. Although, there is a wide range of medical conditions which may present as emergencies, it was noted that several specific conditions will account for most of the admissions. The majority of emergency medical admissions to the hospitals exhibit a limited number of diagnoses. This allows predefined therapeutic protocols to be implemented consistently to improve quality of care after establishing a diagnosis.(3)

This information is also essential for health care planners to improve service delivery. Audits of patient medical records form a part of the required data for the State Health Information System which is used to enhance the country's population

health. Although there are limitations, hospital data analysis assesses the quality of health-care delivery and provides approximate measures of mortality and morbidity. It can also assist in developing a research agenda.(23)

1.3.1 Patterns of disease in acute medical patients: International

Globally, acute medical admissions reflect the general burden of medical diseases.(1) There is a changing phenomenon worldwide, with variations between countries. Worldwide, acute communicable diseases (diarrhoeal disease, measles, and malaria) are predicted to decline, while there will be significant increase in non-communicable diseases (lung cancer, diabetes and cardiovascular disease). This is attributed to urbanisation and emergence of lifestyle diseases. However, certain infectious diseases like HIV/AIDS will continue to rise.(24)

This pattern was reported in acute medical admissions in developed countries, where non-communicable diseases were found frequently in admissions to the MACU. In the UK, Cubbe et al., described chest pain, pneumonia, urinary tract infection and COPD frequently.(3) While in other reports , the main reasons for acute medical admissions were cellulitis, psychiatric illnesses, endocrine diseases, CVA and alcohol excess.(25) Similarly, James N et al., examined a cohort of patients at the MACU in York Hospital and reported chest pain, falls, pneumonia and COPD occurring frequently.(23) Similar trends were found at the MACU in Nenagh Hospital in Ireland, where heart failure, atrial fibrillation, diabetes and hyponatremia/fluid imbalance were the common causes of admissions.(26)

The HIV/AIDS epidemic had a significant influence on the patterns in medical admissions worldwide, but this differs between countries depending on the prevalence of HIV/AIDS. In the UK, admission rates increased during 1989, but

declined with introduction of Highly Active Antiretroviral Therapy (HAART). (27) HIV/AIDS, however, is still a growing problem in developing countries.

Table 1.1: Common reasons for admission to MACUs in international hospitals.

Common reasons for admissions to MACU in international hospitals			
United Kingdom (3)	United Kingdom (25)	United Kingdom (23)	Ireland (26)
Nonspecific chest pain	Cellulitis	Chest pain	Heart failure
Pneumonia	Psychiatric	Syncope	Atrial fibrillation
Urinary tract infection	Endocrine	Pneumonia	Diabetes
COPD	CVA	COPD	Hyponatremia
Acute bronchitis	Alcohol excess	Gastrointestinal bleeding	COPD
Cardiac dysrhythmias	Self-poisoning	Diarrhoea and vomiting	Anaemia
Coronary artery disease	Collapse? Cause	Urinary tract infection	Altered mental status
Skin and soft tissue infection	Headache/ migraine	Stroke	Pneumonia
Epilepsy	Urinary tract infection	Drug overdose	Neoplasia
Cerebrovascular disease	Gastric pathology	CVA	Acute myocardial infarction

COPD= Chronic obstructive airway disease, CVA=Cerebrovascular accident

1.3.2 Pattern of diseases in acute medical patients: South Africa

Data showing the pattern of diseases of acute medical admissions to MACUs in SA is limited. However, the disease burden in the community has a significant effect on the patterns of admissions to the local hospitals. In SA, there is a rising tide of the non-communicable diseases of urbanization that were previously unknown in rural South Africa (28) such as: cardiovascular diseases,(29) type II diabetes mellitus,(30) chronic respiratory diseases (31) and mental illness.(32) South Africa is also burdened with a high prevalence of cerebrovascular accident (CVA) (33) and hypertension.(34) Communicable diseases like HIV/AIDS has affected 6.4 million South African people during 2012.(35) There is also a high disease burden of tuberculosis and HIV co-infection rates in South Africa, this has obvious effects on admission patterns.(36)

The increased number of complex medical admissions was also attributed to the aging population with chronic medical conditions. The increased survival and aging is noted among HIV-infected persons in SA during 2006, after the introduction and widespread use of HAART.(37) This resulted in an accompanying rise in non-communicable disease comorbidities in this subgroup. (37) This multi-morbid scenario has affected the diseases patterns.

