Cohort study of access block trends in a public, regional hospital Emergency Centre in South Africa

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Dedication:

This Master's Dissertation is dedicated to my wonderfully supportive wife and best friend, Carien.

Table of Contents

List of Tables and Figures

Abbreviations

ACEM	Australasian College for Emergency Medicine
ACHS	Australian Council on Healthcare Standards
BOR	Bed Occupancy Rate
CAEP	Canadian Association of Emergency Physicians
ED	Emergency Department
EDOC	Emergency Department Overcrowding
EC	Emergency Centre
EM	Emergency Medicine
EMDRC	Emergency Medicine Division Research Subcommittee
FBU	Functional Business Unit
GP	General Practitioner
HREC	Human Research Ethics Committee
ICU	Intensive Care Unit
IoM	Institute of Medicine
LOS	Length of Stay
MAB	Mean Access Block
NHS	National Health Service
NSW	New South Wales
PD	Patient Days
RSA	Republic of South Africa
SD	Standard Deviation
TABT	Total Access Block Time
UK	United Kingdom
US	United States
USA	United States of America
WHO	World Health Organisation

Part A: LITERATURE REVIEW

Introduction

Access block is probably the most serious and most frequently encountered systems problem in the specialty of Emergency Medicine in the world, and Emergency Centre (EC) staff face it on a daily basis(1,2). Several attempts have been made to describe it, quantify it, identify the causes and evaluate its consequences(3). With the advances in medical and particularly emergency medical care aiming at providing improvements in time, quality and accessibility of appropriate care, the literature has slowly started to move its focus onto the stumbling blocks which prevent reaching these noble goals(2,4).

Background

Worldwide, even in developed countries, it is widely appreciated that healthcare systems are overburdened, poorly funded and periodically placed under massive strain with disease outbreaks, natural disasters and man-made major incidents(3). One of the man-made major incidents is the failure of healthcare systems itself. Inadequate primary, chronic and preventative medical care, combined with an increasing number of people unable to afford medical care lead to more visits to the emergency care system. Emergency medical care and the departments where this is provided experience increased pressure as a result and reflect the failure of the healthcare system as a whole.

In 2007 a series of three reports(1,3) were published by the Institute of Medicine (IoM) of the National Academies in the United States, outlining the state of pressure on the country's emergency departments and ambulance services. The first of these reports, *Hospital Based Emergency Care: At the Breaking Point*(1), placed a large searchlight on the pressure on the emergency departments, pointing out some of the factors contributing of which overcrowding plays a main part. Findings drawn from the report were that there was a rapidly growing demand for emergency care, a significant decline in the number of emergency departments and hospital beds as well as emergency department crowding as patients were not able to be timeously admitted to inpatient beds. This resulted in patients "boarding" in the emergency departments for extended periods of time waiting for an available bed on a ward, and ambulances being diverted away from crowded emergency departments on a very regular basis to more distant and sometimes less appropriate facilities. The "crowding" of patients referred to the concept of patient demands, whether in number or severity, exceeding the supply of resources in the emergency department, whether staff, space, equipment or other resources(2). The mismatch results in delay in patient waiting time, time to clinical assessment and subsequent medical care. To complicate matters, once a patient has been referred for admission, new factors such as high hospital bed occupancy or inpatient bed shortage, as well as the reluctance of nursing staff to admit patients to wards come into the equation(5). Simply put, the increasing number of patients attending for emergency medical care who need admission to hospital outnumbers the decreasing amount of hospital beds available(2). This defines access block(2,7), also referred to as exit block in some literature - access to hospital inpatient beds, or exit from the Emergency Department, for admitted patients.

Origins - US Healthcare System

Who is at risk of access block? The phenomenon of crowding has been well described in North America(3-7) over the last twenty years and especially in the past decade on the back of the above-mentioned report(1). It has received high profile cover in the media where it was even featured on the cover of Time Magazine as far back as 1990, with several articles focusing on this problem in published issues since then. One of the main contributors to the Emergency Departments in the USA being overcrowded as found in the IoM's report(1,3) and mainstream media publications, was due to the way payment was managed in US healthcare. Whenever there was a failure in the payment system, lack of funds from patients themselves, or where the "private" facilities failed to respond to the need of patients (who were acutely ill or injured, or frequently also due to chronic problems), Emergency Departments of hospitals had to provide the safety net for these failures(1). This impact of the US healthcare payment system is not the only reason for overcrowding of Emergency Departments, however. The phenomenon has been reported(8,9) in several other countries, many of which have different approaches to payment and delivery of healthcare. Where it has been described in various countries(10-12), alternative terminology such as "boarders" and "Emergency Department Overcrowding" (EDOC) have been used in equal reference to these phenomena.

Australasia

Emergency Department overcrowding and access block have also received much attention in Australasia(10,11,13–15) where access block has been defined by the Australasian College for Emergency Medicine (ACEM) as "the situation where patients who have been admitted and need a hospital bed are delayed from leaving the Emergency Department (ED) because of lack of inpatient bed capacity"(16). ACEM further defines overcrowding as "the situation where ED function is impeded primarily because the number of patients waiting to be seen, undergoing assessment and treatment, or waiting for departure exceeds the physical or staffing capacity of the department"(17).

What is access block?

In 2009 Harris and Sharma(11) attempted to narrow down the factors that determine congestion in the average Emergency Department and found that the availability of ward beds for admitted patients was a major factor, but that there were still also a large number of other factors yet to be determined. Forero *et al*(18) looked in 2004 whether different definitions of overcrowding or access block had any relevance to the magnitude of the phenomena. The variation in definitions was based on the measurement parameters used, varying between total time in the ED from arrival to departure, time from medical assessment to departure (the active treatment and delay time) and the time of departure delay (period of time from when a patient was ready to depart until actual departure). The authors found that, irrespective of the definition used, the magnitude of access block continued to increase.

Forero followed up on this study with many of his previous co-authors with a report published in 2010 in *Emergency Medicine Australasia*(13,19) where they looked at a number of interventional studies targeting access block. Most of the publications that were reviewed came from Australia, but studies from North America and Europe were also included. The authors used a very structured approach to categorising interventions into four groups, based on what Bagust *et al*(20) suggested in the British Medical Journal in 1999 – those directed to avoid admissions, finding alternatives to admission, more efficient management of existing resources and facilitating early discharge – and additionally a fifth category for descriptive studies and interventions on health outcomes. An initial 220 records were retrieved of which 51 met the inclusion criteria. From these articles there were very limited multicentre interventional studies, but despite this the authors identified that most of the interventions were aimed more at the surrogate markers of access block with only a few focussing on addressing access block as a phenomenon directly.

How severe is access block?

In another attempt to appreciate the global scale of this growing problem, Pines *et al*(21) provided a series of internationally collected perspectives on Emergency Department Crowding in 2011 on behalf of the ED Crowding Interest Group of the Society for Academic Emergency Medicine, which summarised the payment and primary health care system, the extent (if present) of ED crowding as well as any solutions offered to improve the level of crowding from a selection of countries across the world. The publication offered perspective from 15 countries other than the USA, with a mix of varying degrees of social-economic development. The countries included Australia, Canada, Denmark, Finland, France, Germany, Hong Kong, India, Iran, Italy, Netherlands, Saudi Arabia, Spain (Catalonia), Sweden and the United Kingdom. Unfortunately, not all the data was available as many of the countries do not track (or had not tracked at the time of publication) all Emergency Department visits.

The payment systems for healthcare and Emergency Department visits varied between universal public funded systems, systems where public and private health care is separately funded by government and insurance, tiered systems ranging from free government health care to private care, systems where acute care is public funded but specialist care paid by insurance, and a system where payment is shared with half paid by government taxes and employers and the other half by insurance. Irrespective of the funding model, most of the countries showed a varying degree of ED crowding, even those with a public funded healthcare system. Interestingly the countries with no or the least amount of ED crowding figures were those with a well-functioning and mature system of acute care outside of Emergency Departments, such as prehospital, primary care or after-hour care.

However, not all countries with robust systems for primary healthcare had an absence of crowding – the crowding in their case most likely caused by a lack of inpatient hospital beds. Further suggestion is made that a growing trend of “preference-sensitive” visits to ED’s, previously thought of as “inappropriate use”, could be adding to the case load as more people globally appear to prefer visiting an Emergency Department for non-life-threatening problems rather than attending a primary health care facility or physician. This raises the question whether primary healthcare systems are well enough designed to cater for cases that require urgent same-day care, but this question falls outside the scope of this study.

Other populations

Access block does not only have an effect on adult populations, but also poses similar difficulties with emergency paediatric presentations as described by Hostetler *et al*(22) in Chicago in 2009. Although it was found that overcrowding in Emergency Departments appeared to affect children in very similar ways to adults, it was clear that evidence was in short supply specifically looking at paediatric populations - most studies on the topic historically excluded children.

This may infer that the potential risk to children is underestimated. Together with the facts that medical errors(23,24) are not uncommon in paediatric inpatients and medical errors and adverse events(25,26) are proven risks during periods of ED overcrowding, we should assume that children are also at considerable risk in overcrowded ED's, especially as they have an inherent variability in size with the need for weight-based dosing of medication and very often have special health care needs. Unfortunately, this study also excludes children in its population as access block to paediatric inpatient beds is very seldom encountered in the institution in which the study is done.

Other risk factors

Not only has access block been described in various countries(9) and different population groups(26–30), but Mason *et al*(31) found from their evidence review that the type of facility also has relevance to its risk of experiencing access block. Various factors such as being a tertiary institution, not providing a paediatric service, and located in urban settings placed hospitals at higher risk of access block, whereas ED's where more time was spent "holding on" to patients or "working up" of patients also experienced more access block as this lead to longer Emergency Department length of stay(29).

Potential causes

This hints towards the fundamental cause of access block which has been identified in various studies and literature reviews – the shortage or lack of hospital inpatient beds for admissions from the Emergency Department or inversely, increased levels of hospital occupancy. In 2012 Khanna *et al*(32) looked specifically at the relationships between hospital occupancy levels, discharge timing and its effect on ED access block and found that with the rise of inpatient occupancy levels a tipping point is reached where ED access block is "triggered" and continues to deteriorate. They looked in-depth at the "tipping point" and identified three stages or “choking points” through which most facilities move during this process. An inpatient bed occupancy level of 85% has traditionally been regarded(20,33) as the optimum at which hospitals function with regards to its flow processes.

Passing this level and occupancy increases to more than 90% marks the first stage. The second stage is where patients presenting to the ED start to outnumber patients leaving the ED (discharges and admissions), which is when the ED experiences the appreciable “tipping point” of overcrowding and subsequently access block. Stage three is when inpatient admissions outnumber inpatient discharges pointing towards whole hospital overcrowding. Understandably this model of stages varies between hospitals due to a multitude of factors, making a universal solution to this impossible. What was found though was that early discharge planning and strategies (shifting discharges of inpatients from hospital to an earlier time in the day) made a significant difference in overcrowding, as again demonstrated by Khanna *et al*(34) in a further publication in 2016.

It is a disease

Access block should be viewed as an illness, with diagnostic criteria based on its “symptoms”, several causes, multiple complications and potential therapeutic interventions.

Variations in Measuring Access Block

Time

To really appreciate the impact of access block on various outcomes it would be ideal to be able to express it in a measurable or quantifiable way. The “symptoms” of access block and overcrowding have major impact on multiple factors, and consequently attempts have been made to quantify or measure its effect(11,18,28,35). In some countries, the time from triage to final disposition plan from the ED has been set as a measure of ED performance, and the time from disposition plan to admission to a ward has been set and accepted as a benchmark measure of access block.

Harris and Sharma(11) elected not to use a proxy or indicator of access block, but rather the total time as mentioned above when they interrogated data from Emergency Departments in the State of Victoria in Australia in 2010. Although their data was limited to an observational study, their findings using this measure were consistent with other evidence using similar units of measure, such as Cooke *et al*(36) described in their study on data from National

Health Service (NHS) Accident and Emergency Departments in England in 2004, or where a benchmark target (six hours of total ED stay) was used such as Hwang's study(37) from Korean data in 2006. It was consistently shown that the number of doctors, nurses and availability of inpatient beds all had independently significant relevance to the degree of access block.

Alternative measures to the above have been used as proxies of access block in various studies, with varying degrees of sensitivity to determine the impact on Emergency Department function. As an alternative to total time or threshold-based measures, Paoloni and Fowler(38) evaluated the Total Access Block Time (TABT) as an indicator of the impact of access block as it specifically calculated the amount of time after the set threshold of eight hours had been breached, and found it to be more comprehensive than threshold-based measures.

Where the outcomes of the study were not directly dependent on a precise measure of overcrowding or access block, but rather a threshold measure to categorise a variable, different parameters have been used. An example of this is Mahler *et al*(35) using the threshold-based measure of more than two hours of ambulance diversion as an inclusion criterion to define ED overcrowding when they looked at the impact of ED overcrowding on resident education.

Forero *et al*(18) went a step further and compared different threshold-based definitions to establish whether there was a difference in access block magnitude and prevalence related to the definition that was applied. They looked at the ACHS-ACEM (Australian Council on Healthcare Standards and Australasian College for Emergency Medicine) definition of the total ED time from arrival to departure exceeding eight hours, the New South Wales (NSW) 1 definition of active treatment and delay time (from medical assessment to departure) exceeding eight hours, the NSW 2 definition of delay time (from ready for departure to actual departure) exceeding four hours and the Time delay definition of delay time exceeding two hours. It was found that irrespective of the definition used, the rate of access block increased.

When more complex studies are performed such as estimating the impact of access block in terms of increased workload and cost on the Emergency Department, authors also favour customised case-mix models. A good example of this is Stuart(39) who described a custom urgency and disposition case-mix model AWOOS (access block adjusted weighted occasions of service) which incorporated the increased length of stay as a consequence of access block, as well as the additional cost incurred per patient. This method is most likely too complex and unnecessary for measuring access block as a universal phenomenon and moving back to a threshold-based measure would be more practical.

The National Health Service (NHS) in the United Kingdom (UK) has set a target of four hours(9,40) from arrival to discharge/transfer/admission. Australasia has set a target of eight hours from disposition plan to admission(16,41,42). The Canadian Association of Emergency Physicians (CAEP) initially targeted six hours from disposition plan to ward admission(43). This was slightly altered(30) to differentiate between complex and non-complex patients. The target for discharge from the ED or admission to a ward for complex patients was set to eight hours and for non-complex patients to four hours.

In the Western Cape Province of South Africa, the provincial Department of Health has set a target of six hours from disposition plan to ward admission as one of the indicators of hospital efficiency(44).

