EVALUATION OF HOSPITAL SURGE MANAGEMENT STRATEGIES FOR COPING WITH MASS CASUALTY INCIDENTS ALONG NAKURU-ELDORET- MALABA A-104 ROAD, KENYA

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A thesis Submitted in Partial Fulfillment of the Requirements for the Conferment of the Doctor of Philosophy Degree in Disaster Management and Humanitarian Assistance of Masinde Muliro University of Science and Technology

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DECLARATION

This thesis is my original work prepared with no other than the indicated sources and support and has not been presented elsewhere for a degree or any other award.

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CERTIFICATION

The undersigned certify that they have read and hereby approve for acceptance of Masinde Muliro University of Science and Technology a thesis entitled, "**Evaluation of Hospital Surge Management Strategies for Coping With Mass Casualty Incidents along Nakuru- Eldoret- Malaba A-104 Road, Kenya**"

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DEDICATION

I dedicate this work to my family; teachers and supervisors through whose efforts have kept me going over the years. They have made me a better scholar.

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ABSTRACT

Hospitals play a small but important role in minimizing morbidity and mortality to the victims of mass casualty incidents (MCI) which may include man-made and natural disasters. Despite the awareness of the fact that poor response strategies lead to increased morbidity and mortality, many hospitals are ill prepared to adequately respond to victims of mass casualty incidences citing many system deficiencies which are unique to different health care facilities. The general objective of this study was to evaluate hospital surge management strategies for coping with mass casualty incidents along Nakuru- Eldoret- Malaba A-104 Road, Kenya. The specific objectives were; to examine predisposing factors for patient surge at the Emergency Departments, the Wards operating theatre and the ICU; to evaluate the status of critical resources required for mass casualty incidences with unusual high patient surges; to assess strategies applied to cope with surge during mass casualty incidences. The study was grounded on the General System Theory approach. The study adopted descriptive and evaluative research designs. The study population comprised of health care workers, hospital administrators, patients, civil society organizations and the Police. Simple random, convenience and purposive sampling techniques were utilized. Sample size - 286 using sample size selection chart. Data was collected using questionnaires, interviews, FGDs and observation. Quantitative data was analyzed using SPSS 25 and Ms Excel then summarized as percentages, frequencies for descriptive statistics while inferential statistics were extracted thematically. The quantitative data was presented inform of charts, graphs and tables. Qualitative data was presented in narratives and in verbatim quotations. In line with objective one, the results indicated that 74% of the respondents had either experienced or responded to a major emergency incident in the workplace, 72% of the respondents reasoned that job action sheets were available in hospital, 91.6% of the respondents stated that such supplies were available in hospital stations, Further, (83.3%) responded that such a resource was available and in good condition. Further, the study found that increasing staff capacity during mass casualty incidents was an effective strategy during patient surge with 56.48% of the respondents agreeing, A chi-square test was conducted on the relationship between the number of years that the respondents have served in the facilities and experience of major emergency incidence. The chi- square value was 12.607 ($p< 0.05$) and was found to be significant. Regarding presence of designated care areas used temporarily by the hospital, isolation areas rate highest 51.7% availability while auditorium presence rates 53.3% least available. The overall conclusion of the study is that patient surge management strategies are still weak and as such cannot give effective emergency response to mass casualty incidents along Nakuru- Eldoret- MalabaA-104 road, Kenya. Based on the conclusions the study makes the following recommendations; firstly, that there is need for the hospital management to increase the number of staff and increase capacity in terms of equipment and instill a multi-department approach and culture of emergency management to enhance sustainable emergency management system during mass casualty incidents; Secondly, the study recommends that capacity of critical resources be expanded (staffing, equipment, and prioritization of care). Lastly the study recommends that hospital facilities should improve on staff, adequate equipment and proper infrastructure to help in responding to a mass casualty incident. Information derived from the study will help institutions in the study area plan better on resource placement and policy for management of mass casualties.

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LIST OFABBREVIATIONSANDACRONYMS

ATLS	Advanced Trauma Life Support
CDC	Centers for Disease Control and prevention
ICU	Intensive Care Unit
JCAHO	Joint Commission on Accreditation of Healthcare Organizations
LIC	Low Income Countries
MCI	Mass Casualty Incidents
MTRH	Moi Teaching and Referral Hospital
NGOs	Non-governmental Organizations
OR	Operating Room
PEV	Post-Election Violence
TTXS	Table Top Exercises
WHO	World Health Organization
MMUST	Masinde Muliro University of Science and Technology

OPERATIONAL DEFINITION OF KEY TERMS

Casualty- a person killed or injured in a war or accident

County Hospital- Regional health facility which provides specialized care including intensive care and life support and specialist consultations for example Nakuru PGH

Critical Hospital Resource- These are important facilities and equipment's for care and support to patients during emergencies

Comprehensive Emergency Management Plan-is the preparation for and the carrying out of all emergency functions, other than functions for which the military forces are primarily responsible, to mitigate, prepare for, respond to and recover from emergencies

Disaster Preparedness- A continuous cycle of planning, organizing, training, equipping, exercising, evaluating, and taking corrective action in an effort to ensure effective coordination during incident response.

Disaster Response-Aggregate of decisions and measures to (1) contain or mitigate the effects of a disastrous event to prevent any further loss of life and/or property, (2) restore order in its immediate aftermath, and (3) re-establish normality.

Golden hour-refers to a time period lasting for one hour, or less, following traumatic injury being sustained by a casualty or medical emergency, during which there is the highest likelihood that prompt medical treatment will prevent death.

Hospital response capability: is dependent on having a comprehensive emergency management plan inclusive of the worst case scenario, like an MCI, to enhance the level of readiness required to respond to a community's health care needs. The

sudden arrival of a surge of patients presents a logistical challenge to rapidly process a large number of casualties through the system.

Health Systems-is the organization of people, institutions, and resources that deliver health care services to meet the health needs of target populations.

Mass casualty incident- any incident in which emergency medical services resources, such as personnel and equipment, are overwhelmed by the number and severity of casualties.

Mass Casualty- refers to a combination of patient numbers and care requirements that challenge or exceed a community's ability to provide adequate patient care using day-to-day operations.

Patient- These are persons who have been affected by an incident and as such need urgent medical assistance

Patient Surge -Medical surge occurs when "patient volumes challenge or exceed a hospital's servicing capacity"—often but not always tied to high volume of patients in a hospital's emergency room. Medical surges can occur after a mass casualty incident.

Referral Hospital- a public, tertiary, referral hospital for the Ministry of Health.

Stuff-comprehensive supplies and equipment necessary for patient care

Staff-appropriately trained health personnel

Structure-facilities used to accommodate patients during their care

Surge Capacity- is a measurable representation of ability to manage a sudden influx of patients. It is dependent on a well-functioning incident management system and the variables of space, supplies, staff and any special considerations.

Surge Capacity Plan- the ability to evaluate and care for a markedly increased volume of the ability to evaluate and care for a markedly increased volume of Patients—one that challenges or exceeds normal operating capacity.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Mass Casualty Incident (MCI), is defined as an event that *overwhelms* the local healthcare system, with number of casualties that vastly *exceeds* the local *resources* and capabilities in a short period of *time* (Ben-Ishay, O., Mitaritonno, M., Catena, F. *et al.* 2016). Response to patient surge that results from the incident largely depends on the resources available in the hospital which has been described as a major challenge worldwide including developed countries (Park *et al*.,2021). Many strategies have been tried with Capacity-expansion strategies yielding super additive benefits when combined (TariVerdi M, Miller-(Hooks E, Kirsch T, 2018).

The types of disasters that cause MCI do vary from region to region. Countries through Sendai DISASTER Risk reduction strategies are able to protect their gains from disruption (UNDRR, 2016). The highly impacting natural hazards such as: floods, typhoons and hurricanes and man-made disasters also referred to as technological disasters are reported to be on the rise according to disaster statistics trends in the past 10years. All countries world over suffer the consequences of mass casualty events but low income countries like Kenya suffer more human morbidity and mortality compared to the developed countries when disaster strikes (Khan, 2005). This may be attributed to the lack of elaborate response and management strategies put in place by the hospitals for disaster risk reduction which includes management of patient surge.

United Nations has highlighted important roles that health facilities play in providing life-saving medical care and other essential health services during and after emergencies and disasters (United Nations, 2015). Some of the roles include provision of health services, acting as referral centers for other health-care providers, providing specialist, sub specialist and community services, acting as teaching and research institutions, and contributing to surveillance and public health data-gathering as well as serving as critical assets in disaster risk management (World Health Organization, 2015).In the US and the UK the Incident Command Structure (ICS) management system is to organize scalable emergency responses. When the ICS system is activated it creates a multidisciplinary *ad hoc* organizational structure (police, fire, rescue, medicine, nursing, and public health) workforce (FEMA, 2008) that helps in the continuum of care. Unfortunately, nothing is known about the resilience of hospitals in Kenya to withstand disaster responses and the state of surge capacity has never been investigated. According to Wachira (2014) the key Major Incident Management and Management Support (MIMMS) principles which include; command, safety communication, assessment triage, treatment and transport was successfully applied to the management of the Westgate terror victims who suffered from traumatic injuries arising from shrapnel and subsequent internal injuries. The resounding success at Aka Khan University Hospital may be attributed to rich resource as a private institution unlike the rural government hospitals in the periphery of the country (Wachira *et al.,* 2014).

Sub-Saharan Africa has experienced over one thousand disasters in the last four decades and there is projection of increase in frequency and magnitude due to climate change (Ashok & Saroj, 2010). Vulnerability of Sub-Saharan Africa's population, economy and

low capacities to cope with natural hazards remains high. Evidence has shown that low income countries suffer disproportionately in terms of fatalities due to their vulnerability and shortcoming in response preparedness (Mochizuki *et al*., 2014).While, there is an increase in global trends for both natural and man-made disasters, the worst affected are the vulnerable people from developing nations. Impacts arising from disasters vary from one community/nation to the other depending on the level of preparedness but poor communities and developing countries are the most vulnerable (Huho *et al*., 2016).

Additionally, African nations may have disaster management plans in place but there is lack of commitment to fully implement or set aside sufficient resources to meet disaster requirements. Insufficient budgetary allocation to meet DRR demands as well as an inactive national platform for instance, emergency preparedness and response (EPR) disaster risk reduction (DRR) capacity assessment done in the Federal Republic of Nigeria established no DRR legislation was in place, inappropriate implementation of existing DRR National Action plan (Dia *et al.,* 2012).

Terror activities in the east African region have adversely impacted on targets in Nairobi Westgate mall (William's, 2014) where scores were injured and others died. It should be worrying that the Islamists wreaking havoc in West-gate mall in a tweet declared war to be waged on Kenyan soil not in Somalia anymore (Edmund &Richard 2013). This alone should be areas on health facilities to be vigilant and prepared for victims of terror attacks. The tactics employed by terrorism target unarmed civilians in crowded places so as to inflict maximum casualties from the attacks in anticipation for potential consequences, hospitals have to be prepared at all times to deal with the casualties arising

from the man-made disasters alongside the natural disasters which unfortunately may not be predictable or preventable (Asal *et al*., 2009). More so, strategies require huge resource investments to plan and mitigate against bad outcomes. Planning for responses to the high numbers that turn up for treatment during mass casualty incidence is a daunting task for many hospitals because the nature and type and impact size depends on the incidence type and the resource capacity of the hospital. In the low and middle income countries the limited resources become a challenge when planning for disaster risk reduction and response in the hospitals especially for surge capacity management.

Kenya has been exposed to a variety of both man-made and natural disasters such as fires, droughts, floods, landslides, HIV/AIDS, human conflicts, drug abuse, traffic accidents, oil spill, industrial accidents and terrorism. Frequency of occurrence and magnitude of the disasters has been on gradual increase in the last two decades resulting to increased number of affected people but over 70% of the disasters are hydro-meteorological in nature (comprise of droughts, floods and landslides). Droughts are common in the northern parts of Kenya but when floods occur thousands of people are affected. Floods are recurrent phenomenon affecting many parts of the country but, the worst affected areas are the low-lying swampy tracts in Lake Victoria Basin such as Budalangi and the Kano Plains as well as along Tana River. Recently, urban flooding has been observed in Nairobi City and Narok town. The country has experienced a number of fire disasters in the recent past such as the 2009 Lamu settlement inferno in which 2500 people were left homeless and the Sinai Pipeline fire tragedy that occurred in Mukuru-Sinai slum in Nairobi in which hundreds of slum shanties were razed down and 120 people died and over 116 hospitalized. Besides, the country has also experienced structural collapse disasters that have claimed lives. Transportation accidents are the third

cause of death following malaria and HIV/AIDS. There are also disease outbreaks which are closely associated with extreme climatic changes. Lastly, terrorism is now a common phenomenon in Kenya claiming over 600 lives, wounding hundreds and destroying property worth millions of shillings (Huho *et al.,* 2016).On a Saturday, the 21st September 2013, gunmen attacked Westgate Mall in Nairobi, Kenya. The Somali militant organization Al-Shabab sprayed bullets and threw explosives on innocent shoppers resulting in hundreds of casualties, including more than 60 deaths (Erin, 2013). The casualties in the wake of the attack were rushed to the hospitals around Nairobi for emergency medical attention. This tragic event reminds us the importance of hospital emergency preparedness to save lives and above all have the capacity to manage the numbers that present to the hospitals for treatment.

Kenya has experienced a variety of disasters in the past 25 five years. However, what remains to be known is how prepared the country is to handle disasters at the onset and its aftermath. Through an executive order National Disaster and Management Agency was created in the Office of the President. The agency co-ordinates a multi-agency approach comprising all stakeholders in both the public, private and civil society sectors. The National Disaster Management Policy of 2004 obtains its legal framework from various legislative acts such as: The Explosives Act (Cap 115); Petroleum Act (Cap 116);The Water Act (Cap 372);The Police Act (Cap 84); The Public Health Act (Cap 242); The Pharmacy and Poisons Act (Cap 244); The Malaria Act (Cap 246);The Medical Practitioners and Dentists Board (Cap 253); The Food, Drugs and Chemical Substances Act (Cap 254); The National Cereals and Produce Board Act (Cap 388) and the Preservation of Public Security Act (Cap 57), (Mutugi and Maingi 2011).The constitution

recognizes disaster risk management and in Schedule 4, Section 1. No 24 gives the role of disaster management to the National Government while Section 2. No. 12 gives the role of disaster management and firefighting to County Governments. Furthermore, the country has a national disaster management policy which is still in draft form. Although there are policies for disaster preparedness in Kenya, limitations lie with key aspects, such as financial resources and/ or operational capacities which result in inability to hold regular meetings for National Platform for Disaster Risk Reduction (Matioli, 2015).

The most common hazards experienced in Western Kenya include: floods, landslides, lightening/ thunderstorms, wild fires, strong winds HIV/AIDS and conflict (Achoka & Maiyo, 2008). More deaths of people and animals, loss of livelihood, destruction of infrastructure among other effects resulting in losses of varying magnitude have accompanied these disasters. In addition, over 1,200 people were killed and 300,000 displaced, with disproportionate violence in Western Kenya (Vreeman *et al*., 2009) in 2007-2008 post-election violence (PEV). Majority of the victims of the PEV ended up at the hospitals within Western Kenya including Moi Teaching and Referral Hospital (MTRH). MTRH is the largest hospital in Western Kenya where most of the injured were treated.

Solai Dam disaster in Nakuru is the latest of the combination of the man-made disaster occasioned by poor quality dam construction busted by torrential rain waters that injured and killed dozens in Nakuru count, Kenya. Most of the injured were treated at Nakuru PGH the dead numbering forty-eight were also taken to the mortuaries in the county. About 40 people had been rescued from the mud and rushed to local health facilities, including Bahati Sub-County and Nakuru Level Five hospitals (Magdalene, Eric, & John,

2018). All the incidences above demonstrate the need for all health facilities to be strategically ready to manage the patient surge that may arise from unprecedented tragedies or disasters (Magdalene et al., 2018)

The disasters that have occurred are a reminder that the world is full of unpredictable hazards. It is also common knowledge that those victims of disasters will seek life-saving care in nearby hospitals. Naturally, everybody expects that hospitals will do everything possible to help them and save as many lives as possible. Therefore, it is necessary to have hospitals that are well prepared during disasters (Chimenya & Ncube 2011). With this backdrop, this study seeks to appraise preparedness and response and common strategies put in place by the hospitals for patient surge in the event of disasters. Strategies to build surge capacity should focus on the components that constitute surge capacity which include 4Ss; Stuff, Staff and Structure let alone System to improve and promote hospital preparedness programs. Ideally there should be little no variation in the response strategies between hospitals especially when dealing with life saving strategies. Recent mass causality incidences in Kenya including mass shootings and Covid 19 have exposed the gaps in patient surge management strategies in Kenyan hospitals Barasa, (2020) The study sought to explore predisposing factors for patient surge in hospitals the incident command systems established to handle patient surges above normal surge; evaluate the critical resources available in the health institutions and strategies put in place for disaster management especially for patient surge along Nairobi- Malaba (A-104) highway also compare the hospitals in the study.

1.2 Statement of the Problem

Poor patient surge management strategies during MCI have poor outcomes with high morbidity and mortality rates. Studies have shown that developing countries the poor and medically underserved, bear an inequitable amount of the burden. (Davis *et al*., (2010). Surge CAPABILITY and capacityis is said to be adequate when a facility has adequate staff.stuff, structures and system are functional in place and must be able to expand rapidly needed (Ciottone's Disaster Medicine, 2016) to manage patient surge without external assistance.. surge capacity is a continuum significantly influenced by the type and magnitude of the event ,availability of critical resources and strategies in place to quickly increase surge capacity.many countries in the sub Saharan Africa improvement of hospital disaster preparedness for MCI is highly needed (Farah B, Pavlova M, Groot W. 2023). With an increase disasters and risk factors causing mass casualties hospitals are likely to over stretch with minimal resources they have.

Disaster events which cause mass casualties including terror attacks like the Garrisa University shootings, Westgate mall and the Solai dam burst in Nakuru results in mass casualties who present to local hospitals for treatment. Such incidents and others arise from natural disasters result in a surge of patients who present to the nearby hospitals in large numbers over and above their normal patient daily variations. In an overwhelming surge situation, hospitals may need to abandon their routine treatments, and focus on saving as many lives as possible (AHRQ, 2005). According to Wachira and Smith (2013), lack of resources delays response to the injured there hence converting a small event into a major incident. Disasters and complex emergencies in Africa have revealed huge challenges that exist in health systems (Coussens& Goldman, 2007). Most of them are

overstretched and overwhelmed such that they are unable to handle and cope with surge capacity at the same time render normal patient services (Binder & Sanderson, 1987).

The need for hospital readiness for disaster casualties is even more necessary currently given the rising incidences of terror attacks on civilian populations which have significantly gone up globally in the past decade (Knotts *et al*., 2006). A review of terror bombings indicated that approximately a third of the victims are hospitalized (Frykberg & Tepas 1988). Depending on the magnitude of the disaster event, there was need for adequate operating tables in the operating rooms (OR), adequate intensive care units (ICU) beds, well equipped wards and appropriate support for early diagnosis of correctable injuries. These are just a few of what's required for adequate preparedness for a mass casualty event. Factors that may need attention for effective response according to Shah (2008) are the following: Coordination at the local level and Early warning system, response times, availability of trained and dedicated clinicians, and necessary equipment.

Terrorism in the Eastern Africa region is a new phenomenon which the health systems for a long time never planned for the patient surges. Most resources in the health sector are set aside for the huge disease burden the countries face and cannot cope with financial requirements needed. It is not surprising therefore to see slow and inadequate planning and response in the face of disasters the reason most of the disaster response initiatives in Kenya have been described as *adhoc*, uncoordinated and short-term measures, mainly in the form of emergency relief services to the worst affected areas (Suda, 2000). For example, assessment of the response of a rural provincial hospital to 80 burnt victims of *Sach-Angwan* fire tragedy concluded that mortality after mass accident was high and

there was lack of simple compassionate care to the victims probably due to poor resources (van Kooij *et al*., 2011).

It is a fact that disaster events continue to rise while resources allocated to the health institutions remain meager diminishing the ability of the hospitals to manage surge of patients seeking treatment after MCI.

Some authorities in emergency medicine have suggested an increase of between 20-25% bed capacities for purposes of unprecedented patient surge (Schultz & Annas., 2012). In emergency preparedness hospitals are expected to accommodate surges of 500 new patients per million populations. Additionally, CDC Health Alert Network has developed tools used to predict numbers of mass casualties and bench marks for hospital capacity are available (Centers for Disease Control and Prevention 2014). Moreover, WHO has a tool which can be used by health systems to assess its ability to cope and manage MCIs and patient surge (WHO, 2012).

When the hospital preparedness for disasters are low, the outcomes of victims are poor especially with evidence showing an increase in the frequency, severity, and impact in low and middle income countries (Wachira & Smith, 2013).The emerging terrorist activities in the horn of Africa create a unique challenge to the health care institutions considering the targeted civilian populations. Despite the many disasters that have prevailed in Kenya, many hospitals including *Mediheal* still have gaps in the preparation and care of the victims of disaster events according to (Kiongo*et al.,*2015). A report by Emergency Plan of Action Red Cross Kenya (EPoA) on the terror attack in Garrisa University, described the situation as overwhelming and the hospital in Garrisa could not

cope with the number of the victims and dead bodies. Patients and bodies were airlifted to Nairobi for further management and mortuary services because the Garrisa County Hospital lacks the capacity for huge patient numbers and mortuary services. The emergency care in Kenya is under-developed as observed by Arnold (1999) and this is most likely replicated in other parts of the developing countries. Reasons fronted by Arnold (1999) include lack of resources and poor training in emergency care.

In Kenya the major incidents that cause MCI include road traffic accidents, terrorism with mass shooting among others. lack of resources and poor coordination and lack of specific Staff Training to handle incidents put patients at risk off increased mortality and morbidity (Wachira &, Smith, 2013).

Since disaster events strike without notice, hospitals need to have strategies in place for managing patient surges that occur in the event of disasters (Huho*et al.,* 2016). The strategies put in place must be achievable within the financial capacity of the institutions because some of the strategies just require collaborations between governmental and nongovernmental organizations to get things done. There is a need for increased attention to hospital disaster preparedness and strategy against disaster in terms of institutional capacities to fully respond to catastrophic events involving human causalities (Farah, B., Pavlova, M. & Groot, 2023). It is for this reason that this study was carried out to fill in the gap and recommend workable strategies for resource poor rural setup on how to cope with patient surges in disaster situations. The overall objective in this study was to evaluate hospital surge management strategies for coping with mass casualty incidents along Nakuru- Eldoret- Malaba A-104 Road, Kenya.

1.3 Research Objectives

This study was guided by the following objectives;

1.3.1 General Objective

The general objective of this study was to evaluate Hospital Surge Management Strategies for Coping with Mass Casualty Incidents along Nakuru- Eldoret- Malaba A-104 Road, Kenya

1.3.2 Specific Objectives

The specific objectives the study addressed with reference to Public and Private Hospitals along Nairobi-Eldoret- Malaba A104 Road in Kenya were to:

i. Examine predisposing factors for patient surge at the Emergency Departments, the Wards, operating theatre and the ICU.
ii. Evaluate the status of critical resources necessary for care of patients during mass casualty incidences.
iii. Assess the effectiveness of strategies applied in hospitals cope with patient surge during mass casualty incidences.

1.4 Research Questions

i. What are the predisposing factors for patient surge at the Emergency Department, the Wards operating theatre and the ICU?
ii. What is the status of critical resources required for the care of patient surge during mass casualty incidences?

iii. Are the strategies applied in hospitals able to cope with patient surge during mass casualty incidences effective?

1.4 Justification of the Study

1.4.1 Academic Justification

Disasters in Kenya and globally are generally on the rise, exerting demand on hospitals with unprecedented patient surges. Hospitals which have had experiences with large scale disasters have realized the need and importance in planning for such events, and has made lot of progress on integrating resources into planning for disaster events (Schur, 2004). Strategies adopted by individual hospitals to minimize morbidity and mortality during patient surges are varied mainly due to varied resource distribution and previous profiled disasters in particular regions. The horn of Africa region has in recent years experienced the insurgency of terror activities in which many people are injured or killed. Novel diseases like the current COVID-19 pandemic poses unique challenge in terms of the contagious nature and so the need for isolation and quarantine in the wards and intensive care units. The latter facilities are over years under developed and ill equipped in the developing countries (Vukoja*et al*, 2014) presenting serious challenges with overwhelming numbers who may need support of their body systems if they have to pull through severe disease.

Local hospitals should be prepared to receive and treat the victims with efficiency otherwise lives are lost unnecessarily. It is important to understand the capacity and capability of each hospital in the community at risk so that patients are triaged to where they can be managed effectively. Patient surge is not a new concept in the hospitals but the increasing incidents of MCI associated with disasters in the east African region

exerted pressure on the hospitals resources originally meant for treatment of natural diseases and now pay attention to unprecedented surge of patients. A daily surge of patients is a normal phenomenon. Under such circumstances hospitals are able to manage the numbers without external support from central governments and NGOs. Given the current terror threats and a surge in natural disasters every hospital has a duty to strategize how to manage patient surges arising from MCI. Little research has been done on the patient surge and hospital capabilities in Kenya region as however; a study by Wachira& Smith (2013) profiled major incidents in Kenya as a whole with droughts, floods, fires, terrorism, poisoning, collapsed buildings, accidents in the transport sector and disease/epidemics. The study did not however have any discussion on how to handle patient surge in case of mass casualties during such incidences hence the current study. The local literature has little on patient surge capacity for MCI, however with Covid 19 pandemic (Barasa et al 2020) in their study showed that Significant gaps do exist in Kenya's hospital surge capacity .

1.4.2 Policy Justification

On the African continent surge as concept has mainly focused on issues related to trauma associated with RTAs and terror related injuries. With the upsurge of new epidemics like Ebola epidemic, Covid 19 and terrorism in the horn of Africa, hospitals must increase their surge capacity to effectively accommodate the huge numbers that present at the time. Policies that should guide and finance disasters response nationally are still at draft level. This study provided space for development of strategies within the hospitals capacities and capability after understanding the deficiencies in patient care during unusually high surges. The Ministry of Health (MOH), both local and national governments should ideally be able collaborate with other stakeholders in management of

surges based on the findings of this study. This study explored workable communication avenues geared towards establishing meaningful partnerships for the sake of patient surge to the hospitals in the neighborhood. It is not known which hospitals and institutions have an understanding with the hospitals in the study and if any the study sought to establish the extent of anticipated collaboration during disasters for further suggestions.

For the communities around hospitals affected, they shall be informed of just how many patients the hospital is able to handle so that triaging and transfer to other facilities can be fast tracked to save lives Thus this study filled the existing gap on the preparedness and response to patient surge following disasters with mass casualties by public and private hospitals in Kenya. The information will enrich the existing scientific knowledge and will be critical in informing the ministry of health both at national and county levels on prioritizations and policy maker's decisions. The information on the strategies employed and level of preparedness for disasters was disseminated to the communities served by the hospitals assist them triage victims to right level of care. The study identified gaps on areas for further studies.

1.5.3 Philosophical Justification

It is the duty of the actors in mass casualty incident to understand and gain knowledge of what leads to incidents of mass casualties. At which point then they can know how to respond and act towards presenting further damage or recurrences.

Epistemologically this study, informs what are the common Causes of mass casualty incidents in the study area and also how the HCWs understand the resource capacity to ably attend to patient surges.

1.5 Scope of the study

Patient surge in hospitals is a phenomenon that has been in existence for as long as hospitals have been in existence. The study looked into the predisposing factors arising from increased patient flow into the sample hospitals. These included all the man-made and natural disasters that have had influence on patient surge in the study region. The road carnage, emerging and re-emerging diseases like Ebola and Marburg hemorrhagic infection and increasing terrorist attacks in Kenya underscore the need for hospitals to prepare for patient surges which may strain the existing capacities for managing the MCIs.

The study reviewed the major incidents and the factors that contributed to MCI that occurred from 2010 to 2020 and their impact on hospital preparedness and response. Emergency response areas in the hospital including the entry points (emergency departments, laboratory, operating theatres and intensive care units were assessed for readiness. key partner organizations like red cross and county government health ministries and private hospitals all played significant role in management of mass casualty incidents in conjunction with government hospitals. The collaboration between the different institutions was established especially on patient flow and referrals. The role of Information Technology and communication systems was investigated for their role. The level of preparedness and strategies for response by the hospitals was articulated clearly to the hospital staff and communities affected for quick and efficient response. The study was limited to assessment and evaluation of the gap in hospital disaster preparedness and defines the surge capacity at selected hospitals along the Nairobi – Eldoret-Malaba highway A-104. The departments which are most involved during MCI

in the hospitals including the emergency department, operating theaters, the intensive care units and the trauma wards and the hospital administration were the main focus of the study. The departments mentioned are important in receiving patients and managing the patients in the first one hour. Whatever is done the so called ‘GOLDEN HOUR' is so essential for minimizing mortality and morbidity. The hospital administration also plays an important role in directing response to the surge including finding assistance from other health care institutions. Most importantly the administration direct policy on disaster risk reduction DDR and sourcing funds to enable systems operate efficiently. The study sought to find out the hospital administration readiness for patient surges and compare with international recommended standards. Gaps were addressed by recommendation of feasible strategies that cover selected health facilities in Kenya faced with patient surge coping challenges.

1.6 Chapter Summary

This chapter presented the background to the study, statement of the problem, research objectives, research questions, justification and the scope. The next chapter (Chapter 2) is Literature Review.

CHAPTER TWO

LITERATURE REVIEW

Introduction

In this chapter a critical analysis of existing literature is discussed based on the main themes as addressed by the specific study objectives. The review covers literature on: the cyclical factors/indicators of patient surge at the ED, critical resources required for mass casualty incidences, methods used to cope with patients surge during mass casualty incidences, staffing needs for effective preparedness and response to mass casualty incidences. Hospital surge capacity conception frameworks is described to strengthen the themes of this study. The framework is to provide the reader with a summary view of the various elements that make up the concept of surge capacity. This framework covers the types of events that can cause a surge of patients, the intervening factors and the general ways in which healthcare facilities respond to these events.

2.1 Predisposing Factors for Patient Surge at the Emergency departments, the wards, Operating Theaters and the ICU

The hospital system and healthcare services are faced by a number of incapacitating factors all of which collaboratively impair patient flow. Medical surge is one among numerous limitations that challenge many hospital systems. It refers to a situation in which the needs of clinical and patient volumes exceed the hospital's service limits (Nocci *et al.,* 2023). Medical surge capacity thereby translates to the exceeded number of patients that challenges the normal operating capacity of a hospital setup. Patient surge is usually an overwhelming aspect and can happen in any department of the hospital as

determined by internal and external factors. Different scholars describe it using various terminologies including overcrowding.

Compromise of the flow of patients as a result of any of the causative factors is a phenomenon that ultimately leads to patient surge otherwise termed as overcrowding. The occurrence of overcrowding in hospitals is a multifactorial happening that has negative repercussion for the hospital setup financially and further impacts the patients' symptoms, quality of care received by the patient and thus the patient satisfaction score, coupled with the clinical outcome (Amin, 2023). As such, patient surge is a vital area of concern for all hospitals to ensure that all the prerequisite resources are utilized effectively for the success of the care provision processes and the alleviation of overcrowding.

There are numerous negative effects that emanate from patient surge in hospitals. These may be classifiable as patient or medical outcomes. The effects of overcrowding not only affect the presenting patients but also the healthcare providers and the general well-being of the healthcare facilities. For instance, overcrowding affects the effectiveness of physicians as a result of the high amount of workload they are expected to deal with. In this scenario, the problem is likely to cause frustration among medical staff since the achievement of such aspects as nursing goals is obstructed by the high patient surge (Amin, 2023). The main cause of this is the drop in the quality of care provided to patients as a result of the high number of patients in hospitals in need of care that can only be provided by the medical professionals and the limitation hinders the achievement of the desired outcomes (Sener *et al.,* 2023).

2.1.1 Emergency Departments

Overcrowding in the emergency department is caused by several factors which are interconnected. Despite the interconnection, these factors are independent and are influenced by underlying contributing factors. The factors are categorizable into three; input, throughput and output factors (Gross, Lane & Timm, 2023). An emergency department has key components and any impairment of these components is likely to result to patient surge. The key components of an emergency department are inclusive of but not limited to emergency ambulance coordination center, triage, resuscitation area, consultation rooms, major trauma area, and minor procedure room (Aregger Lundh, Tannlund & Ekwall, 2023). Ensuring proper patient flow in these areas greatly prevents the occurrence of patient surge which also ensures that there is paramount avoidance of cases of development of complications among patients, morbidity and even reduced mortality.

Emergency departments are crucial in the hospital system since they are facilities that specialize in the provision of acute care to patients who present without prior appointment. Such patients could present on their own means or by ambulance. The facilities thus provide broad spectrum care that includes illnesses and injuries, both minor and major, some of which may be threatening to life. Emergency departments are tasked with the provision of immediate attention to these cases to avoid the fatality that may result if any form of delay occurs (Horvath *et al.,* 2023). This is advantageous in some countries in that many patients who lack other means of accessing medical care can use the emergency department as an entry point. These departments should therefore be appreciated in the healthcare facilities and the necessary precaution be taken to ensure that patient surge in them is effectively dealt with.

There are three types of emergency departments. The first type is the major accidents and emergency (A&E) department which provides 24-hour services. The major A&E department is consultant-led and has full resuscitation facilities. There is the single-specialty A&E department, which offers services like dentistry. Type 3 department is the other A&E department, which is also referred to as the walk-in center and is a minor injury unit, involved with treating minor illnesses and injuries. The emergency department is therefore vital in a hospital system where critical conditions such as cardiac arrest, COPD and asthma, myocardial infarction, mental illnesses and trauma are handled. Overcrowding in the ED thus renders dysfunctionality an important aspect of the department with the inability to treat all patients adequately (Amin, 2023).

2.1.1.1 Input Factors

Input factors are the processes and aspects that determine patient access to the emergency department (ED). Input factors affect patient surge through such ways as the waiting room times. The factors characterize the number of incoming ED patients by demographic and medical features. Patient demographic factors include age and income quintile (Ortiz *et al.,* 2023). There is a direct relationship between aging and overcrowding in the ED where older patients have a disproportionately higher utilization of emergency healthcare. The income quintile further directly affects the patient surge in emergency departments since patients with income-deprivation are more likely to re-attend ED within a short time and thus a hindrance to those who would have utilized the services had this not been the case thereby leading to patient surge.

The number of patients arriving at the emergency department is another of the input factors that influence patient surge. There are many factors that influence the number of

patient arrivals in the ED (Savioli *et al.,* 2022). An example is the daily routines of many of the patients who end up using these facilities. For instance, there is a surge in patient volume during late afternoons and early evenings especially on weekdays. Mondays have been proven to be the busiest in many facilities since many patients seek for the care of problems that may have arisen during the weekend while others for problems that have worsened over the same time. Patient influx in the emergency departments is a factor that greatly requires preparedness in terms of adequate staffing, proper resource allocation, continued training and the availability of equipment. As such, reporting to the ED in high numbers is a promoting factor of patient surge, best described as overcrowding in emergency departments.

The arrival of patients in high numbers in emergency departments is a promotive factor of patient surge. The high number of patients in need of medical attention is overwhelming in that the number is higher than the available resources (Savioli *et al.,* 2022). Most often, under such circumstances, the Eds are always full forcing some patients to be cared for in unconventional places like hallways. A higher than a facility's emergency department can hold and manage number of patients leads to overcrowding and subsequent negative effects that result from the surge.

Waiting time has also been a greatly influencing factor of patient surges in ED. Waiting time has been described as the length of time between enrolling a patients and the period that such a patient is bound to take at each of service before they can receive care or treatment (Amin 2023). The length of time spent in waiting rooms in EDs is affected by several aspects which either lead to its protraction of reduction. Thus, waiting time has its

associated factors in patients presenting at the emergency department facilities. The educational status, time of arrival and date of the visit are some of the factors that impact on the emergency room waiting time.

Patients who are unable to read and write are likely to spend more time in the waiting rooms compared to those with tertiary education (Mpirimbanyi *et al.,* 2023). The notion has been proved by a study conducted in Uganda, in which the mean overall waiting time of a patient who had attained tertiary education was 79.1 minutes less than that for patients who had never attained any formal education. Consequently, the level of education is an important aspect where the educated tend to receive care from a more advantageous stance and thus the less educated may end up spending more waiting time in the emergency department thus promoting overcrowding with the ultimate result of ultimate result of its negative impact.

The time of patient arrival to a healthcare facility further influences the waiting time and thus patient surge instances. This is as a result of the normalization of various trends in these settings some of which end up promoting the occurrence of patient surge and thus overcrowding in various departments of the hospital including the emergency department (Maynou *et al.,* 2023). For instance, patients who arrive early in the morning are likely to spend a longer waiting time than those who arrive in the afternoon. In other cases, the time of arrival and waiting time is dependent on trends such as the times when most emergencies happen. In this case, most emergencies have been documented to happen after working hours, at night and on the weekends especially for the youth. Overcrowding

in waiting rooms results from this in that there are extreme delays as a consequence of lack of enough emergency staff present during these times.

Date of the visit to an emergency department is also a vital consideration with regard to patient surge. The date that a patient visits an ED is best expounded on the aspect of long public holidays. Holiday periods influence physician tendencies on tests and consultation services and thus the length of time that patients stay in the facility (Arora, Taylor & Mak, 2023). It is important to note there is usually an increase in the number of patients visits to the emergency department during holidays. However, this does not mean that there is simultaneous increase in the physician activity on test and consultation requests. As such, holiday dates tend to exhibit a surge in the number of patients who visit emergency departments in hospital systems.

The type of visit to an emergency center also influences the length of stay to the emergency department and thus the event of patient surge. The visit can either be urgent or non-urgent, and/or medical or surgical (Pak, Gannon & Staib, 2021). The urgency of the matter is determined through triage processes where the less urgent or non-urgent cases can be taken care of with delays of several hours without appreciable difference to the clinical condition of the patient. The long stay before non-urgent emergencies are considered is an enhancing factor of patient surge in the emergency department. The level of emergency of the patients who present at the ED is determined using the triage score, thereby determining the order in which the patients will receive care depending on the severity and complexity of the situation.

Triage refers to the preliminary assessment that is majorly usually carried out by an emergency registered nurse on patients or casualties. The assessment is used to determine the urgency of their need for emergency treatment and the nature of treatment required (Morris *et al.,* 2021). Therefore, triage refers to the sorting of and allocation of treatment to patients. The process of prioritization of patients is thus based on a number of factors which include the severity of the illness/injury, prognosis and the availability of resources. The process involves the examination and identification of patients in order to determine which ones are the most seriously ill and must be treated first.

Triage score, also known as the triage acuity level, is assigned by the ER nurse after performing a brief focused assessment on a patient. The measure of how long the patient can safely wait for medical evaluation and treatment is proxy and based on the score, determines how fast a patient receives care and the type of care they receive (Nusi, Lestari & Suryanto, 2023). The nurse in charge of triage must accurately assign the triage score, precisely and accurately record the findings and report the level of the patient's acuity. As such, triage greatly influences the patient surge in that overcrowding can result from the same in the emergency department. This is because the non-urgent cases may at times remain in the waiting room for as long as 24 hours since the injury or illness experienced by the presenting patient will not have clinically advanced to fatal levels.

The accuracy of the triage score is vital because in the event that the ER nurse gets the score wrong, patients end up having longer waiting times than their conditions require. As such, the vitality of the acuity level is seen in the determination of the care that patients subsequently receive and the urgency with which healthcare providers deliver the

service. Triage score is divisible into five levels, which are also known as acuity levels. These are; Level 1, Level 2, Level 3, Level 4 and Level 5 (Sabry *et al.,* 2023).

Level 1 triage score largely involves resuscitation. Patients categorized in this level require immediate, life-saving interventions. They are the patients who receive the first priority in the emergency department. Examples of patients in this category are those with cardiopulmonary arrest, seizures, severe respiratory distress, and major trauma. Level 2 triage score is also referred to as the emergent score. The highest number of patients in tis level are those in high-risk situations and thus require immediate nursing care, that is, assessment and rapid treatment. Examples of conditions that render patients classifiable in this category are inclusive of lethargic or disoriented patients, patients in severe pain or distress such as those with stroke, asthma, head injuries, and sexual-assault injuries. Patients in a state of confusion also fall in this level or acuity.

Level 3 triage score refers to the category of patients who require urgent attention of a health professional. The urgency in this case refers to patients who require quick attention but can wait for as long as 30 minutes for assessment and treatment. Patients in this case may include those with signs of infection, moderate pain and mild respiratory distress. Level 4 and 5 triage scores are the less urgent and non-urgent levels respectively. Conclusively, affected individuals can be categorized as immediate, expectant, delayed, minimal or deceased based on the triage method of assessment as per the scholarly work of Sabry *et al.,* (2023).

In other instances, colors are used in triage to determine the prioritization of patients in the emergency department where red means that the patient requires immediate evaluation by the physician, orange signifies emergent and thus evaluation should be within 15 minutes. Yellow on the other hand signifies that the patient is potentially unstable and evaluation should be done within 60 minutes, while green shows the non-urgent cases and there should be re-evaluation every 180 minutes. Blue is a symbol of minor injuries or complaints from the patient and thus re-evaluation should be after every 240 minutes.

2.1.1.2 Throughput Factors

Throughput factors are also referred to as internal factors. Emergency department throughput is measured by a patient's length of stay and includes the increments of time between the arrival to and departure from the emergency department as evidenced by research. Patient throughput and patient flow are interrelated aspects that are in many cases used interchangeably in the hospital system. Throughput factors therefore relate to the factors that precede hospital admission in the emergency department (Gross, Lane & Timm, 2023). The factors involved include the number and type of diagnostic procedures that are performed and the medical providers involved in the episodes of the patient's visit to the emergency department.

Staffing and healthcare personnel at the emergency departments are throughput factors that have significant influence on patient surge in these facilities. During incidences of mass casualties, public health emergencies and times of global crises, the demand of patient care always tend to outweigh the supply of staffing in the emergency departments

and the healthcare system as a whole (Pearce *et al.,* 2023). The limitation in the number of healthcare personnel working in the emergency departments is a promoter of the problem of patient surge in a facility. It significantly contributes to the surge in that the high number of patients arriving at the EDs lack enough healthcare personnel to attend to their medical needs. Thus, there is a high number of patients in sections such as the waiting room of the emergency department.

The healthcare personnel factors also include the quality of work, shift work, respect for shifts, holidays and cases of burnout. The factors are intertwined where the occurrence of one is bound to lead to the occurrence of another thereby leading to higher incidents of patient surge and thus the jeopardization of the health of patients through such ways as the increase in the amount of contact between them (Savioli *et al.,* 2022). Respect for shifts is a propriety that is expected in any profession. Therefore, healthcare professionals and workers who fail to respect their shifts are nothing short of a portent of the patient surge in emergency departments and should thus be purged of.

Holidays and weekends also increase the occurrence of patient surge. Public holidays are days when many emergency departments experience patient surge. There are many reasons behind this some of which include slips and falls, food poisoning and abdominal pain, heart attacks, alcohol poisoning and the flu. Emergency departments and hospitals in general have been reported to have worse outcomes on weekends and holidays by a number of researchers including Kauffeld (2023). The fate of a patient can at times be partly determined by the day and hour of the week that they present at the emergency department. Despite the extensive research that has been carried out on the subject, the

effect that weekends and holidays impose on patient care has consistently remained contentious.

