FACTORS THAT AFFECT PATIENT FLOW AT THE ACCIDENT AND EMERGENCY DEPARTMENT OF A TERTIARY HEALTHCARE FACILITY IN A LOWER-MIDDLE-INCOME COUNTRY

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Factors that affect Patient Flow at the Accident and Emergency Department of a Tertiary Healthcare Facility in a Lower-Middle Income Country

A thesis submitted in partial fulfillment of the requirement for the degree of Master of Science in Public Health

By

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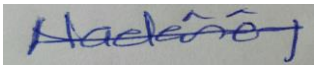
Signature: 

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LIST OF ABBREVIATIONS

AED	Accident and Emergency Department
A&E	Accident and Emergency
BBP	Basic Benefit Package
BOR	Bed Occupancy Rate
CD	Communicable Disease
CLS	Hospital main laboratory
DL	Discriminator List
EDLOS	Emergency Department Length of stay
ED	Emergency Department
EMS	Emergency Medicine Specialist
EP	Emergency Physician
ECS	Emergency Care Services
GHS	Ghana Health Service
HB	Haemoglobin
HCF	Health Care Facility
HIC	High-Income Country
I$	International Dollars
JP	Junior physician
KBTH	Korle Bu Teaching Hospital
LIS	Laboratory Information System
LMIC	Lower-Middle Income Country
LOS	Length of Stay
MOH	Ministry of Health
NAS	National Ambulance Service
NHIS	National Health Insurance Scheme
NCD	Non-Communicable disease
OOP	Out-of-Pocket
OPD	Out-patient Department
PPP	Purchasing Power Parity
PTAT	Patient Turnaround Time
PWT	Patient Wait Time
POCT	Point-of-Care testing

PL	Private-run laboratory
QI	Quality Improvement
SDG	Sustainable Development Goal
TEWS	Triage Early Warning Score
THE	Total Health Expenditure
TAT	Turnaround Time
WT	Waiting Time

GLOSSARY

Average Length of Stay: - Average number of days that a patient remains hospitalised (1).

Bed turnover: - "Number of discharges (including deaths) in a given time period / Number of beds in the hospital during that time period"(2)

Bed occupancy rate:- "Percentage of available beds that have been covered over a given period" calculated as the number of beds effectively occupied (bed-days) divided by the number of beds available (3).

Boarding: - The process of holding patients in the AED until they have been admitted to an inpatient department/facility; or until they have been discharged (4).

Input component:- "includes any condition, event, or system characteristic that contributes to the demand for ED services"(4).

Output component:- conditions that contribute to either admission or discharge of patients in the ED (4)

Point of care testing: - "refers to any diagnostic test administered outside the central laboratory at or near the location of the patient" (5).

Throughput component: - conditions that contribute to patient crowding from the point of ED entry until admission or discharge (4).

ABSTRACT

Introduction: Overcrowding within hospital emergency departments (AED) of most lower-middle-income countries (LMIC) including Ghana, is increasingly becoming a significant public health threat; compromising quality healthcare services delivery and the safety and well-being of patient and staff. Frequent congestion as a result of obstruction in patient flow limits timely access to accident and emergency (A&E) services. In this study, bottlenecks within patients' journey at the AED of a tertiary healthcare facility in Ghana were identified and solutions to these challenges discussed

Method: Study was based on extensive review of literature and observations at the AED. The-input-throughput-output conceptual framework was adapted to identify and analyse patient flow factors.

Results: Nine delay factors were identified; five similar to high-income country settings, and four apparently peculiar to LMIC. Two factors were identified as internal to AED, while five were identified to be external. The other two-Payment and billing processes, and finance and family-related factors- were cross cutting, with fees collection being a contradiction to A&E policy.

Discussion: Delay factors are interlinked with some outside AED's span of control as a result of the institution's organisation of care. The problem also highlights the interaction between policies and their implementation. Decreased input, throughput improvement and increased output will mitigate the problem.

Conclusion: AED crowding should be viewed as system-wide problem.

Recommendation Harnessing process improvement tools such as Plan-Do-Study-Act and technology together with a desire to continuously monitor and improve will impact AED crowding positively.

Key words: Emergency Department; Patient flow; Length of stay; Delay factors; Overcrowding

Word Count: 13, 082

INTRODUCTION

Overcrowding within Accident and Emergency Department (AED) in lower-middle-income countries in the last decade has become an increasingly significant public health problem. Several countries are beginning to highlight its effect on patient and health worker safety. The Sustainable Development Goal (SDG) three which aims to ensure healthy lives and promote the wellbeing of all ages; targets also access to quality essential healthcare services (target 3.8) and effective treatment (target 3.4). AED offer one of such essential healthcare service where timely access and proper treatment in emergencies will contribute to improving peoples' wellbeing. A vital function of AED is to stabilise and resuscitate severely ill patients and such timely access to care and management as advised by the World Health Organisation should not be constrained (6).

Unfortunately, this is not the case at most AEDs in Ghana including that of the Korle-Bu Teaching Hospital (KBTH) where congestion and overcrowding often compromises timely patient care. In recent past media attention has also focused on the congestion at the AED and its effect on bed availability, timely care and utilisation of emergency services (7,8).
The unfortunate demise of a citizen in his vehicle at a hospital car park after failing in attempt to secure a bed for emergency care at seven different hospitals is one recent example of the situation in Ghana (9). The experience highlights serious issues of access, patient flow, congestion, and looming bed management crises in most hospitals and a threat to public health and safety.

The Ghana Health Service in its efforts to improve accident and emergency services in general instituted an investigative committee in June 2018 following the case cited above. The committee was mandated to assess work of the ambulance services and bed management in emergency departments (10).

In the past, several similar attempts to resolve the problem at KBTH's AED have not yielded the desired results. It seems that the underlying factors associated with overcrowding and congestion at the AED in KBTH are unclear.

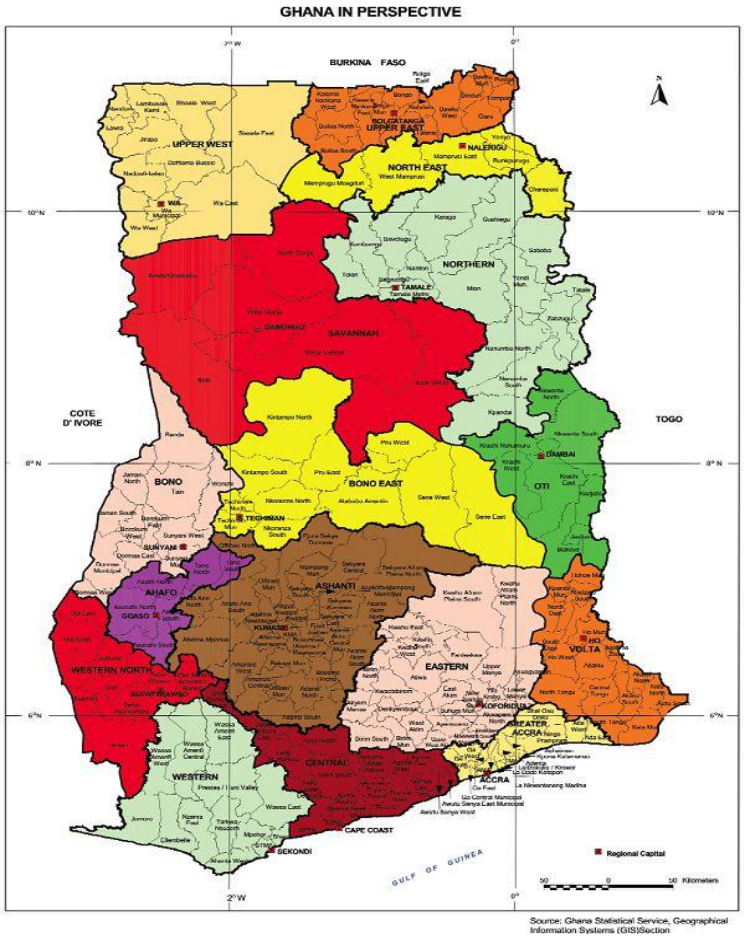
I am responsible for ensuring efficient and effective organisation of patient care in the department. This work is my contribution to an understanding of the factors that impede patient flow in the AED of KBTH in Ghana.

The study findings can help recommend appropriate interventions to improve AED services in KBTH or similar settings. The AED needs such efforts to achieve its mandate of providing timely and effective emergency care services for the general public, thereby contributing to a healthy Ghanaian population. The research findings will also be useful for policymakers, and other hospital managers in addressing patient flow challenges in similar contexts.

1.0 CHAPTER ONE: BACKGROUND INFORMATION ON GHANA

1.1 Geography and socio-demographic characteristics

Ghana is an Anglophone lower-middle income country (LMIC) with a total land area of 238,537 km^2 situated in West Africa. It is bounded by three countries, namely Burkina Faso, Togo and Cote D'voire and Gulf of Guinea, and divided into 16 administrative regions as shown in figure one (1) (11). The total population is approximately 30.2 million (2017est) (12) with 50% concentrated in three regions: Greater Accra, Ashanti and Eastern regions (13). Accra is the capital city. Ghana is in the tropics at latitude 7.946527 and longitude -1.023194 with two distinct weather patterns: the rainy and dry (harmattan) seasons. In 2017, life expectancy at birth was 66.5 years (males) and at 71.5 years (females) (12). In the 2010 population census, literacy rate for males and females 15 years and above was 78.35% and 65.29% respectively (14). Gross National Income per capita was 3880 US dollars (2013 est). In 2014 the total expenditure on health was 3.6% of the country's Gross Domestic Product(15). The total per capita expenditure on health has reduced to 189 International dollars (I$) purchasing power parity (PPP) in 2016 from 251 I$ PPP in 2015. In recent years, Ghana's compulsory financing arrangements have gone down from 52% in 2015 to 43% in 2016. That is the combination of tax funding (32% of total health expenditure (THE) and Social Health Insurance (11% of THE) (16).



1.2 Burden of Disease

The burden of disease in Ghana remains a mix of communicable diseases (CDs) and non-communicable diseases (NCDs). NCDs contribute to 43% of all mortalities with stroke hypertension, diabetes and cancers ranked among the ten topmost causes of mortality (15,17). CD's on the other hand contribute to 48% (15) of mortalities with the conditions such as malaria, HIV/AIDS, diarrhea diseases and respiratory tract infection among the top ten. Generally, the top ten conditions that cause most premature deaths have largely remained unchanged from 2007 to 2017, although there are some variations in the ranking. Also, stroke, Ischemic Heart Disease and road injuries are increasingly becoming the causes of most deaths and disability combined (12).

Figure 1: Map of Ghana showing 16 administrative regions

Source: Know the 16 regional capitals of Ghana (11) (2019)

1.3 Health System

The Ministry of Health (MOH) is responsible for policy formulation and care standards establishment for implementation by the Ghana Health Service (GHS), Teaching Hospitals and Quasi- Government Institution Hospitals (18) which largely provide public sector service; and a regulatory framework for private sector services which are responsible for about 35% of healthcare services (19,20). The public sector provides healthcare services in three hierarchical levels and through a referral and gatekeeping system. The first is the primary level care facilities such as health centres, polyclinics or district hospitals, providing mostly preventive services for a maximum population of 500,000. The secondary level care is provided by regional hospitals and offers both preventive and curative care to a maximum of 1.2 million people, while the tertiary level provides curative services, training, and research with bed capacities between 400-2000 for the entire Ghanaian population. Presently the four are Korle Bu, Komfo Anokye, Tamale and Cape Coast Teaching Hospitals (19). KBTH is the leading national referral centre in Ghana.

1.4 Health Financing

In 2003, the National Health Insurance ACT[i], was enacted to establish the National Health Insurance Scheme (NHIS) as a Healthcare funding strategy to assure all residents in Ghana equitable and universal access to healthcare. This was to increase financial accessibility and limit out-of-pocket (OOP) payment for health care services, including emergency care and transfer services in public and accredited private healthcare facilities (21). In 2012, the new NHIS ACT[ii], established the National Health Insurance Authority and also harmonized the 155 semi-autonomous district-wide (public) mutual health insurance schemes to ensure effective management for efficient service delivery (22). Coverage of the non-exempt population after fourteen years of NHIS introduction was reported to be 38% in 2013 (23) although the entire population was targeted to have full coverage five years after NHIS inception (21). The share of all expenditures borne by the NHIS is 11%.(16)

1.5 Healthcare Access and Emergency Services

Healthcare access and quality index has increased from 29.6% in 1990 to 39.3% in 2016 (12). The improvement over the period[iii] attributable to NHIS introduction has come with increase in demand for emergency care services especially at tertiary level facilities. Another reason is the non-restrictive gatekeeping function of lower-level healthcare facilities for emergencies and the need for immediate management of emergencies. Consequently, high demand and utilisation of emergency services has been very challenging for hospitals including KBTH. Until recently, most Accident and Emergency Department (AED) operated as subunits mostly managed by medical officers without specialized training. Like most countries (24) emergency services in Ghana are not for free. The payment methods include private or public insurance and OOP. Upfront payment is not required before treatment is commenced (25). Nonetheless from my experience patients pay for services either during treatment or prior to transfer or discharge. At KBTH, it is estimated that 50% of patients seeking emergency care pay OOP whilst the remaining rely on NHIS and private insurance. Patients with NHIS pay user fees for services outside the scheme. Common conditions seen at KBTH AED include trauma, medical and surgical cases.