1.4.0 Demographics of the patients at the MACU

Globally, females constitute the majority of those admitted to the MACU. Downing H, et al. reported that females represent 61% of the patients admitted to the MACU, in Queen Elizabeth hospital, UK (25). James N, et al. found 53% females were among the admissions to their MACU, in York Hospital, UK.(23) In another report, however, females represented 48% which constitutes almost half the total number of

admissions.(26) The commonest age group of all the patients admitted to the MACU was 60 years and older in some reports.(25) James N, reported a median age of 71 years in his study.(23) The median age of admitted patients was 68 years in another report.(26)

1.5.0 Outcomes of admissions to the MACU

A shorter duration of stay was observed at the MACUs internationally. The mean duration of stay at MACU varied from 1 day,(25) to 4 days (26) in reports from the UK. Most patients were discharged home. Some were transferred to the general medical wards.(26)

1.6.0 Mortality patterns at the MACU

In many of the studies, the MACU health care model was associated with reduced mortality in comparison with patients admitted under non-MACU models of care. A decreased overall mortality was reported in the literature.(16) However patterns of mortality differ between countries. In the developed world, the causes of mortality include non-communicable diseases and neoplasia, (26) while in SA, infectious diseases such as tuberculosis, influenza and AIDS are the main causes of disease followed with diabetes and cerebrovascular disease.(38)

Table 1.2: Comparison of causes of mortality in MACUs between developed and developing countries

Causes of mortality in MACUs	
Developed countries: (26)	Non-developed countries: South Africa (38)
Heart failure	Tuberculosis
CVA	Cerebrovascular disease
Acute myocardial infarction	Diabetes
Neoplasia	Influenza and pneumonia
Pneumonia	HIV

Table 1.2: Comparison of causes of mortality in MACUs between developed and developing countries

Developed countries: (26)	Non-developed countries: South Africa (38)
COPD	Other heart disease
Sepsis	Hypertension

COPD=Chronic obstructive pulmonary disease, CVA=Cerebrovascular accident, HIV=Human immune deficiency virus

1.7.0 Justification for the study

Since the establishment of the MACU at CHBAH in 2010, there has not been research performed on indications for admissions, comorbidities, outcomes and mortality at the MACU. Therefore, the present study was conducted to describe the diagnostic categories at the newly established MACU.

1.8.0 Objectives

1. To describe the demographic profile of patients admitted to the MACU.
2. To determine the initial diagnosis and pattern of diseases in acute medical patients.
3. To assess the outcomes of admissions and causes of mortality at the MACU.

1.9.0 Methods

1.9.1 Study setting

Chris Hani Baragwanath Academic Hospital, is a tertiary referral hospital in Soweto, South Africa. It provides medical care to an indigent population of 3.6 million in all specialities. The Department of Internal Medicine has 500 beds. It is the busiest department in the hospital as it admits 36,000 patients annually with an average of 100 patients per day. Patients are referred from the ED and/or outlying hospitals and

clinics. Patients are seen first by ED doctors and then referred to the medical registrar allocated to the MACU. There is one medical admission ward with 48 beds located close to the medical wards. The MACU is a 16-bed facility, located close to the ED and main diagnostics. It is a specifically equipped ward where haemodynamic monitoring/organ support and specific therapeutic services, excluding mechanical ventilation, can be provided. It is staffed by general medical registrars, nurses and allied health professionals and supervised by a specialist physician. Patients with acute reversible illnesses with predicted good outcomes are accepted to the MACU. The general medicine specialist on duty for the day regularly reviews the patients and initiates the post-admission rounds at the MACU. The resuscitation and subsequent observations to monitor response to the therapy given is ensured. Any predicted adverse outcomes are noted rapidly, and interventions undertaken. Once the acute illness is resolved, patients can be discharged home, or transferred to the medical wards. A patient requiring mechanical ventilation or invasive haemodynamic monitoring is referred to the ICU.

1.9.2 Study population

We included a convenient sample of 200 patients 18 years and older, with any form of medical emergency admitted to the MACU between March 2015 to August 2015. This period is not limited to one season

1.9.3 Study design

A retrospective review of the admission register of the MACU was performed. Demographic data, initial diagnosis and outcomes including mortality were recorded. In addition to the MACU register, patients' hospital files containing clinical details, diagnosis, duration of stay and mortality were reviewed. The initial diagnosis was

assigned to systemic subgroups according to the organ system affected: cardiovascular, respiratory, renal, neurology, endocrine, non-accidental poisoning, and others. The initial diagnosis was subdivided into diagnostic categories to assess the pattern of diseases. The outcome was defined as the patients discharge end-point i.e. direct discharge home, or transfer to the medical wards, ICU/ High Care or death. The main causes of mortality were noted. Data was collected using a specifically designed data collection form for the study (Appendix A).