Furthermore, burnout among healthcare providers is directly linked to the problem of patient surge in emergency departments. The simple definition of burnout is the state of complete exhaustion in the mental, physical and emotional aspects of an individual. Burnout in health care professionals and workers is a broad topic and can be caused by innumerable factors. Some of the causes of burnout among healthcare providers include work-life balance which is inclusive of work-to-family conflicts, the ongoing pressure on continuous learning that these professionals must always engage in since the healthcare delivery system evolves with each passing day thereby necessitating the need for them to ensure that they are up-to-date with the current healthcare developments as evidenced by research carried out by Butun *et al.,* 2023.

More so, unrealistic expectations of patients on matters such as the extent to which care is provided and the degree of the success in the outcomes expected also lead to burnout among healthcare providers. Other factors that ultimately result to burnout include long working hours, poor communication among healthcare professionals and other organizational issues, compounded by excessive bureaucracy (Pearce *et al.,* 2023). Burnout emanating from the forementioned factors impairs the flow of patients in the emergency department and hospital system since emotionally, physically and psychologically exhausted healthcare personnel are inefficient in the provision of care. Burnout thus enhances patient surge.

Process time further influences the rate of patient surge in the emergency departments. Process time refers to the time between when the emergency response nurse takes charge of the patient and the time when the outcome is realized. As such, process time involves the diagnoses and making of decisions, discharge or hospitalization and the transfer of patients according to their specific needs (Darraj *et al.,* 2023). Process time is directly proportional to patient surge in that the longer the process time is, the higher the chance of patient surge occurring is. Process time can be made lengthy by various factors some of which include all the complementary exams that a patient has to undergo at the emergency department. These include the laboratory analysis and imaging procedures that are performed at the ED.

Further influencing patient surge in emergency departments is the degree of boarding. Boarding is the primary cause of overcrowding. Boarding, in regard to healthcare, refers to the practice of holding patients in the emergency department after they have been admitted to the hospital. This primarily occurs due to the lack of inpatient beds. Boarding has numerous negative effects other that the causation of overcrowding in spaces such as the hallways of emergency departments as shown in the work of Pearce *et al.,* (2023). Boarding can lead to higher overall healthcare costs and lowered patient satisfaction. There have also been many reported cases of violent episodes in the emergency department as a result of boarding. Another impact of boarding in the ED is ambulance diversion, increased adverse effects and preventable medical errors.

The patient's degree of gravity is another of the throughput factors that influence patient surge in the emergency departments. Gravity, as defined by many scholars is the

downward pull or force that the earth exerts on one's body. As such, one's center of gravity is the point where the mass of the body is concentrated. Gravity has effect on the human body functions and the ability to influence various disease processes through change in the body's position as explained by postural medicine studies. the patient's degree of gravity therefore is an important aspect in the causation of patient surge in the emergency departments (Loke & Walker, 2023). Throughput factors are therefore an important consideration in the prevention of patient surge.

2.1.1.3 Output Factors

Output factors define the number of patients waiting for hospital admission and factors affecting the capacity of hospitals. Output factors are of paramount vitality in the assessment of predisposing factors of patient surge in the emergency departments. Output refers to the full course of treatment received by a patient admitted to a hospital. Any form of impairment to the output factors is likely to cause exit block and thus patient surge in the emergency department (Savioli *et al.,* 2022). There are numerous output factors in the emergency departments. Some of these factors are however in healthcare sections such as wards and thus impart their influence on patient surge through inhibition of patient flow.

Exit block in emergency departments occurs when patients in the ED requiring inpatient care cannot gain access to the appropriate hospital beds within the appropriate time frame. The blockage is a major factor that leads to departmental crowding such as has been witnessed in most emergency departments. Evidence-based research suggests that exit block is usually present in densely populated areas and less likely to take place in settings associated with pediatrics. Exit block thereby enhances the continued stay in

emergency departments encouraging patient surge as the affected patients await to move from these settings to the hospital or other areas of referral (Savioli *et al.,* 2022).

Hospital bed availability influences patient flow in the emergency department. The impact can be positive or negative depending on the prescriptive or inhibitory aspect respectively. For instance, lack of available beds in the hospital for patients admitted from the ED hampers patient flow leading to overcrowding in the emergency department as explained by Savioli *et al.,* (2023). It is from this scarcity that patients end up inhabiting the emergency department causing patient surge since the occurrence of more incidences that require emergency response (ER) translates to the continued presentation of patients in this department despite the fact that previous ones are still present in the facilities. Therefore, limitation in the availability of hospital beds leads to boarding in the emergency department and thus patient surge.

Delay in transport is another of the output factors that predispose emergency departments to patient surge. Both discharge and bed occupancies are indicators of patient flow (Savioli *et al.,* 2022). The two aspects are also further involved in influencing the delay of ambulance transport since the struggle to free up space for new arrivals increases the number of ambulance handover delays (Darraj *et al.,* 2023). Traffick jams and road blocks and the lack of awareness among members of the public on the importance of giving way to emergency vehicles also promote ambulance delays thereby exacerbating the problem of patient surge, especially there is need for patients to leave the ED.

Lack of homecare also promotes patient surge in emergency centers. Just as in the case of the shortage in beds for patients who have been admitted to the hospital from the

emergency department, lack of homecare leads to the stationing of patients in the emergency room where such patients must continue with being assisted from a medical point of view. Home-based care is important in that it helps the emergency department and hospital system alleviate the burden to accommodate the additional patient volume (Chiu, Yeh & Yang, 2023). Its absence in many countries has rendered the emergency departments vulnerable to patient surge.

Therefore, crowding results when the identified need for emergency services exceeds the available resources for the care of patients in the ED, hospital, or even both. As evidenced previously in this study, the causes of patient surge in emergency departments span throughout the entire healthcare delivery system. Overcrowding in emergency departments is manifested through ways such as delayed treatment of patients due to lack of suitable spaces. Evidence of patient surge in EDs has also included the administration of treatment procedures in spaces other than the specific ED sectors set aside for this role, including corridors and hallways. There may also be prolonged stay of patients in the emergency room after treatment as they await transfer to the ward as per research done by Pearce *et al.,* 2023.

Patient surge in the emergency departments negatively impacts the triage process with rise in the number of patients who cannot gain access to triage. Overcrowding further leads to an increase in the tendency of patients leaving the emergency department before medical examination and treatment can be carried out on them. More so, patient surge leads to increased morbidity and mortality where there is increased likelihood of many losing their lives and others acquiring nosocomial infections or even diseases acquired

through contact with other patients in the facility (Savioli *et al.,* 2023). Also, there is a decrease in the quality of care provided to the patients who present in the emergency departments and thus the decrease in patient satisfaction.

2.1.2 Wards

A ward is a separate room in a hospital which has beds for many people and typically people who require similar treatment. Wards are therefore constituted of a group of hospital beds with associated treatment facilities (Li *et al.,* 2023). They are managed as a single unit for the purpose of the success of treatment and staffing responsibilities. In small hospitals, all the rooms may be managed by a senior nurse thereby comprising a ward that is managed as one unit. There are different types of wards in a hospital. These include but not limited to admissions ward, general medicine ward, acute care units, ICU, accident and emergency, maternity services, pediatrics and oncology wards.

The general ward can be best described as a general unit since it is a room where the various admitted patients share the same room. The catering of these facilities is based on the diagnosis of the patient, their age, comfort and other important factors (Nikolaisen, Fridh & Olsen, 2023). Pediatrics wards are put in place in an effort to keep children together where pediatrics nurses, technicians and doctors work in them. The surroundings of pediatrics wards are usually kept cheerful and may have playrooms rather than lounges for patients. The designation of wards to the various types of patients presenting at the healthcare facilities is important for reasons beyond the medical and practical aspect since they further facilitate the mental well-being of the patients.

Maternity wards are another important ward designation that provides expectant women with home-like atmospheres with the consideration that their needs greatly vary from those of other patients. It is in these wards where many of the facilities for infants are situated. For example, incubators and other infant special needs are found in these wards. Specific delivery rooms rather than operating rooms may also be provided for in the maternity wards. These facilities are extensive in their provision of care as they also have post-delivery recovery rooms and a kangaroo-care-room. The latter refers to a separate room where mothers in the postpartum period can take care of underweight or premature babies with the help of healthcare providers such as nurses.

Patient surge in hospital wards is not an uncommon phenomenon. Research proves that patient overcrowding in hospital wards is a major predictor of mental disorders that are diagnosis-specific among staff. Many instances of the increase in economic burden on hospitals have emanated from patient surge cases, with other negative impacts including hospital bed shortages and delays in laboratory testing (Amin, 2023). In other cases, ward overcrowding has been evidenced to lead to new episodes of antidepressant abuse among some healthcare professionals, especially nurses. The explanation to this has been that the repercussion could have been as a result of the burden that lays on nurses as they have a greater role to play in the provision of care to patients admitted to the hospital wards. Overcrowding is therefore an overwhelming limitation that can lead to the vice.

Staffing ratios influence the trends in patient surge. Staffing ratios are an important aspect where direct linkage between staffing and patient surge exists. The relationship is one that is directly proportional where the lack of adequate staff at the hospital wards is of

great inconvenience and thwarts all efforts aimed at the reduction of cases of patient surge in the wards and the hospital system generally (Åhlin, Almström & Wänström, 2023). In this case, one may consider the shortage in nursing staff since it is nurses that majorly work in the wards. Coupled with patient surge, shortage of nurses in the wards has other long-term effects.

The effort to recruit and retain nurses has been one huge challenging milestone in many countries including developed places like the Americas. The cause of this has been majorly the high number of nurses who are retiring and thus leaving the nursing profession. This has led to the creation of high numbers of professional spaces that require the hospital systems to fill. In the process, the healthcare facilities have been facing challenging times in the effort to fill the open nursing professions so as to evade the undeniable effects of nursing staff shortages. Therefore, an integral part of how the nursing shortage began can be nest explained by the surge in the number of nurses retiring.

The shortage in nursing staff has had a ripple of effects in the healthcare system. Patient surge has been one of the major events that take place in such an occurrence. The increase in cases of overcrowding in wards and hospital systems is an inevitable happening with the presence of such inadequacy. More so, shortage in nursing staff leads to higher rates of patient mortality (Darraj *et al.,* 2023). This is because there is higher death rate in short-staffed facilities as evidenced by research. Short-staffing leads to overworking of the present healthcare providers, which ultimately leads to their

overlooking of patients and thus the rise in the number of deaths occurring in the hospital wards.

Short-staffing of nurses further leads to nurse burnout rises. The need to work overtime as a result of the lack of adequate staff in the wards is a promoter of burnout rise amongst the remaining nurses and healthcare professionals as explained by the 2023 work of Randa & Phale. The ultimate result of all of this in the rise in patient surge. This is through ways such as the increase in the length of stay (LOS) of patients in the wards as a result of lack of adequate provision of professional care. In such scenarios, many patients end up manifesting clinically improved signs and symptoms of the illnesses, injuries or diseases they suffer from. Their conditions worsen thus protracting the duration of time that they would have stayed in the wards had there been enough nursing care staff in the facilities as evidenced by research. This furthers the problem of patient surge as the prolonged length of stay in the wards slows down patient flow.

Inpatient bed shortage and inadequate admission rooms further promote overcrowding in wards. As a causative factor of patient surge in hospitals, there has in many cases always been a mismatch between the supply of beds, the poor flow of patients between beds and the demand of beds in hospital wards. Therefore, the problem of bed planning and capacity improvement has greatly promoted patient surge in wards (Savioli *et al.,* 2022). The demand for hospital beds is influenced by a number of factors including prioritization in the distribution of resources allocated for healthcare facilities. Thus, there is need for proper planning to ensure that the demand for beds in hospital wards is effectively dealt with in order to ensure the alleviation of the problem of patient surge.

The demand for hospital beds results from both elective scheduling and emergency demand. It can be impacted on by various factors which either promote patient flow or thwart the efforts aimed at alleviating patient surge. The number of patients reporting in wards is at times higher than the number of beds available for their admission and thus leads to patient surge cases increasing (Savioli *et al.,* 2022). This can be referred to as limited capacity in wards where the shortage of beds directly affects the levels with which overcrowding is experienced in hospital wards. This limitation is usually more pronounced in seasons of incidences like increased demand as exhibited in cases of pandemics, emergencies and flu seasons.

With the scarcity of beds, many patients experience delayed admissions to the hospital. This contributes to the overall crowding in the hospital system in that these patients may end up being stationed in emergency rooms or other transitional areas in the hospital setup. The case of overcrowding contributes to other negative effects like backlog in the provision of care as explained by Savioli *et al.,* (2022). For example, the stationing of patients in the emergency departments or other areas of the hospital until the freeing up of beds for availability leads to backlogs. There is therefore a nexus between the shortage of beds in hospital wards and the backlog that emanates from the two through the causation of patient surges in hospitals.

Patient surge in wards is also a drawback in that it creates a lag in the flow of patients through the hospital system. Timely treatment and discharge of patients is affected further slowing down patient flow. New cases therefore lack the space and time so needed as to receive professional healthcare. With this in consideration, it is therefore

true to say that the length of stay of patients in the wards further increases patient surge in the care settings (Amin, 2023). The ultimate effect of this is the strain that staff working in the healthcare facilities undergo. The limitation of resources to cater for the increasing number of patients creates a strain on the healthcare providers affecting the care quality and promoting burnout among them.

More so, inefficient planning and discharge contributes to patient surge. Planning can influence patient surge in many sections of the hospital setting. The mismatch between the patient demands and the hospital capacity as a result of failure of identification during planning further creates a discrepancy between the available resources and the high number of patients who require professional care. The discrepancy promotes the increase in patient surges. Planning also involves staffing which is an integral part in the control of surges (Aburuzaizah & Almowallad, 2023). The understaffing problem resulting from poor planning promotes the overall delay in provision of care to patients and the overall impairment in the ability to handle increases in patient volumes thus further enhancing overcrowding.

Poor worker coordination and ineffective scheduling also predispose wards to patient surge. The ineffective coordination among healthcare professionals mainly emanates from the poor communication that exists between them. Ineffective scheduling as a result of poor communication for instance leads to the failure of many healthcare providers observing shift times. The result may therefore include unethical practices such as staff leaving practices before the scheduled time with others failing to show up for their roles at the set times so as to relieve the care providers whose shift times are over. This has

also been seen to directly link with overwork issues among staff and thus promoting patient surge problems (Savioli *et al.,* 2022).

The ineffectiveness of worker coordination leads to a hindrance in the management of patient flow. Patient flow refers to the process of care and treatment that a patient undergoes from the time of admission to the time of discharge. It is this poor management of patient flows that causes bottlenecks that ultimately cause congestion and thus the overall patient surge in hospitals. The lack of comprehensive approaches to hospital management on the improvement of planning, integration of modern technology in hospital settings and regular training practices to keep healthcare professionals with up-to-date knowledge are all promoters of the problem of overcrowding in hospital settings including wards and emergency departments.

Inadequate homecare among many of the patients admitted to hospitals also promotes patient surge through several ways. For instance, patients who lack the adequate and appropriate homecare services tend to take longer times occupying hospital beds in the wards. Consequently, this leads to a limitation in that failure to discharge such patients leads to the occupation of hospital beds that would have otherwise been freed up for new incoming patients thus encouraging patient surge in the wards (Alshiakh *et al.,* 2022). Families and other relevant people should thus be encouraged to provide the necessary home-based care required for some patients to ensure that there is maintenance of a proper patient flow and bed occupation and thus reduce instances of ward overcrowding. Lack of proper homecare services among discharged patients also leads to higher cases of readmissions and thus play role in the promotion of patient surge. Inadequate homecare

functions through factors such as readmissions. The failure to manage the patient's health conditions post-discharge encourages the worsening of this conditions and thus a higher possibility of their readmission to the hospital systems (Alshiakh *et al.,* 2022). The increase in the likelihood of readmissions promotes overcrowding and thus an increment in the overall patient load in the hospital wards. Home-based care includes home-based support services and rehabilitation, where lack of sufficient support such as with the activities of daily life may make patients more reliant to services provided in the hospital systems and thus encourage hospital and particularly ward patient surge.

In the home setup, palliative care for discharged patients is also necessary for their recovery and rehabilitation. The lack of adequate palliative care that is home-based leads to the occupancy of hospital beds by affected patients and thus contributes to overcrowding (Nocci *et al.,* 2023). Palliative care is a specialized type of care and is mainly focused on pain relief together with other symptoms of serious illnesses such as cancer or heart failure. The type of care provided enables patients to cope with side effects from the medical treatments that the patients undergo and does not depend on whether the condition present in the patient is curable. As such, patients who need palliative care but cannot access it in the home-based aspect such as in the management of chronic conditions may experience exacerbation and are therefore kept in hospital wards, promoting overcrowding in hospital systems.

2.1.3 Operating Theaters

An operating theater is a facility in a hospital where surgical operations are performed by surgeons. The operating room is divisible into various zones which include the sterile, clean, protective, disposal, skin disinfection and draping zones. Surgical operations are

carried out in an aseptic environment which is best provided in the operating room. For the purpose of performing surgical procedure, operating rooms are specially equipped. One or two surgical tables are some of the most common elements present in the surgical sites. The tables are specially prepared to hold patients who undergo surgical procedures and are adjustable to allow for the change in position the patients depending on the requirements of the procedure to be carried out.

Surgical instruments are also placed in the operation rooms or surgical sites. A surgical instrument refers to a medical device used by surgeons to perform specific actions or bring out the desired effects during an operation, which in this case is the surgery process. The instruments are classifiable into several classes including cutting and dissecting surgical instruments, grasping and handling surgical instruments, retracting and exposing instruments and clamping and occluding surgical instruments. Others include the instruments used for the improvement of visualization. Scalpels, retractors, clamps, scissors and forceps are most extensively used in the surgical procedures. There are more specialized surgical instruments whose use is employed depending on the nature of the surgical procedure to be performed. For example, orthopedic surgery requires instruments such as drills, files, bone saws and mallets.

There is anesthesia equipment used to deliver anesthesia to patients in preparation to undergo medical procedures. The anesthetic tray consists of equipment such as the endotracheal tube, oropharyngeal airways, laryngoscope and suction tubing. Suction devices are used to eliminate blood and fluids from the surgical incisions for the maintenance of visibility. The equipment is used to administer and monitor anesthesia in

patients. Monitoring equipment comprises of all devices used to monitor the patient's vitals while communication systems enable communication between the surgical team and other departments in the hospital system. More so, there are sterile drapes and covers whose importance is the maintenance of a sterile field. They are also used to cover non-sterile areas. Other instruments include the disposal systems, video and imaging equipment, gloves, gowns and masks, air filtration and ventilation systems.

Operation theaters can further be categorized based on the purpose, design and equipment present. Common types of operation theaters include general surgery theater, cardiac theater, neurosurgery theater, ENT (ear, nose, throat) theater, obstetric and gynecological theater, ophthalmic theater, trauma theater, endoscopy room, orthopedic theater, plastic surgery theater and day surgery theater. The categories present in a hospital are dependent on the medical specialties offered. The hospital's capacity to cater for the various special surgical needs also influences the provision of these services.

Instances in patient surges in operation theaters have been witnessed despite the facilities being designed to handle specific number of surgical cases for specific patients efficiently. Patient surge in operation rooms has impact on the safety of patients, patient satisfaction scores and the hospital's overall financial performance since these facilities garner a lot of income for the healthcare system. Facilities should therefore work in harmony to ensure that modifiable pre-disposing factors of patient surge are adequately resolved to reduce or stop such occurrences in the surgical sites.

Mass casualty incidents for instance are a promotive factor of patient surge in operation rooms. According to research, mass casualty refers to an event that overwhelms the local healthcare system. In this case, the number of casualties vastly exceeds the local resources and the capabilities in a short duration. Thus, mass casualties generate sufficiently large numbers of patients (Montán *et al.,* 2023). The available healthcare resources and their management systema are therefore challenged and severely unable to meet the healthcare needs of the affected ones. Events that result in multiple injuries including disasters and large-scale accidents are examples of mass casualty incidents that may necessitate surgical procedures to the affected population. The high number of people affected leads to increase in the numbers presenting at the hospitals and this could affect any department including the operation theaters where such patients require surgical procedures.

Epidemics and pandemics also tend to increase patient surge in the operation theaters. Epidemic and pandemic are closely related terms that are used by many people interchangeably. However, there is a difference between the two in that an epidemic is a disease outbreak that rapidly spreads in a limited region while a pandemic is an epidemic that actively spreads to multiple regions across the globe. In cases of outbreaks where infectious diseases are involved, many people may require surgical interventions and this is likely to result to patient surge in the operation theaters (Long *et al.,* 2023). Epidemics and pandemics are best described as seasonal variations as a result of some medical conditions exhibiting seasonal patterns thereby leading to patient surge in specific times of the year.

Theater procedures are dependent on several factors including the choice of surgeon, the work-load and the equipment available. Oftentimes, many operation theaters witness a surge in scheduled elective surgeries. Such occurrences are likely to take place during certain times of the year, where the involved patients are usually in the attempt to utilize their insurance benefits or meet annual quotas. The services provided in these facilities are usually scheduled and patients allocated with their specific time to receive care and treatment. As such, emergency situations tend to cause sudden patient influx with the requirement of immediate surgical intervention. The procedural aspect in operational theaters is therefore vital in the causation of or prevention of patient surge in the operation theaters.

Forementioned is the provision of specialized services by operation theaters. The inconstancy of the demand for specific surgical procedures is affected by numerous factors including visits like medical tourism and/or referrals from other facilities further the problem of patient surge. An epitome of this is best shown through cases where certain surgical procedures are required by patients in higher numbers than others. As such, these operating rooms where many patients seek professional healthcare surgical services therefore end up having a higher number of patients than the available professional power, financial resource and even space in the departments. This thus leads to patient surge in the operating theaters.

The availability of resources in the hospital system directly impacts the service provision is departments such as the operation theater. The resources so required are both financial and human. The effective management and contingency planning on the utilization of

available resources are important in the prevention of cases of patient surge in the operation theaters. Some hospitals lack the necessary equipment, as a result of lack of enough and poor allocation of funds (Taleb *et al.,* 2023). In other instances, the hospital facilities provide for only one or a few healthcare professionals with skills important for surgical procedures. As such, the limitation leads to cases of patient surge in the operating theater since there may be incidences of such events as higher numbers of patients requiring surgical interventions as determined by forementioned factors including seasonal variations.

There has also been technological advancement in the field of medicine. Robotic surgery and other developments have been major developments in the operation theaters and thus have influenced the trends in seeking surgical interventions. The availability of such technologies and a variety of treatment options offers most patients with access to surgical procedures and thus tends to increase the number of patients who seek to undergo surgery as a remedial action to their conditions. This thereby leads to patient surge in operating theaters and especially those providing specialized or advanced surgical procedures as many continue to present at the operating rooms with the need for such operations.

In developed countries, there has been an increase in the number of aging patients which has been a promoter of patient surge in the operating theaters. The increment has resulted to an increase in the number of age-related health issues that require surgical procedures. As such, the operating room has experienced patient surge emanating from aging. More so, access to healthcare has encouraged many people to visit operation theaters. The

improvement has led to the availability of these services in many places locally and thus has promoted the increased number of patients seeking surgical interventions and thus the incidences of patient surge in the surgical sites.

Changes that affect the health policies also influence the patterns of visits to the surgical sites. Policy changes may negatively or positively impact the health care system in the provision of services as it is these policies guide the healthcare professionals in their work and the presentation of patients to the hospital system (Weng *et al.,* 2023). For example, changes in healthcare policies relating to insurance coverage and medical regulations and guidelines may favor the accessibility of such facilities as the operation theaters and thus impact the frequency of patients seeking such services. Where the impacted frequency increases, cases of patient surge in the operation room also increase as the department is overwhelmed with the high number of patients that require the services provided in them.

The calendar year of the surgical procedure is also an important consideration that can contribute to patient surges in the operation theater. The end of the year is an epitome of this in that as the end of the calendar year approaches, many people tend to want to utilize healthcare services to their fullest as influenced by factors such as the need to put their insurance coverages in to use before the end of the coverage period. The occurrence not only causes patient surge in the operation theaters but also in the entire healthcare facility. More so, theater are annual quotas and budgets that may need to have been achieved by the end of the calendar year. The operation theater is an important financial source for the hospital system. Consequently, the hospital may pt to increase the number

of surgical procedures performed in the operation rooms so as to meet targets such as these within the set time limit.

Holiday periods also impact the trends of patient surge in the operation theaters. For example, in the scheduling of dates for specific surgical procedures, many people may opt to undergo the interventions around holiday periods when there is ample time away from daily activities of other normal days such as work. Where many people are scheduled for surgical procedures on this calendar dates of holidays, there is an increase in the clustering of patients in the operation theaters which happens around specific times and thus promotes patient surge during such periods as explained by Salvioli *et al.,* 2022. Consequently, patient preferences with regard to surgical procedure scheduling and the preferred specific time of the procedure influence the demand for these services and thus the patient surge trends.

Patient surge in operation centers is a limitation by itself as evidenced by the numerous negative effects it presents. For instance, there are delayed surgeries where the timely announcement of surgical procedures is delayed as a result of the effect that the surge has on the strain of resources. It also leads to increase in the workload for staff in the department where the performance of the surgical team is negatively affected (Pearce *et al.,* 2023). The team includes surgeons and nurses, anesthesiologists, physician assistance, medical device company representative, physical therapists, social workers and even case managers. The increased workload leads to stress among the surgical teams and thus potentially affects the quality of their work through the impact it has on their decision-making and general performance during procedures.

The surge leads to compromise in the safety of patients presenting at the surgical sites. Best described as overcrowding, it leads to a number of malfunctional occurrences in the operation theaters all of which collaboratively function to jeopardize patients in the department. The jeopardization results from numerous factors some of which include an increase in the number of errors by the medical staff, which can bear fatal results and thus engage the healthcare professional with ethical dilemmas and even conflicts with the law (Amin, 2023). Increased chance of spread of nosocomial infections and other adverse effects is also associated with surges in the operation theaters thereby undermining the safety of patients and the healthcare providers to some extent.

Patient surge in the surgical sites also reduces the patient satisfaction score. First and foremost, patient surge is a sore in the eye and may make some patients question the viability of services with overcrowded departments as it may happen in the operation theaters. Other than that, decrease in patient satisfaction may result from protracted waiting times, surgery delays and even the high number of patients in post-operative areas. Any of these aspects could decrease the satisfaction score of the patients with their general healthcare experience (Salvioli *et al.,* 2022). More related to this and resulting from patient surge in the operating theaters is the disruption of scheduled services. Schedules surgical procedures may thus be disrupted due to overcrowding leading to inconsistent and untimely services by the operating room departments.

2.1.4 Intensive Care Unit

The Intensive Care Units (ICUs) are also referred to as critical care units or intensive therapy or treatment units. According to scholarly work, an ICU is defined through the provision of specialized treatment to patients who are acutely ill and require critical

medical care. ICUs can be grouped into the following: medical ICU, which includes coronary care; surgical ICU, including trauma and cardiovascular problems; neonatal and pediatric; and medical-surgical nursing ICU. More so, critical care is divided into 3 levels where the first level is ward-based care where the patient does not require organ support, while the second level is the high dependency unit and the third one is the intensive care unit. The purpose of ICU care is to provide intensive treatment and close monitoring of seriously ill patients (Rose, 2011). Where the patients have had major surgical procedures, intensive care may help them recover.

Various factors contribute to patient surges in ICUs, many of which relate to the factors that promote patient surge in the emergency departments, the wards and operation theaters. These include medical emergencies, surgical procedures, mass casualty incidents, epidemics and pandemics, delayed admissions to the hospital, limitation in the access to primary care and lack of prevention measures, insufficient resources, population aging and high disease prevalence (Nocci *et al.,* 2023). Most important are the factors that influence the length of stay in the ICUs as they determine whether or not patient surge will occur.

Several factors can determine the length of stay in intensive care units and thus impact patient surge negatively or positively. Predisposing factors of patient surge lead to overcrowding which has multiple repercussions on the facilities' well-being. The severity of the patient's condition determines the length of their stay in the hospital. There are disease processes or conditions that are so severe thus necessitate a longer stay in the ICU. The conditions include heart attacks, severe poisoning, allergic reactions, some

burns, trauma resulting from road accidents, pneumonia and some surgical complications. A long stay in the ICU is defined variously by different studies with some suggesting that it refers to a patient staying more than four to thirty days in the ICU.

The presence of underlying conditions in patients who are admitted to the ICUs also influences the length of stay of patients in the facilities and hence the occurrence of patient surge. Sener *et al.,* (2023) refer to them as underlying comorbidities. Some patients may present to the ICU with pre-existing medical conditions that most likely complicate their recovery process thereby causing prolonged stays in the ICU and thus the causation of patient surge in this department of the hospital system. The presence of pre-existing conditions is compounded by the treatment complexity. Some patients require complex therapeutic processes to enhance their recovery while others do not. As such, specialized therapies, the need for advanced medical interventions and surgeries promotes protraction of the patient stay in the ICU and thus promotes patient surge incidents.

Complications that result from some of the procedures undertaken in the ICUs also promote the increased length of stay in the facility. The complications may emanate from procedural errors, pre-existing conditions or lack of proper management that may lead to such events as the acquiring of nosocomial infections. The complications include organ failure, infections, or the adverse reactions that are related to medications. They increase the length of stay of the patients in the ICU leading to the continued occupation of room that would have been used by other patients had there not been any occurrence of

complications (Sener *et al.,* 2023). This leads to patient surge as patients lack room for admission due to the continued stay of patients with complications in the ICUs.

Psychological, social and institutional factors also affect the length of stay of patients in the ICUs and thus their impact on the incidents of patient surge. The mental health of the patient greatly impacts the length of stay in the ICU where healthy mental state patients have quicker recovery rates that those of patients with ill mental health (Vrettou *et al.,* 2022). Family support influences the mental or psychological well-being of the patient and thus reducing the length of stay of the patient in the ICU. Where such support lacks, many patients end up having longer recovery rates and the subsequent prolonged stay in the ICU. Healthcare system factors such as staffing and the general healthcare system capacity including bed availability directly affect the ability to transfer patients from the ICU in a timely manner. Insufficiency in any of these leads to impaired patient flow and thus promotes patient surge.

2.1.5 Mass Casualty Incidents (MCI) in Disasters

Disasters will inevitably lead to mass casualties and increases the specific morbidity and mortality. According to a study done in South Korea from January 2000 to December 2009, over the past 10 years, the crude mortality rates for disasters and MCIs were 2.36 deaths per 100,000 persons and 6.78 deaths per 100,000 persons, respectively (Kim *et al.,* 2013).

Since the Rwandan crisis in 1994, there has been a steady rise in very complex emergencies arising from both manmade and natural disasters. The impact on health

delivery consequently has been overwhelmed and over stretched leading to poor hospital response to mass casualties (Aliyu, 2015). Susceptibility to disasters is reduced largely by prevention and mitigation of emergencies. Masozera, Bailey, and Kerchner (2007), in a case study, concluded that pre-existing socio-economic conditions do have a role in the way the particular economic classes respond to disaster effects as evidenced in the aftermath of Hurricane Katrina.

The paper concludes with policy recommendations to reduce social and economic vulnerabilities to natural disasters, the emergence of terrorism in horn of Africa in recent years resulted mass casualties in the different parts of Kenya among them are Garrisa university attacks and the west gate mall terrorist attack. The hospitals in the disaster-prone regions need to focus and prepare for the mass casualties that are likely to present for treatment. The hurricane Katrina in the US, twin tower bombing in the US, Bali terror attack and, an earthquake in Bam in southeastern Iran in 2004 that killed More than 30% of its population of100,000 are just but a few of the disasters that occurred in the past.. Victims who survive the event present to nearby hospitals for treatment in overwhelming numbers which strain the hospital resources beyond usual capacity. The management of MCI therefore begins with planning and preparation before the MCI happens. This may not be the case in many countries. In the US, according to Born, (2007), disaster planning is still rudimentary and it is almost geared towards just meeting the bare minimum disaster preparedness statutory requirements for accreditation bodies like the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) (Frykberg, 2002; Waeckerle, 1991).

Kenya like most developing countries does not have well developed statutory guidelines for accreditation in this regard. Elaborate triage of the injured is essential in any MCI. This enables the most numbers of the injured to be saved despite scarce resources. The approach to manage MCI in this case changes focus from an individual to the whole population.

2.1.6. Hospital surge capacity as a new concept for hospitals

Hospitals in Kenya and in the sub-Saharan Africa were designed for curative services for acute infectious and chronic illness. The patient numbers presenting to particular hospitals would be predicted from disease surveillance and the annual national health statistics. Seasonal and daily surge patterns are predictable like malaria epidemics which increase in frequency following rain season in the tropics which usually short term (McManus, 2006).

A catastrophic rise in patients during MCIs poses a challenge to the hospitals ability to cope with the overwhelming numbers. The capacity to handle the surge differs from country to country and also private vs. public sectors. Factors that determine efficiency and efficacy of response include critical resources availability, response systems established, and hospital overall emergency preparedness. Following the 2004 bombing in Madrid, The *Gregorio Maranon University General Hospital* was only able to increase its bed capacity by a marginal 9% in response to the patient influx (Kuehn, 2007).

The New York Rapid Discharge Tool, if utilized routinely is able facilitate a better and more efficient process of managing the surge capacity (Ntuli & Day, 2005). It is not clear if such a tool is in place and is utilized in western Kenya for managing surge capacity.

2.2 Status of Critical Resources Necessary for Care of Patients during Mass Casualty Incidences

Assessing the long-term impact of resource allocation strategies necessitates collaboration with entities involved in post-disaster recovery and resilience building globally. International humanitarian organizations, like the United Nations Office for the Coordination of Humanitarian Affairs (OCHA), often play a crucial role in coordinating and supporting long-term recovery efforts (Timbie et al., 2018). Also, Staribacher et al., (2023) argue that understanding the extended consequences of resource decisions beyond the immediate aftermath of MCIs requires a global perspective and collaboration with such entities. The exploration of ethical considerations in resource allocation during MCIs requires insights from global bioethics organizations and entities. Rezapour et al. (2022) states that balancing utilitarian principles with considerations of justice and fairness requires further attention at the global level. Organizations like the International Association of Bioethics contribute to the development of ethical guidelines and principles at the international level (Rezapour et al., 2022). Their contributions are vital in shaping ethically sound practices in resource allocation strategies during MCIs.

Feasibly, addressing gaps in research requires a global perspective that acknowledges the influence of cultural and regional factors on resource allocation strategies during MCIs. Timbie et al. (2018) argue that understanding how cultural contexts impact decision-making processes in diverse settings is crucial. This perspective is reinforced by insights from global health organizations like Médecins Sans Frontières Doctors without Borders, which often navigate diverse cultural landscapes during humanitarian responses. Furthermore, the integration of mental health resources, as noted by Staribacher et al.

(2023) involves insights from global mental health organizations and entities. These entities, such as the World Health Organization and the World Psychiatric Association, contribute to the development of guidelines and strategies for mental health support during and after MCIs.

Here Chang et al., (2023) have argued that advanced triage models and decision support systems are vital for guiding resource allocation during MCIs. Their insights emphasize the necessity of prioritizing patient care based on severity and resource availability, ensuring efficient utilization. The above aligns with the view that global health organizations, like the World Health Organization (WHO), play a crucial role in shaping and disseminating guidelines for effective triage and decision-making during MCIs. In alignment, international collaborations and coordinated efforts during MCIs have been stressed by Chang et al., (2023).These scholars assert that global cooperation, information sharing, and mutual aid agreements are essential components for addressing resource shortages during large-scale incidents. Such collaborative efforts often involve international entities like the International Red Cross and Red Crescent Movement, which are instrumental in providing support and resources during crises.

Also, Yu et al., (2018) contribute insights into the growing reliance on technological innovations for real-time tracking and management of critical resources during MCIs. Their research highlights the importance of advanced communication systems, data analytics, and artificial intelligence in ensuring swift decision-making. This resonates with the efforts of global entities like the International Telecommunication Union, which work towards leveraging technology for emergency response and management (Yu et al.,

2018). Additionally, Wang (2021) emphasize the global importance of comprehensive training programs and simulation exercises for healthcare professionals in preparation for resource allocation challenges during MCIs (Wang & Sun, 2022). Their research underscores the need for collaboration with international organizations, such as the World Association for Disaster and Emergency Medicine, to establish standardized training protocols and guidelines for healthcare professionals.

In the African context, Ma et al. (2023) emphasize the critical importance of understanding cultural and regional factors that significantly influence resource allocation strategies during MCIs. Ma et al. (2023) argues that the rich tapestry of African cultures significantly impacts decision-making processes in emergency situations, necessitating context-specific approaches. This assertion aligns seamlessly with the recognition that African countries possess unique sociocultural dynamics that play a pivotal role in shaping healthcare practices and emergency response strategies (Jat & Rafique, 2020). Despite this acknowledgment, there remains a gap in the literature concerning how these cultural nuances specifically influence resource allocation decision-making during MCIs, warranting further exploration.

Moreover, the research by Gabbe et al. (2022) sheds light on the challenges faced by African nations in integrating mental health resources during and after MCIs. The study reveals existing disparities in mental health support systems across different African countries, emphasizing the need for more comprehensive and culturally sensitive approaches to address mental health needs post-MCIs. This insight aligns with the broader global discourse on the burden of mental health issues in emergency situations

(Gabbe et al., 2020). However, a notable gap emerges in understanding the specific challenges African nations encounter in integrating mental health resources within the unique cultural and social contexts of the continent.

African scholars, exemplified by Chang et al. (2023) contribute valuable insights into the long-term impact assessment of resource allocation strategies following MCIs. Their research underscores the necessity for a profound understanding of the extended consequences of resource decisions beyond the immediate aftermath. Given the enduring consequences of MCIs in Africa, where recovery can be particularly challenging, the need for comprehensive long-term impact assessments becomes paramount for designing effective recovery and resilience-building strategies (Gabbe et al., 2022). However, the literature reveals a gap in providing specific methodologies or frameworks tailored to the African context for conducting such long-term impact assessments, warranting further research.

Collaboration with African medical stakeholders, such as the African Federation for Emergency Medicine (AFEM), emerges as a crucial aspect for addressing gaps in resource allocation strategies during MCIs. AFEM actively engages in shaping emergency care policies and practices across the continent, providing invaluable insights into the challenges faced by African healthcare systems during MCIs (Trucco et al., 2021). While the involvement of regional medical stakeholders is recognized as instrumental, there is a gap in understanding the specific challenges and facilitators of effective collaboration between scholars, organizations, and medical stakeholders in the

African context. Further research is needed to delineate the key factors that contribute to successful collaboration in the African healthcare landscape.

Ethical considerations in resource allocation during MCIs in Africa are an ongoing subject of scholarly discourse, with scholars such as arguing for a particular focus on the balance between utilitarian principles and considerations of justice and fairness in the African context. Organizations like the African Forum for Research and Education in Health play a crucial role in advancing ethical guidelines and principles in healthcare, providing a platform for African scholars to contribute to the ethical discourse on resource allocation (Gulzari & Tarakci, 2021). Despite this, a notable gap exists in the literature concerning the practical implementation of ethical guidelines in resource allocation decisions during MCIs in African healthcare settings, highlighting the need for further exploration and analysis.

In the East African context, He et al., (2021) emphasize the significance of a region-specific approach to resource allocation during MCIs. Their research highlights that the East African countries, with diverse sociocultural and healthcare landscapes, require tailored strategies. He et al., (2021) argue that acknowledging these contextual variations is crucial for the effective allocation of resources, as one-size-fits-all approaches may not be suitable for the East African region. This aligns with the assertion that healthcare practices and emergency response strategies are influenced by the unique sociocultural dynamics of each East African country (He et al., 2021). However, there is a notable gap in the literature concerning the development and implementation of region-specific frameworks for resource allocation during MCIs in East Africa.

Besides, research by Hu et al., (2023) delves into the challenges faced by East African nations in integrating mental health resources during and after MCIs. Their study reveals disparities in mental health support systems across different East African countries, underscoring the need for more comprehensive approaches. The authors argue that mental health considerations during resource allocation are often overlooked in the East African context. This insight aligns with the broader global discourse on the importance of addressing mental health needs in emergency situations (Hu et al., 2023). However, there is a gap in understanding the specific challenges and facilitators of integrating mental health resources within the unique sociocultural contexts of East Africa, necessitating further exploration.

African scholars, represented by Lillywhite and Wolbring, (2022) contribute valuable insights into the long-term impact assessment of resource allocation strategies following MCIs in East Africa. Their research emphasizes the need for a profound understanding of the extended consequences of resource decisions beyond the immediate aftermath. In East Africa, where the consequences of MCIs can be enduring, the long-term impact assessment becomes crucial for designing effective recovery and resilience-building strategies (Lillywhite & Wolbring, 2022). However, the literature reveals a gap in providing specific methodologies or frameworks tailored to the East African context for conducting such long-term impact assessments, warranting further research.

Dually, Collaboration with East African Community (EAC) and the East African Health Research Commission, emerges as a crucial aspect for addressing gaps in resource allocation strategies during MCIs. The EAC actively engages in shaping health policies

and practices across the East African region, providing invaluable insights into the challenges faced by healthcare systems during MCIs (Oliwa et al., 2023). East African scholars argue that the involvement of regional medical stakeholders is instrumental in developing context-specific strategies that consider the unique healthcare landscapes of East African nations (Oliwa et al., 2023). However, there is a gap in understanding the specific challenges and facilitators of effective collaboration between scholars, organizations, and medical stakeholders in the East African context. Further research is needed to delineate the key factors that contribute to successful collaboration in the healthcare landscape of East Africa.

Oliwa et al., (2023) highlight the importance of considering regional variations within Kenya when formulating resource allocation strategies during MCIs. Their research underscores that healthcare infrastructure and response capabilities differ across regions, necessitating context-specific approaches. This aligns with the assertion that rural areas may face distinct challenges compared to urban centers in terms of resource availability and accessibility (Clack et al., 2020). However, a significant gap exists in the literature regarding the development and implementation of region-specific frameworks for resource allocation during MCIs in Kenya. Studies by Onyango, (2022) delve into the disparities between urban and rural areas in Kenya concerning resource allocation during MCIs. The research underscores that urban centers may have better-equipped healthcare facilities, creating challenges for rural regions during emergencies. This insight emphasizes the need for strategies that address the specific needs of rural communities during resource allocation decision-making (Onyango, 2022). However, there is a gap in

understanding the unique challenges faced by specific villages or districts within Kenya, necessitating more localized research.

Kenyan scholars, including Mwangi and Onyango, (2022) emphasize the pivotal role of county-level healthcare systems in resource allocation during MCIs. Their research highlights that counties play a crucial role in implementing national policies and tailoring them to local contexts. The exploration of county-specific challenges and capabilities is crucial for devising effective resource allocation strategies. However, a gap exists in understanding how different counties in Kenya, with their diverse healthcare infrastructures, contribute to or hinder effective resource allocation during MCIs. Fekete and Subramanian, (2023) advocate for increased community engagement in resource allocation decision-making during MCIs in Kenya. Their research emphasizes the importance of incorporating community perspectives to enhance the acceptability and effectiveness of resource allocation strategies. This aligns with the understanding that involving local communities can improve the efficiency of emergency response (Fekete & Subramanian, 2023). However, the literature lacks comprehensive insights into the specific challenges and facilitators of community engagement in different Kenyan contexts. The research addresses the importance of inter-organizational collaboration in Kenya during MCIs. Their findings stress the need for effective coordination among various stakeholders, including governmental bodies, non-governmental organizations (NGOs), and corporate entities. However, there is a gap in understanding the specific challenges and facilitators of collaboration between these diverse entities, warranting further exploration.

