

A Critical Review of Accident and Emergency Facilities Functionality: A Case Study of Uganda's National Referral Hospital

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Abstract

The functionality of an Accident and Emergency facility directly impacts on the possibility of living of any patient on arrival to that unit. It significantly influences the quality of patient care and the overall efficiency of the day to day activities, given that it acts as the first point of call for patients that come in a very critical state. The purpose of the study was to examine the critical architectural design factors that affect the provision of emergency care services at the facility. A descriptive and exploratory approach using qualitative data collection methods was adopted, involving an extensive review of existing literature and in-depth case studies with the leading case study being the largest and oldest national referral hospital in Uganda, Mulago. Data was collected through observation, literature and interviewing the users which included the medical staff, patients and their attendants at the facility. The study revealed that one of the critical factors for the functionality of these facilities is accessibility - site placement, egress, wayfinding and signages, entrances and the spatial layout of the facility. Furthermore, factors like privacy, security, safety and comfort were also of primary importance for the users' wellbeing. Issues to do with spatial quality such as lighting, ventilation, acoustics and temperature greatly impacted the quality of emergency care. The caretakers at this unit expressed their dissatisfaction at the wait times, highlighting the need to reinvigorate the facility's waiting areas design. Staff members also underscored the need for their privacy. The research revealed critical design lapses at the facility which negatively impact the quality of service

Keywords: Design, Functionality, Accident & Emergency (A&E) Unit.

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1. Introduction

Accident and emergency (A&E) facilities play a very crucial role in the healthcare system, providing urgent and critical care to patients with emergency medical conditions and injuries or trauma ranging from minor to very severe cases (Sakr & Wardrope, 2000). A&E units receive cases of major emergencies such as major trauma or accidents, loss of consciousness, confusion, persistent severe chest or abdominal pain, a stroke, or breathing difficulties. In the realm of healthcare, these units stand as first points of call for critical care, providing immediate medical attention to individuals who have succumbed to accident injuries and life-threatening conditions or sudden illnesses. According to the Health Building Note of England (2013), A&E units are sometimes termed as Emergency Departments (ED). The choice of terminology may depend on regional or institutional conventions. The term "(A&E) Unit" is commonly used in the United Kingdom and some other parts of the world whereas the term ED is commonly used in many healthcare systems, particularly those in the United States. (Health Building Note of England, 2013)

The A&E unit at Mulago encompass the quality of care provided by the medics and the equipment and there's an existing gap in literature about how the built environment/ design of the facility enhances better and urgent provision of emergency care. Due to the prevalence of trauma injuries and emergency health conditions in Kampala, the capital city and central region, there's a need for a comprehensive investigation to understand the strengths, weaknesses, and potential areas for improvement in the functionality of A&E units. Kampala being the capital city of Uganda is rapidly urbanizing and its continuously growing busy traffic has heightened the urgency of efficient A&E units. These facilities serve as the initial point of care for people involved in road traffic injuries (RTIs) and other forms of accidents, emergency situations such as tragic illnesses and mass casualty events and catastrophes.

According to a 2022 report by the World Health Organization (WHO), Physical trauma claims an annual death toll of about 4.5 million lives globally, which contributes to about 10% of global disease burden. In addition, the SDGs 2030 set a target to mitigate the number of fatalities and global injuries due to traffic accidents. The Uganda police annual crime report for the year 2020-2021 indicated a 42% increase in the number of crashes reported in 2021 (17,443 up from 12,249 in 2020). The number of fatal accidents registered also sky rocketed from 3,269 in 2020 to 3,757 in 2021, serious accidents from 5,803 in 2020 to 9070 in 2021, and minor accidents from 12,249 in 2020 to 17,443 in 2021, according to the same report. The Uganda police

crime report for the year 2021/2022 indicated an average monthly admission of 4,012 for trauma patients which represented about 45.8% of total regional referral hospital overall admissions. Of the 134 daily admissions registered, 34 patients representing 25 percent were critically ill while 50 patients (37.5 percent) were moderately ill, and 50 patients (37.5 percent) were in mild conditions categorized as the critical level I," the report states.

Mulago National Referral Hospital (MNRH), located in Kawempe North Division of Kampala as a case study for this research receives an average of 50 patients per day at the old A&E unit with a bed capacity of 30. Of the 50 patients received daily, an average of 20 are reported to be accident casualties while the rest suffer a range of other emergency health issues. (Monitor, 6/14/2022: Mulago unveils new emergency unit). According to a former head of A&E unit at Mulago national Referral Hospital, "Uganda does not have an efficient emergency system and pre-hospital personnel to work on casualties. Many patients die because they are not attended to early enough." Furthermore, the pre-hospital care systems are inefficient thus most patients who sustain emergency conditions and trauma arrive at hospitals by public means, private vehicles or by police cars without receiving any primary care which exacerbates their injury severity (Humphreys, 2019). The gap in literature on A&E units raises a pressing concern to analyze the A&E Unit design at Mulago National Referral Hospital (MNRH) and to examine the factors affecting its functionality and efficiency.