Despite these targets, access block has steadily grown due to several factors – some well-established and others unknown(13,14,29).

Effect

In the ongoing effort to quantify the "symptoms" some authors looked at categorising the outcomes of overcrowding and access block according to their effect, when measured against definitions used for overcrowding within specific processes(7,27). Richardson and Mountain(28) categorised the outcomes into Process Measures (ambulance diversions and delays, "left without being seen" rates, waiting times and EC flow), Quality Measures (patient satisfaction, delay in time-critical interventions and clinical adverse events) and Outcome Measures (clinical complications, mortality and length of stay). One of the most notable factors denotes the failure to increase the number of inpatient beds to meet the demand of increasing EC visits due to growing and ageing populations, increasing burden of disease and improved access to healthcare.

Studies such as Dunn's description(45) of the significant reduction in an Australian EC's waiting times following a period of decreased hospital inpatient bed occupancy, have suggested the scale of the impact of inpatient bed availability on access block and on the overall EC waiting times. Fatovich *et al*(10) evaluated and described the direct effect of access block on total hospital and ambulance diversions, EC waiting times and occupancy. All increased in correlation with high levels of access blocked patients.

Complications

The combined Emergency Department overcrowding and access block have been shown to have several complications(4,46,47), which include issues such as delay in time to antibiotics in treatment of pneumonia(48,49), delay in early intervention in severe sepsis and clinical endpoints such as mortality(50–52). Unfortunately, the solution is not just a matter of increasing the supply to meet the demand. It is much more complex than that.

A feature which aggravates the overall impact of access block is the degree of complexity and sheer number of factors contributing to and affected by it. With the aim to provide a summary of evidence on the subject of access block from around the world, Forero *et al*(19) published a literature review on access block and overcrowding in 2008 which identified and reported 27 different factors which are, in isolation or combination, causes of access block and overcrowding or affected by it. Furthermore, some of the studies included in the review reported that with changes in population demographics, urbanization, improved access to healthcare and social infrastructure, there was an increase in EC visits and subsequent hospital admissions over time. Thus, the need for more hospital inpatient beds increased, but despite the efforts made to increase the number of beds to keep the available beds per population stable, it was overshadowed by the amount of EC visits and resultant hospital admissions (due to ageing population and increased complexity of chronic conditions amongst others). Efforts to alleviate the overcrowding were made on various levels and included initiatives to avoid admission to hospital in the first instance, finding alternatives to inpatient admission, attempts to better manage existing resources and systems, and expedited discharge strategies. These initiatives were all evaluated and found to have mixed and often unsustainable results.

As already suggested, the availability of fully staffed inpatient beds is probably the largest contributor to or cause of access block(11,13,45,53,54). The lack of available inpatient beds is a function of emergency admissions and bed capacity(20,55). Other causes that have been identified include patient flow through the EC, optimal hospital inpatient bed occupancy, demand of inpatient beds from other sources such as elective admissions as well as the level of experience of the staff(56,57).

Thornton *et al*(58) described the improvement in access block and EC performance when an EC and wards in a hospital in South Auckland, Australia were staffed by more senior staff (Specialist level doctors) to compensate for staff shortages during a junior doctor strike. The senior staff's experience resulted in faster discharges, reduced bed occupancy and therefore reduced access block. This, combined with their clinical experience, resulted in improved EC performance (reduced patient waiting times and EC length of stay). Interestingly, although the above suggested that better qualified and more experienced staff has a positive effect on access block, access block may have a reciprocal negative effect on training staff. Mahler *et al*(35) described that during shifts with EC overcrowding residents saw less patients and performed less procedures. The role of optimum hospital inpatient bed occupancy is complex and falls outside the scope of this discussion.

EC overcrowding and access block have been shown to lead to multiple "complications". Forero *et al*(19) identified that it had a significant effect on patients including their care, morbidity and mortality, and satisfaction amongst others. The largest effect was noted in vulnerable population groups. The report stated an alarming estimated 20-30% higher mortality rate which could be attributed to the phenomenon. EC overcrowding greatly impacted EC staff. It increased work-related stress, decreased staff satisfaction and resulted in a frequent decrease or loss of clinical hours due to absence or forced contract changes. This loss of clinical hours further aggravated access block from a workforce perspective.

Treatment

Several strategies have been implemented to manage access block across the world(6,12,32,38,45), with the consensus that attempts to reduce inappropriate or non-urgent EC visits, ambulance diversions or placing a GP-like service in an EC for low acuity patients have no effect on EC overcrowding(28,53,57). The largest contributors to an improvement in access block include improved discharge planning, early discharge and patient flow, the implementation of holding units and buy-in from political leadership with prioritising resources (more beds and better staff allocation)(12,15,32).

African perspective

Most of the literature on the magnitude, causes and effect of access block originated from countries with often well-established healthcare systems and adequate resources. To better understand the impact of this on systems comparable to that of our own, the authors also looked at research done in Africa where low/middle income countries often struggle with a lack of necessary resources relating to healthcare. In 2014 Pascasie and Mtshali(59) identified several triggers to overcrowding in an EC in Kigali, Rwanda. The descriptive study was based on a cross-sectional questionnaire and waiting time was used as measure of overcrowding.

The identified triggers were from input, throughput and output factors similar to those in the international literature, but all triggers also related to severe local resource constraints. The recurring theme of resource constraints within African healthcare systems was highlighted by Hsia *et al*(60) in 2012 in a multi-national study focusing on infrastructure. Areas that were assessed comprised of basic infrastructure such as water and electricity supply, equipment, storage for medication, infection control, staff and patient education and quality control. The fact that none of the hospitals in any of the five countries surveyed (Ghana, Rwanda, Kenya, Tanzania and Uganda) met the minimum standards set by the WHO emphasises the magnitude of any knock-on effect of lack of resources may have on patient care practices.

A multi-centre questionnaire-based study was done in Nigeria and published in 2015 by Makama *et al*(61) which also identified the lack of inpatient beds and resources, increasing severity of illness and hospital system restructuring as major contributors of overcrowding. Waiting times and EC bed occupancy were used to measure overcrowding. Interestingly they found that the inappropriate attendances of non-emergent cases were not a contributing factor. Ike *et al*(62) however reported that inappropriate attendances along with a general lack of resources did contribute to overcrowding in their setting of an emergency department in an Orthopaedic Referral Centre in Lagos, Nigeria. Overcrowding and access block also appears to have similar negative effects on staff and patient safety and satisfaction as found by Quao *et al*(63) in a Ghanaian study in published in 2017.

South Africa

Although the above describes how these phenomena have been major factors in the performance of EC's in other countries, very little research on access block and its causes and effect in the South African setting has been done. The author has failed to find any relevant literature published on the causes or severity of access block in local (national or provincial) emergency centres, but there are studies available in the literature which focussed on triage systems and waiting times in local emergency centres and attributed some of this to access block. Cohen and Bruijns(64) looked at waiting times in EC's in the Western Cape Province as Key Performance Indicators and mentioned access block and overcrowding as anecdotal but poorly researched barriers to safe and efficient patient care. This study was on the back of another published in 2008 by Bruijns *et al*(65) which focussed on the effect of the introduction of nurse triage on EC waiting times, showing that nurse triage introduction dramatically reduced the waiting times for patients attending an EC. In a study looking at crowding in Emergency Centres, Ahiable *et al*(66) described the various categories of people contributing to crowding in a district referral hospital in the Western Cape Province. In their study access block was not directly measured but it hinted towards it being a key culprit to crowding, and rather occupancy was used as a measured proxy for crowding. This identified a gap in our understanding of the magnitude and effect of overcrowding and access block in the South African setting with the resources available.

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Part B: MANUSCRIPT IN ARTICLE FOR PUBLICATION FORMAT

Cohort study of access block trends in a public, regional hospital Emergency Centre in South Africa

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Cohort study of access block trends in a public, regional hospital Emergency Centre in South Africa

Abstract

Background: Access block is one of the most serious and frequently encountered system problems in the specialty of Emergency Medicine and, although well described internationally, within the South African setting limited research has been performed on the phenomenon.

Objectives: To describe the total access block of adult patients and per specialty, the monthly variation of the degree of access block and its correlation to the monthly Emergency Centre head count, hospital bed occupancy rate and monthly patient days and the effect of any interventions made during the study period in an Emergency Centre (EC) at a regional hospital in Cape Town, South Africa.

Methods: The study was a retrospective descriptive study of a pre-existing database of EC access block, monthly EC head count, hospital bed occupancy and hospital patient days from April 2015 to March 2017.

Results: A total of 700 discrete data sets were analysed. The study period of 24 months was divided into two 12-month periods to allow year-on-year comparison – April 2015 to March 2016 (Year 1) and April 2016 to March 2017 (Year 2). The mean access block (SD) for the total study period was 109% (17.7) ranging from 69% to 139%, with a Mean Access Block of 106% for Year 1 and 113% for Year 2. Patients of the Internal Medicine Department made up the largest proportion of boarders in each month of the study period. The comparison of the month-to-month variation of MAB over the study period to the variation of the EC monthly head count showed a weak correlative trend between the two variables with regards to large month-on-month changes, but with no absolute correlation for discrete monthly comparisons ($r(22) = .14$, $p = .53$). Across the study period there was a direct correlation between BOR and PD ($r(22) = .90$, $p < 0.001$), and neither showed a significant correlation with the Mean Access Block. The Mean Access Block was 110% prior to the appointment of a dedicated Bed Manager in August 2016 and increased to 115% afterwards. The Bed Occupancy Rate also increased from 89% prior to 92% after the appointment.

Conclusions: The severity of access block was demonstrated using a basic system of recording Mean Access Block for a 24-month period and demonstrated that, on average, all available space was occupied by boarding patients. Whilst the hospital's patient 'flow' system should address increased access block, the systems employed mostly failed. Although it had no direct positive effect on the Mean Access Block, a dedicated bed manager appeared to make a positive change in how the inpatient system compensated for access block.

Introduction/Background

Access block is one of the most serious and frequently encountered system problems in the specialty of Emergency Medicine and has been described internationally over the past twenty years(1–4). It is defined by the Australasian College for Emergency Medicine (ACEM) as 'the situation where patients who have been admitted and need a hospital bed are delayed from leaving the Emergency Department (ED) because of lack of inpatient bed'(5,6). Access block contributes to ED overcrowding(1). ACEM further defines overcrowding as 'the situation where ED function is impeded primarily because the number of patients waiting to be seen, undergoing assessment and treatment, or waiting for departure exceeds the physical or staffing capacity of the department'(6).

Access block should be viewed as an illness, with several causes, symptoms and management strategies. Factors that have been identified include poor patient flow through the ED and overcrowding, suboptimal hospital inpatient bed occupancy, reduction in hospital inpatient beds, demand of inpatient beds from other sources such as elective admissions and staff shortages or inexperience(2). Thornton and Hazell(7) included most of these factors in their description of the improvement in access block and ED performance when the ED and wards in a hospital in South Auckland, New Zealand were staffed by more senior staff (predominantly Fellows from the ACEM) to compensate for staff shortages during a junior doctor strike. The senior staff's experience resulted in faster discharges, reduced bed occupancy and therefore reduced access block. This, combined with their clinical experience, resulted in improved ED performance (reduced patient waiting times and ED length of stay). Although the above suggests that simply addressing the identified factors may have a positive effect on access block, access block is complex. It is linked to ED 'flow' parameters and optimal hospital inpatient bed occupancy variables and prevents the identification of all its causative factors. Forero and Hillman's literature review(8) on access block and overcrowding identified 27 different factors which are - in isolation or combination - causes of access block and overcrowding, and attributed a higher mortality rate to the phenomenon. Their review reported that with changes in population demographics, urbanization, improved access to healthcare and social infrastructure, there was an increase in ED visits, subsequent hospital admissions and the need for more inpatient hospital beds. The efforts made to increase the number of beds were overshadowed by the number of beds required.

ED overcrowding is a 'symptom' of access block and is also one of its causes. Fatovich(9) evaluated and described the direct effect of access block on total hospital diversion, ambulance diversion, ED waiting times and occupancy – all of which were increased in correlation with high levels of access blocked patients. Mason *et al*(2) grouped the symptoms according to its effect on waiting times, patient outcomes, boarding and the impact on workforce. Attempts have been made to quantify or measure the effect of access block and overcrowding(10-17). Measurable proxies for access block include patient waiting times, ED length of stay (LOS), total access block time, case-mix models, patient satisfaction and outcomes, adverse events and morbidity and mortality rates.

Efforts have been made to treat this 'disease'. Some of the symptoms were managed(18,19) by initiatives to avoid admission to hospital in the first instance, finding alternatives to inpatient admission, attempts to better manage existing resources and systems, and expedited discharge strategies. These 'treatment strategies' had mixed and often unsustainable results. Better results were obtained by improved discharge planning, early discharge and patient flow, the implementation of holding units and buy-in from political leadership and resource allocation (more beds and better staff). Other attempts such as reducing inappropriate or non-urgent ED visits, ambulance diversions or placing a GP-like service in an ED for low acuity patients had no effect on ED overcrowding(20-22). This suggests that access block is still an incurable 'disease' of which we are only controlling the symptoms(23).

Within the Sub-Saharan African context where resource limitation is a common risk factor(24), there have been a limited amount of research done, mostly on overcrowding. Studies in Rwanda, Ghana and Nigeria(25-28) showed that overcrowding exists in most of the health systems reviewed. The triggers or causes of the overcrowding appears to be similar to what was found in developed countries, with the lack of resources featuring prominently. Interestingly, inappropriate attendances (input factor) were found to be a contributing factor(28), as opposed to what was seen in the international literature. The complications of overcrowding also appeared to be similar to that in the rest of the world(26).

Within the South African setting, very limited research has been performed on access block. Most of the studies involving access block focused on waiting times and triage(29-30), and one study(31) describing the population contributing to overcrowding.

The aim of this retrospective study was to describe the access block in an Emergency Centre (EC) at a regional hospital in Cape Town, South Africa from April 2015 to March 2017. The objectives of the study were to describe the total access block of adult patients and the number of patients per specialty; to describe the monthly variation of the degree of access block and its correlation to the monthly EC head count, hospital bed occupancy rate and monthly patient days; and to describe the effect of any interventions made during the study period on access block.

Methods

The study was a retrospective descriptive study of a pre-existing database of EC access block, monthly EC head count, hospital bed occupancy and hospital patient days from April 2015 to March 2017.