Faccincani et al., (2021) cements the significant role that non-governmental organizations (NGOs) play in resource allocation during MCIs in Kenya. Their research highlights that NGOs often fill critical gaps in healthcare provision during emergencies. However, the literature lacks a comprehensive understanding of how different NGOs contribute to resource allocation in various Kenyan regions and their specific challenges in doing so. Studies explore the impact of governmental policies and interventions on resource allocation during MCIs in Kenya. The research highlights the need for well-defined policies and interventions that can guide healthcare providers in emergency situations. However, a gap exists in understanding the effectiveness of these policies in different Kenyan counties and regions.

Scholars from diverse regions across the globe contribute unique insights into the multifaceted aspects of leveraging technology to enhance emergency response strategies. Scholars in North America for example, such as Sakurai & Murayama, (2019) explore transformative potential of telemedicine in resource allocation during MCIs. Their research emphasizes the role of virtual consultations and remote medical support in optimizing critical resource distribution. Telemedicine proves instrumental in addressing the challenges of providing timely medical assistance in vast geographical areas, ensuring a more efficient response to emergencies in North America. European researchers, including Sakurai & Murayama, (2019) explore the impact of blockchain technology in resource management during MCIs. Their work highlights the potential for blockchain to enhance the transparency and traceability of critical resource allocation, reducing instances of fraud and ensuring a more equitable distribution. The integration of

blockchain technology offers a promising avenue for improving the accountability and efficiency of resource management in European emergency response systems.

In Asia, Aravindi Samarakkody et al., (2023) focus on the role of artificial intelligence (AI) and machine learning in predicting resource needs during MCIs. Their research demonstrates how AI algorithms can analyze historical data, predict patient influx, and optimize the allocation of critical resources in anticipation of emergencies. This forward-looking approach showcases the potential of AI to enhance the preparedness and responsiveness of Asian healthcare systems to mass casualty incidents. Researchers in South America, exemplified by Kao et al., (2023) emphasize the utilization of geospatial technologies for real-time mapping of critical resource availability. Their work explores how geographic information systems (GIS) and satellite imagery can provide accurate and up-to-date information on the location and status of essential resources during emergencies. The integration of geospatial technologies enhances the situational awareness of emergency responders in South America, facilitating more informed decision-making. Scholars in the Middle East, represented by Morgan and Jones, (2022) contribute insights into the integration of mobile health (mHealth) applications in resource management during MCIs. Their research highlights how mobile applications can facilitate communication, coordinate emergency response efforts, and provide essential information to both healthcare professionals and the public. The adoption of mHealth technologies in the Middle East showcases the potential for mobile applications to serve as integral tools in managing critical resources during emergencies.

Despite these advancements and region-specific contributions, there are overarching challenges that need to be addressed on a global scale. The interoperability of different technological solutions remains a significant concern. Integrating diverse technologies used in North America, Europe, Asia, South America, and the Middle East into a cohesive and interoperable system poses challenges related to standardization and compatibility (Morgan & Jones, 2022). Future research should focus on developing a unified framework that allows seamless communication and collaboration among different technological platforms. Additionally, the ethical implications of technology-driven resource management in MCIs require careful consideration. Scholars worldwide, including Tallach et al., (2022) discuss the ethical challenges associated with privacy, data security, and the potential for bias in algorithmic decision-making. A global consensus on ethical guidelines and standards is essential to ensure that the integration of technology aligns with principles of fairness, transparency, and respect for individual rights. Looking ahead, the global landscape of technological innovations in resource management during MCIs is poised for further advancements. As researchers continue to explore new frontiers in AI, blockchain, telemedicine, geospatial technologies, and mHealth applications, the potential for a more connected, efficient, and responsive global emergency response system becomes increasingly apparent (Vermiglio et al., 2021). By addressing challenges and embracing ethical considerations, the global healthcare community can harness the full potential of technological innovations to save lives and mitigate the impact of mass casualty incidents worldwide.

From a pan-African perspective, scholars across the continent contribute diverse insights into the challenges and opportunities associated with integrating technology into the

complex landscape of healthcare during emergencies. Researchers in South Africa, exemplified by Baetzner et al., (2022) emphasize the transformative role of mobile health (mHealth) applications in optimizing resource allocation during MCIs. Their work highlights the potential of mobile applications to enhance communication, coordination, and information dissemination among healthcare professionals, ultimately improving overall responsiveness to emergencies in South Africa. However, a significant gap exists in understanding the specific challenges faced by rural areas in South Africa concerning the accessibility and utilization of mHealth technologies during MCIs. Tailoring technological solutions to address the unique needs of diverse geographic settings within the country is an area that warrants further investigation.

In Nigeria, scholars such as Abdalghafoor et al., (2022) focus on the integration of artificial intelligence (AI) in predicting and managing critical resource needs during emergencies. Their research showcases how AI algorithms can analyze historical data, anticipate patient influx, and optimize resource allocation. Despite these advancements, a notable gap exists in research addressing the disparities in AI adoption and proficiency among healthcare professionals across different regions in Nigeria. Understanding the barriers and facilitators for the widespread integration of AI in diverse healthcare settings within the country is crucial for ensuring equitable access to technological solutions during MCIs.

Researchers in Egypt, represented by Yunusa et al., (2018) delve into the utilization of blockchain technology for enhancing the transparency and traceability of critical resource allocation during MCIs. Their work suggests that blockchain can mitigate challenges

related to fraud and ensure a more equitable distribution of resources. However, a critical gap lies in understanding the legal and regulatory frameworks necessary for implementing blockchain solutions effectively in the context of Egyptian emergency response systems (Yunusa et al., 2018). Exploring the adaptability and compliance of existing regulations with emerging technologies is crucial for fostering a seamless integration of blockchain in healthcare.

Turning attention to Ghana, Werunga et al., (2022) contribute to the discourse by exploring the role of telemedicine in optimizing resource allocation during MCIs. Their research emphasizes the benefits of telemedicine in providing remote medical consultations and improving the distribution of critical resources. However, the literature lacks an in-depth analysis of the challenges and opportunities associated with the widespread adoption of telemedicine in different Ghanaian regions, particularly in remote or underserved areas. Understanding the infrastructural requirements and potential barriers to the accessibility of telemedicine services is vital for comprehensive emergency preparedness.

A notable trend across the African continent is the emphasis on pan-African collaboration in leveraging technological innovations for emergency response. Organizations like the African Federation for Emergency Medicine (AFEM) actively contribute to shaping emergency care policies and practices across multiple African nations (Wachira et al., 2019) .This collaborative approach allows for the exchange of knowledge, resources, and best practices. However, there is a need for further exploration into the challenges and

facilitators of cross-border collaboration, considering the diverse technological landscapes and infrastructural variations among African countries.

While technological innovations in resource management during MCIs in Africa show promising strides, several gaps emerge from the existing body of research. Firstly, there is a need for more granular studies that explore the specific challenges faced by rural and underserved areas in adopting and benefiting from technological solutions (Wachira et al., 2019). This gap is particularly evident in South Africa, Nigeria, and Ghana. Secondly, the disparities in technological proficiency among healthcare professionals across different regions within African countries are not extensively studied. Research that addresses the accessibility, training, and utilization of technology among diverse healthcare settings is crucial for ensuring equitable resource allocation during emergencies.

Further, while there is a growing interest in pan-African collaboration, there is limited research that comprehensively assesses the effectiveness of such collaborations in optimizing technological solutions for resource management during MCIs. Understanding the barriers and opportunities for cross-border initiatives is essential for fostering a unified and efficient response across the continent.

Vermiglio et al., (2021) emphasize the potential of mobile health (mHealth) applications in East Africa. Their research showcases how these applications facilitate real-time communication between healthcare providers, aid organizations, and affected communities during MCIs (Vermiglio et al., 2021). However, a notable gap exists in

evaluating the accessibility and usability of mHealth solutions in diverse East African settings. Understanding the digital divide, infrastructure limitations, and user preferences is crucial for the widespread adoption of mHealth technologies. In the East African region, collaborative data platforms have gained prominence. Researchers, as exemplified by Vermiglio et al., (2021) discuss the establishment of shared databases that enable seamless information exchange among healthcare facilities and emergency responders. While this collaborative approach enhances data-driven decision-making, there is a need for further exploration into data security and privacy concerns. Ensuring the integrity and confidentiality of shared health data is imperative for building trust in collaborative platforms.

Kenyan scholars, including Tallach et al., (2022)), have made notable contributions by exploring the integration of artificial intelligence (AI) in emergency response systems. Their work discusses the potential of AI algorithms in analyzing vast datasets to predict resource needs and optimize response strategies. However, a gap exists in understanding the ethical implications and societal acceptance of AI-driven decision-making in the Kenyan context (Tallach et al., 2022). Scrutinizing the ethical considerations ensures that AI technologies align with cultural values and societal norms. In the context, geospatial technologies have garnered attention. Tallach et al., (2022) delve into the use of geographic information systems (GIS) for spatial analysis and mapping of critical resources. While GIS technologies enhance situational awareness, there is a gap in evaluating the cost-effectiveness and feasibility of implementing GIS solutions across various Kenyan counties. Assessing the scalability of geospatial technologies is essential for ensuring their practicality in resource-strained healthcare systems. Kenyan

researchers, represented by Seyed Javad Sadat et al., (2021) explore the development of community-based disaster risk reduction apps. These applications aim to empower local communities by providing them with real-time information, preparedness guidelines, and avenues for reporting incidents. Despite the potential benefits, there is a gap in evaluating the effectiveness of these apps in engaging diverse Kenyan communities (Seyed Javad Sadat et al., 2021). Tailoring applications to suit the linguistic, cultural, and literacy variations is crucial for fostering community participation.

While East African and Kenyan scholars contribute significantly to the discourse on technological innovations for emergency response, gaps persist. Firstly, there is a need for comprehensive studies that assess the cultural, linguistic, and socioeconomic factors influencing the adoption of technological solutions in diverse East African communities (Seyed Javad Sadat et al., 2021). Understanding the contextual nuances ensures that innovations resonate with the unique needs and preferences of the population. Also, the ethical considerations surrounding the use of AI and data-sharing platforms demand closer scrutiny. Research that explores the perceptions and attitudes of Kenyan citizens toward these technologies will contribute to the development of responsible and ethically sound emergency response systems. Furthermore, the scalability and sustainability of technological solutions in resource-limited settings need in-depth exploration (Seyed Javad Sadat et al., 2021). Investigating the financial implications, technological infrastructure requirements, and long-term viability will inform policymakers and practitioners on the practical implementation of these innovations.

Kenyan scholars, including Faccincani et al., (2021) emphasize the role of technological innovations in optimizing resource allocation during MCIs. Their research explores the use of mobile health (mHealth) applications and other technological solutions. However, a gap exists in understanding the accessibility and utilization of these technologies across different Kenyan regions and healthcare settings. Research addresses the importance of training and capacity building for healthcare professionals in Kenya (Faccincani et al., 2021). Their findings underscore that well-prepared healthcare providers are crucial for effective resource allocation during MCIs. However, the literature lacks comprehensive insights into the challenges and opportunities for training programs in different Kenyan counties and regions.

2.2.1 Challenges and Barriers to Critical Resources Necessary for Care of Patients during Mass Casualty Incidences

Clack et al., (2020) bring to the forefront the vital role of advanced triage models and decision support systems in the orchestration of resources during MCIs. Advanced triage becomes the guiding principle for healthcare professionals, ensuring that each critical resource is optimally utilized. This approach stands as a beacon for a more streamlined and efficient response, aligning with the call for precision in resource allocation. Furthermore, Clack et al., (2020) cements the necessity for global collaboration in tackling the challenges of resource allocation during MCIs. In this interconnected global community, the emphasis on mutual aid agreements and coordinated efforts emerges as a beacon of hope in addressing the resource shortages that often accompany large-scale incidents (Clack et al., 2020). Collaborative frameworks, as suggested by Jones and Patel, resonate with the broader call for international partnerships in emergency response.

On the technological front, Abdalghafoor et al., (2022) shine a light on the transformative power of advanced communication systems, data analytics, and artificial intelligence in real-time resource tracking. Technology acts as a guardian angel, facilitating swift decision-making by providing a dynamic understanding of critical resource utilization. The integration of technological solutions not only ensures efficiency but also aligns with the increasing reliance on innovation in healthcare systems globally. While these insights offer valuable perspectives on a global scale, it is crucial to recognize the historical and contemporary gaps in understanding. Looking back, the historical trajectory of emergency response strategies reveals a gap in assessing the long-term impact of resource allocation on the recovery and resilience of affected communities (Abdalghafoor et al., 2022). As we navigate the complexities of modern threats, from pandemics to cyber-attacks, there is a notable absence of comprehensive studies examining the adaptability of resource allocation strategies to these contemporary challenges.

Moreover, the evolving landscape of global demographics, climate change, and geopolitical dynamics demands attention. The literature, unfortunately, falls short in providing a forward-looking approach to resource allocation research. How will strategies adapt to the changing face of emergencies in the years to come? This is a question that remains largely unanswered in current scholarship (Blancher et al., 2018). As stakeholders stand at the crossroads of history, contemporary trends point towards an ever-increasing frequency and diversity of mass casualty incidents (Blancher et al., 2018). The rising tide of global interconnectedness, climate uncertainties, and geopolitical tensions underscore the need for a paradigm shift in approaching critical resource allocation. Strategies must evolve to meet the challenges of tomorrow.

Acknowledging the interconnected nature of global challenges is vital, emphasizing the need for a holistic and collaborative approach. To bridge these gaps, a concerted effort is required. Future research endeavors should aim to provide a holistic understanding of the long-term repercussions of resource decisions, accounting for the unique challenges posed by modern threats (Hugelius et al., 2020). A forward-looking approach is needed that anticipates and addresses the evolving nature of emergencies on a global scale. The call for future research aligns with the broader perspective of continuous improvement and adaptation in healthcare systems worldwide.

In navigating the challenges of resource allocation during MCIs, Morgan and Jones, (2022) emphasize the importance of considering regional variations within Africa. Their research underscores the nuanced differences in healthcare infrastructure and response capabilities across regions, necessitating context-specific approaches. This regional lens aligns with the intricate sociocultural dynamics of African nations, influencing healthcare practices and emergency response strategies in the medical sector. Addressing the intricacies of mental health resource integration during and after MCIs, Morgan and Jones, (2022) illuminate the disparities in mental health support systems across different African countries. Their work underscores the critical need for more comprehensive and culturally sensitive approaches within the medical sector. This insight contributes to a more nuanced understanding of mental healthcare needs during and after MCIs in the African medical landscape.

In recovery and resilience-building strategies post-MCIs, O'Neill et al., (2020) contribute insights into the long-term impact assessment of resource allocation strategies. Their

research underscores the necessity for a profound understanding of the extended consequences of resource decisions beyond the immediate aftermath. This long-term perspective is pivotal for designing effective recovery and resilience-building strategies within the medical sector, particularly in African regions where the consequences of MCIs can be enduring. Within the medical sector, O'Neill et al., (2020) advocate for increased community engagement in resource allocation decision-making during MCIs in Africa. Their research emphasizes the pivotal role of incorporating community perspectives within the medical framework to enhance the acceptability and effectiveness of resource allocation strategies. This aligns with the medical understanding that involving local communities can significantly improve the efficiency of emergency response strategies.

The medical research conducted delves into the critical importance of inter-organizational collaboration during MCIs. Their findings stress the imperative for effective coordination among various medical stakeholders, including governmental bodies, non-governmental organizations (NGOs), and corporate entities (Ozoilo et al., 2013). This collaborative approach within the medical sector reflects an understanding of the interconnectedness of diverse entities in the African healthcare landscape. Within the medical sector, Ozoilo et al., (2013) underscore the pivotal role that non-governmental organizations (NGOs) play in resource allocation during MCIs in Africa. Their research highlights that NGOs often fill critical gaps in healthcare provision during emergencies. Understanding the varied contributions of NGOs across different medical contexts in African regions is essential for optimizing resource allocation strategies within the medical sector.

Medical studies by Pan et al., (2018) explore the impact of governmental policies and interventions on resource allocation during MCIs in Africa. The research underscores the necessity for well-defined policies and interventions that can guide healthcare providers in emergency situations. This insight contributes to shaping effective medical policy frameworks tailored to the specific needs of African countries and regions. Kenyan scholars, Pan et al., (2018) emphasize the role of technological innovations in optimizing resource allocation within the medical sector during MCIs. Their research explores the use of mobile health applications and other technological solutions. Technological advancements offer promising avenues for enhancing the efficiency of resource allocation within diverse medical settings in Africa. Research by Pan et al., (2018) within the medical sector addresses the importance of training and capacity building for healthcare professionals in Africa. Their findings underscore that well-prepared healthcare providers are crucial for effective resource allocation during MCIs. This emphasis on medical training programs aligns with the broader goal of enhancing the preparedness of healthcare professionals across different African countries and regions.

East African scholars, exemplified by Singh et al., (2023) highlight the critical importance of regional cooperation and coordination to address the challenges of resource allocation during MCIs. Their research emphasizes the need for harmonized policies and collaborative efforts among East African states to ensure a swift and efficient response to emergencies. However, barriers to such collaboration, including political differences and bureaucratic hurdles, impede the seamless flow of resources across borders. Within East Africa, studies by Singh et al., (2023) delve into the disparities in healthcare infrastructure and resource availability. The research underscores the

challenges posed by varying levels of development and resources among East African countries. Limited access to advanced medical technologies and inadequacies in healthcare facilities exacerbate the difficulties in ensuring critical resources during MCIs, hindering the region's overall emergency preparedness.

East African scholars such as Tallach et al., (2022) shed light on the legal and regulatory challenges that impede effective resource allocation during cross-border MCIs. Divergent legal frameworks and regulatory standards across East African countries create obstacles in the seamless sharing and deployment of critical resources. These barriers underscore the need for a unified legal framework to facilitate swift and coordinated emergency responses. The role of communication in emergency situations is paramount. Tallach et al., (2022) emphasize the challenges related to communication and information sharing among East African states during MCIs. Barriers such as inadequate communication infrastructure and language diversity hinder the timely exchange of crucial information. Effective communication is crucial for coordinating resource allocation efforts, and overcoming these barriers is imperative for a more efficient emergency response.

Scholars in East Africa, exemplified by Tankel and Einav, (2021) delve into the socio-cultural factors influencing resource allocation during MCIs. The research underscores the impact of cultural beliefs and practices on healthcare decision-making. Barriers rooted in cultural differences may affect the acceptability of certain medical interventions, complicating resource allocation strategies. Understanding and navigating these socio-cultural nuances are essential for effective emergency response. Despite the valuable insights provided by East African scholars, there are notable gaps in the existing

research. Firstly, while the literature emphasizes the importance of regional collaboration, there is a scarcity of comprehensive studies that propose concrete frameworks or strategies for overcoming the political and bureaucratic barriers to such collaboration (Tankel & Einav, 2021). Secondly, the impact of socio-cultural factors on resource allocation is highlighted, but more in-depth research is needed to develop culturally sensitive approaches that resonate with diverse communities across East Africa. Lastly, there is a gap in understanding the specific challenges and opportunities presented by cross-border legal and regulatory frameworks, necessitating further investigation into potential solutions.

In comprehending the challenges associated with mass casualty incidents (MCIs) at the Kenyan level, Yunusa et al., (2018) focus on the imperative need for strategic emergency preparedness planning. Their research underscores the significance of comprehensive plans that consider diverse scenarios, taking into account Kenya's geographical and demographic diversity. However, a notable gap in the literature is evident concerning the integration of strategic planning into routine healthcare systems and its specific contribution to effective resource allocation during MCIs (Yunusa et al., 2018). This lack of integration hinders the seamless application of preparedness measures when faced with unforeseen challenges, revealing a critical area for further exploration and development.

Shifting the lens towards the resilience of healthcare infrastructure during MCIs, Werunga et al., (2022) offer insights into the vulnerabilities and strengths of Kenyan healthcare systems in the face of mass casualty incidents. While their work sheds light on the immediate impacts, a more comprehensive analysis of the long-term consequences on

the resilience of healthcare facilities is notably absent in the existing literature. Understanding the lasting effects on the adaptability and recovery capacity of these facilities is crucial for enhancing overall preparedness and response strategies. Public health education and awareness campaigns, as discussed by Werunga et al., (2022) emerge as essential components in managing MCIs within the Kenyan context. Their research emphasizes the role of informed communities in adhering to emergency protocols and supporting healthcare professionals during crises. However, a critical gap exists in understanding the effectiveness of different public health education strategies and the level of community engagement required to optimize resource allocation. Exploring these aspects can provide valuable insights into tailoring communication strategies to diverse Kenyan populations.

Accordingly, effective communication strategies during MCIs are highlighted by Maritim et al., (2022) as crucial elements for facilitating the coordination of resources and disseminating information. Despite their contributions, the existing literature lacks a thorough investigation into the integration of modern communication technologies and social media platforms. Understanding how these tools can be effectively utilized to enhance real-time communication during emergencies is crucial for improving overall response mechanisms in the Kenyan context. In the emerging field of psychosocial support infrastructure, Maritim et al., (2022) contribute to understanding the importance of integrating mental health support systems into the overall emergency response plan. However, a significant gap exists in comprehending the specific needs of diverse populations within Kenya and how cultural nuances influence the effectiveness of

psychosocial support in the aftermath of MCIs. Addressing this gap is vital for tailoring psychosocial interventions to the unique socio-cultural landscape of Kenya.

Arguably, telemedicine's potential in resource allocation during MCIs is explored by Maritim et al., (2022) emphasizing the benefits of remote medical consultations and optimizing the distribution of critical resources. Despite this, the literature lacks an in-depth analysis of the challenges and opportunities associated with the widespread adoption of telemedicine in different Kenyan regions, especially in remote or underserved areas. Exploring these aspects is essential for leveraging telemedicine effectively in resource allocation strategies. Examining the economic impacts of MCIs on healthcare accessibility, Seyed Javad Sadat et al., (2021) investigate how economic disparities influence the availability of critical resources, particularly in the context of post-incident recovery. However, a gap exists in understanding the long-term economic consequences of MCIs on healthcare infrastructure and the subsequent implications for resource allocation. Closing this gap is essential for developing strategies that account for economic factors in the aftermath of mass casualty incidents. The legal and regulatory frameworks governing resource allocation during MCIs, as highlighted by Seyed Javad Sadat et al., (2021) emphasize the need for clear guidelines. Despite this emphasis, a critical gap exists in examining the implementation challenges and necessary adaptations in these frameworks to suit the dynamic nature of MCIs within the Kenyan context (Wachira et al., 2019). Addressing this gap is crucial for ensuring that legal frameworks effectively support and guide resource mobilization and allocation during emergencies.

2.3 Effectiveness of Strategies Applied in Hospitals to Cope with Patient Surge during Mass Casualty Incidences

Mass casualty refers to an incident that generates a high number of patients seeking health services in the various department of the hospital system. The number is usually significantly high such that the management systems in hospitals are unable to meet the so needed services by the affected patients (Lomaglio *et al.,* 2020). Mass casualties therefore often expose the healthcare facilities to patient surge thereby leading to ripples of effects that bear negative impact to the healthcare system, the patients and healthcare providers. They are generally usually characterized by the influx of patients in the hospital's departments where the lack of the necessary preventive measures creates congestion thereby causing the forementioned negative effects on the healthcare professionals, the patients and the healthcare system as a whole. However, there are numerous strategies that have been employed by governments and healthcare facilities to ensure the achievement of the control of patient surge in the facilities.

A Task Force for Mass Critical Care carried out a study on surge capacity, utilizing the American College of Chest Physicians (CHEST) Guidelines Oversight Committee's methodology, noted that policies should enable programs to optimize critical care resources available to a hospital and that stockpiling of equipment, supplies, and pharmaceuticals prior to a disaster or pandemic increases hospital surge capacity (Einav*et al.,* 2014).

It has also been noted that critical care surge capabilities rely on support from pharmacy, laboratory, radiology, respiratory therapy, and nutrition services; hence, these should be included in all plans (Einav *et al.,* 2014; Rubinson *et al*., 2008; Sprung and Kesecioglu,

2010). They also encouraged health-care facilities to develop local plans to institute substitution, conservation, adaptation, reuse, and reallocation of scarce resources. It has also been suggested that the supply buffer should be an additional 30% of consumables above what one individual patient would require for 10 days (Rubinson *et al*. 2008).The applicability of strategies above in developing countries is likely to be difficult due to scarce resources (finances, human resources and equipment). Analysis of the burden of disease globally indicates that the LIC are most affected with limited funding of the health sector as compared to the high-income countries. When disasters strike, victims of MCI in the LIC are taken care for in already resources strained hospitals. None the less Hospital patient surge will only be managed well if the hospital has ability to increase resources (Kelen and McCarthy, 2006) during the influx of patients in an MCI. It is the duty of the hospital administrators to profile the types of disasters and the put in place the most critical resources needed for MCI to contain the Surge of patients. The disasters are of different types and magnitudes the conserves of the critical resources should also be specific to the most likely MCI. It is important to do so in order to avoid investing in equipment which may not be needed for patient surge at the time. Patient surge during Covid 19 outstripped the ICU bed capacity prompting the government to purchase and equip hospitals with fully functional beds. The cost of ICU room costs between Sh7 million and Sh8 million to set up according to the Daily Nation *News Paper in Kenya* 23 March 2021 , article *By Nasibo Kabale and Elizabeth Merab*.

When the pandemic is over the ICU beds will be underutilized and so the question begs should we have invested in ICU beds in the first place? This is where strategic planning for patient surge comes in. A lot of work has been done to itemize critical resources in health care (National guidance for healthcare system preparedness, 2013) but a detailed

account of resources for specific disaster scenarios is not available for reference. It is therefore the task of the hospital system management to plan and avail individual hospital resources found critical for response to specific types of disasters (Jamil*et al.,* 2013)

Surge capacity planning and expansion is a strategy that has been and continues to be exploited by many healthcare facilities to eradicate the problem of patient surge in hospitals. In this way, the facilities engage in the development regular planning and updating of the surge plans to ensure that the capacity of the system of ample enough for times of patient surge (Humphreys *et al.,* 2022). The plans usually outline all the protocols that guide the management of increased patient volumes. These plans are inclusive of the allocation of resources and staffing ratios to ensure that financial, human and equipment resources are readily available for the success of the process of provision of care for mass casualties. The strategy has been of vital help in the reduction of cases of patient surges.

The key determinant of the demands in any given hospital is the type of mass casualty event that occurs and critical care capacity is a key element of hospital surge capacity planning (Duncan,2014). It has also been noted that surge capacity includes the care across conventional, contingency and crisis spectrums and hospital's plan should account for provision of care across these settings. According to (McCarthy, 2006), the factors that lead to patient surge in a hospital can be from multiple dimensions, such as systems, space, staffing, and supplies. Their individual contribution to the surge requires multidimensional that reflects both the core components and their relative contribution to surge capacity. A better understanding of daily hospital surge capacity and influencing

factors will improve our ability to simulate the potential impact that different types of catastrophic events may have on the surge capacity of hospitals emergency areas (McCarthy *et al.,* 2006).

Delivery of critical care depends on the availability of sufficiently trained medical, nursing, and ancillary staff (Einav *et al.,* 2014). Of important note is the fact critical care needs in a disaster or pandemic scenarios could last longer and the likelihood of depleting staff reserves is greater in the ICU. Towards salvaging the situation hospitals should plan to use adaptive measures to compensate for reduced staffing, such as additional shifts, workload, and changes in shift structure/time (Hick *et al.,* 2010; Einav *et al.,*2014; Sprung *et al.* 2010).

Staff preparation for response to a disaster is vitally important to the successful outcomes of disastrous events and emphasis during preparation should focus on role definition, integration with the incident command system, and the ability to perform cross-trained functions (Einav *et al.,* 2014). The hospital staff preparedness to support critical care surge response should also include knowledge of standard operating procedures, role definition, use of hospital incident command system, cross-training of additional staff, and training in the use of situational awareness tools, particularly those that can assist in decision-making regarding critical care surge planning, operations, response, and recovery.

Quality of preparation depends on adequacy of training and education of ICU, ward staff and those co-opted to perform new roles during a mass casualty event. The training should be done immediately and it should include demonstrations and supervised

practices. Additionally, the training should be about the disease, its ramifications and treatment. Additional, the training should include training of hospital command structure in crisis management procedures and the training scope should include: medical management, personal protection techniques, environmental contamination, laboratory specimens, alert lists, training of non-ICU staff pre-determined tasks, ethical issues, dealing with the deceased and families of dying patients and visitors' restrictions. It has been noted that adequate preparation including education and training can reduce significantly the mortalities associated with mass casualty incidents. Either, administration should identify the staff to participate in training programs, verify that they participated and evaluate their knowledge on annual basis (Sprung *et al*., 2010).

There are different forms of exercises utilized to prepare clinical teams and hospitals for mass casualty events such as large scale and small scale live exercises (Dichter *et al*., 2014). It has been established that although large scale live exercises can effectively test logistical issues, it is difficult to assess clinical issues but small scale live exercise can assess clinical issues effectively. This trade off, between being able to operate a large-scale live exercise while still being able to test clinical decision making, has been dealt with using trained actors (Ashkenazi *et al.,* 2012). These ''smart'' victims can force the training teams to deal with more realistic clinical scenarios.

The U.S. Department of Defense developed a model for determining the number of staff needed for a surge facility popularly known as the Modular Emergency Medical Stem (MEMS) (Joint Commission on Accreditation of Healthcare Organizations, 2006). The model utilizes a network used to access patient care personnel through neighborhood emergency help centers and acute care centers. It identified a number of activities that

help in the search for additional qualified personnel in a time of need: Recruiting from retired or currently unemployed but qualified volunteers, utilization of reserve military medical and nursing providers and other responders, as well as an expanded group of providers, reallocating providers from non-emergency care and non-emergency sites to emergency response assignments and from unaffected regions to affected regions, creating and training a pool of non-medical responders to support health and medical care operations and protection of providers who serve in mass casualty event situations to ensure their willingness to respond.

During contingency and crisis situations, expert input from critical care physicians incorporated into the emergency management personnel at the hospital both during planning for surge capacity as well as during response, prioritized designated locations for expanding existing ICUs using post-anesthesia care units/emergency departments to capacity, then step-down units, large procedure suites, telemetry units and finally hospital wards as well as support services(Sprung *et al*., 2010).The surge capacity objectives should be in line with the individual hospital surge goals (Dichter *et al*., 2014). It is also suggested that hospital should be capable to monitor and track their defined surge capacity supplies and equipment, have the ability to track the number of available ICU capable personnel and other designated specialist "resources" through their partner hospitals, have defined policies and procedures for emergency privileging for all health-care professionals designated, and adequate reimbursement for expenditures and loss of revenue related to delivery of acute critical care services during a disaster should be ensured.

Measures can be taken to increase surge capabilities during mass casualty situations such as obtaining an executive order from local and state governments to facilitate lower staff-to-patient ratios, decreasing the number of routine care activities that are performed, decreasing documentation of care, decreasing stringent rules about privacy and confidentiality to facilitate transfer of information between health care providers, cancelling elective procedures and appointments, using areas of the hospital not normally used for patient care and considering performing low-risk births at home, rather than at hospitals (Kaji, 2013).

Moreover, the ability to successfully and safely expand and maintain surge capacity depend on: type of disaster, number of critically injured casualties, duration of the casualty-generating circumstance, available infrastructure (including staffing, equipment, and drugs and other consumables) as well as quantity and duration of the enhanced critical care provision that is required (Shirley & Mandersloot ,2008). Finally the conceptual frame work for this study is based on three frameworks/ models.

Flexible staffing models have also been put in use to ensure that patient surge is a peril that is brought to its minimum in the healthcare facilities. Flexible staffing strategies ensure that there is flexibility in the provision of care through such ways as effective shift scheduling and the observation of measures such as respect for shifts by the healthcare providers (Cushingberry, 2023). The healthcare facilities have therefore adopted the practice of flexibility in staffing by the use of methods such as the cross-training of all healthcare workers. The practice has improved the efficiency in dealing with mass casualties in that many healthcare providers can now effectively provide even the care that they have not specialized in thus easing the pressure that may have been faced by professionals in specific departments of the hospital system. This has been effective in

reducing patient surge since there has also been cases where temporary staff are hired and providing on-call personnel services. The methods have helped cope with the fluctuations in patient volumes.

The strategy also ensures that there is adequate staffing thus ensuring that all the patients receive treatment and care services amply. Adequate staffing reduces the number of patients who spend time in the hospital systems waiting to be served by the limited number of healthcare providers present in the facilities. In cases of mass casualties the scenario worsens in that the occurrence of such incidents presents the hospital systems with high numbers of patients who require care thereby overwhelming the facilities which reduces the quality of care that each patient gets, causes cases of burnout among the professional healthcare staff, increases the likelihood of occurrence of complications in the patients, promotes the incidences of disease transmission among the patients as a result of contact, encourages the spread of hospital-acquired infections and thus the ultimate occurrence which is worsened cases of patient surge. Therefore, hospitals that have ensured a proper staff-patient ratio have been able to effectively manage patient surges.

Community-based solutions through community engagement have further been used by various hospitals to reduce the negative impact of patient surge on the healthcare system. Hospitals have collaborated with the community to ensure that avoidable incidents that encourage high patient volumes in the healthcare facilities are controlled and stalled whenever possible (Kirschenbaum, 2021). Collaboration with the community has promoted aspects such as the provision of preventive care, the spread of information on

health awareness maters and early intervention of disease processes ultimately leading to the reduction of cases of patient surge in hospitals.

Effective bed management and coordination of patient flow have also been strategies that aim at minimization of the problem of patient surge in areas such as wards, ICUs and emergency departments. Many hospitals have implemented effective and efficient bed management systems that has been critical in the prevention of such events as the violent instances that may occur between patients with regard to the occupation of beds (Åhlin, Almström & Wänström, 2023). The management systems have ensured the optimization of the allocation of beds to patients with subsequent success in real-time monitoring and adjustment of patient flow thereby reducing cases of patient surge as a result of patient influx in the health facilities.

Ensuring adequacy of the required equipment in the hospital is also a necessary strategy in the control of patient surge. The basic Ancillary Equipment for Surge Positive Pressure Ventilation include: Positive pressure ventilation equipment, Manual resuscitator with face masks ,T-piece resuscitators, Airway care, Ancillary respiratory equipment, Airway care, Closed-circuit suction catheter, Endotracheal tube, Tube guide, Endotracheal tube securing device, Single-use suction catheter, Yankauer suction catheter, Suction trap and hoses (regulator to trap and trap to suction device),Vacuum source and suction regulator, Fingertip for suction, Circuits, Expiratory limb filter in Ventilator circuit, HEPA style filter, Humidifiers, Chamber, Sterile water, Medical gas, Monitoring devices, Point-of-care diagnostic devices and Respiratory medication delivery(Einav*et al.,*2014; Rubinson *et al*. 2008; Sprung *et al*., 2010; Sprung and Kesecioglu 2010; Duncan *et al*., 2014).

Medical Equipment for Critical Care Surge include: Oxygen, air regulators, flow meters, Nasal prongs, Face masks, Face mask with reservoir, Intubation equipment,IV access, CVC and CVC ancillary supplies, IV pump (multilumen),Chest drains, Regular blankets, Insulating blankets, air Hugger (3M),Bair Hugger blankets, HOTLINE (Smiths Medical),High-flow IV lines, high-flow three-way connectors, hot line sets, Pressure bags (for blood/fluid),Disposable bath package, Nasogastric and orogastric tubes, Nasogastric and orogastric tube ancillary supplies among others (Einav*et al.,*2014; Rubinson *et al.*, 2008; Sprung *et al.*, 2010; Sprung and Kesecioglu 2010; Duncan *et al*., 2014). Most of the equipment mentioned above basically deal with the emergency care and stabilization of the critically injured patients. The airway patency and breathing effort at the early stages are the most critical in determine the ultimate outcome of the patient. As much as the equipment aforementioned is critical, availability and functionality is a major issue in resource poor setups. Emergency care critical equipment are lacking in many rural hospitals .if they exist then maintainer is poor or lacking making them useless in the face of disaster response. It is not clear how prepared MTRH and the neighboring county hospitals are with critical equipment. This study shall address the readiness for response at the critical entry point in the hospital.

The coordination of patient flow has further been enhanced to reduce crowding and overcrowding in the hospital systems. The streamlining of processes involved in the transfer of patients from one department to the other have been a great milestone in the avoidance of patient surges. The enhancement of the coordination between different departments, for example from the emergency room to specialty units such as wards, ICUs, or operation theaters have ensured smoothness of the processes involved in patient

flow and thus limiting the incidences of patient surge in the involved departments. It is this coordination that should be emulated by healthcare facilities that are yet to ensure proper coordination in their areas of specialty to ensure a surge free environment conducive for healthcare service provision.

There should also be adequate supplies and pharmaceuticals for the management cases of patient surges. Supplies during MCI are aimed at the initial damage control and stabilization of the patients' airway, breathing and circulatory systems. A well-organized entry point in the health facility has a crash cart which is stocked with resuscitation drugs and airway management equipment and the necessary airway management equipment. The equipment at the hospitals point of patient entry should be in proper working condition and enough to serve all patients in need of intervention. However Limited resources are the main restricting factor for equipping and maintain of the critical resources in the lower income countries. Other Pharmaceuticals requirements in mass casualty situations include: Preventive Therapeutics such as DVT prophylaxis, GI hemorrhage prophylaxis, Treatment of reactive bronchospasm (inhalational agents), Infection control (clean water, antiseptics and soap), Vaccines (tetanus, hepatitis), Eye care, Oral hygiene; pharmaceuticals for acute care such as IV fluid solutions, Nutrition, Antibiotics, Vasopressors, Sedatives, Analgesics, Neuromuscular blockers, Anticoagulants, Diuretics, Antiarrythmics(Einav, Hick, Hanfling, Erstad, Toner, Branson, Kanter, Kissoon, Dichter, Devereaux, and Christian 2014; Sprung and Kesecioglu 2010; Duncan *et al.,* 2014).

Furthermore, funding is one of the many issues healthcare institutions need to consider when preparing for patient surge following MCI. They include critical resources, information and communication channels, elaborate patient record management, shelter plans, evacuation for specialized care, and managing mass fatalities. Adequate funding is important to meet the required standard response but the budgetary allocation in resource poor countries may not be enough without external assistance.

The policy document on disaster preparedness does mention three types of funds namely Humanitarian disaster fund, National drought disaster fund; National disaster management contingency fund among others. These funds are to be harmonized and used to mitigate against disasters including offsetting hospital bills at subsidized rates (National Policy for Disaster Management in Kenya, 2009).

There is little or no mention of hospital funding for disaster management at hospital level in the draft policy for disaster management. The finance health system pillar which affects the hospitals ability to close gaps in mounting drills and training staff in disaster response require addressing by the relevant authorities (Cynthia, 2009 & Simiyu*et al*., 2014). Patients visiting Kenya hospitals are categorized as cooperate if they are insured or have a policy cover from the employer who then offsets the hospital bills. In Kenya there is the NHIF cover for those enrolled and paid up for the period covered. The cover is limited and patients have to top up if the bills exceed the insurance payouts.

Furthermore, policy review and adjustments are vital in the control of patient surge in the hospitals as a result of the never-ending fluctuations in patient volumes in the healthcare

facilities. Hospital systems ensure that they regularly review the policies and principles put in place to guide all the actions taking place in the facilities. For instance, there are many policies in hospitals that are the basis rule of action for aspects like admission criteria, resource allocation and planning of discharge (Sener *et al.,* 2023). In the review processes, the hospital systema should ensure that the policies are aligned with the goal of the effective management of patient surges.

Additionally, integration of technology in healthcare facilities has promoted significant reduction in the cases of patient surges. The importance of technology in healthcare cannot be overlooked in that it is a key aspect in meeting the organizational goals and patient expected outcomes. Hospital systems that have integrated up-to-date technological appliances in their facilities continue to enjoy enhanced patient service delivery (Sener *et al.,* 2023). There is also improved efficiency of the organizational and clinical operations and thus improved outcomes and reduced patient surges. Electronic health records and data analytics have been deemed as smart hospital management strategies that have enhanced processes like decision-making and improved communication thereby streamlining other procedures with the subsequent reduction in patient surge.

The use of telehealth services including telemedicine and triage in the prioritization of patients has furthered the control of patient surge in hospitals. This has especially been successful in developed countries and among the high-income individuals. Telemedicine has been defined as the distribution of health-related services and information via electronic information and telecommunication technologies (Rosen *et al.,* 2021). This

provides for long-distance patient and clinician contact, care, advice, reminders and education. There is therefore provision of remote clinical services, vie real-time two-way communication between the healthcare provider and the patient. Hospitals that use telemedicine therefore have all services related to healthcare, education, information and administration encompassed and can therefore be transmitted over to distant patients. This reduces cases of patient surge.

Enhancement of outpatient healthcare services also promotes the reduction of patient surges. Outpatient care includes all of the healthcare services that are provided to patients and are not given withing the setting of the hospital. It can also be referred to as ambulatory care. The services provided in outpatient care are inclusive of but not limited to wellness promotion services, diagnostic services, treatment and rehabilitation services (Shahverdi *et al.,* 2023). The provision of these services in other settings other than the hospital systems has proven to be an effective strategy in the management and reduction of patient surges.

Team alignment furthers the reduction of patient surge. The phenomenon of team alignment refers to the collaborative working together of each of the members within a workforce to bring out the achievement of a desired goal. The thrive of collaboration, efficiency, productivity and communication occurs when teams are aligned (Åhlin, Almström & Wänström, 2023). Maximum productivity and better results are thus achieved when there is team alignment in the healthcare facilities. There are different ways through which team alignment plays role in the management of patient surges. There is improved communication where the healthcare team can share information

seamlessly thereby reducing cases of patient surge. Communication allows for healthcare providers to be well aware of the patient load in the healthcare system.

Team alignment also allows for enhanced coordination among the healthcare providers. Healthcare coordination allows for collaborative effort in the eradication of the problem of patient surges. Coordination not only enhances the promotion of collaboration between healthcare providers but also between the various departments in the healthcare system. This streamlines patient flow, optimizes the utilization of beds and prevents drawbacks that are likely to encourage patient surge. More so, there is efficiency in the unification of emergency response due to aspects of cross-training associated with team alignment. Patient surges resulting from mass casualties caused by accidents or disasters require coordinated team response to ensure proper management. Therefore, hospital systems that have been using the strategy have had the fruition of improved control of patient surge.

Regular training and drills coupled with patient education has also encouraged the prevention of patient surge. Regular training equips healthcare providers with the agility to respond to different scenarios including patient surges and thus their reduction. It is the enhanced preparedness that enables them to promptly act and make informed decisions on the type of care and treatment to be provided to patients based on the specificity of their needs thereby countering patient surges when faced with increased patient volumes (Rezaei *et al.,* 2018). The regular training that these personnel undergo keeps them familiar with all the protocols that guide the response to cases of patient surge and thus

they are able to effectively manage the problem leading to the overall well-being of the patients, the healthcare professionals and the general healthcare system.

Regular training of healthcare professionals also allows for the efficiency of the processes involved in triage. Continuous training and practice keep them well-equipped with the necessary knowledge and skills for the performance of efficient triage processes with maximum success in the prioritization of patients based on the severity of their conditions. Critical cases therefore receive timely attention which improves their conditions reducing instances of surges. Drills among healthcare professionals are important for such reasons as the provision of opportunities for the teams to adapt to changing conditions and trends as well as unexpected challenges as explained by Rezaei *et al.,* (2018). Patient influx in hospitals is one such challenge that greatly demands the adaptability of healthcare providers thence their ability to control surges. Hospitals that have engaged in regular professional training have had it easy with the control of patient surge problems.

