ENSIGN COLLEGE OF PUBLIC HEALTH

FACTORS INFLUENCING CROWDING AND PATIENTS FLOW IN THE EMERGENCY DEPARTMENT: A CASE STUDY OF TEMA GENERAL HOSPITAL

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DECLARATION AND CERTIFICATION

I, **Lawrence Lartey** declare that this work is my original work and has not been published or submitted to any other institution of learning for any award. Where work and ideas or concepts have been taken or adapted from other authors, these have been properly cited and referenced.

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DEDICATION

I, **Lawrence Lartey** dedicate this work to my wife Sonia Lartey. In pursuit of academic excellence you have been a backbone to me. You have been very supportive since day one on this academic journey. God bless you. When God gave me to you, He gave you the very best. Your unconditional love and enthusiastic spirit and unflinching support have made me into the better man that I am today.

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OPERATIONAL DEFINITION OF TERMS

1. **CEDOCS score** is an objective way of measuring Emergency Department crowding
2. **Door-to-doctor time** is the time it takes for a patient to be attended to for the first time after triaging
3. **Dwelling time** is the time taken for disposition to be carried out concerning a patient
4. **ED overcrowding** is defined as the situation where ED function is impeded primarily because the number of patients waiting to be seen, undergoing assessment and treatment, or waiting to leave exceeds the physical and/or staffing capacity of the ED
5. **ED Boarder** is defined as admitted patients waiting to be placed in an inpatient bed
6. **ED Occupancy** is the total volume of patients in the ED compared to the total number of officially designated ED treatment spaces.
7. **Throughput Factors** refers to activities within the emergency department that can hinder or promote patient flow
8. **Triaging** is a method of ranking sick or injured people according to the severity of their sickness or injury in order to ensure that medical and nursing staff and facilities are used most efficiently as well as the assessment of injury intensity and the immediacy or urgency for medical attention

ABBREVIATIONS/ACRONYMS

ACEM	Australasian College for Emergency Medicine
ACEP	American College of Emergency Physicians
AIDS	Acquired Immunodeficiency Syndrome
ATS	Australasian Triage Scale
CAEP	Canadian Association of Emergency Physician
CATS	Canadian Triage and Acuity Scale
CEDOCS	Community Emergency Department Overcrowding Scale
CI	Confidence Interval
D-DT	Door-to-Doctor Time
DT	Dwell Time
DR	Doctor
EC	Emergency Center
ED	Emergency Department
EDOR	Emergency Department Occupancy ratio
EDWIN	Emergency Department Work Index
EMPC	Emergency Management Planning Committee

ER	Emergency Room
ESI	Emergency Severity Index
HIV	Human Immunodeficiency Virus
KATH	Komfo Anokye Teaching Hospital
LOS	Length of Stay
LWBS	Leaving Without Been Seen
MCNZ	Medical Council of New Zealand
MTS	Manchester Triage Score
NEDOCS	National Emergency Department Overcrowding Scale
NHIS	National Health Insurance Scheme
OPD	Out Patients Department
SATS	South African Triaging Scale
SD	Standard Deviation
TGH	Tema General Hospital
USA	United States of America
WHO	World Health Organization

ABSTRACT

There is a general impression that most Emergency Departments are crowded and that affects the quality of care of patients that visit the ED. This research sought to study the factors that influence crowding and patients flow at the ED of Tema General Hospital (TGH). To do this two throughput factors (door-to- doctor time and dwell time) were studied. In order to objectively and statistically access the crowding status of the ED, the Community Emergency Department Overcrowding Study (CEDOCS) was adopted and overall impact of ED crowding on patient outcome was also accessed.

A prospective cross-sectional study was conducted capturing adult patients seen or waiting to be seen at the Adult ED of TGH from Monday to Sunday, over a 1 month period (1st December – 31st December 2016).

A total of 560 patients were enrolled into the study. From the results, hospital related factors were found to significantly (p-value of 0.003 at 95% confidence interval) contribute to crowding at the ED, and ED boarding (53.3%) was the most statistically significant indicator. The ED on the average operated above capacity (average ED occupancy of 140%) for the entire duration of the study. The average door-to-doctor was 31 minutes and that of dwell time was 4.12hours. The average CEDOCS score was found to be 80. From the study 6 days were found to be busy, 21 days extremely busy and 4 days overcrowded. The percentage ratio of patients who died during non-crowded moments was 7% and 14% during crowding moments at the ED. A test of association to establish whether the crowding status influenced mortality at the ED revealed a calculated Chi^2 test statistics of 7.3776 with a p-value of 0.007. In conclusion, patients flow at the ED was influenced by hospital related factors and ED crowding impacts negatively on patient outcome.

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CHAPTER ONE

1.0 INTRODUCTION

Preventive healthcare is a major component of every health care delivery system. It is important to note however that, despite primary preventive measures likes diet, exercises, cessations of smoking (Buttar *et al*., 2005) medical emergencies still occur. And when they do there must be a prompt response to avert mortality. This phenomenon has no regional discrimination.

Despite the great developmental successes chalked in the advanced countries, health systems continue to have challenges. For the health of a nation to be sustainable, there has to be a well-established medical emergency response that would mitigate otherwise adverse health outcomes. Emergency Preparedness is a term that conceptually relates to the response and the actions taken in anticipation of an unforeseen condition with the goal to facilitate rapid, effective and appropriate response to the situation (IASC 2007). It is therefore important to recognize the interrelation between health outcomes and emergency management.

According to the World Health Organization (WHO), the health status of an individual is defined as "the state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity" (WHO 1946). This state characterized by anatomic, physiologic and psychological integrity; ability to perform personally valued family work and community roles; ability to deal with physical, biologic, psychological and social stress a feeling of well-being; and freedom from the risk of disease and untimely death (Stokes *et al*., 1982). When this state is diseased there are implications. The health impact of people and its overall effects on the health of a population is important (European Centre for Health Policy 1999).

On this backdrop when people are diseased and their condition is such that they warrant emergency care it is imperative on the health care delivery system of the state to provide adequate emergency care services to all such persons. This introduces the relevance of Emergency medicine as defined by the Emergency Medicine Planning Committee (EMPC), of the American College of Emergency Physicians (ACEP) as the medical specialty dedicated to the diagnosis and treatment of unforeseen illness or injury which practice includes the initial evaluation, diagnosis, treatment, coordination of care among multiple providers, and disposition of any patient requiring expeditious medical, surgical, or psychiatric care (EMPC 2016).

The main unit within the hospital setting that handles emergencies is the Emergency Department (ED). Due to the peculiar nature and work that goes on at the ED, there are legal ramifications of its operations and implications for proper or poor management hence most EDs are established under legal codes and regimes. For example according to the Medical Council of New Zealand (MCNZ), it is a doctor's duty to help in a medical emergency and a doctor is at risk of being professionally or criminally responsible if he or she fails to render prompt and appropriate medical care to any person (whether the patient is a current patient or not). Operating in such a legal framework a doctor who chooses not to attend must have good reason and be able to defend this position at a later time (Medical Council of NewZealand 2006). There are however instances when some doctors have complained that because of the overwhelming nature of the work at the ED they are unable to promptly attend to all cases at the ED.

In the case of Ghana, the Ministry of Health Policy and Guidelines for Hospital Accident and Emergency services in Ghana (2011) states that, there shall be an area in the health facility which shall be designated as Accidents and Emergency Department which shall operate a 24-hour service and provide initial treatment for a broad spectrum of illnesses and injuries, which may be

life threatening and require immediate attention (Ministry of Health 2011). This presupposes that the ED is a vital component of every exiting hospital in Ghana as stipulated by the Ministry of Health. Emergency departments throughout the world are confronted with a myriad of challenges. Chief among these challenges are overcrowding where approximately half of all EDs report operating near or above maximum capacity (McHugh *et al.,* 2011). Patient flow at the Emergency Room (ER) is also affected where some patients because of overcrowding leave the ED without their care being completed (Niska *et al.,* 2010). In the United States this category of patients who leave the ED without complete care accounts for 2% of all ED visits (Niska *et al.*, 2010). According to the American College of Emergency Physicians, optimal utilization of the ED includes the timely evaluation, management, and stabilization of all patients (ACEP 2011). This is practically the main functions of the ED which translates ultimately into quality patient care and timeliness of interventions.

There are mass emergencies in the form of mass casualties from accidents, natural disasters and in the current global era of terrorism, terrorist attack can complicate the already existing crowding at the ED. Overcrowding has a direct impact on care received at the ED and it is the leading cause of concern over patients safety and the care rendered to patients by health care providers (Carrus *et al*., 2009). Several sources have voiced concerns about disaster preparedness in crowded EDs. A single massive incident is not all that is required to stress a saturated system (Trzeciak & Rivers 2003). A common and popular proposal and response to crowding is to create more room within the department to accommodate the influx of patients. It has been suggested nonetheless, that increasing capacity in an already inefficient system only serves to potentiate the problem, not solve it (Bazzoli *et al.,* 2003; Greene 2007). Overcrowding is therefore a major ED concern throughout the world (Carrus *et al.,* 2009). It is therefore important

to study and examine the intrinsic and extrinsic factors within the ED and the hospital that contribute significantly to crowding. This will assist policy makers to proffer effective solutions and maximize efficiency within the systematic establishment of the ED subsequent to considering spatial expansion. In Ghana not much research has been done when it comes to overcrowding in ED in various hospitals across the country. This therefore has created a policy and knowledge gap in the local context of the intricacies and challenges of overcrowding and the seeming impact on the overall outcome of health delivery. Overcrowding in the ED is therefore an important area of research to embark on.

1.1 BACKGROUND OF THE STUDY

All over the world health researcher focus on areas that have a direct impact on survival and evidence based policy formulations. This is not entirely the case in Africa though the trend is gradually changing within the past decade. One such survey conducted in the USA looked at 250 EDs and their findings that was published in the Annals of Emergency Medicine 2003 discovered the following; 11% of them regularly were on diversion, 73% had two or more boarded patients, 59% used hallways for patients, 38% doubled up patients in rooms, and 47% used non-clinical space for patient care (Schneider *et al*., 2003).

This situation is not foreign to most EDs in the USA and this situation has been termed as "crowding". As alarming as these statistics sound, those within the realm of emergency care know that it is not new and, most importantly, the problem is getting worse (Derlet & Richards 2000). On this backdrop the question is asked about the African situation. What is the crowding status in the TGH ED in Ghana a developing African country?

1.2 PROBLEM STATEMENT

There are several dangers of overcrowding at the ED which eventually threatens quality and access to health care (Morris *et al*., 2012). Overcrowding at the ED has several implications. The ED of Tema General Hospital (TGH) is usually crowded with patients and visiting patient relations. This has been suggested to affect treatment given to the patients and their survival outcomes. Crowding is also said to impair dignity, privacy, and completeness of care**.** Errors are increased with ED crowding (Weissman *et al*., 2007) and many of these are errors of omission rather than errors of commission since the emergency staff must simultaneously care for inpatients and focus on the new emergencies coming in the door (Cowan & Trzeciak 2005).

Although overcrowding has been the topic of discussion among many emergency physicians, the lay press, and legislators, few scientific studies actually document and analyze the problems (Kellermann 2000; Trzeciak & Rivers 2003). ED crowding is associated with delayed and no receipt of antibiotics in the ED for patients admitted with community-acquired pneumonia (Pines *et al.,* 2007). Patients in overcrowded EDs receive delayed care and there is an association between waiting times in the ED and increased 7-day mortality, perhaps reflecting lower quality of care from an overcrowded accident and emergency department (Guttmann *et al*., 2011). These dangers are worth noting and studying the likely causes of overcrowding in order to propose possible solution with a case study of the ED of TGH.

1.3 RATIONAL OF THE STUDY

The situation of overcrowding is common to most EDs and its attendant complications are well documented in most advanced countries and this has informed and influenced health care policy

reforms in the EDs of those countries. This particular research seeks to establish a base line of evidential material and analysis that could contribute in informing health care policy makers with regards to satisfactory and efficient health care provision at TGH. This research will also form a building block to health care data of the ED that is already available to Ghana. Future research can be built on this particular research. Overcrowding has led to prolonged patient waiting times, resulting in increased suffering for those who are kept waiting on trolleys and in wheel chairs at the ED for hours and in some cases even days. This compromises the main objective function of the ED. It is important for health administrators to understand likely factors influencing overcrowding in order to inform further decisions in curbing the problem.

1.4 HYPOTHESES

1. There is an association between Community Emergency Department Overcrowding Study Score (CEDOCS) and Patient Outcome of Mortality at the ED.
2. Boarding Volume contributes significantly to crowding at the ED.
3. There is an association between triage category and mortality.
4. The number of trolleys and wheel chairs can predict the crowding status of the ED
5. The number of doctors on duty at the ED contributes significantly to overcrowding.
6. The number of nurses on duty at the ED contributes significantly to overcrowding.

1.5 RESEARCH QUESTIONS

1. What are the patient factors influencing crowding at the ED?
2. What are the door-to-doctor time and dwell time of patients at the ED?
3. What is the daily modified CEDOCS?
4. What is the daily staffing strength and work load at the ED?

1.6 GENERAL GOAL

To improve healthcare service delivery at the Emergency Department at TGH and influence policy decisions in that regard.

1.7 PRIMARY AIM

The primary objective of the study is to assess factors influencing crowding and patients flow in the emergency department using Tema General Hospital as a test case

1.8 SPECIFIC OBJECTIVES

1. To review input, throughput and output factors in relation to ED overcrowding.
2. To evaluate factors both intrinsic and extrinsic to the emergency department (ED) that influence crowding at the ED.
3. To measure two specific components of throughput: “door-to-doctor” time and “dwell” time at the ED.
4. To estimate the CEDOCS for the studied facility.

1.9 PROFILE OF TEMA GENERAL HOSPITAL

Tema General Hospital (TGH) was constructed in 1954 by J.W Harrow and Sons Limited to provide health care for the Tema Habour workers but was later handed over to the Government of Ghana in 1962 with a vision to be the leading health care provider in Tema Metropolis and its environs. By way of mission, the TGH exists to promote, protect and ensure the health and wellbeing of the clients and the community at large. Situated in a highly industrial city, TGH is close to three major highways namely Accra-Tema Motorway, Tema-Aflao and Tema-Akosombo. TGH is currently a 294 bed facility with 14 wards which serves a catchment population of over 900,000 following the 2010 census. This catchment area extends from

Dangme West and Dangme East Districts, Tema Metropolis with its surrounding towns and villages, Teshie, Nungua, Tema Newtown, Kpone, Ashiaman, Afienya, Kakasunanka, Appolonia, Dawhenya, Prampram, Klagon and newly springing up communities like Lashibi and Sakumono. TGH is the biggest health facility and the major referral health facility in the Tema Metropolis and it provides 24-hour General and Specialist services as well as tuition and attachment for students studying subjects in health as well as National Service Personnel.

As of 2014, the total number of permanent doctors working in TGH was 37 and the total number of House Officers was 46. For the same period the total number of permanent nurses working in TGH was 389 and 209 nurses were either on rotation or on attachment. The hospital has over 20 departments, units and clinics. These include Departments of Obstetrics and Gynecology, General Surgery, Out-Patient Department, Reproductive and Child Health Care/Family Planning, Dental Department, Ophthalmology Department, Public Health Department, Pediatrics Department, Internal Medicine Department/Intensive Care Unit, Accident and Emergency Department, Physiotherapy Department, department of Pathology, Community Mental Health Unit, Neonatal Intensive Care Unit, Radiology Department, In-Service Training Unit, Sickle Cell Clinic, Diabetic Clinic, Dermatology Clinic, Ear Nose and Throat Clinic, Fever's Unit, Chest Clinic, Antiretroviral Clinic, Clinical Engineering Unit, Health Information Unit etc. The total OPD attendance for 2014 was 161,019 patients.

The Adult Emergency Department was started in 2013 and has a 14 bed ward which attends to patient aged 13years and above with urgent and critical health care needs. The vision of the ED is "to be known for our efficient, responsive service and highly quality emergency care. The ED had a total of 8,346 and 7,874 patients on admission for 2015 and 2016 respectively (Ward In-Charge of TGH ED, 2017).