2. Literature review

The US Department of Veterans: Emergency Department design guidelines (2021) highlights that guides are not tailored to specific projects and are unable to anticipate all the rapidly changing demands of healthcare facilities. Each site or project possesses unique conditions and needs. Therefore, site-specific concerns should be considered within the framework of these standards and then applied to individual projects accordingly. The same guide further warns that utilizing the guide does not exempt planners, designers/architects, or constructors from their obligation to deliver comprehensive, operational, secure, and safe designs tailored to the distinctive needs of each project, all while staying within budget and adhering to the established schedule.

Studies from high-income settings have clearly proven that imperative and considerate design of A&E units brings about higher chances of positive patient outcome (Marsh et al., 2020). The Australasian College for Emergency Medicine (ACEM) Emergency Department Design Guidelines (2014) points out that models of care can change rapidly depending on government policies and initiatives, patient needs and demographics, staffing, and other factors. Walid Tarawneh (2018) also affirms this adding that A&E unit design is also influenced by the characteristics of Emergency Medical Services (EMS) provided at the facility. Studies by Marsh and colleagues (2020) further indicate that no standards exist for A&E design in low- and middle-income countries (LMICs). Generally, the design of an A&E unit is paramount in ensuring the efficient delivery of emergency services, patient safety, and staff functionality (Petrino, Tuunainen, Bruzzone, & Garcia-Castrillo, 2023).

Notably, many studies insinuate that A&E units are characterized by constant change, activity, and unpredictability (Günel & Pidd, 2010). Hence, the physical layout and design of these facilities must be flexible and consider the need for adaptability and responsiveness to the evolving nature of emergency healthcare (Łukasik, Porębska, & Health, 2022). Moreover, each site or project possesses unique conditions and needs. Therefore, site-specific concerns should be considered within the framework of these standards and then applied to individual projects accordingly. (The US Department of Veterans: Emergency Department design guidelines, 2021).

According to Marsh et al (2020), the application of design principles derived from high-income settings would be unsuitable for Low- and Middle-Income Countries (LMICs) because of the variations in disease prevalence, staff training, healthcare system attributes, and financial resources. They rather recommended gathering feedback on the current design from key stakeholders, patients, caretakers and staff in order to enhance the design qualities of the A&E units that best fits the conditions in LMICs.

The four key components crucial to the success of an efficient A&E department according to the Planning and Guidance of Accident & Emergency Departments in England., 2013 include; the design, processes, communication and the ability to change. The three factors of considerations in the design of A&E units according to the ACEM (2014), include; Functionality, form and patient & staff wellbeing. Form considerations for instance include spatial layout and how it facilitates effective interactions among staff, patients, relatives, and caregivers and furthermore on how it enhances adaptability, flexibility of the design and its interface with the adjacencies.

2.1 Functional factors

On functionality considerations, design factors such as; accessibility, site placement and location, parking, interface with adjacencies, egress, wayfinding & signages, patient flow, spatial layout, size of spaces, design topologies, finishes, privacy, security & safety, specific rooms and their functional requirements need to be critically delved into. The minimum emergency services sections are basic life support and advanced life support,

these divide the care into 3 classifications i.e. level I., II. and III according to the services provided and their capacity. (Turkey structures minimum Design Standards Manual for health, 2010).

The site of the A&E unit should be strategic to enable urgent and easy access to emergency vehicles, enabling timely responses to emergencies and facilitating the seamless flow of ambulances and other emergency vehicles (Aule et al., 2023). Additionally, when choosing a suitable site for emergencies, it's essential that they be positioned for convenient access to multiple major roads and highways, both for entering and exiting (Jia et al 2007). Another critical aspect in site selection is its placement on the ground floor. Ground floor locations minimize the need for patients to navigate stairs or elevators during emergencies, ensuring faster and more direct routes to emergency medical care.

2.1.2 Access & Entrance

Access into the facility is another vital requirement for the efficient functionality of the A&E unit, designers need to put into consideration the various demographics of users and age ranges when designing a proper functioning access. A close relationship to the main entrance of the hospital is desirable, for patient and relative wayfinding, after-hours access and egress, and parking/public transport. (Zamani & Journal, 2019) Furthermore, designers also need to incorporate and ensure visibility of time and date to help maintain temporal awareness, signages with large fonts with high contrast for easier visibility to the visitors of the facility. (ACEM, 2014)

According to the ACEM (2014), there should be at least two entrances. One for walking (ambulant) patients and lead by the reception desk to the waiting area. The other entrance should be for ambulances/vehicular access for patients received from private vehicles, police trucks or motorist means and should have immediate access to resuscitation or cubicle areas. A canopy over the entrances is advisable for visibility and to protect patients from the elements during transfer. (Standards for accident & emergency departments in Ireland, 1997)

2.1.3 Spatial layout

The spatial layout and patient flow should ensure that patients receive effective and respectful care with minimal delays. Similarly, the experience of the A&E staff is of equal importance. (ACEM, 2018) Furthermore, maintaining a consistent room layout and design throughout the A&E department has been demonstrated to decrease medical errors. This entails having all doors in the same position in each room, with consistent handing and opening directions. Furthermore, standardizing the placement of equipment, communication points, and mechanical and electrical switches and services in each room ensures that these elements are conveniently and appropriately positioned to support safe and effective clinical care. (ACEM, 2018) Spatial needs should be determined based on the activities and equipment used, with a primary focus on the patient. This should involve considering ergonomic data and arranging sequential activities in close proximity to create a dynamic task area. (Health Building Note 15-01 for England, 2013)

2.1.4 Wellbeing

On wellbeing, Harvey et al (2021) suggests that when designing an A&E unit, numerous factors should be put into careful consideration for the experiences of the patients, staff, and visitors in order to be able to address the diverse needs and requirements of all users while considering the varied demographics. Failure to address this issue might increase user dissatisfaction which is a complex and subjective emotion that results in a negative experience. (Thompson et al., 1996) This dissatisfaction can manifest as frustration and, in some cases, aggressive behaviour (Frank et al., 2009).