The database was established in April 2015 as part of a quality improvement project and recorded the number of all adult patients referred to a specialty for admission at least daily. The EC head count, hospital bed occupancy and hospital patient days were captured monthly directly from the hospital's Clinicom® FBU (Functional Business Unit) report and added to the database. The Clinicom® patient administration system calculates the 'Patient Days' (PD) based on the numbers of inpatient and outpatient episodes in a fixed formula.

The 'Patient Day' unit is a proxy of how busy the hospital is. It is a useful parameter in the way it better reflects how the hospital and certain inpatient units are being utilised in terms of occupancy. Historically the number of admitted patients as a function of the amount of beds available each day would represent the 'bed occupancy'. It didn't take into account that often there may have been two or more admitted patients who have occupied a bed at different times within a single day. The ‘Patient Day’ concept compensates for that as it includes all episodes (each patient registered, whether for an emergency, outpatient or inpatient admission) within every day. Each episode is allocated a specific PD according to a fixed formula within the Clinicom® system. The hospital bed occupancy rate is calculated by dividing the monthly PD by the numbers of days in the month, and then dividing the result by the amount of beds in use in the hospital.

Access block was defined by the number of patients who had been referred to an ‘in-house’ specialty discipline and were awaiting a disposition from them (whether that was admission to an inpatient bed, transfer to another facility or discharge) and who were still occupying a space in the EC. The EC was built with a capacity for seventeen stretchers or clinical flat surfaces which could be occupied by patients. This was used as the denominator.

The numbers of adult boarding patients were recorded before each morning ward round by the team on duty the night before and verified by the team on duty for the day and expressed as a percentage of the pre-established EC capacity (denominator), as well as its distribution across the various inpatient specialties. The data were transcribed by the EC Consultant doing the morning ward round. Each day’s recorded data was regarded as one dataset. These data were transcribed to an electronic database on a password-protected computer and checked for errors by the Head of the Clinical Unit.

The EC is at a regional public-sector hospital in Cape Town, South Africa which accepts patients of all ages from a large drainage area covering the city bowl of Cape Town and a large part of the West Coast. The EC manages between 3 500 and 4 000 patients per month of varying severity as self-presenting patients, primary presentations brought in by ambulance, inter-facility transfers referred to the EC (Emergency Medicine) or directly to inpatient specialties. These are either discharged or referred to inpatient specialties for admission (Internal Medicine, General Surgery, Otorhinolaryngology, Urology, Orthopaedic Surgery, Obstetrics and Gynaecology, Paediatrics and Psychiatry).

The database was interrogated to obtain data on EC access block, monthly EC head count, hospital bed occupancy and hospital patient days from April 2015 to March 2017. As the database was set up prior to the onset of this study, the inclusion criteria were predetermined to what were already recorded, with the only applied criteria being that of the time period. Data falling outside of the study period were excluded. Datasets with incomplete data were excluded. Although not a chosen design feature of the study, paediatric patients were excluded from the database and the study as there had not been any significant access block experienced from paediatric cases referred for admission.

The data were analysed using the *IBM™ SPSS Statistics™* programme and expressed with descriptive statistics. Pearson correlations were used to assess and compare data. A confidence interval of 95% was used.

Although this was purely a retrospective study, it was noted that a dedicated Hospital Bed Manager was appointed by the facility in August 2016. There have been several periods of time in the past where a Bed Manager had been appointed at the hospital to facilitate patient flow, but this was not the case at the point in time when the study period commenced. The impact on access block compared to EC monthly head count and whole hospital inpatient bed occupancy was assessed.

Approval was obtained from the University of Cape Town's Human Research Ethics Committee to use the existing database for this study.

Results

The electronic database was examined from 1 April 2015 to 31 March 2017. Each daily set of data recorded containing the total amount of boarding patients, as well as its distribution between the inpatient specialties was regarded as a data set. A total of 731 discrete data sets were extracted of which 31 data sets were excluded as were incomplete. The remaining 700 (731-31) discrete data sets were analysed. The study period of 24 months was divided into two 12-month periods to allow year-on-year comparison – April 2015 to March 2016 (Year 1) and April 2016 to March 2017 (Year 2)(Table 1).

Year 1	APR '15	MAY '15	JUN '15	JUL '15	AUG '15	SEP '15	OCT '15	NOV '15	DEC '15	JAN '16	FEB '16	MAR '16	MEAN
Mean Access Block	69%	112%	91%	99%	112%	114%	111%	105%	86%	130%	138%	99%	106%
EC Monthly Head Count	3632	4141	3414	3661	3803	3592	3699	3454	3629	3769	3402	3810	3667
NSH Mean Bed Occupancy	84%	97%	90%	88%	91%	90%	96%	93%	86%	97%	94%	88%	91%
NSH Patient Days	8377	10011	8990	9156	9407	9044	9951	9323	8898	10070	9070	9127	9285
Year 2	**APR '16**	**MAY '16**	**JUN '16**	**JUL '16**	**AUG '16**	**SEP '16**	**OCT '16**	**NOV '16**	**DEC '16**	**JAN '17**	**FEB '17**	**MAR '17**	**MEAN**
Mean Access Block	81%	103%	107%	129%	133%	139%	119%	98%	124%	107%	103%	112%	113%
EC Monthly Head Count	3593	3740	3394	3635	3889	3604	3745	3631	3678	3737	3238	3437	3610
NSH Mean Bed Occupancy	84%	91%	92%	85%	86%	90%	88%	102%	101%	85%	88%	89%	90%
NSH Patient Days	8441	9468	9210	8809	8913	8891	9142	10232	10460	8834	8261	9226	9157

Table 1 - Mean Access Block (MAB), EC monthly head count, Whole Hospital Mean Bed Occupancy (BOR) and Patient Days (PD) over the period April 2015 to March 2017

Access Block(Figure 1)

The mean access block (MAB) (SD) for the total study period was 109% (17.7) ranging from 69% to 139%. The MAB for Year 1 was 106% which increased to 113% for Year 2. Comparing Year 2 to Year 1, there was a year-on-year increase of 6.7% in MAB. Eight of the twelve months from Year 2 had a higher MAB than the comparative month from Year 1, with the increase ranging from 7% to 44%. The remaining four months from Year 2 had a lower MAB than the comparative month from Year 1, with the decrease ranging from 7% to 25%.

The largest positive difference in comparative months was between December 2015 (86%) and December 2016 (124%). The largest negative difference was between February 2016 (138%) and February 2017 (103%). There was only a weak correlation in monthly variation between Year 1 and Year 2, $r(10) = .23$, $p = .46$.

The monthly MAB in Year 1 ranged from 69% to 138% and daily access block ranged from 29% to 224%. The monthly MAB in Year 2 ranged from 81% to 139% and daily access block ranged from 29% to 253%.

The initial day to day trend showed peaks on the first two days of the week with the lowest values over the weekends. A brief rise was noted following a public holiday.

Later the initial tendency of access block to increase following weekends and public holidays was not continued. However, it was noted that the degree of access block was higher during the week when compared to the weekend.

Figure 1 shows the monthly Mean Access Block for the study period in a year-on-year comparison between Year 1 and Year 2.

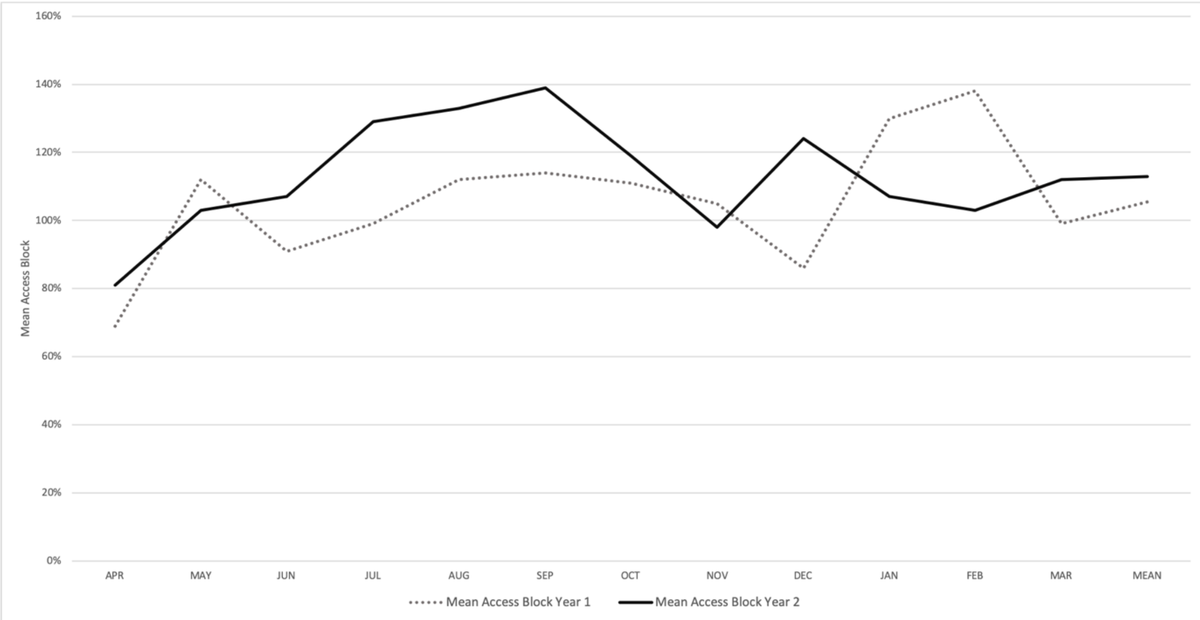

Figure 1 - Mean Access Block (MAB) Year-on-year April 2015 to March 2017

Figure 2 illustrates the departmental contribution of Mean Access Block for each month of the study period by Specialty Discipline.

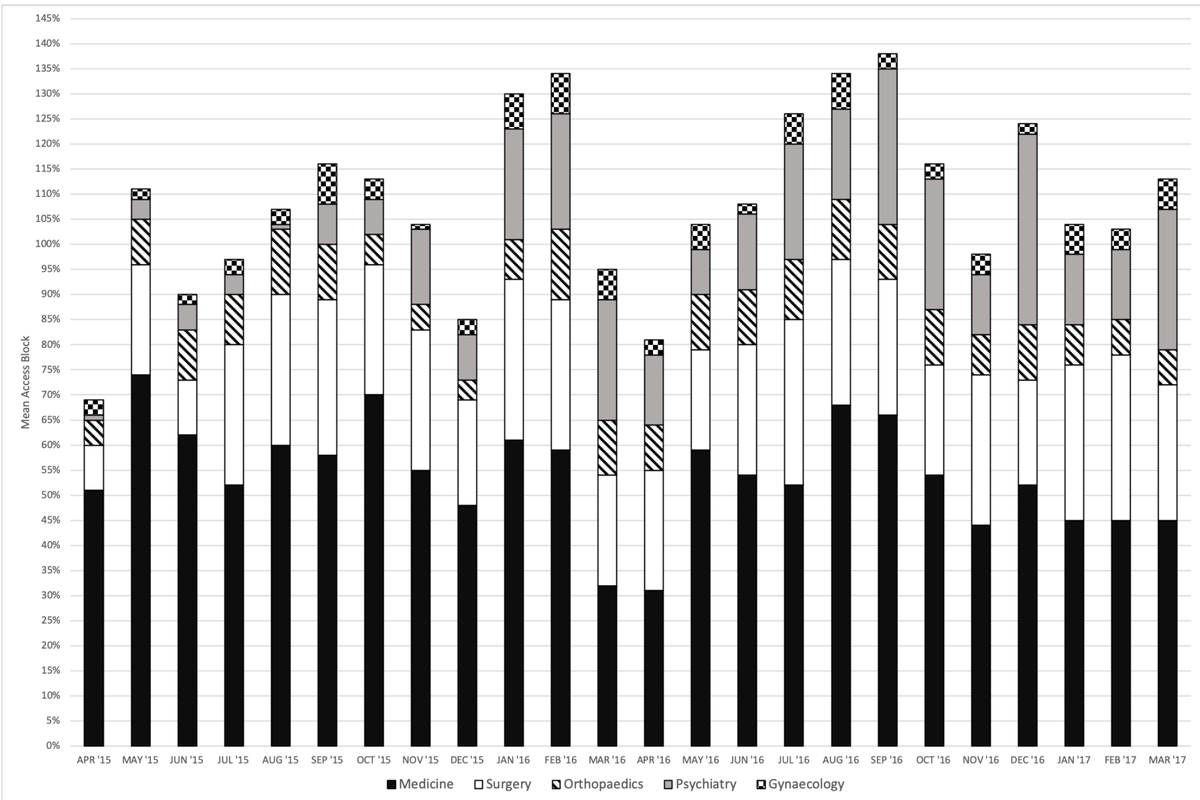

Figure 2 - Mean Access Block (MAB) from April 2015 to March 2017 separated into contribution of boarders by each individual Specialty Discipline

Patients of the Internal Medicine Department made up the largest proportion of boarders in each month of the study period, followed by the General Surgery Department (which included patients from Otorhinolaryngology and Urology), Psychiatry Department, Orthopaedic Surgery Department and Gynaecology Department in order of reducing contribution on average over the study period(Figure 2).

EC Monthly Head Count(Figure 3)

The mean EC monthly head count (SD) for the total study period was 3 639 patients per month (190.3). The mean EC monthly head count for Year 1 was 3 667 which decreased to 3 610 for Year 2. Comparing Year 2 to Year 1, there was a year-on-year decrease of 1.6% in mean EC monthly head count.

The largest positive difference in comparative months was between November 2015 (3 454) and November 2016 (3 631). The largest negative difference was between May 2015 (4 141) and May 2016 (3 740).

The EC monthly head count in Year 1 ranged from 3 402 to 4 141. The EC monthly head count in Year 2 ranged from 3 238 to 3 889.

The month-to-month comparison between Year 1 and Year 2 showed similar patterns with peaks noted in May, August, October, January and March. There was a moderate correlation between Year 1 and Year 2 with $r(10) = .59$, $p = .04$.

Figure 3 illustrates the year-on-year comparison of monthly EC head count.