1.10 SCOPE OF STUDY

The research focuses on data and materials mainly from 2000 that are relevant to the research. Some of the information used may date back year 2000. Concerning the subject matter information from across the globe was used but mainly that of the USA and Europe.

1.11. ORGANIZATION OF THESIS

This research is organized into five Chapters. Chapter One deals with the general introduction and background of the study. The problem statements, justification and hypothesis as well as the aims and objectives to be achieved at the end of the research are captured in this chapter. Chapter Two deals with the literature review relevant to the subject of overcrowding and patient flow at the ED. The laid down protocols and workings of the ED are discussed in this chapter.

Various works from previous researches were referenced to in this chapter and any existing theoretical framework with regards to triaging and patient acuity as well as intrinsic and extrinsic factors that influence ED work were cited. Any other relevant material that enriched the study was discussed. Chapter Three deals with the methods and methodology of this research. Chapter Four captures the results of the study and the analysis of same. Chapter Five is a general and specific discussion around the study. Chapter Six presents the summary, conclusions and recommendations of the study for purposes of policy formulations.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 INTRODUCTION TO ED OVERCROWDING

The emergency center at Komfo Anokye Teaching Hospital (KATH) in Kumasi, Ghana, represents the first formalized Emergency Center (EC) in West Africa. Opened in 2009, the Emergency Center serves as the regional training and referral center for injury and trauma management (Rominski *et al.,* 2014). The main function was to provide emergency services to Ghanaians and other nationals within the West African Sub region. Following this creation, formalization of emergency service provision has become an integral part of health care provision in Ghana.

In 1991 the American College of Emergency Physicians (ACEP) adopted the definition of emergency services as "those health care services provided to evaluate and treat medical conditions of recent onset and severity that would lead a prudent layperson, possessing an average knowledge of medicine and health, to believe that urgent and/or unscheduled medical care is required" (American College of Emergency Physicians 1991). For this to be realized there has to be efficient and effectively functioning Emergency Department (ED). However one of the main hindrances in most EDs is the issue of crowding or overcrowding.

ED overcrowding is basically a demand and supply mismatch and it was first identified as a problem more than 25 years ago (Dickinson 1989). Emergency Department crowding has been found to be a global problem (Moskop *et al.,* 2009) that is associated with poor quality of care

and negative patient outcomes (Carter *et al.*, 2013). Emergency nurses have reported perceived decreases in the quality of care provided to patients during periods of crowding at the ED (Bernstein *et al*., 2009) (Garson *et al*., 2008). Crowding has also been found to be associated with delays in ED care and that delays in resuscitation efforts occur more frequently on crowded days associated with higher in-hospital mortalities (Hong *et al*., 2013). Crowding happens in all emergency departments and is associated with increased mortality, reduced quality of care and staff burnout (College of Emergency Medicine 2014). This makes the subject of ED crowding a critical one in any health care system.

2.2 DEFINING ED OVERCROWDING

Several authorities have attempted to define what ED overcrowding is. Though no single strict definition exists for ED Overcrowding, similar concepts exist for this all important phenomenon that almost all EDs face throughout the world. According to Gordon et al. ED overcrowding refers to an extreme volume of patients in ED treatment areas, forcing the ED to operate beyond its capacity (Gordon *et al.*, 2001). This definition focuses on patient volume and operational capacity as the main variables to consider in ED crowding. In the USA, ED overcrowding has been well documented where for instance in a 2001 report, 91% of US ED directors (525 out of 575 directors) reported problematic crowding in their departments, and 39% reported overcrowding on a daily basis (Derlet *et al.*, 2001).

According to a survey conducted by the American Hospital Association in 2001, there was an indication that the percentage of large hospital EDs that were consistently operating ‘at or above capacity’ had reached 90% (Lewin Group 2002). Overcrowding usually leads to extremely long wait times, especially for those patients who are not critically ill. This leads to patient

dissatisfaction, patient walkouts, and the potential for compromised medical care. The Australasian College for Emergency Medicine (ACEM) defines ED 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 to leave exceeds the physical and/or staffing capacity of the ED (Aacharya *et al.,* 2011). This introduces the concept of physical capacity and staffing as important features of ED overcrowding.

The ACEP Crowding Resource Task Force in 2002 adopted the following definition of ED Crowding, "a situation in which the identified need for emergency services outstrips available resources in the ED". This situation occurs in hospital EDs when there are more patients than staffed ED treatment beds and wait times exceed a reasonable period (EMPC 2016). The important and additional concept that the ACEP definition introduces is wait times. According to the task force, crowding involves an inability to appropriately triage patients, with large numbers of patients accumulating in the ED waiting area of any triage assessment category. This definition highlights some of the key determinants of overcrowding namely ED treatment beds, wait times and patient volume.

2.3 INPUT-THROUGHPUT-OUTPUT CONCEPTUAL MODEL

In order to understand the concept of ED overcrowding a conceptual model has to be adopted. According to most ED models the number of patients at the ED at any given time is a function of three variables: **input, throughput, and output.** Asplin *et al.* in 2003 developed a conceptual model of ED crowding to assist researchers, administrators, and policymakers understand the causes and develop potential solutions to ED crowding (Asplin *et al.,* 2003). This scholarly conceptual model partitions ED crowding into 3 interdependent components: input, throughput,

and output. This was basically to assist the major stakeholders to alleviate ED crowding. It is absolutely necessary for the stakeholders to understand the main causes of crowding before effective solutions and interventions can be made.

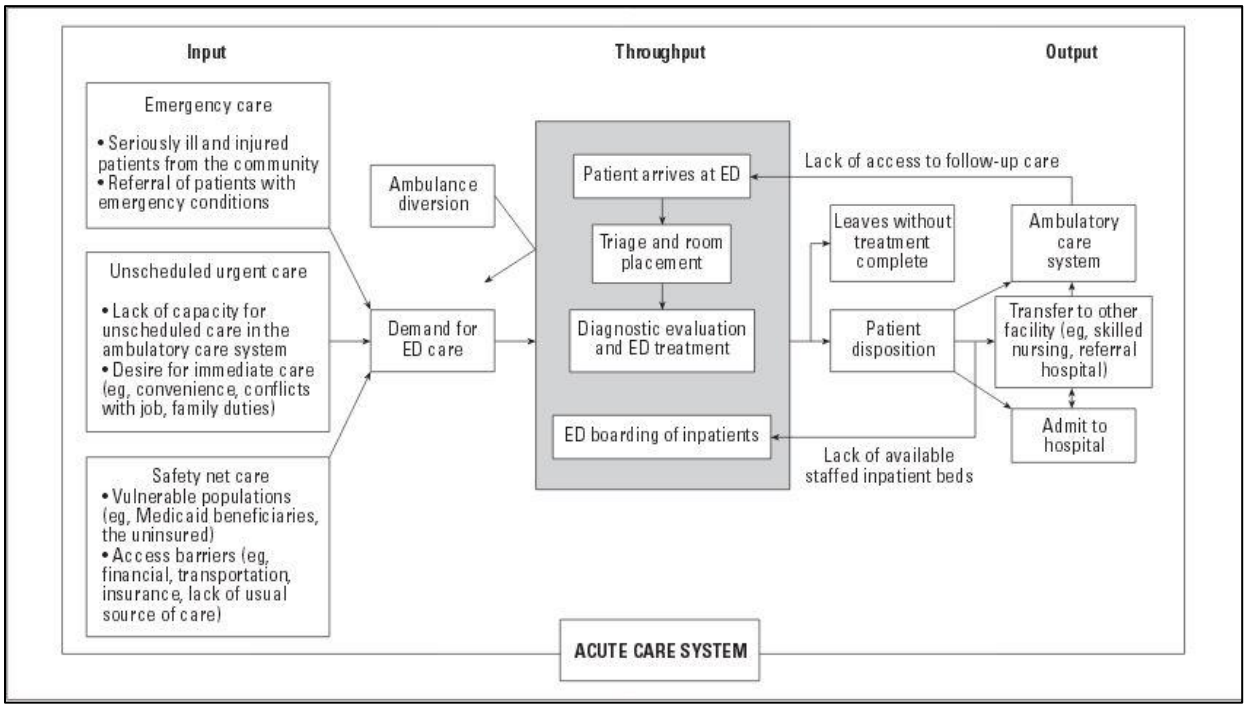


Fig 2.1: Asplin's model of acute care (Asplin *et al*., 2003)

2.4 INPUT COMPONENT

Input factors include patient volume, the acuity and type of patient. There are three stratification of the input factors; Emergency care, unscheduled urgent care and Safety net care (Asplin *et al.*, 2003). The characteristic of the input factors contributes to the demand aspect for ED services provision. The properties of the input components are not so different from similar models of health care utilization. Andersen and Laake's Behavioral Model of Healthcare Utilization describes three (3) factors that affect health care use: patient need for health care services, predisposing factors that affect an individual's likelihood of seeking care, and enabling factors that affect an individual's ability to receive care (Andersen & Laake 1987). These factors are

similar and parallel to the input factors of ED crowding. For purposes of this study emphasis will be placed on the Throughput and Output factors.

2.5 THROUGH PUT COMPONENT

The Throughput component refers to activities within the emergency department that can hinder or promote patient flow. This throughput component of the model identifies patient length of stay in the ED as a potential contributing factor to ED crowding (Asplin *et al.*, 2003). There are 4 primary throughput phases in the model. These include patient arrival at the ED, room placement, and the initial provider evaluation and waiting time for the first physician's examination and lastly ED boarding. Several successful EDs routinely complete triage and room placement within 10 minutes of patient arrival and the initial physician evaluation within 10 minutes of room placement (Hoffenberg *et al*., 2001).

The throughput factors take into consideration the nurse and physician staffing, if diagnostic testing are efficient and readily available as well as how communication flows at the ED with accessible medical information and specialty consultancy. The efficiency of the ED is determined by this phase. The main factor that determines whether a patient ends up at the ED is triaging and it plays a direct role in patient volume and crowding at the ED.

2.5.1 TRIAGING

Triaging is a major area that plays a significant role in ED overcrowding. Triage is a very brief intervention that should occur within 15 minutes of arrival or registration and normally done in less than 5 minutes upon contact (Bullard *et al*., 2012). The aim is to sort patients' priority for treatment based on their clinical need (Rowe *et al*., 2011). The French word "trier", the origin of

the word “triage”, was originally applied to a process of sorting, probably around 1792, by Baron Dominique Larrey, Surgeon in Chief to Napoleon’s Imperial Guard. Larrey was credited with designing a flying ambulance: the Ambulance Volante. Baron Francois Percy also contributed to the organization of a care system for the ongoing management of casualties. Out of the French Service de Santé, not only emerged the concept of triage, but the organizational structure necessary to handle the growing number of casualties in modern warfare (Robertson-Steel 2006).

The hospital is usually filled with many patients with different health care needs. Before the patients will be sorted out and allowed to be attended to by the particular department for which reason they come to the hospital, the attending nurses must do some form of sorting out at the Out Patient Department. How objective can this sorting be so that patients are promptly seen and attended to in the right department within the hospital? According to the Guidelines for Strengthening Accident and Emergency services in Ghana Triaging is a method of ranking sick or injured people according to the severity of their sickness or injury in order to ensure that medical and nursing staff and facilities are used most efficiently as well as the assessment of injury intensity and the immediacy or urgency for medical attention (Ministry of Health 2011)

The earliest written record of the use of triage in emergency medicine, in a systematic sense, was in the early 1960s at Baltimore, USA (Weinerman *et al.,* 1966). This was a Yale Studies in ambulatory medical care versus determinants of use of hospital emergency services where some two thousand consecutive visits to the emergency services of Yale-New Heaven Hospital were accessed in a two week period. The salient characteristics of those using the emergency service were defined and patterns of medical care were analyzed in relation to urgency of need for emergency treatment and other indexes and factors (Weinerman *et al*., 1966).

The approach and system at the time had lapses in formalization and organization of its emergency services structure. In addition, there was no agreement on the definition categories used for the research. Triage was often performed by clerical staff or by the patients themselves who were asked to choose whether they wished to attend "Medical" or "Surgical Casualty". Over time, many departments began to introduce more formalized systems of triage to meet the demands of modern emergency medicine where 2 to 10 categories were used to assign patients (Fitzgerald 1991). At the same time as more formalized systems appeared, there emerged a focus on ED performance. This led to system-wide performance evaluations of the processes and outcomes. These evaluations aligned the need to ensure patients received appropriate, timely and high-quality care with an accurate breakdown of ED workload (Fitzgerald *et al*., 2010).

Common contexts of triage in contemporary health care practices are pre-hospital care (Weinerman *et al*., 1966), emergency care, intensive care (who to admit), waiting lists (e.g. for lifesaving treatments such as organ transplants) and battlefield situations (Jones & Playforth 2001). In case of emergencies and disasters, three stages of triage have emerged in modern healthcare systems (Robertson-Steel 2006).

1. First, pre-hospital triage in order to dispatch ambulance and pre-hospital care resources.
2. Second, triage at the scene by the first clinician attending the patient.
3. Third, triage on arrival at the hospital ED.

In Ghana it is usually the case that the first level of triaging is done by the nurse at the first point of contact in the hospital then secondly by the ED nurse and then the ED doctor as the third tier. This is due to the peculiar nature of the health care system available.

2.5.2 TRIAGING MODELS

There are various triaging models used worldwide but the most commonly used ED triaging guidelines in international literature is the Manchester Triage Score (MTS), the Canadian Triage and Acuity Scale (CATS), The Australasian Triage Scale (ATS) and Emergency Severity Index (ESI) (Christ *et al*., 2010). These models are widely used in the United Kingdom, Canada, Australia and most of Europe with tens of millions of patients being processed through hospital emergency departments (Christ *et al*., 2010). There are five levels of the Triaging process depending on the model and scale used.

System	Countries	Levels	Patient should be seen by provider within
Australasian Triage Scale (ATS)	Australia New Zealand	1. Resuscitation 2. Emergency 3. Urgent 4. Semi-urgent 5. Nonurgent	Level 1 – 0 minutes Level 2 – 10 minutes Level 3 – 30 minutes Level 4 – 60 minutes Level 5 – 120 minutes
Manchester	England Scotland	1. Immediate (red) 2. Very urgent (orange) 3. Urgent (yellow) 4. Standard (green) 5. Nonurgent (blue)	Level 1 – 0 minutes Level 2 – 10 minutes Level 3 – 60 minutes Level 4 – 120 minutes Level 5 – 240 minutes
Canadian Triage and Acuity Scale(CTAS)	Canada	1. Resuscitation 2. Emergency 3. Urgent 4. Less urgent 5. Nonurgent	Level 1 – 0 minutes Level 2 – 15 minutes Level 3 – 30 minutes Level 4 – 60 minutes Level 5 – 120 minutes

Fig. 2.2: Five Level Triage system (Aacharya *et al.*, 2011)

The Triage Scale for Ghana is an adopted version of the South Africa Triage Scale (SATS) which has among other scales proven to have stood the test of time, has shown to reduce mortality and morbidity, is easily taught and understood, is practical and user-friendly, and found reliable and accurate (Ministry of Health 2011). SATS was introduced in the Emergency Center (EC) of Komfo Anokye Teaching Hospital (KATH) in January 2010. There is a five step approach to triaging when using the SATS.

Fig. 2.3: The five step approach (South African Triage Group 2012)

The concept of triaging is vital to the function of the ED and it is the determinant of acuity prior to ED intervention and this has a direct impact on crowding at the ED. Following a research that was conducted by Rominski *et al*. at KATH where over 903 adult patients were triaged and reviewed at the ED, 7.11% were triaged to Red, and 29.4% were triaged to Orange, 61% to Yellow and 0.3% to Green. This then becomes the main determinant of the time lapse available for the physician to attend to at the ED. According to the SATS the color coding after triaging determines how urgently the patient should be seen and if patient should be admitted to the ED (Rominski *et al*., 2014). This introduces the concept of color coding in emergency triaging and management. The color coding serves also as a determinant to the door–to-doctor time.