Patients in A&E units frequently undergo experiences marked by feelings of vulnerability, anxiety, stress, and fear. Of utmost significance to them are factors such as waiting times, the delivery of information, their interactions with staff, and the physical space in which they receive care. Furthermore, The degree of urgency influences whether they perceive a visit positively or negatively (Annemans, Van Audenhove, Vermolen, & Heylighen, 2018). Amenities that address their physical and emotional needs, such as comfortable seating, access to emergency services, and a calming atmosphere enable patients to focus on their well-being rather than the time spent waiting (Thomas et al., 2018). Furthermore, satisfied patients are more likely forgiving of reasonable wait times. (Liu, Finkelstein, Kruk, & Rosenthal, 2018)

To cater for the distinct requirements of different patient groups, strategic placement of furniture and art, ensuring access to information and communication technology, and designing rooms and equipment suitable for specific patient populations are essential components (Hamilton & Shepley, 2010). Designers must be mindful that A&E units caters for patients of varying ages, physical conditions, and mental states and thus the facility should accommodate specific considerations for elderly, bariatric, PWDs and paediatrics. (Walid, 2018)

The design of the A&E unit environment plays an important role in mitigating patients' perceived wait times (Sasanfar, Bagherpour, & Moatari-Kazerouni, 2021). Elements within space such as temperature, lighting, and noise levels, have been demonstrated individually to influence patients' waiting experiences and thus their satisfaction (Soremekun, Takayesu, & Bohan, 2011). Moreover, positive patient experiences are associated with heightened satisfaction among the A&E staff, elevated morale and improved staff retention rates (Johnston et al., 2016). According to the A&E unit design guide by the US Department of Veterans Affairs (2021), the design of the facility should be patient-centered and instill in patients a feeling of empathy and confidence, assuring them

of their significance and the care they will receive. This should be reflected in the design of the emergency department entrance, waiting areas, and public spaces, with a focus on creating a healing environment that avoids an institutional atmosphere. To achieve this, the incorporation of design principles that evoke hospitality and a homely ambiance is essential.

Bingöl (2021) reveals that as caretakers, relatives or friends of patients often arrive in a state of emotional distress, it's imperative to consider designs with calming and aesthetically pleasing surroundings to help reduce the stress and anxiety. This can be achieved through the use of natural light, comfortable seating, and soothing colors and materials. (Hung et al., 2011) It is equally imperative to create a conducive and healthy working environment for the A&E staff through thoughtful design because numerous studies indicate that catering for the satisfaction of one party eventually leads to a positive experience of the others. (Areskoug Josefsson, Avby, Andersson Bäck, & Kjellström, 2018). According to the standards for A&E departments in Ireland (1997), the unit needs to cater for a wide variety of health professionals and other professionals who may be stationed primarily in the unit providing care and support services, or who may be transiting through (Anthony et al., 1997). These include consultant and non-consultant staff, trainees, nursing, non-medical staff like cleaners, security, etc.

2.1.5 Privacy & Security

Privacy and security are also very significant in A&E settings and is an ethical concern and critical for patients' physical and mental well-being (Lin et al., 2013). Additionally, enhancing the feeling of safety in A&E units leads to job satisfaction and less turnover. (Gates et al., 2011) Security is also paramount importance on essential resources, including water, gases, power, ventilation, communication, and information. It encompasses elements such as surveillance, access and egress control, threat mitigation, and the ability to implement a "lockdown" in times of need (Zamani & Journal, 2019)

2.2 Spatial Quality factors

Leaving user wellbeing onto spatial quality, Patti et al (2014) emphasizes designing A&E units with careful attention dedicated to addressing spatial requirements, notably the need for observation, security and patient privacy. Standardization, adequate spatial provisions, and noise control are identified as elements that have significant implications for both efficiency and patient outcomes (Adkins et al., 2017). Moreover, the built environment's influence on factors like effective teamwork, visibility, and accessibility contributes positively to efficiency outcomes (Fay et al., 2018).

2.2.1 Lighting

Efficient lighting is a crucial environmental factor in A&E units, as it plays an important role in enhancing work performance enabling successful task execution but also reducing the risk of occupational hazards for healthcare workers (Wahab, 2019). The lighting design in A&E facilities must effectively address the diverse and conflicting visual requirements of users, as emphasized by Foster (2005) stipulating the relying on both natural and artificial lighting due to its multifaceted activities varying from precision-based procedures to more general tasks.

