



Physical security preparedness measures among level V and VI hospitals in Nairobi County, Kenya

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ABSTRACT

Health Care Institutions play an important role in maintaining life in the event of an emergency. This has contributed to the realization of the requirement to ascertain the physical security readiness status of these institutions as a critical element of national security. The study assessed the existing physical security systems in hospitals and how well they support preparedness of the physical security in hospitals in Level V and VI hospitals of Nairobi County in Kenya. The study was underpinned by the Critical Infrastructure Protection (CIP) and Resilience Theories. A convergent parallel design was used with structured questionnaires, observation checklists, and key informant interviews. The respondents were selected by using purposive sampling and stratified sampling, resulting in 160 health and safety officers, security personnel and hospital administration. Both descriptive and inferential statistics were used to analyse the data. The findings were presented in tables, graphs, and verbatim for qualitative data. The results showed that both hospitals possessed physical security facilities such as access control systems, surveillance systems, perimeter fencing, visitor screening, patrol systems, and written security policies. The systems, however, did not work in the same way at Kenyatta National Hospital as compared to Mbagathi County Referral Hospital and had varying levels of functionality and consistency between the two hospitals. Kenyatta National Hospital had high operational functionality (95%) while Mbagathi County Referral Hospital had low operational functionality (55%). The study determined that there was physical security infrastructure in place, but that preparedness was adversely impacted by a lack of uniform training, lack of drill participation by non-security personnel, resource limitations, and poor inter-agency coordination. Inferential analysis indicated that the level of physical security measures had a significant influence on the level of preparedness outcomes, while organisational and training measures had a greater influence in determining the level of overall preparedness. In conclusion, preparedness of the hospital security should be considered from an infrastructural and organisational aspect. The study recommends that integrated training, improved surveillance systems, standardisation of security protocols, and formalisation of hospitals in Kenya's Critical National Infrastructures should be done.

Keywords: Critical Infrastructure, Hospital Preparedness, Nairobi County, Physical Security, Security Systems

I. INTRODUCTION

Health facilities are integral units of the critical infrastructure of any country and act not only as providers of health services, but also as institutions for social stability and country resilience. Due to the high-density populations in hospitals and the immediacy of responses to emergencies that can promptly turn into national security crises, it is crucial to put in place effective strategic security precautions (World Health Organization [WHO], 2026). Healthcare infrastructure is now considered a critical element in national security, with the continuity of healthcare a major driver of citizens' trust in the government (Chua *et al.*, 2020). Hence, the meaning of 'security preparedness' in this context is not just physical guarding, but it is defined as the capacity of the institutions to foresee and meet the security risks and restore operations without much impact on critical service delivery (Kassan, 2021).

The health care system in Kenya is organised in a hierarchical model in which the delivery of specialised services is made possible. At the apex of this system are Level V hospitals (County Teaching and Secondary Referral hospitals) and Level VI hospitals (National Teaching and Tertiary Referral hospitals). They deliver highly specialised medical care, handle complex diagnostics, and are the centre for health research and paramedical education (Ministry of Health [MoH], 2023). In particular, categories of Level VI facilities, like Kenyatta National Hospital, play a key part in fulfilling the country's health care needs and the management of mass casualty events. Ensuring the effective functioning of such high-level facilities during emergencies, therefore, is a paramount national security issue (Ogola *et al.*, 2022).

Yet a complex of security issues now endangers the functioning of these hospitals. However, traditionally, the focus has been on how to manage the pandemics of infectious diseases, where, for example, the COVID-19 crisis has caused systemic disruptions, and how to mitigate the impacts of terrorism (Ogira *et al.*, 2022). The threat landscape has, in recent times, become larger in scope, encompassing serious civil disorder or violence in the workplace. Hospital access, crowd management, and physical safety of health providers and clients have been directly impacted by widespread protests and civil unrest in Kenya, including a risk of attack and damage to facilities (Kibunja *et al.*, 2021). These modern-day incidents highlight the critical need to assess the readiness of premium medical facilities to deal with the physical security threat from both old and new sources.

The Kenyan government and its partners have put in place comprehensive health security systems to address these vulnerabilities. Steps to improve emergency preparedness at the national and regional levels, including the development of the Health Emergency Preparedness, Response, and Resilience (HEPRR) strategy, the National Action Plan for Health Security, and the creation of the WHO Regional Emergency Hub, have improved emergency preparedness and have aided the process (WHO, 2026). Additionally, national policies include protecting critical infrastructure, and entities such as the Critical Infrastructure Protection Unit coordinate its security (Kassan, 2021). While such top-level policy documents exist, the practical implementation of the national security policies to the ground floor level of actual physical security protection of the facility is still an issue of critical importance. Physical security in public hospitals in Kenya has been reactive and is poorly funded and integrated into the overall hospital management plans (Kibunja *et al.*, 2021).

There is a gap in National health security policies, and thus, it is important to be aware of the actual ground-level physical security preparedness in top-tier hospitals. It represents a crucial case study as Nairobi County has the highest number of Level V and VI hospitals and has experienced several riots in recent years. The aim of this study is to examine the level V and VI hospitals' preparedness for physical security measures in Nairobi County.

1.1 Statement of the Problem

Level V and VI hospitals in the Nairobi county are key solutions in the delivery of specialised services, in the event of an emergency response, and in maintaining continuity of key services in cases of health emergencies or disasters, making them pillars in healthcare and the national security architecture. But recent civil unrest and public health emergencies, as well as new hybrid threats, have underscored the vulnerabilities of the physical security of these facilities. For instance, during the COVID-19 pandemic, acute shortages of intensive care (IC) beds, isolation facilities, and ICUs/integrated response systems (IRS) were identified, with many hospitals not even having enough IC beds in place (Ogira *et al.*, 2022).

