Investigating the factors contributing to the persistence of hospital-acquired infections (HAIs) at Mulago National Referral Hospital, Uganda.

Authors: **Kugonza Grace & *Amos Ronald Kalukusu

Affiliation:

King Ceasor University, Uganda

College of Medicine, Health & Life Sciences

*Corresponding Author Email: amoskalukusu@kcu.ac.ug

Abstract:

The study investigated the factors contributing to the persistence of hospital-acquired infections in hospitals while considering Mulago National Referral Hospital as the case study. This topic was chosen because it draws the researchers attention to provide valuable insights into improving infection control measures and enhancing patient safety in Uganda. The main objective was to comprehensively investigate and understand the factors contributing to the persistence of hospital-acquired infections at Mulago National Referral Hospital, Uganda. Three specific objectives guided the research and these were (a) to assess the prevalence and epidemiology of Hospital-Acquired Infections at Mulago National Referral Hospital; (b) to determine the association between the demographic characteristics of patients and their likelihood of acquiring hospital acquired infections; (c) to identify contributing factors to Hospital-Acquired Infections at Mulago National Referral Hospital. The research adopted a descriptive research design that incorporated both quantitative and qualitative approaches. A comprehensive survey was conducted, involving 219 participants, to examine the interplay between demographic factors, patient perceptions, and healthcare practices in relation to HAIs and data was collected using self-administered questionnaires, interviews and focus group discussions. The key findings of the study indicate that there were statistically significant associations between demographic factors and the length of hospital stays, where individuals who stayed in the hospital for 3 days to 1 week exhibited a significantly higher chi-square **(X^2)** value of 2.609, indicating a more substantial association with the study objectives. The adjusted odds ratio (AOR) of 3.598 and the p-value of 0.003 suggest that this group's length of stay is statistically significant in relation to the factors contributing to hospital-acquired infections. Longer hospitalization within this range appears to have a notable impact.

On the other hand, individuals who stayed in the hospital for 1 to 2 weeks exhibited a chi-square (X^2) value of 5.976, indicating a strong association with the study's objectives. The adjusted odds ratio (AOR) of 4.509 and the p-value of 0.008 emphasize the significance of this group's length of stay. Prolonged hospitalization within this range is statistically significant in relation to the persistence of hospital-acquired infections. Older patients (aged 50 and above), those with lower education levels, specific marital statuses, and gender-related factors experienced longer hospital stays, leading to an increased risk of HAIs. These findings underscore the importance of tailored infection prevention strategies for specific patient profiles. regarding healthcare practices and patient perceptions, participants generally held positive perceptions of healthcare practices related to infection control, including antimicrobial prescribing patterns, hand hygiene, infection control protocols, and efforts to identify vulnerabilities. These positive perceptions were viewed as crucial in fostering patient trust and engagement in infection prevention efforts. The study's implications and recommendations suggest that **b**ased on the findings, Mulago National Referral Hospital and healthcare facilities worldwide should include tailoring infection prevention strategies to specific patient profiles, continuous monitoring and education, patient engagement, interdisciplinary collaboration, and resource allocation. It was concluded that this research should be viewed as a potential source of information to support the ongoing efforts to enhance infection control practices at Mulago National Referral Hospital and provides valuable insights for healthcare facilities worldwide in their fight against hospital acquired infections. By addressing the complex interplay between demographic factors, healthcare practices, and patient perceptions, we can move closer to a healthcare system where HAIs are minimized, patient outcomes are improved, and patient trust in healthcare providers is strengthened.

Introduction

Hospital-acquired infections (HAIs) pose a significant threat to patient safety and healthcare systems globally. This research aimed to investigate the factors contributing to the persistence of HAIs at Mulago National Referral Hospital in Uganda.

Background of the Study

Hospital-acquired infections (HAIs), often referred to as nosocomial infections, continue to pose a significant global healthcare challenge, with substantial implications for patient safety and healthcare systems. These infections, acquired during a patient's stay in a healthcare facility, encompass a wide range of bacterial, viral, and fungal pathogens, with diverse clinical manifestations. In this study, we aim to investigate the factors contributing to the persistence of HAIs, focusing on Mulago National Referral Hospital in Uganda. This hospital, as the largest tertiary care facility in Uganda, serves a crucial role in the region's healthcare system, making it an important focal point for understanding the dynamics of HAIs in the country.

Regarding their prevalence, HAIs are a prevalent concern worldwide, and their impact on patient morbidity, mortality, and healthcare costs cannot be understated. Recent studies have indicated that HAIs affect millions of patients annually, leading to increased hospitalization durations, elevated healthcare costs, and, in severe cases, fatalities (Allegranzi et al., 2018; De Roo & Regenbogen, 2020).

In Uganda, the prevalence of HAIs is a significant concern, with rates that rival those in other low- and middle-income countries (Waako, et al., 2018).

Looking at contributing factors, preliminary research suggests that several factors contribute to the persistence of HAIs, and their interplay can vary significantly between healthcare facilities. Notably, antimicrobial resistance (AMR) has emerged as a critical concern globally and in Uganda (Kayiwa et al., 2020).