2.2.2 Ventilation & Heating

Ventilation & heating are the other key aspects when achieving liveable emergency care spaces. Poorly ventilated and overheated spaces lead to worker fatigue, patient discomfort, infection risk, improper medication storage and biomedical equipment malfunction (Atkinson, 2009). Marsh et al (2020) prioritizes well-designed, naturally-ventilated spaces as they have higher rates of air exchange and lower infection risk than mechanically-ventilated rooms which are cost-prohibitive.

2.2.3 Acoustics

On acoustics, Marsh et al (2020) highlights the need to prioritize minimizing the transmission of sound between adjoining treatment areas revealing that unregulated noise levels within the A&E units associate with impairing clear communication, compromise of patient privacy, adverse patient outcomes and heightened stress levels among both staff and patients. Addressing ambient noise through various design elements including flooring, ceiling materials, door placement, and the location of nursing stations helps create a healing environment in the A&E unit (Mazer, 2002). Mazer suggests using sound-absorbing carpeting, acoustic ceilings, and heavy-duty floor tiles in high-traffic areas.

2.3 User experience considerations

When designing an A&E unit, numerous factors are put into careful consideration for the experiences of the patients, the emergency staff, and visitors in order to be able to address the diverse needs and requirements of all users while considering the varied demographics (Harvey, Bubric, VandenBerg, & Hair, 2021).

Various literature findings indicate that poorly designed spaces might as well increase user dissatisfaction. Dissatisfaction is a complex and subjective emotion that results in a negative experience. It's important to note that dissatisfaction is not necessarily the direct opposite of satisfaction. Patients can simultaneously experience

both satisfaction and dissatisfaction in a given situation (Coyle and Williams, 1999). Dissatisfaction often arises when positive expectations are not met (Thompson et al., 1996). This dissatisfaction can manifest as frustration and, in some cases, aggressive behavior (Frank et al., 2009).

2.3.1 Patient experience

When designing an A&E unit, a crucial consideration is to enhance the overall patient experience within the emergency facility, spanning from the moment of arrival to their final disposition (Mock, 2004). Patients in A&E units frequently undergo experiences marked by feelings of vulnerability, anxiety, stress, and fear. Of utmost significance to them are factors such as waiting times, the delivery of information, their interactions with staff, and the physical space in which they receive care. Furthermore, The degree of urgency influences whether they perceive a visit positively or negatively (Annemans, Van Audenhove, Vermolen, & Heylighen, 2018).

Recognizing the significance of a positive patient experience not only improves patient satisfaction, but it also contributes to the perceived reduction in waiting times (Sayah, Rogers, Devarajan, Kingsley-Rocker, & Lobon, 2014). For example, a positive quality experience may result into the perceived reduction of waiting times in various ways.

Elements within space such as temperature, lighting, and noise levels, have been demonstrated individually to influence patients' waiting experiences and thus their satisfaction (Soremekun, Takayesu, & Bohan, 2011). Moreover, positive patient experiences are associated with heightened satisfaction among the A&E staff, elevated morale and improved staff retention rates (Johnston et al., 2016). Figure 1 below is a study showing the different patient experiences and their correspondent satisfaction frequencies as illustrated in a research by (Sonis, Aaronson, Lee, Philpotts, & White, 2018).



Figure 1: Frequency of identified patient experience themes. (source: Emergency Department Patient Experience: A Systematic Review of the Literature, (Sonis., et al 2018).

Increasing attendance at A&E departments needs to be addressed. It is important to understand why people attend A&E departments as the number and type of patients attending the department will influence the design required (Bos, Sizmur, Graham, van Stel, & Safety, 2013). In 2012, A&E units in England served as the entry point for more than 16.5 million annual visits (Alberti & Nannini, 2013). In the United States of America (USA), there were over 100 million annual visits, representing 40 percent of all hospital admissions (Garcia, 2010). Garcia (2010) further reported that these millions of patients will attend with any number of clinical presentations and complaints requiring the assistance of every medical specialty.

Existing literature and research often indicate that the increasing number of patients seeking urgent care often results in overcrowding the facility which in turn results into long waiting times (Pines et al., 2008). Therefore, when designing waiting areas, and other areas within the A&E facility for the casualties/patients and their relatives, visitors or care takers, it is important to consider the casualty/patient mental state and satisfaction.

Drawing insights from The Australasian College for Emergency Medicine (ACEM) Emergency Department (ED) Design Guidelines (2014), it is crucial to recognize that individuals in these spaces often contend with heightened emotions such as fear, anxiety, or pain. The report concurs with the recommendation that the physical environment should, wherever possible, serve a therapeutic role in alleviating or mitigating these emotional challenges.

3. Methodology

Developing a clear framework outlining the methodology for conducting a particular research is essential to ensure the efficient collection of relevant data without unnecessary expenditure of effort, time, or resources (Pandey et al., 2021). This study will utilize a mixed-method research design, incorporating both qualitative and quantitative research methods to comprehensively analyse the design and functionality of Accident & Emergency units at Mulago National Referral Hospital.

The qualitative approaches natural occurrences and actual experiences. Includes; Observation, photography, sketches and interviews (Mohajan, 2018). Quantitative approach use of measurable phenomenon including numbers and accurate measurements. Includes experimental processes and collection of numeric data (Rutberg, et al, 2018).