These facilities face huge pressure. According to the Ministry of Health, more than 80 of Kenyans rely on public health institutions, especially the level V and VI hospitals, for services. Kenyatta National Hospital reports more than 600,000 outpatient consultations and about 80,000 inpatient admissions per year, indicating that a few key hospitals are under intense strain. Even with this need, Kenya suffered from inadequate critical care resources in the past, and estimates during the COVID-19 pandemic show that the country had less than 600 critical care beds countrywide, with some of the most critical facilities operating with less than a day of medical staff. However, Kenya has historically been poorly resourced in critical care, with estimates during COVID-19 suggesting under 600 critical infrastructure beds countrywide, and some of Kenya's most critical facilities have only a day medical staff (MoH, 2023).

Security risks further compound these challenges. Globally, healthcare facilities are becoming more and more targets of violence and disruption. The World Health Organization reports that over the last few years, over 1,000 attacks have been documented against healthcare facilities across the world, further emphasising that healthcare has become one of the most vulnerable critical infrastructures. In Kenya, the hospitals experienced actual disruption of services and weaknesses in access control, surveillance, and perimeter security during the periods of civil unrest when vandalism and looting took place. Furthermore, research on workplace safety indicates that in emergency health care settings, many health care workers have experienced violence or security concerns that had a detrimental impact on staff morale, retention, and service delivery (Kibunja *et al.*, 2021).

However, these risks also suggest systemic issues with physical security capacity and readiness, such as security-infrastructure shortages, inexperienced security personnel, inter-agency coordination challenges, and non-standardised security frameworks. Although the definition of Critical National Infrastructure has extended to include healthcare facilities, there is also scanty empirical evidence regarding the commensuration, consistency, and effectiveness of the physical security of the healthcare facilities in level V/VI health facilities in Nairobi County. Previous studies have focused on health system resilience, disaster preparedness, or capacity of clinical services, and very little research highlights physical security as an essential component of national security.

One of the problems is hospital security information, which affects the provision of healthcare services, national security, and public confidence, and crisis management is an issue. These vulnerabilities, if they stay, continue to expose hospitals to threats that affect patients, the health care workers, the infrastructure, and the services that are important to keep patients well. Therefore, this study examined the physical security measures and security preparedness in Level V and VI hospitals in Nairobi County, Kenya.

1.2 Objective of the Study

The main objective of the study was to assess the existing physical security preparedness measures among Level V and Level VI hospitals in Nairobi County, Kenya.

II. LITERATURE REVIEW

2.1 Theoretical Review

The research draws upon Critical Infrastructure Protection (CIP) Theory and Resilience Theory, both of which offer a sound and thorough perspective on security readiness in health care institutions (Manyena, 2006; Rinaldi *et al.*, 2001). CIP Theory argues that some facilities, systems, and assets are essential to society, and their disruption or destruction would have a debilitating impact on national security, public safety, economic stability, and public health (Rinaldi *et al.*, 2001). This theory focuses on the systematic identification of risks, vulnerability assessment, mitigation of threats, as well as continuity planning, as key aspects of infrastructure protection. Even in the health care industry, hospitals are recognised as part of critical infrastructure, as they play an irreplaceable and vital role in the provisioning of health care, emergency response, and public health services (Schultz *et al.*, 2003). The CIP approach, therefore, demands that a hospital institute a comprehensive physical security plan, which involves an overview of vulnerability, use of a surveillance system, perimeter protection, access controls, detailed security policy, and continuous evaluation of hospital venues (Schultz *et al.*, 2003).

In addition to CIP's basics, Resilience Theory focuses on an organisation's ability to anticipate disruption, resist it, adapt to it, and recover quickly from it (Manyena, 2006). Resilience theory posits that adaptive capabilities of the organisation to function in adverse conditions became imperative in contrast to the traditional security paradigm that places emphasis on only preventing and protecting conditions. Resilience in the context of hospitals is manifested as proactive emergency preparedness, ongoing staff training, effective resource mobilisation, effective response to emergencies, or the learning of hospitals from previous emergency situations (Norris *et al.*, 2008).

A combination of these two theories provides an overall picture of hospital preparedness. Instead of focusing on physical and structural issues in a bid to lessen infrastructure vulnerabilities, CIP Theory underscores the dynamic organisational capacity needed to maintain operations prior to, during, and following a security incident (Manyena, 2006; Rinaldi *et al.*, 2001). These frameworks collectively argue that good preparedness is more than just the bricks and mortar and involves the ability of the institutions to utilise, maintain, and coordinate security resources (Norris *et al.*, 2008). Therefore, this study addresses the concept of hospital security preparedness as an interaction of physical security systems and organisational security resilience factors, which together form a synergy. The resilience factors include significant institutional capacities, including staff training and development, leadership, communication and coordination, and resource utilisation that enable the hospital to withstand and bounce back from a security threat.

2.2 Empirical Review

Throughout the world, hospitals are studied under critical infrastructure contexts as they rely on tightly coupled networks of electricity, water, communications, and transport and supply chains. The interdependent nature of critical infrastructures and their cascading failures upon disruption of one infrastructure to another, highlighted by Ouyang's review, is significant to the continuity of service for hospitals during times of stress. Achour *et al.* (2014) also show that hospital resilience is severely affected by the performance of supporting systems, and that disruptions to those systems significantly impact continuity of healthcare without damaging the structure of the hospital building. This is important in the context of physical security preparedness as all perimeter protection, monitoring, lighting, security access control, and communications require dependable infrastructure and backup capability.