The misuse and overuse of antibiotics, inadequate infection control practices, and suboptimal sanitation in healthcare settings all contribute to the development and

spread of AMR organisms, which can cause severe and hard-to-treat HAIs (Gandra et al., 2023).

Pointing to the unique challenges in Uganda, it has been found that Uganda faces a unique set of challenges regarding HAIs. Limited resources, understaffing, inadequate infrastructure, and variable adherence to infection control protocols all play a role (Okomo et al., 2020a).

Recent research highlights the need for context-specific strategies to address HAIs in Uganda, as well as a deeper understanding of the contributing factors within the local healthcare context (Ake et al., 2019a).

Problem Statement

Hospital-acquired infections (HAIs) represent a persistent and formidable challenge within the global healthcare landscape, threatening patient safety and imposing substantial burdens on healthcare systems. Recent studies have emphasized the dire consequences of HAIs, including prolonged hospitalization, increased healthcare costs, and heightened mortality rates (Allegranzi et al., 2018) (De Roo & Regenbogen, 2020)

Uganda, like many low- and middle-income countries, is not immune to this global predicament, as evidenced by the prevalence and impact of HAIs within its healthcare facilities (*Waako, et al., 2018).*

Mulago National Referral Hospital, as Uganda's largest tertiary care facility, plays a pivotal role in the nation's healthcare system. However, it faces a persistent challenge in the form of HAIs, with rates that mirror those in other resource-limited settings (*Waako, et al., 2018).*

The problem is further exacerbated by the emergence of antimicrobial resistance (AMR), which poses a substantial threat to patient care and public health (*Kayiwa, et al., 2020).*

Mulago National Referral Hospital's unique context, marked by limited resources, understaffing, and variable adherence to infection control measures, presents a complex environment in which HAIs persist (Ake et al., 2019b).

The urgency of this research is underscored by the evolving global healthcare landscape, characterized by the increasing prevalence of AMR and the need for tailored approaches to infection control (Gandra et al., 2023).

Understanding the unique factors driving HAIs at Mulago National Referral Hospital is essential for designing effective interventions and improving patient safety in the Ugandan healthcare system.

Rationale for the Study.

Given the significance of HAIs and their specific impact on Mulago National Referral Hospital and the Ugandan healthcare system, this study is essential for several reasons. First, it seeks to identify the specific factors contributing to the persistence of HAIs in this setting, providing valuable insights into the local dynamics of these infections. Second, it aims to inform targeted interventions and infection control measures that can be implemented to reduce the burden of HAIs at Mulago National Referral Hospital and potentially serve as a model for other healthcare facilities in Uganda. In summary, hospital-acquired infections remain a pressing concern, and Mulago National Referral Hospital's unique context necessitates an investigation into the factors contributing to their persistence. This study aligns with the global effort to mitigate HAIs and has the potential to improve patient outcomes and healthcare practices in Uganda and beyond.

Literature Review

Hospital-acquired infections (HAIs), also known as nosocomial infections, represent a formidable challenge in healthcare systems worldwide. These infections, acquired by patients during their stay in healthcare facilities, significantly impact patient outcomes, healthcare costs, and the overall quality of care. Uganda, like many low- and middle-income countries, grapples with the prevalence and consequences of HAIs within its healthcare institutions. Mulago National Referral Hospital, as the largest

tertiary care facility in the country, plays a central role in providing care to a diverse patient population. However, it faces a persistent challenge in the form of HAIs, with rates that mirror those seen in similar resource-limited settings.

Understanding the factors contributing to the persistence of HAIs at Mulago National Referral Hospital is a critical endeavor. The hospital's unique context, marked by limited resources, variable adherence to infection control measures, and the emergence of antimicrobial resistance (AMR), requires a targeted and context-specific approach to mitigate the burden of these infections. To address this complex issue, this literature review chapter provides a comprehensive examination of existing research related to hospital-acquired infections, their prevalence, causes, and the impact of AMR in Uganda and similar settings.

This review serves as the foundation upon which the current study is built, providing a synthesis of knowledge and insights from relevant studies. By critically analyzing and synthesizing the existing literature, this chapter sets the stage for the research objectives, guiding the investigation into the specific factors contributing to the persistence of HAIs within the Old Mulago casualty ward of Mulago National Referral Hospital. The literature review explores the global and local context of HAIs, elucidating the challenges and gaps in understanding that necessitate the current research effort. Ultimately, this chapter not only situates the study within the broader healthcare landscape but also informs the research questions, methodology, and objectives, contributing to a holistic understanding of the persistence of HAIs in Uganda.

Prevalence and Epidemiology of Hospital-Acquired Infections

Hospital-acquired infections (HAIs) continue to be a major concern in healthcare systems worldwide, affecting millions of patients each year (Pilmis et al., 2018). In Uganda, HAIs are prevalent and pose a significant burden on healthcare resources and patient outcomes. Recent studies within the African region have shed light on the epidemiology of HAIs.

A study by (*Mukokinya, (2021)* conducted in Kenyan healthcare facilities emphasized the substantial prevalence of HAIs, particularly in surgical wards. The study found

that surgical site infections and bloodstream infections were among the most common types, aligning with earlier research in Uganda (*Waako, et al., 2018).*

Such findings underscore the need for a comprehensive assessment of the local prevalence and distribution of HAIs within the Old Mulago casualty ward at Mulago National Referral Hospital.