The research utilized a qualitative research method to comprehensively analyse the design and functionality of Accident & Emergency unit at Mulago National Referral Hospital. The methodology for conducting a particular research is essential to ensure the efficient collection of relevant data without unnecessary expenditure of effort, time, or resources (Pandey et al., 2021). Also, the qualitative method approaches natural occurrences and actual experiences and includes; observation, photography, sketches and respondent interviews (Mohajan, 2018).

Convenience sampling was used for surveys, with participation from hospital staff, patients, and visitors. Purposeful sampling for in-depth interviews and observations to ensure representation of key stakeholders. Stakeholder interviews involved in-depth interviews conducted with key stakeholders, such as hospital administrators, medical staff, and facility management personnel, to gain insights into their perspectives on the design and functionality of the units. Patient and Visitor Interviews on the other hand included interviews with patients and visitors to understand their experiences, comfort levels, and any challenges they encounter in the Accident and Emergency unit. Anonymity and confidentiality of participants was ensured. All research activities complied with ethical guidelines and regulations.

4. Discussion of findings

The hospital Principal administrator and head of the A&E department and one of the major surgeons at the facility with service for close to 7 years cited that everything that an accident patient needs like a blood bank and scans are within this facility. He stated that the facility is open 24/7 for all emergency situations. The research revealed that the demography of patients arriving at the facility was wide but the most common are patients of Road Traffic Injuries (RTIs), assault and mob violence, with an average of 50 patients per day at the old A&E unit with a bed capacity of 30. Of the 50 patients received daily, an average of 20 are reported to be accident casualties while the rest suffer a range of other emergence health issues.

The interviews revealed that the patient flow at the A&E unit is such that when a patient arrives at the facility, the first thing is to rush them to the triage area to be sorted and then basing on the condition they are going through, they are referred to either the casualty side or the emergency side. It was denoted that one clear thing is that if the patient's condition requires a surgery/operation then he/she belongs to the casualty side. If it's an illness or any sudden health condition that doesn't require any surgery then the patient is directed to the medical emergency side. The inpatients in either the casualty or the medical emergency wards are provided with emergency medical care for days until they are worthy to be discharged. They can then be referred to other departments of the hospital or to pharmacies to purchase medication and later recover fully from their homes.

It was observed that on arrival, there are two entrances into the site; the vehicular entrance and that of the ambulant/ on foot users. The two gates are side to side with a security room between them. However only the vehicular access gate remained open for the five days that the researcher visited the facility and on consultation from the security personnel, he stated that the walk-in gate is closed to ensure that everyone uses the same gate for easier control and security management. Figure 2 shows the patient flow as captured at the unit.

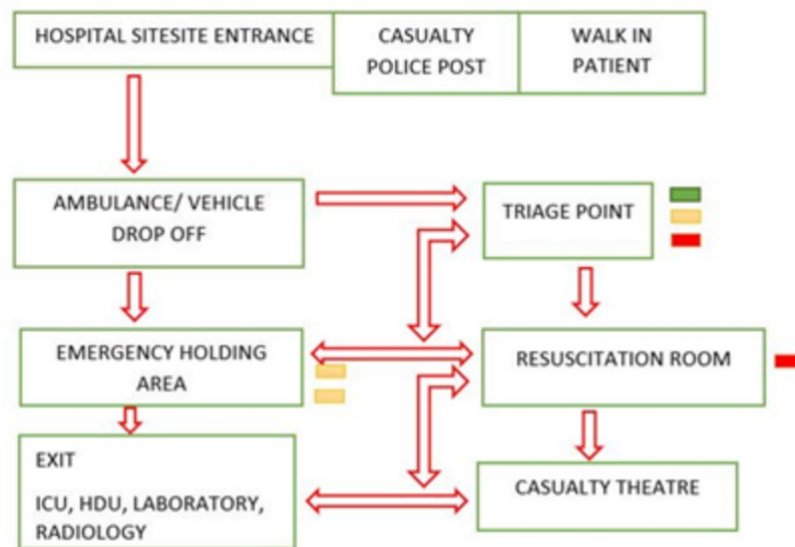


Figure 2: Patient flow as illustrated on the white board in the waiting tent (source: author)

The A&E unit at Mulago National Referral Hospital as seen in figure 3 comprises of a single main block which has a ground and one upper floor. Adjacent parts of the unit include a recently built pharmacy right in front of the medical emergency side and the general toilet/washrooms behind the casualty side. The ground floor comprises of the casualty department and the medical emergency department. The casualty side lies at the left and is semi-detached to the medical emergency which is adjacent to Dwaliro road on the west.