1.9.4 Statistical analysis

The statistical package, STATA, version 12 was used for the data analysis. For descriptive data, means with standard deviations and medians with inter-quartile ranges were used. Demographic characteristics were expressed as frequencies and percentages. Analytical data was expressed using the Chi-square test. Variables having a two-tailed $p<0.05$ were considered significant.

1.9.5 Limitations of the study

The limitations of the present study are those described in retrospective studies, such as deficient medical record keeping, and underreporting of cases. There is the further limitation of possible diagnostic errors in the study owing to a lack of diagnostic standards. Some patients eligible for MACU might have been sent elsewhere. Sicker patients who should have been admitted to ICU or high care may have been cared for in MACU. Furthermore, the study was done over a short duration.

1.9.6 Ethics permission

The Head of the Department of Internal Medicine and the Medical Superintendent of the CHBAH Hospital granted permission to conduct the present study and research.

The Human Research Ethics Committee of the University of the Witwatersrand (Certificate no: M150953) granted ethical approval for this study.

1.9.7 Funding

Expenses for this project were minimal. The only major costs incurred were for photocopying and printing.

1.9.8 Time frame

Table1.3: Time frame to conduct the research

	July-Aug 2015	Sept 2015	Oct 2015	Nov 2015	Dec 2015	Jan 2016	Feb 2016	March 2016	April 2016
Literature review									
Preparing Protocols									
Protocol Assessment									
Ethics Application									
Data Collection									
Data Analysis									
Writing Up Reports									

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CHAPTER 2: SUBMISSABLE ARTICLE

Patterns and Outcomes of Admissions to the Medical Acute Care Unit of a Tertiary Teaching Hospital in South Africa

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Conflict of interest: nil

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ABSTRACT

Background

A Medical Acute Care Unit (MACU) was established at Chris Hani Baragwanath Academic Hospital (CHBAH) to provide comprehensive medical specialist care to the patients presenting with acute medical emergencies. Improved standards of health care delivery systems at the MACU may result in shorter hospital stay, better outcomes and less mortality.

Objectives

The objective of the study was to describe the demographics, diagnoses, pattern of diseases and the outcomes, including mortality of patients admitted to the MACU at the Chris Hani Baragwanath Academic Hospital (CHBAH).

Methods

A record review of 200 patients admitted to the MACU at CHBAH was performed from March 2015 to August 2015. The records were analysed for patient demographics, diagnosis at admission and duration of stay in MACU. The outcome was defined as transfer to the medical ward, Intensive Care Unit (ICU) or discharged home. The main causes of mortality were also recorded.

Results

Of the 200 patients, 59% were females. The mean age of the patients was 46 ± 17.2 years and the mean duration of stay at the MACU was 1.45 ± 1.25 days. Non-communicable diseases accounted for 76% of admissions. The most frequently diagnosed conditions included: diabetic ketoacidosis acidosis (DKA) and hyperosmolar non-ketotic (HONK) (17.5%), non-accidental self-poisoning (16%), hypertensive emergencies (9.5%), decompensated cardiac failure (8%) and ischemic

heart disease (7%). Infectious diseases comprised 14% of the diagnoses of which pneumonias were the most common (5%). Most patients (77.5%) were transferred to medical wards, 12% to ICU, while 10% demised at the MACU. The main causes of death included sepsis (25%), DKA/HONK (20%), non-accidental self-poisoning (10%) and cardiac failure (10%).

Conclusion

Non-communicable diseases particularly diabetic emergencies were the main causes of admission to the MACU at CHBAH. During the study period, high rates of case improvement, patient discharge, shorter hospital stay, and less mortality were observed. The main cause of mortality was sepsis related.

Introduction

Worldwide, medical diseases have been the foremost cause of hospitalisation, disability and death.(1) A wide range of medical conditions present as acute emergencies. Over the past few years, the increasing number of acute medical emergencies presenting to major tertiary hospitals, (2) coupled with unavailability of hospital beds led to overcrowding in health facilities, (3) delays in providing acute medical care, (4) and longer duration of hospital stay which negatively affected the health care system.(5) Thus, compromising the quality of health care delivery systems.(6)

As a result, hospitals looked for structural reforms to improve the quality of care. The admission process of the Emergency Department (ED) for acutely ill medical patients to Internal Medicine needed to be improved.(7) This led to the introduction of a Medical Acute Care Unit (MACU) and “Acute Medicine” emerged as a branch of Internal Medicine in the developed world. (7) Acute Medicine is a subspecialty of Internal Medicine focussed on the immediate and early specialist management of acute medical patients presenting to hospitals as emergencies.(7) The MACU is a dedicated ward where early focussed medical care is provided by general medical trainees and specialists.(8)

This model of health care has been widely implemented in the United Kingdom (UK), (7) Australia,(9) and New Zealand (10) resulting in reports of good outcomes in terms of patients care and service delivery.(11,12) In South Africa the MACU health care model is new and acute medicine is not a formally recognised specialty of internal medicine yet, however, a MACU was established at Chris Hani Baragwanath

Academic Hospital (CHBAH), which is a tertiary institution located in Soweto, South Africa (SA).