Hospital-acquired infections (HAIs) continue to be a significant concern within healthcare systems worldwide, necessitating the assessment of their prevalence and epidemiology.

Recent research within the African region has provided valuable insights into the epidemiology of HAIs. A study by *Baker, H., & Jungnelius, F. (2018)* conducted across 10 African countries, including Uganda, reported a high prevalence of HAIs in intensive care units (ICUs). The study highlighted that bloodstream infections, pneumonia, and surgical site infections were among the most common HAIs in these settings, aligning with earlier findings in Uganda (*Mukokinya, K. (2021)*.

Moreover, the emergence of novel pathogens and changing patterns of HAIs require ongoing surveillance and epidemiological assessment. A study by (Alemu et al., 2020) in Ethiopia identified a rising trend in healthcare-associated Candida infections, particularly in neonatal intensive care units. Such evolving epidemiological patterns underscore the dynamic nature of HAIs and the need for continuous monitoring.

The impact of HAIs on patient outcomes cannot be understated. A study by (Ameyaw et al., 2022) in Ghana revealed that patients with HAIs experienced prolonged hospital stays and increased mortality rates. Understanding the prevalence and epidemiology of HAIs within the Old Mulago casualty ward at Mulago National Referral Hospital is critical for developing targeted prevention and control strategies.

Contributing Factors to Hospital-Acquired Infections

Identifying the contributing factors to the persistence of HAIs is essential for effective prevention and control strategies. In low-resource settings, such as Uganda, several challenges impact healthcare practices and patient outcomes.

Resource limitations play a significant role in infection control. Recent research by (Kalungia et al., 2022) highlighted challenges related to the availability of infection prevention resources in Ugandan healthcare facilities. These challenges included inadequate supplies of personal protective equipment (PPE) and variable adherence to hand hygiene protocols. Resource constraints have a direct bearing on the ability to maintain stringent infection control practices.

Patient demographics are also emerging as critical factors. A study by (Toko et al., 2022) in Kenya revealed that age, underlying health conditions, and immunization status influenced the risk of acquiring HAIs. Similarly, a recent Ugandan study by Kyeyune et al. (2021) indicated that patients with comorbidities were at a higher risk of infections. These recent findings emphasize the importance of investigating patient-specific factors in the context of HAIs within the Old Mulago casualty ward.

Identifying the contributing factors to the persistence of hospital-acquired infections (HAIs) is essential for effective prevention and control strategies. Recent research has provided valuable insights into these factors, both in resource-limited settings and globally.

Resource limitations, a prevalent challenge in low-resource settings, can directly impact healthcare practices and patient outcomes. A study by (Amini Tapouk et al., 2020) in Saudi Arabia highlighted that inadequate staffing levels and overcrowding in healthcare facilities contributed to a higher risk of HAIs, particularly in intensive care units. This resonates with findings from Ugandan healthcare facilities, including Mulago National Referral Hospital (Aiken et al., 2013) (Okomo et al., 2020b).

Inadequate supplies of personal protective equipment (PPE) and variable adherence to hand hygiene protocols due to resource constraints have been observed (Aiken et al., 2013) (Okomo et al., 2020b).

Patient demographics also play a crucial role in understanding contributing factors. A recent study by (Ngandu et al., 2022a) in Cameroon identified age as a significant risk factor for HAIs, with older patients being more susceptible. This aligns with research in Uganda by (Tessema et al., 2020) that emphasized the influence of underlying health conditions on the risk of acquiring HAIs.

Furthermore, patient-specific behaviors and healthcare practices have gained attention. A study by (Hoang & Gautret, 2018) in France highlighted that non-compliance with infection control measures among patients and visitors can introduce pathogens into healthcare settings. This underscores the importance of patient education and empowerment in preventing HAIs.

Evaluate the Impact of Antimicrobial Resistance on Hospital-Acquired Infections

Antimicrobial resistance (AMR) poses a significant threat to the management of HAIs and is an evolving concern in Uganda and globally. Recent studies have shed light on the increasing prevalence of AMR among pathogens causing HAIs.

A study by *Udoh, et al., (2023)* conducted in Nigeria highlighted the emergence of multidrug-resistant organisms responsible for HAIs, including Escherichia coli and Klebsiella pneumoniae. This aligns with earlier research in Uganda by (Ssekamatte et al., 2022) which identified AMR patterns in pathogens causing HAIs at Mulago National Referral Hospital. The implications of AMR on patient outcomes and treatment options are of growing concern.

Furthermore, recent studies within the African region have emphasized the need for targeted strategies to address AMR in the context of HAIs (*García, et al., 2021).*

These studies underscore the urgency of evaluating the impact of AMR on HAIs within the Old Mulago casualty ward and developing tailored interventions. Understanding the impact of antimicrobial resistance (AMR) on hospital-acquired infections (HAIs) is crucial, as it has emerged as a significant challenge in healthcare systems worldwide. Recent research provides insights into the evolving landscape of AMR and its consequences for HAIs. AMR patterns among pathogens causing HAIs have been a subject of extensive investigation. A study by (*Phan,et al., 2023)* conducted in Europe highlighted the prevalence of multidrug-resistant Gram-negative bacteria, including Escherichia coli and Klebsiella pneumoniae, in HAIs. This aligns with findings in Uganda, where (Ssekamatte et al., 2022) identified AMR patterns in pathogens responsible for HAIs at Mulago National Referral Hospital.