1.6 Commitment of Ghana to Emergency Services

Since the 60th World Health Assembly's call for member states to strengthen Emergency care services (ECS) (26), Ghana has implemented many interventions to provide ECS

[i] ACT 650

[ii] ACT 852

[iii] Average yearly percentage increase of 1.8% from 2000 to 2016 as compared to 1.4% from 1990 to 2000

including establishing formal training for Emergency Medicine Specialists (EMS); Emergency Medicine Nurses (EMN) (27); developing a policy on Accident and Emergency (A&E) services (25); and establishing a National Ambulance Service (NAS) (28). The NAS, jointly established by MOH and Ministry of Interior is mandated to handle patients properly, safely and timely during transfer with the right staff and equipment (28). EMS formal training is approved by the Ghana College of Surgeons and Physicians since October 2009. This aims to improve physician capacity and reduce the number of non-EMS in AEDs. By 2016, 40 to 50 EMS should have graduated (27), but as at 2014 only 11 had graduated(29). EMN training, in addition, has started after developing a curriculum(30).

2.0 CHAPTER TWO: PROBLEM STATEMENT, JUSTIFICATION, OBJECTIVES AND METHODOLOGY

2.1 Problem Statement

The AED (31) of KBTH, - the leading national referral centre in Ghana – is a Sub-Budget Management Centre[iv] and serves as an entry point to KBTH with about 7000 patient visits recorded yearly. The AED attends to adolescents and adult patients with trauma and non-trauma conditions either referred from both public and private health care facilities or self-referred from the community and beyond. Similar to most AED's, the department provides initial stabilization and resuscitation prior to patient transfer or discharge. To ensure AED patient flow, MOH's A&E policy (25) mandates all health facilities to have an AED patient transfer protocol.

In response KBTH has set a 48-hour maximum AED length of stay (LOS) for patient disposition (discharge or transfer) either to another KBTH clinical unit or to another hospital facility for further care. This protocol, however, is not rigorously followed. For more than 50% of patients seen, the average LOS is above the allowable LOS and affects AED patient flow, often resulting in congestion and overcrowding (8). This overcrowding is defined as AED's inability to timely meet the next patients' need as patient volumes exceed physical infrastructure or staffing capacity (32,33). Congestion caused from boarding patients, results in increased likelihood and occurrence of medical errors, increased patient waiting time and delays in prompt intervention, increased LOS, increased patient care cost, and access block- which limits the number of newly admitted cases. All these ultimately affect the quality of patient care with resultant increase in disability, severity of morbidity and even mortality (33–37).

Consequently, AED staff are also adversely affected: increased stress and exhaustion, demotivation, and poor work satisfaction (35,37). Furthermore, AED suffers financial loss as a result of low bed turnover and decreased bed capacity. These affect revenue generation with implications on resources for work. Under the present circumstances the congestion and consequent reduction in responsiveness of KBTH have dire consequences and poses a serious public health threat since the leading AED in Ghana cannot be relied upon to provide timely care (32,36). Especially any delay in accessing AED interventions creates further public health crisis; compromises patient safety; and endangers reliability of emergency healthcare system (32,36).

Three main interlinked components, namely: input, throughput and output (4) affect patient flow. Examples of each component (4,32,34,36,38–40) are listed in table one below with some throughput considered the most time consuming (4,38,40).

Table 1: Examples of factors for three interlinked components

Input	Throughput	Output
-Patient volume -Illness severity and type -Gatekeeping system	-Poor facility design -Less patient-centered approach -Waiting time for physician contact -Laboratory services -Diagnostic imaging services -Variation in treatment protocol -Patient specific administrative & financial procedures	-Inadequate inpatient capacity - Limited capacity of OPDs for referrals - lack of follow up access at primary care facilities

Source: Multiple Studies (4,32,34,36,38–40)

[iv] Sub-Budget Management Centre : Hospital departments with devolved administrative powers

Moreover, other studies (41,42) have shown that AED inefficient work processes also contribute to overcrowding and adversely affect quality of patient outcomes. Work processes include admission (admission protocols and policies), discharge payment, triage and registration processes. If these processes are managed properly, quality of care outcomes can improve, patient waiting times could be reduced; and increased patient satisfaction could also be achieved. But what does it take to manage these work processes at the AED in a typical LMIC setting like Ghana?

2.2 Justification

In Ghana, recent media spotlight on reduced access to timely AED care nicknamed the "no bed syndrome"(43) has highlighted the precarious threat to public health due to patients' inability to promptly access emergency care. The AED of KBTH serves as an entry point for all referred emergency cases and self-referrals in Greater Accra Region, and also the alternative option to access care when other clinical departments are closed. Per MOH's policy (25) no patient should be denied access to care, thus even when AED is filled to capacity, there is a public expectation that patients must be seen. KBTH is perceived as one of the final destinations for resolution of all healthcare problems within Ghana. Inability to access timely A&E care may result in severe consequences, and this increases patients and family anxiety and decreases staff morale. To address issues of patient flow in order to increase access, the 36 bed capacity facility has been expanded to 67 bed capacity in 2018. This has however not resolved the AED congestion issue which means besides floor space, there are multiple factors affecting patient flow(44,45).

Evidence shows that initiatives to improve access to AED services is the foremost Quality Improvement (QI) project that should be undertaken, as staff found inaccessibility to services resulting from congestion a huge problem and a major disincentive (35). AED overcrowding is not a new phenomenon but has been mostly studied in high-income countries (HIC), (6) where resources and support services such as laboratory and radiological services are often more readily available as opposed to LMICs. Again in HIC, A&E healthcare service is not limited by availability of finances largely due to the presence of social and private health insurance schemes in comparison to LMICs like Ghana where although social insurance exists, healthcare funding remains largely OOP and plays a defining role in access to A&E care. Again, availability, accessibility and affordability of other medicine and non-medicine resources play a vital role in AED work processes. In a resource limited setting such as Ghana, how do these factors interplay to influence workflow processes in situations of overcrowding and congestion? Since emergency care and it's specialization as a field of medicine in LMICs is relatively new, a better understanding of the factors influencing work processes and congestion at a busy AED such as that of KBTH is both important and urgent. This study makes a contribution by highlighting a typical emergency overcrowding situation in a LMIC setting and using lessons from other settings to suggest remedies.

2.3 General Objective

The overall goal of this study is to explore factors that affect patient flow and outcomes in all aspects of the patient journey in the Accident and Emergency Department at the Korle Bu Teaching Hospital in Accra Ghana in order to address bottlenecks that potentially contribute to overcrowding.

2.3.1 Specific Objectives

1. To describe types and relevance of emergencies admitted and managed at the AED.
2. To describe the existing workflow processes in the patients journey in the AED.
3. To identify and analyse the factors influencing the workflow processes in the AED.
4. To review literature for similar problems and solutions.

5. To provide recommendation to the respective stakeholders for redress on the basis of the findings.

2.4 Methodology

A review of literature and desk study to answer the specific research objectives was conducted. Databases and search engines namely: Google Scholar, PubMED, Google, and VU LIB[v]-Search Engine were employed to find relevant journal articles published within the past 25 years (1994-2019) in English Language. English language articles were selected because the researcher's language proficiency is limited to English.

The relevant articles timeframe was selected to bring to bear the different publication perspectives of this age old problem, and to see their trends over time and contribution to the study topic. Literature from HIC were mainly used as relevant literature from Ghana and other LIMCS, which may share similar characteristics, were very limited probably as a result of little research conducted on AED. To deepen the search and citation of relevant references, the reference list of useful articles found were consulted using "snow balling" technique. During the search, articles were first selected based on the research title and thereafter shortlisted based on abstract contents. Search terms used include emergency, crowding, access block, ED length of stay. More details on the search strategy, including word combinations is attached as Appendix I.

In addition to what is gleaned from the literature, this work is partly based on my experience working at the AED of KBTH from December 2014 -to August 2018. In drawing from my personal experience, I have been conscious of potential biases inherent in personal observation studies and have weighed such observations against what has been reported in the literature.

2.5 Conceptual Framework

The concept of efficiency in healthcare services has been researched to identify factors that contribute to inefficiencies using several frameworks (46,47). One such framework that has been used to guide studies on overcrowding in healthcare system is the conceptual framework of acute care system workflow and crowding known as the input-throughput-output conceptual framework (4). The framework conceptualizes Emergency Department (ED) crowding to be a result of three interdependent components namely, input, throughput and output within an emergency healthcare service delivery system that amongst others, provides unscheduled care. This framework is practical as it enables researchers to study and understand the causes and effects of ED crowding in a well ordered manner in order to arrive at practical solutions without missing out important causes (4). Secondly, it is a model of choice of many researchers to understand and improve hospital processes.

For this work the framework as shown in figure two below by categorising input into two distinct groups namely: "provider referred" and "auto-referred" in order to highlight two main ED patients' sources and also to remove the inherent perceived a priori classification of cases. At throughput, "triage" and "room placement" are separated into two distinct components to clearly distinguish between them. Room component has been further broken down to show the different possible patient rooms. ED death which was absent in the original framework has been included at both throughput and output. Throughput is extended to cover "patient disposition" since this decision occurs there. Patient disposition has two different arrows leading to ED boarding since boarding may occur before or after a decision. These adaptations have been made to make the framework better fit my setting. "Ambulance diversion", "left without being seen" and "patient arrives" categories have been

[v] Vrije Universiteit library

omitted as they will not be discussed. Given the study's general objective, the research mainly focused on throughput which systematically guided my thought processes for AED workflow. Where relevant the input and output factors affecting throughput were analysed. The original framework is included as Appendix II.

2.5.1 Input Component

This component constitutes service demand factors which arise from individuals need for ED care, and their ability to seek and receive care. (4).

2.5.2 Throughput Component

This component accentuates the role of efficiency and effectiveness in ED processes and their impact on patient length of stay (4).

2.5.3. Output Component

This component stresses the inpatients system's ability to provide inpatient beds for admissions (4).

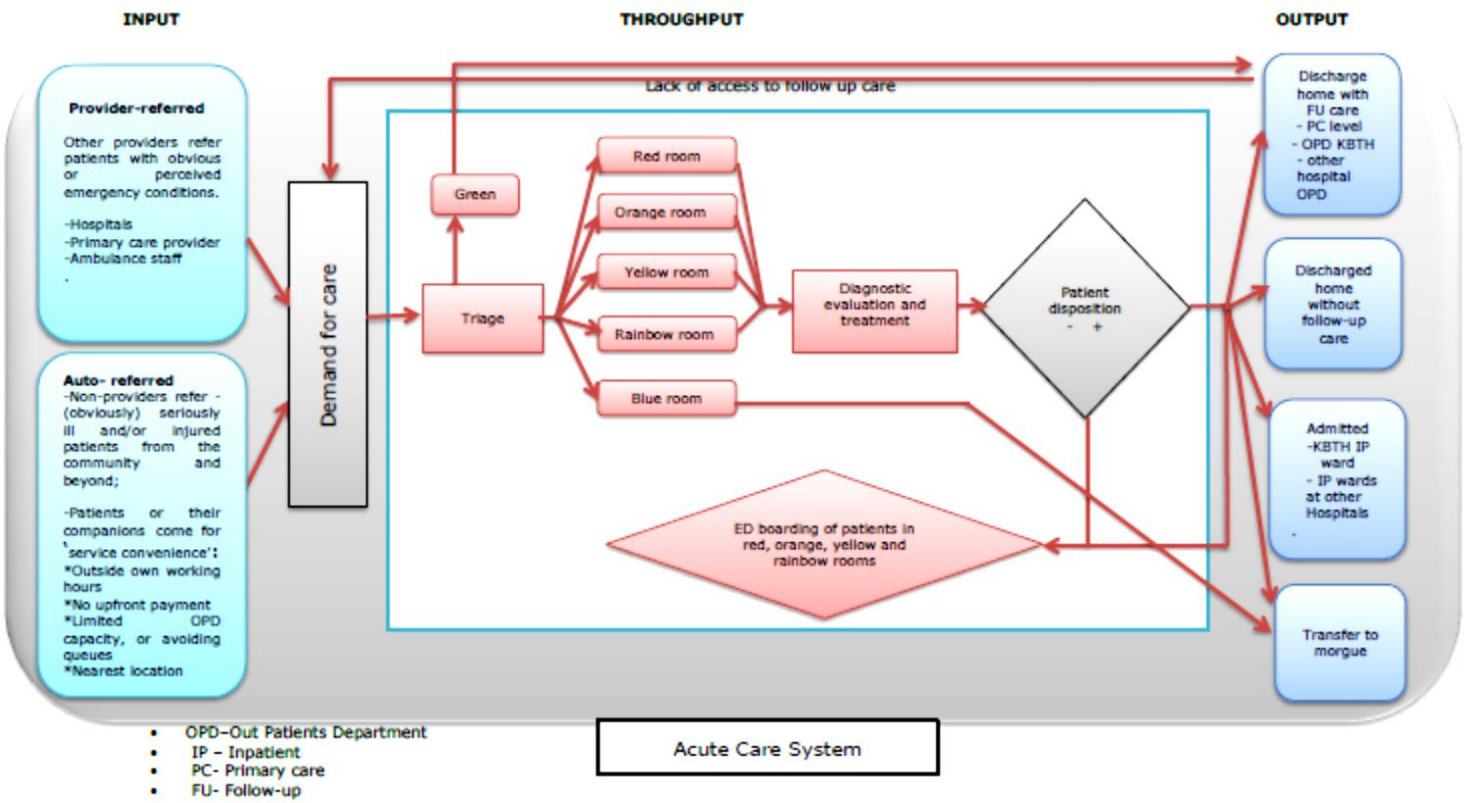


Figure 2: Adapted Input-Throughput-Output Conceptual Framework for Overcrowding in an Acute Care System from Asplin et.al