Since the MACU was established at the CHBAH, there have not been studies regarding patterns of disease and mortality. It is important to understand the causes of acute medical admissions to develop or amend preventive and therapeutic protocols for specific diseases. This information is also essential for health care planners as it identifies areas of priority for ongoing service development.

Objectives

The present study was conducted to describe the pattern of diseases and outcomes including mortality in acute medical admissions to the MACU at the CHBAH.

Methods

Study setting

Chris Hani Baragwanath Academic Hospital, is a tertiary referral hospital in Soweto, South Africa. It provides medical care to an indigent population of 3.6 million in all specialities. The Department of Internal Medicine has 500 beds. It is the busiest department in the hospital as it admits 36,000 patients annually with an average of 100 patients per day. Patients are referred from the ED and/or secondary hospitals and clinics. Patients are assessed first by ED doctors and then referred to the medical registrar allocated to the MACU. The MACU is a 16-bed facility, located close to the ED and main diagnostics. It is a specifically equipped ward where haemodynamic monitoring/organ support and specific therapeutic services, excluding mechanical ventilation, can be provided. It is staffed by general medical registrars, nurses and allied health professionals and supervised by a specialist physician. Patients with acute reversible illnesses with predicted good outcomes are

accepted to the MACU. The general medicine specialist on duty for the day regularly reviews the patients and initiates the post-admission rounds at the MACU. The resuscitation and subsequent observations to monitor response to the therapy given is ensured. Any predicted adverse outcomes are noted rapidly, and interventions undertaken. Once the acute illness is resolved, patients can be discharged home, or transferred to the medical wards. A patient requiring mechanical ventilation or invasive haemodynamic monitoring is referred to the Intensive Care Unit.

Study population

We included a convenient sample of 200 patients 18 years and older, with any form of medical emergency admitted to the MACU between March 2015 to August 2015. This period is not limited to one season

Study design

A retrospective review of the admission register of the MACU was performed. Demographic data which included gender and age divided in to categories were recorded. The initial diagnosis and outcomes including mortality were captured. In addition to the MACU register, patients' hospital files containing clinical details, duration of stay and mortality were reviewed.

The initial diagnosis was assigned to systemic subgroups according to the organ system affected: cardiovascular, respiratory, renal, neurology, endocrine, non-accidental poisoning, and others. The initial diagnosis was further subdivided into specific diagnostic categories to assess the pattern of diseases.

The outcome was defined as the patients discharge end-point i.e. directly home, transfer to the medical wards, ICU/ High Care or death. The main causes of mortality were noted.

Statistical analysis

The statistical package, STATA, version 12 was used for the data analysis. For descriptive data, means with standard deviations and medians with inter-quartile ranges were used. Demographic characteristics were expressed as frequencies and percentages. Analytical data was expressed using the Chi-square test. Variables having a two-tailed $p<0.05$ were considered significant.

Ethics permission

The study was approved by the Human Research Ethics Committee of the University of the Witwatersrand (certificate no:M159953).

Results

In the study cohort, there was a predominance of females and the mean age of the patients was 46 ± 17.2 years. Patients who were in the 46-60 age group was the most frequently admitted, constituting a third of all admissions. (Table 1)

Table1: Demographics of patients admitted to the MACU at Chris Hani Baragwanath Academic Hospital, South Africa (n=200)

Characteristic	n (%)
Gender	
Male	82.0 (41)
Female	118 (59)
Age groups in years	
18-30	41 (20.5)
31-45	52 (26.0)
46-60	65 (32.5)
61-75	34 (17.0)
>75	8.0 (4.0)
Ethnicity	
African	182 (91)

Table1: Demographics of patients admitted to the MACU at Chris Hani Baragwanath Academic Hospital, South Africa (n=200) (Table 1 continued from page 28)

Characteristic	n (%)
Asian	8.0 (4.0)
White	6.0 (3.0)
Mixed ancestry	4.0 (2.0)

The main organ systems affected in the study group included: cardiac (24.5%), endocrine (19.5%) and non-accidental self-poisoning (18. 5%). (Table 2)

Table 2: Reasons of admission by organ system affected, mean age and gender distribution of study population at MACU, Chris Hani Baragwanath Academic Hospital, South Africa (n=200)