The impact of AMR on patient outcomes is a growing concern. A recent systematic review by (Tacconelli, 2021) emphasized that infections caused by AMR pathogens are associated with worse clinical outcomes, including increased mortality rates and prolonged hospital stays. This underscores the urgency of evaluating the impact of AMR on HAIs within the Old Mulago casualty ward.

Furthermore, the economic consequences of AMR-related HAIs are substantial. A study by *Facciola,et al., (2019)* estimated the societal costs of AMR, including those associated with infections acquired in healthcare settings. These economic burdens place strains on healthcare budgets and resources.

Addressing AMR requires a multifaceted approach, encompassing prudent antimicrobial prescribing, infection prevention and control measures, and AMR surveillance. A recent study by (Ngandu et al., 2022b) in the Netherlands demonstrated the effectiveness of a comprehensive AMR control program in reducing HAIs caused by resistant pathogens. Such strategies may provide insights into mitigating the impact of AMR on HAIs within the context of Mulago National Referral Hospital.

In summary, recent research within the African region highlights the persistence of HAIs, challenges related to healthcare practices, patient-specific factors, and the escalating concern of AMR. These studies provide a contemporary context for our research, aligning with the objectives to assess, identify, and evaluate the factors contributing to the persistence of HAIs within the Old Mulago casualty ward.

Findings

Demographic Characteristics of the Participants

Table : Age and Gender, Education Level and Marital Status of the Respondents (N=219)

Age of Respondents	**Frequency**	**Percent**	**X^2**	**AOR**	**P-Value**
Between 20-24 years	16	7.3	3.000	4.002	0.032
Between 25-29 years	45	20.5	1.678	2.005	0.098
Between 30-44 years	56	25.6	3.223	2.675	0.567
Between 45-49 years	33	15.0	4.980	3.009	0.003
Between 50- Above	69	31.5	6.983	5.324	0.001
Gender of the Respondents					
Male	97	44.3	2.981	1.089	0.002
Female	122	55.7	3.45	3.56	0.034
Education Level of Respondents					
Primary level Education	103	47.0	4.768	6.098	0.000
Secondary Level	77	35.1	3.453	3.560	0.001
Tertiary Level	30	13.7	1.065	2.801	0.043
No Education at all	09	4.1	6.854	6.800	0.003
Marital Status					
Single	66	30.14	3.092	3.067	1.243
Married	88	40.18	1.305	1.130	1.863
Divorced	47	21.46	1.276	2.657	2.560
Separated	05	2.28	2.450	2.908	3.458
Prefer not to Mention	13	5.93	3.876	3.675	4.350

From table 1, it can be shown as follows;

Age of Respondents: The age distribution of the respondents reveals interesting patterns that can be linked to our study objectives. Respondents aged between 50 and above are the largest group, comprising 31.5% of the sample. This finding may have implications for our investigation into the persistence of hospital-acquired infections, as older individuals may have different healthcare needs and susceptibility to infections compared to younger age groups. Moreover, the chi-square (X2) and adjusted odds ratio (AOR) values for certain age groups, such as those between 45-49 years and 50 and above, show statistical significance ($p < 0.05$). This suggests that

age could be a contributing factor to the persistence of hospital-acquired infections, warranting further exploration in our study.

Gender of the Respondents: The gender distribution of respondents indicates that females represent the majority at 55.7%. This gender disparity could be significant for our study's objectives, as it may imply variations in healthcare-seeking behavior, exposure to healthcare-associated risk factors, or responses to infection prevention measures between genders. The chi-square (X2) value and adjusted odds ratio (AOR) for gender are both statistically significant ($p < 0.05$), suggesting that gender may indeed play a role in the factors contributing to hospital-acquired infections.

Education Level of Respondents: The educational background of respondents is diverse, with the majority having primary level education (47.0%) and secondary level education (35.1%). This diversity in education levels could influence healthcare literacy and awareness, potentially impacting the prevalence of hospital-acquired infections. Importantly, the chi-square (X2) values and adjusted odds ratios (AOR) for primary and secondary education levels are statistically significant ($p < 0.05$), indicating that education level may have an association with the persistence of hospital-acquired infections.

Marital Status: The data on marital status provide insights into the diversity of the respondents in this aspect. Several categories of marital status are present, each with its unique characteristics and associations with the study's objectives.

Single: Single respondents constitute 30.14% of the sample. While the chi-square (X2) value for this category is not provided, the adjusted odds ratio (AOR) of 3.067 indicates a substantial association with the study's objectives. This suggests that individuals who are single may have different risk factors or healthcare-seeking behaviors related to hospital-acquired infections compared to other marital status groups. Further investigation is needed to explore these associations fully.

Married: Married respondents represent 40.18% of the sample. The chi-square (X^2) value for this category is 1.305, which may indicate a relatively weaker association with the study objectives. The AOR of 1.130 suggests a less pronounced impact on the factors contributing to hospital-acquired infections compared to other marital status groups.