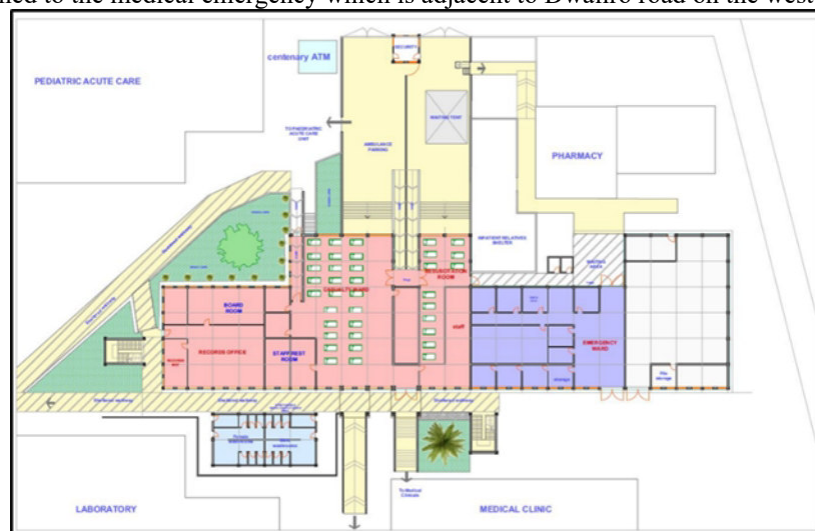


Figure 3: Spatial layout of the A&E unit (source: Author)

The A&E unit at Mulago National Referral Hospital (MNRH) suffers significant gaps affecting its functionality and user experience. The exhaustive analysis covered patient flow, spatial layout, accessibility, entrances, lighting, ventilation, privacy, security, safety, acoustics, and overall well-being.

The patient flow within the A&E unit lacks efficiency, resulting in prolonged wait times and confusion among the patients and their caretakers. The current triage is just a small zone outside the ward room where a security personnel tells patients where to go based on what he thinks their condition is. Contrary to what's denoted on the unit's patient flow chart, the procedure is not fully followed as most patients try to skip the registration, triage process to meet the doctors faster and in the process, they are drawn back. Only one entrance is open for both the ambulant and the vehicular access causing inefficient access by patients and caretakers to their designated areas. Additionally, the absence of a fast track service for minor injuries exacerbates delays as all categories of patients follow the same process.

The inefficient design and triage processes also contribute to unnecessary delay and confusion among patients. While the spatial layout's simplicity is commendable, the lack of a clear separation between casualty and medical emergency patients' treatment facilities affects the adaptability of the unit's design. Additionally, the absence of a flexible triage system further hampers the unit's ability to accommodate different care models.

The ground floor placement however enhances its flexibility to be changed to new models in the future. Furthermore, the open plan designs and the absence of corridors and walls in the patient-staff spaces enables visibility hence visual and verbal communication between the two parties.

Although the A&E unit's site is strategically located on Mulago hill hence enabling easy visibility, access and egress, the facility lacks designated parking for department staff, causing delays when they need to urgently reach the site. The use of a single entrance for all patients (both casualty and medical emergency patients) contradicts the recommendations required for efficient wayfinding and patient flow causing delays as patients end up mixed up and confused. The difficulty is also partly as a result of the inadequate wayfinding systems at the unit which contributes to navigation difficulties for new patients and caretakers. Wayfinding difficulties arise as a result of the faded and poorly visible signages used at the premises. Additionally, the wayfinding and signages present issues of language barriers, especially with the signages primarily being in English which pose challenges for illiterate visitors and non-English speakers. Despite being designed to accommodate ambulant and stretcher-bound patients, a wide demographic of patients such as the bariatric the entrance faces challenges with overcrowding, impacting patient flow. Moreover, the lack of a dedicated entrance for critical cases arriving by helicopter neglects a potential aspect of emergency care.

While the facility benefits from natural lighting due to the curtain walls at the casualty ward and resuscitation rooms, inconsistent lighting in some areas like the emergency ward, the triage area and the ramp access create limitations for accessibility and navigation during the day. The absence of efficient artificial lighting techniques such as task lights or spotlights for specific activities create limitations during precise operations such as surgeries resulting into use of torches for such.

The medical emergency ward was dark even during day because it receives insufficient daylight since the waiting shade adjacent limits the sunrays reaching the openings. Furthermore, it has smaller and fewer windows that compromised the quantity of the natural light into the building interior. Due to the facility's orientation, glare issues from the afternoon sun on the west-facing front façade raises concerns about the overall effectiveness of lighting design. The inefficiency of the lighting dynamics in the triage access which is a high-traffic area minimizes the visibility, security and safety for both staff and visitors.

With the permanent louvres designed over all the windows and the exterior doors and the curtain walls on the front façade possessing wire meshes as a Permanent Vent Over (PVO), natural ventilation is predominant in the facility with artificial ventilation being evident in administrative spaces only. This brings about ventilation challenges in areas susceptible to crowding such as the triage area and the casualty ward itself, necessitating the consideration of mechanical systems. Positively, the linear form of the building enables cross-ventilation especially for spaces such as the casualty ward and medical emergency ward which are open plans and draw air directly from the east and west external façade windows.

More positive is that the waiting areas are under pavilion-like structures enhancing the ventilation of these spaces. Other spaces such as the resuscitation room with the staff change rooms are also cross ventilated because the partitions walls are short hence allowing efficient flow of air through the spaces. The quality of air in the ward room is usually characterized by bad odour arising from patients' wounds, chemicals, medicine and even the dust bins in which patients dump foodstuffs and other wastes. As a result, patients highlighted an implementation of mechanical systems such as fans and air conditioners to enhance the quality of air in this space.