2.5.3 Discriminator List

The second part of the SATS is the discriminator list which helps to generate the actual triage colour (red, orange, yellow, green and blue) which will determine urgency level and essentially also when the patient will be attended to. There are however some **discriminators** that require **special attention**. It has been found that physiology alone does not pick up and classify patients with these discriminators safely and effectively. These discriminators therefore serve as a **safety net** for those patients with severe enough pathology to be seen more urgently. Advanced triage protocols have been reported to decrease patient length of stay (Lee *et al*., 1996).

Priority COLOUR	Target time	Management
RED	IMMEDIATE	Take to the resuscitation room for **emergency** management
ORANGE	< 10 mins	Refer to majors for **very urgent** management
YELLOW	< 1 hour	Refer to majors for **urgent** management
GREEN	< 4 hours	Refer to designated area for non-urgent cases
BLUE	< 2 hours	Refer to doctor for certification

Fig 2.4: SATS priority levels and target times for intervention (South African Triage Group 2012)

2.5.4 **Benefits of Triaging** (Ministry of Health 2011).

1. To expedite the delivery of time-critical treatment for patients with life-threatening conditions
2. To ensure that all people requiring emergency care are appropriately categorized according to their clinical condition
3. To improve patient flow
4. To improve patient satisfaction
5. To decrease the patient's overall length of stay
6. To facilitate streaming of less urgent patients
7. To be user-friendly for all levels of health care professionals

2.5.5 ED CROWDING AND TRIAGING

Triaging has been found to be directly related to ED crowding. Connor *et al*. conducted a study where health records of 500 patients presenting to two urban tertiary care EDs with chest pain or shortness of breath, triaged as high acuity and subsequently discharged home were reviewed

(Connor *et al*., 2014). They discovered that during ED crowding, mean time to physician initial assessment was 132.0 minutes in the non-monitored (less acute) area vs. 99.1 minutes in the monitored (more acute) area, $P < 0.0001$.

The mean time to physician initial assessment was significantly longer for those patients triaged when the ED was crowded (107.3 minutes vs. 76.0 minutes, $P < 0.0001$). This goes to indicate that it takes a longer time for patients to be seen by physicians during crowding moments at the ED (Connor *et al.,* 2014). This means that it takes a longer time for a physician to attend to a patient when the ED is crowded compared to when the ED is not crowded after triaging. In instances where the patients are not triaged at all it takes an even longer time for the physician to attend to them in the ED. When a patient is triaged and rendered acute the chances of him/her being attended immediately is higher than with a patient that is triaged as less acute. Therefore, if there are more less acute patients in the ED the stronger the likelihood of the facility experiencing crowding.

Triage destination can greatly influence the course of the patient's visit, including time to assessment, extent of workup, and length of stay in the ED (Yoon *et al.,* 2003). Assignment of a triage score, and subsequent placement in a non-monitored (less acute) vs. monitored (more acute) area of the ED affects physician thinking and decision making about the patient's presentation (Fitzgerald *et al*., 2010). A research conducted by Van der Linden *et al.,* concluded that crowding affects the triage process, leading to longer waiting times to triage and longer ED LOS. Crowding however does not influence triage destination (Van Der Linden *et al.,* 2016).

2.6 ED OCUPANCY AND CROWDING

The ED occupancy rate which is commonly used as a measure of ED crowding is defined by the total number of patients in the ED divided by the number of licensed ED beds (Kulstad *et al.,* 2010). ED Occupancy ratio (EDOR) is defined as the ratio of total number of patients in the ED (admitted and not admitted) to the number of beds in the ED (McCarthy *et al*., 2008). Where the number of ED beds include numbers of beds in all areas of the ED, monitored and non-monitored. In the case of Tema General Hospital and for the purpose of this study, ED beds will include beds as well as trolleys in the ward and the walk way.

Van der Linden *et al*., reviewed 1-year health records of 49,539 patients who visited the ED and the data extracted included: occupancy ratio, ED occupancy, demographics, length of stay (LOS), time to triage, triage score, years working as a triage nurse, and triage destination. Data were analyzed using descriptive statistics and regression analyses (Van Der Linden *et al*., 2016). The study concluded that of the patients, 39.3% (n=19,480) arrived during crowding (ED occupancy ratio>1) and 60.7% of the patients (n=30,059) arrived during non-crowding (ED occupancy ratio≤1). During crowding, more patients stayed more than 4 hours in the ED compared to during non-crowding (19.3% vs. 16%, P<0.001). The study also showed that Higher ED occupancy was also significantly associated with longer LOS (P<0.001) (Van Der Linden *et al.,* 2016). ED occupancy has therefore become an accepted measure of ED crowding.

According to a study done by Sion et al. where data on all patients (total of 54,410) who visited the ED of an urban tertiary academic hospital in Korea for 2 consecutive years were reviewed (Sion *et al.,* 2014). The EDOR was found to be associated with increased 1- to-3 day mortality even after controlling for potential confounders though the not significantly associated with 4-to-

7 day mortalities and overall mortality at discharge (Sion *et al*., 2014). That means, for the first three days of a patient arriving at the ED there is an association between the ED occupancy rate and mortality. Though there is no universally accepted threshold that defines ED crowding (Moskop *et al*., 2009) (Bullard *et al*., 2012). ED occupancy score of greater than 1.5 would indicate that the ED is crowded. Previous studies showed that ED crowding may lead to an increase in waiting room time (Ackroyd-Stolarz *et al*., 2011).

2.7 OUTPUT COMPONENT

The Disposition of patients, availability of inpatient beds, ambulance services, transfers and referrals to other facilities form the major components of the output phase (Asplin *et al.*, 2003).

2.7.1 ED BOARDING

Keeping admitted patients in either the emergency department or some other location of the hospital while awaiting an inpatient bed is often referred to as "boarding." Boarding begins when an Emergency Physician makes the decision to admit and ends when the patient is placed in an appropriate inpatient unit bed or is delivered to surgical or procedural services. If they are inefficient the ED is likely to be overcrowded when these patients are admitted or discharged (Derlet *et al*., 2001). According to Derlet the most commonly cited reason for ED overcrowding is the inability to move patients from the ED to inpatient bed. This concept of ED Boarding interfaces between the throughput and output factors (Derlet *et al.*, 2001).

ACEP has identified "Boarding" as the primary cause of overcrowding (EMPC 2016). Boarding is the practice of holding patients in the emergency department after they have been admitted to the hospital, because no inpatient beds are available. Patients boarded at the ED continue to

consume nurses and physician time and does not allow new patients to be promptly attended to. The presence of boarded patients at the ED means new patients who come to the ED must compete with the boarders for the same beds and this will eventually lead to ED overcrowding. Once the causes and consequences of boarding at the ED is researched into it may be the most important factor and strategy to eliminate ED crowding (Kellermann 2000). Patients who are discharged from the ED must be cleared financially before leaving the ED, other patients who have been referred to other hospitals will have to wait at the ED till inpatients beds are available in these facilities. When the relations of the patients are not available after discharge the patients must board until the relatives finally come to the ED to facilitate financial clearance. All these have the tendency to contribute to ED crowding. Boarding of admitted patients in the ED contributes to lower quality of care, reduced timeliness of care, and reduced patient satisfaction (ACEP 2011). It is important to adopt a particular definition of variables when researching in ED crowding. This is because various authorities and jurisdictions have various definitions that are peculiar to their local situation. For purposes of this research the following definitions will be adopted.

ED Crowding	Definition	Interpretation
A. Input measures		
1. Ambulance Diversion	Ability of ambulances to offload	An ED is crowded when the 90th percentile time between ambulance arrival and offload is greater than 15 minutes
2. Leaving without been seen (LWBS)	Patients who leave without being seen or treated	An ED is crowded when the number of patients who LWBS is greater than or equal to 5%.
3. Time until triage	Time when patient arrives and initial triage begins	An ED is crowded when there is a delay greater than 5 minutes from the time of patient arrival to the beginning of their initial triage

B. Throughput measures		
4. ED occupancy rate	An occupancy rate is the total volume of patients in the ED compared to the total number of officially designated ED treatment spaces.	An ED is crowded when the occupancy rate is greater than 100%.
5. Length of Stay (LOS)	Patients' total length of stay in the ED	An ED is crowded when the 90th percentile patient's; total length of stay is greater than 4 hours
6. Waiting time	Time until a physician first sees the patient	An ED is crowded when an emergent patient waits longer than 30 minutes to be seen by a physician.
C. Output measures		
7. ED boarding time	Boarders are defined as admitted patients waiting to be placed in an inpatient bed.	An ED is crowded when less than 90% of patients have left the ED 2 hour after the admission decision.
8. Number of patients boarding in the ED.	Boarders are defined as admitted patients waiting to be placed in an inpatient bed.	An ED is crowded when there is greater than10% occupancy of boarders in the ED.

Table 2.1: Modified consensus definition of emergency department crowding (Boyle et al. 2012)

2.8 ED CROWDING AND MORTALITY

Richardson performed a retrospective stratified cohort study that compared the mortality rate of all patients who entered an Australian ED during shifts classified as "overcrowded" and an equivalent number during "not overcrowded" shifts in 2002-2004 using 75% occupancy as the definition for ED crowding. During the 736 shifts from both categories of 34,377 overcrowded and 32,231 not overcrowded presentations, 144 deaths occurred in the overcrowded cohort and 101 deaths occurred in the not overcrowded cohort over the 48-week period (0.42% and 0.31%, respectively; p = .025) with a relative risk for 10-day mortality of 1.34 (95% CI = 1.04-1.72) (Richardson 2006). This was a descriptive analysis though it had no statistical analysis to prove

the significance of these findings. This again goes to show how important it is to provide statistical analysis when discussing overcrowding. Suffice to still recognize the implications of ED overcrowding and patient outcome. Mortality is a common patient outcome measure and is commonly used as an indicator of quality of care. The current leaders in ED crowding research use death as a common measure of adverse patient outcomes of ED crowding (Robert Wood Johnson Foundation 2004).

A retrospective cohort analysis of patients admitted in 2007 through the EDs of nonfederal, acute care hospitals in California was conducted on 995,379 ED visits which resulted in admission to 187 hospitals and it was realized that patients who were admitted on days with high ED crowding experienced 5% greater odds of inpatient death (95% confidence interval 2% to 8%) (Sun *et al*., 2013). This gives an indication that the chances of a patient dying is higher in a crowded ED than a non-crowded ED. Statistical analysis should however be conducted to ascertain the validity of this claim.

2.9 INTRINSIC FACTORS AFFECTING PATIENT FLOW

A pilot study was conducted to assess the degree of crowding in hospital EDs and to measure the degree of physical crowding and personnel shortage. To do this a mail survey was sent to a random sample of 250 EDs chosen from a database compiled by the American College of Emergency Physicians of 5,064 EDs in the United States in 2001. The study found that 11% of the ED regularly were on diversion, 73% had two or more boarded patients, 59% used hallways for patients, 38% doubled up patients in rooms, and 47% used non-clinical space for patient care (Schneider *et al.*, 2003). Following this staggering statistics Arkun *et al*. proceeded to study both intrinsic and extrinsic factors that contribute to crowding and patient flow at the ED. There are

two intrinsic components of patient flow "door-to-doctor" time and dwell time (time from disposition to physical transport to in-patient bed) which they studied (Arkun *et al*., 2010). The door time is the time that the patient is first seen and triaged by the nurse and the doctor time is the first time a physician attends to the patient at the ED. The study concluded that the day of the week also proved to be significant with an observed spike in both "door-to-doctor" and dwell times on Mondays. The major determinants of "door-to-doctor" and dwell times were triage category and ED occupancy. They were found to be statistically significant and that there are significant differences in "door-to-doctor" times and dwell times for the triage categories (Arkun *et al*., 2010). The door-to-doctor time and the dwell time are related directly with ED crowding.

2.10 MEASURMENT TOOLS AND SCALES OF ED CROWDING

Currently there is no one single definition for ED crowding and this is because the measurement tools and scales are developed and designed following research in either academic institution, urban or rural ED setting. Many factors such as increased patient volume, nursing staff shortages, decreased inpatient beds, increased acuity of patients entering the ED, and increased number of patients boarded in the ED have been shown to consistently contribute to ED crowding (Magid et al., 2004)(Weiss *et al*., 2006). It is however instructive to note that some of these parameters are good predictors of ED crowding though they are unable to strictly indicate if there is ED crowding in a scientific and objective manner since its application vary from hospital to hospital. No two hospitals talking about overcrowding uses the same characteristics and this makes objectively defining ED overcrowding difficult. Three tools and scales that have been developed over time to objectively measure ED crowding will be discussed below and one such scale will be adopted, modified and used for the purposes of this research. Such tools were first made available by Bernstein *et al* when they developed the Emergency Department Work

Index (EDWIN) in 2003. It used Emergency Severity Index (ESI) triage categories and numerical values about ED capacity which correlated excellently with the nurse/physician assessment of ED crowding (Bernstein *et al.,* 2009). Weiss et al. also set out to develop a simple tool for objectively assessing the degree of overcrowding in a hospital ED. This eventually became known as the National ED Crowding Study score (NEDOCS) (Weiss *et al*., 2004). The purpose of the NEDOCS was to develop a simple screening tool that can be used easily and quickly to determine the degree of ED overcrowding at an academic institution.

The following four subscales were considered in developing the tool:

A. Number of patients at various steps in ED management,
B. Times needed for various steps in ED management,
C. Staffing in the ED, and
D. Diversion status(Weiss *et al.,* 2004).

The results were then tallied on an even Likert-like scale with the following meanings: 1 = not busy, 2 = busy, 3 =extremely busy but not overcrowded, 4= overcrowded, 5 =severely overcrowded, 6 =dangerously overcrowded (Weiss *et al.,* 2004). For interpretation purposes, the 6-point scale was converted linearly to a scale ranging from 0 to 200. Where a NEDOCS score of 100 represented both an ED that was at capacity and the cutoff for overcrowding (0= not busy, 40 =busy, 80 =extremely busy but not overcrowded, 120 overcrowded, 160 severely overcrowded, 200= dangerously overcrowded) (Weiss *et al.,* 2004). The NEDOCS is good for measuring ED Crowding on the National scale and preferably in academic institutions. The NEDOCS and EDWIN were found to be comparable in their prediction of crowding; however, the NEDOCS score showed better statistical significance and was easier to obtain (Weiss *et al*., 2006).

Following the success and acceptance of the NEDOCS for measuring ED crowding Weiss et al. proceeded to develop another tool and scale in 2011 following a research done in 13 community hospitals in California (Weiss *et al.,* 2014). This became known as the Community ED Overcrowding Study Scale (CEDOCS). A prediction model was developed using multivariable linear regression to determine the measures that predicted ED crowding. A parsimonious model was developed to allow for a clinical useful tool that explained a significant amount of variability predicted by the full ED crowding model. The goals of this study were to (1) identify valid variables that correlate with ED crowding and (2) determine a model that can be used in the future to accurate reflect the degree of ED crowding among community hospitals (Weiss *et al*., 2014).

Because Tema General Hospital (TGH) is a community hospital, the CEDOCS model will be adopted for this study. The reduced model was developed based on a model that included predictors that accounted for at least 90% of the variability of the full model or when a predictor variable explained at least 2% of the variability of the outcome (Weiss *et al*, 2014). The model was used to develop a web calculator for determining objectively ED crowding. The formula used to calculate the CEDOCS score is as follows:

A Number of critical care patients,

B Longest time for an admitted patient waiting in the ED since admission,

C Number of patients in the waiting room,

D Number of ED patients to number ED bed ratio, and

E ED visits/ year.

Four new variables were found to be important in the development of the new CEDOCS score:

(1) "Number of hospital beds" was replaced with "number of ED visits/year,"

(2) "Number of respirators" was replaced with "critical care ED patients,"

(3) "Total admits in the ED" is replaced with "number of waiting room patients," and

(4) Waiting room wait time was removed.