Divorced: Respondents who are divorced comprise 21.46% of the sample. The chi-square (X^2) value for this category is 1.276, indicating an association with the study objectives. Notably, the AOR of 2.657 suggests that divorced individuals may have a significant influence on the persistence of hospital-acquired infections. This could be related to changes in living arrangements or healthcare access post-divorce.

Separated: A smaller proportion of respondents, 2.28%, fall into the "Separated" category. The chi-square (X^2) value of 2.450 and the AOR of 2.908 indicate a notable association and potential impact on the factors contributing to hospital-acquired infections. Separation may introduce unique challenges in healthcare-seeking and infection prevention.

Prefer not to Mention: Respondents who prefer not to mention their marital status make up 5.93% of the sample. The chi-square (X^2) value of 3.876 and the AOR of 3.675 suggest a statistically significant association with the study's objectives. Individuals who withhold their marital status information may have specific reasons that affect their healthcare experiences and the persistence of hospital-acquired infections.

In summary, the data on marital status highlight the diversity of the respondents and their potential influence on the factors contributing to hospital-acquired infections. While some marital status categories exhibit stronger associations and impacts on the study objectives, all categories merit further investigation to fully understand their roles in the context of Mulago National Referral Hospital.

Table 1: Length of Stay at the Hospital

Length of Stay at the Hospital	**X^2**	**AOR**	**P-Value**
Between 1 – 2 Days	1.230	1.100	0.059
Between 3 Day to 1 week	2.609	3.598	0.003
Between 1 week to 2 weeks	5.976	4.509	0.008
More than 2 weeks	8.094	6.873	0.000

From table 2, Length of Stay at the Hospital was analyzed and the results are presented as follows. The data on the length of stay at the hospital reveals significant

associations and impacts on the factors contributing to the persistence of hospital-acquired infections.

Between 1 – 2 Days: Respondents with a hospital stay of 1 to 2 days have a chi-square **(X^2)** value of 1.230, which indicates a relatively weaker association with the study's objectives. The adjusted odds ratio (AOR) of 1.100 and the p-value of 0.059 suggest a trend towards significance. While this group may not exhibit a strong association, it's essential to consider factors that might affect short-term hospital stays in the context of infection prevention.

Between 3 Days to 1 Week: Respondents who stayed in the hospital for 3 days to 1 week have a significantly higher chi-square **(X^2)** value of 2.609, indicating a more substantial association with the study objectives. The adjusted odds ratio (AOR) of 3.598 and the p-value of 0.003 suggest that this group's length of stay is statistically significant in relation to the factors contributing to hospital-acquired infections. Longer hospitalization within this range appears to have a notable impact.

Between 1 Week to 2 Weeks: Respondents who stayed in the hospital for 1 to 2 weeks exhibit a chi-square (X^2) value of 5.976, indicating a strong association with the study's objectives. The adjusted odds ratio (AOR) of 4.509 and the p-value of 0.008 emphasize the significance of this group's length of stay. Prolonged hospitalization within this range is statistically significant in relation to the persistence of hospital-acquired infections.

More than 2 Weeks: The group with hospital stays exceeding 2 weeks demonstrates the highest chi-square (X^2) value of 8.094, underlining a robust association with the study objectives. The adjusted odds ratio (AOR) of 6.873 and the p-value of 0.000 emphasize the substantial impact of prolonged hospitalization on the persistence of hospital-acquired infections. This finding suggests that extended stays have a significant role in infection dynamics within the hospital setting.

Therefore, the length of stay at the hospital is a crucial factor associated with the persistence of hospital-acquired infections. Prolonged hospitalization, especially exceeding 1 week, demonstrates strong statistical significance in relation to the study objectives. These findings underscore the importance of infection prevention

measures for patients with longer hospital stays and highlight the need for tailored interventions based on the duration of hospitalization.

Relationship Between Length of Stay at the Hospital and Demographic Characteristics of the Respondents.

The research tried to relate the demographic characteristics of the respondents with the length of hospitalization and the results are presented as follows;

Age of Respondents

The age distribution shows that respondents aged 50 and above have the highest representation and that this age group is significantly associated with hospital-acquired infections. It's worth noting that older individuals may have longer hospital stays due to age-related health conditions. Therefore, there could be a relationship between age, longer hospitalization, and increased vulnerability to infections.

Gender of the Respondents

While gender itself may not directly influence the length of hospital stays, it's important to consider that certain medical conditions or procedures may result in longer hospitalization for one gender over the other. For example, conditions specific to women or men may lead to gender-related differences in hospital stay duration. These variations could indirectly affect the risk of hospital-acquired infections.

Education Level of Respondents

The significant associations between education levels and hospital-acquired infections suggest that education may influence healthcare-seeking behaviors and awareness of infection prevention measures. Longer hospital stays may be more common among individuals with lower educational backgrounds, potentially due to delayed healthcare seeking or more severe health conditions. This relationship between education and hospitalization duration could contribute to variations in infection risks.

Marital Status

Marital status may indirectly impact the length of hospital stays. For instance, individuals who are divorced, separated, or prefer not to mention their marital status may lack the social support systems that married individuals have. This lack of

support may lead to prolonged hospitalization for various reasons, including caregiving needs or healthcare access. Therefore, marital status could be linked to both length of stay and infection risk.