Source:A conceptual model of emergency department crowding (4) 2003 (Adapted by Author, 2019)

3.0 CHAPTER THREE: DESCRIPTION OF INPUT-THROUGHPUT-OUTPUT COMPONENTS OF KBTH AED

This chapter presents a description of AED input-throughput–output components with detailed focus on throughput description. The throughput includes triage, patient management in rooms, diagnostic evaluation and treatment, patient disposition and AED boarding. Appendix III shows the process map of AED patient flow from entry to exit in KBTH.

3.1 Patient type and condition that demand AED care

In this sub chapter I describe in brief the patient type and relevance of condition presented at the AED.

3.1.1 Provider -referred and auto-referred patients

Individuals who access A&E services may have either an apparent or a perceived need for emergency care. Such individuals are either referred from providers, self-refer or are referred by non-providers. Provider-referred patients have a formal referral note and may come from primary, secondary or tertiary healthcare providers (public or private) or brought by ambulance staff. The AED may or may not receive prior notification before their arrival. Self-referred and non-provider referred patients do not present with a referral note. Some are brought to the AED by bystanders or by family members when their illness is perceived to be serious or as a result of road traffic injuries. Others self-refer because of location convenience (where AED is close to their residence) or payment convenience because service payments are not upfront or working hours' convenience since AED is a 24 hour facility. Self–referrals may also result from lack of access to follow up care due to limited capacity of regular service provider, restricted working hours and frequency of regular lower facility service including its closure. A&E cases presented may include medical, surgical and trauma emergencies from adolescents, adult males and females. Conditions presented may be primary or comorbid. The cases relevance is determined at triage. Appendix IV shows examples of AED cases (unpublished departmental report).

3.2 Triage

In this sub chapter triage description which is the first throughput component focusing on triage area, triage process and triage tool is given.

3.2.1 Triage area

Per MOH policy on A&E (25), hospital emergency units should amongst others have a triage, resuscitation and observation areas. Accordingly, the clinical area of KBTH AED[vi] has an enclosed space opposite AED's main entrance for triage operations. Within triage is a telephone for internal calls and external referral notification calls. A call log to register referred patient details and a triage log to document triage results are available. Other equipment and triage arrangement are detailed in Appendix V.

3.2.2 Triage Tool

Triage procedure is nurse-led by a triage-trained officer with the triage scale. The scale -a two-part tool consists of Triage Early Warning Score (TEWS) and a Discriminator List (DL) (25). Both tools must work in tandem for appropriate results. As displayed in figure three TEWS is calculated based on patient vital signs while DL as figure four shows, uses TEWS to generate triage colour. The colour generated is then used to categorise patient acuity level into "red", " orange", "yellow", "green", and "blue", influencing sorting and care prioritization (25). A red colour code signifies immediate emergency management; orange

[vi] The AED Unit houses the Gynaecological emergency services, but the department is formally not part of the AED.

denotes urgent management within ten minutes; colour yellow, management within 60 minutes; green for streaming within 240 minutes and blue death certification by physician.

1. Adult Triage Score. (TEWS)

	3	2	1	0	1	2	3	
Mobility				Walking	With Help	Stretcher/ Immobile		Mobility
RR		less than 9		9-14	15-20	21-29	more than 29	RR
HR		less than 41	41-50	51-100	101-110	111-129	more than 129	HR
SBP	less than 71	71–80	81-100	101-199		more than 199		SBP
Temp		Cold OR Under 35		35-38.4		Hot OR Over 38.4		Temp
AVPU		Confused		Alert	Reacts to Voice	Reacts to Pain	Unresponsive	AVPU
Trauma				No	Yes			Trauma
over 12 years / taller than 150cm								

Key: RR: Respiratory Rate HR: Heart Rate SBP: Systolic Blood Pressure
AVPU: Alertness, Verbal Response, Reaction to pain, Unresponsiveness
TEWS: Triage Early Warning Scale Temp: Temperature

Figure 3: Triage Early Warning Score scale for Adults
Source: MOH Policy and Guidelines for Hospital A&E Services in Ghana (25) 2011

Colour	RED	ORANGE	YELLOW	GREEN	BLUE
TEWS	7 or more	5-6	3-4	0-2	DEAD
Target time to treat	Immediate	less than 10 mins	less than 60 mins	less than 240 mins	
Mechanism of injury		High energy transfer			
Presentation		Shortness of breath - acute		ALL OTHER PATIENTS	DEAD
		Coughing blood			
		Chest pain			
		Haemorrhage - uncontrolled	Haemorrhage - controlled		
	Seizure - current	Seizure - post ictal			
		Focal neurology - acute			
		Level of consciousness reduced			
		Psychosis / Aggression			
		Threatened limb			
		Dislocation - other joint	Dislocation - finger or toe		
		Fracture - compound	Fracture - closed		
	Burn – face / inhalation	Burn over 20%	Burn - other		
		Burn - electrical			
		Burn - circumferential			
		Burn - chemical			
		Poisoning / Overdose	Abdominal pain		
	Hypoglycaemia - glucose less than 3	Diabetic - glucose over 11 & ketonuria	Diabetic - glucose over 17 (no ketonuria)		
		Vomiting - fresh blood	Vomiting - persistent		
		Pregnancy & abdominal trauma or pain	Pregnancy & trauma		
			Pregnancy & PV bleed		
Pain		Severe	Moderate	Mild	
	Senior Healthcare Professional's Discretion				

Key: TEWS- Triage Early Warning Score

Figure 4: Triage Discriminator List for Adults
Source: MOH Policy and Guidelines for Hospital A&E Services in Ghana (25) 2011

3.2.3 Triage Process and Patient Placement Red, Yellow, Orange and Rainbow Units

Triage is mostly done based on the arrival order of a patient. In exceptional cases however, this order is not adhered to; since nurses can at a glance determine some emergencies and directly transfer to the resuscitation area. This practice is similar to other countries (48). In critical conditions, triaging may be done in an ambulance until a bed is available. Two nurses[vii] at triage provide a 24 hour triaging cover spread over three shifts. They conduct triage simultaneously on different patients with little privacy. Triaging time varies between 10-20 minutes. At triage vital signs and point–of-care testing (POCT)[viii] for glucose, urine ketones, haemoglobin and urine pregnancy are undertaken although no additional tests orders can be administered. The steps help calculate triage score to determine acuity. After triaging, patients with high acuity injuries or critical illness[ix], moderately severe presentations[x]; or relatively low acuity presentations[xi] are transferred to "Red", "Orange" or "Yellow" units respectively based on bed availability for physician assessment. Conversely, a doctor is assigned to see patients at triage if space is unavailable.

Additionally, patients either stay in chairs or are kept at the rainbow area which is an open space adapted to contain patient overflows until either a bed becomes available; they are discharged, or they are transferred to the ward. When required, more stable patients lose their beds to less stable patients with efforts intensified to obtain an inpatient bed. Patients classified green, after a careful explanation, are referred either to the OPD service or seen by a doctor, treated and discharged. Patients who are colour-coded blue are transferred to the department's cold room after a physician certifies death. Additionally, when an external HCF through a phone call notifies AED of a patient transfer, if AED cannot receive the patient due to full capacity, patient details are recorded and call returned when a free bed is anticipated.

3. 3 Patient Management within Red, Yellow, Orange and Rainbow Units

In this sub-chapter a description of the patient management processes within AED placement units is given.

3.3.1 Capacity of Patient Management Units

The red, orange, yellow and rainbow units have thirteen, seventeen and twenty bed spaces respectively. Red has a complement of eight nurses at day and six nurses at night; Orange and yellow units six nurses at day and four nurses at night. Rainbow has three nurses at day and two nurses at night.

3.3.2. Patient Management by Accident and Emergency Department Physicians

The nurse sets up for physician[xii] to examine patient and document in the patient folder. After that, diagnostic tests are ordered and treatment commences with available medication from the departmental pharmacy. Family member brings remaining medications from other pharmacy units within KBTH or private pharmacies outside the hospital. Based on the results of diagnostic tests, physicians continue patient management without external specialist consultation.

[vii] Nurses at minimum rank of staff nurse

[viii] POCT refers to any diagnostic test administered outside the central laboratory at or near the location of the patient

[ix] Triage early warning score of 7 and above, or discriminating factors for red

[x] Triage early warning score of between 6-5 or discriminating factors for orange

[xi] Triage early warning score of between 3-4 or discriminating factor for yellow

[xii] Emergency Medicine Specialist or Medical Officer

3.3.3 Patient Management by Specialists

If a decision for inpatient service is made by physicians, the appropriate specialty with admission privileges is contacted. The contact is usually either by phone or by physical contact to the most junior team member. The member then first examines the patient and consults on the phone with senior members, or consults together with the entire team.[xiii] An admission disposition is confirmed with a written order. If teams' decision conflicts with physicians' earlier assessment, patient management continues at AED. In situations where both teams agree on patient disposition, the physicians can write the admission order for inpatient transfer. For patients with comorbid conditions, more than one specialist team is contacted. Within 48 hours decision for patient transfer or discharge must be made.

3. 4 Diagnostic Evaluation and Treatment during Management

In this sub chapter a description of the laboratory and radiology ordering and results collection processes during management is given.

3.4.1 Laboratory Test Orders

Physicians and teams order laboratory tests to aid in patient management. Figure five illustrates the process from the point of lab order to the point of using lab results. The process map indicates that lab location, range of lab tests, payment arrangement, mode of sample transport and results transmission are likely contributory factors to LOS. It also shows the dependence on private labs. The map, additionally, depicts AED's reliance on family to undertake several activities and their ability to pay for ordered tests.

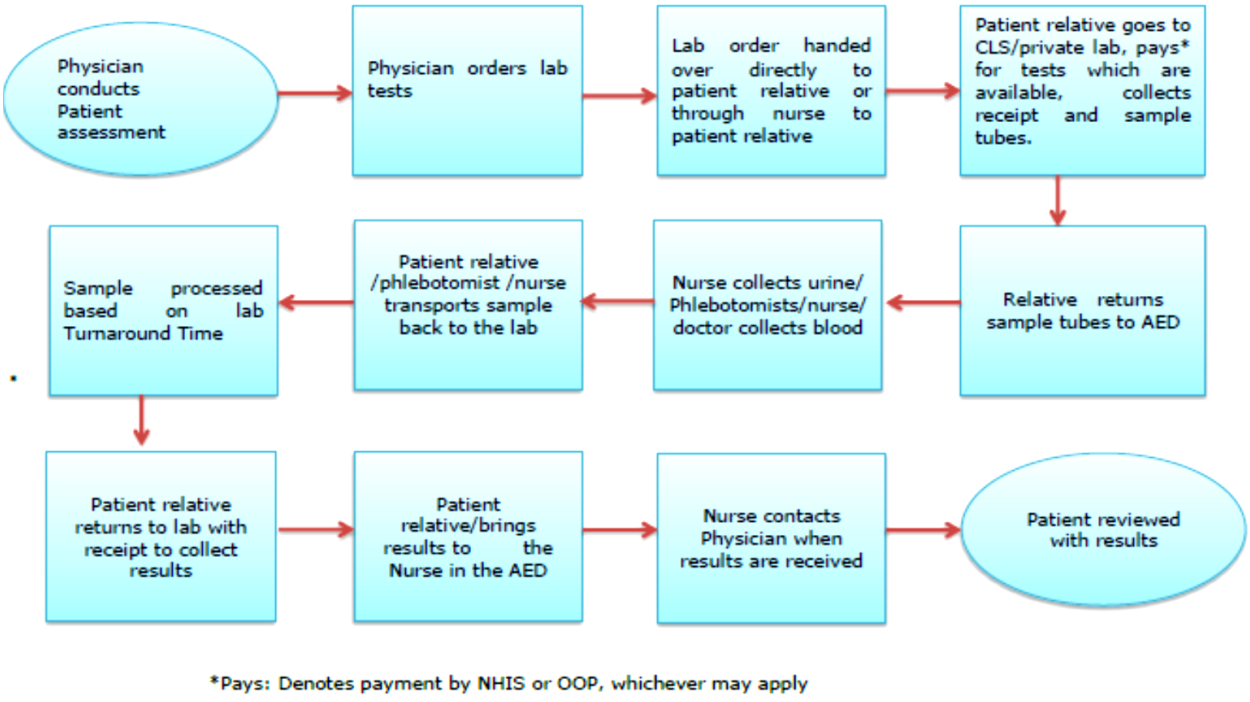


Figure 5: A process map for obtaining laboratory test results for AED patients from the point of order to the point of report submission for patient review.