Post-drill evaluations have been used to provide valuable feedback on the performance of healthcare teams. It is the feedback that provides the facilities with the relevant information on the identification of areas for improvement where the implementation of the necessary intervention measures allows for the control of problems like surges. There is further instillation of confidence and boosted morale among healthcare providers who undergo regular training (Rezaei *et al.,* 2018). This reduces the actual stress that may result from the real-time occurrences of patient-surge enabling them to effectively and efficiently take the necessary measures to curb the same.

Patient education plays a vital role in the reduction of patient surges. Where communities in collaboration with hospitals have put effort in the education of patients and the community as a whole on health issues and the appropriate measures that should be taken in response to the various health challenges that they may face, patient surge has been significantly reduced. Patient education provides awareness on preventive care, timely seeking of primary care, self-management of chronic conditions, appropriate use of emergency services, adherence to medication, understanding of alternative healthcare resources, vaccination campaigns, health literacy, promotion of menta health awareness, and community health programs (Sener *et al.,* 2023). Investing in patient education is therefore a proactive approach that has contributed to reduced patient surges. This has especially been for conditions that can be effectively managed through preventive measures and early initiation of treatment measures.

Collaboration with external agencies is another of the essential strategies that have been used to reduce cases of patient surge. Through ways such as the sharing of resources including personnel and equipment during periods of increased patient demand has been an effective measure for the control of surges. Collaboration with external agencies has enhanced the staffing ratios, provision of specialized expertise, success in patient transfers and coordination in response to emergencies, public health intervention, integration of technology, logistical support, community outreach and education and mutual aid agreements (Keeley *et al.,* 2020). Thus, the provision of additional resources, support and expertise has been crucial in the management of patient surges.

Staffing is an essential factor in realization of the hospital surge capabilities and illustrates how health care staff shortages profoundly affect a hospital's ability to manage

surge (Rutgers research report." Health and Hospital Networks American Hospital Association, 2006.) During disaster with MCI more staff is needed with some requiring to work for longer periods if necessary. The existing nursing and physician shortage require hospitals to either recruit more staff on temporary basis or divert the ambulances to neighboring hospitals. The need for adequate staff during mass casualty incident becomes necessary because the interventions required must be done with a short time in order to minimize morbidity and or mortality. Adequate staffing in place will ensure a self-sufficient surge capacity for the majority of the victims in the hospital in the initial stages of a mass casualty event when the majority of victims present and outside support is not forthcoming. Response also becomes more efficient if all staff is hospital based. (Cone *et al.,* 2003 & Donaldson *et al*, 2005).

Many hospitals still struggle to maintain adequate staffing for quality health care delivery (Buerhaus*et al.,* 2009). The Kenyan hospital workforce shortage is in public domain and well documented, the shortage of nurses (range of 1.2 to 0.08 per 1,000) in the public hospitals countrywide is complicated by mal-distribution and varying workforce characteristics (for example, age profile) across counties in Kenya (Wakaba *et al.,* 2014). Disasters with patient surge would complicate matters more in already strained work force this study sought to look into local strategies that can improve care of the patient surge at same time manage the normal patient load. According to the World Health Organization's World Health Report 2006, Kenya is among 57 countries with critical shortage of staff a deficit totaling to 2.4 million doctors, nurses, and midwives, with the proportional shortfalls being greatest in sub-Saharan Africa (WHO, 2006).

Establishment of crisis command centers has further provided relief to the healthcare system in dealing with patient surge. A crisis management command center (CMCC) as defined by scholarly work is a pre-prepared facility that can be physical or virtual and is used to provide centralized command and control thereby ensuring proper coordination in the course of action (Kelen *et al.,* 2023). The centers are a strategic initiative that has had significant impact on the control of patient surges through ways such as real-time monitoring and centralized coordination, situational awareness, emergency protocols and workflows, multidisciplinary collaboration, community engagement and efficient decision-making. The centers have thus been pivotal in the reduction of patient surges in the healthcare systems during crises that lead to patient influx and higher patient demand in the healthcare facilities.

The overall well-being of healthcare facilities is thus dependent on the realization and implementation of prescriptive and prohibitive strategies with the aim of improvement in the provision of healthcare services. Failure to indulge in activities that enhance the quality of care and treatment provided to patients in the various hospital departments with regard to the availability of resources.

2.3.1 Methods and models used to cope with patients surge during mass casualty incidences

Patient surge in hospitals with a sudden arrival of casualties present a logistical challenge to process a large number of patients through the system. The need for hospitals to develop surge plans for all sorts of incidents must be in place (Einav*et al*., 2006). Events that result in patient surge have been identified as, anticipated, progressive, insidious and

sudden onset (no-notice) events. Health care systems are said to better manage patient surge during MCI by alignment of emergency operations and management plans with community preparedness and response organizations. Hospitals use different approaches to improve their emergency responses to patient surges capabilities and each of the approaches when combined reinforce one another and have resulted in increased efforts by hospitals to improve their disaster preparedness and response capabilities and community integration (Sauer *et al*., 2009).

Different types of surge hospitals can be created to handle the patient surge. Most importantly the key to successful response to MCI with many casualties for institutions is local and state preparedness with clear agreements and relationship before disasters as illustrated in hurricanes Katrina and Rita in the US. The agency for health care research and quality (AHRQ) a branch of US department of health and human service gives guidance on how to use closed hospitals to manage the surge or expand the surge capacity. Other facilities that can be used to expand the surge capacity may include; shuttered hospitals or closed wards. These facilities can be reconditioned and equipped to the set standards of wards. If resources are available, mobile medical facilities can assist in treating the patients on injury site.

Facilities of opportunities are facilities which ordinarily are idle, closed in hospital setup or other public utility buildings which can be converted into temporary accommodation for patients exceeding the hospital bed capacity. This concept is known as health care community-based surge capacity as opposed to hospital based surge capacity (Bostick*et al*., 2008). Agencies like Agency for Healthcare Research and Quality (AHRQ) have an

established *adhoc* number of 500 extra patients per million populations in urban areas for care sites away from the overloaded facilities (Kanter& Moran, 2007).

Non-medical facilities like churches and schools which are converted to hospitals because of their proximity to incident site and many others. How has Kenya as a country tried to cope with the recent patient surge in west gate and the Garrisa university shootings? Surge capacities are obviously different in the incidents; in the case of the Westgate shooting the incident in capital city had many private hospitals managing patients while in the Garrisa incident the hospital is one with limited resources to cope with the numbers at no notice. The health system simply could not cope even with the state intervention illustrated by mortalities that followed.

2.3.1.1 Reverse Triage Model

Apart from implementing disaster plans, some surge capacity concepts which utilize reverse triage are useful. In this type of concept patients are disposed using a classification system that allows conceptual classification of patients for suitable disposition. Those deemed safe for early discharge home are discharged to create space for the surges in demand (Kelen *et al*.,2006). Normally classification system with an acceptable risk based taxonomy including those deemed safe for discharge during surge events is applied (Kelen *et al*., 2015).

The reverse triage model as one of its kind which creates 10-20% inpatient beds in a short time. Those discharged should be carrying little risk of complication and do not need attention in next 96h according to Polaris (2016).

Before making decision to discharge critically ill patients must be rapidly assessed for their stability to be transferred or need for continuing inpatient care. If they meet criteria for discharge they can be transferred to a step down facility to create surge capacity for disaster victims (Satterthwaite and Atkinson, 2012).

The ability to respond effectively to events producing a massive influx of patients that disrupt daily operations requires surge capacity. Key components of surge capacity include the four S's: 'staff,' 'stuff,' 'structure,' and 'systems (Adams, 2009).The state of staffing and critical resources in African hospitals is already deplorable even in absence of disasters for effective response to emergencies more so mass casualties. It is important to assess the critical resources of the hospital as part of preparedness for major disaster events.

The surge capacity for emergencies in (SCOPE study) observed some shortcoming in preparation when benchmarked with US Standards. International best-practice models for mass casualty care state that the number of available operating theatres and the ability to take simple x-rays are measures of the capacity to provide care for both critical and non-critical patients (Centers for Disease Control and Prevention 2014). By assessing what resources MTRH and one level 5 hospital we shall be able to inform and probably influence more fund allocation for staffing and equipping the all-important departments responsible for managing the injured.

In disaster event, the injured present to the nearby health facilities for emergency care. The surge capacity to a large extent will determine how many of those who present was treated effectively. In the words of Dynes, "Existing research tradition is predominately

Western, community-based, urban, and deals with sudden onset agents from 'natural' causes" (Dynes 2004).

2.3.1.2 The Demand Capability Model

According to Quarantelli and Russel (1977) demand capability model is an important concept especially in low-income countries because it explains the response and preparedness deficiencies of individual organizations including hospitals. The model holds that low resource set ups have poorly funded health systems which makes them incapable of coping with huge surges of MCIs presenting to them. The demand and stress on the health systems in the face of disasters makes it crack if policies are not in place when disaster strikes (Quarantelli and Dynes 1977). The argument in this model is that when disaster strikes and casualties are on mass scale presenting for treatment, the functional structures can't cope with sharp and unanticipated demands on the health systems. In order to avoid stress during response to Mass Casualty Incident(MCI) from natural and man-made disasters, hospitals must find a way of adapting to excessive demands by the huge numbers of critically injured patients who require urgent treatment in resource limited set up. The hospitals should ideally have strategies in place either short term or long term to mitigate and plan for disasters and MCIs. Priorities do differ depending on financial capabilities of different institutions leading to variable capability and capacity to equip and manage unprecedented surges of patients.

It is clear from past experience that Hospitals which have disaster management plans are usually better placed to handle surges over and above the established capacity surge allowed. The terror attack on the world trade center had two affiliated hospitals take up the patient surge and it is notable that the two hospitals had disaster management plan in

place which was applied and that the patient surge was well managed with overall critical mortality rate of 37.5% (Cushman, Pachter, & Beaton, 2003) much less than expected. In 2004, there was a terrorist bombing in trains in Madrid Spain where scores were injured and hundreds dead. Most importantly the sizes of hospitals and resources of the two closest hospitals as well as the early hour, were probably decisive in the adequacy of overall response.

2.3.1.3 The systems dynamic model

This model fronted by William Manley RN SD has been used by other researchers to analyze patient flows in hospitals and other health care facilities (Homer & Hirsch, 2006).

Lane *et al.* (2000) describes how systems dynamic model applied in hospitals can alter and manage staffing and change hospital policy movement of staff and all internal reorganization and re-structuring during patient surge in a single emergency. It's a tool that can be used to investigate how health care providers can and should respond to increases in patient demand for treatment above usual levels. It is that can be useful in different situations including bed closures, increases in bed demand and crisis times.

The need for better prepared and mounting of sufficient healthcare response requires continued planning for appropriate, sufficient and timely response (JCAHO, 2004).Factors that may lead sudden patient surge are different for different disaster events, geographical location, and socioeconomic status with the less developed worst hit. The fact that major disaster incidences are rare, once in a long while, community awareness of probable disasters may not be so obvious. In fact some research indicate

that in some communities it would be necessary to have them hit by a disaster in order to have them focus attention on mitigation and planning on risk reduction(World Bank, 2010).Without a major disaster experience, many health institutions remain unprepared for disasters even in developed countries. They may be even less ready to accept and care for patient surge from chemical or biological attacks, conventional or nuclear explosive detonations, unusual natural disasters, or novel infectious disease outbreaks. This study looked at the various risks of patient surge both normal daily surges and surge during disasters in the study sites. In all scenarios the volume of patients are expected to over stretch the hospital capacities compromising care hence poor outcomes. The risks will emerge shall inform the hospital/s which events can lead to patient surges and what should be put in place for preparedness and response strategy.

2.3.1.4 The Influenza Model

The influenza conceptual model in Figure 2.1 is a useful tool when planning for hospital surge capacity especially for incidents that will result in huge numbers of patients in short time.

Surge capacity and capability in hospitals is a complex issue that presents uniquely not to mention that the response to the MCI has no standardized approach. As it is from literature many strategies to cope with patient surge is fragmented with particular works addressing very specific aspects of patient surge. The conceptual Mass Casualty Conceptual Model developed by Culley and Effken and others described later in this proposal provides some guidance to the health care providers that manage patient surges during MCIs. The Culley and Effken model was derived from empirical observations, insights, and deductions, existing literature, and theoretical-conceptual models such as Structural Contingency Theory (SCT), Technology Theory (TC), and Vicente's Human-

Tech Ladder Model. The conceptual model is contextually driven and multilevel with temporally ordered dynamic interactions.

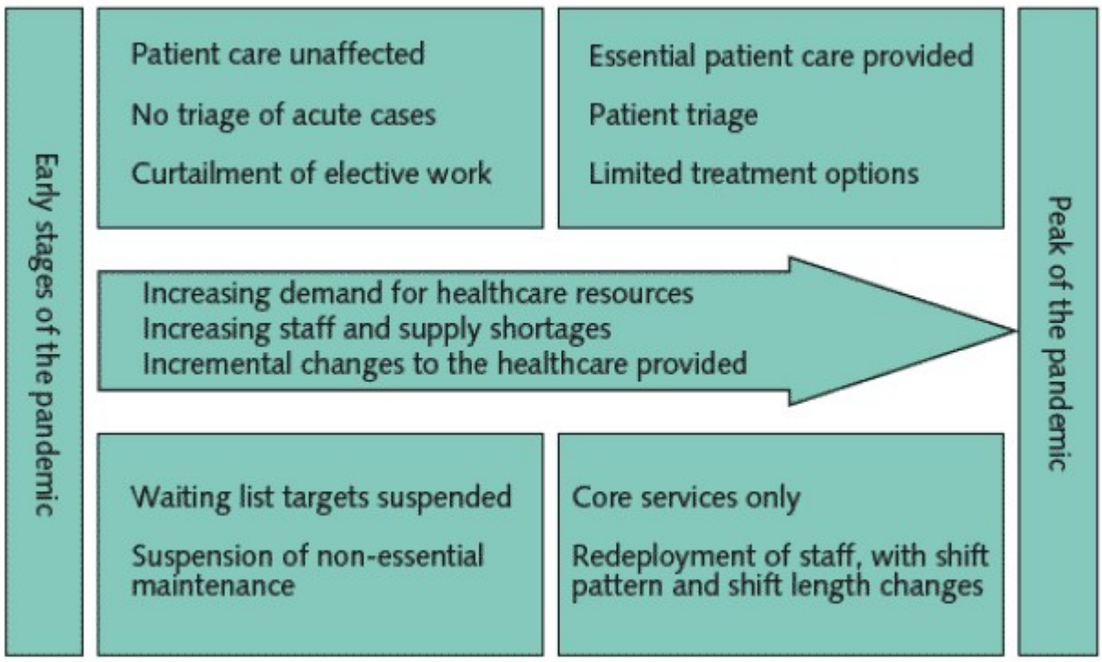


Figure 2.1: Surge capacity - a conceptual model. Source: Adapted from Mass medical care with scarce resources: A community planning guide, Agency for Healthcare Research and Quality, 2007, emergency publication no. 07-0001.

Whereas SCT views context as both external and internal, TC emphasizes the internal context and focuses on information technology, structure and, triage while SCT measures the fit between structure and contingency factors such as contextual factors (duration, setting, size and nature of the environment),patients that affect differentiation and integration of the organization; and structure or organizational framework needed by each triage unit to support the workforce in managing diverse patient needs. Besides, the model has included Vicente's Model to study the fit of information technology to the workforce.

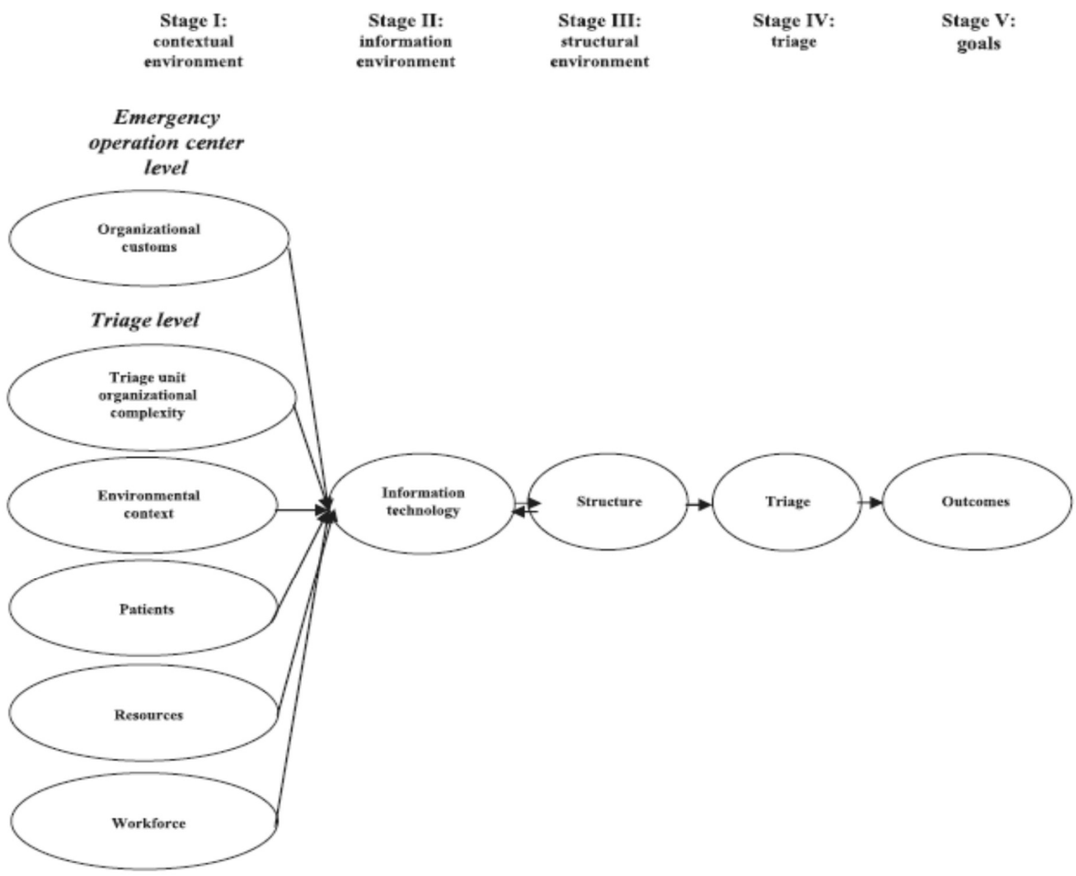


Figure 2.2 Mass Casualty Conceptual Model (Culley and Effken 2010)

According to Culley and Effken (2010) the MCCM depicts five stages that impact the continuum of care during an MCE. The model suggested the key constructs that summarizes the 10 hypothesized constructs and relationships, and the 44 indicators, along with the theoretical base for each stage.

Stage I (Contextual Environment): environmental factors that initiate and influence MCEs, patients affected, and resources available, including the following constructs: Organizational Customs, Triage Unit Organizational Complexity, Environmental Context, Patients, Resources, and Workforce.

Stage II (Informational Environment): information and technology necessary to control and support an appropriate work flow design that matches the skill mix and experience of the available workforce. Stage II includes the Information Technology (IT) construct.

Stage III (Structural Environment): adhoc organizational structure used to organize a scalable multidisciplinary emergency response to incidents of any magnitude and includes the Structure construct. This stage describes the organizational framework needed by each triage unit (from hierarchical to flexible) to support the workforce in managing the diverse needs of each patient. The degree to which a hierarchical or flexible structure is appropriate is hypothesized to be influenced by the knowledge and technology available at the point of care to control patient variance at the source. IT directly influences the Structural Environment, and Structure influences IT, as illustrated by the bidirectional arrows in Figure 2.2.

Stage IV (Triage): the process used to classify and prioritize victims according to predetermined severity algorithms to ensure the greatest survivability with limited resources includes the Triage construct. Accurate triage depends on an appropriate organizational structure and IT to facilitate communication that assists the workforce to accurately prioritize the treatment of patients while controlling resources.

Stage V (Goals): outcomes that include the numbers of lives saved and deformities prevented, the number of injuries prevented to both patients and the workforce, and the appropriate use of resources to measure the effectiveness of the organizational system.

2.3.2 Disaster management in the Context Mass Casualty Incidents

Nobody dies by “disaster”. During the crises, emergencies or disasters people die of well recognizable, often banal causes that in other circumstances could be prevented (Stikova,

Lazarevski, & Gligorov, 2008). This is the main reason for better preparedness for appropriate response to crises and disasters. There are four essential phases in the management of disasters: preparedness or warning phase, response or emergency phase, rehabilitation and recovery.

2.3.2.1 Pre- Disaster Activities

Anticipation a crucial aspect of the disaster management process. This involves taking a proactive approach to major incident management. It means that the expert and responsible people should identify the possible hazards and predict the possibility for their occurrence. For example, the presence of a river may increase the likelihood of flooding in a district for which planning should be undertaken. Another one is connected with occurrence of the highly pathogenic H5N1 influenza virus and increase of the likelihood for mutation and appearance of the more easily transmissible human to human strain with bigger pandemic potential (Baxter 2007).

Additionally, assessment is a crucial management task which contributes directly to effective decision making, planning and control of the organized response. Assessment of needs and resources is required in all types of disasters, whatever the cause and whatever the speed of onset. Assessment is needed during all identifiable phases of a disaster: from the start of emergency life-saving through the period of stabilization and rehabilitation, and into long term recovery, reconstruction and return to normalcy. Three general priorities are to be identified for early assessment: location of problem, magnitude of problem and immediate priorities.

The assessment process is as follows: identify information, needs and resources; collect data; analyze and interpret; report conclusions; design/modify disaster response. For better public health preparedness, we need information for better risk determination and appropriate quantitative risk assessment. The purpose of risk analysis is to guide communities in planning for protecting health and safety. It is possible to be done by developing and maintaining 3 sets of plans: hazard reduction plans vulnerability reduction plans emergency preparedness plans. The main task of these plans is prevention, preparation and response in case of preparedness for disaster occurrence and appropriate handling if disaster appears. There are many different approaches for estimation, but it seems that USA Federal Emergency Management Agency (FEMA) approach is the most valuable and useable approach for now (Stikova, Lazarevski, &Gligorov, 2008). FEMA approach to hazards assessments is composed by 5 different steps with proposed very strict measurable scales and criteria for estimation as well as scale for overall ranking. These different scales and proposed criteria for application of FEMA hazard analysis are based on: History of disaster; Vulnerability of the population/properties; Maximum threat for affecting/damaging; probability of occurrence and trends in occurrence.

Prevention describes those activities that can be implemented following the risk assessment to stop the designated major disaster/incident from occurring (or minimizing its likelihood) – these are examples of hazard reduction programs. Reduction is "identifying and analyzing long-term risks to human life and property from natural or non-natural hazards; taking steps to eliminate these risks if practicable and, if not, reducing the magnitude of their impact and the likelihood of their occurring" Risk

reduction methods are based on the principles of acceptance, avoidance, and mitigation. Some examples of hazard reduction plans are remediation of contaminated land before building on or building barriers to reduce a flooding risk.

Preparedness describes those activities, whose implementation as soon as there is advance warning of an imminent threat will minimize the impact of the incident. Activities include both forecasting and implementing the precautionary measures. It involves both organizations and individuals who are involved in the response, recovery and post-incident audit phases. The processes of inter-agency working are also clarified including how they will be controlled and how they will work with each other. Roles are clearly delineated for organizations and individuals. These are examples of vulnerability reduction programs. Vulnerability reduction describes those activities whose implementation is designed to minimize the consequences of a natural hazard event. This is achieved by lowering the vulnerability to natural hazards and /or reducing the number of elements at risk. Measures will usually be aimed at modifying behavior (WHO 2007). For the health sector, preparedness typically means assuring resiliency of: health facilities to extreme conditions, availability of priority hospital services (focusing on trauma, women's health, child care and chronic conditions), management and triage of mass casualties, evacuation of the injured and quarantine procedures, capacity for search and rescue operations, and the ability to establish disease surveillance and control measures rapidly. The key requirement is that those who need to respond are ready to do so (Cummings &Stikova, 2007). Careful planning is essential in order to assign responsibilities, identify challenges, introduce special procedures, and establish fallback

mechanisms. Preparations and training should focus on identifying essential staff, establishing roster systems, testing procedures, and stockpiling essential supplies.

2.3.2.2 Post-Disaster Activities

Response activities include many different actions as follows: Development of specific incident algorithm; Command and control; Safety (self, scene and survivors); Communication; Scene assessment; Triage; Treatment; Transport. Command and control. Response describes those activities whose implementation in the immediate aftermath of a major disaster/ incident will provide health and social care (to casualties/ those affected by the incident), and will rehabilitate or reconstruct the physical structures of the community. Essential elements of the response include equitable access to adequate safe water, hygienic sanitation, and food and shelter, and protection of affected populations from ill-health and violation. Responses should give priority to the most vulnerable people: women (especially when pregnant), young children, older people and persons who are disabled or chronically ill. It includes how the emergency preparedness and response plan is activated (including Alert and Standby). There are many different emergency plans, some of them being: generic (all hazards) or specific; single agency or multi-agency; local, regional or national; business continuity plans.

Communication is another important aspect of response. According Cummings &Stikova (2007) effective command requires good communication both horizontally between incident officers and vertically (up and down the individual service chains of command). It is usually based on bronze (operational), silver (tactical) and gold (strategic) levels of command. On arrival at the scene of an event, the emergency services will take

appropriate immediate measures and assess the extent of the problem, under the command of their respective officers. This is the bronze management level. Silver is a tactical level of management introduced in order to determine priority in allocating resources, to plan and co-ordinate when a task will be undertaken, and to obtain other resources as required. Most, but not all, of the tactical functions will be discharged at or close to the scene of the incident. The purpose of the gold or strategic level of management is to establish a framework of policy within which Tactical Commanders will work, to give support to the Tactical Commander(s) by the provision of resources, to give consideration to the prioritization of demands from any number of incidents. This involves the process of communication between individuals/ organizations at bronze and between bronze and silver/ gold as appropriate.

Stikova, Lazarevski, &Gligorov (2008) assert that Scene Assessment is key in disaster management within the health sector. The information required at this stage is contained in the acronym METHANE. The initial information to be passed from the scene assessment of a major incident that should be done is:

- M -Has a major incident been declared
- E -What is the exact location (grid reference)
- T - What type of incident is it (e.g. rail, chemical or road)
- H - What hazards are on site (current and potential?)
- A - How is incident accessed (i.e. approach direction)
- N - Numbers of casualties (type and severity)
- E - Emergency services (present and required)

During response to MCIs Triage activities (sieve and sort) are undertaken to sort casualties into priority groups for treatment (Cummings &Stikova 2007). . Whenever the numbers of casualties exceeds the numbers of skilled rescuers present, then the following triage principles should be used: Get the right patient to the right place at the right time; do the most for the most.

Triage is a dynamic process. The aim is to priorities the casualties into groups on the basis of the treatment required:

- Priority 1 (immediate) Casualties who require life-saving procedures
- Priority 2 (urgent) Casualties who require procedures within 4-6 hours
- Priority 3 (delayed) less serious casualties who do not require treatment within the times given above Priority 4 (expectant) Casualties whose injuries are so severe that either they would not be expected to survive or their treatment would require so much input from existing resources that it would compromise the survival of other less seriously ill casualties.

Treatment involves applying those medical interventions that will enable the patient be stabilized prior to scene evacuation closely linked to treatment is transport. Transport involves getting the right patient, to the right facility at the right time.

Recovery encompasses all those activities designed to “address the enduring human, physical, environmental, social and economic consequences of major disasters/ incidents.” Its objective is to rebuild, restore, and rehabilitate the community and all possible disasters’ impacts

Recovery means that the crises are resolved. The recovery phase begins at the earliest opportunity after the onset of the disaster, running simultaneously with the response phase and continues until disruption has been rectified, demands on services have

returned to normal levels, and the needs of those affected (directly or indirectly) have been met.

The common objectives of recovery (and response) are:

> saving and protecting life; relieving suffering; containing the emergency – limiting its escalation or spread; providing the public with warnings, advice and information; protecting the health and safety of personnel; safeguarding the environment; protecting property; maintaining normal services at an appropriate level; promoting and facilitating self-help in the community; facilitating the physical, social, economic and psychological recovery of the community(WHO, 2007).

From a health perspective the crises are resolved when essential health systems have been repaired and rebuilt; when the major health needs of the most vulnerable populations receive attention; and when the health-care environment is secured for both patients and health personnel (Stikova, Lazarevski, &Gligorov 2008). To achieve this, a health sector recovery plan is essential. Such plans focus on essential lifelines to those in need, the restoration of services in primary health centers and hospitals, rehabilitation of laboratory services, disease surveillance and public health programs. They include the identification of vital staff, their support and training, and the provision of essential supplies and equipment. The specialty of emergency medicine meets the scientific, clinical and organizational need for a medical discipline that has a primary concern with emergencies. Emergency medical care of a high standard should be available to every person in need in

all situations and at all times. The scope of activities is early diagnosis and treatment of all life, organ or limb threatening conditions. Objective of emergency medicine is to provide an integrated system of pre-hospital, in-hospital emergency care, to reduce the mortality, morbidity, disability and suffering associated with injury and sudden illness and to study the epidemiology and management of major incidents and disasters. The provision of high quality emergency care requires physicians with specialized training. Unfortunately this kind of education is not available in all Western-Balkan countries. The implementation of EU standards of training in emergency medicine and pan-European examination should be one of the national health care priorities.

2.3.2.3 Legal Frameworks for Potential Health Sector Response Strategies to MCI

The first legally binding WHO instrument, the International Health Regulations (IHR), has been revised in 2005. This revised version, IHR (2005), constitutes a renewed legal framework for WHO to collectively address public health emergencies of international concern, of whatever nature (infectious agent, chemical, nuclear, etc.) or origin (natural, accidental, deliberate). IHR (2005) came into force on 15 June 2007 (WHO, 2007). WHO has a mandate to support the countries in preparing their health systems to cope effectively with the health aspects of crises and to strengthen their public health readiness it requires complex prevention and preparedness strategies. Good governance and good management of health systems are particularly the most important prerequisites for effective operational crisis response.

2.7.3.4 Disaster risk reduction

Globally efforts have been advanced to address risks and frameworks to reduced the same for minimizing impact on populations. The Sendai framework 2015-2030 was

adopted is a good example which can apply to health institutions especially resilience of health infrastructure (United Nations General Assembly, 2015.), the framework is meant to build on Hyogo framework. One other important aspect of the sendai framework is calls for a trans-disciplinary approach supporting closer collaboration among the players to prevent, prepare for, and recover from disasters, as well as respond effectively.(UNISDR Scientific and Technical Advisory Group (STAG). Science is used for disaster risk reduction (UNISDR Science and Technical Advisory Group report, 2015).

2.4 Conceptual Framework of the Study

The conceptual framework highlights the major variables under investigation as shown in the conceptual model in Figure 2.3. It attempts to explain the relation between the independent and dependent variables as well as the intervening variables. The study is based on General System Theory which was originally proposed by biologist Ludwig Von Bertalanffy (1928), and later popularized by Zadeh and Desoer (2008).

Systems theory was originally proposed by biologist Ludwig von Bertalanffy in 1928. Various systems theories such as General Systems Theory, Chaos Theory, Complex-Adaptive Systems, and Integral Theory are described and examples are provided within the context of the human body (Ackoff, 1971; Hasselblatt & Katok, 2003). One important aspect of the systems theory is its application when promoting the unification of health care teams to enhance patient care (Johnson, Miller, & Horowitz, 2008). A great attribute to systems is its ability to change, adapt, respond to events, seek goals, mend injuries, and attend to their own survival in lifelike ways (Meadows, 2009, p. 12).

According to McEntire, Gilmore, and Peters (2010), systems thinking in health provide new opportunities for exploring and finding solutions for the better health of people. Each process is a system, and ordinally systems are individual processes; complex systems may be hundreds, thousands of processes (Hasselblatt& Katok, 2003) Processes are inherently hierarchical – you can drill down into each process, into each step of each process.

The hospitals and health care institutions are complex systems in the sense that includes many other micro-systems or a network of systems which are interconnected and work together to achieve the common goal of patient care (King, Battles, Baker, Alonso, & Salas, 2008). Systems also have the ability to "change, adapt, respond to events, seek goals, mend injuries, and attend to their own survival in lifelike ways" (Meadows, 2009, p. 12).

Systems Approach to surge capacity in hospitals enables health care providers at different hierarchies see the dynamics of the change that is necessary. Complex systems do have inherent changing mixtures of flaws are heavily and successfully defended against failure. According to the second pair of basic system theory concepts, an open and dynamic complex system like the healthcare system is viewed as a suite of interrelated subsystems that are kept in a state of dynamic equilibrium by feedback loops of information and control (Ackoff, 1971)

In the study, systems theory is applied to demonstrate a healthcare system hierarchy with other stakeholders which consists of interactive systems linked with control and communication and collaborations in different layers. The fact disaster and vulnerability

and emergency care are complex systems, the general system theory and the chaos theory applied.

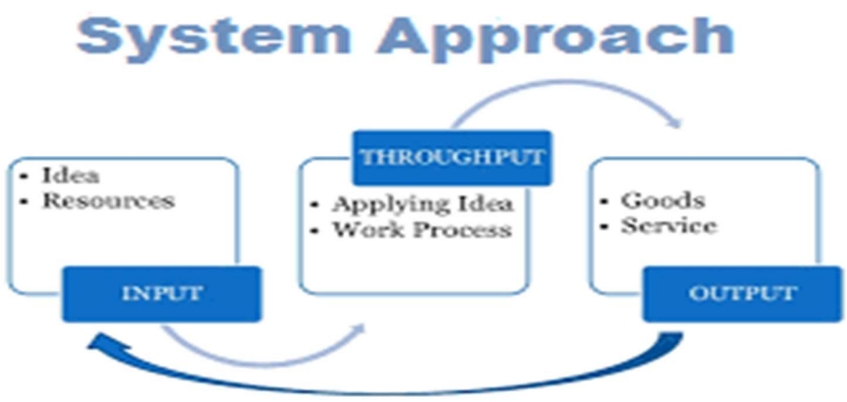


Figure 2.3 System Approach

The study expounded on the Chaos Theory which is defined as *order without predictability*. The phenomenon of chaos theory was introduced by Edward Lorenz in 1972 with conceptualization of *butterfly effect*. Chaos Theory has found its application in various fields including emergency medicine organization crisis and disasters (Farazmand, 2001). Response to immense stress by systems can be unpredictable and hard to control and resist attempts to effective management and organization (Myers and Wee 2005; Rosenfeld et al, 2005)

McEntire *et al*. (2010) suggested that Chaos theory is impossible to detect simple linear cause and effect relationships in situations and that many variables do interact in complex ways to produce disaster. The two theories general system theories and chaos theory attempt to explain how the different variable are interrelated in a complex emergency response situations with overwhelming patient numbers in a hospital(Figure 2.4). Figure 2.4 shows the relationships and interrelationships among independent, dependent and intervening variables.

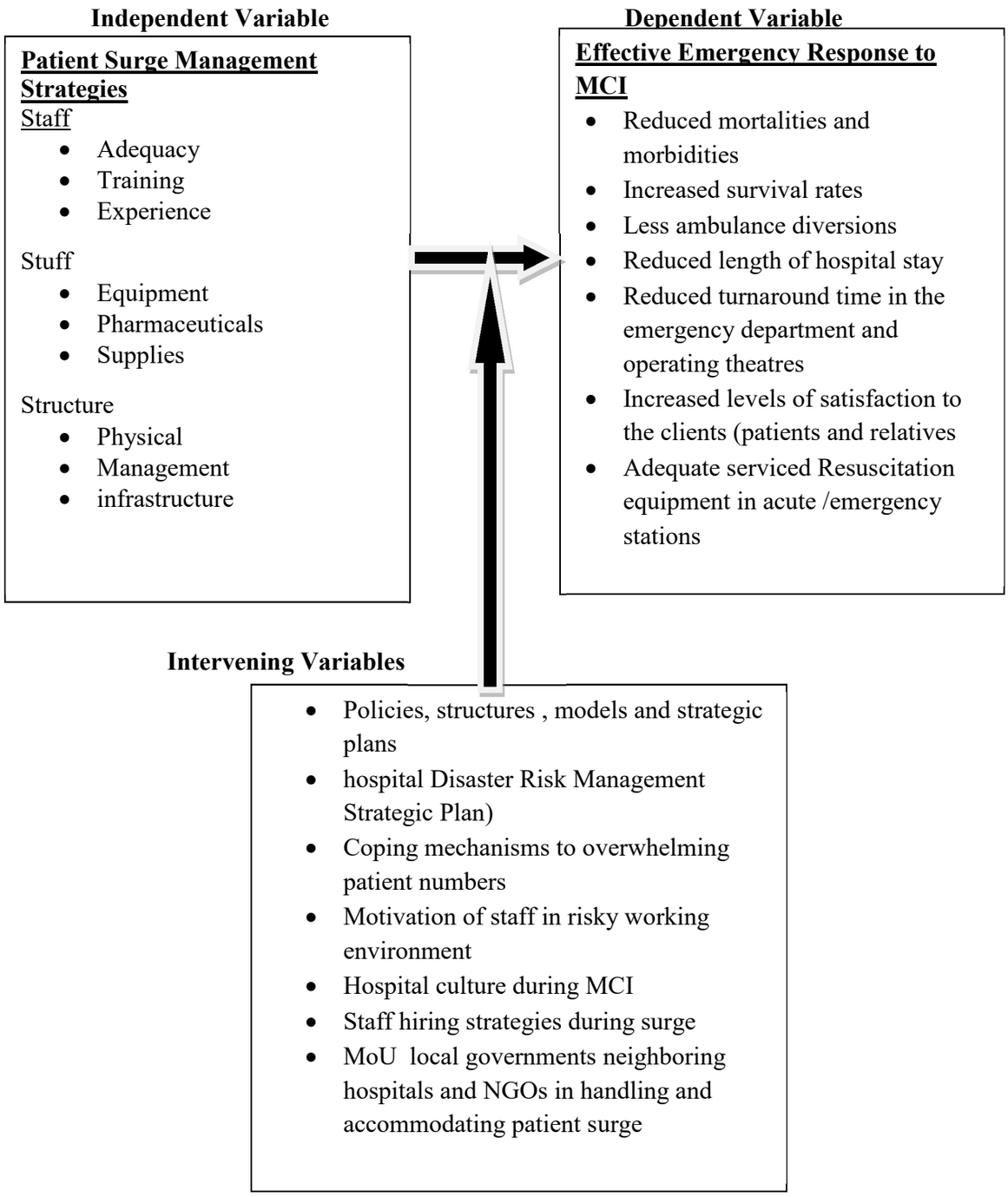


Figure 2.4 Conceptual Model of Surge capacity management and effective response to MCI Source: Researcher, 2023

Researcher, 2019

The conceptual framework showing the independent, intervening and independent variables was important in guiding the study. The systems theory addressed the independent variable indicating the Surge capacity management strategies which produced outcome seen on the dependent variable which is Effective response to Mass casualty Incidents underpinned by the chaos theory depending on available policies and structures and plans and models and strategic plans (hospital Disaster Risk Management Strategic Plan), Coping mechanisms to overwhelming patient numbers**,** Motivation of staff in risky working environment Hospital culture during MCI which are the intervening factors based on this model. The intervention from these variables, therefore, determined the response to the incident was effective or not. This was the focus of this study.

2.10 Chapter Summary

Whereas attempts to contain surge capacity are ongoing, many guidelines have been developed towards defining and applying surge models to address surge capacity. In hospitals there are still many gaps to be addressed concerning the surge concept applicability in different scenarios and geo-economics environments. However, theory and literature searched reveals conceptual and methodological differences despite the commonality of outcomes in the event of disasters. There are many core issues that the African continent has to address, especially huge disease burdens and poor staffing to patient ratios (Rogo *et al.,* 2006) giving emergency preparation for mass casualties less attention with much effort directed towards curative services. Therefore, when faced with MCI casualties, the health facilities and systems are over stretched beyond their capacities. The outcomes for the patients are not favorable in the hospitals since many are poorly prepared for the surge of patients during mass casualty incidences. Some factors

attributed to the poor hospital conditions on the African continent include poorly financed and unaccountable health systems; including weak referral systems. Coping with a sudden surge of patients in emergency situations is a problem to be addressed (Jamison *et al.,* 2006). A review of Kenya's reveals that there is a Comprehensive Disaster Management Policy but at (draft) level no law yet to guide preparedness (Matioli, 2015)) during MCI.

Finally the conceptual framework was guided by one main theory with its subsets; Systems Theory (ST); Subsets –General System theory and Chaos Theory(Von Bertalanffy, 1972).

CHAPTER THREE

RESEARCH METHODOLOGY

Introduction

This chapter covers research locale; study population; research design; sampling strategy; data collection instruments; validity and reliability of instruments and data processing and analysis; ethical considerations; assumptions and study limitations.

3.1 Research Design

Research design is a blue print for conducting a study with maximum control over factors that may interfere with the validity of the findings (Gray, Grove, & Sutherland, 2016), a plan that describes how, when and where data was collected. The study adopted a mixed method approach, descriptive and evaluation research designs. Descriptive research design is appropriate in ascertaining and giving reports the way things are (Mugenda & Mugenda, 1999). Evaluation research is used to analyze the impact of a social intervention on a certain social problem which the intervention is trying to solve (Sekaran, 2003). The questions of surge capacity need to be addressed at different levels in the health system. Therefore, the two methods were integrated at the data interpretation phase of the study. Table 3.1 highlights a summary of research design. Multiple qualitative approaches quantitative approaches were combined. Later triangulated at data analysis. The qualitative approach evaluated healthcare staff experiences and perceptions of a mass casualty terrorist incident response The quantitative data were from verbal responses on state of critical resource availability. Observations made were also quantifiable.

Table 3.1 Research Design as per Specific Objective

NO	OBJECTIVE	MEASURABLE VARIABLE	RESEARCH DESIGN
1	To examine predisposing factors for patient surge at the emergence departments, the wards, operating theatres and ICU	Leadership structures, Plans on transport systems Availability of critical equipment and space, Patient numbers at the time, Hospital culture during MCI	Descriptive Study
2	To explore the status of critical resources required for mass casualty incidences.	Adult ICU capacity Adult Oxygen source and tubing Adult mechanical ventilator set Pediatric mechanical ventilator set Presence of Critical care nurse Suction catheter and suction apparatus Laryngoscope (pediatric), Presence of Critical care physician Sedatives* Pediatric ICU capacity	Evaluation

		Availability of Emergency drugs Theatre spaces, critical care beds ,bed availability	
3	To analyze the strategies applied to cope with patients' surge during mass casualty incidences.	-Available policies and structures hospital Disaster Risk Management Strategic Plan -Coping mechanisms to overwhelming patient numbers -Motivation of staff in risky working environment Alternative sites of patient management, collaboration between hospital and NGOs,role of county government and national governments,churches,schools as temporary shelters, donors , Local and international statutes	Descriptive

Source: Researcher, 2023

3.2 Study Area

The study sought to cover public and private hospitals in Uasin Gishu, Nakuru, Bungoma counties all along the A-104 Highway see appendix 1, Kenya. These hospitals were purposively selected based on the convenience of accessibility and the fact that MCI are very common in the region.