The Open-plan layout of the facility compromises patient privacy, and the inadequacy of partitioned rooms affects the overall sense of privacy for patients and their caretakers. The Limitation of private spaces for the medical staff also highlights a major privacy issue emphasizing a need for staff lounges and better designed change and washrooms tailored for their needs.

Safety is generally appreciated through provision of fire rated walls, floorings that mitigate injuries during emergencies and facilitation of walking support on ramps for the PWDs. However, it is a doubt that the fire safety measures at the facility are efficient given the lack of basic equipment such as the fire extinguishers, fire warning signages and doors. Furthermore, the floor surface just outside the facility was concrete which poses cleaning challenges increasing the risks of infections.

Security is very key at this facility given that patients and their caretakers are susceptible to agitation and violence. Security personnel were observed to wonder around all parts of the facility even though the facility does not incorporate any design for these security personnel except for the checkup room for the policemen at the gate area. Surveillance cameras, biometric locks on doors to more private entities and burglar proofs are the other ways that the facility manages security.

On the wellbeing of the users, the absence of a separate entrance for transporting deceased patients compromises dignity and well-being as the patients and their caretakers are exposed to distressing scenes. The researcher's witness to a corpse being carried into the mortuary van, with blood dropping onto the entrance area, highlights the urgent need for a redesign to shield visitors from distressing sights. The limited views accessible to patients, especially in the casualty and resuscitation areas, highlights a missed opportunity to provide a more

engaging and visually appealing environment. Furthermore, the lack of well-intended views may contribute to a sense of confinement and discomfort, especially for patients undergoing traumatic experiences. Also, the lack of proper planned positive distractions makes the place very boring emphasizing the need of design features to enhance relaxed feeling in the facility such as visual art, plants and TVs to watch as you wait which made the waiting seem even longer. The facility's design, where the same parking is used for both ambulances bringing in new patients and vehicles transporting corpses to the mortuary, raises significant concerns.

Internally, potential sources of noise were identified, including yelling and shouting from freshly brought patients in pain, the cries of caretakers and family members of recently deceased patients, and amplified announcements made by security personnel to inform caretakers and relatives. Externally, noise sources included sirens from approaching ambulances and other vehicles, as well as the general hustle and bustle of vehicles and motorists on Dwaliro road.

The positive aspect of the observed quietness within the A&E unit correlates the literature's emphasis on the importance of managing noise levels in healthcare settings. Security measures restricting access to patient wards contribute to a more controlled and serene internal environment. However, the potential sources of internal noise, such as patient distress and emotional reactions from caretakers and family members, highlight the inherent challenges in completely eliminating noise in emergency care settings. Externally, the noise from approaching ambulances and other vehicles is an unavoidable aspect of the facility.

While these noises are essential for signalling the arrival of critical cases, efforts can be made to mitigate their impact on the internal environment through the strategic placement of waiting areas and the use of sound-absorbing materials. Internal and external noise sources at the A&E unit, though generally controlled, pose challenges in maintaining a serene environment, especially during distressing events. The facility needs better alternative communication methods rather than the use of amplifiers. This can aid to minimize noise disturbance and hence emphasize the importance of sound control.

Discrepancies between user expectations and the actual design features impact patient and caretakers' comfort and their satisfaction at the facility. The seats at the waiting areas of the A&E unit are hard wood and cause discomfort among the users highlighting a need to facilitate more ergonomically and friendly furniture to enhance a positive experience. Also, the lack of positive distractions, engaging views, and consideration for mental well-being during traumatic events highlight gaps in the current design of the A&E unit at MNRH.

5. Conclusion

The efficient functioning of A&E unit at MNRH from the study conducted reveals extensive gaps in the built environment requirements to enhance the provision of better emergency care at the facility. From studies on spatial requirements ranging from sound control, ventilation, lighting, privacy and the other discussed spatial quality considerations, It is evident that a redesign implementing better integration of these design features would facilitate better operation of the facility and more positive patient outcome.

The examination of the patient flow in the Accident and Emergency (A&E) unit at MNRH reveals several critical challenges that impact the efficiency of service delivery and the overall patient experience. Notably, deviations from the established patient flow chart, the absence of a fast-track service for minor injuries, and the lack of a well-defined triage process contribute to delayed waiting times, confusion, and a less-than-optimal patient journey. The faded and unreadable patient flow chart adds another layer of complexity, hindering patients' understanding of the process and potentially leading to further delays. The absence of patient-focused design elements, such as features to mitigate perceived wait times through relaxation and entertainment, exacerbates the issue. This mismatch between the existing design and the recommended patient-focused approach, as outlined in Health Building Note 15-01: Accident & emergency departments, England (2013), underscores the need for urgent interventions.

Sound control in the A&E unit emphasizes the importance of managing noise levels for the well-being of both patients and staff. While the internal environment was generally quiet, potential sources of noise such as patient distress and amplified announcements posed challenges. External factors, particularly traffic noise from the nearby Dwaliro road, were identified as contributors to noise risk. Recommendations on the sound attenuation include implementing alternative communication methods, redesigning waiting areas for strategic placement, and incorporating sound-absorbing materials to create a serene environment.