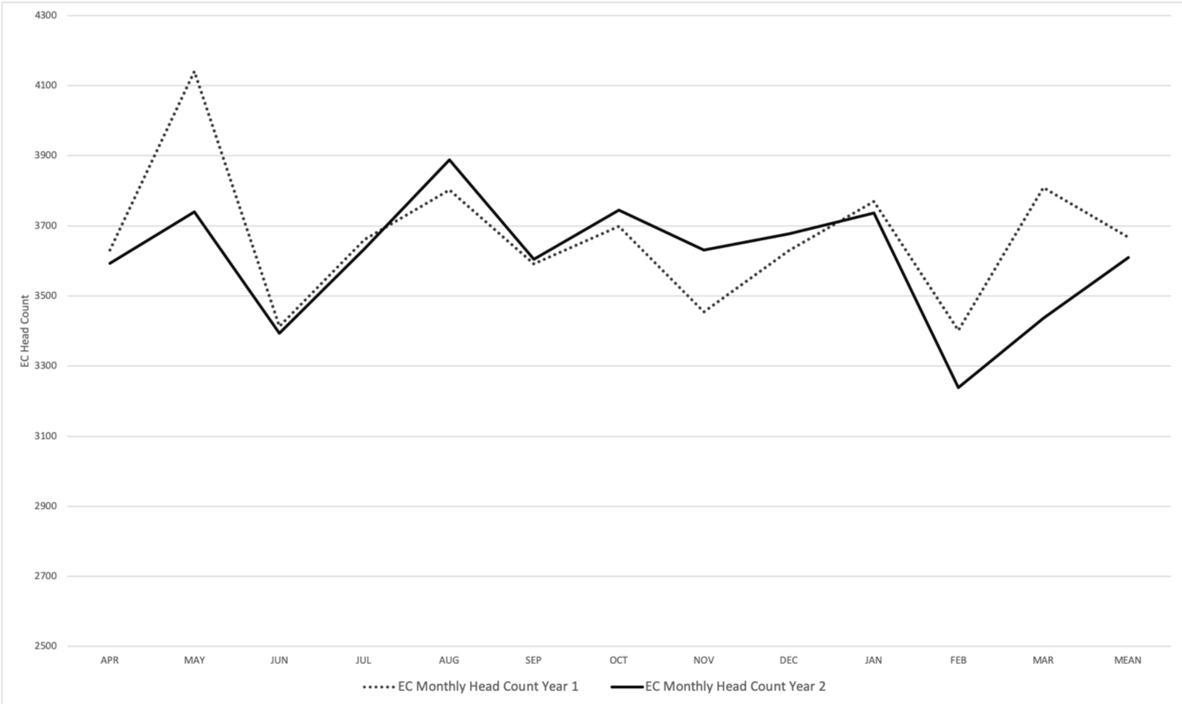

Figure 3 - EC Monthly Head Count year-on-year April 2015 to March 2017

The mean monthly EC Head Count across the study period remained stable.

<u>Hospital Bed Occupancy Rate (BOR) and Monthly Patient Days (PD)</u>

The mean Whole Hospital Bed Occupancy Rate (BOR) (SD) for the total study period was 91% (5.1) ranging from 84% to 102%. The mean BOR for Year 1 was 91% which decreased to 90% for Year 2. Comparing Year 2 to Year 1, there was a year-on-year decrease of 1.1% in mean BOR.

The largest positive difference of BOR in comparative months was between December 2015 (86%) and December 2016 (101%). The largest negative difference in BOR was between January 2016 (97%) and January 2017 (85%).

The monthly BOR in Year 1 ranged from 84% to 97% and in Year 2 ranged from 84% to 102%. There was a very weak negative correlation between BOR in Year 1 and Year 2 with $r(10) = -.04$, $p = .88$.

The mean Patient Days (PD) (SD) for the total study period was 9 221 (572.5) ranging from 8 261 to 10 460. The mean PD for Year 1 was 9 285 which decreased to 9 157 for Year 2. Comparing Year 2 to Year 1, there was a year-on-year decrease of 1.4% in mean PD.

The largest positive difference of PD in comparative months was between December 2015 (8 898) and December 2016 (10 460). The largest negative difference in BOR was between January 2016 (10 070) and January 2017 (8 834).

The monthly PD ranged from 8 377 to 10 070 in Year 1 and ranged from 8 261 to 10 460 in Year 2.

There was a weak correlation between PD in Year 1 and Year 2 with $r(10) = .11, p = .74$.

<u>Mean Access Block vs EC Monthly Head Count(Figure 4, Figure 5)</u>

The comparison of the month-to-month variation of MAB over the study period to the variation of the EC monthly head count showed a weak correlative trend between the two variables with regards to large month-on-month changes. However, there were no absolute correlations seen for discrete monthly comparisons. The Pearson Correlation Coefficient over the 24-month period revealed $r(22) = .14, p = .53$.

Figure 4 shows the month-to-month comparison of EC Mean Access Block to EC monthly head count for Year 1, and Figure 5 shows the month-to-month comparison of EC Mean Access Block to EC monthly head count for Year 2.

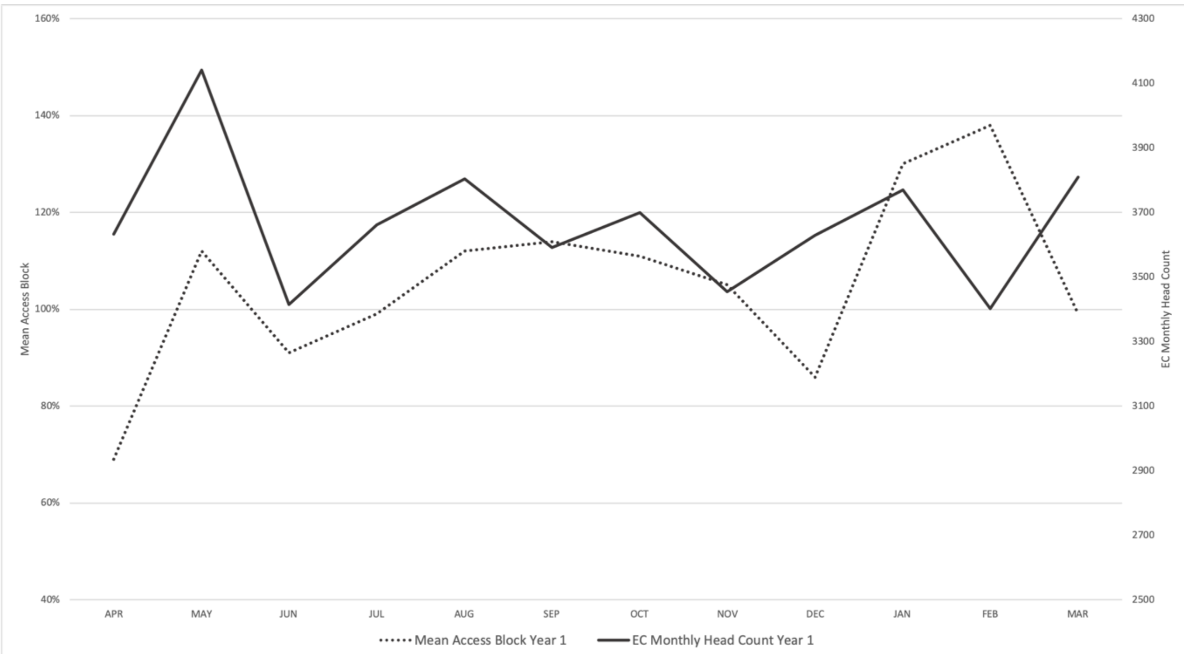

Figure 4 - Mean Access Block (MAB) vs EC monthly head count Year 1 (April 2015 to March 2016)

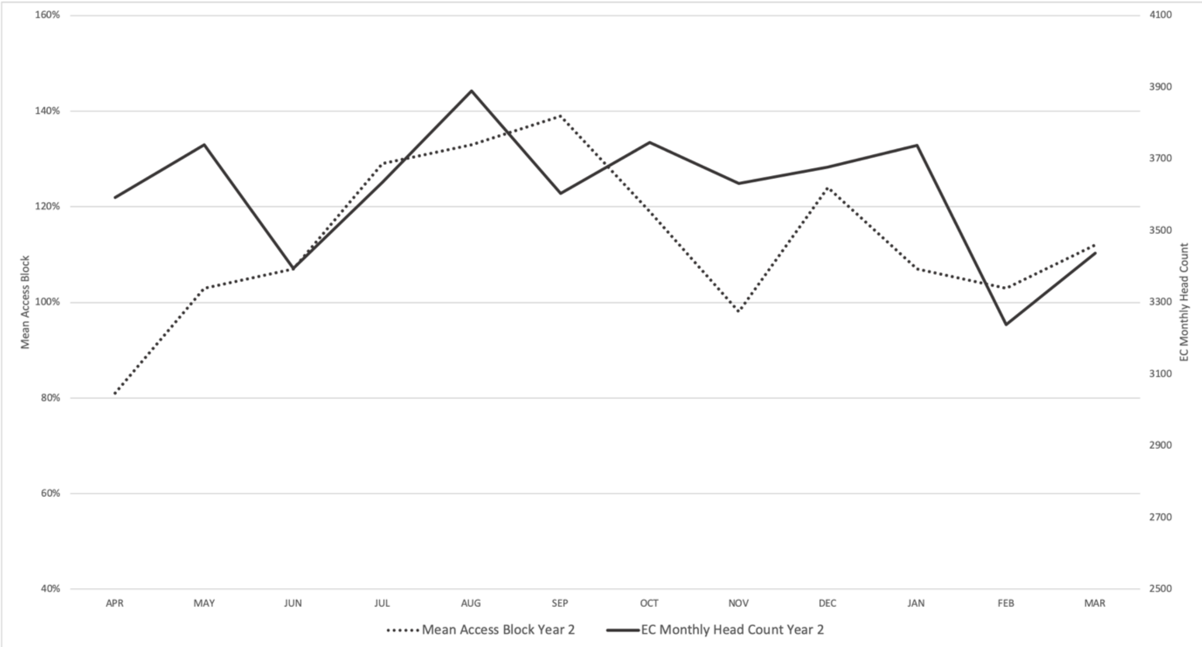

Figure 5 - Mean Access Block (MAB) vs EC monthly head count Year 2 (April 2016 to March 2017)

The period from April 2015 to January 2016 showed a weak correlation between MAB and EC monthly head count: $r(8) = .39$, $p = .27$. This was weaker in the period from February 2016 to March 2017: $r(12) = .07$, $p = .82$. Of note, the two highest peaks in MAB across the study period (February 2016 and September 2016) both had lower EC monthly head counts compared to the respective preceding and proceeding months.

The standard deviation for MAB for Year 1 was 18.7 and decreased to 16.5 in Year 2. The standard deviation for EC monthly head count for Year 1 was 205.2 and decreased to 178.4 in Year 2.

Mean Access Block vs Hospital Bed Occupancy and Monthly Patient Days(Figure 6, Figure 7)

The Clinicom® patient administration system of the hospital calculates the 'Patient Days' (PD) based on the numbers of inpatient and outpatient episodes in a fixed formula, which is then used to calculate the whole hospital Bed Occupancy Rates (BOR). In an ideal system the hospital PD and BOR should increase to compensate for an increase in MAB from the EC.

Figure 6 shows the comparison between EC Mean Access Block and Hospital Bed Occupancy and Patient Days for Year 1, and Figure 7 shows the same data for Year 2.

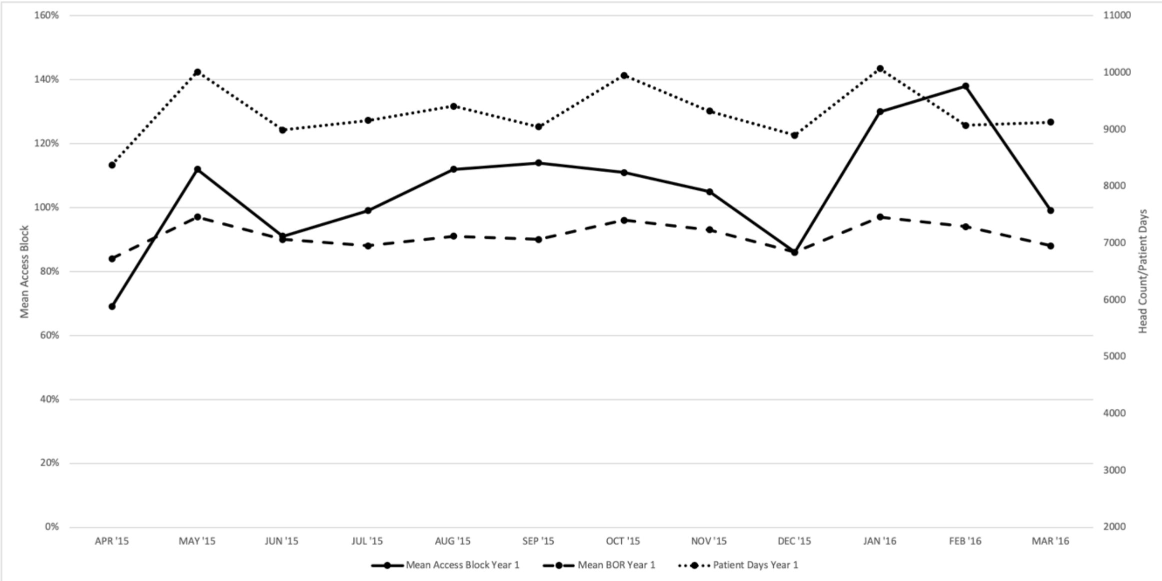

Figure 6 - Mean Access Block (MAB) vs Mean Hospital Bed Occupancy (BOR) and Patient Days Year 1 (April 2015 to March 2016)

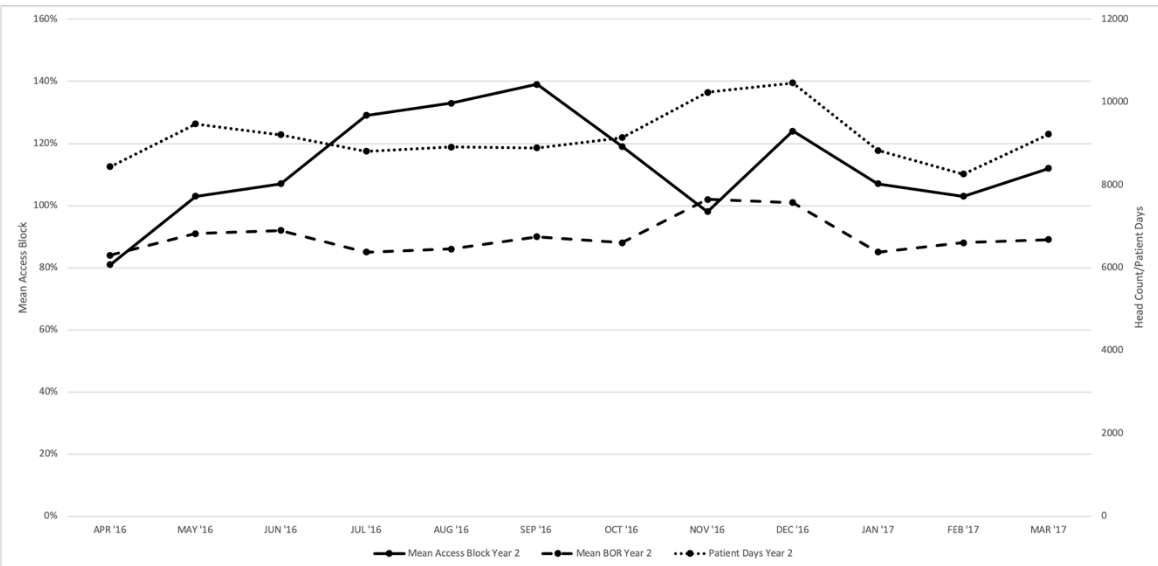

Figure 7 - Mean Access Block (MAB) vs Mean Hospital Bed Occupancy (BOR) and Patient Days Year 2 (April 2016 to March 2017)

Across the study period there was a direct correlation between BOR and PD ($r(22) = .90$, $p < 0.001$), and neither showed a significant correlation with the MAB. The correlation between MAB and BOR was $r(22) = .32$, $p = .13$ and between MAB and PD was $r(22) = .31$, $p = .14$.