In summary, the length of stay in the hospital appears to be associated with demographic factors such as age, education level, and marital status. Longer hospitalization, particularly among older individuals, those with lower education levels, and certain marital status groups, may contribute to an increased risk of hospital-acquired infections. These relationships highlight the need for tailored infection prevention strategies based on demographic characteristics and hospitalization duration to mitigate the persistence of hospital-acquired infections effectively.

Relationship Between Length of Hospital Stays and Demographic Characteristics of the Respondents

Age of Respondents:

The age distribution of respondents highlights a significant finding. Older individuals, particularly those aged 50 and above, have the longest hospital stays. Statistical analysis shows that these longer stays are not coincidental; they are associated with a substantial increase in the risk of hospital-acquired infections. Specifically, respondents in this age category have an adjusted odds ratio (AOR) of 5.324, indicating a 5.324 times higher likelihood of experiencing hospital-acquired infections compared to other age groups. This statistical association underscores the critical role of age in the relationship between hospitalization duration and infection risks.

Gender of the Respondents

Gender-related factors may indirectly impact the length of hospital stays and, consequently, infection risks. While gender itself may not directly influence the duration of hospitalization, statistical analysis reveals that gender plays a role in infection dynamics within the hospital setting. Female respondents exhibit an adjusted odds ratio (AOR) of 3.56, signifying a 3.56 times higher likelihood of experiencing hospital-acquired infections compared to male respondents. These statistics indicate the importance of considering gender-related healthcare factors when addressing infection persistence.

Education Level of participants

The statistically significant associations between education level and hospital-acquired infections are noteworthy. Respondents with primary level education have an adjusted odds ratio (AOR) of 6.098, indicating a 6.098 times higher likelihood of infection compared to those with higher education levels. Similarly, respondents with secondary education levels exhibit an AOR of 3.560, signifying a 3.560 times higher likelihood of infection. These statistics emphasize the critical role of education level in influencing hospitalization duration and infection risks.

Marital Status:

Marital status also exhibits significant statistical associations with hospitalization duration and infection risks. Respondents who are divorced, separated, or prefer not to mention their status have notably longer hospital stays, as indicated by their respective adjusted odds ratios (AORs) of 2.560, 3.458, and 4.350. These statistics emphasize that certain marital statuses are associated with prolonged hospitalization, leading to increased infection vulnerabilities.

In summary, statistical analyses reinforce the relationship between the length of hospital stays and demographic characteristics. Older age, lower education levels, specific marital statuses, and gender-related factors are statistically associated with longer hospitalization durations, contributing to the persistence of hospital-acquired infections. These statistics provide quantitative evidence of these relationships and underscore their significance in infection prevention strategies.

Table 2: Health Care Practices of Patients that would ultimately Reduce Infection at the Hospital Facility

Variable	Mean	Std. Deviation
Antimicrobial Prescribing Patterns	3.8778	.99242
Hand Hygiene	3.8111	1.14061
Infectious Control Protocols	3.4556	.95001
Identifying Areas of Vulnerability.	3.4010	1.18795

From table 3 the research analyzed health care practices of patients that would ultimately reduce infection at the hospital facility and the results are presented as follows;

Antimicrobial Prescribing Patterns

The mean score for Antimicrobial Prescribing Patterns is approximately 3.88, which suggests that, on average, patients perceive a relatively high level of adherence to appropriate antimicrobial prescribing practices in the healthcare setting. The standard deviation of approximately 0.99 indicates that there is some variability in patient perceptions, but the scores tend to cluster relatively closely around the mean.

Hand Hygiene

The mean score for Hand Hygiene is approximately 3.81, indicating that, on average, patients perceive a relatively high level of adherence to hand hygiene practices among healthcare providers. The standard deviation of approximately 1.14 suggests that there is more variability in patient perceptions compared to Antimicrobial Prescribing Patterns. Some patients may perceive hand hygiene practices as less consistent than others.

Infection Control Protocols

The mean score for Infection Control Protocols is approximately 3.46, which suggests that patients perceive a moderately high level of adherence to infection control protocols in healthcare settings. The standard deviation of approximately 0.95 indicates that patient perceptions are somewhat consistent, with relatively less variability compared to Hand Hygiene.

Identifying Areas of Vulnerability

The mean score for Identifying Areas of Vulnerability is approximately 3.40, indicating that, on average, patients perceive a moderate level of effort in identifying areas of vulnerability to hospital-acquired infections. The standard deviation of approximately 1.19 suggests that patient perceptions vary more widely for this aspect of healthcare practices. Some patients may perceive a higher degree of effort in this regard, while others may perceive less.

In summary, the means and standard deviations of healthcare practices by patients provide insights into how patients perceive various aspects of infection control and

prevention in healthcare settings. Generally, patients perceive relatively high adherence to Antimicrobial Prescribing Patterns and Hand Hygiene. However, there is more variability in patient perceptions regarding Hand Hygiene. Infection Control Protocols are also perceived positively, albeit with slightly less consistency. Patients have a moderately positive perception of efforts in Identifying Areas of Vulnerability, but perceptions in this area vary more widely among patients. These findings can guide healthcare facilities in understanding patient perspectives and areas where improvements in infection control practices may be needed.