In Low- and Middle-Income Countries (LMIC) and Sub-Saharan Africa (SSA), hospital physical security is rarely isolated as a stand-alone topic; instead, it is embedded in studies of all-hazard preparedness, disaster response, and hospital resilience. Farah *et al.* (2023) on SSA hospital disaster preparedness found that evidence has improved in recent years but remains uneven and concentrated in a few countries. The review identifies recurrent barriers including underfunding, poor knowledge, inadequate governance and leadership, weak collaboration, poor transparency and bureaucracy, while also noting that hospitals in many SSA settings lack response plans, surveillance systems, and emergency coordination structures (Farah *et al.*, 2023).

The dominant empirical methodology in the SSA literature is the cross-sectional facility assessment using adapted World Health Organization (WHO) checklists, structured observation, and key-informant interviews. In Tanzania, Koka *et al.* (2018) surveyed all 25 regional hospitals and found that 92% had experienced a disaster in the previous five years, yet only 20% had a disaster plan, no hospital had all components of surge capacity, and only 12% had backup communication systems (Koka *et al.*, 2018). In Northwest Ethiopia, Ayenew *et al.* (2022) used an adopted WHO observation checklist across ten public hospitals and found an overall preparedness score of 54.75%, with logistics and finance the weakest domain and patient-care/support services the strongest (Ayenew *et al.*, 2022). These studies are not exclusively about security hardware, but they are highly relevant because they operationalise preparedness through observable measures of equipment, infrastructure, communications, plans, and support systems, the same kinds of domains required for assessing CCTV functionality, access control, perimeter protection, lighting, and patrol readiness in referral hospitals.

A consistent theme in the LMIC and SSA literature is that organisational factors determine whether physical measures work. Farah *et al.* (2023) identify training deficits, weak leadership, and poor inter-organisational collaboration as central barriers in SSA hospitals (Farah *et al.*, 2023). Copeland *et al.* (2023) scoping review of empirical resilience studies similarly shows that resilience research increasingly recognises interdependence across system levels, but the field remains fragmented in its concepts and measures, making comparison across hospital studies difficult (Copeland *et al.*, 2023). In the Kenyan context, studies show that health managers facing chronic resource scarcity, role ambiguity, and political interference adopt absorptive, adaptive, and transformative strategies, and that these depend on cognitive, behavioural, and contextual organisational capacities rather than physical assets alone (Kagwanja *et al.*, 2020). For physical security preparedness in hospitals, the implication is straightforward: the presence of cameras, gates, policies, or guards is unlikely to be sufficient unless leadership, communication, and financing sustain their use.

At the level of hospital organisation, Mwangi *et al.*'s tertiary-hospital study in Kenya found that pandemic preparedness was strengthened by the rapid creation of leadership and incident-management structures, coordination with partners, harmonised communication and an ethical framework for decision-making (Mwangi *et al.*, 2024). Kagwanja *et al.*'s work on everyday resilience in Kenya reaches a similar conclusion from another angle, showing that managers keep services functioning through combinations of absorptive, adaptive, and transformative responses to scarcity and institutional constraints (Kagwanja *et al.*, 2020). Together, these studies reinforce the fact that organisational security resilience leadership, communication, coordination, and resource mobilisation is not ancillary to physical security preparedness; it is the mechanism through which physical systems become functional and sustained.

For Nairobi specifically, countywide study of 32 hospitals was conducted by Simiyu *et al.* (2014) using an analytical cross-sectional design. The researchers assessed hospital equipment, infrastructure, surrounding environment, training, drills, staff knowledge, and staff capability. They found disaster preparedness capacity in 68.88% of hospitals overall, with only a small difference between public and private facilities. Importantly, the highest-rated indicator was the surrounding hospital environment, while inter-hospital training and drills were the lowest-rated domains; the authors also noted that surveillance systems were a useful comparator from other settings and implied that such systems would strengthen Nairobi hospitals' preparedness profile (Simiyu *et al.*, 2014). For a paper on physical security in Nairobi Level V and VI hospitals, this is the key local empirical signal: built environment and infrastructure matter, but drills, training, and cross-facility coordination appear to be the weaker link.

III METHODOLOGY

3.1 Research Design

The research design employed in this study was a convergent parallel research design with a mixed method approach that operationalised both quantitative and qualitative variables to enable a detailed evaluation of the current level of security preparedness in Level V and VI hospitals. This design was appropriate for examining existing structures, policies, and practices through observational checklists without manipulating the variables of interest (Mishra & Alok, 2022). The design was aligned with the study objective, which was to determine the extent to which hospitals, as a subset of Critical National Infrastructure (CNI), were safeguarded against physical security threats that could compromise patient safety and national stability. The quantitative and qualitative data were analysed separately and merged at the interpretation stage for purposes of determining validity and triangulating results.

3.2 Study Area

The study was conducted in Nairobi County, which is the capital city of Kenya and the most urbanized county in Kenya. With a population of more than 4.3 million people, Nairobi's demographics span from affluent neighbourhoods, to large informal settlements, with diverse socio-economic groups. The county has county-managed

referral hospitals and national referral hospitals and is therefore a suitable backdrop to exploring healthcare delivery at various levels of healthcare provision. Apart from being a national capital, Nairobi is also a major medical hub, providing services to its local population and people from other parts of Kenya and neighbouring countries in the East African region.

In Mbagathi Road in Ngumo Estate, lies the Mbagathi County Referral Hospital, a Level V hospital. The facility has an estimated bed capacity of approximately 200 and primarily serves the southern region of Nairobi, including Kibera informal settlement, which has an estimated population of up to 250,000 residents. Originally established as an infectious disease hospital, Mbagathi has expanded to provide general referral services and manages high patient volumes related to HIV/AIDS, tuberculosis, and emergency cases. It has a staff comprising doctors, nurses, and specialized units for infectious disease control (Nairobi City County Health Services Department, 2024).