However, although poor, there was much better correlation between BOR/PD and MAB in Year 1 ($r(22) = .80/.64$, $p < 0.001$) than in Year 2 ($r(22) = -0.01/0.09$, $p = .97/.66$).

Effect of Interventions made during the study period

A dedicated Hospital Bed Manager had been used as an attempt on several previous occasions by the hospital to improve patient flow, bed occupancy and EC overcrowding, and was again appointed by the facility in August 2016. The data for the six months prior to the appointment and following the appointment were analysed. The mean EC monthly head count for the six-month period prior to the appointment was 3 596 which increased to 3 606 for the six months after the appointment. The MAB was 110% prior to the appointment and increased to 115% after the appointment. The BOR also increased from 89% prior to the appointment to 92% after the appointment of the Bed Manager. The correlation between MAB and BOR for the six months prior to the appointment was $r(4) = .32$, $p = .54$, and for the six months after the appointment $r(4) = .39$, $p = .44$.

Discussion

The flow of patients through an EC can be simplified into three categories – patients entering the unit (input), the processes that happen within the unit to stabilise, treat, investigate and plan the disposition of each patient(throughput), and the process of the patient physically leaving the unit(output)(8,32–34).

Input is indicated by the EC monthly head count in this study. Historically it was believed that increased numbers of patients contribute directly to overcrowding and access block as was seen in parts of Africa(25,28), but that has been shown to not be the case(35) in developed countries. From the recorded data it was observed that although there was the expected month-to-month variation, there was a slight decline in the mean monthly head count for the study period. Over the 24 months there was a year-on-year decline in the mean monthly head count indicating that the EC was seeing fewer patients. Despite this decline, there was a year-on-year increase in the mean access block. The numbers of patients attending the EC were not a contributor to the degree of access block over the study period.

However, in isolated months it may have been a contributing factor. In May 2015 a significant increase in the EC monthly head count was coupled with a relevant increase in the degree of access block. In December 2015 an increase in the EC monthly head count was coupled with a lower degree of mean access block. The month of December is usually linked with an increase in trauma cases due to the interpersonal violence and road traffic collisions over the holiday periods. This results in an increase in patient numbers. However, most of these cases do not require admission and don't contribute to access block as measured in this study. Similarly, larger numbers of inappropriate attendances or non-urgent patients did not contribute to access block in a comparable African EC setting(27) although the same study found that higher severity of illness is a cause of overcrowding. Our study did not differentiate between severity of cases, which is a factor to consider in further research.

With regards to throughput it can be argued that these processes occurring in the EC between arrival and disposition of each patient have limited effect on access block(15). This is due to the nature of each of the individual processes. A delay in the time waiting for investigation results or treatment of a patient that is likely to be discharged will add to patient crowding, but not to access block. Other flow processes that are more complex include factors such as staff levels, availability of investigations, availability of medication or consumables, admission pathways via other services such as surgical theatre or endoscopy, and which has been shown in other literature to contribute to access block(28,39). These factors were not directly measured in this study and would need to be included in further research.

The third category of patient flow - output or disposition from the EC - includes discharge, transfer to another facility or referral to a specialty discipline for admission. Once referred, these boarding patients then wait to be moved to an inpatient bed. This is dependent on the availability of a suitable inpatient bed, inpatient wards timeously communicating available beds to the EC and the availability of staff to transfer to and accommodate the patient on the ward(4,14,18,23). The communication of available inpatient beds at the time of the study was a 'push' system requiring EC staff to continuously contact wards to check for available beds, and if present the patient was transferred. This 'push' system was ineffective in the first 18 months of the study as increased levels of MAB had either no, late or inadequate compensatory increases in PD and BOR to address the access block.

A dedicated Hospital Bed Manager was again appointed in August 2016 and employed a combination of the 'push' and 'pull' systems. The 'pull' system required wards with vacated beds to contact the EC and request patient transfer. Although the MAB did not improve after the bed manager was appointed, this combined system was more effective in bed utilisation than the prior processes as evident by the BOR having increased, and there was better correlation between MAB and BOR within the final six months of the study. This suggested that the patient flow system compensated better for the increase in MAB by increasing the BOR. This active management of admissions and bed utilisation has been proven to improve patient flow and access block as was seen in similar studies(23,57–59). It was also the responsibility of the Bed Manager to facilitate inpatient discharges and expedite planned transfers of inpatients to other facilities. This was not directly measured but may have contributed to patient flow processes which would influence BOR and ultimately access block from the EC.

There are multiple other contributing factors to these three categories(23,36). Where there is a large change in any of these aspects of flow in terms of numbers of patients or the time any of the various processes take, the flow is affected, and patients will either flow faster or slower through the unit (or become stagnant)(37,38). The effect of patient crowding on the flow processes should not be underestimated. Crowding and overcrowding has its own collection of causes(1,2,14,39,40) and contributors, measures(3,10,11,13,15–17,41–43) and effects(8,39,44–51). The combination of flow processes and crowding contribute to access block as has been shown in several studies(11,14,18,33,52–55).

The magnitude of the access block needs to be understood. International data indicates that EC morbidity and mortality increases where access block exceeds 20%(57). The MAB for the study period was 109%. This indicates that boarding patients were on average occupying all EC beds at any given time. The impact on morbidity and mortality was outside of the scope of this study, but further research into the relationship between the level of access block and morbidity and mortality within the same facility using the same method of measuring access block would be necessary to compare it to international literature.

Several limitations were identified in this study with regards to the data used, of which the following were the most significant. The data used in this study recorded the number of patients that had been referred to a specialty at the hospital and still present in the EC at a fixed point in time. It did not record the total number of patients that had been referred to these specialties and discharged or transferred subsequent or prior to the head count. Whilst the EC monthly head count was stable, it does not account for changing severity of illness or injury which may have impacted referral and admission rates. Major changes to protocols, guidelines or local standard operating procedures requiring patients to be referred for admission may have impacted referral and admission rates and were not accounted for in this study. The database used only contained recorded numbers for adult boarding patients. Paediatric patients were excluded from the database and the study as there had not been any significant access block experienced from paediatric cases referred for admission.

Conclusions and Recommendations

Access block is a complex disease without a known cure, and also very real and present in the South African healthcare system. The severity of access block was demonstrated using a basic system of recording mean access block for a 24-month period and demonstrated that, on average, all available space was occupied by boarding patients. Whilst the hospital's patient 'flow' system should address increased access block, the systems employed mostly failed. A dedicated bed manager appeared to make a positive change in how the inpatient system compensated for access block but not for access block itself, but further research within this facility is necessary to assess whether this will generate a reduction in the degree of access block experienced in the longer term. A modernised patient tracking system may allow more insight locally into this 'disease', enabling comparison with international data and systems improvement strategies, especially if it allows the function of tracking time spent within the system to allow for a time-threshold measure of access block. Once a standard of measuring access block has been set, further research is also suggested in aspects more relevant to an African health system, such as the relationships between inappropriate attendances and access block/overcrowding, specific resource constraints and its relation to access block and also the correlation and bi-directional impact between the prevalence of communicable diseases such as Tuberculosis and the degree of access block.

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Supplemental Files for Article Submission

Table 1.

Year 1	APR '15	MAY '15	JUN '15	JUL '15	AUG '15	SEP '15	OCT '15	NOV '15	DEC '15	JAN '16	FEB '16	MAR '16	MEAN
Mean Access Block	69%	112%	91%	99%	112%	114%	111%	105%	86%	130%	138%	99%	106%
EC Monthly Head Count	3632	4141	3414	3661	3803	3592	3699	3454	3629	3769	3402	3810	3667
NSH Mean Bed Occupancy	84%	97%	90%	88%	91%	90%	96%	93%	86%	97%	94%	88%	91%
NSH Patient Days	8377	10011	8990	9156	9407	9044	9951	9323	8898	10070	9070	9127	9285

Year 2	APR '16	MAY '16	JUN '16	JUL '16	AUG '16	SEP '16	OCT '16	NOV '16	DEC '16	JAN '17	FEB '17	MAR '17	MEAN
Mean Access Block	81%	103%	107%	129%	133%	139%	119%	98%	124%	107%	103%	112%	113%
EC Monthly Head Count	3593	3740	3394	3635	3889	3604	3745	3631	3678	3737	3238	3437	3610
NSH Mean Bed Occupancy	84%	91%	92%	85%	86%	90%	88%	102%	101%	85%	88%	89%	90%
NSH Patient Days	8441	9468	9210	8809	8913	8891	9142	10232	10460	8834	8261	9226	9157

Table 1 – Mean Access Block (MAB), EC monthly head count, Whole Hospital Mean Bed Occupancy (BOR) and Patient Days (PD) over the period April 2015 to March 2017

Fig. 1.

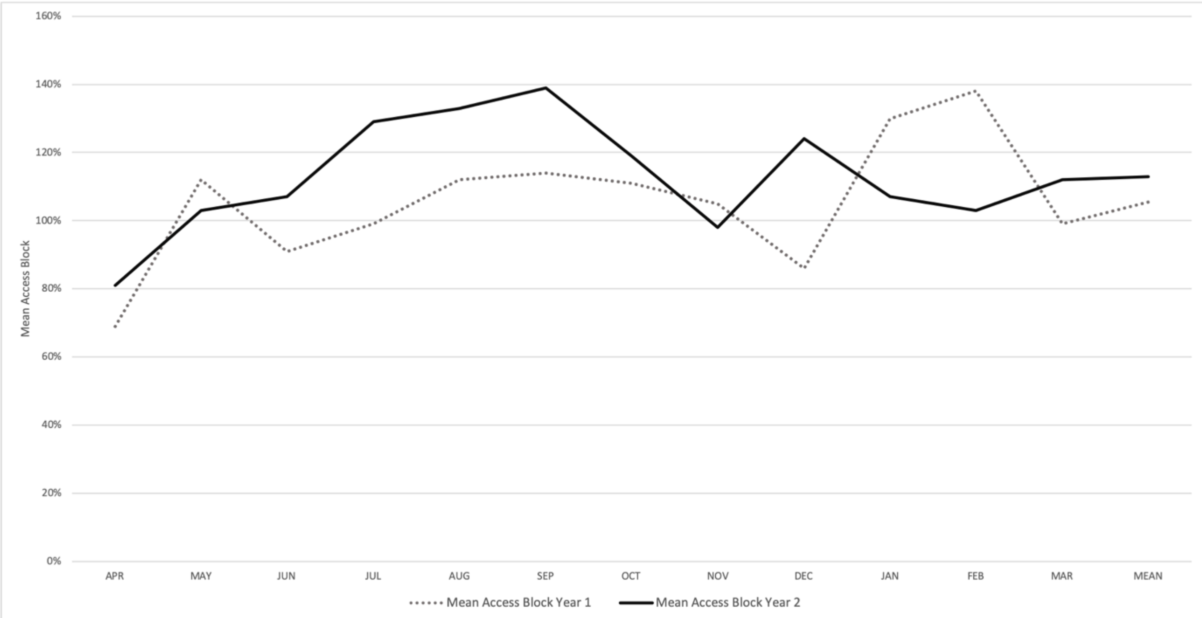

Figure 1 – Mean Access Block (MAB) Year-on-year April 2015 to March 2017

Fig. 2.

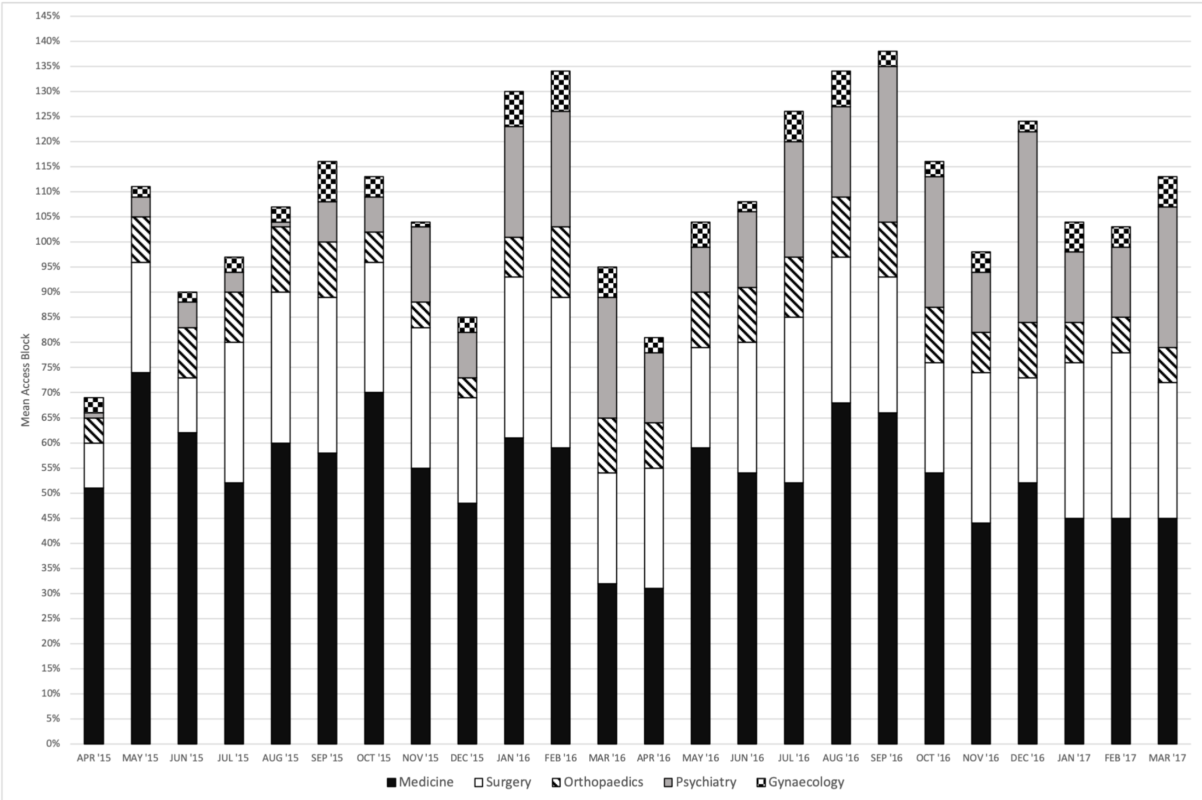

Figure 2 – Mean Access Block (MAB) from April 2015 to March 2017 separated into contribution of boarders by each individual Specialty Discipline

Fig. 3.