Source: Author, 2019

[xiii] Team composed of house officer, medical officer, residents, specialists and consultants

3.4.2. Radiology Test Orders

For some disease conditions, radiology investigations are ordered for patient management. The AED's satellite radiology unit (SRU) also serves other patients from different hospital departments. Figure six describes the process of obtaining radiology test results. The process shows that SRU only performs technical functions while non-technical functions related to its work are performed at the main hospital radiology unit (MHRU). Patients scheduling occurs likely resulting from SRU additional responsibility; with the patient family involved in tasks such as scheduling appointment, patient transfer and paying for services. Furthermore, private-run facilities are relied on.

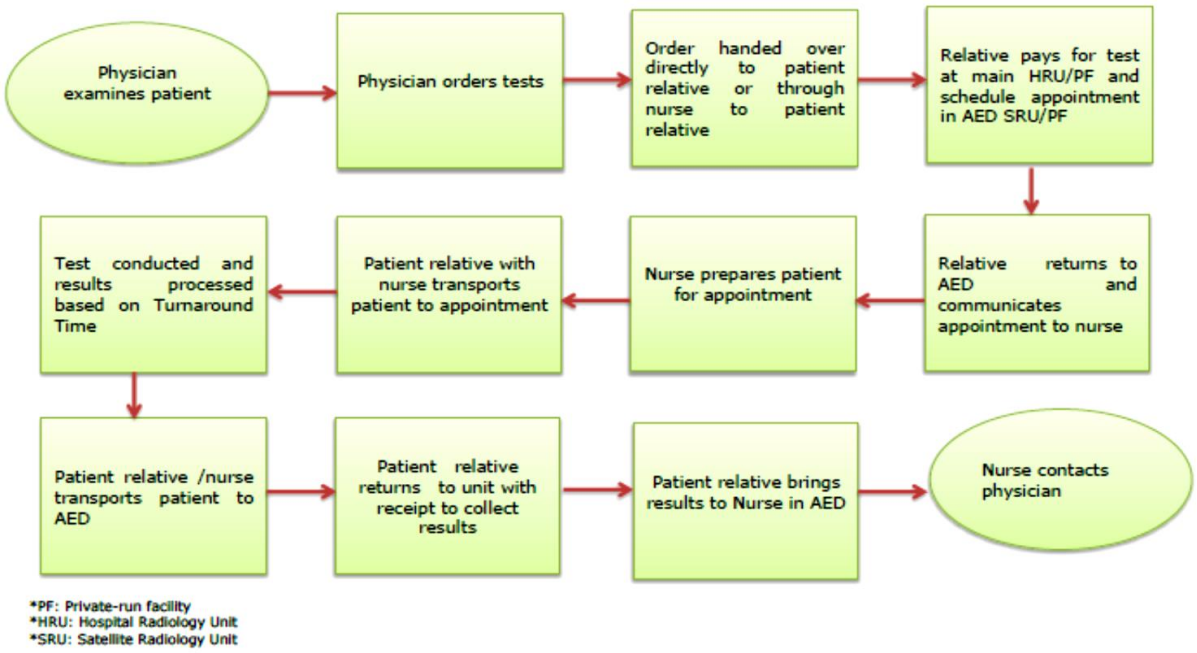


Figure 6: A process map for obtaining radiology test results of AED patients from the point of order to point of report submission for patient review

Source: Author, 2019

3. 5. Patient Disposition and AED Boarding

In this sub chapter a description of the interaction between disposition and boarding is given.

3. 5.1 Boarding prior to Patient Disposition

AED patient boards while awaiting the outcome of processes which inform disposition. Such processes include, awaiting radiology or laboratory tests results, awaiting funds to pay and schedule a test, awaiting appointment schedule and waiting for medication. Other reasons could be the time to specialist consultation.

3. 5.2 Boarding after Patient Disposition

When a disposition is made, several interlinked processes are undertaken to implement the order. A break in the link results in boarding. Figure seven below demonstrates AED transfer and discharge processes. It shows the link among inpatient admission process, payment and billing processes, and family ability to settle the bill and to make external care arrangements, the response of social welfare unit and inpatient bed capacity and how they contribute to delays in implementing dispositions.

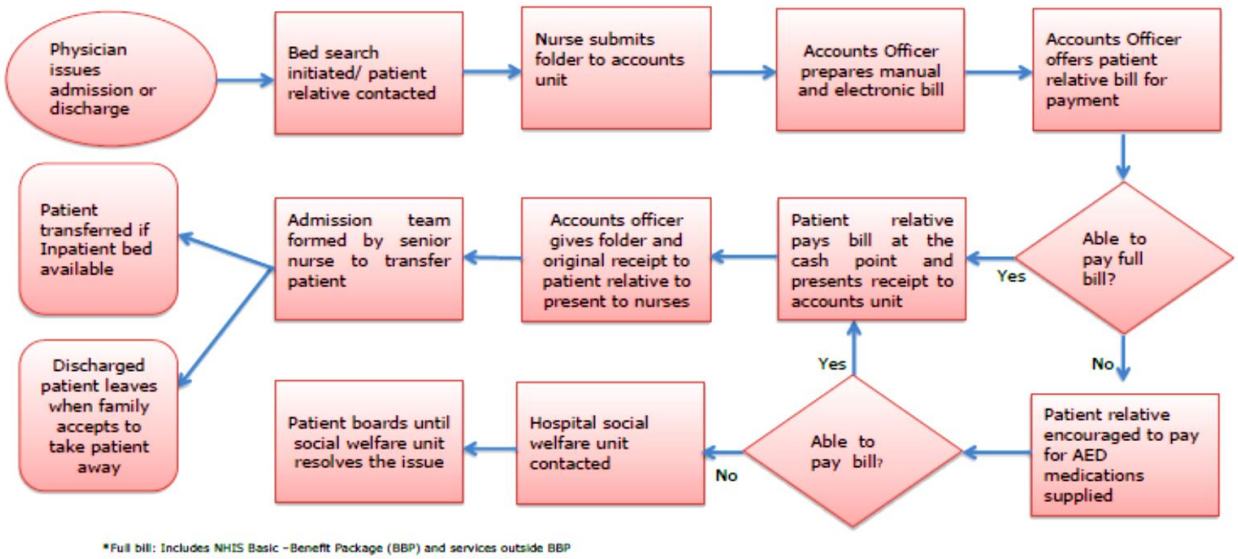


Figure 7: A process map of implementing AED patient admission or discharge order
Source: Author, 2019

3.6 Patient Transfer, Discharge or Death

After a patient disposition has been made, patients are referred to internal or external hospital ambulatory services; referred to primary level facilities, transferred to hospital inpatient services or discharged home. The inability of the lower level facilities to continue patient management results in care demand at AED. Furthermore, when a patient is brought in dead or dies, after physician certification, the deceased is transferred to the mortuary. Figure eight demonstrates the deceased transfer process and highlights how AED transfer arrangements and mini mortuary design contribute to reduce AED bed capacity; thereby resulting in fewer beds for patient use.

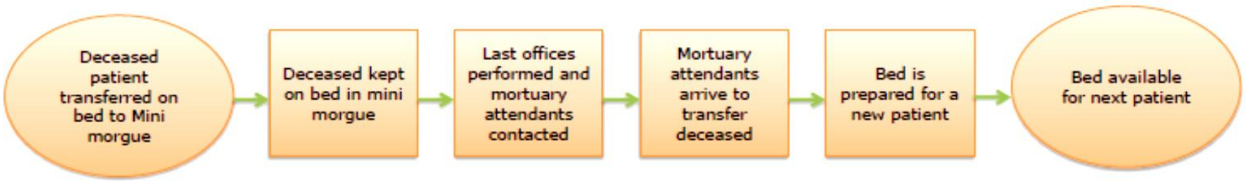


Figure 8: A process map of transferring deceased patients from AED to KBTH mortuary
Source: Author, 2019

4.0 CHAPTER FOUR: OPERATIONAL BOTTLENECKS AND LITERATURE FINDINGS

This chapter presents identified internal and external AED operational bottlenecks as well as relevant literature findings.

4.1 Internal Factors influencing Patient Flow in AED

4.1.1 Triage-team composition and functions

The nurse-led triage functions exclude ordering tests for some patient conditions. Two nurses per shift at triage could be considered inadequate due to patient volumes. Staff number and their limited assessment may contribute to increased patient wait time (PWT) as diagnostic orders for some conditions could be given and results obtained while waiting to have doctor evaluation. Phone calls for enquiries, other patient enquiries, documenting transfer requests, in addition, result in interruptions that may lead to distractions and subsequent triage scores misclassification or recording. Alternatively, unanswered calls may impact negatively on callers. Furthermore, when a doctor is assigned at triage to see patients, patient management begins while patient wait's to be assigned a bed. Patient wait time and volume is subsequently reduced. Delay in assigning a doctor, further prolongs patient wait times and increases volumes. In addition the lack of complete patient privacy at triage may reduce the pace of triage and quality of information patients give out leading to inaccurate triage score which invariably affects patient scheduling.

Literature on triage-team composition and functions

Triage is an important function within emergency departments the world over. It serves as a first formal contact between the healthcare provider and patient; and schedules care based on need and efficient use of department resources (49). Also, triage reduces the cost of care and PWT especially for low acuity patients (50). Triage tools vary by country (51) and one such tool is the South African Triage Scale designed, validated and adapted in LMIC for emergencies determination(25,52,53).

Triage functions

In triage, trieur[xiv] inaccuracies may occur and likely impact patient sorting, case scheduling and wait times. A retrospective study (52) to assess nurses' triage scores accuracies and reasons for inaccurate results in South Africa showed that more than half the time (68.3%), nurses assigned accurate scores. Of the incorrectly assigned scores, more patients (55.6%) received a lower triage score and few patients (44.4%) a higher triage score. Patients with trauma conditions were likely to receive a higher score, while non-trauma conditions were likely to be given a lower score. Although the difference in assigning an accurate triage score between trauma and non-trauma patients was not statistically significant ($p=0.23$), assigning a lower triage score to non-trauma patients was significantly more likely to occur (OR 1.697). The study identified that human errors, numerical miscalculations and discriminator errors resulted in the erroneous triage scores. Failing to record and select incorrect triage category were identified for the errors. Given the study method, circumstances underlying the errors could not be identified although distractions affecting staff concentration could be a reason. Besides, the study was done in lower level nursing cadre, but given the reasons for and type of errors; other cadres may also falter, and thus affect triage scheduling and PWT.

A 72-hour observational study (54) to determine triage nurse performance and working time concluded that telephone functions engaged 22% of nurses' time. These calls could be necessary for the patients, more urgent than patient being seen or not related to patient care. As well, more than half of all patients (54%) had their triage process interrupted by

[xiv] The performer of triage

non-primary functions at triage. Although the interruptions increased PWT before triage, patients with high acuity had significant longer wait time, probably due to the condition and need for further assistance at triage. A significant correlation (r=0.69) existed between frequency of interruptions and duration of PWT. Another observational study (55) identified phone calls as a distractions within triage that affect patient flow by increasing triage time. The study showed an increase in triage time when nurses were interrupted by phone calls relating to patients or others. In a more recent qualitative study (56) to identify the frequency and types of interruptions at triage, staff, visitors and patients interruptions were seen. Over half (78%) of interruptions including phone calls were not related to patient care. Significance of interruption to PWT was not determined.