Kenyatta National Hospital is located at Upper Hill in Nairobi, a level VI health care facility. It is the largest hospital in East Africa, with a capacity of 1800-2400 beds. This hospital is a teaching hospital and national referral centre for patients from all over Kenya and neighbouring countries. Kenyatta National Hospital has an average of more than 600,000 outpatient visits and about 80,000 inpatient admissions each year. Boasting over 6,000 employees, the institution is home to consultants, resident doctors, nurses, allied health professionals, administrative staff, and so much more – its human health workforce solidifies its status as the driving force of Kenyan health care.

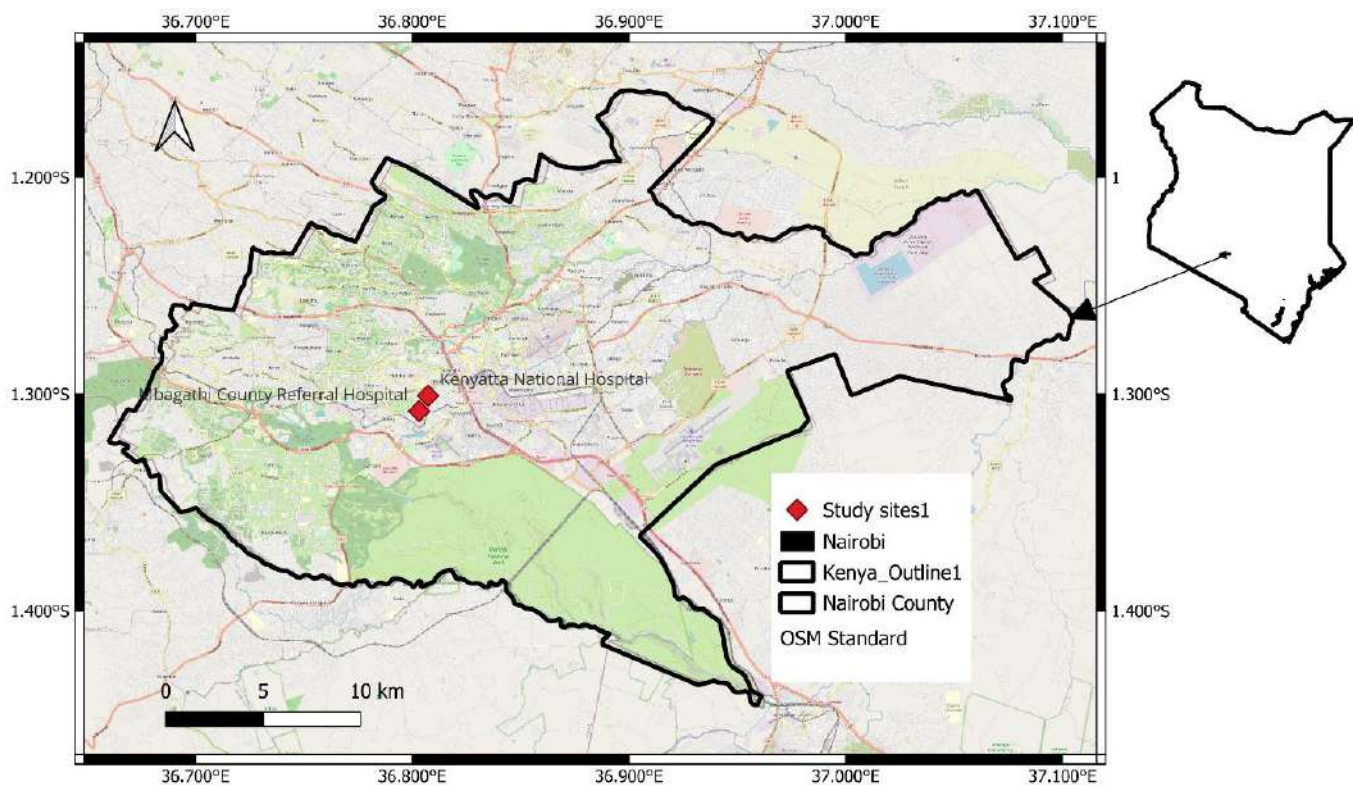


Figure 1
Map of the study sites in Nairobi County, Kenya
 Source: Researcher (2026)

3.3 Study Population

The target population consisted of staff members of the two purposively selected hospitals, namely Mbagathi County Referral Hospital and Kenyatta National Hospital. The estimated Target Population included 1,622 employees as summarized in Table 1. These employees were divided into three general stratas namely hospital administrators, security staff, and health and safety officers. Administrators included all the top-level hospitality leaders, such as directors, departmental leaders, supervisors, and other administrative employees who work in the decision-making process on a day-to-day basis. Security staff consisted of security personnel such as security officers, gate supervisors, guards, and others who had direct responsibility for enforcing physical security controls, monitoring access, and protecting hospital facilities. Health and safety officers comprised doctors, nurses, pharmacists, laboratory technologists,

clinical officers, and other health professionals involved in service delivery and other activities related to safety in the hospitals.

These categories were chosen due to their direct involvement in hospital management, physical security measure implementation, and continuity of healthcare service delivery. They were thus ideally suited to share pertinent data on the existing physical security standard, the current set of issues regarding the hospitals' preparedness, and strategic interventions for physical security strengthening in Level V and VI hospitals. Key informants were selected from those directly involved in the management of institutional preparedness and security management.

Table 1

Target Population

Target Population Category	Mbagathi County Referral Hospital (Level V)	Kenyatta National Hospital (Level VI)	Total
Hospital Administration	30	150	180
Security Personnel	42	200	242
Health and Safety Officers	150	1,050	1,200
Total	222	1,400	1,622

3.4 Sampling Strategy and Determination of Sample Size

This study employed purposive sampling and proportionate stratified sampling techniques. The two hospitals were selected using purposive sampling since the study was aimed at sponsoring the Kenya County Level V and VI hospitals. Mbagathi County Referral Hospital was a representative of a Level V hospital, while Kenyatta National Hospital represented a Level VI hospital. These hospitals were chosen as having a strategic significance, high numbers of patients, and to understand healthcare delivery and preparedness for national security. The three target population categories of hospital administrators, security personnel, and health safety officers were then sampled using proportionate stratified sampling as shown in Table 2. This method was suitable as the population was comprised of distinct categories and the sample had to reflect the number/ size of the categories in the population (Kothari, 2004).