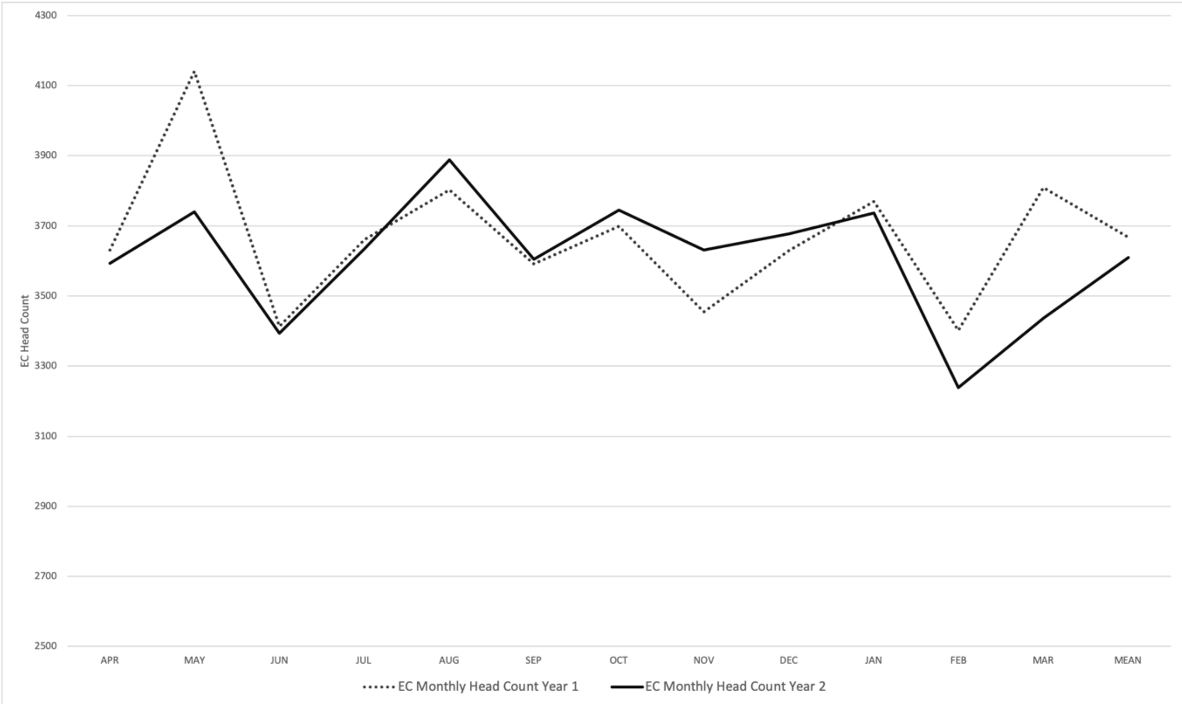

Figure 3 – EC Monthly Head Count year-on-year April 2015 to March 2017

Fig. 4.

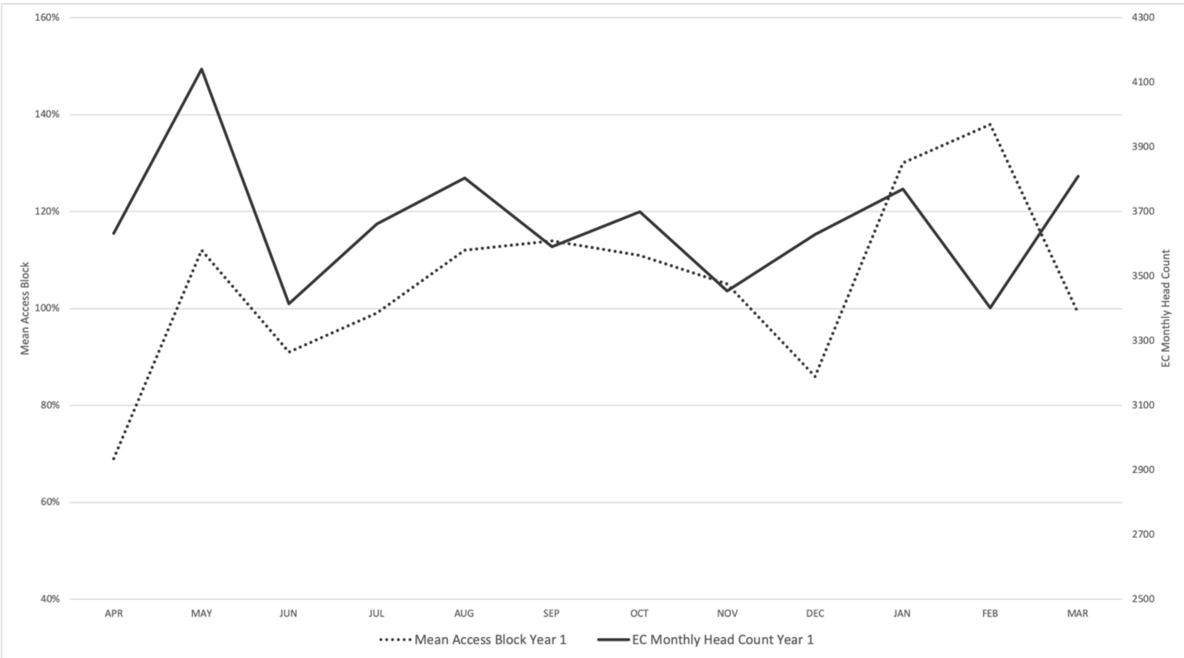

Figure 4 – Mean Access Block (MAB) vs EC monthly head count Year 1 (April 2015 to March 2016)

Fig. 5.

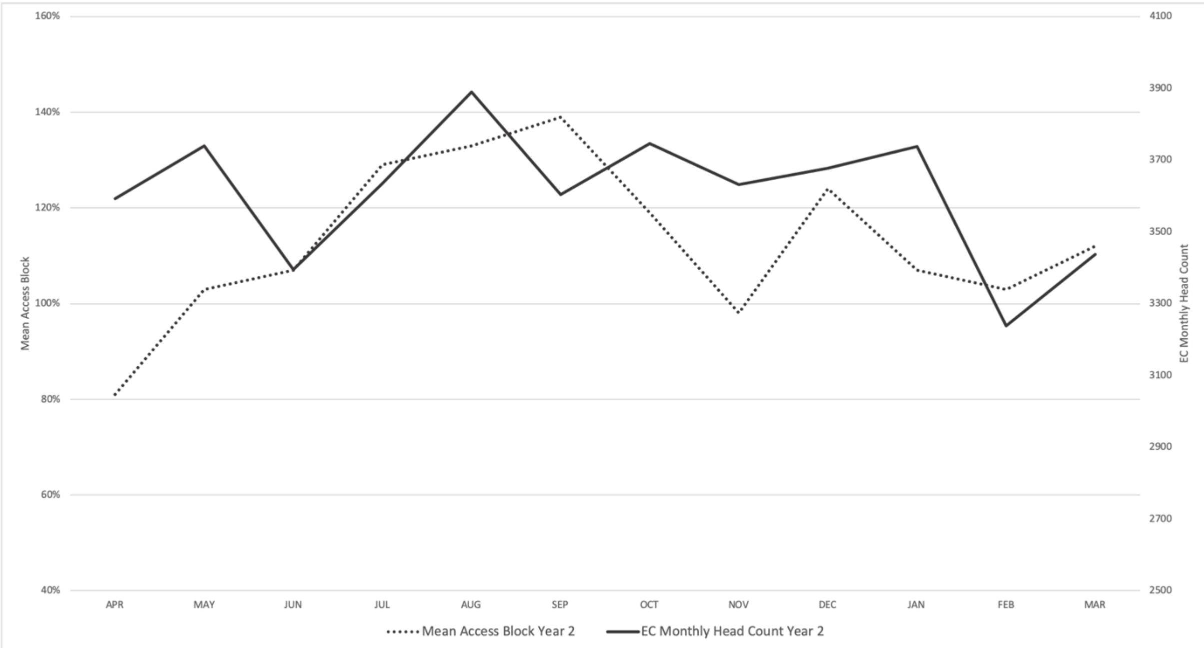

Figure 5 – Mean Access Block (MAB) vs EC monthly head count Year 2 (April 2016 to March 2017)

Fig. 6.

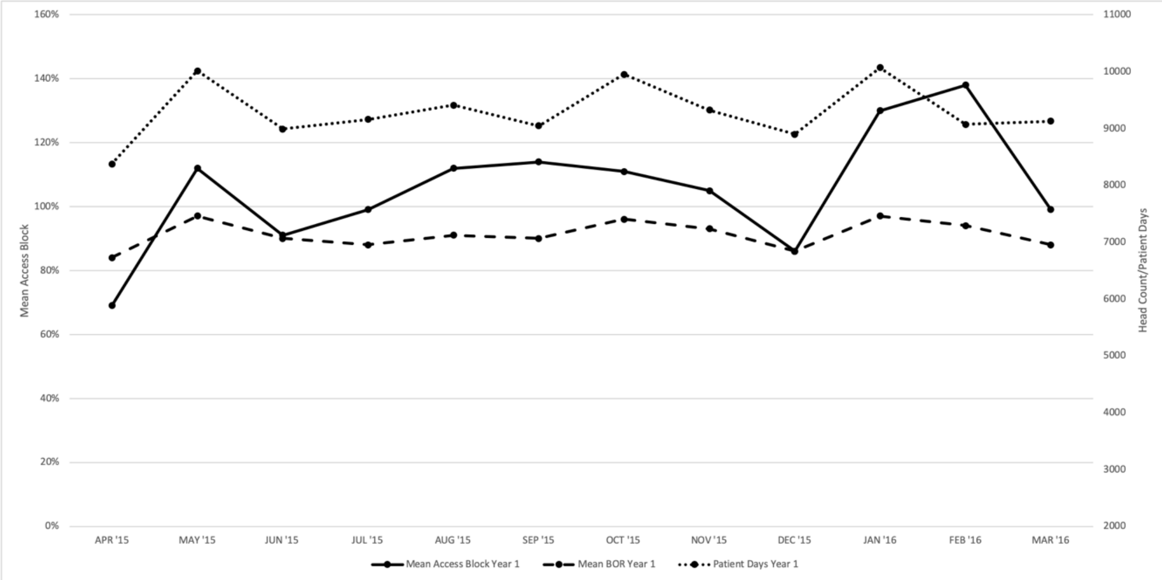

Figure 6 – Mean Access Block (MAB) vs Mean Hospital Bed Occupancy (BOR) and Patient Days Year 1 (April 2015 to March 2016)

Fig. 7.

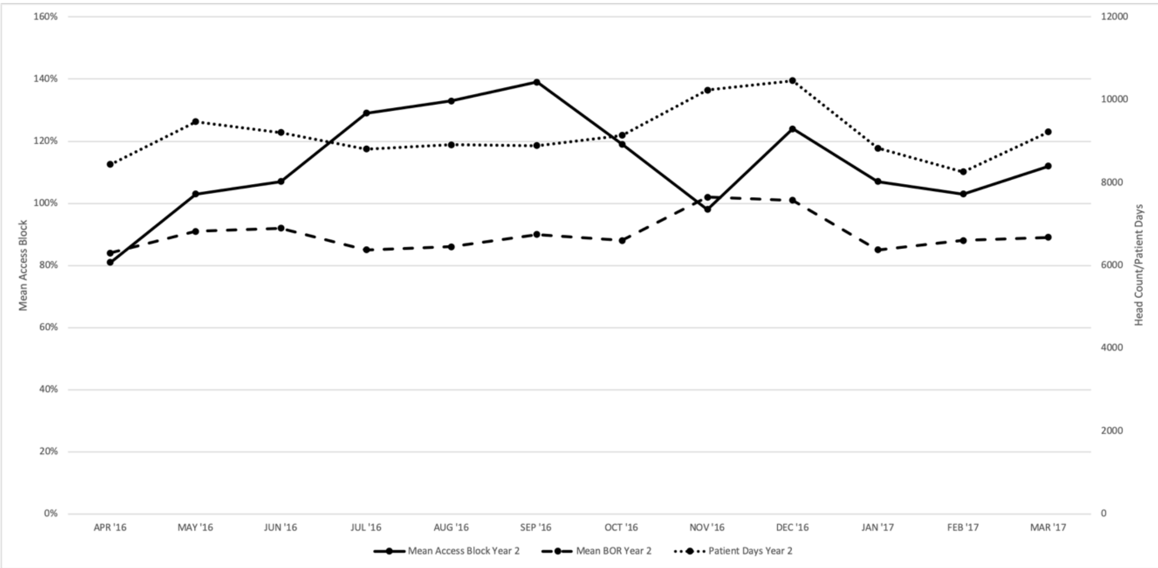

Figure 7 – Mean Access Block (MAB) vs Mean Hospital Bed Occupancy (BOR) and Patient Days Year 2 (April 2016 to March 2017)

Part C: APPENDICES

APPENDIX 1 – Research Protocol

Research Proposal: Cohort study of access block trends in a public, regional hospital Emergency Centre in South Africa

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Declaration

I, David Hermanus Schoeman hereby declare that the work on which this thesis is based is my original work (except where acknowledgements indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree in this or any other university.
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Signature: *David Schoeman*

Date: 14 March 2017

Cohort study of access block trends in a public, regional hospital Emergency Centre in South Africa

1. **Introduction**

Access block is probably the most serious and most frequently encountered systems problem in the specialty of Emergency Medicine in the world, and Emergency Centre (EC) staff face it on a daily basis. The phenomenon has been well described in North America over the last twenty years[(1-4)], and has received much attention in Australasia[(5-10)] where it has been defined by the Australasian College for Emergency Medicine (ACEP) as "the situation where patients who have been admitted and need a hospital bed are delayed from leaving the Emergency Department (ED) because of lack of inpatient bed capacity"[(11)]. ACEP further defines overcrowding as "this refers to the situation where ED function is impeded primarily because the number of patients waiting to be seen, undergoing assessment and treatment, or waiting for departure exceeds the physical or staffing capacity of the department"[(12)]. Where it has been described in various countries, alternative terminology such as "boarders" and "Emergency Department Overcrowding" (EDOC) have been used in equal reference to these phenomena[(4, 5, 13)].