3.3 Study Population

Study population refers to the entire group of individuals/subjects or a collection of units of observation and units of analysis which the study utilized to generalize the observation (Gray, Grove, & Sutherland 2016; Polit & Beck, 2004). The respondents included health care workers in the emergency departments, the OR, ICU and wards where patients are likely to be accommodated during MCI. The administrators and managers in the hospitals were also interviewed. Other respondents were Red Cross officials in Uasin Gishu County and county officers in charge of disaster management. Religious leaders were interviewed for their role is setting up alternative treatment sites in their premises and patients in trauma wards for their experience on daily surges..

3.4 Sampling Methods and Sample size

3.4.1 Sampling

The study used simple random sampling and convenience sampling to select respondents from different departments notably the emergency department, the OR, ICU, and the wards. Babbie (2007) posits that random sampling is appropriate when the population is

not homogeneous. Convenient sampling is appropriate for this study because the staff to be interviewed in the target population was easily accessible and the departments have few numbers on duty on any particular day so using census method all can be reached and interviewed. Purposive sampling was used to select key informant for interviews. According to Sekaran (2003), purposeful sampling is applicable where the subjects to be selected are the only one in the best position to provide the information required.Purposeful sampling or criterion –based sampling ensures the sample has the characteristic relevant to the research questions (Mason, 2006). Convenient sampling method was also be used to reach and interview the staff in the following departments; emergency, theatre, ICU, trauma wards, laboratory, and children wards, general surgery wards. The head of section in the listed sections were sampled purposively for the survey.

3.4.2 Sample size determination

Sampling was done based on the sample size selection Chart Table 3.2. The Chart was used to determine the number of nurses, doctors and clinical officers that were interviewed from emergency, theatre, ICU, trauma wards, laboratory, and children wards and general surgery wards during specific shifts in five private and public hospitals that were targeted by the study. The hospitals covered three counties namely Nakuru, UasinGishu and Bungoma counties. The data from the hospital indicated that there were a total of 1000 health care workers during various shifts who could be interviewed. Based on the number of health care workers, the sample was based on Isaac & Michael (1981); Smith, (1983) who proposed that for a population of 1000 and above a sample size of 286 is sufficiently representative at a precision level of 95%. The population 286 made was the unit of analysis. This is shown in Table 3.2.

3.4.3 Sampling Procedure

The study was conducted in five hospitals, two hospitals within Uasin Gishu county namely, Moi Teaching and Referral hospital and Mediheal Hospital the other hospitals included Webuye county hospital, Bungoma county referral hospital and Elburgon sub-County hospital. The five hospitals were purposively sampled due to their strategic location and based on the number of patients they handle during major incidents along Nakuru- Eldoret- MalabaA-104 Road. The study purposely sampled four sections of the hospital that are mostly used during MCI. The four sections included ICU, Operating Theatres, Emergency department and General Wards. The sample distribution was done based on the staffing capacity of the hospital. Stratified proportionate sampling was used to determine the number of health care workers who were interviewed in each of the five hospitals as shown in Table 3.4

Table 3.2: Sample distribution for health care workers across the five hospitals

Hospital	**Sample size**	**Sampling strategy**
Moi Teaching and Referral hospital	86	Purposive, convenience and Simple random
Mediheal Hospital	40	Purposive, convenience and Simple random
Webuye county hospital	50	Purposive, convenience and Simple random
Elburgon sub-County hospital	50	Purposive, convenience and Simple random
Bungoma county referral hospital	60	Purposive, convenience and Simple random
	286	

Source: Researcher, 2019

Table 3.5: Sample size Selection Chart

SAMPLE SIZE SELECTION CHART

Recommended sample sizes for two different precision levels *Source: Isaac and Michael, 1981; Smith, MF, 1983*					
	Sample Size			Sample Size	
Population size	+5%	10%	Population size	5%	10%
10	10		275	163	74
15	14		300	172	76
20	19		325	180	77
25	24		350	187	78
30	28		375	194	80
35	32		400	201	81
40	36		425	207	82
45	40		450	212	82
50	44		475	218	83
55	48		500	222	83
60	52		1000	286	91
65	56		2000	333	95
70	59		3000	353	97
75	63		4000	364	98
80	66		5000	370	98
85	70		6000	375	98
90	73		7000	378	99
95	76		8000	381	99
100	81	51	9000	383	99
125	96	56	10000	385	99
150	110	61	15000	390	99
175	122	64	20000	392	100
200	134	67	25000	394	100
225	144	70	50000	397	100
250	154	72	100000	398	100

Source: http://www.uwex.edu/ces/tobaccoeval/resources/surveychart.html

Purposive sampling was used to select key informants who included: 5 administrators, 1 from each hospital; 1 Red Cross official; an officer from CJPC; an Officer from the county government Uasin Gishu and a Senior Police officer. The sample also included three FGDs of 8 participants each made of expert panels. Table 3.3 shows a summary of sampling strategies and methods of data collection for each sampled group.

Table 3.3: Summary of sampling Strategies and Methods of Data collection

Study population	**Target Population**	**Sample size**	**Sampling Methods**	**Methods of Data Collection**
Heath care workers- Nurses, Doctors and clinical officers in emergency, theatre, ICU, trauma wards, laboratory, children wards, general surgery wards	1000	286	Convenience, purposive and Simple random sampling	Questionnaire
Hospital administrators	5	5	Purposive	Interviews
The Victims/Patients	400	40	Simple random sampling (10%)	Interviews
Red cross Official	3	3	Purposive	Interview
County Government officers	3	3	Purposive	Interview
Religious leaders (CJPC Official)	3	3	Purposive	Interview
Senior Police officer	3	3		Interview
FGD participants	24	24		FGD
Total	1441	367		

Source: Researcher, 2019

3.4.4 Sampling Procedure

The study was conducted in five hospitals, two hospitals within Uasin Gishu county namely, Moi Teaching and Referral hospital and Mediheal Hospital the other hospitals included Webuye county hospital, Bungoma county referral hospital and Elburgon sub-County hospital. The five hospitals were purposively sampled due to their strategic location and based on the number of patients they handle during major incidents along collection instruments.

3.5 Reliability

According to Phelan and Wren (2005), reliability is a measure of the degree to which the research instruments yield consistent results or data after repeated trials. The data resulting from the piloting was used to test for reliability of the questionnaire questions with regard to research objectives and complexity of the language used. The test-retest method was used on the questionnaires and interviews and focused groups at two week interval between the first and second test. The reliability of the test and retest results was determined by calculation of the correlation coefficient between the first and second test (Douley, 2004). An alpha value of 0.7 was adopted for this study (Mugenda&Mugenda, 2009). internal consistency of (Cronbach $\alpha = 0.96$) was used in one study and anything above 0.7 was said to be adequate test-retest reliability (Marin SM, Hutton A, & Witt RR. 2020)

3.6 Data Collection Procedure

In order to meet the intended objectives of the study, the researcher came up with questions that answered by respondents through interviews, questionnaires and FGDs. Key Informant Interviews, FGDs and questionnaires were used in the process of data collection. Data from the key informants and FGDs were captured both in writing through audio recording with the permission of the participants and later transcribed by the researcher. During the KIIs, the researcher asked the respondents the questions which they responded to in the best way they could. The researcher recorded all these responses in note books and also through an audio recorder.

During the FGDs, the researcher in the company of research assistant asked the respondents specific questions which elicited discussions from among the respondents. The FGDs were homogeneous in terms of gender.

Questionnaires were used to collect data from health care workers. In selecting the health care workers, both random and convenience sampling methods were used during the process of data collection. The data collectors therefore determined a random direction from where to start data collection. In cases where respondents were not available in targeted sections convenience sampling was used by getting the respondents from the next respondent

3.7 Data Analysis and Presentation

Data for each objective was analyzed using both qualitative and quantitative techniques. For Quantitative data descriptive and inferential statistics was applied. The data was

cleaned and entered into SPSS version 20 and analyzed for percentages and frequencies and inferential statistics such as t-tests and correlation analysis.

The qualitative data from the interviews and focused groups was coded to identify the different themes by respondents and the conversation analysis to establish the general understanding of patient surge preparation and response.

The descriptive summary was presented as percentages and frequencies deviation while inferential statistics applied Chi Square test. Data was presented in form of narratives for qualitative data while the quantitative data was presented in form of tables, graphs and pie charts.

3.8 Ethical Considerations

Before conducting a study, it is required that the researcher has not only the expertise and diligence, but also observes honesty and integrity. To ensure that the research observes ethical values, the rights of human subjects involved must be recognized and protected. Therefore, the researcher ensured that the rights to self-determination, anonymity and confidentiality were observed. According to Burns and Grove (1993) an informed consent is the prospective subject's agreement to voluntarily participate in the study. Such consent is reached at after the subject has been given essential information about the research and voluntarily accepts to participate in the study.

The researcher and the research assistants comprehensively explained to the participants, the purpose, objectives and benefits of the study including means of data collection. Issues of anonymity were guaranteed to the participants by ensuring that their names are not attached either to the questionnaire or any feedback meant for the study.

Anonymity is defined as a condition where the subjects cannot be linked with his or her individual responses either by the researcher or any other person (Burns and Gloves, 1993; Kumar, 2005). The study was restricted to only gathering data by asking questions, Focus Group Discussions, Key Informant Interviews and observations which have no health risk to the participants.

The researcher sought approval from two relevant authorities before commencing the research, that is: The Institutional Ethics Review Commission (IERC) based in MMUST which ensured the safety of the study respondents, later a research permit was sought from National Commission of Science, Technology and Innovation (NACOSTI) and the Hospitals where the data was collected. All the participants also provided written consent when they agree to participate in the study. All the data collected was kept in lockable cupboards accessible only to the research team.

3.9 Limitations

Owing to rarity of major disasters in the region and the sampled institutions response bias is bound to occur however this limitation was minimized by broadening of the sampling frame in the region.

Secondly there are disaster events of real concern to the country that occur in particular regions more frequently. It is common place to see floods in the Kano planes around Lake Victoria and terror attacks in the North Eastern part of the country. Regions which experience disasters more frequently learn from past experiences and gaps in the surge preparation. Where the staff has had little exposure, simulation table top exercises were used to create scenarios for appropriate responses.

Finally, the researcher recognizes that many developing countries in many cases are not prepared for disasters and mass casualties' events. It therefore follows that surge capacity in the health institutions is inadequate from the start. Also, the fact that there is variation in resource distribution, with some hospitals more endowed than others response and surge preparation cannot be same across board. All the same time and logistics cannot allow sampling of all hospitals. Different variety of data collection is meant to capture most of what is basic for surge capacity in health care facilities.

3.10 Chapter Summary

This study is basically institutional and was designed review of information from hospital staff and records, the cyclical events impacting on surge capacity were recorded and analyzed to evaluate the impact on stuff and staff in hospital. In regard to sample and sampling technique used were based on the availability of respondents in the hospitals and from key informants. Data was checked for completeness and analyzed using descriptive and inferential statistics the presented in tables and graphs.

CHAPTER FOUR

PREDISPOSING FACTORS FOR PATIENT SURGE AT MERGENCY DEPARTMENTS WARDS, OPERATING THEATRES ICU ALONG NAKURU-ELDORET- MALABA, A104 ROAD, KENYA

4.1 Introduction

This chapter discusses the findings for the first objective of the study. The chapter is divided into various sections and themes to address the objective. The sections include the length of service by the respondents in hospitals, experience of respondents in mass incidents, types of mass incidents experienced, ability to cope with mass incidents among other themes.

4.2 Length of Service by the Respondent in the Facilities

The study sought to determine the length of service by the respondents in the targeted facilities. The respondents were required to provide the number of years that they have worked in the facility. The findings are as represented in Figure 4.1.

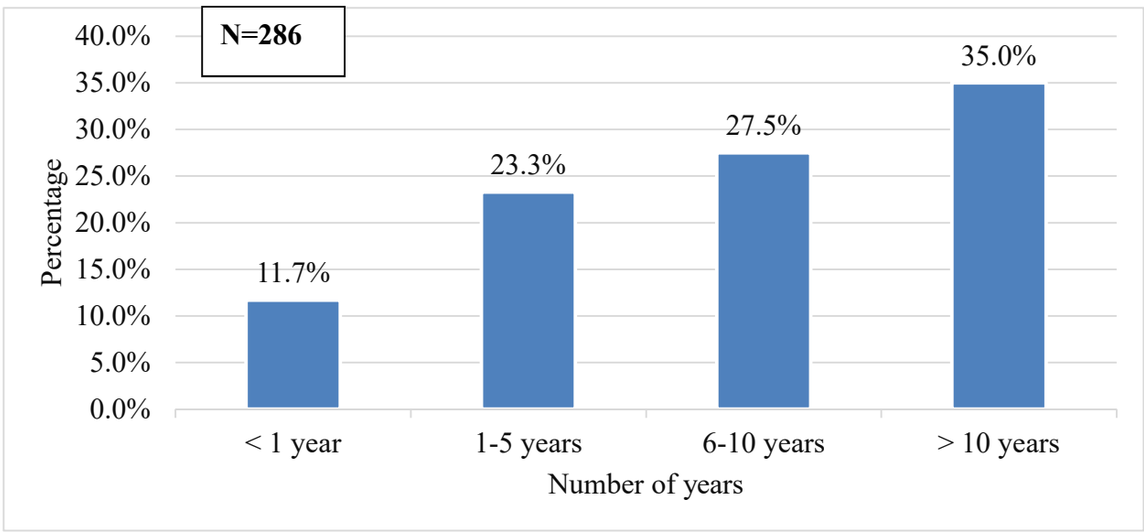


Figure 4.1: Number of years of service by respondents in the facilities

Source: Field data (2020)

From the results in Figure 4.1, it can be observed that 35% of the respondents have been at the facility for more than 10 years. Those who have served between 6-10 years followed at 27.5 %. Those who have served in the facility between 1-5 years were 23.3% of the respondents and the least were those who have served for less than 1 year in the facilities at 11.7 %. This therefore illustrates that all the respondents who have served in the facilities in different number of years were included in the study. From the findings, it can be observed that the study had a high number of the respondents to have worked in the hospital facility for more than 10 years. The likelihood of one responding to a mass casualty incident is directly proportional to the number of years worked in the facility. This means that those who have worked for many years in the facility have a high likelihood of experiencing and responding to a disaster event compared to those who have worked for a short period especially in terms of surge response skills.

A chi-square test was conducted on the relationship between the number of years that the respondents have served in the facilities and experience of major emergency incidence. The chi- square value was 12.607 ($p< 0.05$) and was found to be significant. Therefore, it means that there is significant relationship between the number of years in service and experiencing or responding to major emergency incident. This means that the more the number of years one serves in a facility, the high likelihood of the person to experience and respond to a major emergency incident. This is because there are various types of mass casualty incidents and patient surges that happen daily hence requires skilled response by the medical personnel in the hospitals.

Variable	Chi square value	df	Significance level/p-value
Period of service	12.607	3	.006

The findings from interviews further revealed that the number of years that one served at the hospitals led to accumulated experience which was necessary for efficient response during mass casualty incidences. One hospital administrator from MTRH opined that;

> Majority of our senior staff have gone through a lot of capacity building activities which has been significant in handling emergencies. The Emergency department in particular has staff that has gone through various trainings on mass causality incidents and this has been a major strength of this hospital within the entire Western Kenya region (Interview Hospital Administrator MTRH, 30th January 2020).

The study findings were further supported by the findings from FGDs in which one of the police officers opined that;

> Emergency response, especially during mass casualty incidents requires experience of working in Emergency situations. Police officers who respond to emergencies tend to have first aid training which enables them to save lives in emergency situation. This can only happen when one has sufficient experience in their line of work. Much as the officers may not have ambulances to respond to emergencies but those with first aid training and experience can always help in offering first aid to victims as more help comes from the medical practitioners (FGD Participant, 20th February, 2020).

In another interview with the county officers in charge of disaster management, through their representative, they voiced out the following:

> Mass casualty incidents are the major cause of patient surge in the healthcare facilities. Depending on the type of service required by the presenting patients, various departments have frequently been overwhelmed by the need to attend to high numbers of patients with limited resources. Many of the respondents to these cases lack the prerequisite know-how of the necessary remedial measures that need to be taken to achieve maximum levels of the health of the patients. The short period of the respondents in service in the healthcare system is therefore a problem that worsens cases of mass casualties (Interview with the county officers, Disaster Management, 29th January, 2020).

This was supported by a ward caregiver from the MTRH who stated that;

> Mass casualty incidents are situations that expose the various departments in the healthcare facilities to overcrowding. Whenever incidents like road accidents or pandemics occur, there usually is a high number of people visiting the hospital where many seek emergency care. The lack of responders who have been in service in the field of healthcare long enough to have acquired the skills that enable them to efficiently handle patients in times of surges is a hindrance to the eradication of problems related to mass casualty incidence surges. The hospitals are in need of these personnel to ease the high number of patients during such times and thus ensure satisfaction of all those in the facilities (interview with a ward caregiver MTRH, 17th January, 2020).

One of the components that the healthcare system is in great need of is experienced respondents so as to create a system that is self-sufficient during and without cases of mass casualty incidents. The acquisition of the necessary skills among healthcare professionals is a consequence of continued training that is compounded by lengthy in the time of service. It therefore translates to the fruition of highly experienced healthcare providers who are able to deal with the problem of patient surge. This is however not

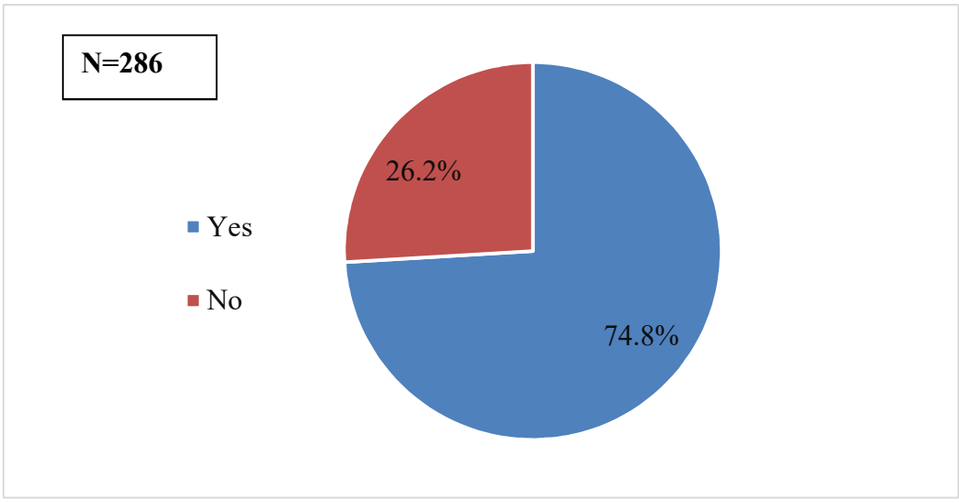
going to be a successful venture in isolation. There is need for consideration of other factors to ensure that the hospitals are able to handle surges.

The need for an increase in the number of experienced personnel in the healthcare facilities was further supported by a patient who opined that:

> Hospitals are in need of healthcare providers with more years of service. This is because there is a limitation in the number of highly experienced healthcare personnel in the facilities. For instance, when there are road accidents and some of the affected people are in need of special care by specialized healthcare providers, there usually tends to be delay which promotes overcrowding as the patients are forced to queue in order to receive care from the few personnel who are present in the facility with those skills. The situation causes not only overcrowding but also instances of worsened conditions among the patients. Equipping the hospitals with service providers who have been in service for long enough to know how to effectively manage cases of surge resulting from mass casualty incidents therefore reduces instances of overcrowding failure to which the problem continues to develop (interview with a patient, 16th January, 2020).

4.3 Experience of Respondents to Major Emergency Incident

The respondents were asked to state whether they have experienced or responded to a major emergency incident in the facility that they worked. The findings are represented in Figure 4.2. From the findings, it is revealed that 74.8% of the respondents had



experienced or responded to a major emergency incident while 26.2% of them had not yet experienced or responded to a major emergency incident.

Figure 4.2: Respondents who have experienced or responded to a major emergency incident with patient surge.

This is in tandem with the correlation done on the number of years of respondents have worked in the facility and the likelihood of responding or experiencing to a major emergency incident. Therefore, this result is in tandem with the number of years one has worked in the facility. Those who have worked longer in the facility have either experienced or responded to a major emergency incident in the country. Most of the staff who were involved in the study were from the emergency department, operating theatres and the ICU. Most of the patients who are involved in a disaster are taken to these departments in the hospital hence the staff have a high likelihood of experiencing or responding to the patients.

The patients who were interviewed during the study also revealed that they had experienced the MCI and had gone through some difficulty in accessing emergency response. This lack of prompt response to the MCI had been occasioned by either the distance from the hospital of the time that one had to wait before receiving the first treatment. For example, the patients had to wait for between one hour to six hours to get treatment due to the overwhelming number of patients during MCI.

There are many instances that the hospitals experience higher numbers of patients compared the available resource thus creating surges. In many of the hospitals, the available healthcare personnel are inexperienced on the manner in which to handle major emergency incidents. As such, patients in distress, pain and even the danger of fatal

results coupled with a myriad of other problems end up spending higher amounts of time in places such as the waiting rooms due to the unavailability of respondents with higher experience to major emergency incidents.

During an interview with the religious leaders, there was support of this sentiment through the following statement:

> There are hospitals that are well-equipped with all the required appliances and facilitations to promote the well-being of the patients and their care givers. Despite this, other problems like the lack of persons who are experienced with response to major emergency incidents. Take for instance, where the healthcare personnel are only efficient in the provision of care for minor cases of emergency incidents. The facilities are likely to be handicapped in their provision of care during cases of major mass casualty incidents as their staff are only used to the minor incidents. There is therefore greater likelihood of overcrowding and more harm to the three aspects involved in the processes. These are the patient, the healthcare giver and the healthcare facility (interview with religious leaders, 26th January, 2020).

More so, an official of the Kenya Red Cross team stated the following concerning the experience of healthcare providers to major emergency incidents:

> There is a higher number of healthcare workers who are experienced in minor emergency incidents than the major ones. This is a disadvantageous case in that whenever there are instances of mass casualties which have been higher recently due to the increased number of incidences such as road accidents and disease outbreaks there is always great need for major emergency care. The limitation in the healthcare facilities thus leads to the build up of high numbers of patients waiting to be provided with acre and thus the occurrence of cases of surges. The lack of enough respondents who are experienced with the situations of major emergency incidents therefore predisposes the hospital to overcrowding in times of mass casualties (Interview with Kenya Red Cross official, 29th January, 2020).

The limitation in the experience of major emergency incidents among the respondents hinders the achievement of the anticipated success in the fight against patient surge in healthcare facilities. Most of the available healthcare providers have limited experience with the various mechanisms with which to handle the different types of patients who present at the hospitals. This is best explained in the individualization of care where each patient has special needs specific to them thus necessitating individualization of care. The

lack of enough experience o the way to handle these major cases therefore predisposes the hospitals to patient surge during mass casualty incidences.

4.4 Type of Mass Casualty Experienced

The respondents provided information on the various types of mass casualties that they have experienced in the facilities during their service delivery. The findings are summarized in Table 4.1. From the results, road traffic accidents were the most experienced mass casualty at 75% followed by other types like landslides, post-election etc. Explosive shrapnel injuries were the least experienced at 0.8%. About 20% of the respondents did not answer the question since they had not experienced any of the mass casualty incidents in their workstation.

Table 4.1: Types of mass casualties

Type of mass casualty	N	Percentage	Rank
Mass shooting	5	1.7	4
Explosive shrapnel injuries	3	0.8	5
Road traffic accidents on mass casualties	215	75	1
Others (e.g. landslide, post-election violence(2007/2008)) Tribal clashes	7	2.5	3
Domestic violence	56	20	2
Total	**286**	**100**	

Source: Field Data (2020)

The Nakuru- Eldoret- Malaba, A104 road, Kenya is prone a number of road traffic accidents which have occurred over the past. This is in agreement with the responses from the medical staff that the mass casualty that they have experienced in the hospitals is from road accidents and they occur on this road. This may due to the high traffic on the road with the long-distance vehicles using this road to connect Nairobi to Uganda to Rwanda and the democratic republic of Congo (DRC).

- Road traffic accidents-75% (90) SIMILAR in turkey Road traffic accidents (RTAs) were the predominant cause of MCIs.(Mohanty, C. R (2022) signifying the importance of standardized MCI management protocols.

Explosive shrapnel Injuries were the least experienced at 0.8% . (Wachira et al.(2014) in AKHU reported 175 people were injured and 67 people died Westgate mall shootings.

Epidemiology of mass casualty incidents in a tertiary care trauma center in eastern India: A retrospective observational study, with knowledge of the most predominant causes of MCI will help local health facilities make rational and objective decisions when planning for responses to the injured. This should be the case because the mechanisms of injury are different.

One of the FGD participants revealed that;

> The most common cases of Mass Casualty incidents in this area are those that involve road traffic accidents. One particular that has been commonly affected is Kipkaren area. The most recent case is one in which a lorry rammed into a crowd of people who were going around their daily businesses in the busy market, killing 6 people on the spot and injuring several others. Before this incident there was another one in which a trailer collided with a passenger service vehicle, killing 10 people on the spot. These incidents have been common in these areas and have been a big concern in the area (FGD participant, Eldoret, 15th February 2020).

During interview with one senior police officer it emerged that the most common cases of mass casualty incident in the area were the cases of road accidents. The assertions were supported by the officials from the county fire department who argued that they received frequent calls to respond to such accidents. The official from Kenya Red cross in support of the findings revealed that accidents were common especially on the Eldoret-Malaba highway. He specifically indicated Kipkaren area had been marked as a black spot.

Most of the Health Care Workers in the hospitals indicated that majority of the road traffic accidents on mass casualties have occurred on this particular road. Some of the mass casualty incidents that have occurred on this road include the Sachangwan (Kenya) accident that occurred on January 31, 2009, hundreds of people gathered near Molo town to collect spilled fuel from an overturned petrol tanker when it burst into flames. About

24 hospitals were overwhelmed and packed with victims, including small children, suffering from horrific burns (The standard, 1st Feb 2009). Some were loaded onto ambulances for transfer to specialist burns units. Supplies, including body bags and extra medicine, were sent by helicopter to the region. Three hundred seventy-three people were affected; 130 were badly burned, some beyond recognition, and a further 72 died in hospitals. One hundred seventy-one were treated in various hospitals for their injuries and discharged (Wachira& Smith, 2013).

There are various types of mass casualty incidents experienced by hospitals and healthcare providers. These incidents can either be conventional or catastrophic. In any part of the country, mass casualty incidents can quickly exhaust the available resources. This is in particular for the rural areas where resources are more limited and therefore tend to be depleted faster than more developed communities. In many instances, mass casualties are often unpredictable and this creates necessity for emergency preparedness with the government and societies working together in effort to ensure maximum preparedness for such incidents. It is this effort that usually enables healthcare facilities and providers to be able to mitigate events like death, trauma or injuries that may result from the incidents of mass casualties.

Conventional mass casualty incidents are those that are experienced on almost a daily basis in the healthcare facilities. They are the incidents that most patients often report at the hospital departments. The incidences occur on a regular basis and include events like adverse weather conditions and vehicle crashes. The catastrophic mass casualties are less common and usually emanate from severe occurrences such as a natural disaster. In both types of mass casualty incidents, the level of injury or trauma experienced and in need of

medical intervention varies from patient to patient thereby affecting the cases of patient surge in the hospitals where the affected patients present.

During an interview with the county officers in charge of disaster management, one had the following to say:

> Patient surge in hospitals is one perplexity that has been unsolved in most of the Kenyan hospitals for a long time. There are many reports of the negative impact that results from overcrowding in hospitals including the development of complications, transmission of diseases as a result of contact and worsening of the clinical symptoms of the patients who visit hospitals as a result of mass casualty incidents. Where the involved type of mass casualty incident involves severe levels of injury or trauma, there is a high likelihood of the development of patient surges in the facility. However, when the incidents involve minor cases of injuries which require minimal or readily available care from the healthcare facilities, then the likelihood of patient surge is also low (interview with disaster management county officers, 26th January, 2020).

The same was echoed by an administrator from the MTRH who stated the following:

> There are different types of mass casualties. The effect of this is that the type of incident determines the type of injury sustained and the amount of damage that results from the same and thus the amount of care that one requires upon presentation at the hospital setup. There are differences in the level of specialization and care required by these patients. Therefore, patients who are involved in severely catastrophic mass casualty incidents often end up requiring more care than those involved in minor incidents. As such, should there be ahigh number of people involved in catastrophic mass casualty incidents, there is an increase in the possibility of the occurrence of cases of patient surge (interview with MTRH administrator, 25th January, 2020).

4.5. Ability to cope with the numbers and flow of patients during major emergencies with patient surge

The researcher wanted to know whether the facilities had the ability to cope with the increased numbers of patients during major emergencies. The findings are as summarized in Figure 4.3.

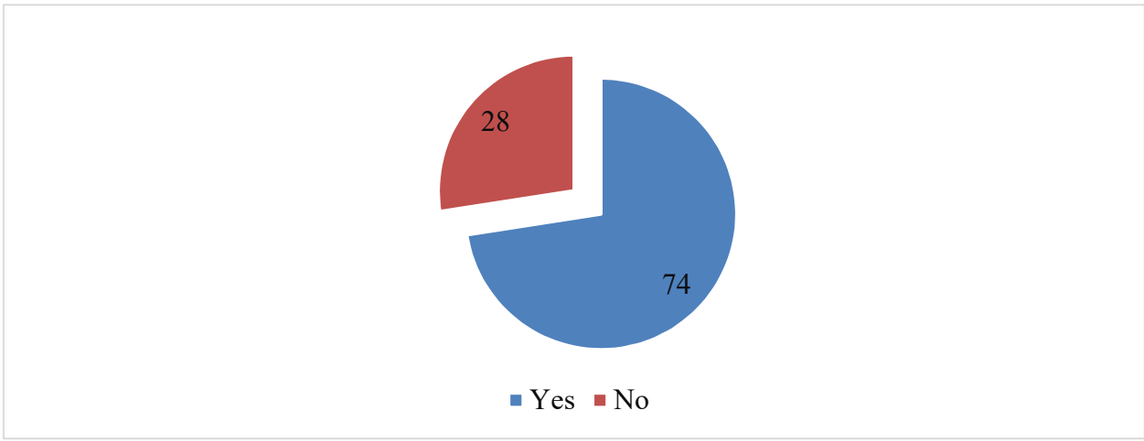


Figure 4.3: Ability to cope with number of patients during major emergencies

Source: Field Data (2020)

The Figure reveals that 74% of the respondents indicated that their facility was able to cope with increased numbers of patients during major emergencies while 28% of them declined. The Hospital administrators revealed during interviews that in the event of mass casualty incidents there were challenges in coping with the huge numbers, however, in the event of such unforeseen circumstances, the hospital would take extra measure to cope with the situation. One of the administrators opined that

> When our hospital bed capacity is full and more patients are still coming in, we can create room for more patients by utilizing extra-spaces within the hospitals. Some of the areas that can be converted to wards include corridors, nurse stations and even the lobby (Interview with Hospital Administrator, 29th January 2020).

A paper by TariVerdi*et al*., (2018) pointed out that during a mass casualty incident, patterns of patient arrival at the hospital facility solely depend on the circumstances of the event and unit service capacities depend on availability of required resources like staff and equipment. One of the respondents indicated that during a mass casualty incident, the hospital management mobilizes resources from various departments to respond to the

emergency. By pooling together, the human resource, then the hospital is able to cope with patient surge during a mass incident. In addition, the hospitals had mechanisms through which they use during incidents involving masses and liaising with other neighboring institutions to help where necessary.

Mass casualty incidents call for a well-prepared healthcare system in the various departments involved in the provision of care. The preparedness of the available facilities is important in the alleviation of healthcare problems such as patient surge. The ability of these facilities to cope with high numbers of patients and patient flow is embedded in their level of preparation for emergencies. Impairment of the healthcare system's ability to handle high numbers and thus flow of patients predisposes the facilities to patient surge which is an inconvenience to the functionality of the healthcare system, which includes the patients, facility and healthcare providers. The inability can be as a result of a number of factors including shortage in staffing, funding and even experience levels.

The ability to cope with numbers and flow of the patients was evidenced as a predisposing factor of patient surge cases by a registered nurse working in the operation room through the following articulation:

> Overcrowding is a major problem in this facility where a lot of time is spent in the waiting room line ups as patients wait for their turn to be served. There are several aspects behind this conundrum including limitations such as shortage of beds, lack of some appliances and equipment required to perform special procedures as well as poor worker coordination in some of the healthcare departments. It is these limitations that thwart the healthcare system's efforts to curb the problem of overcrowding, thus predisposing it to the problem even more. Further, there are instances of obstruction in the flow of patients. This causes departmental problems in that some departments, such as the emergency department, end up holding more patients than their capacity thereby making the patients overcrowd as they await their chance to be admitted to the hospital wards. Other patients end up in places such as hallways with increased risks of development of new diseases, complications or even squabbles with other patients (interview with a nurse MTRH, 17th January, 2020).

The sentiment was furthered by a patient who stated that:

> *Hospitali ni mahali ambapo wagonjwa hutarajia kupata afuenikutokana na matatizo yanayotokana na ajali wanazokumbana nazo katika shughuli zao. Ni hospitali ambazo zinafaa kuwapa matibabau yatakayowawezesha kurejelea hali zao za afya njema. Matibabu haya huwawezesha majeruhi kuponaili kuweza kurejeahali zao za kawaida. Hivyo bazi, kutokuwepo na uwezo wa kuwashughulikia majeruhi hawa katika hospitali, kuna uwezekano wa kuwepo kwa msongamano wa wagonjwa katika mandhari haya ya vituo vya afya. Hali kama hizi huweza kuendeleza kuudhoofika kwa afya kwa majeruhi na hata kukuza zaidi udhaifu wa matibabu ya vituo hivi* (Hospitals are places where patients expect to gain relief of their distress resulting from cases of occurrences such as mass casualty incidents. It is the healthcare facilities that offer care which enables patients to regain their stable health conditions. The care offered ensures that the patients improve from the trauma and injury that they are exposed to in situations such as road accidents and disease outbreaks. In this case, the inability of hospitals to provide enough care to the patients thereby ensuring a consistent and successful process time leads to overcrowding. Whenever a patient cannot properly access services from the time of first presentation at the healthcare facility to their admission or discharge, there is usually one or more instances of overcrowding in some departments and thus disadvantaging the proves of recovery of the patients) (interview with a patient, 24th January, 2020).

4.6 Sufficiency of resources to respond to mass casualty victims

The study sought to find out whether the resources in the facilities were sufficient to respond to mass casualty victims. The results are summarized in Table 4.2.

Table 4.2: Sufficiency of resources

	Sufficient		**Not sufficient**		**Non-response**	
	N	**Percentage**	**N**	**Percentage**	**N**	**Percentage**
Staffing	122	42.5	122	44.2	42	15.6
Equipment	122	42.5	122	44.2	42	15.6
Infrastructure	124	43.3	124	43.3	38	13.4

Source: Field data (2020)

From Table 4.2 it can be noted that 43.3% of the respondents agreed that infrastructure is sufficient in the facility to respond to mass casualties while 42.5% stated that staffing and equipment were sufficient to respond to mass casualties. However, 43.3% of the respondents stated that the infrastructure was not sufficient to respond to mass incidents while 44.2% stated that staffing and equipment were not sufficient. Some of the respondents did not respond to this question due to uncertainty and comprised 13.4% of the respondents.

The findings were supported by hospital administrators who opined that in regard to staffing challenges in the event mass casualty incidents, there are ways to cover shortages. One of the administrators revealed that;

> In the event of these MCIs, all health care workers are put on high alert because they are essential workers and as such they are always prepared. One way to cope with shortages in the case of MCIs is recalling staffs that are on leave. Sometimes we also use seniormedical students to come in and assist other doctors and nurses handle patients during such unfortunate times (Interview with Hospital Administrator (MTRH), 29th January 2020).

According to TariVerdi *et al*., (2018), during a mass casualty incident, the health care system is faced with an abrupt increase in demand for intensive care resources. The efficient management of various critical resources like staff, equipment, and infrastructure is important to achieve demand requirements during surge (TariVerdi *et al*., 2018). The current COVID-19 pandemic has exposed the country in terms of sufficiency of resources to respond to patient surge during the pandemic. Most of the hospital facilities in the country do not have enough resources in terms of staff, equipment and infrastructure to respond to the COVID-19 pandemic. This pandemic has seen the president of the republic of Kenya to call on the 47 counties to increase their ICU bed

capacities to at least 300 so that they can be able to cope with the increased infection of the Corona virus pandemic in the country. This is the latest incident that has really put the hospital facilities into test on the availability of resources during a mass incident like the COVID-19 pandemic.

For the success of any enterprise, there has to be availability of resources. The basis of the success of a facility is laid on the availability of resources upon which all the activities are run. The availability of resources ensures that the processes engaged in are successful in that the prerequisite factors that are generally referred to as resources are available. The aspect is indispensable in the healthcare system in that the availability and sufficiency of resources determines the success of the process of provision of care and patient satisfaction scores. The resources referred to in this case are finances, equipment and trained personnel. Whether or not a healthcare facility experiences perplexities such as patient surge is dependent on the adequacy of the available resources.

During an interview with the MTRH administrator, he opined that:

> It is quite disheartening when patients have to cluster in specific hospitals as a result of some facilities lacking enough appliances and equipment with which to perform certain procedures. The accumulation of many patients in specific hospitals due to their ability to provide care as a result of the sufficiency of their resources predisposes them to overcrowding. Seen in the current state of many of the healthcare facilities, patients, like other consumers in any other industry, usually visit hospitals where they are likely to receive adequate care of the accepted standard. Consequently, there is an increased likelihood of these facilities having problems related to overcrowding (interview with MTRH administrator, 12th March, 2020).

In another interview with a patient, there waste following remark:

> *Kuna tatizo la uhaba katika hospitali za nchi yetu tukufu. Japo serikali imeweka mikataba ya kuhakikisha kuwa hospitali zinaweza kumudu idadi ya juu ya wagonjwa, tatizo lenyewe limeendelea kukua kwakiwango kikubwa. Ukosefu wa vifaa vya matumizi katika matibabu ya wagonjwa ni jambo moja tu kati ya mengi yanayotokana na hali mbaya ya uchumi hospitalini. Kutokana na hili, wagonjwa wengi wanaona ni heri kusaka matibabu katika hospitali zinazoweza kumudu*

> *mahitaji yoteyamatibabu yao. Hizi ni hospitali ambazo zina vifaa na wahudumu wa kutosha. Ni jambo ambalo linasababisha kuwepo kwa wagonjwa wengi kwa wakati mmoja katika hospitali zingine* (There has been the problem of lack and want in the hospitals of our country. Despite the government's efforts to curb the situation, it has continued blossom in in even higher rate. The insufficiency of equipment in the hospitals is just but one of the aspects that represents the lack of adequate resources. As a result, many patients deem it better to seek care from facilities that are able to handle all their health requirements. These are the facilities with adequate stuff and supplies. It is a problem that has led to overcrowding in some facilities.) (Interview with a patient, 13th March, 2020).

In agreement with the findings of the study a report by Sprung*et al*., (2010), indicates that when disasters occur, staffing may be limited due to staff absenteeism, illness and closure of childcare facilities. Therefore, the report indicates that plans to coordinate and increase staff are paramount for continued and expanded ICU care. Some of the staffs to increase in the ICU include intensivists, nurses and expanded support staff personnel. The report indicates that it is important that the roles and responsibilities of key individuals be defined before the occurrence of a disaster. The hospital workers need Education, preparation and communication to be fully prepared to respond to a major disaster effectively. The number of trained staff is the dominant rate-limiting step to increasing surge capacity (Sprung*et al*., 2010) apart from stuff and infra-structure.

A chi-square test was conducted between sufficiency of staff and the number of patients/ patients surge in the facilities. The chi-square value of 8.462 was obtained at a p-value of 0.05. The value therefore shows that there was no significant relationship between sufficiency of staff and number of patients.

Ho: There is no significant difference between staff sufficiency and number of patients

Variable	Chi square value	Df	Significance level/p-value
Sufficiency of staff	8.462	5	0.133

Number of patients/patient upsurge: Significant at p value <0.05

According to WHO (2022), a successful mass casualty outcome requires coordination and collaboration structures as well as all stakeholders within the response, which might include first responders, healthcare workers, Guide: Mass casualty preparedness and response in emergency units.This means staff numbers alone cannot enable efficient response to MCI. Other factors include the infrastructures and necessary equipment.

4.7 State of Resource's Ability to Handle Patients Flowing on Massive Scale After Disaster Event

The respondents were asked the status of resource's ability to handle patients flow during a disaster event. The findings are as indicated in Figure 4. 4.

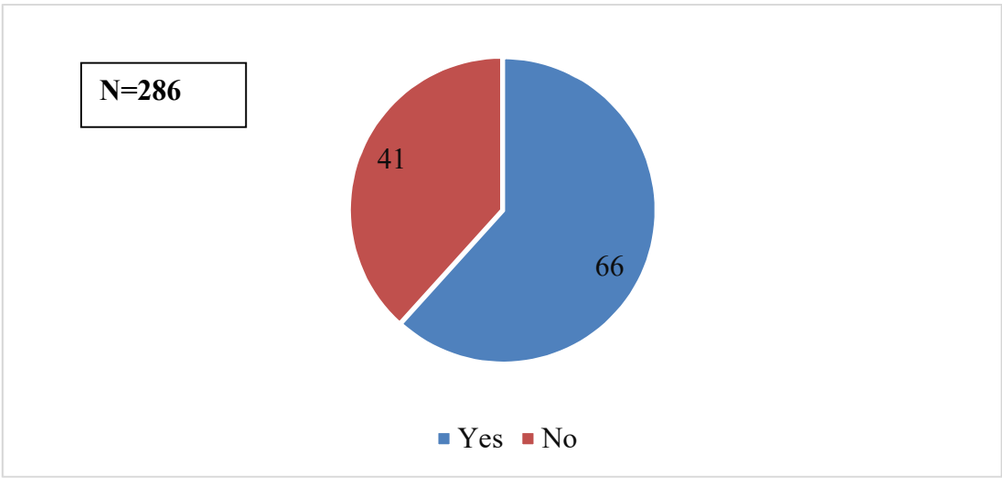


Figure 4.4: Status of resource's ability to handle patients during a disaster event

Source: Field Data (2020)

The results show that 66% of the respondents agreed that there is enough resources in the hospital to handle the increased number of patients during a disaster occurrence. However, 41% of them did not agree that the facilities had adequate resources to handle patients during a disaster event.

A correlation analysis was conducted between the state of resources and availability of equipment. It was found out that there was a strong significant association between the state of resources in the hospital and availability of equipment.

Variable	Spearman's correlation coefficient	Significance level/p-value
State of Resource	0.756	0.000

Dependent variable: Availability of equipment

4.8 Availability of equipment/facilities in working state for MCI response

The study sought to find out the availability of equipment in working state for MCI response. The findings are summarized in Table 4.3. From the table it can be observed that laboratory at 87.5% agreed that there was a laboratory followed by radiological services at 85.8%. The other equipment and facilities that the respondents agreed were blood bank 64.2%, ward beds 62.5%, ICU beds 56.7% and lastly beds in ED at 54.2%.

In addition, 37.5% of the respondents disagreed that the hospital had enough ICU beds for MCI response while 31.7% disagreed that there lacks enough blood bank stock in case of an MCI. However, 9.2% were not sure whether there is enough beds in ED for MCI. Hospitals should ensure that adequate essential medical equipment, pharmaceuticals and other important supplies are available during a disaster (Sprung*et*

al., 2010). Therefore, the hospital needs to know in advance the kind of resources that are available and those that are not to prepare better before the disaster occurs.