The sample size was determined using Yamane's formula:

$$n = \frac{N}{1 + N(e)^2}$$

Where:

n = required sample size

N = target population

e = margin of error

Given:

$$N = 1622$$

$$e = 0.075$$

$$n = \frac{1622}{1 + 1622(0.075)^2}$$

$$n = \frac{1622}{1 + 1622(0.005625)}$$

$$n = \frac{1622}{10.12375}$$

$$n = 160$$

**Table 2***Sample Size Distribution*

Target Category	Population	Mbagathi County Referral Hospital (Level V)	Kenyatta National Hospital (Level VI)	Total Sample
Hospital Administration		3	15	18
Security Personnel		4	20	24
Health and Safety Officers		15	103	118
Total		22	138	160

3.5 Data Collection Instruments

This study relied on both primary and secondary data. The quantitative data were obtained using structured questionnaires, which allow measuring the presence of indicators of preparedness, like access control systems, physical security measures, emergency response capability, etc. Qualitative data were obtained using key informant interviews (KII) conducted with hospital administrators, security officials, and emergency response coordinators, among others, to account for and inform the quantitative results. Document analysis was run on the various hospital records and the various studies previously undertaken from published as well as unpublished information, such as books, journals, research papers, internet articles, and theses.

3.6 Data Analysis and Presentation

Data analysis in this study involved both descriptive and inferential statistical techniques, supported by qualitative thematic analysis. Data preparation and statistical analysis were conducted by SPSS (Version 26). The collected data were preliminarily edited, cleaned, coded, and classified to make it complete, consistent, and accurate. For statistical analysis, the answers to the questionnaires were numerically coded. The data were then analysed using SPSS. The quantitative data collected from the respondents were summarised and organised; and their main characteristics were described by using the descriptive statistics. This enabled the outcomes to be displayed in an extensive and relevant way. The analyses were conducted using the following: Frequency, Percentage, Mean, and Standard deviation.

All categorical variables, such as respondent category, hospitals, gender, level of education, and years of experience, were tabulated with frequencies and percentages. The descriptive results were presented in tables, bar charts, and pie charts for elucidation, comparisons, and interpretations. The sample data collected has been used to make conclusions regarding the population through inferential statistics. This enabled the researcher to give due consideration to and analyse the interaction of the variables, and also test the hypothesis of the study. The collected data were analysed using SPSS version 26 at 95% confidence level and a level of significance of 0.05. The Pearson correlation technique was used to investigate the strength and direction of the association among the study variables. Multiple linear regression was used to find the independent variables related to the physical security preparedness.

3.7 Ethical Considerations

Ethical issues were carefully observed with regard to confidentiality, rights, dignity, and welfare of the respondents. A letter of authorization from the National Defence University–Kenya (NDU) and a research permit from the National Commission for Science, Technology and Innovation (NACOSTI) were received. They were voluntary, and informed consent was obtained from all the respondents before the data collection. Participants were informed of their right to decline or withdraw from the study at any stage without penalty. Confidentiality and anonymity were rigorously respected. Questionnaires/reports included no personal identifiers. All information was kept safe, and privacy and confidentiality were respected and used for educational purposes only.

IV. FINDINGS & DISCUSSION**4.1 Existing Physical Security Measures in Level V and Level VI Hospitals**

The study aimed to inform on the current physical security features in V Level and VI Level Hospitals in Nairobi. As summarized in Table 3, both hospitals had some basic physical security infrastructure in place, but each did more or less with respect to the effectiveness of this infrastructure. At the county level, a functionality score of 55% was obtained for Magathi County Referral Hospital, which had 11 out of 20 checklist items fully functional. Kenyatta National Hospital (Level VI) performed better with 19 out of 20 items fully functional and a score of 95 percent. The difference between them indicates that both hospitals have worked to secure their properties, but the upper-level facility has managed to make its security measures effective practices, while the lower-level facility has significant gaps that have not been addressed.

Table 3*Security features observed at both Mbagathi County Referral Hospital and Kenyatta National Hospital*

Security Feature	Mbagathi County Referral Hospital (Level V)	Kenyatta National Hospital (Level VI)
Perimeter wall/fencing	Present, secure	Present, secure, multiple controlled gates
Manned entry/exit gates	Present & functional	Present & functional, 24-hour staffing
Security patrols	Conducted routinely	Routine foot & vehicle patrols
Deployment in sensitive areas (ICU, pharmacy, records)	Present & functional	Present & functional
CCTV coverage	Present but inadequate / partial	Comprehensive, covers entrances, wards, parking, public areas
CCTV monitoring	Inadequate / inconsistent	Continuous electronic monitoring with incident reporting
Security lighting	Present but insufficient in some areas	Installed around buildings, walkways, parking
Emergency exits & evacuation routes	Present, needs better maintenance/signage	Present & functional, clearly marked
Biometric/card-based access control	Absent	Present but not fully adequate (only partial gap)
Security screening equipment (entry points)	Not observed	Present at selected entry points
Visitor access management	Controlled through designated entry points	Controlled through designated entry points & procedures
Incident reporting / emergency response protocols	Available	Available, coordinated by dedicated department
Coordination with external agencies (police, EMS)	Evident	Evident, formalised
Dedicated security governance structure	Not a distinct department	Dedicated Security and Safety Department
Overall functionality score	55% (11 fully functional, 5 partial, 4 absent)	95% (19 fully functional, 1 partial, 0 absent)

Kenyatta National Hospital had a better overall picture with functional, integrated and electronically monitored Security systems and a dedicated Security and Safety Department looking after all matters. While the physical elements of a security system could be found at Mbagathi County Referral Hospital (MCRH), including its perimeter, gates, and a few posts and guards deployed at sensitive spots, there is a high reliance on people and workforce as opposed to technology. At Mbagathi, the most obvious deficiencies included a lack of any biometric or card-based access control, as well as insufficient lighting in some areas and the inconsistent monitoring of CCTVs. The findings resummarized in Figure 2.