In some countries, the time from triage to final disposition plan from the EC has been set as a measure of EC performance, and time from disposition plan up to admission to a ward has been set and accepted as a benchmark measure of access block [(7)]. The National Health Service (NHS) in the UK has set a target of four (4) hours[(14)] from arrival to discharge/transfer/admission. Australasia has set a target of eight (8) hours[(11, 15, 16)] from disposition plan to admission. The Canadian Association of Emergency Physicians (CAEP) has committed to six (6) hours from disposition plan to ward admission[(17)]. In the Western Cape, the provincial Department of Health has set a target of six (6) hours of "boarding" patients in the Emergency Centre from disposition plan to admission as one of the indicators of hospital efficiency[(18)]. Despite these targets, access block has steadily grown due to several established and other unknown factors[(6, 8, 19)]. Studies such as Dunn's [(20)] description of the significant reduction in an Australian EC's waiting times following a decrease in hospital inpatient bed occupancy, have suggested the scale of impact of access block to inpatient beds on the overall EC waiting times. Fatovich[(5)] evaluated and described the direct effect of access block on total hospital and ambulance diversion, EC waiting times and occupancy which were all increased in correlation with high levels of access blocked patients. Access block does not only have an effect on adult populations, but also poses similar difficulties with emergency paediatric presentations as described by Hostetler *et al.* in Chicago [21] in 2009.

A feature which aggravates the overall impact of access block is the degree of complexity and sheer number of factors contributing to and affected by it. With the aim to provide a summary of evidence on the subject of access block from around the world, Forero and Hillman published a literature review on access block and overcrowding[22] in 2008 which identified and reported 27 different factors which are in isolation or combination causes of access block and overcrowding, or affected by it. The report also stated an alarming estimated 20-30% higher mortality rate which could be attributed to the phenomena [23, 24]. Furthermore, some of the studies included in the review reported that with changes in population demographics, urbanization, improved access to healthcare and social infrastructure, there was an increase in EC visits and subsequent hospital admissions over time. Thus, the need for more hospital inpatient beds increased, but despite the efforts made to increase the number of beds to keep the available beds per population stable, it was overshadowed by the amount of EC visits and hospital admissions (due to ageing population, increased complexity of chronic conditions, etc.). This EC overcrowding had a significant effect on patients (their care, mortality, satisfaction, etc.), the biggest effect being on vulnerable population groups. It also impacted greatly on EC staff. Increased work-related stress, decreased staff satisfaction and thus a frequent decrease or loss of clinical hours due to absence or forced contract changes further propagate the problem from a workforce perspective.

Access block should be viewed as an illness, with several causes, symptoms and treatment strategies. As already suggested, the availability of fully staffed inpatient beds is probably the largest contributor to or cause of access block[6, 7, 20, 25, 26]. The lack of available inpatient beds is a function of emergency demand as well as emergency admissions and bed capacity[10]. Other causes that have been identified include patient flow through the EC[5, 19], optimal hospital inpatient bed occupancy, demand of inpatient beds from other sources such as elective admissions[26] as well as the level of experience of the staff. Thornton and Hazell[27] described the improvement in access block and EC performance when an EC and wards in a hospital in South Auckland, Australia were staffed by more senior staff (Fellows from the Australasian College for Emergency Medicine) to compensate for staff shortages during a junior doctor strike. The senior staff's experience resulted in faster discharges, reduced bed occupancy and therefore reduced access block. This, combined with their clinical experience resulted in improved EC performance (reduced patient waiting times and EC length of stay). Interestingly, although the above suggested that better qualified and more experienced staff has a positive effect on access block, access block may have a reciprocal negative effect on training staff. Mahler *et al*[28] described that during shifts with EC overcrowding residents saw less patients and performed less procedures. The role of optimum hospital inpatient bed occupancy is complex and falls outside the scope of this discussion.

The "symptoms" of access block and overcrowding have major impact on multiple factors, and consequently attempts have been made to quantify or measure its effect [7, 28-32]. Several strategies have been implemented to manage access block across the world[2, 9, 13, 20, 25, 29], with the consensus that attempts to reduce inappropriate or non-urgent EC visits, ambulance diversions or placing a GP-like service in an EC for low acuity patients have no effect[31] on EC overcrowding. The largest contributors to an improvement in access block include improved discharge planning, early discharge and patient flow, the implementation of holding units and buy-in from political leadership with prioritising resources (more beds and better staff allocation)[9, 10, 13].

Although the above describes how these phenomena have been major factors in the performance of EC's in other countries, very little research on access block and its causes and effect in the South African setting has been done. The author has failed to find any relevant literature published on access block in local (national or provincial) emergency centres. This identified a gap in our understanding of the magnitude and effect of overcrowding and access block in the South African setting with the resources available. This study aims to describe the access block encountered at a regional hospital's Emergency Centre over a 24-month period.

Daily statistics of boarding patients by discipline have been collected by the New Somerset Hospital Emergency Centre management during the morning consultant handover round since April 2015. The purpose was to communicate the number of boarders to other departments to improve flow from the EC and aid in quality assurance. This information was accompanied by the hospital bed status by ward and discipline to identify possible movement. The data collection is a continuing process and assists in initiating escalation policies when necessary.

1.1 Aim

The aim of this retrospective observational cohort analysis is to describe and critically appraise the access block of admitted adult patients (boarders) in the Emergency Centre of New Somerset Hospital (NSH), a regional hospital in Cape Town, South Africa over a 24-month period from April 2015 to April 2017.

1.2 Objectives

To describe the total number of adult patients referred and/or admitted to a specialty (boarders) as well as the number of patients per specialty which causes access block to the Emergency Centre of New Somerset Hospital as it has been recorded daily over a 24-month period.

To describe the monthly variation of degree of access block over the proposed time period.

To describe the correlation of monthly variation of degree of access block to monthly head count of adult patients seen in the Emergency Centre over the same time period.

To describe the correlation of monthly variation of degree of access block to monthly variation in adult whole-hospital bed occupancy.

To describe any interventions during the study time to effect access block, such as the appointment of a bed manager, and the subsequent effect on access block as a function of head count variation, boarder number variation and hospital bed occupancy rates.

2. Methods

2.1 Study Design

The study will be a retrospective, descriptive study of a database interrogation.

2.2 Study population and setting

New Somerset Hospital is a regional government-sector hospital in Cape Town, Western Cape province of South Africa. The hospital has an Emergency Centre which caters for and accepts patients from a large drainage area covering the city bowl and a large part of the West Coast. The study population is adult patients who daily present to the Emergency Centre, either as self-presenting patients, primary presentations brought in by ambulance, inter-facility transfers referred to the EC or directly to other specialties. A daily head count of all patients is kept by the hospital's Clinicom® electronic patient registry and reported on a monthly basis in a clinical Functional Business Unit (FBU) report along with the monthly hospital inpatient bed occupancy rates. The number of all adult patients referred to a specialty for admission is recorded at least daily in a boarding patient database for quality assurance. The investigator will interrogate the FBU reports and boarder patient database for the data. For this discussion, the following inclusion and exclusion criteria will apply:

2.2.1 Inclusion Criteria:

- For the monthly head count report:
  - Adult patients (13 years and older) presenting to the Emergency Centre.
- For the hospital inpatient bed occupancy:
  - Adult patients (13 years and older) admitted to dedicated specialty hospital beds
- For the boarding patient database:
  - Adult patients (13 years and older) referred to a clinical specialty for admission by the Emergency Centre clinical staff
  - Adult patients (13 years and older) directly referred to a clinical specialty for admission from another facility or external practitioner via the Emergency Centre.
  - Adult patients (13 years and older) brought to the Emergency Centre from a specialist Outpatient Department for non-elective admission.

- o Adult patients (13 years and older) brought to the Emergency Centre from an inpatient ward for emergency care or resuscitation when there is no immediate set-up bed (high care or ICU) available

- The above data sets falling in the time period between and including April 2015 and March 2017.

2.2.2 Exclusion criteria:

- All Paediatric patients (younger than 13 years of age) as they are assessed in a separate part of the Emergency Centre and access block to the paediatric wards have not commonly experienced.

- Adult patients referred from other facilities for special investigations (e.g. ultrasound or Computer Tomography scans) and waiting in the Emergency Centre whilst in-transit

- Patients discharged from the Emergency Centre and awaiting transport

- Patients referred to specialties and sub-specialties not located at New Somerset Hospital and awaiting transport

- Terminally ill patients expected to imminently die who are palliated and who will not be admitted because of this.

- Data sets before April 2015 or after March 2017.

2.3 Research procedures and data collection methods

The number of boarding patients (by specialty and in total) referred to or admitted by a specialty in the New Somerset Hospital Emergency Centre are recorded daily during the EC consultant morning handover ward round and written down in a "ward round book". No name, demographic or clinical information is recorded, and the data is purely used for routine performance and quality assurance. The numbers are transcribed to a computer database on a weekly to bi-weekly basis for storage. Over the study period this will provide an estimated sample of 730 raw data sets. The database will be interrogated to obtain the data for analysis which falls within the time-period parameters of the study. The Emergency Centre patient head count and hospital inpatient bed occupancy rates are collected on the Clinicom®

electronic patient registry. This data is distributed to each department each month in a clinical Functional Business Unit (FBU) report for performance and quality assurance. The variables required for the study will be extracted from the reports using the inclusion criteria as an initial starting point.

2.4 Data Safety

An access-controlled office computer at New Somerset Hospital is used for database storage. The database and reports will be interrogated by the investigator and a Microsoft© Excel™ spreadsheet will be used for data analysis. As the data only consists of numbers with no patient details, there is no safety or confidentiality concern.

2.5 Data Analysis

Basic descriptive statistics will be used to summarise the data samples of boarder numbers over time, EC patient head count and hospital inpatient bed occupancy rates, which will include central tendency (described using mean or median) and variance (described using standard deviation or interquartile range). Variables will be expressed as numbers and proportions. Where appropriate confidence intervals will be provided.

As the samples are multivariate, graphical representation via scatterplots will be used to describe relationships between variables, as well as quantitative measure of dependence. These comparisons and correlations will be described through regression analysis (chi-squared test) to demonstrate the relation to any intervention.

3. Ethical Considerations

This study complies with the principles of the Helsinki Declaration of 2013.

3.1 Description of risks and benefits.

Once collected, the data will be used to describe access block to the Emergency Centre by specialty over time and the variations in both. Once analysed the data should provide a good overview for the hospital as well as regional and provincial Health Department of the impact of Emergency Centre access block and perhaps allow further research into key findings from this study that will allow better understanding of how to measure the impact of access block on health parameters such as whole hospital mortality.

The data will be extracted as numerical values which makes it unlikely for a breach of patient confidentiality to occur.

The author therefore anticipates minimal risk, not exceeding the everyday risk standard.

3.2 Informed consent process.

Due to the retrospective design, the proposed benefit and low risk of the study, individual consent is not anticipated, and a waiver of consent will be requested from the Human Research Ethics Committee. However, permission will be sought from departmental and institutional management.

3.3 Privacy and confidentiality.

The study team has no individual interest in patients as the study aims to describe variables in groups. There is no patient data captured thus the risk to breaching of privacy or confidentiality is low.

3.4 Reimbursement of participation.

Given the study design, there will be no reimbursement for participation.

4. Limitations

- The research team will not be blinded to the details of the study and objectives
- As a retrospective study design, this study is limited by the nature of the design as it is dependent on the accuracy of its source material and bound by the parameters and endpoints set in advance. It is recognised that records may be missing or incomplete which may impact data analysis. This will be reported in the dissertation discussion.

- The study will be done at a single regional hospital therefore external validity may not be always present.
- There will be seasonal variations from surge conditions, as well as unpredicted mass events which may affect the internal validity and statistical significance of the findings.
- Although all patients referred to a specialty will be classified as boarders and added to the boarding patient database, some patients may be assessed by the specialty team and deemed not for admission and hence discharged, thereby skewing the data.

5. **Dissemination of Findings**

The findings of this study will be made available to the New Somerset Hospital institutional and Emergency Centre management for review, as a basis for further research or the development of protocols within its scope of practice. The results will also be made available to the Western Cape Provincial Department of Health as a basis for further research on its part related to the findings of this study, or potentially contribute to the development of national guidelines. Finally, the results may be used for publication in a peer-reviewed journal.

6. **Projected Timeline**

From the point of Ethics approval, the projected timeline will culminate in final submission in 6 months:

Month 1: EMDRC

Month 2: SxDRC

Month 3: HREC

Month 4: Data transcription and Statistical Analysis

Month 4-5: Write-up

Month 5: Submission of final draft to supervisors for approval

Submission for examination

7. **Resources Utilisation**

Resource	Responsibility
Transport	Self
Telecommunication and Internet	Self
Stationary (including data storage)	Self
Statistics	Centre for Evidence Based Healthcare, SUN

7.1 Budget projection

Expense	Detail	Cost	Units	Total
Transport	Travel expense to NSH	R1.51/km (AA rates)	30km	R45.30
Telecommunication	Cell phone calls	R540/mth incl of 300minutes	30min	R54
Stationary	Printing/Data storage	Devices already owned	R200	R200
Statistics	Statistical analysis for write-up	R200/hr and subsidised for first 2hrs	2hrs	R0
Grand Total				R299.30

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APPENDIX 2 – Data Collection Tool

	1	2	3	4	5	6	7	8	9	10
Total										
Medicine										
Surgery										
Orthopaedics										
Psychiatry										
Gynaecology										
Afternoon										
Total										
Medicine										
Surgery										
Orthopaedics										
Psychiatry										
Gynaecology										

	1	2	3	4	5	6	7	8	9	10
Access Block	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	MEAN
Mean Access Block													#DIV/0!
EC Monthly Head Count													#DIV/0!
NSH Mean Bed Occupancy													#DIV/0!
NSH Patient Days													#DIV/0!