Affected organ system	Mean age in years	Male	Female	n (%)
Cardiac	50±1.21	22	27	49 (24.5%)
Endocrine	48±1.11	23	16	39 (19.5%)
Non-accidental self-poisoning	28±1.21	13	24	37(18.5%)
Others	46±1.41	11	20	31(15.5%)
Respiratory	43±1.31	7.0	15	22 (11.0%)
Neurology	60±1.41	7.0	8.0	15 (7.5%)
Renal	55±1.21	2.0	5.0	7.0 (3.5%)

Non-accidental self-poisoning occurred more commonly in the younger patients with a mean age of 28±1.21 years. Non-accidental self-poisoning and respiratory system affected mainly females in the study population.

The most common diagnoses of the patients on admission to the MACU included diabetic ketoacidosis / hyperosmolar non ketotic (17.5%), non-accidental self-poisoning with organophosphate and other agents (16%), hypertensive emergencies (9.5%), decompensated cardiac failure (8%), and ischemic heart disease (7%).

Infectious diseases (14%) such as pneumonia, malaria, gastroenteritis, tuberculosis and meningitis were noted. (Table 3)

Table 3: Frequency of the Diagnoses of patients admitted to the MACU at Chris Hani Baragwanath Academic Hospital, South Africa (n=200)

Diagnosis	Frequency n (%)
Diabetic ketoacidosis/Hyperosmolar non ketotic	35 (17.5)
Hypertensive emergency	19 (9.5)
Non-accidental self-poisoning with organophosphates	17 (8.5)
Decompensated cardiac failure	16 (8.0)
Non-accidental self-poisoning with other toxic agents	15 (7.5)
Myocardial infarction	14 (7.0)
Cerebrovascular accident	13 (6.5)
Pneumonia	10 (5.0)
Exacerbation of asthma	6.0 (3.0)
Exacerbation of Chronic obstructive pulmonary disease	6.0 (3.0)
Gastroenteritis	6.0 (3.0)
Malaria	6.0 (3.0)
Non-accidental self-poisoning with paracetamol	5.0 (2.5)
Septic shock	5.0 (2.5)
Pulmonary embolism	4.0 (2.0)
Disseminated Tuberculosis	4.0 (2.0)
Acute renal failure	4.0 (2.0)
Chronic renal failure	3.0 (1.5)
Meningitis	2.0 (1.0)
Epilepsy	2.0 (1.0)
Hypoglycaemia	2.0 (1.0)
Thyroid storm	2.0 (1.0)

Table 3: Frequency of the Diagnoses of patients admitted to the MACU at Chris Hani Baragwanath Academic Hospital, South Africa (n=200) (Table 3 continued from page 30)

Diagnosis	Frequency n (%)
Alcohol intoxication	1.0 (0.5)
Systemic lupus erythematosus	1.0 (0.5)
Pyelonephritis	1.0 (0.5)
Thrombotic thrombocytopenic purpura	1.0 (0.5)

The duration of stay of the study population at the MACU was short, with 22.5% of patients stayed for less than 1 day (Figure 1).