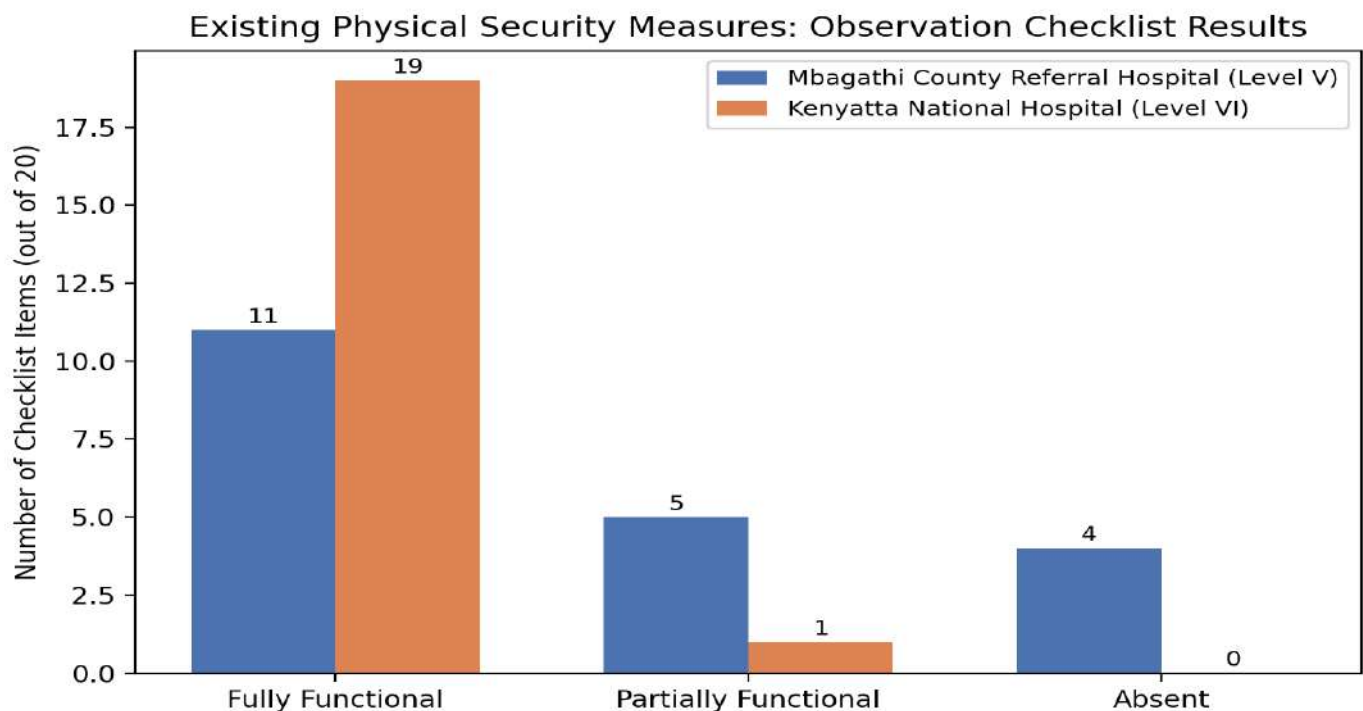


Figure 2
Observation Checklist Functionality by Hospital

4.2 Effectiveness of Physical Security Measures in Enhancing Preparedness

Respondents were then asked to rate specific security items, and the results were statistically compared with the physical security to ascertain how effective these measures actually were, and how close they were to other aspects of preparedness. The results are given in Table 4. Strong positive correlation was found between physical security and the different dimensions of security preparedness, resilience, and national security for all groups of the respondents. Strategic security preparedness was highly positively correlated with physical security among healthcare professionals and among hospital administrators ($r = .814$, $p < .001$). This is a sign that physical security was positively correlated with strategic security preparedness within healthcare settings. Likewise, a strong positive association between physical security and national security integration ($r = 0.802$, $p < .001$), indicating that the improvement of physical security was tightly bound to the integration of HCIs into national security arrangements.

Physical security had a very strong positive correlation with emergency preparedness and resilience ($r = 0.839$, $p < .001$) among healthcare service providers and healthcare support staff. This underscores that healthcare facilities with better physical security measures were also seen as more capable of preparing for, responding to, and recovering from emergencies and security breaches. Healthcare institutions also had a strong correlation with the contribution to national and human security, both on the physical security side ($r = 0.772$, $p < .001$) and on the public security side ($r = 0.723$, $p < .001$). While being the lowest of the correlations shown, this was still a significant and strong correlation.

Responses from personnel serving in security roles also indicated very strong positive relationships. There was a strong correlation between physical security and emergency preparedness/continuity ($r = .839$, $p < .001$), meaning that increased physical security led to increased ability to conduct essential healthcare operations during emergency or security disruption situations. Among the security personnel, there was the highest correlation between physical security and national security integration ($r = 0.840$, $p < .001$). This shows a special correlation with tangible protection of Health Care Facilities and their links with the broader national security context.