These new variables were adopted and used for this research. At the end of the Weiss *et al* research the Web site that they developed allow for easy access to the CEDOCS algorithm online (http://hsc.unm.edu/emermed/cedocs2012d.shtm) (Weiss *et al.*, 2014) http://emed.unm.edu/clinical/resources/cedocs.html (accessed on 17th January 2017)

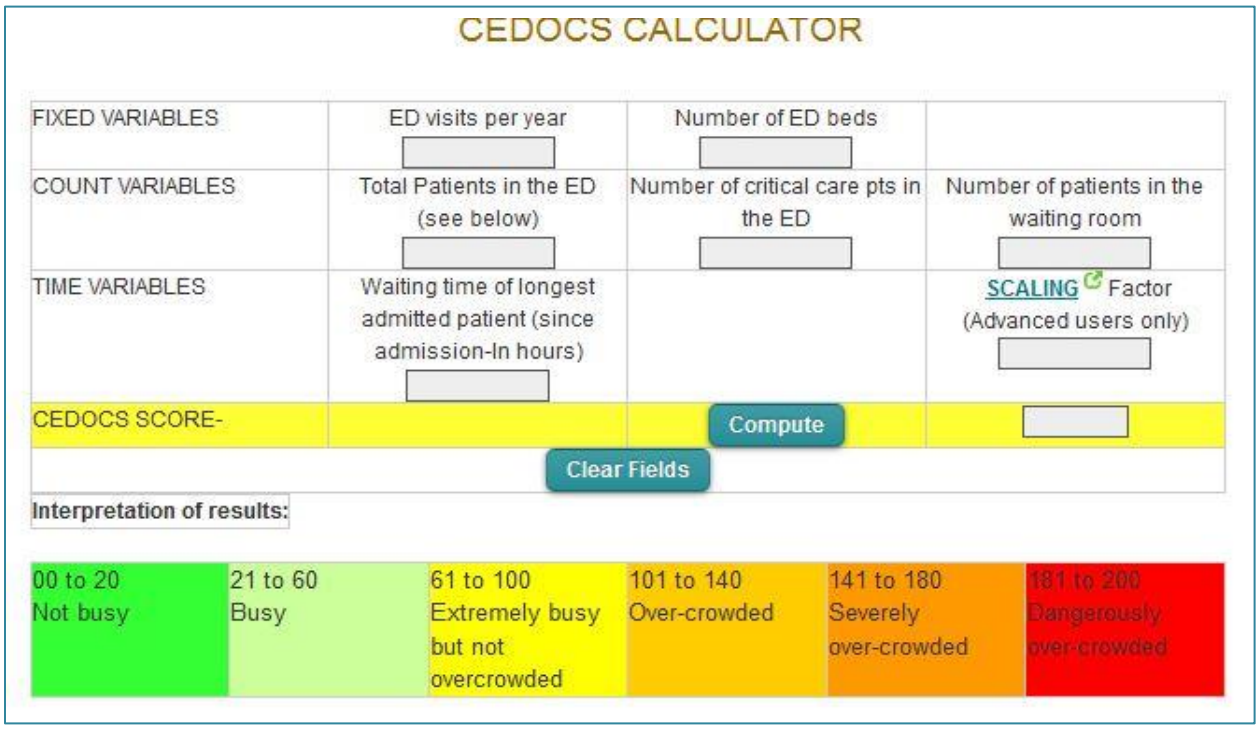


Fig. 2.5 (a): An interface of the CEDOCS Calculator

The Scaling factor will not be used for this research. In this version the units of measurement have been added. http://emed.unm.edu/clinical/resources/cedocs.html accessed on 17th January 2017

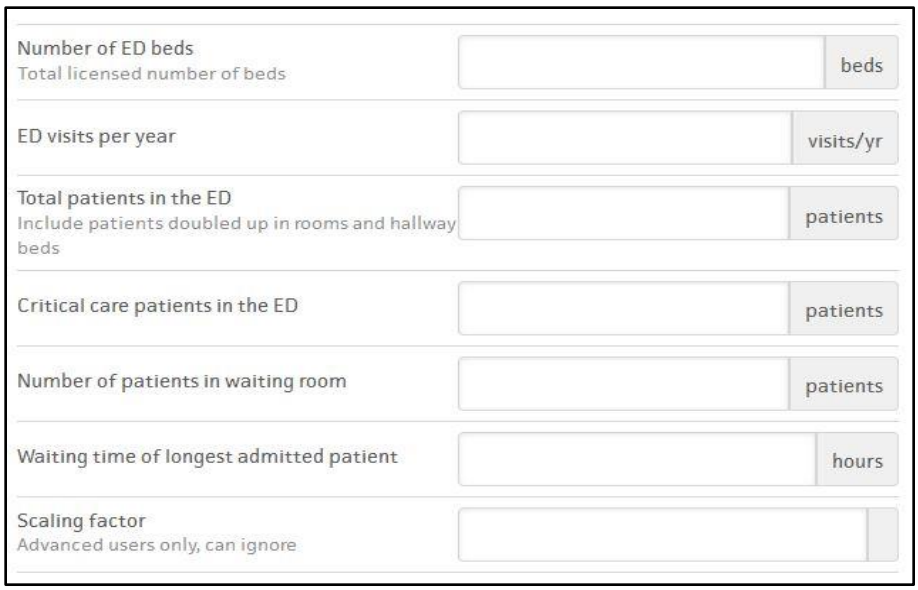


Fig. 2.5 (b): An interface of the CEDOCS CALCULATOR (Weiss *et al.* 2014)

Once the various values are entered into the calculator the CEDOCS score will be determined. Unlike NEDOCS, the calculations for CEDOCS were based on a scale of 0 to 100, so doubling the CEDOCS score gives values in the same range as NEDOCS. When comparing CEDOCS and NEDOCS to the outcome variable, the coefficient of determination (R^2) was 47% for CEDOCS and 39% for NEDOCS. (Weiss *et al.*, 2014). Weiss et al. looked specifically at ED occupancy, which has been suggested as a good marker of ED crowding, and found that it, by itself, was not representative enough of the complex nature of ED crowding to suffice as a measure of that variable. Although it is by far the simplest, correlation with the crowding outcome variable was 0.6, less than the correlation for either NEDOCS (r=0.62) or the CEDOCS (r=0.67) (Weiss *et al.*, 2014).

2.11 LENGTH OF STAY AND ED CROWDING

A study conducted in the Netherlands by Van der Linden *et al* in 94 EDs revealed that the mean Length of Stay (LOS) for discharged patients was 119 (SD ± 40) minutes and mean LOS for

admitted patients was 146 (SD ± 49) minutes. Consultation delays, laboratory and radiology delays, and hospital bed shortages for patients needing admission were the most cited reasons for crowding in that particular study (Van Der Linden *et al*., 2013). Admitted patients had a longer LOS because of delays in obtaining inpatient beds and (68%) of respondents reported that crowding occurred several times a week or even daily, mostly between 12:00 and 20:00. Measures taken by hospitals to manage crowding included placing patients in hallways and using fast-track with treatment of patients by trained nurse practitioners(Van Der Linden *et al*., 2013). The LOS at the ED is another variable for determining ED crowding though its significance has not yet been ascertained.

2.12 CAUSES OF ED OVERCROWDING

The causes of ED overcrowding are multifaceted and the Joint Position Statement of the CAEP and NENA has outlined 6 causes ED overcrowding (Canadian Association of Emergency Physicians 2001)

1. Lack of beds for admitted patients and subsequent boarding of patients in the ED
2. Lack of access to primary care, specialist physicians and nurse practitioners
3. Shortage of nursing and physician staff
4. Increased complexity and acuity of patients presenting to the ED
5. Large volumes of patients with non-urgent problems who could be assessed and treated in a different setting
6. Lack of alternative advanced diagnostic testing and facilities

2.13 EFFECTS OF ED OVERCROWDING

The primary goal of any healthcare delivery system is to provide for its clientele the optimal services to help improve quality of life. However, when there are challenges in the delivery system the impact of the patients cannot be underestimated. Some notable effects of ED overcrowding include the following;

1. Inadequate patient care
2. Prolonged delays in the treatment of pain and suffering
3. Long waiting times and patient dissatisfaction
4. Ambulance diversions
5. Decreased nurse/physician satisfaction
6. Negative effect on teaching and research (Canadian Association of Emergency Physicians 2001)

CHAPTER 3

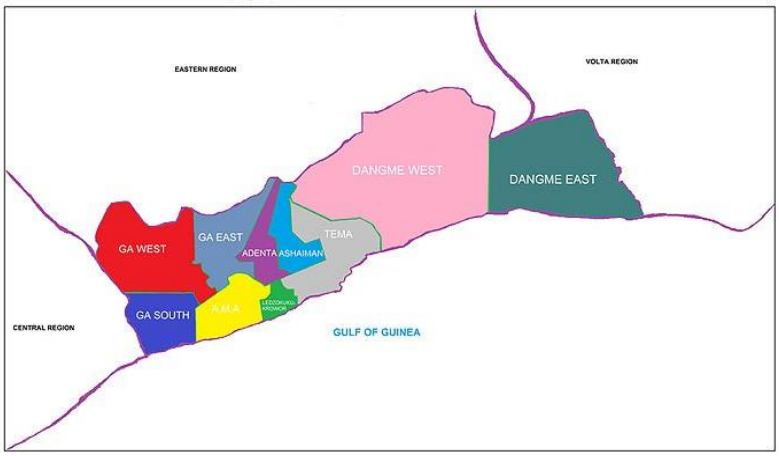
3.0 RESEARCH METHODOLOGY

3.1 STUDY DESIGN

A prospective cross-sectional study was conducted capturing adult patients seen or waiting to be seen at the Adult ED from Monday to Sunday, over a 1 month period (1st December –31st December 2016). This methodology was chosen to get "snapshot" or static view of the department that could be used to reflect the status at the busiest time of the day as well follow up patients till their disposition at the ED of Tema General Hospital.

3.2 SETTING OF STUDY SITE

Tema General Hospital (TGH) is one of the few sub regional hospitals in Ghana. Most of referrals from TGH go to Korle-Bu Teaching Hospital, 37 Military Hospital and Ridge Hospital in Accra. The hospital is situated in the heart of Tema, one of the two metropolitans in the Grater Accra Region and one of the six metropolitans in Ghana. TGH is the major referral point within the Tema Metropolis and receives patients and referrals from major communities such as Tema with over 25 communities, Ashiaman, Tema New Town, Ningo-Prampram, Aflao, Legon, Teshie-Nungua, Dangme West District, Dangme East District, etc. It also sometimes receives referrals from surrounding administrative including Eastern and Volta Region. TGH is a 294 bed capacity hospital with over 20,000 visits per year and over 20 departments within the facility. The ED had a total of 8,346 and 7,874 patients on admission in 2015 and 2016 respectively (Ward In-Charge of TGH ED, 2017).



Map 3.1: A map showing the location of Tema and other Districts in Greater Accra

3.3 SELECTION OF PARTICIPANTS

3.3.1 Inclusion Criteria

All patients aged 18 years and above who were being seen or waiting to be seen at the Adult Emergency Department of Tema General Hospital (TGH) and have been duly triaged and qualified as emergency were included (i.e. Triage color code of red, orange or yellow). This included all patients who arrived at the ED after triaging in wheel chairs, trolleys or walking. Patients were made to consent for their participation with accompanying adult relatives doing same for patients in critical conditions.

3.3.2 Exclusion Criteria

Pediatric patients, as well as non-emergent patients following triaging were excluded in this study. Staffs who reported ill to the ED were excluded because they are usually given preferential treatment and they follow a different patient flow dynamic at the ED. Patients who reported to the ED without triaging were not included in the study. This was to allow for consistency in the data collection.

3.4 METHODS AND MEASUREMENTS

Two trained research assistants documented the various study times using different modalities. The **"door"** time, for example, was taken from a triage form that is manual time-stated when the patient is triaged by a nurse either at the OPD or in the ambulance triage area or at the ED in some instances of die emergencies. The **"doctor"** time was taken from the ED doctors notes, which was manually entered when the ED doctor first makes contact with a patient. The **"door-to-doctor"** time was therefore the difference between these two timed variables in hours.

Following patient disposition decision by the ED doctor, whether admitted, referred or discharged, the time is entered into the patient folder in the ED by the attending doctor. This was the **Disposition** Time. The disposition time is documented in the patient's folder and this time was captured during data collection. The time that the disposition is actually implemented is documented in the nurses' notes and ED records. This was also retrieved per patient. The **"Dwell"** time determined was the time difference in hours between disposition time and actualization of disposition (i.e. when patient physically leaves the ED weather admitted to the ward, discharged home, referred to another facility).

The acuity of patients waiting to be seen was categorized as decided by the triaging system. The research assessed the triaging processes and categorization of patients entering the ED. Other variables that were documented include **fixed variables** (Number of ED visits per year and Number of ED beds). This was provided by the records officer at the ED. The ED has been in existence for just about three years and proper documentation effectively was done in 2016 according to the Nurse-in-Charge and hence the 2016 ED total visits were used.

The Total number of Patients in ED included those on trolleys and wheel chairs, those admitted as critical care patients and those in the waiting room yet to be seen by the ED doctor. The Number of patients in the waiting room (patients waiting to be seen at the ED was also captured. This constituted the **Count Variables.**

The **Time variable** was the longest time of the patient in the waiting room. This has been modified to suit the model of the Ghanaian designation of the ED. The variables collected were imputed into an online calculator designed to be used for the **CEDOCS score.** This gives an objective picture of overcrowding.

Factors influencing ED crowding were also assessed as well as the staffing situation at the ED daily. The information needed for data collection was derived from patient folder, nurses' notes and ED records. When need be patients were contacted for clarification of patient information captured.

3.4.1 TARGET AND STUDY POPULATION

The population for this study as stated in the selection criteria were patients who came to TGH for Emergency medical care during the period of the study. However, because of convenience and accessibility, the study was limited to the ED and the Medical Department.

3.5 SAMPLE AND SAMPLING PROCEDURE

The sample for the research constituted all patients and medical staff at the ED at the time of study. This formed the targeted study population. Out of the over 15 departments in TGH, the ED was the department of interest for this study and this is due to the peculiar nature and work

that goes on at the ED. The ED was therefore purposefully selected. According to the Nurse-in-Charge and the information officer of the ED, there was an average attendance of about 656 patients per month for 2016 which averages to 21 patients per day. This constituted the expected number of patients for the study in the month of December 2016. Following the inclusion and exclusion protocols for this study the total number of patients whose data was captured was 560.

3.6 DATA COLLECTION

A data collection form was developed with inputs from work that had already being done by Dr Weiss on Community Emergency Department Overcrowding Study Scale done (CEDOCS) in California, USA in 2011 and published in American Journal of Emergency Medicine in 2014. His permission was sought and the tool developed became the main collection tool for the research. The predictor variables included had operational definitions following the literature review. Data was collected for the 31 days in December 2016. The research assistants were guided and given all the necessary clarifications before initiation of data collection. The information needed were collected from the patients folders, the nurses chart and triage forms and in some instances from the patients where further clarification were sought. Other sets of information were sought from the Nurse-in-Charge of the ED and the ED and hospital information officer, Human resource manager of the hospital.

All ED data were collected prospectively onsite and subsequently transferred onto EXCEL 2014 for data entry and then STATA 14 was used for data analysis. During the data collection phase, data was collected during the day for every day of the week between 1st December 2016 and 31st December 2016. The advantage in using this particular instrument was its convenient and easy to

use and administer. Secondly it captured snap shots of the activities at the ED during the days of the week. This instrument was less expensive and comprehensive in nature.

The Data collection form had five sections:

- Section A: Demography
- Section B: Patient factors influencing crowding at the ED
- Section C: Time records
- Section D: Community Emergency Overcrowding Study Scale (CEDOCS) score modified and adopted for this research
- Section E: ED staffing and work load

3.6.1 Validity and Reliability

All questionnaires returned were checked for mistakes and completeness. Questionnaires with unclear responses or which had missing information that could not be clarified were excluded. The data was entered in an excel spreadsheet and exported into STATA 14. Double data entry and cleaning was done to reduce data entry errors and validated authenticity.

3.6.2 Pretesting

Three days (24th November 2016 to 27th November 2016) was used as pretexting days to collect data from the Accident Center (AC) of the Tema General Hospital using the data collection form designed whiles following all the described protocols espoused earlier. The Accident Center is an Emergency Unit for accident and trauma patients and has similar characteristics to that of the ED

of the hospital. The data collected from the pre-test afforded the opportunity of editing the instrument all mistakes and ambiguities were worked on and corrected.