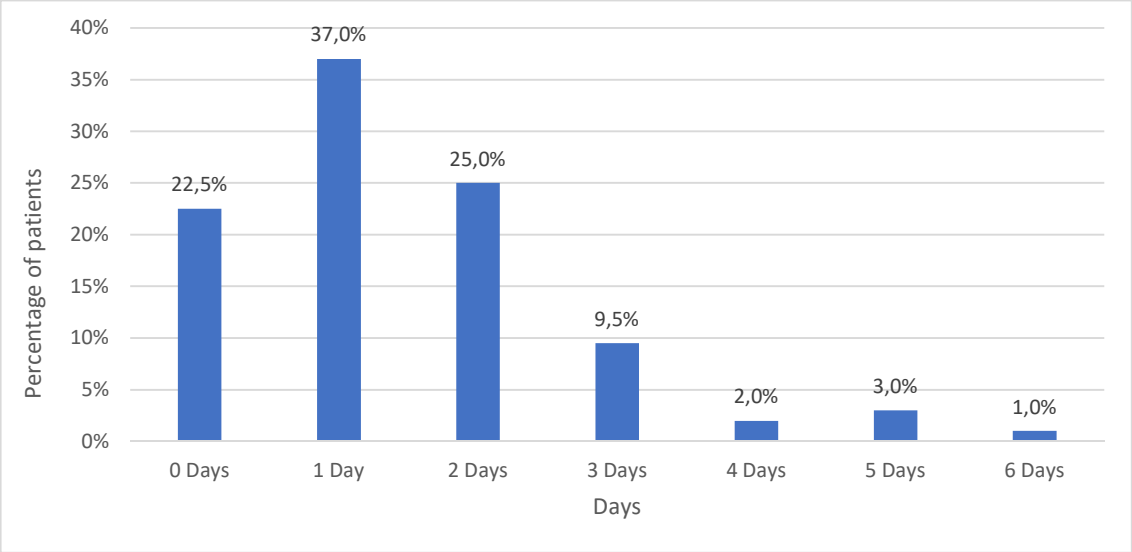


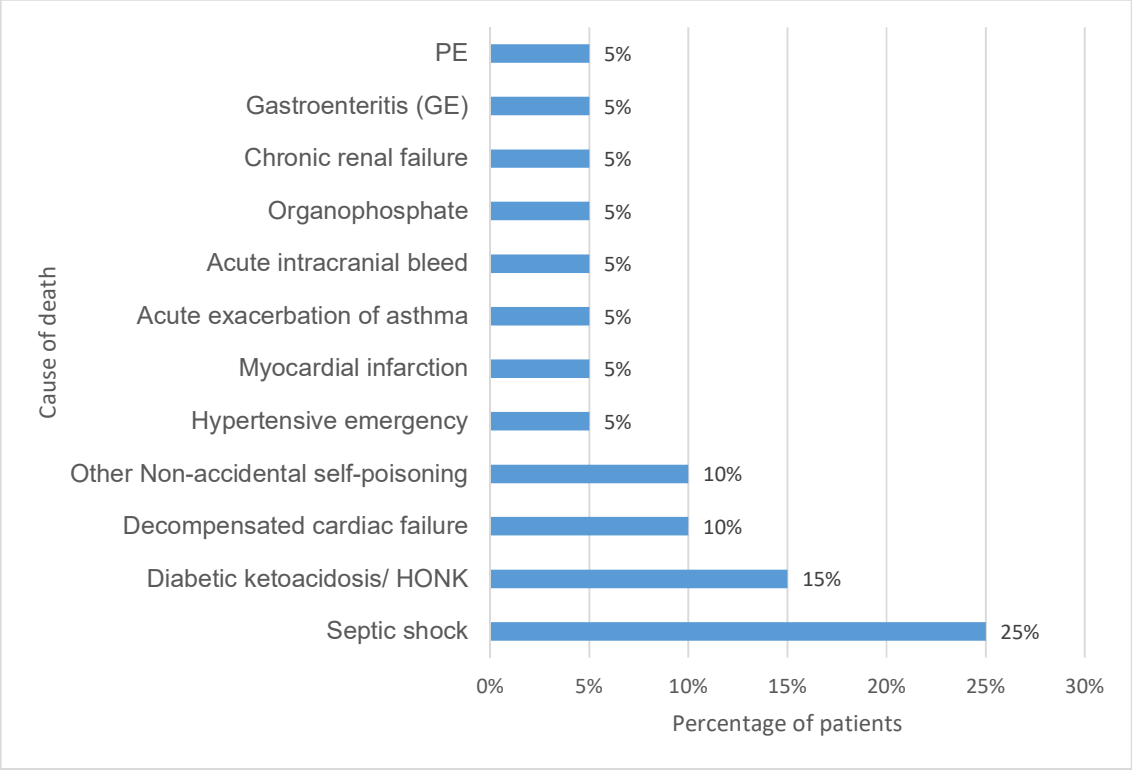
Figure 1: Duration of stay of patients at MACU, Chris Hani Baragwanath Academic Hospital, South Africa (n=200)

The mean duration of stay at the MACU was 1.45 ± 1.25 days which differed in the different age groups. It was longer (1.90± 1.44) days in the younger patients 18-30 years old. Shortest mean duration of stay (1.00 ±1.69) was noted in older patients >75 years old. However, this difference in duration of stay was not significant (p value 0.07). Duration of stay did not differ significantly among males versus females.

There was no significant relationship between duration of stay and organ system affected or diagnosis.

The outcomes of admissions to the MACU were favourable in most patients (77.5) showing recovery and transfer to the general medical wards. A few patients (12%) required invasive haemodynamic monitoring and were subsequently transferred to the ICU, and only 1% were discharged home. A proportion of 10% of the patients admitted to the MACU demised.

Of 20 patients who demised in MACU, the main causes of death were sepsis related (25%), diabetic ketoacidosis/hyperosmolar non ketotic (20%), non-accidental self-poisoning with organophosphates and other toxic agents (15%), cardiac failure (10%), and hypertension (5%). (Figure 2)



PE=Pulmonary Embolus, HONK= Hyperosmolar non ketotic
Figure 2: Causes of death of study patients who demised in MACU presented as percentages (n-20)

Discussion

To the best of our knowledge, this will be the first study describing the patterns of diseases in acute medical admissions to the MACU in SA.