In total, the Pearson correlation coefficients varied from ($r = 0.772$) to ($r = 0.840$), and all groups of respondents had a positive association, which was constant and strong. Furthermore, all the relationships were statistically significant ($p < .001$). The results suggest that physical security is closely linked to strategic security preparedness, resilience, continuity of healthcare services, and the role and interlinkage of health institutions in national and human security systems. These findings reinforce the need for making physical security a part of the security preparedness and resilience in healthcare institutions.

Table 4*Correlation Analysis Between Physical Security Infrastructure and Preparedness Dimensions*

Respondent Group	Physical Security Correlated With	Pearson r	p-value
Healthcare professionals & hospital administrators	Strategic security preparedness	0.814	< .001
Healthcare professionals & hospital administrators	National security integration	0.802	< .001
Healthcare service providers & support staff	Emergency preparedness & resilience	0.839	< .001
Healthcare service providers & support staff	National & human security contribution	0.772	< .001
Security personnel	Emergency preparedness & continuity	0.839	< .001
Security personnel	National security integration	0.840	< .001

4.3 Staff Training on Security Issues and Awareness

The study further interrogated the staff training on security matters and whether they are aware of them. The findings are shown in Table 5. The results show significant variations between security training and frequency of drills among the three groups that responded. There were 21 (67.7%) respondents who reported they had received security-related training among health care professionals and hospital administrators, and 10 (32.3%) had not. When asked about the frequency with which emergency or security drills are conducted, 25.8% said the drills were conducted frequently, 29.0% said occasionally, 25.8% said rarely, and 19.4% said never. Of this group, a majority had received training, but the frequency of the drills varied, indicating that preparedness was done, but not consistently.

There were other survey results when it came to healthcare service providers and support staff. 27 (71.1%) respondents did not receive training, while 11 (28.9%) respondents did receive training. The number of people who reported that a drill was frequently or occasionally conducted was also relatively small (21.1% and 13.2%, respectively). By contrast, 31.6% said drills were not performed on a regular basis, and 34.2% said that they had never been involved in such drills. All respondents indicated either 'rarely' or 'never' when asked whether healthcare service providers and support staff conduct drills routinely, which equates to 65.8%. The security personnel's readiness level with regard to training and practical exercises was the highest. All 28 respondents (100.0%) reported having received relevant training. In addition, 20 respondents (71.4%) reported that they did drills frequently, and the other 8 respondents (28.6%) reported doing drills occasionally. There were no reported responses among the security personnel that drills were infrequently or never being held. This indicates a fairly developed culture for training and actual security preparedness amongst personnel directly responsible for the security of healthcare facilities.

Overall, the results show that there is a distinct gap in respondents' security preparedness. For both security personnel and professionals responsible for healthcare, moderate and universal, respectively, levels of training coverage and drill participation were identified. Healthcare service providers and support staff had the most prevalent knowledge gaps, with most not trained and large percentages saying that they had not heard of drills or only heard a little. The results indicate that perhaps security readiness within healthcare institutions is focused on those who have direct responsibility for security and not systematically brought to all categories of staff. Developing training at the institutional level and providing regular multidisciplinary drills might consequently be able to improve collective preparedness, coordinated response, and continuing healthcare services in the event of security incidents or emergencies.

Table 5*Training Coverage and Drill Participation by Respondent Group*

Respondent Group	Trained	Not Trained	Frequent Drills	Occasional	Rarely	Never
Healthcare professionals & hospital administrators	21 (67.7%)	10 (32.3%)	8 (25.8%)	9 (29.0%)	8 (25.8%)	6 (19.4%)
Healthcare service providers & support staff	11 (28.9%)	27 (71.1%)	8 (21.1%)	5 (13.2%)	12 (31.6%)	13 (34.2%)
Security personnel	28 (100.0%)	0 (0.0%)	20 (71.4%)	8 (28.6%)	0 (0.0%)	0 (0.0%)

Respondent groups also showed differences in their training and frequency of drill participation, indicating that preparedness is not systematic among health care institutions but rather is occupationally based. It could be that the practices of security personnel are comparatively robust as their jobs are closely linked to the security of hospital

infrastructure, staff, and patients. This is also illustrated in the broader hospital preparedness literature with higher levels of knowledge and preparedness reported by personnel who work in roles more closely related to emergency operations, in part due to their higher exposure to emergency-related training and preparedness activities. A systematic review of hospital disaster preparedness in sub-Saharan Africa by Farah *et al.* (2023) showed that the level of preparedness and knowledge varied significantly between healthcare cadres, and those directly engaging in disaster environments had higher scores due to their work and training exposure.

The results about healthcare providers and healthcare managers are especially similar to those identified in Kenya. Muthiani *et al.*'s (2022) study on emergency configuration training for nurses working in Machakos Level Five Hospital found that while significant numbers of nurses had been trained in emergency configuration, few had participated in actual emergency drills. In particular, their study revealed that 65 percent had taken preparedness training, and 68 percent had not taken part in emergency drills. The authors also found that there was a significant correlation between knowledge and emergency preparedness and between knowledge of emergency procedures and emergency preparedness. The actual results of the present study consequently validate the difference between trained and continually operationally prepared by conducting repeated practical drills. Irregular drill attendance can limit the number of times staff train and do the job, and the ability of staff to "test" how they react in a mock emergency, with responsibilities being worked out or clarification needed.

This relative lack of preparedness among healthcare service providers and support staff also closely aligns with prior findings identified in scholarship. Based on an integrative review of 36 studies, Gowing *et al.* (2017) reported that studies on disaster preparedness for research and intervention had focused more on medical, nursing, public-health, and paramedic staff members and much less on allied health staff and support personnel. The authors therefore proposed that the definition of 'preparedness' should apply to all members of the multidisciplinary healthcare team, both to support personnel and healthcare professionals, as everyone in the hospital may have a role to play in an emergency situation, whether internal or external. The present study thus extends the empirical evidence for this argument by demonstrating that gaps in preparedness can be more strongly marked for staff whose jobs are more typically not considered security-related or in response to an emergency situation. Inequalities in preparedness can have a negative impact on institutional response as support staff play a critical role in patient transfer, services, patient communication, utilities, access controls, and continuity of hospital operations.