3.7 SOURCES OF DATA AND LITERATURE

The data and literature that was used and referenced for this research was obtained from both primary and secondary sources. Primary source of data was eventually generated from the research. The secondary data was gotten mostly from the patients' folders and the administration of the hospital and the ED.

3.8 DATA ANALYSIS PROCEDURE

All analyses were conducted using STATA statistical software package (Stata Corp. 2007. *Stata Statistical Software: Release* 14. StataCorp LP, College Station, TX, USA). This included the use of comprehensive univariate and bivariate analytical approaches to describe the data and consequently measure relationships and levels of associations between variables. Multivariate regression models were then built to further explore the effect of chosen predictors on a dependent variable at a statistical significant level set at a p-value <0.05.

3.9 SCOPE

This research used secondary literature mainly from 2000 to 2016 that were relevant to the research. Some of the information used dated back to year 2000 for relevant inputs into the study. Concerning the subject matter information from across the globe was used. The research was carried out from 1st December 2016 to 31st December 2016.

3.10 ETHICAL CONSIDERATION

Ethical clearance was sought from Ensign College of Public Health Ethics Review Board. Additionally, an administrative approval was sought from the Medical Director and administration of Tema General Hospital. The Clinical Coordinator of the Hospital, Head of ED and MD, the Ward Nurse-in-Charge were all informed about the research and they duly gave their approval.

3.11 INFORMED CONSENT/ CONTRACT

Informed consent was obtained from each participant during the study in writing. During instances where patient could not append their consenting signature or thumbprint, attending relations were allowed to guarantee consent following verbal or gesture consent from the patient. In instances where patients were unconscious consent was sought from attendant relations or accompanying friend.

3.12 PRIVACY AND CONFIDENTIALITY

All information collected during the research was treated as private and confidential especially when the information gotten was sensitive and had the likelihood of causing the person great distress if known by outsiders. Information was protected from unauthorized people from viewing the content. Only the researcher and the assistants were privy to have access to the data collected. All personal information about patients was de-identified during the data handling stage.

3.13 VOLUNTARY PARTICIPATION

Patients were allowed to participate voluntarily during the entire duration of the study. Any patient who wanted to be excluded or wanted to redraw at any point during the study was freely allowed to and was ousted out without cohesion, force or persuasion to keep participants in the study. The decision to participate or to stay in the study was decided by the participants except in instances where the patient was unconscious.

3.14 LIMITATIONS OF STUDY

The main challenge encountered during the research was data capturing. This was because the folders from which some information was not always available. Either the folder had been sent to the pharmacy or the laboratory to facilitate care of these patients. Since all the patients were unwell it was occasionally difficult to get their full attention. Following up on patients till their disposition from the ED was challenging due to the nature of work at the ED. Getting literature on a similar research done locally was difficult. Some of the literature used crowding and overcrowding interchangeably though in concept it meant the same thing. This was because a similar research has not been done in Ghana. Some of the results were subject to reporting errors and incomplete responses.

The research took place in a single clinical facility and this limits the ability of the results to relate to other health facilities as they may have dissimilar patient demographics and ED staffing. The study was done in an urban District Government hospital and may show different trend in a rural and other level health facility. Another limitation was the length and timing of the study. This did not allow for variations in the ED admissions with the seasons and could not account for

some of the variability observed in some of the results. Another major challenge was the theoretical and operational definition for ED crowding. There is no standard definition for ED crowding.

CHAPTER FOUR

4.0 RESULTS AND ANALYSIS

4.1 Summary of Demographic Information about patients

There were 560 respondents that participated in the study. On average 26 patients were seen daily at the ED during the period of study with a minimum and maximum number of patients being 15 and 34 patients. Out of the 560 patients that reported to the ED for the period of the study about 60% constituted females and the remaining 40% were males as seen in Table 4.1. The highest percentage of attendants with regards to age were found in the 30-46 years old bracket, constituting 29.11% followed by those in 13-29 years group forming 28.21% of the respondents with the least age group been aged 81-100years (3.75%). The mean age of all the patients who participated in the research was 44.3 years with a minimum and maximum age of 13 and 99 respectively.

As seen in Table 4.1 about 91% of the patients involved in the research belong to the Christian faith and 9% the Islamic faith. The highest level of education of the patients attained at the time of the study was as follows; primary (20%), JHS/Middle (43.93%), Secondary/Technical/Vocational (21.43%) and Tertiary (56%). From the research, about 60% of the patients who were enrolled into the study reside outside the Tema Metropolis and the remaining 40% live within the Tema enclave. With regard to the reported occupation by the respondents during the period of the study, slightly over half of the patients were Apprentice (51.61%) and 17.14% were government workers.

Table 4.1: Demographic Characteristics of Patients

Variables N= 560	Categories	n (%)
Gender	Female	337 (60.18)
	Male	223 (39.82)
Age Group (yrs.)	13-29	158 (28.21)
	30-46	163 (29.11)
	47-63	126 (22.50)
	64-80	92 (16.43)
	81-100	21 (3.75)
Religion	Christian	509 (90.89)
	Islam	49 (8.75)
	Others	2 (0.36)
Highest Level of Education	None	26(4.64)
	Primary	112 (20.00)
	JHS/Middle	246 (43.93)
	Sec/Tech/Voc	120 (21.43)
	Tertiary	56 (10.00)
Residence	Outside Tema	335 (59.82)
	Tema	225 (40.18)
Occupation	Unemployed	6 (1.07)
	Self-Employed	31 (5.54)
	Gov't Employed	96 (17.14)
	Apprentice	289 (51.61)
	Other	138 (24.64)
NHIS	Yes	362 (64.64)
	No	198 (35.36)
Age	Mean age = 44.33	SD = 19.64

At the time of the study, a very sizable proportion of the respondent (64.64%) reported not having active membership subscription with National Health Insurance Scheme (NHIS) whilst 35.36% had actively working membership (see Table 4.1). On the state of the patients upon arrival at the facility, the analysis revealed majority (78.21%) of them arrived at the ED in wheel chairs and 20.89% on trolleys during the period of the study. With respect to the number of nurses and doctors at post daily for the period of the study, there was an average of 2 doctors and 4 nurses working at the ED daily.

4.1.1 ED Boarding

Patients who have been admitted to the main hospital ward who were still occupying beds at the ED were said to be boarding which contributes to ED crowding. For the duration of the study there was a daily ED boarding volume of 7 patients/beds with a minimum and maximum boarding volume of 1 and 13 patients/beds respectively.

4.2 FACTORS INFLUENCING CROWDING AT THE ED

There are four major factors that are said to influence crowding at the ED. These factors that were studied included the under listed;

1) factors that relate directly to the ED,
2) factors that are ED interrelated,
3) factors that are Hospital related and
4) factors that neither relate to the ED nor the Hospital.

With regards to ED factors most of the patients were been attended to by the ED doctors constituting 78.75% with less than 1% of the patients waiting to be first seen by the ED doctor.

ED interrelated factors revealed by the **st**udy showed that about half (55.90%) of the patients at the ED at the time of the study had their relatives gone to the pharmacy to purchase drugs and 33.03% of the patients were waiting for investigation results as seen in **Table 4.2** below.

From the study of hospital related factors it was found that most of the patients at the ED (78.65%) were waiting for financial clearance from the accounts department after discharge/referral to another facility and 18.65% were waiting for an in-hospital bed to go on admission. Factors that were not related to the ED and the hospital under study showed that most of the patients who had been scheduled to leave the ward had majority of them (78.58%) waiting to buy drugs before leaving and 20.47% were waiting for their relatives to facilitate their leaving the ED. This is seen in **Table 4.2** below.

Table 4.2: Emergence Department Factors and Emergency Department Interrelated factors

ED Factors	Frequency	Percent (%)
Patient been seen by the ED doctor	441	78.75
Patient waiting for a doctor to attend	5	0.89
Patient waiting for disposition decision	47	8.39
Patient waiting for test results done	67	11.96
Total	560	100.00

ED Interrelated Factors	Frequency	Percent (%)
Patient/relations gone to the pharmacy	308	55.90
Patient waiting for results of labs	182	33.03
Patient waiting for review or admitted	61	11.07
Total	551	100.00

Hospital Factors	Frequency	Percent (%)
Patient waiting for financial clearance	409	78.65
Patient waiting to go to an in-hospital (When bed is available)	14	2.69
Patient waiting to go to an in-hospital (When bed is not available)	97	18.65
Total	520	100.00

Non-ED-Hospital related Factors	Frequency	Percent (%)
Patient waiting for a bed in another hospital	2	0.39
Patient waiting for relatives after discharge	104	20.47
Patient waiting to purchase drugs	399	78.54
Patient waiting for relatives after referral	3	0.59
Total	508	100.00

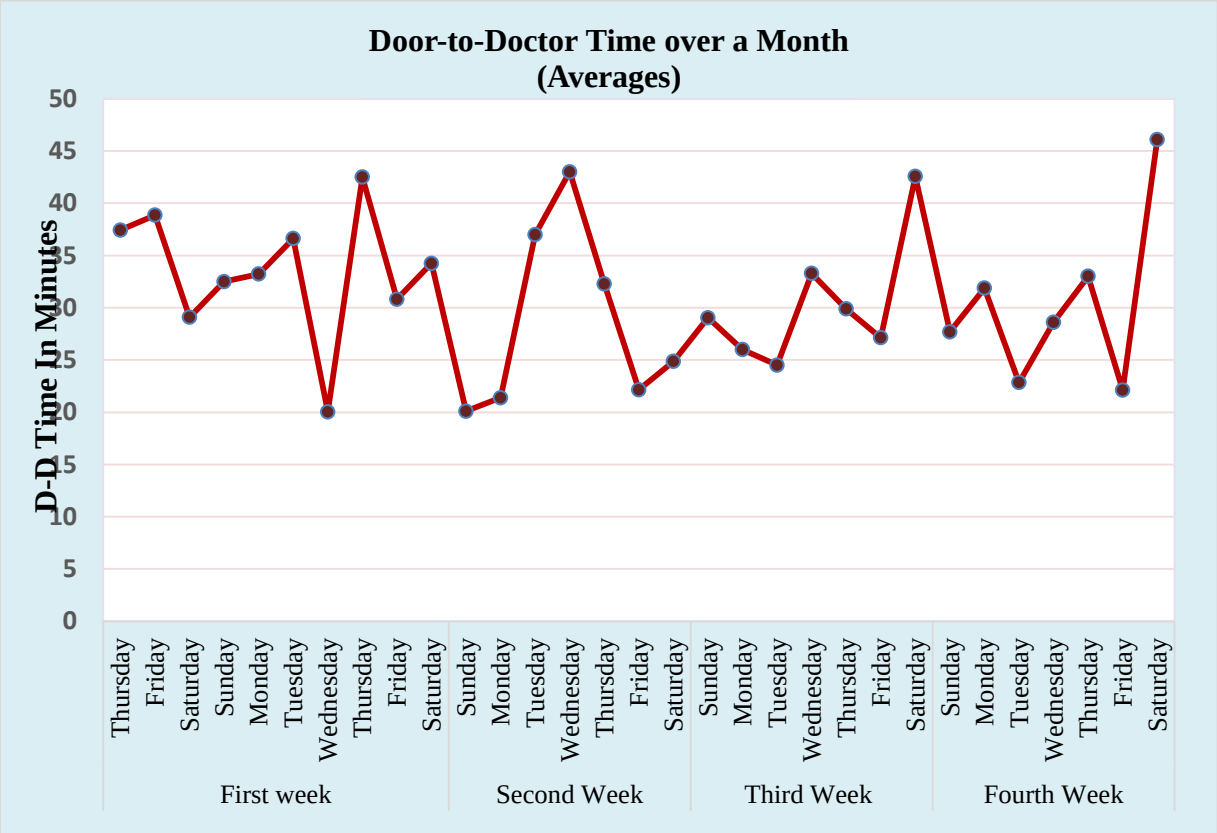
[1] During the time of data collection some of the patients had died.

4.3 THROUGH-PUT FACTORS OF PATIENT FLOW AT THE ED

4.3.1 Door-to-Doctor Time Analysis

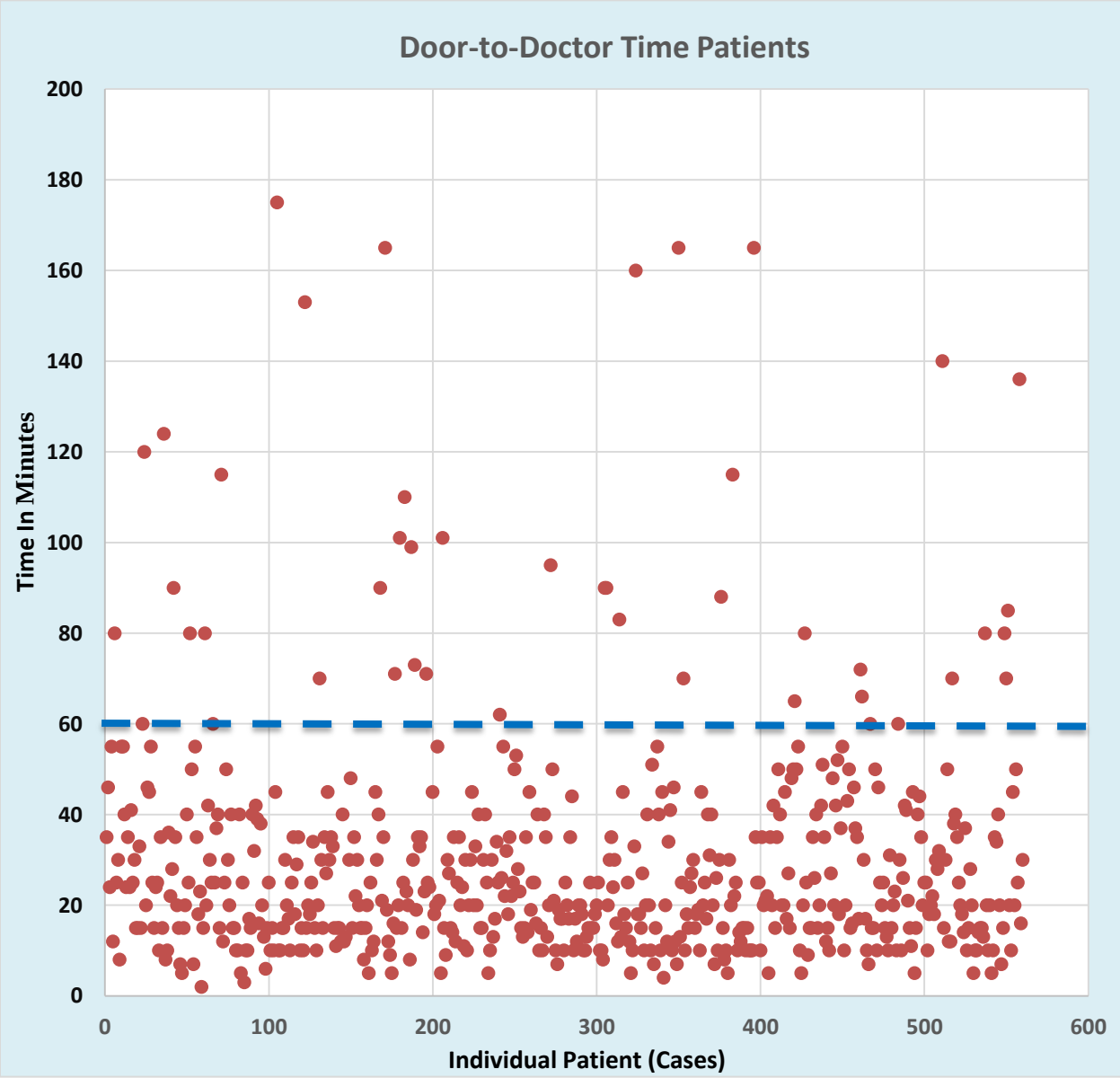
When the patient arrives at the OPD a door time is taken by the triaging nurse and the time that the patient is eventually attended to by the ED doctor is documented at the door time. The door-to-doctor (D-D) time is therefore the difference in these two times. For the period of the study the daily average door-to-doctor time was found to be 31 minutes. The maximum and minimum daily average door-to-doctor time was found to be 46 minutes which was on a Saturday and 20 minutes which was on a Wednesday respectively. The trend analysis showed that the daily average of the D-D time gradually rises from Tuesday and peaks over the weekend.