Table 4.3: Equipment/ facilities in working condition for MCI response

Equipment/ facility	Agree		Disagree		Not sure		NR		Rank
	N	%	N	%	N	%	N	%	
Blood bank	184	64.2	91	31.7	9	3.3	2	0.8	3
Laboratory	250	87.5	31	10.8	0	0	5	1.7	1
Beds in ED	154	54.2	100	35	26	9.2	5	1.7	6
ICU beds	162	56.7	107	37.5	14	5	2	0.8	5
Ward beds	179	62.5	84	29.2	17	5.8	7	2.5	4
Radiological services	245	85.8	26	9.2	12	4.2	2	0.8	2

Source: Field data (2020)

A correlation coefficient was calculated on the relationship between equipment's availability and handling of patient surge in hospitals. The coefficient was – 0.202 at a p-value of 0.032. This shows that there was significant negative relationship between equipment's availability and handling of patient surge. This therefore means that improved equipment availability results in reduced number of patients above the normal turn out.

Variable	Spearman's correlation coefficient	Significance level/p-value
Availability of equipment	-0.202	0.032

Dependent variable: Daily patient surge

The factors predisposing healthcare systems to surges are independent and intertwined as seen in the case of the availability of funds and thus the necessary equipment. Another problem is in the management aspect where such practices as regular checks and maintenance practices of the hospital equipment are necessary to avoid compromise in

the care of the patients and their safety. Sometimes out of negligence, there is failure in the management system which leads to the presence of malfunctional equipment in the hospitals. Some of the equipment that are commonly non-functional in some healthcare facilities include the electronic health record (EHR) systems, X-ray machines, infusion pumps and MRI (Magnetic Resonance Imaging) machines.

During the sequence of interviews with the Kenyan Red Cross officials, there was the following sentiment:

> The availability and adequacy of resources in hospitals has not been the only challenge faced by the healthcare facilities. There have been other instances where hospitals have their equipment and appliances present in them. However, the available appliances are not usable since they exhibit traits such as being malfunctional which renders them incompetent for use by the healthcare personnel and patients. Such equipment and appliances include MRI and X-ray machines. The problem has also caused cases of patient surge in some facilities (Interview with Keyan Red Cross officials, 12th March, 2020).

In another interview, this was articulated as a predisposing factor of patient surge in the healthcare system by a county officer in charge of disaster management. He stated that:

> Mass casualty incidents expose the hospitals to overcrowding in that they are occurrences that lead to high numbers of patients requiring healthcare services. Under conditions where there are high numbers of patients in the healthcare facilities, there is need for availability of ample resources to cater for the various needs of the patients. In the even that the available equipment are not in working states, there is impairment of the provision of care to the patients for the various designated purposes set for the malfunctioning equipment. A good example is in the case where the incidents leading to casualties expose patients to conditions that require such processes as scanning. Malfunctioning or breakdown of the X-ray or MRI machines thus causes cases of overcrowding in the hospitals where these machines are available in working states (interview with county officer of disaster management, 11th March, 2020).

Malfunctioning equipment area dangerous aspect in the healthcare facilities. This is because the attempt to put into use such equipment can have devastating effects for both the healthcare provider and even worse for the patient under care. Serious repercussions such as compromise in the treatment of patients which can impose potential harm to the patient. For tests that are critical, the use of malfunctional equipment leads to increase in

the waiting times and healthcare professionals strain as they attempt to effectively provide efficient care with the limited available resources. Where the electronic health records are erroneous leads to negative effect on the accuracy of records kept on the information of patients which is a jeopardizing factor.

4.9 Patient surge above daily surge in your department that you are able to handle without external help

The respondents were asked to state the patient above daily turn out in the various departments that they are able to handle without external assistance. The responses are summarized in Figure 4.5. From the results, it is observed that 27.5% of the respondents indicated that they could handle between 0-10 patients daily without external help. Those who could handle between 11-20 patients were 24.2%, 21-30 patients were 8.3%, 31-50 patients were 7.5% while those who could handle above 50 patients in a day were 24.2%.

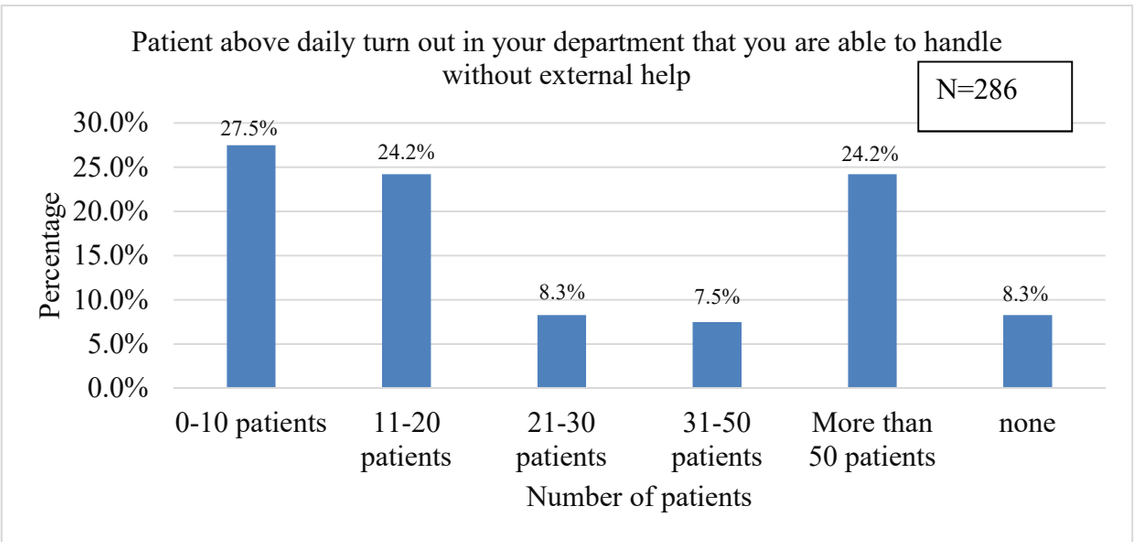


Figure 4.5: patient above daily turn out in your department that you are able to handle without external assistance

Source: Field data (2020)

A regression analysis was conducted on equipment availability; coping strategies and the handling of patients above the normal turn out. It was found out that availability of equipment was significantly associated with handling of patient number above turn out ($p<0.05$) while coping strategies were not significantly related to it ($p>0.05$). However, both of the variables were found to be negative hence they were negatively associated indicating that improved equipment and coping strategies led to reduction in the number of patients above the normal turn out they could handle.

Independent Variable	Beta standardized coefficients	Significance level	Adjusted R Square
Availability of equipment	-0.121	0.038	0.158
Coping strategies	-0.097	0.155	

Dependent Variable: Ability to handle Patient number above daily turn

The Adjusted square for the variables was (R=0.158) indicating that 15.8% of the changes in patients' numbers above the normal turn up is explained by the coping strategies and availability of equipment in the hospital facilities. Therefore, it means that when a hospital has effective coping strategies during a mass casualty incident then they are able to support a large number of patients above the normal during an incident of large magnitude. When a facility is properly equipped with the relevant equipment then the number of patients it can serve effectively increases. The availability of resources in the hospitals is a key factor in determining the number of patients a facility can handle above the normal turn up.

Therefore, the average number of patients that a healthcare facility serves on a daily basis is also a great determinant of the likelihood of the occurrence of overcrowding in the different departments of the system. Mass casualty incidents usually occur as unplanned for events that lead to high numbers of patients in the facilities thus a higher demand for healthcare services than the normal daily demand. Such an occurrence is usually overwhelming to the system as the healthcare providers have to put in extra effort to be able to manage the higher number of patients. Where the available departments in a facility cannot handle the sudden increase in the number of patients resulting from mass casualty incidents, problems related patient surges are experienced.

4.10 Chapter Summary

The first objective of the study sought to examine the predisposing factors for patient surge at the emergency departments, the wards, operating theatres and the ICU. It was observed that 74% of the respondents had either experienced or respondent to a major emergency incident in the workplace. However, the study found out that there is no enough staff, equipment and infrastructure to respond to a mass casualty incident in the study area.

CHAPTER FIVE

AN EVALUATION OF THE STATUS OF CRITICAL RESOURCES REQUIRED FOR MASS CASUALTY INCIDENCES ALONG NAKURU- ELDORET-MALABA A104 ROAD, KENYA

This chapter delves on the status of critical resources required for MCIs. It has canvassed the availability of these resources as well as their functional status.

5.1 Availability of disaster supplies for disaster in hospital stations/departments.

Mass casualty incidents (MCIs) are characterized by such high numbers (tens to hundreds to tens of thousands), severity, and diversity of injuries and illnesses that can overwhelm the ability of local medical resources to deliver comprehensive and definitive medical care to all victims. Recent experience with large scale natural disasters, bombings, threats of weapons of mass destruction, and pandemics such as Covid-19, suggest that modern-day mass casualty events would compromise the ability of all local, regional, or national health systems to deliver services consistent with established standards of care while rapidly overwhelming both the medical and public health systems.

5.1.1 Incident Command System Vests

As illustrated in Figure 5.1, 28% of the respondents, interviewed, averred that incident command system vests as disaster supplies were available. On the contrary, 43% of the respondents indicated that such vests were not available. Further, 21.6% of the total respondents were not sure whether such supplies for disaster were available. Disturbingly 7.4% respondents were neutral and therefore did not assertively respond to the inquiry.

Mass Casualty Incidents (MCIs) poise unpredictable and devastating events, ranging from natural disasters to acts of terrorism and pandemics. The unique challenges presented by MCIs cement the critical importance of having well-prepared hospital stations and departments equipped with ample disaster supplies. The discussion focuses on the availability, functionality, and strategic considerations of disaster supplies, using the Nakuru-Eldoret-Malaba A104 road in Kenya as a contextual backdrop. MCIs can overwhelm local medical resources, making it challenging to provide comprehensive care to a large number of victims. MCIs, characterized by a sudden surge in the number of victims, pose significant challenges to local medical resources, necessitating a proactive and strategic approach to preparedness. The Nakuru-Eldoret-Malaba A104 road in western Kenya serves as a lifeline, facilitating the movement of goods, services, and people. However, the nature of its importance raises concerns about the potential impact of an MCI on the crucial artery and the preparedness of hospitals to respond.

Availability of disaster supplies goes beyond the presence of stock since it requires attention to accessibility and functionality. In the chaos of an MCI, non-functional and inaccessible supplies are of little use and can jeopardize the probability of providing and comprehensive care to a large number of victims. Regular checks and maintenance procedures are imperative to ensure the functionality and accessibility of these critical resources. Hospitals in western region and wider nation must establish functional protocols for ongoing monitoring, testing, and upkeep of disaster supplies. This includes physical resources, technological infrastructure and communication systems that play a pivotal role in managing MCIs.

Jointly, hospital staff must undergo continuous training to manage and maintain these supplies. Training programs should be tailored to the specific needs and challenges posed by different types of MCIs. Such proactive approach ensures that healthcare professionals are well-acquainted with the diverse range of supplies and also adept at utilizing them under high-stress conditions. The diversity of potential MCIs necessitates the maintenance of a broad spectrum of supplies to cater to varying scenarios. Natural disasters, acts of terrorism, and pandemics each require distinct resources and response strategies. Hospitals and medical facilities must, therefore, curate a comprehensive inventory that aligns with the multifaceted nature of potential MCIs. Notably, the nature of the MCI influences the types of supplies required. A natural disaster, such as an earthquake or flood, may necessitate different resources than a pandemic like COVID-19. Therefore, having a broad spectrum of supplies capable of addressing various types of MCIs is crucial.

Personnel in hospitals and medical facilities must receive regular training to use these supplies. Training programs should be designed to keep all staff members updated on the latest procedures and protocols. The above ensures that healthcare professionals are well-prepared to handle the unique challenges posed by different MCIs. In managing MCIs, the role of information and communication technology (ICT) is pivotal. Efficient communication systems improve coordination between different departments and facilities, leading to a more effective response. The integration of ICT can streamline information flow, enhance situational awareness, and facilitate decision-making during high-stress situations. The government and policy-makers play a crucial role in ensuring the availability of disaster supplies. Policies should be in place to guarantee that hospitals

and medical facilities receive adequate funding and resources to handle MCIs. Regular audits and inspections can help identify any gaps in the availability and functionality of these essential supplies.

In examining the availability and use of Incident Command System (ICS) vests emerge as a critical aspect. These vests are essential markers for personnel involved in emergency response, aiding in the identification and coordination of key stakeholders. The study engaged a diverse group of respondents, in charge of disaster management, religious leaders, and patients in trauma wards. Their perspectives provide a comprehensive understanding of the current state of emergency preparedness in the sampled hospitals and organizations. The study revealed divergent views on the availability of ICS vests among the respondents.

Figure 5.1 demonstrates that 28% of those interviewed affirmed the presence of incident command system vests as essential disaster supplies, while 43% reported their non-availability. Furthermore, 21.6% expressed uncertainty about the existence of such supplies, and 7.4% adopted a neutral stance, refraining from providing a definitive response.

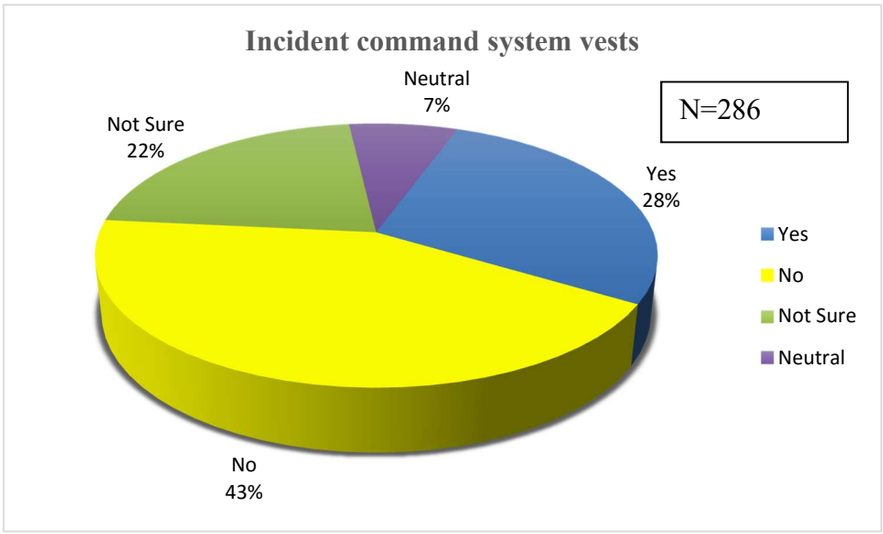


Figure 5.1 Incident Command Systemic Vests

Source: Field Data, 2020

Hospital administrators shed light on the significance of ICS vests in ensuring the safety of staff during emergencies. The vests were identified as a symbolic representation of the functionality of the hospital's Incident Command System. Administrators emphasized the importance of these vests, particularly the color-coded ICS vests and accompanying signage, in reducing confusion and facilitating communication among healthcare workers and supervisors. Feasibly, one of the hospital administrators opined that:

> In the procurement process in our hospitals, one of the things we prioritize is Personal Protective Equipment (PPEs). While major disasters and Mass Casualty Incidents (MCIs) are not common in this region, we ensure that equipment like ICS vests is readily available. Our medical staffs are akin to soldiers in the battlefield, especially when responding to mass casualty incidents, be it an accident or a pandemic like COVID-19. Therefore, all protective gear, including incident command vests, is something we consistently ensure is available to doctors, nurses, and other healthcare workers in the hospital" (Interview with hospital administrator on 30th January 2020).

According to Aliyu, (2015), in emergency and disaster management situations globally, there has been the integration of local fire, police, and emergency medical services for incident command system paraphernalia. However, modern responses to MCIs involve services from many different agencies and organizations including public health in this regard, there is need to have highly visible clothing like incident command vests for the sake of ensuring safety and ease in identification during MCI.

The more complex the disaster, the more agencies will participate in incident command system. According to FEMA (2008) by definition, MCIs require unprecedented coordination, collaboration, and cooperation of disparate organizations and jurisdictions to ensure operational success. Incident Command System (ICS) is created to provide a common organizational structure and language to coordinate and simplify communication and establish clear lines of authority with a seamless command structure.

5.1.2 Job Action Sheets

The study sought to ascertain whether job action sheets were available as disaster supplies in MCI.As illustrated in figure 5.2, 72% of the respondents reasoned that job action sheets were available in hospital stations. Contrariwise, 7% of the respondents stated that such supplies were not available in hospital stations. Further, 14% of the respondents were not sure while additional 7% were neutral on the responses.

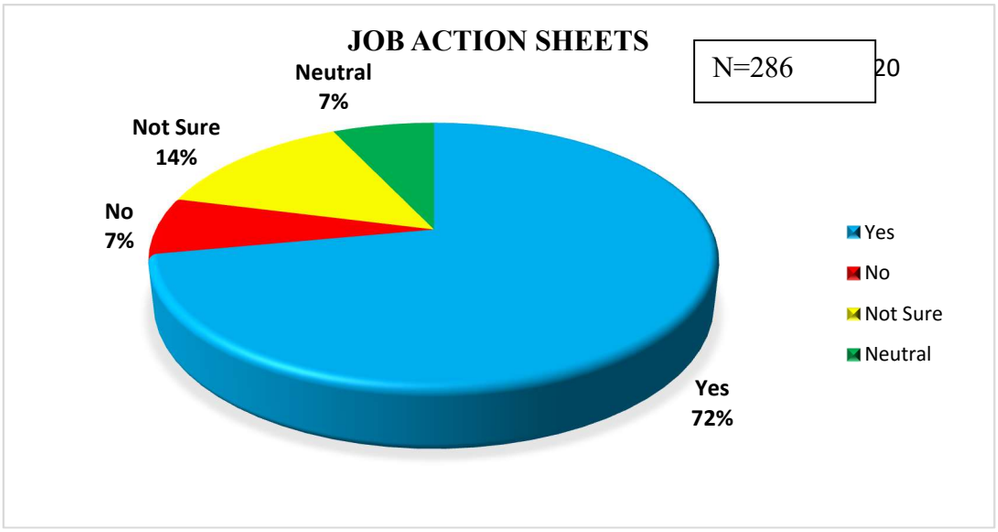


Figure 5.2 Job Action Sheets

Source: Field Data, 2020.

One of the hospital administrators revealed that the job actions sheets are important for the process of emergency response in the ED and within the context of the Hospital's incident command system in case of an MCI. She stated that;

> The job action sheets make it possible for anyone in the hospital to function in roles that are not in their normal job description. Each job action sheet is custom tailored to the individual role. All of the responsibilities are outlined on the form, so any individual can pick it up and perform the duties, which ensure all tasks are completed. Education and training are easier because of the consistency of roles provided by the job action sheets. Staffs are trained in the HEICS plan through orientation, scheduled classes, and mock drills additionally; The HEICS format interfaces with the community's response plan and provides a coordinated effort among agencies responding to any disaster.

Job action sheets are key for proper disaster planning and the functionality of Hospital Emergency Incident Command System (HEICS) for ED in any hospital (Weber, *et al*., 2006). HEICS is an emergency management system based on the public safety field's

Incident Command System. This disaster readiness tool employs logical management structure, defined responsibilities, clear reporting channels, and a common nomenclature to unify hospitals with other local emergency responders (Adini, 2006). One of the benefits of HEICS is that every staff member has a checklist to use; an individual checklist to use during a disaster promotes responsibility and accountability for each position, the checklist prompts the individual to perform the necessary tasks, It also helps the individual move along in an orderly and thorough fashion, when multitasking or caught up in the midst of a real disaster (Arvola, 2013). Listing specific tasks prevents important items from being missed and helps to maintain some organization during chaos, for example at Brandon Regional Hospital in California, previously, before the hospital started using HEICS, hospital staff reported to the ED when they heard the disaster page without knowing their job assignment, HEICS provides instant information on defined job duties and tasks, reporting structure, communication channels, and accountability, It provides the tools necessary to survive a difficult situation.

The plan allows certain sections to be activated. The HEICS plan is flexible and allows for activation of only those sections or positions specific to the individual disaster, This offers an efficient, cost-productive response (Arvola, 2013). For example, the incident commander, patient information officer, liaison officer, safety and security officer, and operations section chief are the only job titles activated for a small-scale disaster. Other staff members can take over specific roles as needed. The checklists allow another individual to step in and take over a given position if the usual individual is not available, incapacitated, or unable to reach the hospital.

Quoting the hospital administrator,

> The job action sheets are crucial for the process of emergency response in the ED and within the context of the Hospital's incident command system in case of an MCI. These sheets make it possible for anyone in the hospital to function in roles that are not in their normal job description. Each job action sheet is custom-tailored to the individual role, outlining all responsibilities comprehensively. This ensures that any staff member can pick it up and perform the duties, guaranteeing the completion of all tasks. Education and training are facilitated because of the consistency of roles provided by the job action sheets. Staffs are trained in the HEICS plan through orientation, scheduled classes, and mock drills additionally; The HEICS format interfaces with the community's response plan and provides a coordinated effort among agencies responding to any disaster.

The inherent flexibility of the Hospital Emergency Incident Command System (HEICS) plan is a cornerstone in ensuring an agile and efficient response to various disaster scales. This adaptability is exemplified through the activation of specific sections or positions tailored to the unique demands of an individual disaster, facilitating a response that is both efficient and cost-effective (Adini, 2006). For smaller-scale disasters, a select set of job titles, including the incident commander, patient information officer, liaison officer, safety and security officer, and operations section chief, are strategically activated. This targeted approach ensures a focused deployment of resources and expertise.

In such scenarios, other staff members possess the capability to seamlessly assume specific roles as dictated by the evolving situation. This dynamic allocation of responsibilities enhances the overall responsiveness of the emergency response team. The utilization of checklists associated with the plan further contributes to the smooth transition of duties, offering a systematic and organized framework for task distribution.

Quoting a healthcare worker from Moi Teaching and Referral Hospital,

> In our extensive experience, the flexibility embedded within the HEICS plan is truly invaluable. It provides us with the adaptive framework needed to tailor our response meticulously to the distinctive demands presented by each disaster scenario, ensuring a well-coordinated and resource-efficient approach. The strategic

> activation of specific job titles, especially for smaller-scale disasters, streamlines our collective efforts, enabling us to focus our attention on critical areas that demand immediate attention. This adaptability, deeply ingrained in our emergency response protocol, stands as a key factor in our overarching ability to effectively navigate unforeseen challenges and uncertainties, ultimately ensuring the seamless continuity of patient care.

This adaptability not only optimizes resource utilization but also strengthens the resilience of the emergency response system. As healthcare workers, administrators, and other stakeholders collaborate, the HEICS plan stands as a testament to the importance of flexibility in maintaining an effective and responsive healthcare infrastructure during Mass Casualty Incidents (Arvola, 2013). Insights from different hospitals emphasize job action sheets as instruments of resilience, the backbone of coordinated emergency responses. The quotes showcase the universal acknowledgment of their role in fostering responsibility, accountability, and adaptability. The administrator's account from Brandon Regional Hospital in California serves as a stark reminder of the transformative impact of job action sheets, highlighting the paradigm shift brought about by effective emergency planning tools.

Arguably, voices from diverse hospital settings contribute valuable perspectives on the vital role of job action sheets.

Statement from a healthcare professional at Webuye County Hospital affirms that,

> Within the walls of Webuye County Hospital, job action sheets emerge as our lifeline during emergencies. Their significance extends beyond the mere enumeration of tasks; they cultivate a culture of responsibility within our healthcare team. Every checkmark on that meticulously crafted checklist signifies a stride toward a safer and more organized response to crises. The sheets become not just documents but guiding principles, ensuring that our collective efforts align seamlessly during high-pressure situations. The shared responsibility embedded in these sheets transforms them into instruments of cohesion, allowing us to navigate through the complexities of emergency response with clarity and efficiency.

The ideologies gained from shared experiences underscore the dynamic nature of job action sheets as indispensable tools shaping the narrative of emergency response. First and foremost, prioritizing regular training programs and drills becomes imperative. Conducting these initiatives ensures that staff members across healthcare institutions become intimately familiar with job action sheets and the associated emergency response plans. The aim is to cultivate a workforce well-versed in the utilization of these tools, fostering a more efficient and coordinated response during actual emergencies. Also, fostering cross-institutional collaboration is essential for a comprehensive and unified approach to emergency preparedness. By encouraging the sharing of best practices and experiences related to job action sheets among different hospitals and healthcare institutions, a collaborative network can be established. This network serves as a platform for the exchange of valuable insights, contributing to the development of standardized procedures and guidelines that can be universally applied. Thirdly, recognizing the need for continuous evaluation and improvement is crucial. Emergency response plans, including job action sheets, should not be static documents but dynamic tools that evolve based on real-world feedback. Regular evaluation and improvement processes, incorporating insights gained from actual emergency situations and simulations, are necessary to refine and enhance these tools. This adaptive approach ensures that emergency response plans remain effective and adaptable to evolving challenges. Overall, there is a call for community engagement and awareness initiatives. Making community members aware of the role of job action sheets in emergency response through engagement programs is essential. This effort aims to create a shared understanding within the community, fostering a sense of collective responsibility during emergencies. By involving the community in the discourse surrounding emergency

preparedness, a more cohesive and informed approach can be cultivated, strengthening the overall resilience of the community in the face of unforeseen challenges.

5.1.3 Writing Material

Writing material are essential supplies for record management in MCI. This study sought to know whether writing materials were available in hospital stations. As indicated in figure 5.3, 91.6% of the respondents stated that such supplies were available in hospital stations. Additionally, 2.5% of those interviewed opined that such supplies were not available. The study further found out that, 4.4% of the respondents were not sure whether such supplies are in hospital stations. Only 1.5% of the respondents were neutral in their responses.

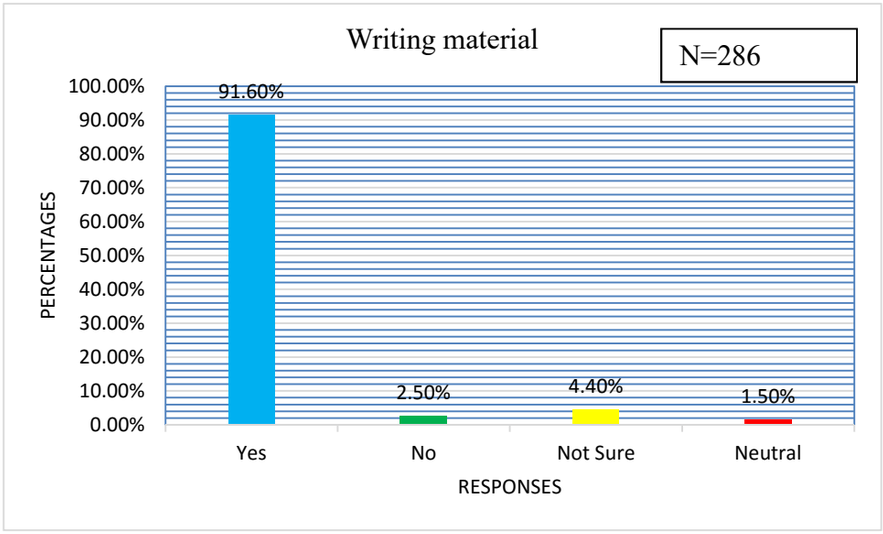


Figure 5.3 Writing Material

Source: Field Data, 2020

Amid the chaos and urgency of Mass Casualty Incidents, the importance of writing materials becomes profoundly evident. These supplies serve as the silent architects of meticulous record-keeping, playing a pivotal role in the aftermath of critical incidents.

The resounding affirmation from healthcare respondents amplifies their indispensable nature in navigating the complexities of emergency response.

A pertinent quote from an administrator at Moi Teaching and Referral Hospital adds depth to this understanding;

> In the uncharted waters of Mass Casualty Incidents, readily available writing materials at Moi Teaching and Referral Hospital serve as our compass. They empower our healthcare team to swiftly and accurately document critical information, creating a comprehensive record that becomes our guiding light during subsequent analyses and decision-making. In those crucial moments, when chaos threatens to engulf us, these writing materials stand as beacons of order, ensuring that every detail is meticulously recorded. It's not just about documentation; it's about wielding the power to distill chaos into clarity. Each stroke of the pen becomes a decisive action, each notation a strategic move in our collective response. The comprehensive record crafted in those moments becomes more than a log; it transforms into a roadmap, guiding us through the labyrinth of uncertainties in the aftermath of Mass Casualty Incidents.

Here, the metaphorical use of a compass portrays writing materials not merely as mundane tools but as instruments guiding the healthcare team through the uncharted territories of MCI. The emphasis on swift and accurate documentation reinforces their role as catalysts for informed decision-making in the aftermath of crises. The availability of writing materials transcends mere logistical convenience; it is a linchpin in the broader framework of emergency response. These materials provide the means to document patient information, treatment protocols, and other critical details essential for a coordinated and efficient response. Healthcare professionals across various hospitals unanimously acknowledge their paramount importance in the emergency response context.

Further enriching this perspective, a healthcare professional at Mediheal Hospital emphasizes the crucial role of writing materials in emergency situations.

> Writing materials at Mediheal Hospital are the unsung heroes during emergencies. They provide the means to meticulously document patient conditions, treatment plans, and communication logs swiftly. Amid chaos, these materials become our anchors, ensuring that vital information is captured and communicated effectively among healthcare teams. The pen becomes a lifeline, translating the urgency of the moment into written records that guide subsequent actions. In the intricate dance of emergency response, each notation on paper represents a step towards organized and efficient care delivery. These materials go beyond being tools; they become conduits of collaboration and coherence in the tumultuous environment of Mass Casualty Incidents. The written record they create is not just a documentation; it's a testament to the resilience and preparedness of our healthcare team in the face of unforeseen challenges.

This portrayal of writing materials as "unsung heroes" encapsulates their transformative role in facilitating seamless information flow and ensuring coordinated efforts during the tumultuous times of Mass Casualty Incidents. The emphasis on meticulous documentation aligns with the broader scientific understanding that a comprehensive record is fundamental for post-event analyses, continuous improvement, and adaptive strategies in the face of evolving challenges. Scientifically, the significance of writing materials in emergency response is underscored by the critical need for accurate and timely documentation. In healthcare, a comprehensive record is a bureaucratic formality but a strategic asset. Detailed documentation enables healthcare providers to track patient conditions, administer appropriate treatments, and maintain communication logs vital for effective teamwork. Moreover, the scientific community recognizes that a thorough record is the cornerstone for post-event analyses. It provides valuable insights into the efficacy of response strategies, areas for improvement, and best practices that can inform future emergency preparedness. In essence, writing materials become conduits for knowledge transfer and adaptation, fostering a culture of continuous improvement within the healthcare system.

5.1.4 Communication Devices

Regardless of whether a situation is classified as a medical disaster or MCI, it requires rapid and effective communication devices. In order to optimize overall response to patients in a catastrophic situation, communication channels must be factored in, in hospital stations. In this light therefore, the study found out that 91.6 % of the respondents agreed to the inquiry that communication devices were available in hospital stations. On the contrary, 7.4% of the respondents indicated that communication devices were not available. Further, 1% of the respondents were not sure whether such supplies are in hospital stations.

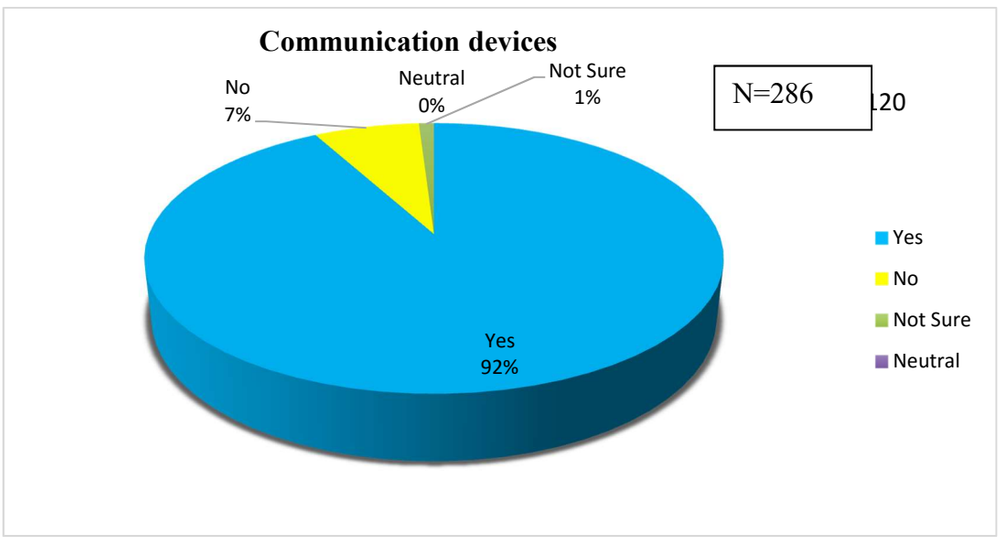


Figure 5.4 Communication Devices

Source: Field Data, 2020

Studies have shown that communication is a preponderant link between mass casualties and responders. Renee *et al*, (2019) opine that the ability to successfully allocate resources and organize an effective response to an MCI is centered on flexible, integrated communication, and information systems. A command center should be organized and equipped with multiple radios tuned into separate frequencies that are “uninterrupted by a priority scan frequency lock-out,” which has shown to be effective. Each scene commander should be equipped with headsets, microphones, and clipboards, and checklists to enable continuous feedback to command regarding scene dynamics.

Rapid and effective communication is paramount. Whether facing a medical disaster or a Mass Casualty Incident (MCI), the availability of communication devices becomes a critical determinant in optimizing patient care and overall response. This section explores the findings related to communication devices in hospital stations, shedding light on their prevalence and the impact on response efficiency. A Vital Component The study delved into the availability of communication devices in hospital stations, seeking to ascertain the preparedness of healthcare facilities in facilitating effective communication during emergencies. Figure 5.4 provides a visual representation of the respondents' perspectives on the presence of these crucial tools.

Renee et al. (2019) further emphasize the need for a well-equipped command center, highlighting the significance of multiple radios tuned into separate frequencies. The uninterrupted operation, free from priority scan frequency lock-out, is identified as a crucial factor in ensuring seamless communication. Moreover, the study advocates for scene commanders to be equipped with headsets, microphones, clipboards, and checklists. These tools facilitate continuous feedback to the command center regarding the dynamic nature of the scene. The study draws from the insights provided by Renee et

al. (2019), underlining the role of communication devices in establishing an efficient command center during MCIs. The command center serves as the nerve center for coordinating responses, making timely decisions, and disseminating critical information. The researchers stress the need for the command center to be equipped with advanced communication tools to ensure a swift and well-coordinated response.

In their research, Renee et al. (2019) highlight the effectiveness of having separate frequencies for each radio in the command center. This approach minimizes the risk of interruptions, enabling responders to receive and convey information without delays or interference. Furthermore, the emphasis on providing scene commanders with headsets, microphones, clipboards, and checklists underscores the meticulous planning required for effective communication in the chaotic environment of MCIs.

While the majority of respondents affirm the availability of communication devices, the study also unveils a notable percentage (7.4%) indicating the absence of such tools in hospital stations. This raises questions about the potential challenges faced by these facilities in ensuring comprehensive communication readiness. The uncertainty expressed by 1% of respondents further highlights the need for a closer examination of the factors contributing to this ambiguity.

Insights shared by Dr. Patel, an esteemed expert in disaster response at Moi Teaching and Referral Hospital, shed light on the critical role of communication devices,

> In the intricate dance of Mass Casualty Incidents, communication devices are the heartbeat that orchestrates response efforts. They transcend being mere tools; they represent the vital connection that ensures seamless information flow and prompt decision-making. A well-furnished command center, supported by advanced communication systems, stands as the bedrock of successful disaster management. It is through these devices that responders navigate the complexities of emergencies, adapt to evolving

> situations, and ultimately, safeguard lives." Dr. Patel's expertise underscores the indispensable nature of communication devices, portraying them as the vital thread weaving through the fabric of emergency response. This aligns seamlessly with the study's findings, underscoring the ongoing need for vigilant attention to the availability and functionality of communication devices in hospital stations.

The study's findings provide valuable insights into the state of communication preparedness in hospital stations during Mass Casualty Incidents (MCI). While the majority of respondents, comprising 91.6%, affirm the availability of communication devices, addressing the concerns raised by the remaining 7.4% who perceive a lack of such devices is crucial for comprehensive preparedness. In light of these findings, the following recommendations are proposed to fortify communication readiness in hospital settings. One key recommendation is the implementation of comprehensive assessments of communication infrastructure within hospitals. These evaluations should aim to identify existing gaps, assess the functionality of current devices, and analyze potential vulnerabilities in the communication network. By conducting thorough assessments, hospitals can develop a clear understanding of their communication capabilities and shortcomings, allowing for targeted improvements. Recognizing the rapid evolution of communication technologies, hospitals are urged to invest in advanced devices that support seamless and uninterrupted communication. This may involve integrating modern radio systems, embracing digital communication platforms, and implementing redundant systems to ensure continuity in communication during emergencies. The investment in cutting-edge technologies is essential to keep pace with the dynamic nature of disaster response. To enhance the effectiveness of communication during emergencies, healthcare professionals should undergo regular training sessions and drills. These exercises should focus on familiarizing staff with the operation of communication devices, establishing protocols for information dissemination, and practicing coordination within the command

center. Regular training ensures that healthcare teams are well-prepared to handle communication challenges in the high-stakes environment of an MCI. Hospitals are encouraged to explore collaborative networking opportunities with other healthcare institutions, emergency response agencies, and communication technology providers. Sharing best practices, insights, and resources can foster a collective improvement in communication preparedness across the healthcare sector. Collaborative networking creates a supportive environment where institutions can learn from each other and collectively elevate their communication capabilities. Another avenue for bolstering communication infrastructure is through public-private partnerships. Hospitals can explore partnerships with communication technology companies to gain access to cutting-edge devices and expertise. Such collaborations can lead to advancements in communication technology tailored to the specific needs of hospital settings, ultimately enhancing overall preparedness for communication during MCIs.

5.1.5 State, regional and local maps, blueprints of facilities

Maps provide important directions in hospital environment. The study sought to ascertain whether maps as disaster supplies were available. In this light therefore the study found out that state, regional and local maps were available. Out of the total respondents, 43% indicated that such supplies were available. On the contrary, 43% stated that such supplies were not available. Additionally, 13% of the total respondents were not sure whether such supplies were available. Only 2% were neutral in their responses.

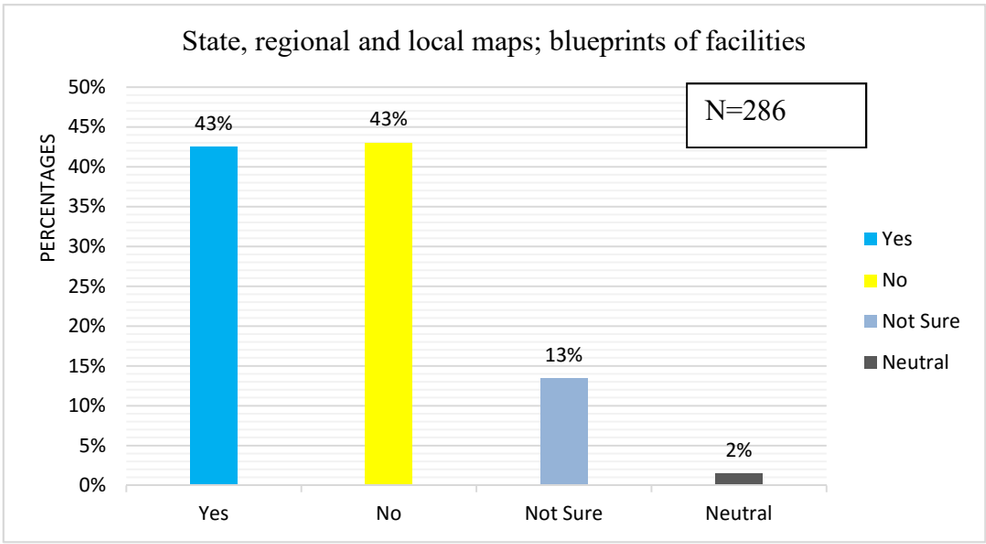


Figure 5.5 State, regional and local maps, blueprints of facilities

Source: Field Data, 2020

Much as there was lack of consensus on the availability of maps, the hospital managers acknowledged that maps would form an important aspect of the planning process as it would give then the information needed on available facilities and resources at the time of an MCI. It further emerged during the interviews that the hospitals had not fully embraced the latest mapping technologies that would most likely give the most relevant information for MCI response.

According to Amran*et al* (2011) Mapping forms an important part of disaster planning and emergency response during MCI. In the era of technology one of the most effective ways to map is through spatial mapping which is likely to give timely and precise information on various factors that would influence effective response to MCI. They further state that a combination of technologies including geographic information systems (GIS) with decision support systems (DSS), Spatial Decision Support Systems (SDSS) are some of the technologies that can aid spatial mapping for MCI response. These three

technologies were first introduced in the mid 1980's and have been used in developed countries to aid emergency response.

Hameed *et al* (2010) further adds that the these mapping technologies are intended to simplify and make evidence-based decisions concerning the evacuation of critically injured patients from an MCI location, this SDSS provides the information required by emergency service personnel at MCI location to make decisions in what is typically, a highly stressful and often chaotic situation. In addition to providing, within a matter of seconds, critical information describing hospital driving time/proximity, trauma level and bed capacity, the model is also useful within a planning context. For example, the model can be used to examine proposed locations for large scale events, conferences, etc. in relation to health care facilities or to help to determine where to position a mobile health facility in relation to the event.

In EMS, such models are focused on the optimization of ambulance locations in order to maximize coverage (Hameed *et al.,* 2010). These models have evolved from the simple static models first developed 30 years ago to incorporate dynamic circumstantial changes. For example, such models can determine how best to fill the gap in coverage that is created when an ambulance within a particular geographical catchment is dispatched. In recent years, there have been a handful of attempts to optimize ambulance response times using models that incorporate dynamic traffic changes (Amran *et al.,* 2011). Advances in computer technologies that support decision making have made this process easier.

5.1.6 Computers, TV and AV Equipment

In an age dominated by technological advancements and facing an unprecedented rise in epidemics and pandemics, the role of technological gadgets as indispensable tools in humanitarian crises cannot be overstated. The section explores availability of computers, TVs, and AV equipment in hospital stations, crucial components for modern emergency response. The findings from the respondents shed light on the current state of technological preparedness in healthcare institutions during Mass Casualty Incidents (MCIs). Accordingly, 70% of the respondents stated that such disaster supplies were available. On the contrary, 25% stated that the supplies were not in hospital stations. Additionally, 3% of the respondents were not sure and 2% were neutral in their responses.

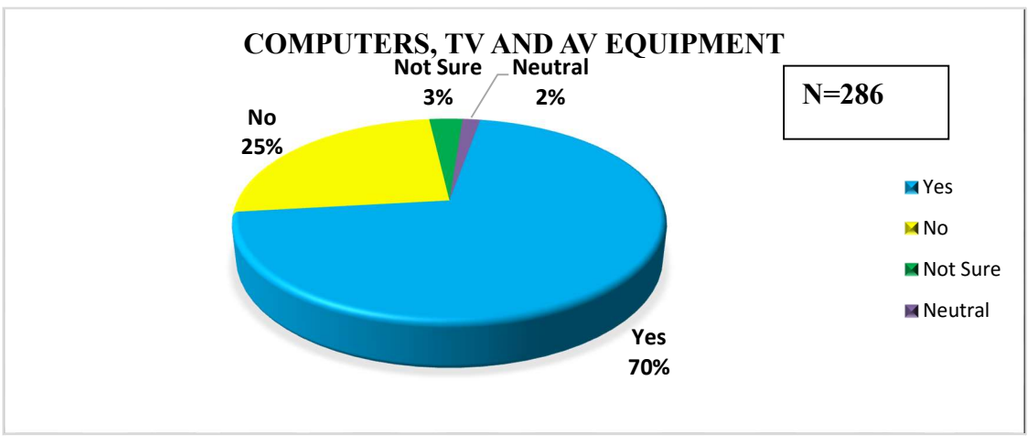


Figure 5.6 Computers, TVs and AV Equipment

Source: Field Data, 2020

Recently, there has been a push towards deployment of information and communication technologies (ICTs) for emergency crisis response (Chan *et al*, 2004). It is expected that such technologies will improve information sharing, resource allocation, communication,

and collaboration among emergency medical services (EMS) and emergency departments (EDs) of hospitals.