The results also align with those of previous studies conducted in other healthcare facilities in sub-Saharan Africa that noted gaps in training and practical readiness. Berhanu *et al.* (2016) found that 92,8% of the disaster-related training needs of health professionals in Southwest Ethiopia indicated a need, while the rate of training received was found to be 20,6%. The authors stated that the lack of opportunities for refreshing training contributed to the gaps in disaster preparedness knowledge and competencies. Likewise, Koka *et al.* (2018) found that only 32 per cent of the regional level hospitals across Tanzania provided routine or surge triage training, while less than 50 percent participated in a disaster drill in the previous year. They found that the elements of hospital preparedness were interrelated: training, drills, communication, safety, and security. The results from these regional studies corroborate the results of the present study: lack of and unequal access to preparedness training and exercises are not an institutional problem alone, but one that is part of the wider problems in healthcare readiness for sub-Saharan Africa.

The significance of drills becomes even clearer when the results are combined with evidence regarding threats to security. A training/preparedness simulation programme of an active shooter scenario with emergency department staff revealed significant increases in perceived readiness and knowledge after simulation (Sanchez *et al.*, 2018). Their intervention intentionally ensured representation of emergency management staff, simulation personnel, and security and clinical leadership, and demonstrated the benefits of having multiple departments prepared to meet security threats in hospitals. In the present study, the high levels of ownership of the drill among security officers are seen as a significant institutional resource, although it is also revealed that a good level of physical security cannot rely on physical security personnel alone. Healthcare professionals, administrators, and support staff must be sufficiently exposed to security exercises as they may play significant roles in the overall effectiveness of the response during incidents that include armed intrusion, fire, evacuation, civil disturbance, and other emergencies that involve the overall facility.

The findings, therefore, reveal an important preparedness imbalance within healthcare institutions. Routine security staff seem to be somewhat more consistently prepared than other hospital staff groupings, such as those in specialised positions. This interpretation is aligned with Gowing *et al.* (2017), who reported the overall positive impact of preparedness interventions on knowledge, skills, and attitudes, but recommended that interventions should be expanded to the entire healthcare team. This is also in line with the systematic review conducted by Farah *et al.* (2023), which identified the lack of skilled staff, along with low levels of awareness and poor coordination, among the factors limiting hospitals' preparedness to respond to disasters occurring in the SSA region and suggested the need to implement coordinated and multidisciplinary preparedness and training of hospital staff.

The evidence collectively indicates that a security-department-centre approach to physical security in healthcare must transition to a whole-of-hospital preparedness approach. Security personnel may provide specialist protection and incident-response functions, but the resilience of a healthcare institution ultimately depends on whether clinical, administrative, technical, and support personnel understand their respective roles and can act collectively during an emergency. Regular multidisciplinary drills would therefore serve not merely as training activities but as mechanisms for testing communication, coordination, role clarity, and continuity arrangements across the institution. The present findings consequently extend existing literature by demonstrating that the critical issue is not simply whether healthcare institutions provide security training, but whether such training and practical exercises are equitably institutionalised across the different categories of personnel whose coordinated actions are required during security emergencies.

V. CONCLUSION & RECOMMENDATIONS

5.1 Conclusion

The present study assessed the current physical security of the hospitals of level V and VI in Nairobi County and its contribution towards the security preparedness in Nairobi County, specifically in Kenyatta National Hospital and Mbagathi County Referral Hospital. The results show that both institutions have implemented various physical security systems, such as surveillance, access control, perimeter fence, screening of visitors, security guards, and security policies that have been documented. These measures are a result of the increasing awareness of hospitals as vital facilities that are targets for various forms of security threats, which can cause disruption to the provision of healthcare services and impact public safety.

In the study, the physical security infrastructure has been determined to help increase the preparedness of hospitals and also to support increases in hospital capacity with respect to prevention, detection, and response to security incidents. A statistical analysis revealed that the physical security measures and the outcome of preparedness is significant in that when proper security is implemented, preparedness is enhanced. The use of surveillance cameras, controlled access points, and security personnel was proposed as a viable strategy for enhancing security and supporting situation awareness and incident response.

However, findings show that the physical security infrastructure alone can't explain the preparedness. The performance, maintenance, and integration in the operations and employees' satisfaction varied widely across hospitals. The overall preparedness and performance of the Kenyatta National Hospital were better than those in Mbagathi County Referral Hospital, indicating that the institutions' capabilities and availability of resources influence the extent of the investment in security. This further emphasizes the need not only to invest in infrastructure but to have security systems that are effective, aligned, and goal-oriented.

5.2 Recommendations

The management staff in hospitals should consider security preparedness in a holistic and proactive manner and combine the two levels of physical security and organisational security preparedness. Security is not an operational function, but rather it is part and parcel of the governance and risk management of the hospital. A routine and mandatory training programme on security awareness should be conducted for various categories of persons in hospitals, like doctors, nurses, supporting staff, contract and government staff. Security threats and emergency response, the debt of incidents, evacuation, and personal responsibility related to security incidents should be addressed. Consistent training will lead to enhanced staff knowledge and readiness in the institution.

Secondly, the hospital management should hold simulation exercises for all departments and emergency preparedness exercises periodically. Exercises should be realistic scenarios, such as an unauthorized entry, a current security threat, fire, a mass casualty event, an act of terror, and an infrastructure failure occurring at any point in time. Drill outcomes should be shared and incorporated into preparedness improvement plans.

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Data Availability

The data for this study would be made available upon request from the corresponding author.

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