In terms of user experience requirements, the study revealed a gap between desired features outlined in the literature and observed conditions in the A&E facility. Dissatisfaction with design elements, particularly seating in the waiting tent, suggests a need for improvements. Recommendations include upgrading furniture for enhanced comfort, introducing environmental enhancements such as favourable lighting and calming music, and involving key stakeholders in the redesign process for a more user-centric environment.

The findings on the use of positive distractions and views for the positive wellbeing of patients and their caretakers at the facility emphasizes the significance of creating an environment that considers psychological and emotional needs. Dissatisfaction with the absence of positive distractions and limited views underlines their

potential impact on reducing perceived waiting times and enhancing overall satisfaction. Recommendations include incorporating artistic elements, introducing greenery, establishing designated spaces for positive distractions, and assessing and redesigning areas to provide more visually engaging views.

The study on mental well-being in the A&E unit highlights the critical impact of distressing scenes on patients and caretakers. Inadequacies in ward design and shared use of parking for incoming ambulances contribute to a distressing environment. Recommendations include redesigning ward spaces for privacy, creating private areas for patients with severe conditions, establishing a separate entrance for vehicles transporting deceased patients, and enhancing aesthetically pleasant views.

The spatial layout analysis of the Accident and Emergency (A&E) unit at Mulago National Referral Hospital highlights a straightforward design with open-plan ward and resuscitation rooms, contributing to easy navigation. However, the current layout does not fully align with recommended models of care, as casualty and medical emergency patients share the initial assessment area before diverging into separate clinical areas. While the unit exhibits some adaptability with partitioned spaces, achieving optimal flexibility for different models of care is an ongoing challenge.

The absence of dedicated Patient Assessment Areas (triage) for casualty and medical emergency patients could impact efficiency and patient outcomes. Nevertheless, the ground floor placement and open-plan design enhance visibility and communication between patients and staff, which is commendable.

The study on the wayfinding in the A&E unit of Mulago National Referral Hospital revealed a significant gap between the literature recommendations and what is on ground. While standards in the literature review emphasize the importance of strategic signage and consistency, the field findings expose pitfalls in existing wayfinding systems. Notably, the struggles reported by Respondent 4 and observed issues like faded and illegible signs, concealed toilet indicators, and a lack of signages in the indigenous languages created a language barrier since a number of the visitors aren't educated. This emphasizes the urgent need for improvements.

The nuanced nature of the spatial layout's impact on wayfinding becomes apparent, showcasing that a well-planned environment can alleviate navigation challenges. The study highlights the critical role of regular maintenance in preserving the effectiveness of wayfinding elements, preventing issues like faded markings and enhancing longevity.

The study on A&E entrances in the literature review emphasized the crucial role these points of contact play in enhancing urgency into the facility hence influencing the quality of emergency care. Much as the data findings aligns with the literature review in highlighting the need of separate ambulant and ambulance accesses, the question left is if they are really efficient. The observed functionality of entrances into the facility, as reported by Respondent 2 and observed by the researcher, reveals some gap in the adherence to design principles and practical challenges. For example, the narrowness of the entry doors results into congestion hence hardship in entrance.

While the design of entrances somewhat aligns with recommended principles for quick access for ambulant and accident patients, the issue of overcrowding introduces a practical challenge. Congestion at the entrance, caused by an influx of visitors and caretakers, hampers the smooth flow of patients. The operational aspect of front curtain wall doors remaining closed during non-crisis periods, mandated by the triage process, raises considerations about usability and visibility.

The designation of specific doors for staff use contributes to security and controlled access, aligning with literature recommendations. However, the absence of explicit mention of a helipad for helicopter arrivals in the data findings highlights a potential gap in preparedness for critical cases requiring immediate aerial transport.

The discussion on privacy and security in the A&E unit draws attention to the critical value of these aspects for both ethical considerations and the overall well-being of patients, medical staff, support staff and visitors or relatives/family of patients at the facility. The findings revealed practical challenges in maintaining privacy within specific areas of the facility, highlighting the need for better comprehensive solutions.

Firstly, the open-plan nature of the casualty ward denotes challenges to patient privacy, particularly during physical examinations. The inadequacies in the measures, such as cubicle curtains and partitioned rooms, demonstrate limitations in accommodating the varying needs for private spaces during emergency care in the facility. The challenges faced by medical staff in areas like changing rooms further emphasize the complexity of balancing operational needs with the necessity of providing privacy.

On a positive note, the provision of personal rooms for non-clinical staff recognizes the diverse needs within the A&E facility, reflecting a step towards acknowledging the importance of private spaces for all individuals working within the A&E unit. However, challenges persist for caretakers and family members, as the open shelter lacks the necessary privacy, compromising their sense of safety and security.

The field study and analysis of ventilation and temperature control in the A&E facility reveals a combination of natural and mechanical ventilation strategies. While waiting spaces benefit from natural ventilation, there are challenges in certain areas, particularly the wards, where congestion and limited airflow contribute to poor air quality.

6. Limitation and future study

One evident limitation was the ability to get interviewees as most of the persons particularly patients were not emotionally at their best due to what had brought them to the A&E Unit. Future studies could consider a generation of standard designs for A&E taking from the revelations and proposals from this research.

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