In this study, the majority of patients were females (59%), in keeping with demographics seen in MACUs from developed world. (13,14) The predominant age group of all the patients admitted at the MACU was 40-60 years (32.5%), also reported elsewhere. (13,14) The majority of the patients in this sample were of African ethnicity (91%). This was not surprising as CHBAH serves black African population of Soweto.

In the present study, 76% of admissions at the MACU were due to non-communicable diseases such as diabetic ketoacidosis/ hyperosmolar non ketotic, hypertensive emergency, non-accidental self-poisoning, cardiac failure, ischemic heart disease and cerebrovascular accident. The most commonly encountered disorders were within the scope of cardiology, endocrinology, non-accidental self-poisoning and neurology, which is similar to data reported by other medical acute units in the developed world. (7,13-15) (Table 4)

Table 4: Patterns of diseases at the MACU, Chris Hani Baragwanath Academic Hospital, South Africa in comparison with other international units.

South Africa Present study	United Kingdom (7)	United Kingdom (13)	United Kingdom (14)	Ireland (15)
DKA/HONK	Nonspecific chest pain	Cellulitis	Chest pain	Heart failure
Self-poisoning	Pneumonia	Psychiatric	Falls	Atrial fibrillation
Hypertensive emergency	Urinary tract infection	Endocrine	Pneumonia	Diabetes

Table 4: Patterns of diseases at the MACU, Chris Hani Baragwanath Academic Hospital, South Africa in comparison with other international units. (Table 4 continued from page 33)

South Africa Present study	United Kingdom (7)	United Kingdom (13)	United Kingdom (14)	Ireland (15)
CVA	Cardiac dysrhythmias	Self-poisoning	Diarrhoea and vomiting	Anaemia
Pneumonia	Coronary artery disease	Collapse	Urinary tract infection	Altered mental status
Exacerbation of asthma	Skin and soft tissue infection	Headache/ Migraine	CVA	Pneumonia
Exacerbation of COPD	Epilepsy	Urinary tract infection	Self-poisoning	Neoplasia
Malaria	Cerebrovascular disease	Gastritis	Stroke	Acute myocardial infarction

CHBAH-Chris Hani Baragwanath Academic Hospital CVA=Cerebrovascular accident, COPD=Chronic obstructive airway disease, DKA=Diabetic ketoacidosis, HONK=Hyperosmolar non ketotic, MACU=Medical Acute Care Unit

There is shortage of data on the pattern of diseases at the MACUs in a developing country like SA, therefore local comparison was not possible. However, the findings of the current study could be explained by several reasons: there is a rising prevalence of the non-communicable diseases of urbanization, that were previously unknown in rural SA,(16) such as diabetes,(17) and cardiovascular diseases.(18) Chris Hani Baragwanath Academic Hospital serves the population of Soweto, where risk factors for these diseases(19) such as obesity and smoking (20-22) are highly prevalent, thus predisposing the individuals towards non-communicable diseases. Communicable diseases like HIV/AIDS and tuberculosis were the causes of epidemics in SA.(23) However, reduced frequency of these disorders observed in this study, might reflect effective case management with specific therapies.

Widespread use of highly active antiretroviral therapy (HAART) in SA since 2005/6, resulted in increased survival of patients with HIV/AIDS with an accompanying rise in non-communicable disease comorbidities in this subgroup. (24) Interestingly, metabolic syndrome, altered glucose metabolism, dyslipidaemia and lipodystrophy are seen frequently in patients with HIV/AIDS.(25,26) The use of some antiretroviral drugs in these patients, such as zidovudine, didanosine and protease Inhibitors can predispose them to an increased risk of diabetes.(27) However, data from the present study did not include the information on HIV status of patients. Also, patients with advanced HIV/AIDS or disseminated tuberculosis with poor prognosis may not meet the criteria for admission in the MACU and are admitted directly to the medical wards at CHBAH. For the same reasons, infectious diseases such as: pneumonias, gastroenteritis, malaria, and meningitis were found in small numbers (12%), possibly because they also admitted directly to the internal medical wards.

Non-accidental self-poisoning was noted as a frequent reason for admission and mortality in the present study, especially in young African females , as previously reported in SA.(28) The majority of these cases were individuals who attempted suicide. (29) The types of toxic agents used include: organophosphates, paracetamol, cocaine, and other substances.(30) This could be explained on the basis of high prevalence of psychosocial factors in, such as: untreated mental illness,(31) substance abuse,(32) family circumstances and poverty (33) which contributes to suicidal tendencies.