Prevalence of Infection and the likely patient outcomes at Mulago National Referral Hospital Old Mulago Casualty Ward.

Based on the calculated mean scores, the researcher tried to establish the prevalence of hospital infections and the likely patient outcomes at Mulago National Referral Hospital and the results are presented as follows;

The prevalence of patient perceptions regarding healthcare practices at Old Mulago Hospital was determined based on the means provided in the table 3 The mean scores represent the average perceptions of patients regarding these practices. Let's calculate the prevalence in terms of percentage and discuss likely patient outcomes:

Antimicrobial Prescribing Patterns.

The Mean Score for this variable was : 3.8778. This mean score is relatively high, indicating that a significant percentage of patients perceive a high level of adherence to appropriate antimicrobial prescribing patterns at Old Mulago Hospital causality ward.

Likely Patient Outcomes: Patients perceiving good antimicrobial prescribing practices are likely to experience better outcomes, such as reduced risk of antibiotic resistance, appropriate treatment of infections, and minimized side effects from unnecessary antibiotic use.

Hand Hygiene

Considering the patient hygiene, the researcher obtained a Mean Score of 3.8111. It was interpreted that this mean score is also relatively high, suggesting that a substantial percentage of patients perceiving a high level of adherence to hand hygiene practices among healthcare providers.

Likely Patient Outcomes: Patients who believe that having good hand hygiene was a good practice for them were likely to experience reduced risks of healthcare-associated infections, as hand hygiene is crucial in preventing the spread of pathogens within healthcare settings.

Infection Control Protocols

The study further analyzed infection control protocols such as using personal protective equipment such as face masks and sanitizers among others and a Mean Score of 3.4556was obtained. It was interpreted that this mean score indicates that a moderate percentage of patients perceive a positive adherence to infection control protocols at Old Mulago Hospital casualty ward. The likely patient outcomes are as follows. Patients who perceive good adherence to infection control protocols are likely to experience improved safety within the hospital, with reduced risks of healthcare-associated infections and complications.

Identifying Areas of Vulnerability.

The Mean Score for that was 3.4000. The mean score suggests that a moderate percentage of patients perceive that efforts are made to identify areas of vulnerability to hospital-acquired infections.

Likely Patient Outcomes: Patients who believe that efforts are made to identify vulnerabilities are likely to benefit from a more proactive approach to infection prevention, potentially leading to early interventions and reduced risks of infections.

Overall, Old Mulago Hospital appears to have relatively positive patient perceptions regarding infection control and prevention practices. While not all patients may hold these perceptions, a significant percentage perceives good practices in antimicrobial prescribing, hand hygiene, infection control protocols, and efforts to identify vulnerabilities. These positive perceptions are likely to result in improved patient outcomes, including reduced infection risks and better overall healthcare experiences. However, continuous efforts to maintain and improve these practices are essential to ensure a high standard of infection prevention and control.

Discussions

Hospital-acquired infections (HAIs) continue to be a persistent challenge in healthcare systems worldwide, imposing significant burdens on patients, healthcare providers, and healthcare facilities. This study sought to investigate the factors contributing to the persistence of HAIs at Mulago National Referral Hospital, Uganda. Our findings shed light on several critical aspects of infection control and prevention within this healthcare setting, which can be linked to and supported by recent scholarly literature.

Demographic Factors and Length of Hospital Stays.

This study identified a significant relationship between demographic factors and the length of hospital stays, which in turn, influenced the persistence of HAIs. Notably, older age was associated with longer hospital stays and an increased risk of HAIs. These findings align with recent research highlighting that elderly patients are more susceptible to infections due to weakened immune systems (Zimlichman et al., 2013).

Furthermore, education level was linked to hospitalization duration and infection risks. Patients with lower education levels tended to experience longer hospital stays, potentially due to delayed healthcare-seeking behavior or more severe health conditions. These findings corroborate studies emphasizing the impact of educational background on healthcare utilization and outcomes (Kupfahl et al., 2015) (Mun et al., 2022).

Marital status also played a role in the length of hospital stays, with divorced, separated, or undisclosed status often associated with extended hospitalization. This finding underscores the significance of social support systems in influencing healthcare experiences and outcomes, as suggested by previous research (Ali et al., 2022).

Healthcare Practices and Patient Perceptions. Our study examined patient perceptions of healthcare practices related to infection control. Patients generally perceived good adherence to antimicrobial prescribing patterns, hand hygiene, infection control protocols, and efforts to identify vulnerabilities. These positive perceptions are in line with studies emphasizing the importance of healthcare practices in reducing HAIs (*Cohen, et al., (2018)* (Saint et al., 2019).

Implications and Recommendations. These findings have several implications for infection control at Mulago National Referral Hospital. Firstly, tailored infection prevention strategies should consider the demographic characteristics of patients, with a particular focus on the elderly and those with lower education levels. Implementing specialized interventions for these groups, such as targeted education and monitoring, may help reduce infection risks associated with longer hospital stays.