Over the past few years, several computer-based systems have been proposed to help EMS personnel track casualties and resources, communicate with receiving hospitals, and triage casualties effectively. Most of these systems are based on PDAs, GIS, GPS, and local and wireless LAN networking (Killeen *et al*, 2006). Other systems enable hazardous materials (HAZMAT) units to view hazardous substance databases and patient symptoms on handheld devices at the scene of a HAZMAT incident. Tele-presence systems that stitch together live video feeds in real-time have been developed to help first responders achieve better situational awareness of the incident site (Ammenwerth *et al*, 2006). According to Asaro *et al*. (2006) Research in communication technology adoption and use suggests that users' beliefs and attitudes towards technology use are important predictors of the successful deployment of technologies.

As stakeholders unravel technological preparedness, it becomes imperative to explore the broader implications of incorporating information and communication technologies (ICTs) into emergency crisis response. The adoption of ICTs is positioned as a transformative force expected to improve information sharing, resource allocation, communication, and collaboration among emergency medical services (EMS) and hospital emergency departments (EDs) (Chan et al, 2004). This signals a paradigm shift towards a more interconnected and technologically-driven approach to managing crises. Recent years have witnessed the emergence of various computer-based systems designed to enhance the capabilities of EMS personnel. Proposed systems leverage technologies such as Personal Digital Assistants (PDAs), Geographic Information Systems (GIS), Global Positioning Systems (GPS), and local and wireless LAN networking (Killeen et

al, 2006). These systems aim to streamline casualty tracking, facilitate communication with receiving hospitals, and improve the triaging of casualties, marking a significant stride in the integration of technology into emergency medical services.

Moreover, advancements extend to specialized applications, such as Hazardous Materials (HAZMAT) units, which utilize handheld devices to access hazardous substance databases and patient symptom information at the scene of an incident. Tele-presence systems, integrating live video feeds in real-time, further contribute to enhancing first responders' situational awareness (Ammenwerth et al, 2006). The incorporation of such technologies aligns with the evolving landscape of emergency response, emphasizing the role of real-time information and communication in decision-making and resource allocation. It is noteworthy that research on technology adoption and use, as highlighted by Asaro et al. (2006), underscores the significance of users' beliefs and attitudes in predicting the successful deployment of technologies. The human factor emerges as a critical determinant in the effective integration of technological solutions into the fabric of emergency response systems. As healthcare professionals play a pivotal role in utilizing these technologies during crises, understanding their perceptions and attitudes becomes paramount for successful implementation.

5.1.7 White boards, bulletin board, flip charts or other visual aids

Information sharing is key in MCIs. The study was undertaken to establish whether aforementioned supplies were available in hospital stations. The study found out that, out of the total respondents, 58% stated that such supplies were available in hospital stations

N=286

whereas 37% of the respondents stated that such disaster supplies were not available. Additional 4% of the total respondents were not sure and 1% was neutral in their responses.

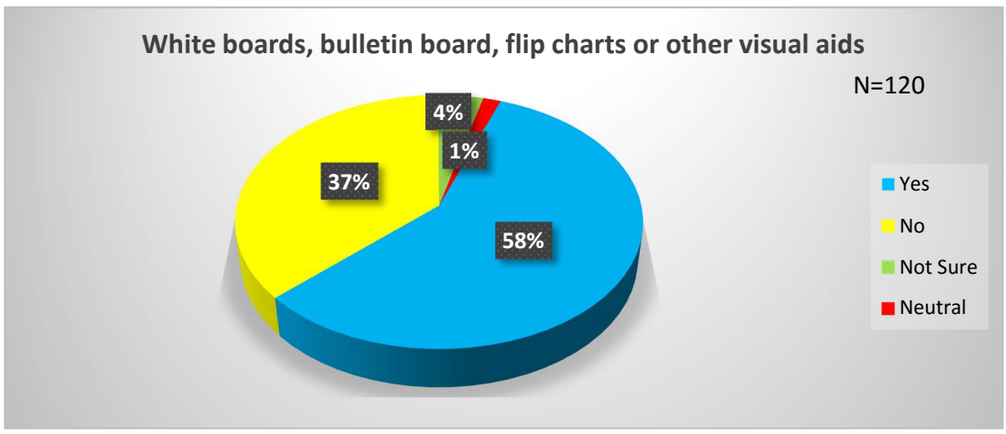


Figure 5.7 White boards, bulletin board, flip charts or other visual Aids

Source: Field Data, 2020

5.1.8 Hospital Clinical Operations

The study sought to ascertain whether hospital clinicians (doctors ,nurses ,clinical officers) operations were available in hospital stations. As illustrated in figure 5.8, 94.16% of the respondents reasoned that hospital clinicians were available to manage patients. On the contrary, 4% of the total respondents interviewed stated that such disaster services were not available. Further findings revealed that, 0.83% were both not aware and neutral in their responses.

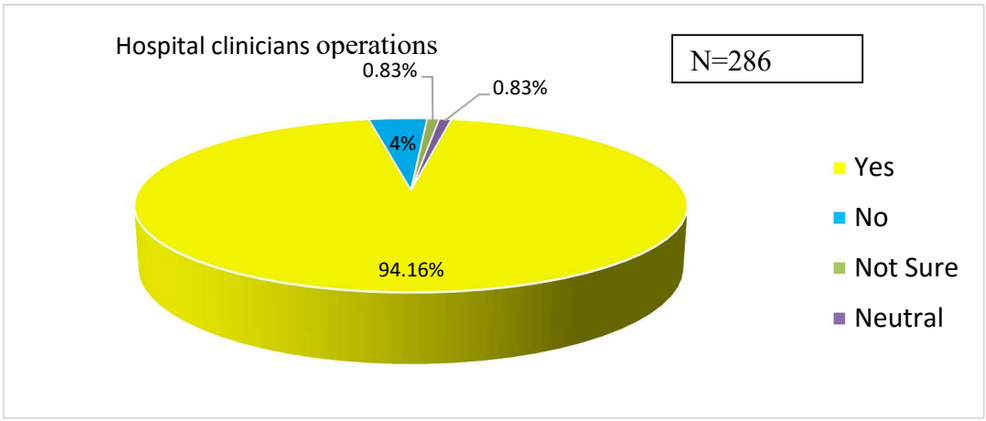


Figure 5.8 Hospital clinicians operations

Source: Field Data,2020

Here, the section delves into the findings regarding the presence of hospital clinicians in hospital stations during MCIs, exploring the implications of their availability on the overall clinical operations and patient outcomes. The data presented in Figure 5.8 provides a snapshot of the respondents' perspectives on the availability of hospital clinicians during MCIs. An overwhelming 94.16% of respondents affirm the presence of hospital clinicians in hospital stations, attesting to the crucial role these healthcare professionals play in managing patients during emergencies. This resounding affirmation reflects the perceived importance of having a skilled and experienced clinical workforce readily available to address the diverse medical needs that arise during MCIs. However, the study also reveals a noteworthy 4% of respondents who assert the absence of hospital clinicians in hospital stations during disaster scenarios. This finding raises concerns about the potential implications of a shortage of clinical personnel in emergency situations. While the majority recognizes the necessity of clinicians in managing patient care during MCIs, the existence of a significant minority expressing otherwise necessitates a closer examination of the underlying factors contributing to this perception.

In addition to the respondents who were not aware or maintained a neutral stance (0.83%), it is crucial to explore the nuances surrounding the awareness and perceptions of hospital clinicians' availability. This includes considering factors such as communication protocols, training programs, and the role of hospital administrators in disseminating information about the presence and preparedness of clinical staff during emergencies.

The high percentage affirming the availability of hospital clinicians suggests a positive outlook on the healthcare system's preparedness for MCIs. Clinicians are essential in providing immediate medical attention, triaging patients, and coordinating with other emergency response personnel to ensure a cohesive and effective response. However, the minority expressing a lack of awareness or neutrality raises questions about the communication channels within healthcare institutions, as well as the overall awareness of staff regarding emergency response protocols.

Providing a perspective from a different healthcare institution, a representative from Elburgon Sub-County Hospital emphasizes the significance of hospital clinicians during MCIs

> In our hospital, the presence of skilled clinicians during Mass Casualty Incidents is non-negotiable. These professionals form the backbone of our emergency response, ensuring that patients receive prompt and effective care. Their expertise and ability to adapt to dynamic situations contribute significantly to the success of our emergency operations.

This quote highlights the universal acknowledgment of the critical role hospital clinician’s play during MCIs, transcending specific institutions. It underscores the importance of having skilled and adaptable healthcare professionals to navigate the complexities of emergency situations, providing assurance to patients and optimizing clinical outcomes. Several considerations emerge for enhancing future preparedness. First and foremost, communication strategies within healthcare institutions need to be robust,

ensuring that all staff members are well-informed about emergency response protocols and the roles of hospital clinicians. This can be achieved through regular training programs, drills, and effective dissemination of information. Moreover, hospitals should explore collaborations with external organizations, such as medical associations and disaster management agencies, to leverage additional clinical support during large-scale emergencies. Developing partnerships that allow for the mobilization of clinicians from neighboring institutions can enhance the overall capacity to manage patient care effectively. Investing in ongoing training and professional development for hospital clinicians in the context of MCIs is also crucial. The above includes scenario-based training, simulation exercises, and continuous education on the latest protocols and best practices in emergency medicine. Well-prepared and well-trained clinicians are better equipped to handle the dynamic and challenging nature of MCIs, ensuring a more coordinated and efficient response.

5.2 Availability and condition of critical resources in hospital departments

A mass casualty incident is likely to overwhelm a community that has only limited resources. Plans and procedures should be established to identify and list sources of external assistance. Neighboring facilities must be identified, canvassed and enumerated. Account must be taken of the possibility that these facilities will also be over extended. Therefore, contingencies should be sufficient to account for the worst possible circumstances. Neighboring hospitals or territories should be approached and their agreement sought for mutual support (Pan American Health Organization, 2001).

This study therefore sought to ascertain the availability of critical resources in hospital departments during MCI.

Table 5.1 Availability and condition of critical resources in hospital departments

	Available				Not available		NR	
	Good condition		Poor condition					
	N	%	N	%	N	%	N	%
Crystalloid solution with IV tubing	262	91.7	0	0	24	8.3	0	0
Adult ICU bed capacity	262	91.7	0	0	24	8.3	0	0
Ambu bag, adult	262	91.7	0	0	24	8.3	0	0
Endotracheal tube	262	91.7	24	8.3	0	0	0	0
Laryngoscope, adult	262	91.7	0	0	24	8.3	0	0
Oxygen source and tubing	262	91.7	0	0	24	8.3	0	0
pediatric mechanical ventilator	262	91.7	24	8.3	0	0	0	0
Ambu bag, pediatric	238	83.3	24	8.35	24	8.35	0	0
Adult mechanical ventilator set	238	83.3	0	0	47	16.7	0	0
Critical care nurse	238	83.3	0	0	47	16.7	0	0
Sunction catheter and sunction apparatus	262	91.7	0	0	24	8.3	0	0
Laryngoscope, peds	262	91.7	0	0	24	8.3	0	0

Critical care physician	262	91.7	0	0	24	8.3	0	0
Sedatives	262	91.7	0	0	24	8.3	0	0
Peds ICU capacity	238	83.3	0	0	24	16.7	0	0
Adult medical/surgical bed	214	75	24	8.3	47	16.7	0	0
Needles, sterile	262	91.7	0	0	24	8.3	0	0
Non-critical care nurse	286	100	0	0	0	0	0	0
Latex free non-sterile gloves	286	100	0	0	0	0	0	0
IV Catheters(18-24g) and heplocks	286	100	0	0	0	0	0	0
Pressors	262	91.7	24	8.3	0	0	0	0
BP cuffs, adults	214	75	0	0	71	25	0	0
BP cuffs, pediatrics	262	91.7	0	0	24	8.3	0	0
Peds medical/surgical bed	286	100	0	0	0	0	0	0
Oxygen mask, adult	262	91.7	0	0	24	8.3	0	0

Source: Field Data, 2020

Regarding Crystalloid solution with IV tubing, 91.7% of the total respondents averred that critical resources in hospital departments were available and in good condition while 8.3% were of the contrary opinion and stated that critical resources were not available. Additionally, among the respondents interviewed none were neutral.

Further, 91.7% respondents argued that Adult ICU bed capacity were available and in good condition while 8.3% indicated that such resources were not available in hospital departments. Similar results were given by the respondents who asserted that Ambu bag, adult were available and in good condition. In the same vein, 10(8.3%) of the respondents stated that such resources were not available.

When interviewed about Endotracheal tube, 91.7% respondents adduced that such resources were available and in good condition. On the contrary, 8.3% of the total respondents reasoned that such a resource was available but was in parlous state.
Regarding laryngoscope, adult Oxygen source and tubing pediatric mechanical ventilator, the respondents 91.7% concomitantly stated that such resources were available and in good condition whereas 8.3% respectively indicated that critical resources were not available in hospital departments.

Since the SARS epidemic of 2002–2003, and the threat of an influenza pandemic, specific attention has been focused on how to plan for and implement a large-scale bio-event approach that does require triage management of large numbers of survivable and no survivable respiratory failure cases where evacuation is not an option. The demand for positive pressure ventilation is likely far exceed conventional ICU capabilities, and without careful pre-disaster planning, hundreds or thousands of victims may have to forgo potentially life-saving critical care. Whereas most of these MCIs would occur in chemical inhalation disasters, radiation exposures, and tsunamis causing aspiration pneumonia and septic shock, it is bio-event public health emergencies that many believe have the greatest likelihood of causing mass respiratory failure. Hick and O'Laughlin

(2006) provide a sample concept of operations for the development of triage criteria for restriction of mechanical ventilation in epidemic situations. Christian et al. (2006) and Melnychuk and Kenny (2006) provide an expanded critical care pandemic triage protocol for assessment of admission to critical care units during an influenza pandemic. This triage protocol uses the Sequential Organ Failure Assessment score (SOFA).

Laryngoscope both adult and pediatric, critical care physician and sedatives are important in hospitals departments. In this light, 91.7% respondents stated that such resources were available and in good condition while 8.3% of the total respondents reasoned that such resources were not available.

Further, 83.3% of the total respondents indicated that Pediatrics ICU capacity were available and in good condition whereas 16.7% of the respondents indicated that the resources were not available. Those of the contrary opinion reasoned that due to the overwhelming numbers of in-patients, ICU capacity is not sufficient. Adult medical/surgical beds are a critical facility in hospitals. According to the respondents interviewed, only 75% stated that such a facility was in existence and in good condition whereas 8.3% stated that the available resources were in bad condition. Additionally, 16.7% of the respondents were of the contrary opinion and opined that adult medical/surgical beds were not available for a surge.

Other studies on MCI suggest that having medical beds is critical. Guidelines suggest that 20% of general hospital beds are available within 24 hours during conventional disasters, and a several fold increase can be realized if acute care patients are admitted

preferentially (Daugherty, 2007). Theoretically, if personnel and equipment are available, most of a general hospital can be modified for a semblance of critical care delivery. The lessons of SARS have resulted in decisions to purchase countrywide ventilator resources in anticipation of a more aggressive and lethal influenza pandemic.

Critical care nurse is an important resource. The respondents interviewed 83.3% argued that such a resource was available and in good condition while 16.7% disregarded the inquiry and reasoned that such a resource was not available in hospitals departments.

In normal circumstances and on a daily basis, critical care is offered only to those whose condition is potentially reversible and who have a good chance of surviving with intensive care support. Many patients still die in the critical care unit. A prime requisite for admission is that the underlying condition is reversible. Therefore, treatment is meant to support the patient, during which time treatments or the natural history of the acute affliction will lead to resolution. Rubinson& Toole (2005) suggest that a major challenge of MCIs is "to determine when, and on what basis, traditional standards of critical care are modified to accommodate emergency conditions, and when modified standards to focus on key interventions". This model of care is referred to as mass critical care. In an MCI, mass critical care is implemented when usual surge response code orange/disaster protocols such as canceling elective surgery, discharging or transferring patients as possible, and opening up alternative care areas will be insufficient to meet the demands placed on the health care system.

Resources such as needles and sterile are preponderant resources in hospitals. According to the respondents interviewed, only 91.7% averred that such resources were available and in good condition. On the contrary, 8.3% respondents who were interviewed stated that such resources are not readily available in hospital departments but can be borrowed from other departments.

In terms of non-critical care nurse, latex free non-sterile gloves and IV Catheters (18-24g) as well as heplocks, Pediatrics medical/surgical bed, those who participated in the study were in agreement that such critical resources were available. A hundred and twenty respondents as illustrated in table 5.1 adduced that such critical resources were available and in good condition.

Additionally, 91.7% of the total respondents averred that pressers were available and in good condition. Contrariwise, though the resources were available, 8.3% of the respondents indicated that resources available were not in good condition.

BP cuffs, adults and BP cuffs, pediatrics are essential facilities in hospital departments. According to the respondents interviewed, 75% and 91.7% respectively, agreed to the inquiry by asserting that these resources were available and in good shape. On the contrary, 25% and 8.3% of the total respondents respectively reasoned that such resources were not available.

Airway management in emergencies situation is critical in life-saving activities. In this regard, Oxygen mask, adult is a necessary resource. According to the respondents interviewed, 91.7% stated that Oxygen mask, adult was available and in good condition

whereas 8.3% of the respondents were of the contrary opinion and stated that such resources were not available in hospital departments.

Other studies suggest that, Triage management are limited by the availability of medical-grade oxygen, which is not supplied through the Strategic National Stockpile (Schultz, 1996). Bulk liquid is the main source of oxygen for hospitals and remains the best option for supporting mass mechanical ventilation. The large majority of non-ventilated patients will be maintained outside the hospital setting with oxygen supplies using reservoir cannulas or pulsed-dose technology.

5.3 Chapter Summary

Mass critical care requires modification to standards of critical care interventions, personnel staffing, equipment, and triage management to provide an acceptable level of care. At a minimum, hospitals must plan to deliver to critically ill patients a basic mode. This must include issues of health care rationing and the decision process on who will receive mechanical ventilation and other life-saving treatments. The study found out that,, 72% of the respondents reasoned that job action sheets were available in hospital stations.Contrariwise,7% of the respondents stated that such supplies were not available in hospital stations. 91.6% of the respondents stated that such supplies were available in hospital stations. Additionally, 2.5% of those interviewed opined that such supplies were not available. The study further found out that, 4.4% of the respondents were not sure whether such supplies are in hospital stations. Further, (83.3%) argued that such a resource was available and in good condition while (16.7%) disregarded the inquiry and reasoned that such a resource was not available in hospitals departments.

CHAPTER SIX

AN ASSESSEMNT OF STRATEGIES APPLIED TO COPE WITH PATIENTS' SURGE DURING MASS CASUALTY INCIDENCES ALONG NAKURU-ELDORET- MALABA A104 ROAD, KENYA

6.1 Introduction

The study sought to explore the strategies that are applied by hospitals to cope with patients surge during mass casualty incidences with reference to both public and private hospitals along Nakuru- Eldoret- Malaba, A-104 Road, and Kenya. This chapter therefore presents and discusses findings of the strategies as; transfer to other hospitals, discharge stable patients, bed sharing, referrals to neighboring private hospitals, opening up urgent care centers, outpatient departments adopted for inpatients, home-care for low severity illnesses, Chronic care facilities for long term patients, Designate an area for use as a temporary morgue, ensure adequate supply of body bags and Recalling staff on leave.

6.2 Strategies Applied to Cope with Patients' Surge during Mass Casualty Incidences

The study sought to establish the strategies that were applied by various hospitals along Nakuru- Eldoret- Malaba A-104 Road, Kenya to cope with Patients' Surge during Mass Casualty Incidences. The results are as indicated in Table 6.1 and are discussed in the subsequent sections.

Table 6.1: Strategies applied to cope with patients' surge during mass casualty incidences

Strategies	Agree		Disagree		Not sure		Non-response		Rank
	N	%	N	%	N	%	N	%	
Transfer to other hospitals	114	40	155	54.2	7	2.5	9	3.3	7
Discharge stable patients to create space	224	78.3	35	12.5	0	0	26	9.2	1
Bed sharing	200	70	59	20.8	7	2.5	19	6.7	2
Referrals to neighboring private hospitals	66	23.3	133	46.7	26	9.2	59	20.8	9
Opening up urgent care centers	73	25.8	131	45.8	40	14.2	40	14.2	8
Outpatient departments adapted for inpatients	121	42.5	97	34.2	40	14.2	26	9.2	4
Home care for low-severity illness	126	44.2	72	25	47	16.7	40	14.2	3
Chronic care facilities for long term patients	100	35	84	29.2	54	19.2	47	16.7	6
Designate an area for use as a temporary morgue	112	39.2	104	36.7	38	13.3	31	10.8	5
Ensure adequate supply of body bags	121	42.5	66	23.3	64	22.5	33	11.7	4

Source: Field data (2020)

6.2.1 Transfer to other hospitals

The results in Table 6.1 reveal that 30% agreed, 54.2% disagreed while 2.5% of the respondents were not sure of transfer to other hospitals is a strategy that is explored during a mass casualty incidence by both public and private hospitals. Majority of the respondents therefore did not regard transfer as a strategy employed by the many public and private hospitals during patients surge in a mass casualty incident. The mass casualty management is a concern in many parts of the world and the ability of given hospitals to manage the patient surge basically rely on the capacity of the medical facilities in terms of both human and equipment (Tariverdi *et al*., 2018). It therefore means that medical

facilities that are of low capacity or not in a position to handle special medical treatment may be impacted on negatively during mass casualty incidences as they may not be in a position to handle the large number during the emergency. As much as the majority of the respondents do not agree that their hospitals do transfer patients during the surge, a Key informant admits that when a given medical facility cannot accommodate a given number of patients then a transfer is always an option in coordination with other neighboring hospitals and even to better equipped and staffed hospitals outside the region of study for more specialized care.

In an interview with the workers in the OR, one opined that:

> The healthcare facilities are handicapped in the ability to hold high numbers of patients during times of mass casualty incidents. The high number of patients presenting in the hospitals during this periods is an overwhelming aspect where the available resources are limited compared to the high number of patients in need of healthcare services. Where such instances have occurred, our hospitals are left with the only option of transferring patients to neighboring hospitals to ensure that there is ease in the patient surge problem.

This was further supported by a county health officer who pointed out that:

> Staffing and funds are factors that have been a hindrance to the success of the evaluation of the problem of patient surge in healthcare facilities. Therefore, instances of overcrowding in hospitals have continued to worsen in the present day necessitating the transfer of patients from the hospitals experiencing the problem to other facilities where such problems are not in occurrence at the time (interview with county officers).

Healthcare facilities that have been under the peril of patient surges have had to transfer some of their patient to other hospitals in the attempt to ease the pressure resulting from overcrowding. This is as evidenced by an interview with the Nurse in Charge of the MTRH wards who opined that:

> Mass casualty incidents are times when the healthcare system is faced by the challenge of insufficiency of the holding capacity. The various departments including the emergency department, operating theaters, ICU and wards become under constant pressure with the need to evacuate some of the patients in order to let in more so as to ensure that all the patients in need of care are well-served to enable them recover into their normal stable states of wellness. With this increase in the number of patients in dire need of care, the hospitals have been engaging in practices like the transfer of some of the patients to other hospitals so as to ensure

> that there is minimal overcrowding and thus solving the problem of patient surges in the healthcare system (interview with nurse in charge, MTRH, 11th March, 2020).

In another interview with the Kenya Red Cross officials, one articulated that:

> There has been an increase in the buildup of positive relationships between various healthcare facilities all as an impact of the need to create space as a result of the problem of patient surges. Mass casualties have been instances that lead to overcrowding in hospitals due to the limitation in the availability of resources in the facilities. There has therefore been a lot of instances of transfers of patients between hospitals to ensure a decrease in the high numbers of patients in some hospitals thereby easing the issue of patient surge with the consequent promotion of patient satisfaction in the care provided and healthcare professional success in the provision of care since the provision of care is only provided to the number of patients that a facility can withstand (Interview with Kenya Red Cross officials, 16th March, 2020).

6.2.2 Discharge of stable patients to create space

As indicated in Table 6.1 discharge of stable patients to create space for the increasing number of casualties during a mass casualty was rated by respondents as 78.3% agreed while 2.5% in disagreement. Majority of the respondents attest to the application of the strategy by both public and private hospitals. The findings from the Key informants interviews in both public and private hospitals, patients vary based on progress of recovery where there are those in critical conditions while there are those patients who are about to recover fully. It was therefore confirmed that during **FGDs,** it is always a practice that the ones that have shown improvement and can be nursed from home are discharged to create space for the critically affected mass patients to be treated. This practice home healthcare was implemented more aggressively during the Covid 19 pandemic rated as one of the fastest growing industries (Bureau of Labor Statistics, 2020).

In the sequence of interviews with the Kenyan Red Cross officials, one had the following to say:

> There are many factors that predispose our healthcare system to overcrowding. Shortage of funds, staffing and space in the hospitals limits the capacity to hold a high number of patients during cases of crises such as it may happen in the cases of road accidents that lead to mass casualties. This limitation is a drawback to the healthcare system in that the quality of care provided to the patient does not meet the required standards thereby leading to a further reduction in the patient satisfaction scores and thus the general success in the treatment procedures aimed at improving the health of these patients. Thus, hospitals have had to ensure that there is discharge of patients who have attained stable or almost stable conditions so as to create space for others (interview with Red Cross Officials).

According to Armony *et al*., (2015) it is medically advisable to discharge stable patients in times of mass casualty to avoid contact with the incoming patients mostly when it involves infectious diseases like Cholera, and Corona Viruses. It is likely that during a mass casualty incident, where the medical facilities need more space therefore, the hospital management may opt for discharging stable patients for home based care or as out-patients and create space for the critically affected who require close monitoring.

The need for space in the event of mass casualty incidents in healthcare facilities has necessitated the discharge of patients who are stable to create space for the victims of such incidents. In departments such as wards and emergency departments, for example, patients who have been under care and in current stable conditions are being discharged to allow for the accommodation of the newly presented patients. The strategy has been effective in the minimization of cases of patient surges.

6.2.3 Bed Sharing

Based on the results from Table 6.1, 70% of the respondents agreed, 20.8% disagreed while 2.5% were not sure whether hospitals make patients share beds during mass casualty incidences. However, according to a Key informant (Nurse in charge), due to the inability to predict the type and magnitude of many disasters that can cause mass casualty

and insufficient funds, the many medical facilities are not in a position to attain the bare minimum number of bed capacity that can take care of mass casualty at a time of emergencies. It therefore confirms that majority of both public and private hospitals are compelled to subject patients into sharing beds due lack of bed capacity in mass casualty incidence.

The sentiments on bed sharing were echoed by the patients who revealed that bed sharing was a serious issue in various hospitals. One of the patients indicated that;

> Bed sharing is happen and it's not good for the health of patients especially like right now with the COVID-19 pandemic. The Hospital has tried to protect patients but the large numbers make it not possible to maintain social distance.

In line with these Findings Yi *et al*., (2010) is of the opinion that Surge planning is very important for all medical facilities in terms of bed capacity to enable adequate response during an emergency and general preparedness for health care It is therefore expected that better planning of the bed capacity in health care facilities should be in a position to accommodate both large volume of patients admitted in a given time and also patients that were already admitted for treatment of other diseases.

The strategy of bed sharing in management of patient surge is also referred to as co-bedding. Bed sharing has been effective in the relief of the pressure that emanates from patient surge and high demand in the healthcare facilities as was explained by a nurse working in the MTRH ward where she stated the following:

> Co-bedding is not a long-term solution to the problem of crowding in the various departments of a hospital. However, the strategy offers relief to the healthcare facility during times of high demand. It has enhanced the optimization of space where there is maximum utilization of the existing resources in the hospitals without need to immediately seek for more in times of surges. Patients sharing the units allows for rapid response to the emergency cases or other events that lead to sudden peak in the number of patients reporting at the hospital thereby reducing the levels of crowding

> and thus efficiency in the provision of care (Interview with a nurse, MTRH, 26th January, 2020).

Co-bedding is also an important tool in the management of similar conditions among patients. In the event of surges, the healthcare providers usually opt to place patients with similar conditions and healthcare needs in the same units thereby facilitating the provision of care and thus allowing for the success of the monitoring processes. This is as was articulated by the nurse who was interviewed. The following was her statement:

> In times of high demand and peaks of patient surges, co-bedding not only creates space for the accommodation of more patients but also enhances processes such as patient monitoring. Whenever patients with similar conditions are placed together, the healthcare providers can easily access and care for them thereby enhancing the achievement of the desired results which is the improvement in the conditions of the patients. More so, it allows for the development of team collaboration through fostering proper coordination and communication among the healthcare providers. This is through working closely together in the shared units (interview with a nurse, MTRH, 11th March, 2020).

The strategy however poses serious challenges including interference with the privacy of patients. Patients are forced to share the units by the demanding situation of patient surge. The situation leads to problems such as intrusion into their spaces and thus privacy. More so, there is effect on the control of the spread infections and a limitation in the achievement of high quality of care. This thus calls for the healthcare system's caution in the adoption of such measures where the safety, health and well-being of the patients should be prioritized.

6.2.4 Referrals to Neighboring Hospitals

The referral of patients to other hospitals is one of the commonest management strategies during patient surge incidents such as those resulting from MCIs. It is an approach where patients are transferred to other hospitals with available resources including beds, staff

and equipment for certain procedures. In the Kenya healthcare referral system, there are four levels of service and these are inclusive of community health services, primary care, county referral and national referral services. The purpose of referrals is usually basically to seek specific medical services. However, referral to different healthcare facilities is an applicable strategy in the management of patient surges.

There are various ways through which referrals to other hospitals help in easing the problems of patient surge and these include balance in the patient load, timely emergency response and team alignment. The transfer of patients to healthcare facilities in different geographical locations is a vital aspect in the use of this strategy to ease patient surges. It is a preventive measure in that it helps avoid the concentration of patient surges in some areas. The referral approach also enables a coordinated emergency response thus patients receive timely and adequate care. The communication that exists between hospitals as a result of the referral strategy furthers their collaboration and that of the healthcare system as a whole.

Based on the results shown in table 6.1, to evaluate referrals to neighboring hospitals as a strategy used during mass casualty incidences, 23.3% of the respondents agreed, 46.7% disagreed while 9.2% were undecided on whether the strategy is used to mitigate the patients surge in the existing hospitals. Analysis reveal that majority of the respondents affirm that the strategy is not mainly used. However, according to Key informant in both public and private hospitals, all medical facilities have a working agreement that in the event one facility is in lack of or insufficient equipment or have patients that need specialized treatment then they coordinate and do referrals between and among the

facilities. According to Almazrou *et al.* (1990), referrals are in the basis of health care facilities seeking advanced medical care from higher medical facilities based on their capacity advantage and skills to take care of certain types of diseases that need specialized treatment. It is therefore evident that referrals can be done between private and public hospitals based on their capacities advantage in terms of expertise and equipment to help in a critical medical condition and when the available equipment and experts are overwhelmed.

The difference in hospital resources that may enable referrals highly depend on three features namely availability of increasingly specialized personnel, more sophisticated diagnostic and more advanced therapeutic technologies that can enable adequate diagnosis and treatment of certain advancing complex medical conditions (Mulligan *et al.*,2003). Referrals to other hospitals therefore may be hampered by the low resources and capacity for advanced medical care in both private and public hospitals that in turn reveals the low percentage of respondents rating referrals as a strategy used during mass casualty incidences. However, from an FGDs, referrals are done mainly from private hospitals to public hospitals that are more advanced like the Moi Teaching and Referral Hospital along Nakuru, Eldoret and Malaba road in Kenya.

6.2.5 Opening up Urgent Care Centers

As indicted in Table 6.1 Opening up an urgent care centers during mass casualty incidences was rated at 25.8% of the respondents agreed, 45.8% disagreed while 14.2% were not sure whether it was a strategy explored during a mass casualty incidences to

mitigate the patients surge. The results reveal that there is likelihood of low establishment of urgent care centers in both public and private hospitals in the study area that increased the number of respondents in disagreement with the strategy as used during mass casualty incidences. From a key informant in public hospital, hospitals may have urgent care centers but with insufficient resources like staffing or that in turn make them ineffective in time of need. However, there is an increase in adoption and establishment of the urgent care centers by 5.8% and globally, findings by Stomeinoff (2018) reveal that over 89 million patients visit various urgent care centers annually due to the low cost and limited time spent for the medical care. From focus group discussions, in both private and public hospitals, as much as insufficient resources may affect establishment of urgent care centers, other departments such as dialysis center, inpatients unused wards and radiology centers can always be turned into urgent care centers during a mass casualty incident.

In an interview with the county officials in charge of disaster management, through their representative, they had the following to say regarding the opening up of urgent care centers in management of patient surge:

> The effectiveness of this strategy in the prevention and control of patient surge is through reasons such as an increase in the capacity of the healthcare facilities. With the opening up of such centers, there has been creation of more capacity for the provision of care for cases that are non-emergent thereby freeing up more space in the emergency departments of hospitals in times of patient surges. Their presence also ensures that patients have timely access to care allowing for remedial action to betaken thereby preventing the development of severity in the conditions they experience. Other than that, it ensures that the available emergency departments are left for critical care thus alleviating incidences of crowding. The centers can also offer cost-effective care, preventive care and early intervention (Interview with county officials, disaster management, 27th January, 2020).

6.2.6 Outpatient departments adapted for inpatients

Results in table 6.1 indicate that 42.5% of the respondents agreed, 34.2% disagreed while 14.2% were undecided on the use of the outpatients departments for inpatients during a mass casualty incident. It was confirmed by a key informant in public hospital that many of the outpatients departments often serve as alternative places to provide health care for patients who need urgent attention during an emergency where a large number of patients are received by the hospitals. This study resonates with Spry *et al.,* (2012) that found out that many hospitals when faced with patients surge divert resources into mitigating the emergencies and there is and the study has demonstrated a significant reduction of inpatient mortality rate when the strategy is used by both public and private hospitals.

However, in a survey of 21 hospitals in low income countries, significant deficiencies in patients surge management was realized and the study recommended improvement such as diverting resources and designating other departments to accommodate the large number of patients received and enhance faster treatment and reduce mortality to limited levels in hospitals (Veirum *et al*., 2007). Failure to adopt better strategies during patient surge may cause increase in mortality of even patients that had no server conditions and hence need for an all system in the emergency management from better triage system, assessment, inpatient treatment and monitoring of the large number of patients accommodated in the departments that are meant for outpatients (Munga, 2008).

Healthcare facilities have come up with creative solutions to adapt outpatient departments for the provision of inpatient care in the occurrence of patient surges. The strategies that have been effectively used in this measure have included setting up of temporary beds in the outpatient departments. The setup also includes the making of partitioned sections to

ensure the privacy of patients. There is also an extension in the in the hours of operation for the outpatient departments. This allows for the accommodation of more patients and care is provided beyond the normal working hours ensuring that patient surge is effectively controlled. Therefore, the adaptation of outpatient departments to perform services for inpatient departments is crucial and applicable in the curbing of patient surges.

6.2.7 Home care for low-severity illness

The results shown in table 6.1 revealed that 44.2% of the respondents agreed, 25% disagreed while 16.7% were not sure whether their hospitals use home care for low – severity illness as a strategy during patient surge. There is an emerging attention in home care treatment of less server diseases and chronic conditions to be optimized if the care is given at home based on the cost reduction for both the patients and the health care providers. Studies reveal that home care treatment of patients tremendously improves the health of many patients compared to health center treatment of inpatients (OHTA, 2013). However, during a mass casualty incident that is characterized by insufficient resources and capacities, there is need for adequate and additional resources hence health care providers opt to sending patients with less server illness home to be taken care of while creating space for the mass casualties. From a key informant in both public and private hospitals, certain medical cases are infectious for example the cases of a pandemic so the hospital management are only left with an option of home care for less server patients to avoid increased infection to the inpatient already in the hospitals.

In the home setup, patients can access care through several means as was explained by an official from the Kenya Red cross team who stated that:

> The healthcare system is utilizing home-based care to create enough space to hold higher numbers of patients in times of patient surges. There are various services used by such patients as they continue to receive healthcare from home. These include the use of telehealth services. For example, some patients make inquiries and consultations remotely from their homes. This allows for the healthcare professionals access to the patients thus providing care such as assessment of conditions and provision of medical advice on the guidance of self-care at home. Where patients have the required technological devices, the medical professional can also conduct virtual follow-ups through appointments and thus avoid cases of patient surge in the healthcare facilities. Relief of the hospital departments from crowding through the provision of home-based care for illnesses that are less severe creates and reserves in-person resources for the provision of care to more critical conditions (interview with Kenya Red Cross official, 13th March, 2020).

Homecare implementation for individuals with low-severity illnesses is vital in ensuring that the various departments in a healthcare facility function seamlessly with minimal or no problems associated with patient surge. Homecare ensures that departments such as wards are freed up of patients with less severe conditions and can receive care from their homes thereby creating room for the accommodation of more critical cases.

6.2.8 Designate an area for use as a Temporary Morgue

The results in table 6.1 have shown that in examining the hospitals designation of areas for use as temporary morgues, majority of the respondents 39.2% agreed, 36.7% disagreed while 13.3% were not sure whether its an option strategy in the event of mass casualty incidents. During disasters it's expected that many may lose lives and there is need for proper management of the bodies by the hospital facilities. The management entails a series of activities from search of the corpse, identification, and transfer to the facilities that serve as morgues before the bodies are delivered to the family members for

disposal (WHO, 2004). When the so many lose lives then there is a possibility that the morgue facilities may be overwhelmed hence need for a strategy to manage the excess bodies above the available capacity. From a key informant in the mortuary department in public hospital, in a case of a disaster that has claimed many lives, it is expected the available facilities are expanded utilizing buildings that are not fully utilized normally or pitching dome tents and employing the use of Mortuary Enhanced Remain Cooling (MERC) which is regarded as first direct cooling contact system using liquid cooling technology which is completely portable, scalable and interoperable.

The importance of the use of this strategy in the management of health crises that exhibit high mortality rates was articulated by a county officer of disaster management who stated the following:

> In the prevention of surges, the designation of areas for temporary use as morgues allows for the dignified handling of the deceased during times of high mortality. Furthermore, there is efficiency that is exhibited logistically where such areas ensure that there is facilitation of the processes involved in the storage and documentation of information on the deceased. It also ensures that potential transportation is facilitated together with the provision of proper preservation measures thereby creating a system where hygienic conditions can be maintained and rapid decomposition avoided. Additionally, the presence of separate and designated areas for use as temporary morgues provides for the compliance of the healthcare staff to the legal regulatory and ethical standards that guide the processes involved in handling of the deceased. The efficiency in rapid response and deployment of services in handling the deceased is therefore enhanced reducing surge problems in times of crises (interview with county officer, disaster management, 11th March, 2020).

Emergencies and pandemics lead to high rates of mortality among the affected patients. The increase in the numbers of death is a promoting factor of surges and can be a result of surges. During such times, the morgues are impaired in functionality since the numbers of corpses are usually higher than their holding capacity. Therefore, patients and

healthcare providers tend to be affected emotionally especially when the healthcare facilities lack space to preserve the deceased. While this strategy is dismal in the management of patient surges, it is necessary and is usually successful with careful planning and proper execution of services. The dignity of the deceased and support of the affected families and healthcare personnel is necessary.

6.2. 9 Ensure adequate supply of body bags

According to the findings in table 6.1 supply of adequate body bags in the event of a disaster where so many have lost live was rated as 42.5% of the respondents agreed, 23.3% disagreed while 22.5% were not aware if additional body bags is used as a strategy to manage the large number of bodies during a disaster. From the findings, it is evident that majority of both public and private hospitals adopt the use of body bags in an emergency situation. Body bags which are also known as human remain pouch are used to temporarily store copse in the mortuaries or used to transport the corpse to disposal site. It was established from the FGDs that in the event that the additional body bags are exhausted in a mass loss of lives, the authorities like police and other first responders during a disaster use blankets, bed sheets, polythene bags and sleeping bags and even reuse the body bags to help store or transport the bodies. From a key informant, hospitals can store additional body bags but the nature of disasters where it is not easy to predict, lack of financial allocation and non-commitment for a respectful handling of the bodies affects acquisition of the adequate body bags.

6.3 Strategies adopted by the hospitals in handling patients for lack of capacity in terms of staffing during MCI

The study sought to establish strategies adopted by various hospitals in handling patients for lack of capacity in terms of staffing during MCI. The findings are as indicated in Table 6.2 and are discussed in the subsequent sections.

Table 6.2 Strategies adopted by the hospitals in handling patients for lack of capacity in terms of staffing during MCI

Strategy	Agree		Disagree		Not sure		NR		Rank
	N	%	N	%	N	%	N	%	
Recalling staff on leave	220	77.5	30	10.8	14	5	19	6.7	1
Increasing number of working hours	195	68.3	52	18.3	7	2.5	31	10.8	2
Engaging medical students	179	62.5	71	25	12	4.2	23	8.3	3
Engaging medical personnel from security agencies	102	35.8	109	38.3	45	15.8	29	10	5
Engaging Community Health Volunteers	109	38.3	97	34.2	45	15.8	33	11.7	4

Source: Field data (2020)

6.3.1 Recalling staff on leave

The results in Table 6.2 show that 77.5% of the respondents agreed, 10.8% disagreed while 5% were not sure whether the hospital management do recall staff on leave when there exist patients surge in an emergency situation as a strategy to mitigate the impact of the emergency. Analysis reveals that majority of the respondents affirm the strategy as being used by both private and public hospitals to increase the human resource capacity during mass causality incidents. During a mass casualty incidence, rapid mobilization of the health personnel is needed due to the uncertainty and the unexpected dimension of the

causalities in terms of victim surge (Epstein *et al*., 2010). Many organizations therefore have information system that enables them to send a recall message as fast as possible to all the staff that are on leave to resume during a patient surge.

According to Key informant at the emergency department of both public and private hospitals, the recall systems must be integrated and have a routine test to ensure effectiveness during a mass casualty incidence. According to (Windokun and Hamid, 2010) in a study to test the information systems during mass casualty incidence, timely replies from the simulated disaster recall 50%, 48% not timely due to inaccessibility while 2% missed the message. It was therefore established that with adequate information systems, staff recall has been highly embraced by many organizations and hospitals during emergencies to increase the human resource capacity during an emergency. It was established that he percentage of respondents who disagreed had not experienced mass casualty incidences and therefore had no adequate information about recalling of the staffs on leave.

6.3.2 Increasing number of working hours

The results in Table 6.2 show that 68.3% of the respondents agreed, 18.3% disagreed while 2.5% were not certain about the increasing the number of working hours for staff as a strategy in increasing the staff capacity during a mass casualty incident. It was established from the FGDs that majority of the participants had experienced increased working hours at any given time when the number of patients increased than had been planned. Study revealed that Medical personnel in public hospitals have 48 hours of work in a week different from the private medical personnel where the number of working

hours is as stipulated by the employer. It was therefore established that many private hospital medical personnel spent an average of 50 working hours in a week. However, they both public and private hospitals practice extension of working hours when there is patients surge. It was established that the extension of hours was purely due to lack of additional staff members on standby to help during mass casualty incidences.