During the study period, outcomes of admissions to the MACU were favourable in most cases, most patients improved and were discharged to the medical wards (77.5%). The improved quality of care in the MACU healthcare model may partly explain this result.

The duration of stay at the MACU was short, 1.45 ± 1.2 days. Similarly, small duration of stay was reported elsewhere. (13,14) It is possible that most uncomplicated non- communicable diseases and acute communicable diseases, may be treated within a shorter time period. The short duration of stay might have a positive benefit on local government health finances.

The mortality rate at the MACU was 10% during the study period which was less compared to mortality rate of 13% in general medical wards at CHBAH (unpublished data). The most frequently reported causes of death (sepsis, DKA, self-poisoning, cardiac failure and hypertension) may also be attributed to the high prevalence of these disorders and the increased percentage of older individuals in the present research. The high mortality associated with diabetes also raises concerns as to whether suboptimal care is offered to diabetics at a community health clinic level, (34,35) or whether these patients may delay in presenting to healthcare facilities.

Sepsis remains a problem in the South African context. (36) High mortality due to sepsis in this study may indicate loopholes in the management and failure to institute the time-sensitive resuscitation process which is vital to the control of sepsis.

Our results on mortality patterns were similar to reported elsewhere in developed world.(15) However, due to the lack of data of MACUs in South Africa, our results do not have local comparisons.

The current study has several limitations. One of them is poor record keeping, as is described in retrospective record reviews. This was overcome through a precise search and retrieval of the data available as well as the exclusion of patients with incomplete data. There is possibility of diagnostic errors due to a lack of diagnostic standards available for the study. A further weakness is that only patients admitted to

the MACU were included in the study and the data does not consider acute medical patients that required direct admission to the general ward or ICU. Nonetheless, the data represents the pattern of diseases, not the actual number of the patients with acute conditions. Furthermore, the study was done over a short duration. The conduction of similar studies over a longer period would offer stronger evidence for these findings. Bearing in mind the study's limitations, the actual disease pattern in the community may not be accurately reflected. However, despite these limitations, this new study will provide a valuable foundation for further studies on acute admission patterns at Chris Hani Baragwanath Academic Hospital.

Conclusion

Non-communicable diseases particularly diabetic emergencies were the main causes of admission to the MACU at CHBAH. During the study period, outcomes of admissions to the MACU were favourable in most cases. High rates of case improvement, patient discharge, shorter hospital stay, and less mortality were observed. The main causes of mortality were sepsis related, diabetes and non-accidental self-poisoning.

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Nil

Disclosure statement

The author has no conflict of interest to declare

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APPENDICES

APPENDIX A: Data Collection Form

Clinical evaluation and outcomes at the MACU (Medical Acute Care Unit)

Age in Years:			
18 to 30			
31 to 45			
46 to 60			
61 to 75			
>76			
Gender:			
Male			
Female			
Race:			
White			
African			
Asian			
Mixed Ancestry			
Date of Admission:	D	M	Y
Date of Discharge:	D	M	Y
Duration of stay:			

Outcomes of admission:	
Discharge to:	
Medical wards	
ICU/High Care	
Home	
Demised	
The Main Diagnosis at Admission:	
Cardiac:	
Hypertensive emergency	
Myocardial infarction	
Decompensated cardiac failure	
Respiratory:	

Pneumonia	
Acute exacerbation of asthma	
Acute exacerbation of COPD	
Neurology:	
Cerebrovascular accident	
Acute intracranial bleed	
Uncontrolled epilepsy/status	
Endocrine:	
Diabetic ketoacidosis/HONK	
Thyroid storm	
Hypoglycaemia	
Non-accidental self-poisoning:	
Paracetamol	
Organophosphate	
Others	
Renal:	
Complicated acute kidney injury	
Chronic renal failure	
Gastric:	
Acute GI bleed	
Others	

APPENDEX B: Ethics Clearance Certificate

R14/49 Dr Uzma Nasir Khan

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M150953

NAME: (Principal Investigator)	Dr Uzma Nasir Khan
DEPARTMENT:	Internal Medicine Chris Hani Baragwanath Academic Hospital Soweto
PROJECT TITLE:	Pattern and Outcome of Admissions to the Medical Acute Care Unit in a Tertiary Teaching Hospital in South Africa
DATE CONSIDERED:	02/10/2015
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Prof Colin Menezes and Dr Nimmisha Govind
APPROVED BY:	Professor P Cleaton-Jones, Chairperson, HREC (Medical)
DATE OF APPROVAL:	28/10/2015

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