Triage composition

Studies have reported a relationship between the composition of triage and the effect on PWT. Results from an Interventional study (57) at a USA university hospital showed that adding a senior physician (faculty) to the triage team significantly shortened LOS for both admissions and discharges ($p=0.005$). Including faculty came with additional costs to patient care as the faculty was not originally an ED staff. In a case control study in Hong Kong (58) PWT and processing time were assessed when a doctor was included in the triage team. Statistically significant results ($p<0.001$) favoured including the doctor on the team as PWT and processing time was reduced. Intervention was more beneficial to low acuity cases with trauma conditions than high acuity cases. Reasons why high acuity cases were unaffected were not given. A physician included on the team came at no additional cost because the physician was already an ED staff. These two earlier studies show that a physician on the team impacts PWT, with possible impact further along patient management process. However, this may come at a cost if the physician is not already an ED staff.

Conversely, the results of a systematic review (59) found that there was a significant reduction in median LOS for randomised control trial studies with doctors as triage team members. However due to the number of studies, Rowe et al. 2011 cautioned this adoption since new policies required human and financial considerations and suggested that further studies be conducted. In a retrospective study (60) in Sweden, LOS and patient safety were assessed as triage outcomes in determining the relevance of a physician's position in triage team. Results showed that physician as a team lead in triage seemed more efficient than as team support as a result of the reduced time to physician contact ($P<0.001$). Though study does not explain why the nurse/junior physician (JP) model was more efficient than the nurse/emergency physician (EP) mode, given that the EP is perceived to have more experience than the JP; it could be that the JP was supervised by a more experienced physician. As well, a more recent retrospective cohort study (61) in Switzerland shows a significant association between introducing an EP in triage and the effect on WT and LOS. Using the emergency severity index to categorise patient acuity levels, the study showed a significant improvement in median WT ($p<0.01$) for all 5 levels of patients but more in discharged than admitted cases. For median LOS a significant increase ($P<0.01$) was seen in all levels except in level five patients with a decrease in median LOS.

Additional triage nurse functions

Studies (62,63) suggest that nurse capacity and responsibility within triage should include requesting labs and radiographs through protocols to reduce PWT by shortening steps to the request. A case-control study conducted in Hong Kong (62) demonstrated the feasibility of increasing the capacity of nurses through protocols to initiate radiograph requests. Nurse initiated requests for patients without the need for minor procedures, showed the reduction in WT was statistically significant ($p<0.001$) though lower compared to other studies. Cases and controls were not studied at the same time increasing the likelihood of some confounders. Similarly, results of a prospective study (63) in the USA showed no statistically

significant difference between some nurse-ordered diagnostic tests using a protocol and that of physicians (x-ray P=0.001, Urinalysis P=0.0182). This implies that when trained, nurses could initiate diagnostic requests correctly and contribute to reduce PWT.
Nevertheless, results from a systematic review (64) suggests that although triage nurses diagnostic tests orders seem to be effective in some cases , there is the need to undertake further good quality studies to arrive at a definite conclusion. Conversely a prospective study (65) in Australia which compared the outcome of nurse initiated radiographs and emergency physician initiated radiograph on patient transit time showed no significant difference between the two groups although it demonstrated that nurses initiating the process were not as dangerous as it's been previously thought.

4.1.2 Billing and payment system during patient management

Patients are obliged to pay for services at the end of their stay - before transfer or discharge. However, other services during the care process require direct payment. For NHIS patients, obtaining a valid claims form is needed to secure payment for such processes without which OOP will be required. The process for obtaining and using the forms in the respective units are cumbersome and time-consuming. Moreover they are required to be optimally filled to obtain the right bill for patient and also generate a pass for discharge or transfer. For OOP patients, though processes are less cumbersome compared to NHIS process, failure to make partial or full payments results in holding patients until some form of payment is made probably as a result of poor follow up systems to collect fees. This practice reduces bed capacity and limits bed use. Moreover since cash collection is the only acceptable means of payment, undue delays resulting from technical or human failures at the collection point also delay AED work process.

Literature on billing and payment system during patient management

No evidence was found that billing and payment affect AED work flow process probably due to the extent of Universal Health Coverage in HIC.

4.1.3 Inpatient transfer procedure

An admission disposition requires an inpatient transfer and need to be AED initiated at all times. Transfer most often happens after transfer bill is settled, availability of an ad hoc transfer team formed by a senor nurse, transfer equipment and an available inpatient bed. Delay in obtaining any one of these hinders the transfer process and prolongs patient EDLOS. Assembling an ad hoc admission team is delayed when primary responsibilities of members conflict with the transfer time. Again, transferring equipment which is difficult to maneuver is unsafe for both patient and staff and often discourages staff use due to legal and health implications. As well, at night if environmental conditions such as poorly lit corridor, security are not rife, insecurities are heightened and transfer deferred. This delays the transfer process, prolong patient EDLOS and result in boarding.

Literature on Inpatient transfer procedure

No evidence that AED transfer procedure when an inpatient bed is available affects AED workflow process was found.

4.2 External Factors directly influencing AED Patient Flow

4.2.1 Patient type and conditions presenting at AED

A&E patients present a mix of emergencies and non-emergencies, although AED has been designed to primarily see emergencies. Emergencies may be obvious or perceived and referred from providers, individuals and others in the community. Provider referred patients may have provider-initiated referral due to several reasons including limited provider capacity and patient insolvency; or patient-demanded referral due to several reasons

including perceived better AED quality of care. Individuals or community referred emergencies may be as a result of the proximity of HCF or preference. Non-emergency visits are likely to result from self-referrals or provider-referred for convenience reasons. Since AED is opened all the time, adult patients who find their primary care service times inconvenient, or do not have access to primary care, or do not want seeking care to conflict with other personal commitments, or cannot afford primary care services may likely access AED services. Unlike other hospital departments a referral note is not mandatory for AED access; as such patients who need other hospital services may use the AED as an entry point to obtain a referral. As well these patients may come with medical, surgical and trauma presentations with primary or comorbid conditions. Influxes of such patients increase the patient volumes and contribute to overcrowding**.**

AED patient types and conditions literature findings

Studies have concluded that patient visits and conditions presented often contribute to overcrowding. In a one month prospective study (66) 18% of admitted patients at the ED did not require inpatient services but were admitted due to social and personal reasons; non-availability of family to offer care and bring them to OPD services due to age or disability; and the absence of needed home or nursery services. Study results however did not demonstrate a statistically significant association between these conditions and ED crowding. One cross sectional study (67) showed that a significant number of visits (24.2%) were not appropriate for AED and was greater in younger female patients than male patients; and lesser in older patients. With some reasons being shorter opening hours of primary care facility, primary physician refusal to see without an appointment, unavailable social support system and a desire for integrated services at each patient visit. Although study did not establish a significant effect on patient wait times in the AED, an increase work load from such patients cannot be ruled out. Another study (68) identified that the age of patients was associated with wait times.

One more study (69)using data of a US house-hold survey identified factors that contribute to ED use in communities. Of the health system factors identified, communities with high ED use had outpatient capacity constraints, and few physicians to offer care. In terms of availability and proximity of service, though the distance between communities and services was not statistically significant, high-income earners use of ED service was higher than low income earners. However, individuals with lower socio-economic status frequent the ED as well as individuals with chronic medical conditions. Additionally in communities where ED services use was low; most of the members were insured. Being issued probably made primary physician services affordable. This implies that insurance coverage, socioeconomic status and health factors contributed to the use of the ED which could increase patient volumes and cause overcrowding. Consistent with portions of the above findings is a two-year cross-sectional study conducted in Canada (70) among 95173 randomly sampled ≥ 65year olds that showed 48% used ED services as a result of limited levels of continuity of care with a primary care physician and also the lack of a primary physician. Study findings showed that there was a significant difference between urban and rural dwellers in the use of primary care services.

A systematic literature review(71) concluded that 37% of all ED visits after triage or ED evaluation was classified as non-urgent. The study found that younger adults were more likely to use the ED for non-urgent visits than older adults (OR>2). Similarly, individuals with a low socio-economic status had a moderate association with non-urgent ED visits than those with a high status (OR<2). This is probably due to their inability to afford primary care services. While gender and insurance had varied effects on non-urgent visits, convenience and cost were identified to be associated with non-urgent visits across all the papers. In terms of accessibility, studies associated with poor access to primary care

facilities and difficulties in obtaining especially weekend physician appointments to non-urgent ED visits. Additionally, the perceived severity of condition by patients contributed to ED non-urgent visits.

4.2.2 Specialist coordination and admission policy

Admission orders are the sole prerogative of inpatient specialist team and given to physicians when authorised by these teams. Since the team is usually contacted through the most junior members by a phone call or through a verbal request, the time taken to receive consultancy services is often prolonged, increasing the admission decision time. The duty roster of teams guides the physicians in their contact. An outdated, incomplete or a non-existent roster increases the time to consultant contact resulting in delays. Additionally, team members' first assessment and subsequent validation through consultation with senior members either on the phone or face to face increases wait time. Moreover, when patient presents with comorbid conditions, the waiting time is further prolonged since more than one specialist team is required. Delay in admissions may also arise from a disagreement between the different specialty teams on the primary condition and therefore which inpatient ward must admit the patient. There is no known protocol to resolve this issue thus resulting in patient boarding. Similarly, since teams have the upper hand, a non-admit disposition made due to financial reasons cannot be challenged. Since patient disposition is also influenced by diagnostic test results, delays in consultation may also arise when teams are waiting for such results.

Specialist coordination and Admission policy literature findings

The results of a prospective study (66) in Taiwan teaching Hospital showed that of the 70% potential inpatients after 72 hours stay in the ED, 33.6% had a delayed transfer from being assigned a lower level admission priority due to their financial inability and conditions requiring long term hospitalisation. Since the Chief Resident had sole admission privileges, the decision could not be challenged. A retrospective study (72) in Canada used ED triage and acuity scale to stratify processes and determine their levels in order to identify and analyse factors strongly associated with prolonged LOS. The results established a positive correlation between specialty consultation and increased LOS, with variations based on the number of specialty services consulted. Similarly, using length of stay (LOS) as the outcome measure, a prospective cohort study (73) showed that a significant increase in LOS was found in admitted patients requiring consultations as a result of consultation decision time. Among the factors was a longer latency period between the time of arrival and first consultation request, as well as multiple consultations for patients on admission.

Kang et al. (41) using simulation studies, investigated the impact of different admission policy models on patient flow. Study results showed that admission procedures may significantly impact EDLOS depending on whether it is the physician consultants[xv] that take the decision, or whether it is the AED specialist (team) who takes the decision. Although the AED specialist does not need to await consultant arrival and decision; once a patient has arrived on a ward, responsible physicians there may disagree with the decision to admit the patient on their ward. Additionally the study highlights the influence of decisions being taken in a team, particularly in the case of teaching hospitals, where physician trainees may be involved.

Furthermore, a recent retrospective study (74) conducted in Yogyakarta to identify contributing factors to LOS identified the need for specialist consultations as one of the factors. The study showed a significant association ($p<0.05$) between time of specialist consultation (SC) and LOS.

[xv] Includes attending, residents, interns, physician extender

4.2.3 Diagnostic services and treatment

Except a few POCT done at triage, all other lab tests are done outside the AED either at the hospital's main laboratory (CLS) or at Private-run laboratories (PL) outside the hospital. PL may be used at CLS downtimes or from physician preference. CLS location increases sample transport time. Likewise, the payment processes increase processing time as there are no special prioritised arrangements for patients family to obtain services such as payment of tests, collection of sample tubes, submission of samples and collection of results outside the regular queues and first-come first-served principle at CLS. Sample processing is within determined CLS TAT and results released when receipt is presented. In instances where results are identified to be crucial for patient management, the CLS does not have direct contact with the requesting Physician other than contact through a patient relative. The results are further delayed with relative absence. Although a phlebotomist is present to primarily collect and transport samples and return results, the time consuming payment processes makes him ineffective in the blood draw since most of his time is consumed processing payments for the blood samples he's transported. Additionally for radiological investigations, AED cases often compete with other hospital cases although the unit is situated in the AED. Payment is also a prerequisite for performing test, and delayed payments contribute to delays in undertaking the test, image processing time, report writing and release of results. When the pharmacy has stock out of essential emergency medicines due to procurement delays, patients have to buy medications and this leads to delays.