APPENDIX 3 – Emergency Medicine Division Research Committee Approval

EMDRC
This document is for committee review of applications to the Emergency Medicine Division Research Subcommittee. All comments on this document with the exception of those placed in the confidential area may be shared with the researcher

RESEARCH REVIEW MEETING FEEDBACK

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*Required fields

EMDRC reference (office use):	EM2016.034

About the meeting

05/04/2017

About the project

(The boxes below will automatically expand to include your text on populating. Please note the maximum allowed character count per box)

Project title*

Cohort study of access block trends in a public, regional hospital Emergency Centre in South Africa

Project lead*

Dawie Schoeman

Decision*

Proposal accepted. Please follow the guidance on www.emct.info for Ethics submission

Meeting comments*

Committee is happy for you to move forward and submit to HREC provided you address the issues raised by the reviewers to your supervisors satisfaction. In particular, the description of the methods needs more detail (i.e. how will the critical appraisal be done) and you need to describe how "boarders" are defined.

The committee recommends the following items (all marked). Please address in a cover letter with your resubmission how you intend to address these*

☒ None

☐ Referral to writing centre recommended

☐ Further (choose an item) training is required

☐ Digital literacy training is required

The following additional review material is included in the feedback. Please let us know if you did not receive any of these.*

☒ Reviewer reports (number 2)

☒ Annotated proposals (number 1)

☐ Other material (0)

Review matrix:*	Very unlikely	Unlikely	Neutral	Likely	Very likely
Feasible in terms of resources	☐	☐	☐	☒	☐
Feasible in terms of costs	☐	☐	☐	☒	☐
Feasible in terms of time-line	☐	☐	☐	☒	☐

EMDRC
This document is for committee review of applications to the Emergency Medicine Division Research Subcommittee. All comments on this document with the exception of those placed in the confidential area may be shared with the researcher

RESEARCH REVIEW MEETING FEEDBACK

Appropriate for intended degree	☐	☐	☐	☐	☒
Publishable	☐	☐	☐	☐	☒

Signature Removed

Dr Colleen J. Saunders

Signature*

Meeting chair*

APPENDIX 4 – Institutional Approval

Western Cape Government
Health

NEW SOMERSET HOSPITAL

Enquiries: Dr. D Stokes
Contact: 021 402 6408
Email: dstokes@westerncape.gov.za

Dear Dr Schoeman

PERMISSION TO CONDUCT A RESEARCH STUDY AT NEW SOMERSET HOSPITAL

Research Proposal: Cohort Study of Access Block trends in a public, regional hospital Emergency Centre in South Africa.

I am pleased to inform you that your request to conduct a study at New Somerset Hospital with Prof. Dickerson is provisionally approved, pending Human Research Ethics Committee Approval Letter. You will be required to submit your request to the Health Research Department at Head Office for their approval, as all research requests are considered centrally at Head Office and allocated a unique research number.

Contact person: Josh-Lee Kroukamp Josh-lee.Kroukamp@westerncape.gov.za

Please note that the above-mentioned approval should be obtained prior to the commencement of your research at NSH.

We wish you all the success in your studies.

Yours Sincerely

Signature Removed

Dr. Donna Stokes
Chief Executive Officer
New Somerset Hospital

Date: 01 February 2018

Beach Road, Green Point, Cape Town, 8001
tel: +27 21 402 6408 fax: +27 21 402 6409

Private Bag, Green point, 8051
www.capegateway.go.v.za

APPENDIX 5 – Human Research Ethics Committee Approvals

UNIVERSITY OF CAPE TOWN
Faculty of Health Sciences
Human Research Ethics Committee

Room E53-46 Old Main Building
Groote Schuur Hospital
Observatory 7925
Telephone [021] 406 6626
Email: shuretta.thomas@uct.ac.za
Website: www.health.uct.ac.za/fhs/research/humanethics/forms

16 March 2018

HREC REF: 079/2018

Prof Roger Dickerson
Emergency Medicine
New Somerset Hospital
Private bag
Greenpoint
8005

Dear Prof Dickerson

PROJECT TITLE: COHORT STUDY OF ACCESS BLOCK TRENDS IN A PUBLIC, REGIONAL HOSPITAL EMERGENCY CENTRE IN SOUTH AFRICA (MMED CANDIDATE - DR D SCHOEMAN)

Thank you for submitting your response to the Faculty of Health Sciences Human Research Ethics Committee.

It is a pleasure to inform you that the HREC has **formally approved** the above-mentioned study.

Approval is granted for one year until the 30 March 2019.

Please submit a progress form, using the standardised Annual Report Form if the study continues beyond the approval period. Please submit a Standard Closure form if the study is completed within the approval period.
(Forms can be found on our website: www.health.uct.ac.za/fhs/research/humanethics/forms)

Please quote the HREC REF in all your correspondence.

Please note that the ongoing ethical conduct of the study remains the responsibility of the principal investigator.

Please note that for all studies approved by the HREC, the principal investigator **must** obtain appropriate institutional approval, where necessary, before the research may occur.

The HREC acknowledge that the student, Dr David Schoeman will also be involved in this study.

Yours sincerely

Signature Removed

PROFESSOR M BLOCKMAN
CHAIRPERSON, FHS HUMAN RESEARCH ETHICS COMMITTEE
Federal Wide Assurance Number: FWA00001637.

HREC 079/2018

UNIVERSITY OF CAPE TOWN
IYUNIVESITHI YASEKAPA • UNIVERSITEIT VAN KAAPSTAD

HUMAN RESEARCH
ETHICS COMMITTEE
2 8 MAR 2019
HEALTH SCIENCES FACULTY
UNIVERSITY OF CAPE TOWN

FACULTY OF HEALTH SCIENCES
Human Research Ethics Committee

FHS017: Annual Progress Report / Renewal

Record Reviews/Audits/Collection of Biological Specimens/Repositories/Databases/Registries

HREC office use only (FWA00001637; IRB00001938)			
This serves as notification of annual approval, including any documentation described below.			
☑ Approved	Annual progress report	Approved until/next renewal date	30·03·2020
☐ Not approved	See attached comments		
Signature Chairperson of the HREC	Signature Removed	Date Signed	01/04/2019

Principal Investigator to complete the following:

1. Protocol information

Date (when submitting this form)	28/03/2019		
HREC REF Number	079/2018	Current Ethics Approval was granted until	30/03/2019
Protocol title	Cohort study of access block trends in a public, regional hospital Emergency Centre in South Africa (MMed Candidate – Dr D Schoeman)		
Principal Investigator	Roger Dickerson		
Department / Office Internal Mail Address	Division of Emergency Medicine, Department of Surgery, University of Cape Town / New Somerset Hospital, Portswood Road, Green Point 8005		
1.1 Does this protocol receive US Federal funding?		☐ Yes	✓ No

2. Protocol status (tick ✓)

☐	Research-related activities are ongoing
✓	Data collection is complete, data analysis only
Please indicate (in the block below) the titles and HREC reference numbers of any projects currently making use of the Database/registry/repository.	
Cohort study of access block trends in a public, regional hospital Emergency Centre in South Africa (MMed Candidate – Dr D Schoeman) HREC REF Number: 079/2018	

3. Protocol summary

Total number of records or specimens collected, reviewed or stored since the original approval	700	
Total number of records or specimens collected, reviewed or stored since last progress report	N/A	
Have any research-related outputs (e.g. publications, abstracts, conference presentations) resulted from this research? If yes, please list and attach with this report.	☐ Yes	✓ No

4. Signature

Signature of PI	Signature Removed	Date	28/03/2019

APPENDIX 6 – Instructions for Authors

The authors selected the South African Medical Journal (SAMJ) for publication as the core of the study demonstrates the lack of research into the phenomenon of Access Block within the South African and African contexts. SAMJ is also an open access journal which allows a broader audience access to the study's findings – particularly from similar resource constrained environments.

The preparation and publication instructions for authors as published on the SAMJ website (http://www.samj.org.za/index.php/samj/about/submissions#authorGuidelines) are:

- **General article format/layout**

Accepted manuscripts that are not in the correct format specified in these guidelines will be returned to the author(s) for correction, which will delay publication.

General:

- Manuscripts must be written in UK English.
- The manuscript must be in Microsoft Word format. Text must be single-spaced, in 12-point Times New Roman font, and contain no unnecessary formatting (such as text in boxes).
- Please make your article concise, even if it is below the word limit.
- Qualifications, ***full*** affiliation (department, school/faculty, institution, city, country) and contact details of ALL authors must be provided in the manuscript and in the online submission process.
- Abbreviations should be spelt out when first used and thereafter used consistently, e.g. 'intravenous (IV)' or 'Department of Health (DoH)'.
- Include sections on Acknowledgements, Conflict of Interest, Author Contributions and Funding sources. If none is applicable, please state 'none'.
- Scientific measurements must be expressed in SI units except: blood pressure (mmHg) and haemoglobin (g/dL).
- Litres is denoted with an uppercase L e.g. 'mL' for millilitres).
- Units should be preceded by a space (except for % and ºC), e.g. '40 kg' and '20 cm' but '50%' and '19ºC'.

- Please be sure to insert proper symbols e.g. μ not u for micro, α not a for alpha, β not B for beta, etc.
- Numbers should be written as grouped per thousand-units, i.e. 4 000, 22 160.
- Quotes should be placed in single quotation marks: i.e. The respondent stated: '...'
- Round brackets (parentheses) should be used, as opposed to square brackets, which are reserved for denoting concentrations or insertions in direct quotes.
- If you wish material to be in a box, simply indicate this in the text. You may use the table format –this is the *only* exception. Please DO NOT use fill, format lines and so on.

SAMJ is a generalist medical journal, therefore for articles covering genetics, it is the responsibility of authors to apply the following:
- Please ensure that all genes are in italics, and proteins/enzymes/hormones are not.
- Ensure that all genes are presented in the correct case e.g. TP53 not Tp53.
**NB: Copyeditors cannot be expected to pick up and correct errors with regards to the above, although they will raise queries where concerned.
- Define all genes, proteins and related shorthand terms at first mention, e.g. '188del11' can be glossed as 'an 11 bp deletion at nucleotide 188.'
- Use the latest approved gene or protein symbol as appropriate:

- Human Gene Mapping Workshop (HGMW): genetic notations and symbols
- HUGO Gene Nomenclature Committee: approved gene symbols and nomenclature
- OMIM: Online Mendelian Inheritance in Man (MIM) nomenclature and instructions
- Bennet et al. Standardized human pedigree nomenclature: Update and assessment of the recommendations of the National Society of Genetic Counsellors. J Genet Counsel 2008;17:424-433: standard human pedigree nomenclature.

Research

Guideline word limit: 4 000 words

Research articles describe the background, methods, results and conclusions of an original research study. The article should contain the following sections: introduction, methods, results, discussion and conclusion, and should include a structured abstract (see below). The introduction should be concise – no more than three paragraphs – on the background to the research question, and must include references to other relevant published studies that clearly lay out the rationale for conducting the study. Some common reasons for conducting a study are: to fill a gap in the literature, a logical extension of previous work, or to answer an important clinical question. If other papers related to the same study have been published previously, please make sure to refer to them specifically. Describe the study methods in as much detail as possible so that others would be able to replicate the study should they need to. Results should describe the study sample as well as the findings from the study itself, but all interpretation of findings must be kept in the discussion section, which should consider primary outcomes first before any secondary or tertiary findings or post-hoc analyses. The conclusion should briefly summarise the main message of the paper and provide recommendations for further study.

Select figures and tables for your paper carefully and sparingly. Use only those figures that provided added value to the paper, over and above what is written in the text.
Do not replicate data in tables and in text .

Structured abstract

- This should be 250-400 words, with the following recommended headings:
  - **Background:** why the study is being done and how it relates to other published work.
  - **Objectives:** what the study intends to find out
  - **Methods:** must include study design, number of participants, description of the intervention, primary and secondary outcomes, any specific analyses that were done on the data.
  - **Results:** first sentence must be brief population and sample description; outline the results according to the methods described. Primary outcomes must be described first, even if they are not the most significant findings of the study.
  - **Conclusion:** must be supported by the data, include recommendations for further study/actions.
- Please ensure that the structured abstract is complete, accurate and clear and has been approved by all authors.
- Do not include any references in the abstracts.

Main article

All articles are to include the following main sections: Introduction/Background, Methods, Results, Discussion, Conclusions.

The following are additional heading or section options that may appear within these:

- Objectives (within Introduction/Background): a clear statement of the main aim of the study and the major hypothesis tested or research question posed
- Design (within Methods): including factors such as prospective, randomisation, blinding, placebo control, case control, crossover, criterion standards for diagnostic tests, etc.
- Setting (within Methods): level of care, e.g. primary, secondary, number of participating centres.
- Participants (instead of patients or subjects; within Methods): numbers entering and completing the study, sex, age and any other biological, behavioural, social or cultural factors (e.g. smoking status, socioeconomic group, educational attainment, co-existing disease indicators, etc)that may have an impact on the study results. Clearly define how participants were enrolled, and describe selection and exclusion criteria.
- Interventions (within Methods): what, how, when and for how long. Typically for randomised controlled trials, crossover trials, and before and after studies.
- Main outcome measures (within Methods): those as planned in the protocol, and those ultimately measured. Explain differences, if any.

Results

- Start with description of the population and sample. Include key characteristics of comparison groups.
- Main results with (for quantitative studies) 95% confidence intervals and, where appropriate, the exact level of statistical significance and the number need to treat/harm. Whenever possible, state absolute rather than relative risks.
- Do not replicate data in tables and in text.
- If presenting mean and standard deviations, specify this clearly. Our house style is to present this as follows:
- E.g.: The mean (SD) birth weight was 2 500 (1 210) g. Do not use the ± symbol for mean (SD).

- Leave interpretation to the Discussion section. The Results section should just report the findings as per the Methods section.

Discussion

Please ensure that the discussion is concise and follows this overall structure – sub-headings are not needed:

- Statement of principal findings
- Strengths and weaknesses of the study
- Contribution to the body of knowledge
- Strengths and weaknesses in relation to other studies
- The meaning of the study – e.g. what this study means to clinicians and policymakers
- Unanswered questions and recommendations for future research

Conclusions

This may be the only section readers look at, therefore write it carefully. Include primary conclusions and their implications, suggesting areas for further research if appropriate. Do not go beyond the data in the article.

Access to the Instructions for Authors may be found through
http://www.samj.org.za/index.php/samj/about/submissions#authorGuidelines
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APPENDIX 7 – Turnitin Report

Turnitin Originality Report

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