Figure 4.1 Average daily door-to-doctor time



For the period of the study, 10 out of the 560 patients were attended to after 120 minutes of triaging by the OPD nurse. All the 560 patients were attended to within 180 minutes of triaging. However majority of the patients were attended to within 60 minutes of triaging by the OPD nurse and eventually sent to the ED. This is seen in Figure 4.2 below.

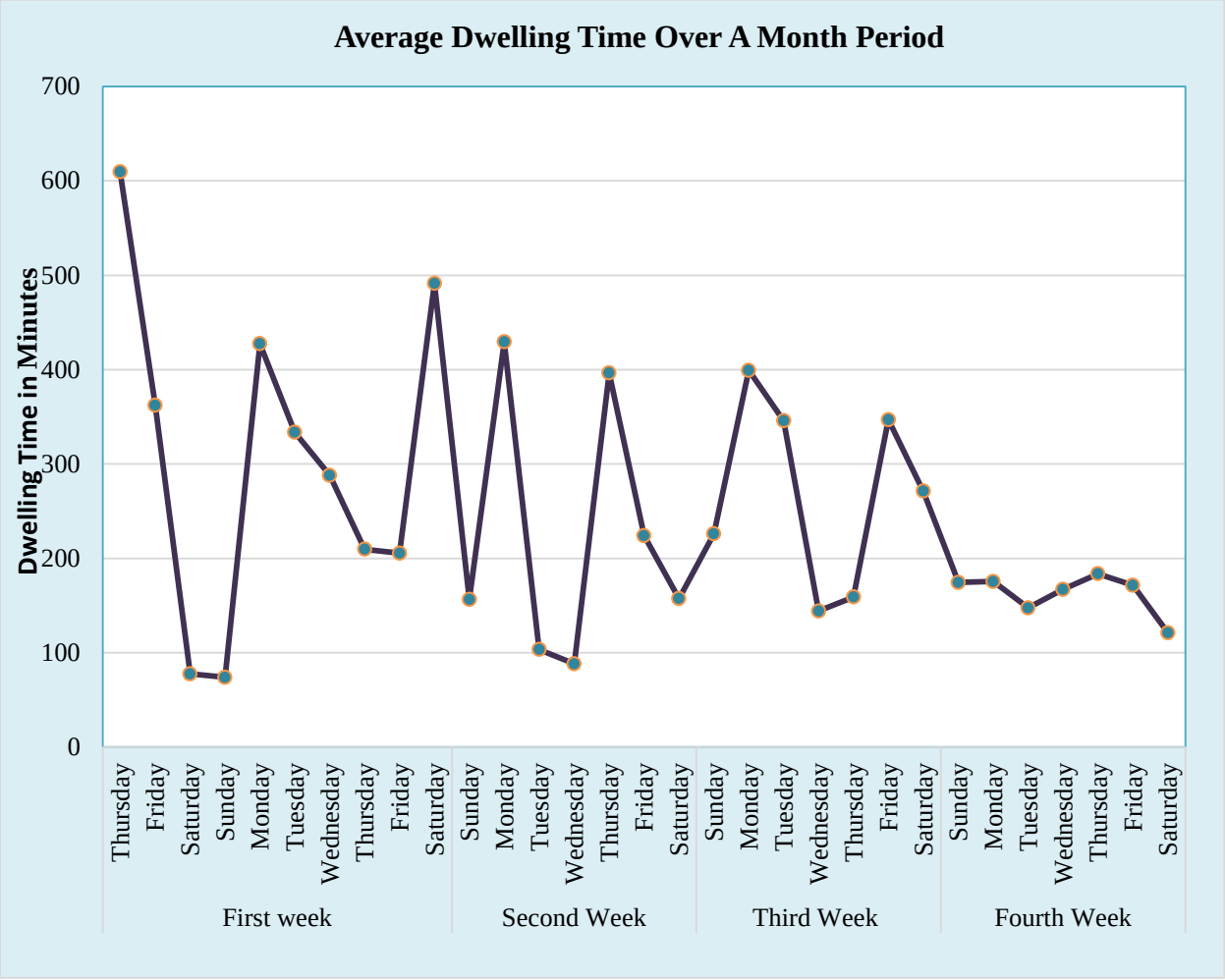
Figure 4.2: Door-to-Doctor Time of patients



4.3.2 Dwelling Time Analysis

The disposition time is the time at which the destination of the patient is declared by the ED doctor to be either "*discharged*" or "*admitted*" to the main hospital and the time that the disposition was actually carried out were also documented. The Dwell time is thus, the difference in these two times. From the study the overall average daily dwell time was found to be 247 minutes (4.12 hours) with a maximum and minimum daily average dwell time of 610 minute (10.17 hours) and 74 minutes (1.23 hours) respectively.

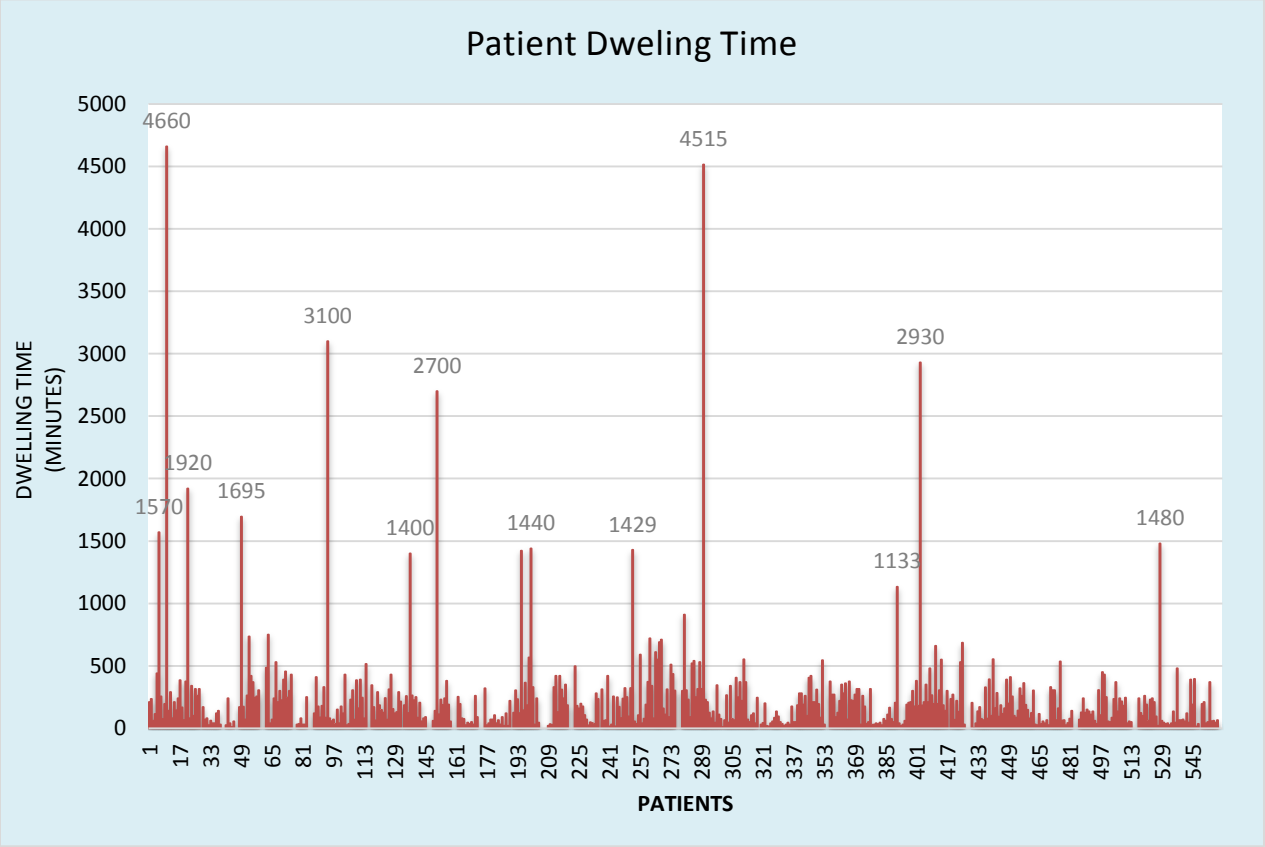
Figure 4.3 Average daily Dwelling Time



There were 7 peaks of average daily dwelling time. Three of those days occurred on Mondays, followed by Thursdays (twice) and one on Friday and Saturday respectively. Hence from the trend plot, Mondays had many patients staying at the ED after disposition and from Thursday through to Saturday the dwelling times peaked.

From Fig 4, the patient with the highest dwelling time spent 4,660 minutes (3.236 days) and there were over than 14 patients who were on the ward for more than 1000 minutes (16 hours) after their disposition were made by the ED doctor.

Figure 4.4: Dwelling Times of Patients



4.4 TRIAGING ANALYSIS

4.4.1 Triaging Category and Outcome of Patients

When a patient arrived at the OPD, the triaging nurse triaged and categorized the severity of the illness of the patient. Based on the triage category, the patient was sent to the ED for the necessary treatment options. The various categories enrolled into the study in order of severity of illness were Category Red (A), Category Orange (B) and Category Yellow(C). Where patients in first category (Red), are considered the most ill, followed by Orange and then Yellow. From the study as seen in the **Table 4.3** below the highest triaged category was orange (39.46%) and patients' triaged red and yellow were 31.79%and 28.75% respectively.

Table 4.3: Triaging category and outcome of patients

Triaging Category	Frequency N=560	Percentage (%)	Male	Female	Alive	Dead
Red (A)	178	31.79	79	99	123	55
Orange (B)	221	39.46	91	130	221	0
Yellow (C)	161	28.75	53	108	161	0

For all triaged categories, females were dominant compared to males among the respondents. For every patient that came to the ED there were two expected outcomes. Either the patient dies at whiles on the ward or survives at the time of discharged, referral or admission. For the duration of the study out of the total of 560 patients who visited the ED, 55 of these patients died at the ED constituting about 10% of all patients seen at the ED during the study.

As shown in **Table 4.3,** no deaths were recorded for patients' triaged as Category B (Orange) and C (Yellow). All the 55 deaths were initially triaged Category A (Red).

4.4.2 A test of association between Triaging Category and Sex

A bivariate analysis (Fisher Chi-Square) test was conducted to ascertain whether there was an association between the triaged category and the sex of the patients that visited the ED for the entire duration of the study at an α=0.05. The test result gave *a p-value* of 0.086, leading to the conclusion that there is no enough statistical evidence to conclude any significant association between the triaged category and the sex of the patient.

4.4.3 Association between Triaging Category and Outcome of Patient

To ascertain if there was any association between the triaged category and outcome of patient the Chi^2 test generated a *p-value* of <0.001. This indicates that there was an association between the triaged category of the respondents and their outcome (dead or alive) and this was found to be significant.

4.4.4 Association between NHIS status and Outcome of Patients

A test to find out the level of association between the patient's existing status with the NHIS and the health outcome after treatment also produced a p-value =0.644 in a Chi^2 test. An indication of no significant association between prevailing NHIS status at the time of participation and health outcome at a predetermine α–level of 0.05

4.5 COMMUNITY EMERGENCY DEPARTMENT OVERCROWDING (CEDOCS) SCORE

4.5.1 Calculating the CEDOCS score

To measure the crowding status of the ward the Community Emergency Department Overcrowding (CEDOCS), scores were measured using an online calculator (http://emed.unm.edu/clinical/resources/cedocs.html). There were six variables that were fed into the calculator as seen in Table 4.4 below. This was done for every patient and the daily averages were also calculated as well as the overall average for the duration of the study was also calculated.

Table 4.4: Variables that fed the CEDOCS calculator and the overall averages for the period

Variable	Average for the 31 days	Deviation
Fixed Variable		
ED visits per year	8,346 (Patients/year for 2015)	0
Number of ED Bed	15	1
Count Variables		
Total Number of Patients at the ED	26	5
Number of Critically ill patients at ED	3	1
Total Number of Patients in Waiting Room	8	3
Time Variable		
Waiting Time of the Longest Admitted Patient	2 (Hours)	1

4.5.2 Categorization and Interpretation of the CEDOCS score

The count variables and time variable captured for each patient together with the number of beds and the ED total visits for 2015 were fed into the CEDOCS calculator and for each patient the CEDOCS score was calculated. The score is then used to determine the crowding status of the patient at the time of the study. There were six levels of categorization based on the score ranging from "*Not busy*" to "*Dangerously overcrowded*" ED. For 6 out of the 31 days, the average daily CEDOCS score revealed the ED was busy. The ED was found to be extremely busy but not overcrowded for 21 of the days using their average daily CEDOCS scores and 4 days were found to be overcrowded with an average daily score of 101-140. The daily average CEDOCS score for the duration of the study is shown in Table 4.5 below.

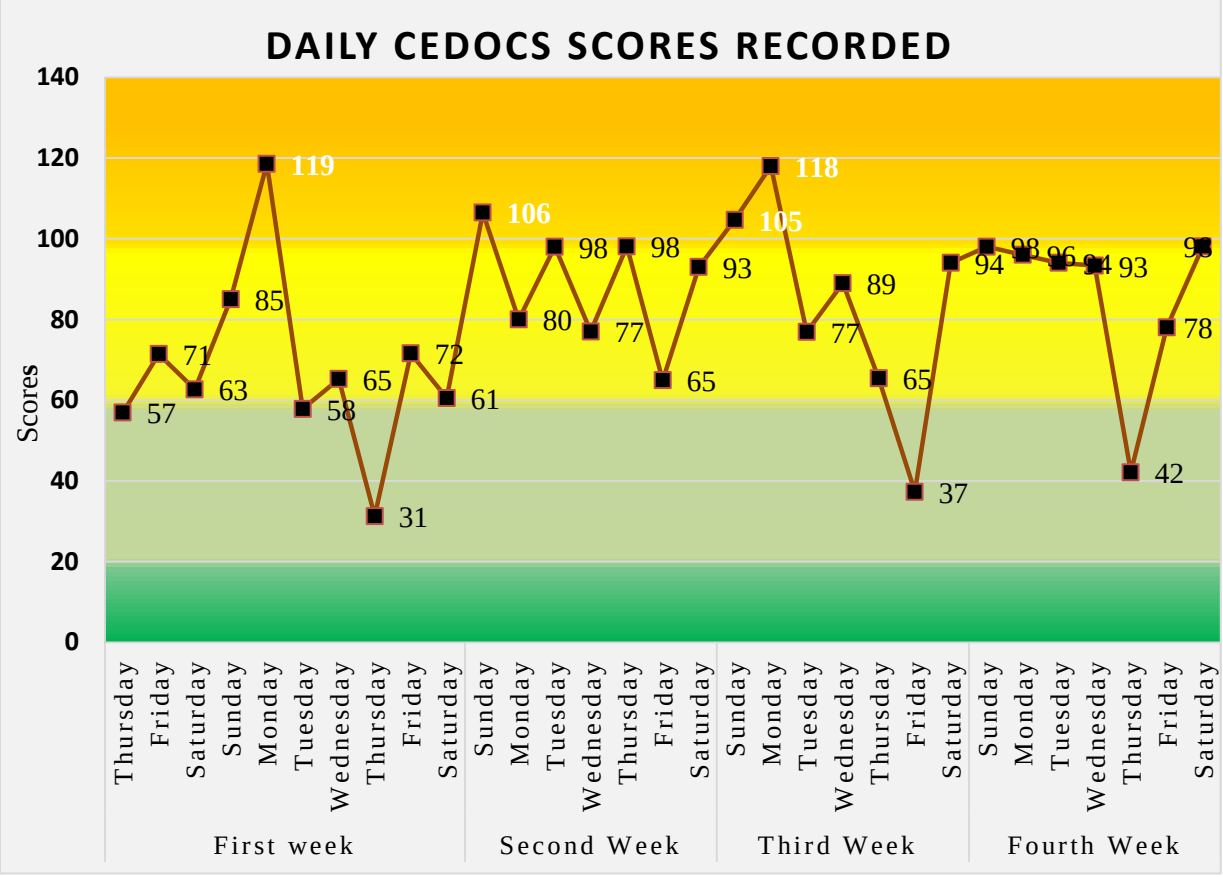
Table 4.5: CEDOCS score categorization and Interpretation

Number of Days (N=31)	**CEDOCS score Range**	**Color Interpretation**
0	0-21	Not Busy
6	21-60	Busy
21	61-100	Extremely busy but not overcrowded
4	101-140	Overcrowded
0	141-180	Severely Overcrowded
0	181-200	Dangerously Overcrowded

4.5.3 Average Daily CEDOCS score

For all the 560 respondents the daily CEDOCS score was calculated and then the daily average CEDOCS was calculated. This gave daily averages of the CEDOCS score for the 31 days period of the study as presented earlier together with the daily categorization and interpretation. The figure below indicates that there were 11 days that peaked from low CEDOCS scores. Based on these scores, 4 of the days were found to be overcrowded. These days were two Sundays and two Mondays. This means the most crowded days for the research were found to be Sunday and Monday and the ward started getting crowded from Thursdays and rises steady to a peak on Mondays. The Overall Average CEDOCS score over the 31 days was found to be 80 with the minimum CEDOCS score been 31 and the maximum score been 119.