Diagnostic services and treatment literature findings

Sinreich and Marmor (40) time-in-motion study in six hospitals in Israel purposed to examine how patient turnaround time (PTAT) could be reduced to improve quality. The study results showed that patient wait times contributed more than half (51-63%) of total PTAT. Of the patient wait time components, time away for an X-ray examination at a local site or a general site had the most impact; followed by time for blood analysis results, and also wait time to see a physician; all together contributed 30% of PTAT. These results were statistically significant irrespective of the size of the hospital facility. A retrospective cohort study (75) in four hospitals in Australia to examine the relationship amongst all lab tests performed in the main laboratory, the volume of tests, the TAT and EDLOS showed a statistically significant association between an increase in test ordered by nurses and LOS. Study showed that for each test order event with five additional tests, median LOS increased by 10 minutes; and each 30 minute increase in TAT was significantly associated with 17 minutes increase in EDLOS. Day patients, however, stayed shorter than night patients although TAT at night was shorter.

Another cross-sectional study in Iran (76) assessed ED lab TAT and identified causes of Lab TAT delays. Studying three lab tests over one week, study results showed that TAT was delayed and did not meet Q-Probes standard and recommended TAT intervals. Causes of delays included a longer ED waiting period[xvi] and order processing steps[xvii] which are steps before the sample processing in the lab. Though delays were not determined to be statistically significant with EDLOS, results show that processes before lab sample processing contribute to TAT delays. These results were similar to a study (77) on root cause analysis of lab delays in Canada.

Other causes of prolonged TAT have been determined to be the sample transport system. In a study (78) to compare the TAT and quality of lab results using a pneumatic tube delivery system against a human messenger,the results showed no statistically significant difference

[xvi] Time between specimen ready and specimen dispatched

[xvii] Time between Physician order and nurse register order on Computer

in sample quality between the systems. However, the mean TAT for tests was significantly shorter for samples delivered by the tube system against the human messenger showing that using a non-human transport system could reduce TAT without compromising quality.

Additionally, an interventional study (79) in the USA to determine the impact of a Stat[xviii] lab within the Central lab on ED LOS showed that TAT for patients on admission significantly improved after the introduction of the lab. Patient median LOS was significantly reduced from 466 minutes to 402 minutes. This effect was not significant for discharged patients. In this study, a more efficient transport system was used and could have contributed to improving TAT. To resolve the issues of sample transport and associated time cost, POCT is suggested as a useful tool to diagnose ED patients and reduce TAT. The review (5) on POCT's impact on ED crowding concludes that when effectively employed, POCT can reduce prolonged EDLOS. Though there are cost implications for its use, overall, the advantages outweigh the cost.

Ryan et al.(80) observational study at an Ireland ED to identify patient journey bottlenecks observed a significant association between patients with radiologist test orders and LOS. Study results showed that patients with radiological tests were 4.4 times more likely to stay over the mandated four hours. Another study (81) showed that reducing AED radiology report TAT inconsistencies were associated with improved AED throughput. Applying multiple improvement interventions and using mean TAT, percentage of AED radiographs read within 35 minutes and the impact on EDLOS, showed a significant improvement in mean TAT ($p<0.01$) and associated with decreased time to disposition from 88.7 mins to 79.8minutes. Although this study was undertaken in a pediatric ED, since operations and test requests are likely to be same for adult EDS, this study can be applied.

4.2.4. Mortuary services

The design of the AED mini morgue encourages deceased patients to be kept on beds which otherwise can be used for new patients. When mortuary services do not appear timely when they are called, beds are misused. Since preparing a bed for the next patient takes about thirty minutes, the longer the deceased is kept on the bed, the longer getting a new bed takes. The unavailable bed reduces the AED bed capacity, contributing to delays in assigning beds.

Literature on mortuary services

An interventional study (82) to improve AED crowding in Rwanda using interlinked strategies including reallocating room space, showed that when corpses were directly delivered to the hospital mortuary instead of keeping in the AED for future transfer, AED crowding in the hallways decreased. Reallocating room space may have contributed to reduced crowding since the repurposed room served patient care functions and impacted on wait times

4.2.5 Inpatient services and capacity of other hospitals

An inpatient service has to receive patients to free up bed space for new AED patients. Often the services also directly admit patients from other sources resulting in competition for bed space. By convention there is bed specialization[xix] thus the hospital beds are seen more as departmental beds. Consequently although bed space maybe available on any particular ward, a patient cannot be transferred to any vacant bed. Additionally, some wards come with different charges. Thus a patient who cannot afford the charges on a particular ward cannot be transferred there although bed space exists. Therefore although the hospital

[xviii] Abbreviation of latin word "statim" meaning immediately without delay

[xix] Wards are categorised to take care of specific type of cases

bed occupancy rate may be low, since the departmental rate is presumably 100% patients remain boarding at the AED. In some departments, admissions and discharges occur at set times. Thus if a patient is medically discharged outside the discharge time, the patient continues to occupy the inpatient bed until the set time of discharge. By so doing, a new inpatient is blocked from accessing the unit. For other hospitals, often there is a perception that a patient transferred to a tertiary facility can no longer receive care at a lower level facility, thus their reluctance to accept transfers from the AED. Additionally, lower level facilities consider that once a patient has been transferred to a tertiary centre, care must be continued therefore they are mostly unwilling to receive patients who are referred after stabilisation of emergent condition.

Literature on inpatient services and capacity of other hospitals

A retrospective observational study (83) to determine how hospital occupancy affects EDLOS for admitted patients identified that high hospital occupancy is associated with the EDLOS. The study showed that when hospital bed occupancy rate (BOR) increases by 10%, admitted patients EDLOS is prolonged by 18 minutes. At an occupancy exceeding 90% threshold, there is an apparent extensive increase in EDLOS. Conversely a study(84) to determine the association between EDLOS and hospital census variables showed a significant association ($p=0.01$) between EDLOS and some critical hospital units like the ICU and the percentage of patients admitted each day. No relationship was found between EDLOS, admitted patient volume and total hospital BOR suggesting that EDLOS and inpatient capacity are linked to units that care for high acuity cases and not the entire hospital.

To determine the association between improved inpatient discharges time and ED boarding, a computer modeling study (85) showed that a 4 hour upward adjustment to inpatient discharge time removed ED boarding. Additionally, when discharge times were varied, boarding hours were decreased as more than half of patients due for discharge could leave. Findings of a retrospective observational study on 23 hospitals (86) on hospital occupancy level effect for inpatient admissions and ED flow, and the impact of shifting discharge time on occupancy level; showed that at three critical BOR averages of 91%, 96% and 99%, EDLOS for admitted patients prolonged further, inpatient admissions reduced as a result of access block on inpatient wards. Results also showed a significant association between one hour earlier discharge and overcrowding ($P<0.001$).

4.2.6 Finance and family related factors

Care at AED appear heavily reliant on the patient family for several functions most of which are related to finance. These functions include paying for diagnostic tests, diagnostic investigation scheduling, sample transport, results collection, obtaining medicines and other non- medicine consumables for patient care. Absence of a relative contributes to care delays as some unperformed functions serve as bottle necks to patient care; consequently affecting patient flow. The financial position of families also dictates their presence and availability to perform these functions. Since NHIS BBP does not cover all AED interventions, some form of copayment is required. When families are financially constrained, time is taken to obtain money and perform finance-related functions negatively affect AED processes. Although the hospital has a social welfare unit, the period between the first contact and the final resolution of issue is often prolonged, contributing to service delays and congestion.

Literature on finance and family related factors

In a study (87) to determine family support to patients in an AED in India, results showed that tasks performed include procuring medicines and other supplies, collecting reports, transporting lab samples and paying fees. Reasons for the support were low staff levels and also to prepare family for homecare. Study however did not assess the association of these

functions and AED crowding. Another study (88) to assess ED internal factors on patient flow and effect on reorganization identified four factors including non-ED –non hospital factors like waiting for patient relatives. Reorganization impacted significantly on such patients only at night. Study did not indicate the exact role of patient relative in the hospital process.

5.0 DISCUSSION

Understanding the factors influencing patient flow and overcrowding in AED is a critical step to proffer the right solutions in addressing bottlenecks. This thesis report results from personal experience and review of the literature in exploring, identifying and analysing factors that impede AED patient flow at KBTH. The findings indicate that several factors in AED work processes contribute to delays leading to prolonged LOS, resulting in congestion and overcrowding. These factors, internal and external to AED, can be classified under all three components of the input-throughput-output conceptual framework as seen in table 2 below:

Table 2: Factors identified as bottlenecks in AED workflow process

Component	Factor
Input	• Patent type and condition
Throughput	• Triage organisation: composition and functions
	• Payment and billing processes
	• Inpatient transfer process
	• Admission policy and specialist services
	• Diagnostic services and treatment
	• Finance and family-related issues
Output	• Inpatient capacity
	• Mortuary services

Source: Author, 2019

5.1 Triage composition and function

As noted in the findings, triage at KBTH is a nurse-led function and a triage tool aids to determine acuity level leading to patient sorting and prioritisation. Interruptions at triage through phone calls, logging calls and patient enquiries serve as distractions which may lead to triage score errors and also affect the swiftness of triage. Reviewed literature (54–56) indicate that triage errors can occur and the pace of triage can be affected by phone calls and other human interruptions. It's difficult to say though how necessary and urgent the calls and interruptions were, whether they were in the interest of the patients being attended to, and the extent to which these calls could have been delegated to another person. Having nurses manage the triage phone and other enquiries in addition to triage function influences PWT and contribute to delays. In addition, human interruptions from patients and their family members, because triage is the first to be seen upon arrival, also contribute to delays. Though the population literacy rate is high, patients and family may rarely read symbols and notifications placed in the AED probably due to their state of mind upon arrival or that the symbols are not self-explanatory. Placing a trained clerk to answer such issues could lessen the interruptions on the nurses.

The findings also showed that at triage, nurses conduct POCT and check vital signs, but do not order additional tests. The literature reveals that nurses can be guided through protocols to order tests for some patient conditions. This increase in responsibility can reduce LOS (65). Given that nurses were trained to use triage scale, additional training to increase their responsibility is possible. Ordering tests could be explored to make good use of PWT so that results can be presented at the time of seeing the doctor. The possible risks could be that PWT will be much longer depending on the TAT for results and patient could miss seeing the doctor altogether. Also most of the work could be done by triage nurses with supervision from a physician who occasionally, can take over to provide some interventions. By so doing, more nurses can be assigned to work at triage.

Other findings pointed out that whenever a doctor is assigned to triage to see patients with established acuity levels awaiting to be assigned a bed, patient volume at triage decreases. Reviewed literature indicates that including a doctor at triage reduces patient wait time (41,57,58,60). Since the findings corroborate the existing practice in KBTH, a consideration to permanently include a doctor in the triage team should be given. The implication is that an additional cost will be incurred if a new doctor has to be employed to fill this role. On the other hand, including such a supervising physician may shorten patient management processes later on.

5.2 Billing and Payment Processes; Family and finance related factors

Findings revealed that bills must be settled partially or fully before patients are allowed to exit the AED. In addition, diagnostic tests and other services require upfront payment. Since there was no evidence found in reviewed literature on how billing and payment processes result in ED delays, this factor could be peculiar to our setting. Perhaps, the MOH, recognising the potential delay payment could bring to A&E services indicated in the A&E policy (25) that within 48 hours money should not be taken. In reality; this is not entirely practiced and contributes to delayed AED processes. It is unclear why this policy is not being wholly implemented. It may be that KBTH is either not receiving revenue from AED financing sources listed in the policy or the timeliness of reimbursement negatively affects operations. Considering that the policy hasn't been reviewed since it was written, a review could address this.

Though billing and payment processes result in delays, they are likely to be the hospital's control measure to track the volume of services, revenue generated and to also meet external audit obligations. Also, since locating patients within the hospital is difficult due to defragmentation of hospital processes, support services like laboratory and radiology may deem upfront payment the best option. Additionally, it could well be that the difficulty associated with poor follow up and addressing systems in the hospital and country respectively, leads to collecting fees before patient exit to decrease the potential loss of revenue, since forwarding their bills to them is impossible. The AED may also not like to misrepresent itself publicly as offering free services to discourage abuse. This creates a dilemma between keeping patients and allowing them to leave. Patients' inability to settle bill fully and the practice of determining which part of the bill must first be settled before consideration for patient exit, opens doors for system abuse. Furthermore, since no alternate forms of payment such as mobile money transfers exist, there is dependence on cash transactions which may result in delays. Billing and payment highlight larger issues of organising care in a centralised hospital, with decentralised departments being responsible to generate revenue internally for support of departmental and hospital operations.

Linked to billing and payment process is family and finance–related factor, since families must provide finance to settle bills. Findings revealed that AED depend on patient family members to schedule tests, obtain sample tubes and transport blood samples, buy medication since a financial commitment through upfront payment or NHIS through processing claims forms is a prerequisite for service. The paucity of evidence from reviewed literature on the impact of family and finance roles on AED delays could reflect peculiarity to a LMIC. Since in HICs, families mostly serve as agents for moral support and also obtain patient condition updates from health staff.