Increase in the number of working hours of the healthcare providers was supported as a strategic measure in the prevention of patient surges by one of the nurses working in the MTRH wards with the following statement:

> Times of crises usually necessitate longer working periods since the high numbers of patients usually outnumber the staff available in the healthcare departments. Whenever this is the case, the available staff have to work for more hours than scheduled for them with the aim of ensuring that the patients are well-taken care of and that crowding is prevented. The strategy also helps in the improvement of patient satisfaction scores since provision of care is not halted by such aspects as the end of a healthcare professional's shift time. The management ensures that there are regulatory measures and policies that guide the extension in the number of working hours among the staff. More so, rotation and rest periods are observed with respect to schedules in order to ensure reasonable working hours of the available staff in order to maintain their effectiveness and well-being by avoiding cases of burnout (interview with MTRH nurse, 16th March, 2020).

6.3.3 Engaging Medical Students

The results in Table 6.2 indicate that majority of the respondents 62.5% agreed, 25% disagreed while 4.2% were not certain on the use of medical students as a strategy to increase the staff capacity during some mass casualty incidents. Undergraduate and postgraduate medical students mostly in their final years have been used to increase the capacity during emergencies. However, it was learnt from the Key informants that there are conditions that may not allow them to be engaged fully such as when it involves more expertise and very contagious diseases. However, there are instances where the students

are relieved from engaging themselves with the hospital for example during the 2003 Server Acute Respiratory Syndrome (SARS) and the COVID 19 cases there are some hospitals that gave them a break for fear of subjecting them to infections in Canada (UNEP, 2003)

During times of mass casualty incidents, healthcare facilities usually require vast numbers of healthcare providers. This is necessary to ensure that the risk of burnout among staff is alleviated and that patients receive the best care possible from qualified personnel. Under severe cases of patient surge, hospitals usually engage medical students in the provision of care as was explained by the managing director of the MTRH. He stated that:

> There are times when the mass casualty incidents overwhelm the available staff creating advanced problems related to medical surges. The engagement of medical students in the management of medical surges has been effective in the provision of additional support. Through the training that such students have undergone, they are able to apply the acquired knowledge in cases of patient surges and have thus proved to be beneficial to the healthcare facility. Through performance of roles such as data entry and administrative tasks, medical students have been vital in helping ease the problem of mass casualty surges. More so, they have also been engaged in the provision of basic patient care while under supervision. Subsequently, in the event of increased demand, the engagement of medica students has helped reduce the workload of the healthcare professionals thereby curbing surges (interview with MTRH managing director, 16th March, 2020).

6.3.4 Engaging Medical Personnel from Security Agencies

The results shown in Table 6.2 show that 35.8% (43) of the respondents agreed, 38.3% disagreed while 15.8% were not certain on the use of medical personnel from security agencies as a strategy to increase the staff capacity during mass casualty incidents. It was established from the Key informants that some of the medical personnel that are normally

used are mainly from the military and the administration police who are trained as doctors, clinicians and nurses to help increase the staff capacity during a mass casualty incident. However, there are a large percentage of the respondents who disagreed with the strategy use during mass casualty incidents due to the fact that they have never experienced a situation where the security personnel had to be engaged to offer medical services. According to Hui ma *et al*., (2016), there has been a mutual working relationship between the security and the civilian medical personnel in reduction of impacts of disasters involving mass casualty incidents in many parts of the world and that has shown tremendous improvement in emergency response mainly during the SARS, Influenza, A (H1N1), and Ebola. It is therefore evident that the medical personnel from the security agencies have been adequately used in pandemics when the cases are overwhelming.

6.3.5 Engaging Community Health Volunteers

The results shown in table 6.2 revealed that Community health volunteers as a strategy in increasing staff capacity during mass casualty incidents was rated by the respondents with 38.3% of the respondents agreeing, 34.2% disagreeing while 15.8% not certain. The concept of community health volunteers has gained popularity in both developed and developing countries in bridging the gap created by the insufficient staff in the health sectors based on the fact that community health problems are best understood by the community members and hence the CHV stands to help provide sustainable solutions (Bhutta*et al*., 2010).

From FGDs, the participants confirmed the role of the CHVs during mass casualty incidences majorly when there is an emergency in the community they become the first

responders with basic medical knowledge to help the victims with main focus on the illicit brew poisoning in the community, cholera outbreak and mass casualties from road accidents. It was however established that the Community Health Volunteerism face a range of challenges that reduce their effectiveness such as lack of motivation in terms of allowances and insufficient equipment and materials. These challenges could therefore account for the 34.2% disagreement of the CHVs effectiveness during mass casualty incidences.

During interviews, one of the Officials from Kenya Red cross stated that they have worked closely with community heath volunteers with the aim of building their capacity in case of disaster. He opined that;

> These community volunteers sometimes play the essential role of becoming first responders when disasters occur. It is therefore paramount that we help them have basic skills such as first aid skills because in many cases they are always the first people on the scene during disasters (Interview with Red-cross Official, 27th February 2020).

6. 4 Availability of designated hospital command Centre

Results in Figure 6.1 indicate that 80.8% of the respondents were adequately informed, 12.5% not adequately informed while 6.7% did not know about the availability designated hospital command center in both private and public hospitals.

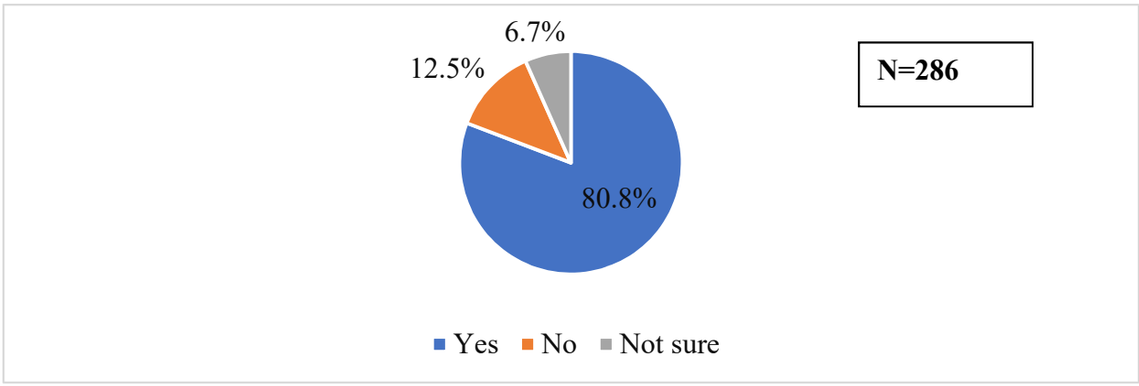


Figure 6.1: Availability of the designated command center

Source: Field Data, 2020

Analysis reveals that majority of the respondents have full knowledge of the designated command center hence, it is expected to increase response during an emergency through faster mobilization of personnel and equipment in both private and public hospitals. According to (Shahin *et al*., 2017), the benefits of application of incident command system lies in the increased preparedness of health care centers, coordination and effective responses during an emergency involving mass casualty. However, it was established from Key informants from both private and public hospitals that lack of motivation, incompatibility of the system with management structure of the hospital, lack of administrative culture of emergency management and lack of multiplicity of resources of decision making still remain to be existing barriers that reduce effectiveness of the incident command systems in both public and private hospitals.

6.5 Presence of designated care areas for patient flow

Results in Figure 6.2 show that presence of auditorium was rated by the respondents at 25% availability, 53.3% not available while 21.7% were not sure about the availability of

the auditorium that can be used during patient surge. Lobbies presences in both private and public hospitals were rated by the respondents as 31.7% available, 48.3% not available while 20% of the respondents were not sure of its availability in both public and private hospitals. Isolation areas presences were rated by the respondent at 51.7% available, 40% not available while 8.3% were not certain of the availability of the isolation areas in both public and private hospitals for use during mass casualty incidents.

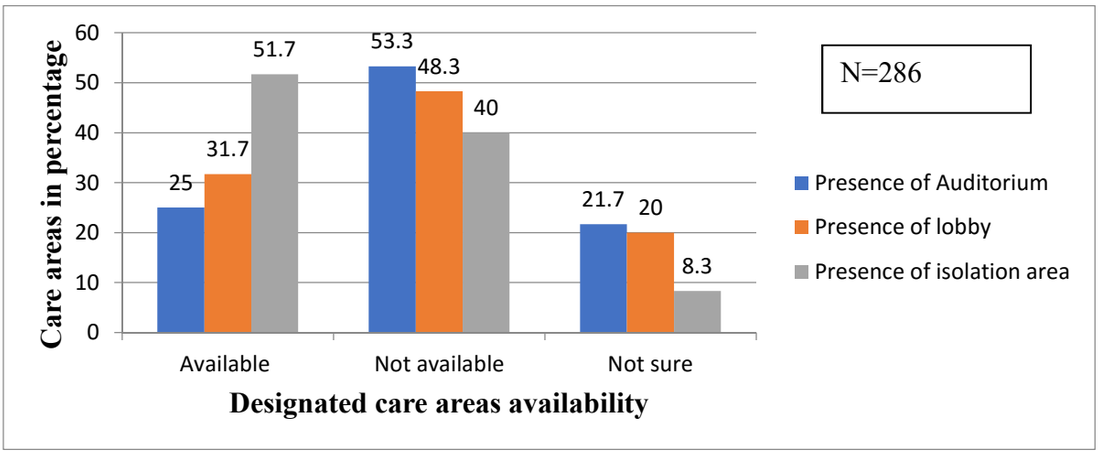


Figure 6.2 Presence of designated care areas

Source: **Field data (2020)**

The findings from the key informants revealed that isolation areas designation rates higher than auditorium and lobby areas while auditorium presence is rated the lowest as care areas in terms of availability in hospitals for use during mass casualty incidences. It was established from the Key informants that apart from the auditorium, lobby and isolation areas, hospitals at times are forced to use hospital corridors, dome tents and even stadia for holding patients or as observation for temporary patients care during patient surge.

Healthcare command centers are managed to facilitate and manage patient throughput. The availability of designated hospital command centers is vital in the management of patient surges where coordination and optimization of resources can be done effectively. It is from these centers that communication is carried out. This is a crucial aspect in all levels of provision of care since communication allows for resource allocation and quick decision-making. The availability of hospital command centers in the management of patient surge was described as an effective strategy by the MTRH administrator who stated that:

> Hospital command centers ensure that coordination is adhered to through centralized communication. Therefore, decision-making and allocation of resources are effective and efficient. More so, there is success in the provision of care to patients since there is direct deployment of staff in the provision of services with patients being directed to the appropriate departments from which they are to seek care. The centers also manage essential supplies. It is these activities by the command centers that increase the capacity of the healthcare facilities to handle increase in the numbers of patients who report to the facilities (interview with MTRH administrator, 20th March, 2020).

During the Interviews with patients, they echoed what had been stated by the key informants and the heath care workers regarding the availability of designated areas for patients flow. The patients stated that there was need to increase spaces where patients could be received as the waiting areas like the lobby were congested. The patients further revealed that there was need to increase the registration rooms along with the number of staff so that service delivery in hospitals would be faster.

6.6 Chapter Summary

In line with objective three which sought to explore the strategies applied to cope with patients surge during mass casualty incidents, 43.08% of the respondents agree, 31.84%

disagree, 11.43% not sure whether the use of the strategies are employed in a mass casualty incidents while there is a none response of 11.43% from the respondents. In terms of strategies used to increase staff capacity during mass casualty incidents, 56.48% of the respondents agreed, 25.32% disagreed, 8.66% were not sure while 9.5% were of none response about staff capacity during patient surge. Regarding presence of designated care areas used temporarily by the hospital, isolation areas rate highest 51.7% availability while auditorium presence rates 53.3% least available in both private and public hospitals for mass casualty incident management along Nakuru – Eldoret –Malaba road in Kenya.

CHAPTER SEVEN

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

7.1 Introduction

This chapter discusses the summary, conclusions and recommendations of the study. The chapter gives the summary of findings based on each of the three specific objectives of the study. The summary is based on the findings that have been discussed in chapters four, five and six. The study further gives the conclusions of the study based on the overall objective as well as the specific objectives. Additionally the chapter gives recommendations of the study as well as areas for further research.

7.2 Summary of Findings

The first objective of the study sought to examine the predisposing factors for patient surge at the emergency departments, the wards, operating theatres and the ICU. It was observed that 74% of the respondents had either experienced or respondent to a major emergency incident in the workplace. However, the study found out that there is not adequate staffing, equipment and infrastructure to respond to a surge of patients arising from mass casualty incident in the study area.

In line with specific objective two, mass critical care requires modification to standards of critical care interventions, personnel staffing, equipment, and triage management to provide an acceptable level of care. At a minimum, hospitals must plan to deliver to critically ill patients a basic mode. This must include issues of health care rationing and the decision process on who will receive mechanical ventilation and other life-saving

treatments. The study found out that, 72% of the respondents reasoned that job action sheets were available in hospital stations. Contrariwise, 7% of the respondents stated that such supplies were not available in hospital stations. 91.6% of the respondents stated that such supplies were available in hospital stations. Additionally, 2.5% of those interviewed opined that such supplies were not available. The study further found out that, 4.4% of the respondents were not sure whether such supplies are in hospital stations. Further, (83.3%) responded that such a resource was available and in good condition while (16.7%) disregarded the inquiry and reasoned that such a resource was not available in hospitals departments

In line with objective three which sought to explore the strategies applied to cope with patients surge during mass casualty incidents, 43.08% of the respondents agree, 31.84% disagree, 11.43% not sure whether the use of the strategies is employed in a mass casualty incidents for patient surge while there is a none response of 11.43% from the respondents. In terms of strategies used to increase staff capacity during mass casualty incidents, 56.48% of the respondents agreed, 25.32% disagreed, 8.66% were not sure while 9.5% were of none response about staff capacity during patient surge. Regarding presence of designated care areas used temporarily by the hospital, isolation areas rate highest 51.7% availability while auditorium presence rates 53.3% least available in both private and public hospitals for mass casualty incident management along Nakuru – Eldoret –Malaba road in Kenya.

7.3 Conclusions

From the findings the overall conclusion of the study is that patient surge management strategies are still weak and as such cannot give effective emergency response to mass casualty incidents along Nakuru- Eldoret- Malaba 104 road, Kenya.

This is based on the fact that majority of hospitals where the study was conducted were grappling with a number of challenges including lack of enough staff, lack of enough capacities and spaces in hospitals which makes it difficult for these facilities to cope with large numbers of patients during MCI.

In line with the first objective, the study concluded that availability of adequate staff, equipment and infrastructure are key factors to be considered for patient surge at the ED, wards, operating theaters and the ICU. There is an increase in copying strategy during mass casualty incidents however; there are existing challenges such as low staff numbers, lack of motivation to the emergency responders, low administrative culture in emergency management and low allocation of resources for emergency management.
Incident command system vests(ICS) was not well established. The ICS vests needed for easy identification of staff was not adequate. This means organizing teams of people can be a headache.

In line with specific objective two, the study concluded that the status of available critical resources is wanting in MCIs. This challenge overwhelms MCI responders on a daily basis with high acuity, declining bed capacity, and health care worker (HCW) shortages, will be the sudden presentation of large numbers of severely critical victims. Most

importantly the equipment of critical importance the injured was not readily available ie self-inflating bags and laryngoscopes. These are crucial in airway management.. Prioritization of procurement should be informed especially the emergence department

In line with the third objective there is an increase in application of copying strategies, some of which were not very good for the health of the patients such as bed sharing. Some strategies on increasing staff capacity were also not worker friendly for example recalling workers on leave would go against the labor laws; there was also lack of sufficient space in designated waiting areas for patient flow.

7.3 Recommendations

Based on the conclusions the study makes the following recommendations.

First the study recommends that there is need for the hospital management to increase the number of staff, increased capacity in terms of equipment and instill a multidisciplinary approach and culture of emergency management to enhance sustainable emergency management system during mass casualty incidents.

Secondly, the study recommends that mechanisms are put in place for quick and immediate needs response including critical resources, staffing, equipment, and stuff to cope with a major MCI. This calls for legislation of relevant policies and adequate budget allocation for paying staff, building the infrastructure and purchase of equipment needed for patient management.

Lastly the study recommends that hospital facilities should improve on patient put through by adopting or developing efficient strategies for care of patients without overcrowding stations. This may require collaborations between the local and central governments; collaboration with NGOs like the Red Cross And other world organizations like WHO for expert opinion and financial support.

7.4 Suggestions for Further Research

i. Strategies put in Place by the government to capacity build in hospitals for Disaster preparedness in line with increasing fatalities on the roads.

ii. The availability of technology for early warning, coordination and communication among Kenya hospitals and ambulances during MCI

iii. Nationwide survey for resources in hospitals and their capacity to manage surge as a baseline study

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APPENDICES

Appendix 1: Introductory letter and Consent form

Consent for expert opinion in focused group discussions (FGD)

I am **Dr. Kituyi P.W**, a facilitator for this discussion about your opinion on hospital critical resources that should be in place for disaster and patient surge in MCI with mass casualties**.** Your input and the results of this discussion will help us better understand your experiences and also contribute to future programs aimed at risk reduction especially minimizing bad outcome during disaster events. Thank you for agreeing to participate in this discussion. The results of this research was shared among the study partners in order to better address the needs of the community on better preparation for mass casualties that present to hospitals when many are injured.

Today you will give your expert opinion in a group interview, which should take between 1 to2 hours. Your participation is voluntary. If you do not wish to participate, please feel free to stop at any time. As this is a group discussion aimed at representing this community, we ask that you respond in a matter that you believe best expresses your experiences within the broader context of this community. Your responses were interpreted as being the perceptions of this community and were treated completely anonymously. Taking part in this interview is your agreement to participate.

During the group interview, 1 will not be able to guarantee confidentiality because we were discussing information as a group. Therefore, if you would feel uncomfortable with any of your statements being shared with others in or outside the group, please do not share them during the process.

If you would like a copy of this letter for your records, please let me know and I will provide a copy for you now. If you have any questions regarding the study, contact **Dr. Kituyi Werunga**, the principal investigator at **0722635920.**

Consent form for respondents

Good morning/afternoon?' My name is Dr. Kituyi P. Werunga. I am part of research team conducting a study titled **PATIENT SURGE MANAGEMENT STRATEGIES FOR EFFECTIVE EMERGENCY RESPONSE TO MASS CASUALTY INCIDENTS ALONG NAKURU-ELDORET- MALABA A-109 ROAD, KENYA**

The purpose of the study is to assess how the hospitals are prepared to handle and manage disaster victims. The information generated will inform all stakeholders involved in Health intervention initiatives design appropriate strategies for patient flow during disaster events.

Procedure for the study

The study involved asking you some questions concerning your hospital and level of disaster preparation.

Benefit and risks

The result of this study is expected to patient flow during disaster events with numbers of patients the system is unable to cope. There are no anticipated risks to you as a participant since no interventions took place.

Confidentiality

All the information collected was treated in confidence and used only for purposes of this study. The dissemination of results was by way of summarized information that had no reference to any particular individual.

Voluntary consent

You are free to choose whether to take part in the study or not, feel free to withdraw at any time during the interview. Feel free to ask any question before or after the interview. For any issues/questions concerning your right and that of your child please contact the County Public Health Officer. For any questions concerning this study please conduct Principal Investigator Dr. Kituyi Werunga Telephone**: 0722635920**

I hereby invite you to take part in the interview on the above subject. The interview will take approximately 45 minutes.

Statement of informed consent

The above information has been clearly explained to me and I have read/understood it. I do here by voluntarily agree to participate in this study.

Respondent's signature/thumb print.....

Name of research assistant eliciting consent.....

Signature.....

Date…….

Appendix 2: Questionnaires for Health care givers in the emergency departments, the OR, ICU and wards where patients are likely to be accommodated during MCI.

Part 1: Basic Information

Date;…….

Hospital……..

Geographical region…….

Designation. (DOCTOR INCHARGE, NURSEI/C, OTHERS ……) tick appropriately

Part B: Predisposing factors for patient surge at the Emergency Departments, the Wards operating theatres and the ICU

1. How long have you served in this facility

Period of Service	Tick where appropriate
Less than 1 year	
1-5 Years	
6-10 years	
More than 10 years	

2. In your stay here have you experienced/Responded to a major emergency incident

Yes…….No……If Yes which of the following mass casualty DISASTER SCENARIOS have you experienced commonly

Mass shooting……..……..

Explosive shrapnel injuries…….

Road traffic accidents on mass casualties…….

Any other ……

3. In Your opinion, for the for the scenario in 2 above ,List and explain the critical resources necessary for efficient management of victims at the following hospitals care places;

a. Emergency department

b. Operating theatre

c. ICU

d. Wards.

4. Can the state of resources currently in your hospital able to handle patients flowing in on massive scale after disaster event?

Yes……..NO…….

Explain your response.

…….....

.....

.....

5. Does your hospital have the following equipment/facilities in working state for MCI response?

Blood Bank- Yes……../No……. Explain……

Laboratory- Yes……../No…….. Explain……..

Beds in ED Yes……/No… Explain……

ICU Beds Yes……/No…. Explain…….

Ward beds Yes…../No…. EXPLAIN……..

Radiological services Yes……No …. Explain……..…

……

……

……

6. How do you handle patients who cannot be managed in this hospital for lack of capacity?

……

……

……

Part C: status of critical resources required for mass casualty incidences.

8. What is the status of the availability and condition of the following CRITICAL RESOURCES in the hospital where you work?

Resource	**Available**		**Not available**
	Good Condition	**Poor Condition**	
Crystalloid solution with IV tubing			
Adult ICU capacity			
Ambu bag, adult			
Endotracheal tube			
Laryngoscope, adult			
Oxygen source and tubing			
Ambu bag, pediatric			
Adult mechanical ventilator set			
Pediatric mechanical ventilator set			

Critical care nurse			
Suction catheter and suction apparatus			
Laryngoscope, peds			
Critical care physician			
Sedatives*			
Peds ICU capacity			
Adult medical/surgical bed			
Needles, sterile			
Non-critical care nurse			
Latex-free, non-sterile gloves*			
IV catheters (18-24g), and heplocks			
Pressors*			
BP cuffs, adult			
BP cuffs, pediatric			
Peds medical/surgical bed			
Oxygen mask, adult			

9. How many ambulances exist in the facility for emergency response .,……

10. Are these ambulances well equipped for the following emergency activities

	Well equipped	Moderately equipped	Poorly equipped	Not equipped

BLS in Emergencies Emergency				
ALS in Emergencies Emergency				

11. What the availability of the following critical facilities for BLS/ALS in ambulances in the locality (Tick appropriately).

Equipment	Available in good condition	Available in poor condition	Not Available
Ventilation and Airway Equipment			
Monitoring and Defibrillation			
Immobilization Devices			
Bandages/Hemorrhage Control			
Two-way communication device between ground ambulance, dispatch, medical control, and receiving facility			
Infection Control			
Injury-prevention Equipment			
Medications			
Vascular Access			

Please explain the your answer…….....

……

……

……

……

……

……

……

12. Is there a designated hospital command centre, i.e. a specific location prepared to convene and coordinate hospital-wide emergency response activities and equipped with effective means of communication?

Yes……No……

13. Are there designated care areas for patient overflow (e.g. auditorium, lobby).

Yes……No……

If Yes how are these areas prepared to deal with the overflow in the event this happens

……

……

……

Part D: Strategies applied to cope with patients' surge during mass casualty incidences

14. Do you get to manage all patients who come to your outpatient department Yes…/No… explain……..

15. Do you sometimes get overwhelmed with the numbers that present to the ED, theatres, and ICU.Yes……./No…….

If the answer is YES, How does the hospital cope with the numbers that need;

ICU admissions……

……..

……..

Emergency Surgery……..…

…….

Ward admission with no space…….

……..……

……....

16. How often are ambulances diverted OR dispatched to other hospitals for lack of space or service. Often……Not often…….

17. Does your hospital have the capacity to expand bed capacity, and staff during MCI. Yes……../No…….

if no, how your hospital accommodate patient numbers more than the bed capacity…….

……

…….

18. During disaster event can your hospital have supplies at stations where they wasmost useful including;

	Yes	No	Not Sure
Incident Command System vests			
Job Action sheets			
Writing material			
Communication devices (Radios, telephones, etc.)			
State, Regional and Local maps; blueprints of facilities, etc.			
Computers, Television and other AV equipment			

White boards, bulletin board, flip charts or other visual aids.			
Hospital Clinical Operations			

Part E: Strategies that can be employed to expand surge capacity during MCI in hospitals

19. Based on your experience as a medical practitioner, what would be the best way to make emergency response more effective in your? …….

……

……

……

……

Is there need to have medical volunteers in the community to help in emergencies Yes…….. No……..If Yes in how will this improve the process of emergency response …….....……

……

……..

How will this help medical personnel who receive these patients of further medical attention…….....

.....

..

20. Increase hospital capacity by outsourcing the care of non-critical patients to appropriate alternative treatment sites e.g.

	Agree	Disagree

Outpatient departments adapted for inpatient use,		
Home care for low-severity illness,		
Chronic-care facilities for long-term patients		

21. Identify potential gaps in the provision of medical care, with emphasis on critical and emergent surgical care. Yes……..No……..

22. Address these gaps in coordination with the authorities and neighboring and network hospitals

Agree……..Disagree……..

23. Adapt hospital admission and discharge criteria and prioritize clinical interventions according to available treatment capacity and demand. Agree……..Disagree……..

……

……

……..

24. Designate an area for use as a temporary morgue.

Agree……..Disagree……..

25. Ensure the adequate supply of body bags. Agree……..Disagree……..

26. In your opinion, explain how explain how you think surge capacity during MCI in hospitals in hospitals can be improved

……

……

……

Appendix 3: Interview Guide for Hospital Administrators and Managers

Date;…….

Hospital……..

Geographical region…….

RESPONDENT. (DOCTOR INCHARGE, NURSEI/C, ADMINSTRATOR, FINANCE MANAGER, REDCROSS OFFICER, OTHERS ……) tick appropriately

Part A: Predisposing factors for patient surge (Emergency Departments, the Wards operating theatres and the ICU.) *Circle station*.

1. What is the monthly average of the number of patients managed in your station?

Monthly Number of patients	Tick where Appropriate
10-100	
100-500	
500-1000	
More than 1000	

.....

2. Any mass casualty incidences in the past 10 years? Yes/No .If yes, list the incidences and say how the hospital was prepared.

……

……

……

……

How many patients were managed through this station in each of the incidences?

Incidents	Number of Patients	Year of Incident

3. Were you able to cope with the numbers and flow of patients yes/no?

Yes……No…….

If no, what factors led to slow or poor response to mass casualty victims?

Please list and explain them under the following categories;

-

staffing;……

……

……

……

……

equipment;……

……

……

……

……

……

……..

-

Infrastructure;……

……

……

……

…….

4. In your opinion what can the hospital management and the govt. do to improve overall preparedness.

……

……

……

……

……

……

DISASTER SCENARIOS OVER TABLE TOP EXERCICES

1. Mass shooting and explosive shrapnel injuries

2. Road traffic accidents on mass casualties

for the scenario 1&2 ,List and explain the critical resources necessary for efficient management of victims at the following hospitals care places;

a. Emergency department

B. Operating theatre

c. ICU

D. Wards.

2. Can the state of resources currently in your hospital able to handle patients flowing in on massive scale after disaster event? Explain your response.

…….....

.....

.....

.....

3. Does your hospital have the following equipment/facilities in working state for MCI response?

Blood Bank- Y/N. Explain……

Laboratory- Y/N. Explain……..

Beds in ED Y/N Explain……

ICU Beds Y/N explain…….

Ward beds Y/N EXPLAIN……..

Radiological services; explain……

……

……

……..

How do channel patients who cannot be managed in this hospital for lack of capacity?

……

……

……

Patient flow plan; answer yes or no

1. Your hospital has a plan that clearly shows the ingress and egress of patients during a disaster. YES/NO/OTHERS.EXPLAIN……..

2. Elaborate plans exist on how patients was moved during a surge capacity crisis. For example use of portable x-rays.

YES/NO/OTHERS EXPLAIN…….

3. Early discharges for home care is a viable solution in our hospital for those whose admission was deferred because of limited bed capacity. Yes/no /others EXPLAIN……

……..

4. What is the total number of the under listed hospital medical personnel?

Cadre	Number
Doctors,	

Nurses	
laboratory staff	
Radiology staff	
Specialized emergency physicians	
Others	

Do you have adequate Doctors, nurses, and laboratory staff and support staff to manage MCI in your hospital?

Yes……./No……...EXPLAIN……

…….

5. Staff/structures

Does your hospital have structures and space that can be expanded or converted to accommodate mass casualties? Y/N EXPLAIN……

What in your opinion can be considered the CRITICAL RESOURCES the hospital requires in order to handle mass casualties?

Equipment status

Key ;A –available, NA-NOT available .ANF - available not functional			Quantity	
Crystalloid solution with IV tubing				
Adult ICU capacity				
Ambu bag, adult				
Endotracheal tube				
Laryngoscope, adult				
Oxygen source and tubing				
Ambu bag, pediatric				
Adult mechanical ventilator set				
Pediatric mechanical ventilator set				
Critical care nurse				
Suction catheter and suction apparatus				
Laryngoscope, paediatrics				
Critical care physician				
Sedatives*				
Paediatrics ICU capacity				
Adult medical/surgical bed				
Needles, sterile				
Non-critical care nurse				

Latex-free, non-sterile gloves*		
IV catheters (18-24g), and heplocks		
Pressors*		
BP cuffs, adult		
BP cuffs, pediatric		
Pediatrics medical/surgical bed		
Oxygen mask, adult		

Key ;A –available, NA-NOT available .ANF - available not functional

Bed capacity

Department	Total no of beds	Beds occupied	Available for use	Expandable capacity
Emergency				
ICU				
Surgical wards				
Trauma wards				

STAFFING EMERGENCY DEPARTMENT

No. of surgeons on duty …….

No. of nurses on duty ……

No of doctors trained in BLS/ACLS……..

WHERE is extra numbers doctor/nurses mobilized from for surge ……

Number vaccinated Against;

Hepatitis …….

Yellow fever ……..

Pneumonia …….

Others……

……

ICU

No of surgeons on duty ……

No. of nurses on duty ……

No of doctors trained in BLS/ACLS……..

WHERE is extra numbers doctor/nurses mobilized from for surge …….

No. Vaccinated against; hepatitis……. yellow fever ……..pneumonia……. Ebola……others…….

SURGICAL /TRAUMA WARDS

No of surgeons on duty ……

No. of nurses on duty ……

No of doctors trained in BLS/ACLS……..

WHERE is extra numbers doctor/nurses mobilized from for surge ……

No. Vaccinated against; hepatitis……. yellow fever ……..pneumonia……. Ebola……others…….

STRATEGIES USED TO COPE WITH PATIENT SURGE.

1. Do you get to manage all patients who come to your outpatient department Y/N explain……..

2. Do sometimes get overwhelmed with the numbers that present to the ED, theatres, and ICU.Y/N.

IF THE answer is YES, How does the hospital cope with the numbers that need;

- ICU admissions
- Emergency Surgery
- ward admission with no space.

3. How often are ambulances diverted OR dispatched to other hospitals for lack of space or service. Specify……..

Does your hospital have the capacity to expand bed capacity, and staff during MCI.Y/N .if no, how your hospital accommodate patient numbers more than the bed capacity.

During disaster event can your hospital have supplies at stations where they wasmost useful including;

Incident Command System vests

Job Action sheets

Writing material

Communication devices (Radios, telephones, etc.)

State, Regional and Local maps; blueprints of facilities, etc.

Computers, Television and other AV equipment

White boards, bulletin board, flip charts or other visual aids.

Hospital Clinical Operations;

4 Emergency department;

Patient flow plan; answer yes or no

5. Your hospital has a plan that clearly shows the ingress and egress of patients during a disaster. YES/NO/OTHERS.EXPLAIN……..

6. Elaborate plans exist on how patients wasmoved during a surge capacity crisis. For example use of portable x-rays.

YES/NO/OTHERS EXPLAIN…….

7. Early discharges for home care is a viable solution in our hospital for those whose admission was deferred because of limited bed capacity. Yes/no /others EXPLAIN……

Focused group discussions

Expert panel composition

Participant Type	Number	
Administration and hospital operations	4	
Adult intensive care nurse	2	
Adult intensive care physician	2	
Burn specialist	1	
Infectious disease physician	1	
Internal medicine physician	2	

Medical/surgical nurse	2	
Pediatric intensive care nurse	1	
Pediatric intensive care physician	2	
Pediatric nurse	2	
Pediatric physician	2	
Radiation specialist	1	
Trauma physician	1	

Focused group discussions

8.What in your opinion can be considered the CRITICAL RESOURCES the hospital requires in order to handle mass casualties the common disasters in your region?

Resource	
Crystalloid solution with IV tubing	
Adult ICU capacity	
Ambu bag, adult	
Endotracheal tube	
Laryngoscope, adult	
Oxygen source and tubing	
Ambu bag, pediatric	
Adult mechanical ventilator set	
Pediatric mechanical ventilator set	
Critical care nurse	
Suction catheter and suction apparatus	

Laryngoscope, peds	
Critical care physician	
Sedatives*	
Peds ICU capacity	
Adult medical/surgical bed	
Needles, sterile	
Non-critical care nurse	
Latex-free, non-sterile gloves*	
IV catheters (18-24g), and heplocks	
Pressors*	
BP cuffs, adult	
BP cuffs, pediatric	
Peds medical/surgical bed	
Oxygen mask, adult	

1st session with experts.

1. Add to the list above of the critical resources to make complete of the resources needed for emergency response including stuff and staff. If all have agreed;

2nd session; experts divided into groups to anonymously decide which of the resources are considered critical.

3rd session we meet to reach at least 50% consensus of the critical resources.

Appendix 4: FGD Guide.

1. What laws govern disaster management at county levels in Kenya.

2. Explain how ready the county government is prepared to manage disaster victims with mass casualties in terms of;

a) Staffing/relevant training

b) Drugs and equipment for 1st responders

c) Physical facilities (hospital space, beds operating theatres, radiology support, ICU space,

d) Transportation of the injured**.**

Staffing/relevant training	Drugs and equipment for 1st responders	Physical facilities	Transportation of the injured	Disaster management drills

3. List the sources of external financial support during mass casualty incident.

4 what role does the community play in assisting the injured

5. In your opinion, is your institution doing enough to minimize bad outcome from MCIs. Explain.

6. Suggest ways of improving operations in your organization or institution during MCI.

Appendix 4: Observation Checklist

Equipment status

Key ;A –available, NA-NOT available .ANF - available not functional			Quantity
Crystalloid solution with IV tubing			
Adult ICU capacity			
Ambu bag, adult			
Endotracheal tube			
Laryngoscope, adult			
Oxygen source and tubing			
Ambu bag, pediatric			
Adult mechanical ventilator set			
Pediatric mechanical ventilator set			
Critical care nurse			
Suction catheter and suction apparatus			
Laryngoscope, paediatrics			
Critical care physician			
Sedatives*			
Paediatrics ICU capacity			
Adult medical/surgical bed			
Needles, sterile			
Non-critical care nurse			
Latex-free, non-sterile gloves*			

			IV catheters (18-24g), and heplocks					
			Pressors*					
			BP cuffs, adult					
			BP cuffs, pediatric					
			Paediatrics medical/surgical bed					
			Oxygen mask, adult					

Key ;A –available, NA-NOT available .ANF - available not functional

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ICU				
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Trauma wards				

STAFFING EMERGENCY DEPARTMENT

No. of surgeons on duty …….

No. of nurses on duty ……

No of doctors trained in BLS/ACLS……..

WHERE is extra numbers doctor/nurses mobilized from for surge ……

Number vaccinated Against;

Hepatitis …….

Yellow fever ……..

Pneumonia …….

Others……

……

ICU

No of surgeons on duty ……

No. of nurses on duty ……

No of doctors trained in BLS/ACLS……..

WHERE is extra numbers doctor/nurses mobilized from for surge …….

No. Vaccinated against; hepatitis……. yellow fever ……..pneumonia……. Ebola……others…….

SURGICAL /TRAUMA WARDS

No of surgeons on duty

No. of nurses on duty ……

No of doctors trained in BLS/ACLS……..

WHERE is extra numbers doctor/nurses mobilized from for surge ……

No. Vaccinated against; hepatitis……. yellow fever ……..pneumonia……. Ebola……others…….

Appendix 5: Map of Study Area

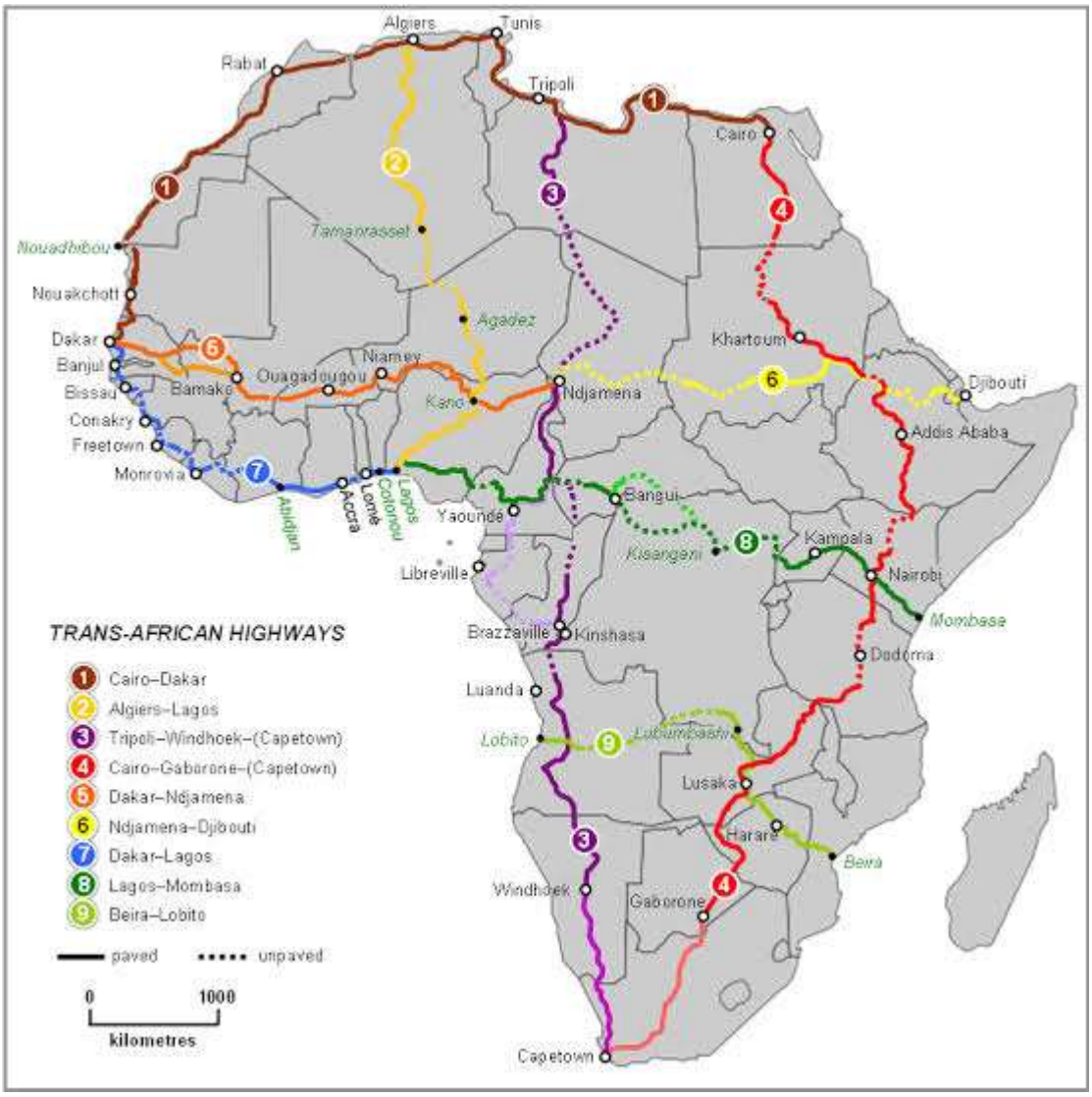

Figure 3.1: Study Areas focus on Moi teaching and referral hospital,Mediheal hospital in UasinGishuCountyElburgon (Nakuru County) andWebuye (Bungoma County)along A-104 HIGHWAY(Mombasa- Lagos transnational highway

Source: Google Maps

Appendix6: NACOSTI PERMIT

THIS IS TO CERTIFY THAT:
DR. PROTUS KITUYI WERUNGA
of MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY, 0-30100 ELDORET ,has been permitted to conduct research in *Uasin-Gishu County*

on the topic: *PATIENT SURGE MANAGEMENT STRATEGIES FOR EFFECTIVE RESPONSE TO MASS CASUALTY INCIDENTS ALONG NAKURU-ELDORET- MALABA, A104 ROAD, KENYA*

for the period ending:
23rd July,2020

.....
Applicant's Signature

Permit No : NACOSTI/P/19/16589/31511
Date Of Issue : 23rd July,2019
Fee Recieved :Ksh 2000

.....
Direc or General
National Com.nission for Science, Technology & Innovation

THE SCIENCE, TECHNOLOGY AND INNOVATION ACT, 2013

The Grant of Research Licenses is guided by the Science, Technology and Innovation (Research Licensing) Regulations, 2014.

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TEL: 020 400 7000, 0713 788787, 0735 404245
il: dg@nacosti.g gistry@nacosti.go.ke

Appendix 7: MMUST PROPOSAL APPROVAL

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

Tel: 056-30870
Fax: 056-30153
E-mail: directordps@mmust.ac.ke
Website: www.mmust.ac.ke

P.O Box 190
Kakamega – 50100
Kenya

Directorate of Postgraduate Studies

Ref: MMU/COR: 509099

7th May, 2019

Kituyi P. Werunga,
CDM/H/15/13,
P.O. Box 190-50100,
KAKAMEGA.

Dear Mr. Werunga,

RE: APPROVAL OF PROPOSAL

I am pleased to inform you that the Directorate of Postgraduate Studies has considered and approved your Ph.D. proposal entitled "***Patient Surge Management Strategies for Effective Response to Mass Casualty Incidents along Nakuru- Eldoret- Malaba, A104 Road, Kenya***" and appointed the following as supervisors:

1. Prof. Kennedy Onkware
2. Dr. Ruth N. Simiyu

You are required to submit through your supervisor(s) progress reports every three months to the Director of Postgraduate Studies. Such reports should be copied to the following: Chairman, School of Disaster Management and Humanitarian Assistance Graduate Studies Committee; Chairman, Emergency Management Studies & Departmental Graduate Studies Committee. Kindly adhere to research ethics consideration in conducting research.

It is the policy and regulations of the University that you observe a deadline of three years from the date of registration to complete your Ph.D thesis. Do not hesitate to consult this office in case of any problem encountered in the course of your work.

We wish you the best in your research and hope the study will make original contribution to knowledge.

Yours Sincerely,

DEAN
SCHOOL OF GRADUATE STUDIES
MASINDE MULIRO UNIVERSITY
OF SCIENCE & TECHNOLOGY
Date: ..... Sign: .....

Dr. Consolata Ngala
ASSOCIATE DEAN, DIRECTORATE OF POSTGRADUATE STUDIES