Figure 4.5: Daily Average CEDOCS Score



4.5.4 Frequency of crowding status at the ED

For purposes of binary interpretation of the crowding status at the ED based on the CEDOCS score the overall average score of 80 as mentioned earlier was adopted as the balance point. Every CEDOCS score that was above 80 was considered as crowded and below 80 not crowded. It was determined that 330 of the respondents were at the ED when the ward was not crowded and 230 of the patients were on the ward during crowding periods. The daily CEDOCS scores when averaged revealed that 21 out of the 31 days for the period of the study were found to be crowded and 10 days found to be not crowded.

Table 4.6: Frequency of crowding status at the ED

Crowding Status (CEDOCS) score	Frequency (patients) n=560	Percentage (%)	Frequency (days) n=31	Percentage (%)
Not Crowded	330	58.93	10	32.26
Crowded	230	41.07	21	67.74

4.5.5 Association between crowding status at ED and Mortality

The percentage ratio of patients who died during non-crowded moments was 7% and 14% during crowding moments at the ED. A test of association to establish whether the crowding status influenced mortality at the ED revealed a Chi^2 of 7.3776 with a p-value of 0.007. This indicates that there was a significant associated between the crowding status at the ED and mortality at the ED. The more crowded the ED the probability of a mortality occurring was high.

4.5.6 Association between Triaging Category and ED crowding status

To address the research question on whether "there is an association between the triaged category of the patients and the crowding status of the ED", a bivariate analysis of the triaged category (Red, Orange and Yellow) of patients when they arrived at the ED versus the crowding status yielded a Pearson Chi2 of 7.7724 with a p-value = 0.021. This indicates that there is a significant association between the triaged category and the crowding status at the ED. This means if many patients are triaged red, orange or yellow then there is a higher likelihood of making the ward crowded.

4.6: CORRELATION ANALYSIS OF CROWDING STATUS (CEDOCS SCORE) AND SELECTED INDEPENDENT VARIABLES

Table 4.7: Correlation between CEDOCS score and selected independent variables

Independent Variable	**Average CEDOCS Correlation (N=31)**
ED Boarding Volume	0.4608
Total Number of Trolleys	0.7231
Total Number Of Wheel Chairs	0.8377
Total Number of Patients	0.9147
Number of Patients in waiting room	0.8979
Number of Nurses	-0.0966

To establish the correlation between the crowding status at the ED and some selected independent variables a Pearson's Correlation analysis was done. From Table 4.7 above, there was a positive correlation between the CEDOCS score and the ED boarding volume, number of ED trolleys, number of wheel chairs, number of patients in the waiting room and the total number of patients in the ED. The strongest positive correlation with the Crowding status of the

ED was found to be the total number of patients in the ED with a correlation (r) = 0.9147. The number of nurses however, had a weak negative correlation with the crowding status of the ED.

4.7 REGRESSION ANALYSIS OF SOME SELECTED VARIABLES

To predict the effect of some selected variables on the crowding status of the ward, both multiple linear and logistic regression analysis was performed.

4.7.1 Regression analysis of two time variables (Door-to-Doctor Time and Dwell Time) and CEDOCS score

To assess effect of *door-to-doctor* time and *dwell* time on crowding at the ED, a linear regression model was built using the individual CEDOC score as the response variable. It was determined that both predictors have p-value of 0.700 and 0.395 respectively, indicating no significant statistical effect.

Table 4.8: Regression analyses of D-DT and DT and CEDOCS score

CEDOCS	Coefficient	P-Value	95% Confidence Interval	
Door-to-Doctor Time	-0.0139878	0.700	-0.0852918	0.0573162
Dwell Time	-0.0023324	0.397	-0.0077421	0.0030774
Constant	77.76554	0.000	74.36229	81.16878

4.7.2 Independent variables predicting the CEDOCS score

From Table 4.9, the CEDOCS score predictors that were found to be statistically significant included the number of trolleys and the number of wheel chairs at the ED with a P-value of 0.015 and 0.000 at 95% CI. The CEDOCS score will increase by 3.38 for every unit increase in the number of trolley used at the ED adjusting for all other variables. The CEDOCS score will also increase by 4.84 for every unit increase in the number wheel chairs at the ED adjusting for all other variables. The number of nurses or doctors did not impact the crowding status of the ward in any significant way.

Table 4.9: Regression analysis of some selected independent variables and CEDOCS score

CEDOCS Predictors	*Coefficient*	*P-Value*	*95% Confidence Interval*
Number of Doctors	2.605896	0.442	-4.275795 - 9.487587
Number of Nurses	-1.715781	0.552	-7592657 - 4.161095
Number of ED Beds	8.042453	0.017	1.568267 - 14.51664
Numbers of ED Trolleys	3.383011	0.015	0.7316153 - 6.034406
Number of ED wheel chairs	4.836366	0.000	3.130642 - 6.54209
ED Boarding Volume	0.55101	0.549	-1.328219 - 2.420239
Constant	183.17604	0.057	-166.9495 - 2.597405

4.7.3 Analysis of CEDOCS score and some selected independent variables

A multiple linear regression model to determine whether some selected variables could predict the crowding status yielded an adjusted R-squared of 0.9692 which meant that 96.92% of the variability in the CEDOCS score could be explained by the total number of patients, beds, trolleys, wheel chairs and critically ill patients at the ED, as well as the waiting time.

Table 4.10: Regression analysis of CEDOCS score and selected independent variables

CEDOCS Predictors	**Coefficient**	**P-Value**	**95% Confidence Interval**
Total Number of patients at ED	3.838564	0.000	3.471162 4.205966
Total Number of critically ill patients at ED	4.314477	0.000	4.09135 4.537604
Longest waiting time of patients	2.56608	0.000	2.242535 2.889625
Number of ED beds	0.1621505	0.685	-0.062140 0.9457113
Number of trolleys at ED	-1.027505	0.000	-1.4599 -0.5951098
Number of ED wheel chairs	-1.028123	0.000	-1.455286 -0.6009591
Constant	-40.77459	0.000	-49.03517 -32.51401

It can also be deduced from the research that, with the exception of the total number of beds at the ED during the period of the study the total number of patients, trolleys, wheel chairs and critically ill patients at the ED, as well as the waiting time were found to be statistically significant in predicting the CEDOCS score. For every unit increase in the total number of patients at the ED the CEDOCS score will increase by 3.84 adjusting for all other variables. Also

for a unit decrease in the total number of trolleys and wheel chairs in the ED the CEDOCS score will decrease by 1.03 and 1.03 respectively adjusting for all other variable.

4.8 Logistic regression of factors that influence patient flow and the crowding status at the ED

The CEDOCS score was converted into a binary variable where a score of 80 and above was considered as "***crowded***" and a score below 80 was considered as "***not crowded***" and recoded as "1" and "0" respectively. Using a logistic regression model it was discovered that of the four factors under study, only Hospital related factors were found to be statistically significant with a p-value of 0.003 at 95% CI in influencing CEDOC scores. Thus, when the various factors were decoupled to determine the influence on ED crowding, a patient waiting to go to an in-hospital bed (when bed is not available) was the only statistically significant indicator with a 0.527 lower odds, when all other factors are held constant.

Table 4.11 Logistic regression of factors that influence patient flow and the crowding status at the ED

CEDOCS	***Odds Ratio***	***P-Value***	***95% Confidence Interval***
ED Factors	0.8924286	0.219	0.7443134 1.070018
ED interrelated Factor	1.00992	0.828	0.9239048 1.103943
Hospital Factors	0.5273518	0.003	0.3452575 0.8054857
Non ED/Hospital Factors	0.669144	0.060	0.440507 1.016451
Constant	7.41279	0.024	1.297754 42.34196

CHAPTER 5

5.0 DISCUSSION

5.1 DEMOGRAPHIC CHARACTERISTICS

Tema General Hospital is a major referral center that receives several medical cases within and around the Tema Metropolis, with most emergencies cases ending up at the Emergency Department. This sharp rise in ED use has been blamed on a multitude of factors, many of which are extrinsic. Recent trends indicate that much of the increased volume seen in EDs can be attributed to visits for non-emergent cases and may be interpreted as "problems or dissatisfaction with the performance and accessibility of local primary care delivery systems (Cunningham & May 2003). A total of 560 patients were enrolled into the study over a 31-day period, which in no uncertainty terms is a huge number for a ward of 14 beds averagely. It is important to note that more females attended the ED than males and most of the patients belonged to the youth age group (mean age of 44.3 years).

Many more youth are reporting to the ED with emergency medical complications that require urgent health care. Are these medical conditions be life style related or from communicable diseases? To have 60% of the patients coming from places outside the Tema Metropolis is instructive to note. There are several other health facilities within Tema and most residents are likely to visit these facilities when they take ill. This may explain why only 40% of the respondents reside within Tema. On the other hand they are fewer health facilities immediately outside Tema and most of people living in these areas will have to travel to Tema for medical care. This explains why 60% of the respondents come from outside the Tema Metropolis. This could explain why majority of the respondents reside outside Tema but seek medical care within

Tema. That means health care service delivery must be made available and assessable to all patients within and outside the Tema enclave. This will in the long run reduce the numbers of patients that visit the TGH.

The main public health financing scheme is the NHIS and 64.64% of the respondents did not have active membership subscription with the NHIS whiles 35.36% had actively working membership. Considering the very rigorous national campaign being pursued by the Ministry of Health and the Ghana Health Service to get all members of the population unto the scheme this finding is not encouraging. This means, the stake holders have a lot of work and education to embark on in order to increase active membership of the NHIS. There was however no significant association between prevailing NHIS status at the time of participation and health outcome.

5.2 ED BOARDING AND ED OCCUPANCY

ED Boarding occurs when patients who have been admitted occupy ED bed whiles waiting for in-patient bed. According to Boyle *et al.,* the ED is crowded when there is greater than10% occupancy of boarders in the ED (Boyle *et al.,* 2012). For the duration of the study, there was an average daily ED boarding volume of 7 patients/beds (53.3% occupancy) that means the ED was constantly crowded using this measure for the entire duration of the study. This is a crude measure of ED crowding and it doesn't carry any statistical weight. This is known to contribute greatly to ED Crowding nonetheless.

ED Occupancy (capacity) is the number of beds (in this case including trolleys and wheel chairs) occupied by patients divided by the number of mandated beds at the ED. An occupancy rate is the total volume of patients in the ED compared to the total number of officially

designated ED treatment spaces (Boyle *et al.*, 2012). This measure gives an indication of the operation capacity of the ward. According to Boyle the ED is crowded when the occupancy rate is greater than 100% (Boyle *et al.*, 2012). This is a crude measure of ED crowding and it doesn't carry any statistical weight. For the duration of the study the average daily ED Occupancy was 140% (36.4%--207.1%). That means the ED was averagely operating above capacity and has negative implications on patient outcomes. This will to a large extent, compromise the quality of care and contribute to the crowding status of the ward. In similar study conducted by Arkun *et al.* in an urban Level II Trauma Center ED with a volume of 50,000 adult visits per year *in the USA in 2010,* they found that, the facility operated at an average of 85% capacity (61- 102%) with 27% of patients admitted and only awaiting bed assignment. This indicates a sharp contrast of ED occupancy of 140% and ED boarding volume of 53.3% respectively for TGH ED. They further expounded that, the lack of physical space could explain their observation (Arkun *et al.*, 2010). This may be same for the findings following the study at the TGH ED. There is therefore the need for policy stakeholders to consider expanding the ED at TGH.

5.3 FACTORS INFLUENCING CROWDING AT THE ED

After a patient had been triaged at the OPD and recommended for emergency care, the patient is sent to the ED. From the ED, the patient may be required to perform some laboratory investigations, imaging tests, purchasing of drugs and other specialized test which could be done both within and outside the hospital premises. The patient may then be admitted to the main hospital ward, referred to another facility for further care, discharged home or may not be alive. At every stage of this flow there are various factors that interplay to create a patient flow system at the ED. Miro *et al.* identified four factors that cause delay in patients flow; ED, ED interrelated, Hospital and non ED-non Hospital factors (Miró *et al.*, 2003). These four factors

were studied. From the research, most of the patients in the ED were attended to by ED doctors (78.75%) and more than half (55.90%) of the patients had their relations gone to the pharmacy to purchase drugs whiles 33.03% of the patients were waiting for investigations results to be ready. It is instructive to note that of the four main factors, hospital related factors were found to be statistically significant in determining patients flow at the ED adjusting for the other variables. The implication is that, whatever goes on in the main hospital has a direct impact on what goes on at the ED. The availability of in-patient beds has the tendency to facilitate the transfer of patient from the ED to the main ward. The issue of financially clearing patients after disposition is also vital in facilitating the flow of patient out of the ward. All these hospital related factors has a direct influence on patient flow at the ED.

5.4 THROUGH-PUT FACTORS OF PATIENT FLOW AT THE ED

There are two through-put factors that were studied. A similar study was conducted where two specific components of throughput: *Door-to-Doctor* time and *Dwell* time were studied by Arkun et al (Arkun *et al.,* 2010). The *Door-to-Doctor* time gives an indication of how long the patient waits after triaging to be attended to by the ED doctor whiles the Dwell time gives an indication of how quickly patients leave the ED after disposition decision has been taken. The patients, staff and logistics dynamics on the ward and the hospital directly affects these time factors. The result revealed an average of 31minutes after triaging for an emergent patient to be attended to by the ED doctor. By standard operations, a Triaged category A and B are to be attended to within 10minutes and 20 minutes respectively. Hence with an overall average of 31 minutes there is a lag time in attending to patients at the ED and looking at how patients need timely interventions there is a likelihood of having negative patient outcomes with this door to doctor time at the ED.

From the study, the door-to-doctor time gradually rose from Tuesday and peaks over the weekend. There are several factors that may account for this observation ranging from staff strength, triage categories, bed capacity, boarding and many other factors. The number of staff over the weekend are usually less than during mid-week and because most of the health facilities around the hospital do not run on weekends most of their emergency cases are referred to the ED of TGH and this increases the patients volume at the ED and hence the likelihood of delays in attending to the ED patients.

The Dwell time gives an indication of how quickly patients are dispatched from the ED after disposition decision is made. For instance, when the doctor decides that the patient should be admitted to the hospital in-patient at 6:00pm and because of lack of bed at the in-patient unit he/she still occupies a bed at the ED, that particular bed becomes unavailable to other new patients. When the patient eventually lives the ward at 9:00pm then the dwell time becomes 3 hours. From the research overall mean dwelling time was found to be 4.12 hours. That means it takes an average of 4 hours for disposition decisions to be actually carried out. During these 4 hours, the particular bed that the patient is occupying is unavailable to other patients and this has the tendency of increasing the ED occupancy rate. Again just like the door-to-doctor time, the trend analysis shows that the dwelling time peaks over the weekend. From the study of Arkun *et al.,* the median "door-to-doctor" time was 1.8 hours and the median dwell time was 5.5 hours with the biggest influence being triage category, day of the week, and ED occupancy (Arkun *et al.,* 2010). It is therefore very interesting to note that the mean door-to-doctor time as well as the dwell time was less compared to the study of Arkun *et al.,* which is good looking at the challenges the health care delivery system faces in Ghana. There may be several factors similar to that of the door-to-doctor time that explains this observation but this will need further scientific studies to ascertain

possible explanations for this observation. From the research it was determined that the door-to-doctor time and the dwelling time had no significant statistical effect in predicting the crowding status of the ED using the CEDOCS score though for clinical intervention they are important.