How families are depended on at KBTH's AED may have negative consequences on their productivity, especially for the bread winners. Creating a balance between giving support to hospital processes for the sake of the patient, without which care may be compromised, or on the other hand, leaving the hospital to work for income to support care is dicey. Knowing

that family may be needed at any point in time in the care process, most families arrange to leave a representative in the hospital. This family dependence could be one of the reasons why visitor population outside visiting hours is high with KBTH finding it a challenge to accommodate them. Depending on family could be a reflection of inadequate staff, poor organisation of care, and wrong use of family support. It also highlights the issue of low NHIS coverage, high OOP, limited NHIS BBP, cumbersome administrative claims processes and their effect on emergency care. Informing patients about their expected total bill at the point of discharge or transfer contributes to delays since relatives may now have to source for funds. Frequent cash deposits in anticipation of final bill could be encouraged, but this may also violate the A&E policy on fees collection.

KBTH may consider a fund to support A&E services for impoverished individuals or implementing sections on financing sources outlined in the A&E policy (25) by engaging the relevant stakeholders. Abuse of the fund by those who seek AED care because of convenience must be guarded against. A flat fee that includes all care within the first 24 or 48 hours could be instituted with set modalities for revenue sharing among the departments involved in patient care within the period.

5.3 Patient type and condition

Findings indicate that AED patients are either provider-referred or self-refer due to severity of condition, limited access to primary care facility and convenience. Study findings show that ED visits are non-emergency and emergency; with non-emergency visits resulting from limited primary level facility and physicians' access, convenience and chronic conditions, family constraints in elderly care, absence of home care and inappropriate conditions (59-64). Though data on condition types, acuity levels, and reasons for seeking care were not analysed, an inference from literature can be made.

The AED location and working hours is convenient for the surrounding community to seek care when other lower level facilities are closed. Also, since KBTH OPD services times are restricted, with no services on weekends and holidays, patients in need are forced to access AED care. With an increase in life expectancy and an NCD burden, it is likely that older patients with chronic conditions may be referred for management of complications. One solution may be to extend opening hours of KBTH OPD and primary level facilities or to establish AED internal policies that limit access by non- emergency cases.

5.4 Admission Policies and Specialist services

This study observed that in KBTH admission privileges are the preserve of specialist teams who are mostly contacted on phone for service because they not within the AED. More than one specialist may be contacted for patients with comorbid conditions. Literature findings indicate that admission privileges are for inpatient specialist with consultation decision time, specialty consultation and variations on the number of specialty services consulted increasing LOS (72,73). Admission privileges thus determine patient transfer time; as well as time to consult services. Since teams are mostly reached on phones, the absence of properly updated roster will delay the call process. Moreover, since doctors are called doctors on their personal phones, delays can be anticipated if calls go unanswered or answering is delayed for personal reasons. Here, the relationship between using personal phones and poor administrative process on delays is seen

Also literature revealed that EMS given admission privileges can reduce EDLOS (41).Since the AED EMS have no such powers, delays continue. Empowering EMS with admission privileges can reduce time to consult and also resolve instances of disagreement when admissions may be denied because of patients financial considerations(66). Relinquishing full admission privileges from inpatient teams may come with challenges due to type of

training and medical experience of other teams (41), but its achievable and impacts on EDLOS. Giving privileges to EMS may affect some teams and individual consultants; as such this new model must be tested and integrated properly to reduce any negative effect. Delays by the inpatient service teams may be a reflection of their practice style. Altering the model may compromise training of junior doctors since they may not be able to see cases by themselves. This also raises the issue of balance between training and timeliness and their effect on delays. Additionally, patients disposition depend on results of ordered investigations. Physicians may in part contribute to this delay due to provider –preference particular diagnostic-services the interplay between provider preference and effect on LOS is seen.

5.5 Diagnostic Services and Treatment

As the findings show, processes before obtaining results of diagnostic service orders depend on patients' family since service requires upfront payment. Additionally, family is responsible to obtain medication and other consumables if not available in the department. Studies reviewed indicate that diagnostic service TAT has a significant association with AED LOS. Per MOH policy (25) AED must either have support from a dedicated AED lab or a hospital lab to reduce delays. Although the AED is supported by CLS, sample transport system and order processing time, reasons similar to some study findings (75,76,78) contribute to TAT delays. CLS may consider TAT to cover period when samples are received to when results are validated as opposed to the period covering test order to results submission.

It could be that CLS realising the little or no control it has over processes before and after the actual sample processing time distances itself from their effect. However, these processes may be the largest contributor to delays as most lab equipment is automated and the lab may be constrained in improving its TAT within automation limitations. This notwithstanding, attempts to expedite blood draw by placing a phlebotomist with additional responsibilities at AED is being practiced. As observed (76), if the phlebotomist's responsibility is dedicated to only blood draw, then the sample collection process will be more efficient. The focus then will be the efficient transportation of the sample. A dedicated human courier (76) or a more efficient system such as a pneumatic transport system (78) could be employed and this will eliminate the dependence on patient relatives and their exposure to infections during specimen carriage. However, there may be additional costs implications with hiring new personnel and introducing the system. The efficiency of the two systems should be determined in order to stagger their introduction. The success of the new system will partly depend on payment process restructuring.

Alternatively, since CLS serves non-AED patients, having a dedicated AED service within the CLS such as a STAT lab (79) could decrease TAT as samples from AED will receive stat services. AED already uses POCT at its triage. Extending POCT within the AED for other routine labs can be considered to reduce delays. Challenges with POCT use such as cost, technical capacity of users, quality of test kit, quality control issues and collaboration between CLS personnel should be considered in order to forestall unnecessary friction (5). Incorporating these approaches with strategies to obtain and review results in time will decrease TAT. This could be achieved by giving physician access to Lab information system (LIS).

Radiology issues are similar to the lab although there is a dedicated unit. Restructuring of payment system and adopting Patient Archiving Communication System (PACS) may help reduce TAT. These measures coupled with a hospital policy on when physicians can opt for private diagnostic services can improve TAT. Although literature on association between medication access TAT and ED LOS was not found, looking at studies from lab and

radiology, increased TAT to medicines will also contribute to AED patient LOS with dire implications.

5.6 Inpatient capacity and transfer process and Mortuary services

As revealed in the findings, inpatient bed capacity, the practice of bed specialization and non-uniform discharge times affect inpatient transfers. Reviewed literature showed that hospital and departmental occupancy rates affect inpatient bed capacity and subsequent admission of ED patients (83,84)as well as a shift in discharge times (85,86).

As observed, due to the practice of admitting patients based on bed specialisation, the frequency of any specialty in the AED affects the number that can be admitted based on the ward's capacity. Considering KBTH as a single unit, and reducing the practice of bed specilisation could impact on inpatient capacity issues since more beds will be used. This change is a sensitive one and stakeholders must be properly engaged to mitigate resistance and unintended negative effect on patient care. Additionally, KBTH may incur high cost since further training of especially nurses will be required for effective ward management. This arrangement will affect how care is organised, resource allocation and revenue collection since each inpatient unit is responsible to provide resources for cases managed and to receive revenue.

Since beds are also reserved to offer premium services, when such beds are available, patients who can't afford care may not be admitted, leading to prolonged ED LOS. This shows the role finance plays in admissions. Central Management should have policies on the balance between generating internal funds and making such specialised beds available for patient use. Ultimately, consideration for expansion of inpatient facility should be made since the hospital hasn't seen any major expansion in the recent past. With the increase in Ghanaian population, this could be justified.

Additionally studies (80,81) on the effect of hospital discharge times showed that adjusting hospital discharge times impact positively on ED LOS, since patients leave the hospital at different times and by so doing create room for admissions. Since KBTH departments have different discharge times and processes, departments with a more flexible discharge time and process is likely to create more bed space for admissions than ones with a rigid time and process. Central management may consider a definite policy on patient discharge times. Having a discharge lounge could free bed space as discharge processes are being undertaken.

Linked to inpatient capacity is the inpatient transfer process undertaken by AED staff. There was no evidence found on how inpatient transfer process affects EDLOS when beds are available, however as observed the delay results from the absence of a dedicated transfer staff, poor transfer equipment and others as shown in Appendix VI

Also an interaction between availability of equipment and human resources and physical infrastructure condition on transfer delays is seen. Identifying staff workloads and assigning daily task may be a way of having an admission team without competing work schedule. Reliable transfer-equipment to protect staff health and patient should be available. Additionally, walkways should be safe and motorable irrespective of weather conditions.

As observed, AED keeps deceased patients on beds until they are conveyed by the hospital mortuary service. As seen in literature, reorganisng use of space in the ED including direct transfer of corpse reduces overcrowding (76). While direct transfer of corpse by the AED to may not be feasible due to distance, reviewing the current mortuary arrangements to have

the mortuary van on standby at the AED could be helpful in promptly transferring corpses and freeing beds for use

5.7 Strengths and weaknesses of the framework

Adapting Asplin's input-throughput-output conceptual framework on overcrowding to identify and analyse bottlenecks in A&E workflow processes was very beneficial in understanding the interlinked factors in a LMIC. The three components of the framework enabled categorization of the issues identified. However the framework is limited in highlighting issues which cuts across the three components. Death as an adverse outcome in the ED was not presented in the framework.

5.8 Limitations

No formal and systematic recording of my personal observations were made other than keeping a personal work diary. .Keeping a diary generates a lot of information that makes focus difficult, however since filing a diary depends on short-term memory, less recall bias occurs. As well, a dairy is effective in gathering information over a long period of time and gives understanding into processes that tend to develop slowly over time, which a period of observation or video recording may miss out. Most literature used was from HICs but since studies on strengthening A&E services have mostly been documented by HIC, with little known in LMIC, being guided by the literature is helpful to understand issues in A&E care. Clearly the experiences of HIC needed to be interpreted for validity in a LMIC context.

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6.0 CONCLUSION AND RECOMMENDATION

Overcrowding in AED in LMIC is gaining prominence; affecting essential healthcare access and effective treatment. Several factors were found to negatively affect workflow processes. The study therefore explored and analysed AED patient flow factors using components in care process. An adapted input-throughput-output framework was used in analyzing work processes.

Generally, it was seen that all three components contribute to poor patient flow. Over all, nine interlinking factors; internal or external to AED processes with some similarities to HICs were identified. Factors internal to AED were fewer than external factors, while factors similar to HICS are more than dissimilar factors. Of the dissimilar factors which appear peculiar to LMIC -payment and billing processes, and financial and family related factors - are issues cutting across.

Patient type and condition factor, an input component, is suggestive of a weakness in implementing the gatekeeper system. This weakness must be addressed.

Throughput components are both internal and external. Factors such as triage oragnisation, inpatient transfer process, aspects of billing and payment processes lie within AED's control and must be streamlined. The external factors: admission policies and specialist services, diagnostic services and treatment with their billing and payment processes, financial and family-related processes are moistly outside AED's control. However, they appear to contribute more to delays and a partnership with support service departments must be forged to resolve the issue.

No evidence was seen on the cross-cutting issue of payment and how it causes delay. Payment contradicts MOH A&E financing policy and appears to influence delays. How the Ministry has looked on for a failed implementation of its policy on fees is worth asking.

Also, the issue of how collecting fees interfere with care processes highlights: 1) the lack of coordination in revenue collection by departments which give AED support services; 2) the responsibility of decentralised departments to raise revenue internally to support hospital operations.

Again, issues of NHIS A&E BBP and the hospital insurance claims processes are brought to the fore.

The dependency on family for some hospital processes needs to be reviewed. It may be a reflection of inadequate staff numbers, or weak staff supervision, poor adherence to set standards or failure to adopt process improvement tools to enhance hospital services.

Furthermore the output factor of transfer depends on inpatient capacity, conditions for admitting patient and hospital occupancy rates. Patient exit after discharge depend on the willingness and ability of family to make home care arrangements and capacity of other facilities to continue with follow up care. Transfer of deceased though seemingly insignificant also influences flow.

This study has given an understanding of contributing factors to patient delays which results in poor patient flow and consequently overcrowding and congestion in a tertiary level facility. It has shown how factors interplay resulting in patient obstruction and the sources of obstruction. It has given insight on how care in AED interconnects with larger hospital arrangements including decentralised management style, payment structures, health care

funding and access to patient location. Study shows the need to see AED crowding from a system's perspective and the role in harmonisation of certain aspects of care process to ameliorate the problem. It also raises the issue of policy viability, interaction between policies and implementation and healthcare funding in general. These findings will give understanding to KBTH management on organising emergency care within its structure using policy as a guide and MOH in either reviewing its policy or determining the steps to make implementation possible. This study has added to the knowledge of factors associated with poor patient flow and given direction to AED on ways to intervene.

6.2 Recommendation

In view of the above-mentioned issues, the following recommendations are offered to the different stakeholders including MOH, GHS, KBTH Central Management, AED Management.