5.5 ROLE OF TRIAGING AND WORK AT THE ED

When patients arrive at the OPD they have to be sorted out by the OPD nurse according to the severity of the illness and this is known as triaging. Once this has been done the level of severity from least to worst is coded as C, B and A and they are given color identification: yellow, orange and red respectively. This is according to the South African Triage Score (South African Triage Group 2012). A color code of red means there must be medical and or surgical intervention immediately. A color code of orange means the patient has a time lapse of 10 minutes to be attended to and interventions initiated. A code of yellow means the patient has within one hour to receive medical and or surgical intervention. From the research there was fairly an even distribution of severity of patients' illness based on the triage category: Red (31.79%), Orange (39.79%) and Yellow (28.75%). Rominski *et al.* did a research at KATH where over 903 adult patients were triaged and reviewed at the ED, 7.11% were triaged to Red, and 29.4% were triaged to Orange, 61% to Yellow and 0.3% to Green (Rominski *et al.*, 2014). The similarity here is that the highest triaged category was Orange. This gives an indication that most of these patients have up to 10 minutes for intervention.

In all the triage categories female patients dominated in terms of numbers. It is presumed that the worst cases are coded red and hence an expected outcome of mortality if any to be in that category. This was confirmed by the research where all the 55 mortalities witnessed for the entire duration of the study were patients who were initially triaged red. The question then arises as to

how critically ill patients that come to the ED are managed? What factors interplay to determine the outcome of these patients?

The bivariate analysis done on the data gave a test result with *a p-value* of 0.086, leading to the conclusion that there is no enough statistical evidence to conclude any significant association between the triaged category and the sex of the patient. With regards to the triage category and the outcome of the patients (alive or dead), the study revealed that there was a significant association with a Chi^2 test generated *p-value* of <0.001. The chance of a patient who has been triaged red dying was found to be higher than a patient who was triaged as orange or yellow.

5.6 COMMUNITY EMERGENCY DEPARTMENT OVERCROWDING (CEDOCS) SCORE

The CEDOCS score gives an indication of the crowding situation at the ED using the score ranges. The research outcome pointed to 6 days being busy (CEDOCS score = 21-60), whereas 21 days were found to be extremely busy (CEDOCS score = 61-100) but not overcrowded and 4 days were found to be overcrowded (CEDOCS score 101-104). That means for the entire duration of the study the ward was busy, extremely busy or overcrowded. This is important to note, looking at the impact of having a crowded ward on patient care, work load on the health staff and outcomes of patients. As stated earlier the crowing status can affect the through-put factors, compromise quality of care of patient, increase the length of stay of the patient and many other factors. If for a whole month the ward is consistently busy and crowded then it is important to understand fully the associations and correlations of this. The overall average CEDOCS score was found to be 80 for the duration of the study which puts the ward constantly below color code Green. The two days with the worst crowding situation on the ward was Sunday and Monday

and this coincide with the highest door-to-doctor time as well as the dwell time. Arkun *et al.* found that days of the week also had significantly different times with Mondays having longer "door-to-doctor" and dwell times in their study(Arkun *et al.,* 2010). Chan *et al.* also who concluded that the day of the week has no significant influence over throughput in the ED (Chan *et al.,* 1997).

The results indicate that there was a significant association between the crowding status at the ED and mortality at the ED which undoubtedly will have effect on the overall outcome for patients. Death is a common measure of adverse patient outcomes of ED crowding (Robert Wood Johnson Foundation 2004). The more the ED was crowded the higher the probability of mortalities occurring. As Sun *et al.* found out, patients who are admitted during crowding moments have a higher chance of dying than those admitted during non-crowded moments (Sun *et al.*, 2013).This meant that mortalities are likely to drop when the crowding situation on the ward improved. How does the triaging done at the OPD contribute to crowding at the ED? There was a significant association between the triaging categories and the crowding status of the ward (Pearson Chi2 of 7.7724 with a p-value = 0.021). If more patients are triaged and they qualify to be at the ED then the chances of crowding at the ED also increases. This further begs the question of the quality and correctness or otherwise of triaging been done at the OPD. This has to be seriously evaluated.

5.7 CORRELATION ANALYSIS OF CROWDING STATUS (CEDOCS SCORE) AND SELECTED INDEPENDENT VARIABLES

Some of the factors that are likely to influence the crowding situation on the ward were explored. It was discovered that as the ED boarding volume increased as the ED became crowded. This

confirms Derlet citation of ED boarding as on the main causes of ED crowding (Derlet *et al.*, 2001). This finding also affirms from the ACEP concept that ED boarding is the primary cause of ED crowding (EMPC 2016). When the number of trolley and wheel chairs increases at the ED the chances of the ED becoming crowded also increases. There was a strong positive linear correlation between crowding and the number of patients at the ED (r=0.9147). As the number of patients at the ED increases the ED get more crowded. Interestingly as the number of nurses increased the crowding situation on the ward got better.

5.8 REGRESSION ANALYSIS OF SOME SELECTED VARIABLES

How can the crowding situation be predicted at the ED so that the necessary interventions will be put in place to avoid overcrowding on the wards. Inasmuch as the through-put factors (door-to-doctor time and dwelling time) are clinically important by way of the quickness of intervention and rapid dispatch of patients from the ward they were found not be statistically significant (p-value of 0.700 and 0.395 respectively for Door-to-doctor time and Dwelling time) in predicting the crowding situation on the ward. That means whether the patients were seen on time or they stayed longer on the ward before leaving it was not going to affect how crowded the ward was going to be. That means there may be other equally important variables that could predict the crowding situation at the ED. This led to the exploration of other variables including the number of doctors and nurses at the ED, the total number of patients, the number of trolleys and wheel chairs and ED boarding volume.

It was determined that the number of doctors, nurses and ED boarding volume were not significant in predicting the crowding situation on the ward whereas the number of beds, trolleys and wheel chairs at the ED were significant in predicting the crowding situation on the ward.

From the research, the finding suggests that physical space is of essence if crowding is to be controlled at the ED. The number of beds, trolleys and wheel chairs indicate the total patient volume at the ED at a particular time and these are good predictors of the state of the ward with regards to crowding. Suffice to say that, with every unit increase in the number of doctors at the ED the CEDOCS score increased by 2.61 holding all other variables constant. That means that there is a likelihood of the ward getting crowded even when the number of doctors are increased at the ED if the over important variables are not corrected. However with very unit increase in the number of nurses the CEDOCS score decreased by 1.72 holding all other variables constant. This means that the ED is less likely to be crowded if the number of nurses at the ED is increased.

Other variables that could predict the crowding situation on the ED were further studied in a predictive model. The total number of patients at the ED, as well as the total number of critically ill patients and how long patients waited before they were attended to by the ED doctors were found to be significant in predicting the crowding status of the ED. For every unit increase in the waiting time of patients the CEDOCS increased by 2.57 holding all other variables constant. That is to say that when it takes a longer time for patients to be attended then there is a likelihood of the ward becoming crowded

CHAPTER 6

6.1 CONCLUSION

The findings from the study revealed that the Emergency Department at the Tema General Hospital operated at full capacity on daily basis and the door-to-doctor time and the dwell times were not significant in predicting the crowding status of the ED. The metric CEDOCS score was helpful in objectively and statistically determining the crowding status of the ED. It was discovered that, the ward was busy on 6 days whiles extremely busy on 21 days and overcrowded on 4 days. The weekends had peaks of crowding with increased door-to-doctor times and dwelling times. Hospital related factors were significant in determining the flow of patients at the ED. Hence for effective and efficient flow of patients at the ED challenges with bed availability in the hospital, how quickly financial clearance can be made and how quickly the pharmacy can serve patients must be looked at.

The number of doctors and nurses on duty were not significant in determining whether the ward was going to be crowded or not. However when the number of nurses on duty increased the ward was less crowded. The total number of patients together with the number of trolleys and wheel chairs at the ED were significant in giving an indication of the crowding status of the ED.

For the duration of the study, out of the total of 560 patients who visited the ED, 55 of them died at the ED, constituting about 10% of all patients seen. Revealing enough, all the deaths cases were initially triaged Category A (Red). This is clear evidence that patients in these category need all the lifesaving effort and time to avoid such calamities. As a public health intervention, the populace will need to be educated on the need to avoid delays in sending life threatening case

to the hospital for early attention. A further step on this will be the call for policy maker to ensure all needed logistical support is offered the National Ambulance Service so they can strategically positioned the local units in close proximity to the citizenry.

6.2 RECOMMENDATION

For purposes of improving health care delivery at the ED and TGH at large the following recommendations are made;

1. The size of the ED needs to be physically expanded and the staff strength improved to match the volume of Emergency patients. The challenge of staff strength can be accomplished by using on-call doctors and nurses by engaging them during crowding moments so as to limit the negative effects of crowding on the patients. This is critical to the effective and efficient functioning of the ED. The space can also be improved by reducing the turnaround time of the patients.
2. There must be clearly defined turnaround time goals in the ED for admitted, referred and discharged patients. This must duly be implemented to reduce the crowding situation on the ward.
3. Patients who have been discharged but still in the facility waiting for relative to settle their bills must be relocated to a mid-shift ward pending disposition from the ward. This is to minimize the impact of crowding at the ED.
4. Someone who can manage and coordinate the transfer of patients to the in-patient bed must be hired. This person will be responsible for managing the beds at the ED and the main hospital ward.

5. Further studies need to be carried out to understand the impact of ED occupancy and ED boarding as well as the door-to-doctor time and dwell time on operations at the ED in TGH.
6. With regards to triaging a trained physician should be stationed at the triaging unit or the triage nurses must be retrained so as to improve on the accuracy of triaging at the OPD. This will in the long run reduce the numbers of wrongly triaged cases that may end up at the ED and in the process reduce the ED patient volume and it attendant issues.
7. There must be further study to understand why the throughput factors and crowding status are worse usually over the weekends. This will help to correct if any lapses experienced during the weekends.
8. Since most of the patients reside outside the enclave of the Tema Metropolis, it is important for further studies to be conducted to understand why patients have to travel long distances to access health care during emergencies especially within the concept of Primary health care. The health care delivery system immediately around Tema must be strengthened to absolve some of the patients. This will eventually reduce the patient volume that may end up at the ED and crowding likely to be minimized.
9. Further variables that are likely to cause crowding at the ED must be studies and future research on national emergency department crowding scale score must be undertaken to give a national picture of ED crowding in Ghana. This will help policy maker to institute policies that will enhance adequate and effective health care to emergency patients in Ghana.

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CONCENT FORM

ENSIGN COLLEGE OF PUBLIC HEALTH

FACTORS INFLUENCING CROWDING AND PATIENTS FLOW IN THE EMERGENCY DEPARTMENT: A CASE STUDY OF TEMA GENERAL HOSPITAL

DATA COLLECTION TOOL

Dear respondent,

My name is Lawrence Lartey a graduate student of Ensign College of Public Health, undertaking research work for the award of a Master of Public Health (MPH) degree.

The primary goal of this study is **to assess factors that influence crowding and patients flow in the emergency department using Tema General Hospital as a test case**. I will be using information from your folder and if need be for clarification I will contact you. Any information about you gotten during this study will be kept strictly confidential and only known to the research team. The final report will be an aggregation of all information gathered from several other patients and hence any finding made will not be attributed to you individually.

You are assured that no discrimination or unfair treatment will be meted out to you because of your participation. Neither will you be disadvantaged or ill-treated at Emergency Department or any other area of this hospital because of your participation in this study. If at any point during the study you strongly feel you no longer want to participate, you have every right to pull out and any information about you will not be included in the study.

Your participation in this research will go a long way to contribute to knowledge to help policy makers and health care practitioners understand the factors that influence crowding at the Emergency Department so they can offer solutions.

Do I have your consent to apply the tool to you now?

YES [ ] **NO [ ]**

Signature: _____ **Date:_____**

QUESTIONNAIRE No: ……. Date ……..

INSTRUCTION: PLEASE TICK A BOX LIKE THIS √ TO SELECT AN ANSWER THAT BEST APPLIES TO YOU OR BY WRITING YOUR ANSWER IN THE SPACE PROVIDED WHERE APPLICABL

SECTION A: DEMOGRAPHY

1. Folder Number ……

2. Day of the Week ……..

3. Time ……..

4. Referral: a. Yes [ ] b. No[ ]

5. If Yes to **Q4,** from which facility:

a. Government [ ]
b. CHAG [ ]
c. Private [ ]
d. Quasi [ ]

6. Form of Arrival at the ED:

a. Walk in [ ]
b. Trolley [ ]
c. Wheel chair [ ]
d. Ambulance [ ]

7. Acuity after Triage ……

8. Age ……

9. Sex …….

10. Religion of Patient:

a. Christian [ ] b. Islam [ ]

c. Traditional [ ] d. No Religion [ ]

e. Others ……..…

11. Residence: a. Tema [ ] b. Outside Tema [ ]

12. Highest Level of Education

a. None [ ] b. Primary [ ]
a. JHS/Middle [ ] d. Sec./Tech/Voc [ ]
e. Tertiary [ ]

13. Occupation

a. Unemployed [ ] b. Self-employed [ ]
c. Gov't Employed [ ] d. Apprentice [ ]
e. Other (Specify)……

14. NHIS Status: **Yes** [ ] b. **No** [ ]

15. Patient Outcome: a. Alive [ ] b. Dead [ ]

SECTION B

PATIENT FACTORS INFLUENCING CROWDING AT THE ED
(Circle the best appropriate explanation)

16. Emergency Department Factors

a. Patient waiting for a doctor to attend to attend for the first in the ED
b. Patient being seen by the ED doctor
c. Patient waiting for test results done at the ED or hospital
d. Patient waiting for disposition decision to be made

17. Emergency Department Interrelated Factors

a. Patient waiting for results of investigations done or to be done outside the hospital
b. Patient waiting for review or admitted by other departments in the hospital
c. Patient or relations gone to the pharmacy to purchase medications

18. Hospital Related Factors

a. Patient waiting to go to an in-hospital bed (when bed is available)

b. Patient waiting to go to an in-hospital bed (when bed is not available)
c. Patient waiting for financial clearance from the accounts department after discharge/referral

19. Non -Emergency Department non-hospital related factors

a. Patient waiting for relatives after discharge
b. Patient waiting for relatives after referral to another facility
c. Patient waiting for an available bed in another facility after referral
d. Patient waiting for social welfare assistance
e. Patient waiting for an ambulance
f. Patient waiting to purchase drugs

SECTION C: TIME RECORDS

20. Time Patient is first seen and triaged by OPD nurse	……..
21. Time patient is first seen by the ED physician	…….
22. "Door-to-Doctor" Time	…….
23. Time that disposition is made concerning patient	……..
24. Time that patient actually leaves the ED (disposition effected)	…….
25. "Dwell Time"	……..

SECTION D:

COMMUNITY EMERGENCY DEPARTMENT OVERCROWDING STUDY SCALE (CEDOCS) MODIFIED AND ADOPTED FOR THIS RESEARCH

Fixed Variables **26.** ED visits per year	……..
27. Number of ED Beds	…….
Count Variables **28. Total** Patients in ED including those on trolleys and wheel chairs	…….
29. Number of admitted critical care patients in the ED	……..
30. Number of patients in the waiting room (patients waiting to be seen)	……
Time Variable **31.** Longest waiting time of patient(D-DT)	…….
32. CEDOCS SCORE	……..

SECTION E

ED STAFFING AND WORK LOAD

33. Number of ED doctors	…….
34. Number of ED nurses (including those playing administrative roles)	…….
35. Number of ED beds occupied by patients	……
36. Number of trolleys occupied by patients in ED (in the walk way)	……
37. Number of wheel chairs occupied by patients in the ED (in the resuscitation area)	…….
38. ED boarding volume (admitted to the MD but waiting for a bed)	……