Ministry of Health

1. Undertake a review of A&E policy or engage KBTH in operationalization of existing policy.

Ghana Health Service

1. Partner KBTH to identify primary care facilities whose OPD services could be extended and their providers' skills enhanced in order to increase access and reduce referrals of otherwise basic conditions. This could be done on a pilot basis and extended in due time.

KBTH Central Management

Long Term

1. Consider expanding inpatient capacity to accommodate patients since the hospital hasn't seen any major expansion of its inpatient wards.
2. Engage NHIA to review BBP, and provider payment modalities for AED cases.

Short term

1. Initiate research on the role of billing and payment processes and family-related factors in AED delays in order to harmonise revenue collection amongst the four departments.
2. Introduce Electronic Medical Records, LIS with physician access and PACS to improve TAT of diagnostic services.
3. Introduce a bed-management computerised system and limit practice of bed specialisation.
4. Implement a centralised decision on discharge times to bring uniformity while providing a discharge room to hold patients as discharge processes continue

AED Management

1. QI team should continuously monitor a set of indicators covering aspects of input, throughput and output factors; and introduce a Plan-Do-Study-Act cycle for continuous QI.

Further research by Author

1. To undertake a time-in-motion study for selected patient cases including quantitative LOS measurements and qualitative description of process, related to an institutionalised Plan-Do-Study-Act cycle for QI

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And now, to Him who makes all things possible in His own time, The Triune God, the Almighty, in whom my faith and hope rests, glory and praise to you for evermore!

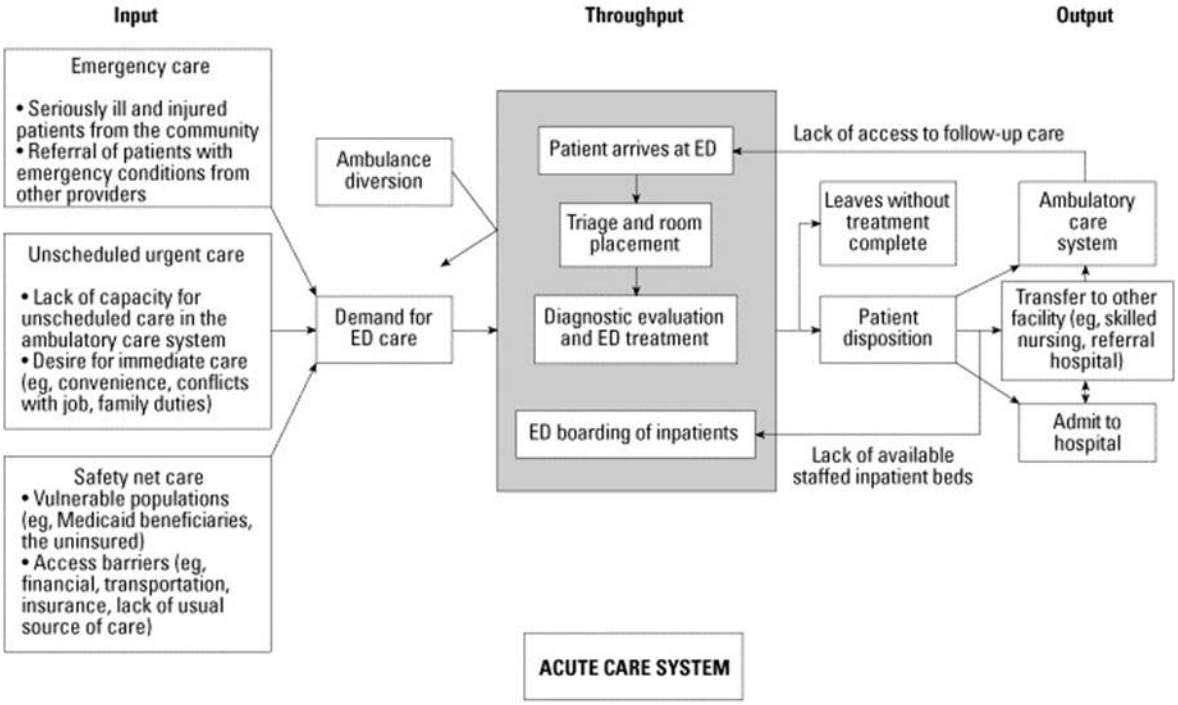
DEDICATION

I dedicate this thesis work to the memory of all who have lost their lives and to those whose conditions have worsened from delayed intervention due to overcrowding at an emergency department. And to those workers who strive each day to make a genuine contribution towards improving emergency services delivery.

Appendix I: List of search sources, terms and combinations

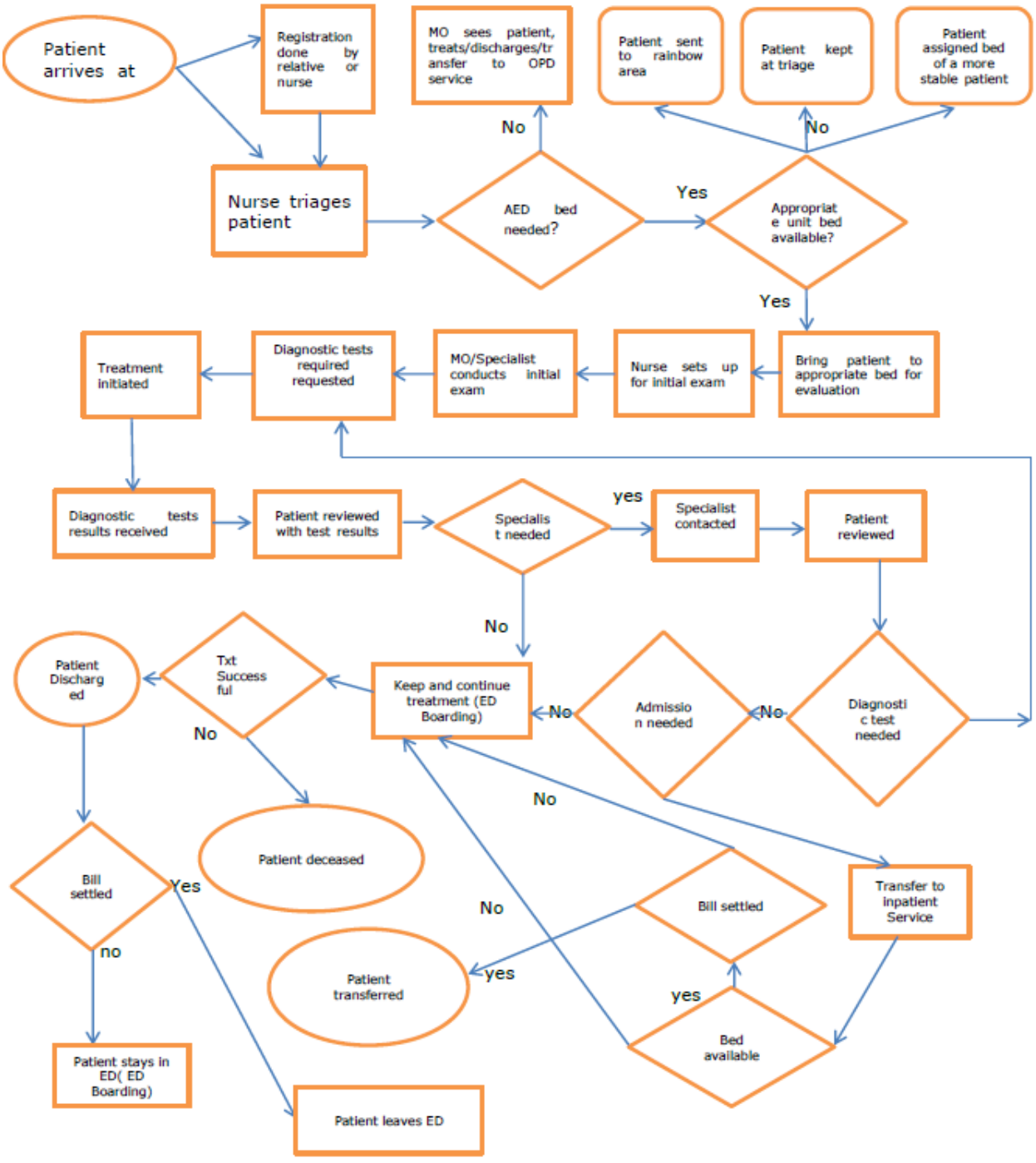
Source Search Engines databases	• Google Scholar • PubMED • Google • Vrije Universiteit LIB Search Engine • WHO • MOH • Ghana Statistical Service
Objective 1	• Scheduled OR Unscheduled care AND ED Crowding • Co-morbid condition AND ED visits • Emergency conditions AND ED Congestion • Trauma OR Non trauma cases AND ED Visits • Referred cases AND Emergency Visits • Self-referred cases AND ED Visits • Non-emergency conditions AND ED crowding • Convenient service AND Emergency Visits • Acuity of emergencies AND Emergency Crowding
Objective 2	• Triage AND ED Crowding • Admission process AND ED Crowding • Discharge and admission process in ED • Specialist services • Laboratory and radiology investigations • Support services • Staffing numbers • Transfer process • Treatment in ED
Objective 3	• Throughput measures AND ED length of Stay • Laboratory Turnaround Time AND ED Crowding • Radiology Turnaround Time AND ED Length of stay ED flow • Inpatient Capacity And ED Crowding • Billing System OR Payment process AND ED crowding • Family factors AND ED Crowding • Admission process AND ED crowding • Caregivers AND Acute Care Setting • Output AND ED length of Stay • ED patient wait times • ED crowding AND causes, solutions • LMIC OR HIC AND ED crowding • ED Work processes AND ED Length of stay
Objective 4	• Diagnostic service turnaround time AND ED length of Stay • Inpatient Capacity And ED patient flow • Billing System OR Payment Process AND ED crowding • Family factors AND ED Crowding • Admission process AND ED crowding • Caregivers AND Acute Care Setting • ED efficiency AND patient length of Stay • ED patient wait times AND Patient flow • ED crowding AND causes • ED crowding AND Solutions • ED Work processes AND ED Length of stay

Appendix II: Input-throughput-output Conceptual framework on overcrowding



Source: Asplin et al. 2003 (4)

Appendix III: General process map of workflow from patient entry to exit at AED



TXT- treatment
ED- Emergency Department
Source, Author 2019

Appendix IV : Top ten Surgical, Medical and Trauma cases at the AED for a particular month

RANKING	Medical Cases	Surgical Cases	Trauma Cases
1ST	Hypertensive Heart Disease	Acute Abdomen	Road Traffic Accidents
2ND	All types of malaria	Acute Retention of urine Haematuria	Trauma
3RD	All types of CVA/Stroke	Appendicitis/Perforated Appendix	Fall
4TH	Severe Anaemia	Urethral Stricture	Assault
5TH	Other heart Disease	Intestinal Obstruction / Perforation types of hernia	Foreign Body
6TH	Hyper/Hypoglycemia in DM/DKA	Peritonitis / Visceral Perforation	Burns
7TH	Pneumonia / Pneumonitis	Benign Prostate Hyperplasia	Dog Bite
8TH	Sickle Cell Disease/ VOC	Rectal Prolapse	Fall from height
9TH	Seizure / Epilepsy	Choletiasis / Cholesistitis	Human Bite
10TH	Congestive Cardiac Failure	All types of hernia	Gun Shot Wound

Source: Unpublished Departmental Report, 2018

Appendix V: Equipment and arrangement at triage

Item	Description
Arrangement	An enclosed space directly opposite main ED entrance Within the enclosed space are a writing desk and three chairs for staff, as well as individual patient waiting chairs
Equipment	Defibrillator
	Glucometer
	Haemoglobinometre
	Infection prevention materials
	Pulse oximeter ,
	Sphygmomanometers (manual and digital)
	Thermometers (Digital)
	Trolley for patient examination
	X-ray view box

Appendix VI: Interplay of transfer process and some of other factors

Inpatient bed available	Transfer process initiated	Patient bill prepared	Patient bill paid	Transfer team constituted	Patient transferred	Comments
Yes	Yes	Yes	Yes	Yes	Yes	Efficient AED process Efficient Inpatient process Efficient family factor
Yes	Yes	No	No	No	No	Inefficient AED processes
No	Yes	Yes	Yes	Yes	No	Inefficient inpatient process
No	No	No	No	No	No	Inefficient Inpatient process Inefficient family factor Inefficient AED process
Yes	Yes	Yes	No	Yes	Yes	Inefficient family factor Efficient AED process with potential loss of revenue
Yes	Yes	No	No	Yes	Yes	Inefficient Ed process Efficient ED process with potential loss of revenue Efficient inpatient processes
Yes	Yes	Yes	Yes	No	No	Inefficient AED process