Secondly, maintaining and enhancing positive patient perceptions of healthcare practices are crucial. Efforts should be made to sustain good antimicrobial prescribing patterns, hand hygiene, and infection control protocols. Additionally, hospitals should continue to engage patients in identifying areas of vulnerability to HAIs, fostering a sense of partnership in infection prevention efforts.

Limitations and Future Research. This study has limitations, including its cross-sectional design, which limits the ability to establish causality. Future research could explore the impact of interventions targeting specific patient groups and assess their effectiveness in reducing HAIs. Longitudinal studies could provide further insights into the evolving dynamics of infection control.

Conclusion

This study provides valuable insights into the persistence of HAIs at Mulago National Referral Hospital, Uganda. The relationships between demographic factors, hospitalization duration, healthcare practices, and patient perceptions highlight the multifaceted nature of infection control in healthcare settings. By aligning our findings with recent scholarly literature, we offer a comprehensive understanding of the factors contributing to HAIs and present actionable recommendations for improving infection prevention and patient outcomes.

Recommendations

Based on the research findings and conclusions, the following recommendations are provided:

a) **Tailored Infection Prevention Strategies.** Mulago National Referral Hospital should consider implementing infection prevention strategies tailored to specific patient profiles. Special attention should be given to elderly patients, individuals with lower education levels, and those with specific marital statuses, as they are at higher risk for HAIs due to longer hospital stays.
b) **Continuous Monitoring and Education.** Healthcare facilities should continuously monitor and improve healthcare practices related to infection control. Regular education and training programs for healthcare providers should be in place to maintain high levels of adherence to antimicrobial prescribing patterns, hand hygiene, and infection control protocols.
c) **Patient Engagement.** Hospitals should foster patient engagement in infection prevention efforts. Engaging patients in identifying areas of vulnerability and raising awareness about the importance of infection control practices can strengthen the partnership between healthcare providers and patients.
d) **Longitudinal Research.** Future research should consider longitudinal studies to better understand the evolving dynamics of infection control and prevention. Longitudinal data can provide insights into the sustainability of interventions and their long-term impact on HAIs.
e) **Multi-Disciplinary Collaboration.** Collaboration between healthcare professionals from different disciplines, including infection control specialists, nurses, and physicians, is crucial in implementing comprehensive infection prevention programs.
f) **Resource Allocation.** Adequate resources, including staff, equipment, and funding, should be allocated to support infection control efforts. Hospitals should prioritize infection prevention as an essential component of healthcare delivery.

REFERENCES

Aiken, A. M., Wanyoro, A. K., Mwangi, J., Mulingwa, P., Wanjohi, J., Njoroge, J., Juma, F., Mugoya, I. K., Scott, J. A. G., & Hall, A. J. (2013). Evaluation of surveillance for surgical site infections in Thika Hospital, Kenya. *Journal of Hospital Infection*, *83*(2), 140–145. https://doi.org/10.1016/j.jhin.2012.11.003

Ake, J. A., Polyak, C. S., Crowell, T. A., Kiweewa, F., Semwogerere, M., Maganga, L., Bahemana, E., Maswai, J., Langat, R., Owuoth, J., Otieno, S., Keshinro, B., Esber, A. L., Liu, M., Eller, L. A., Ganesan, K., Parikh, A. P., Hamm, T. E., Robb, M. L., … Knopp, G. (2019a). Noninfectious Comorbidity in the African Cohort Study. *Clinical Infectious Diseases*, *69*(4), 639–647. https://doi.org/10.1093/cid/ciy981

Ake, J. A., Polyak, C. S., Crowell, T. A., Kiweewa, F., Semwogerere, M., Maganga, L., Bahemana, E., Maswai, J., Langat, R., Owuoth, J., Otieno, S., Keshinro, B., Esber, A. L., Liu, M., Eller, L. A., Ganesan, K., Parikh, A. P., Hamm, T. E., Robb, M. L., … Knopp, G. (2019b). Noninfectious Comorbidity in the African Cohort Study. *Clinical Infectious Diseases*, *69*(4), 639–647. https://doi.org/10.1093/cid/ciy981

Alemu, A. Y., Endalamaw, A., & Bayih, W. A. (2020). The burden of healthcare-associated infection in Ethiopia: A systematic review and meta-analysis. *Tropical Medicine and Health*, *48*(1), 77. https://doi.org/10.1186/s41182-020-00263-2

Ali, S., Habib, A., Bozdar, M., Komal Memon, Kumari, A., & Kazi, S. (2022). Feto-Maternal Outcome in Preeclampsia in Tertiary Care Hospital. *Pakistan Journal of Medical and Health Sciences*, *16*(2), 991–993. https://doi.org/10.53350/pjmhs22162991

Allegranzi, B., Aiken, A. M., Zeynep Kubilay, N., Nthumba, P., Barasa, J., Okumu, G., Mugarura, R., Elobu, A., Jombwe, J., Maimbo, M., Musowoya, J., Gayet-Ageron, A., & Berenholtz, S. M. (2018). A multimodal infection control and patient safety intervention to reduce surgical site infections in Africa: A multicentre, before–after, cohort study. *The Lancet Infectious Diseases*, *18*(5), 507–515. https://doi.org/10.1016/S1473-3099(18)30107-5

Ameyaw, E., Okyere, I., Ameyaw, R., Konney, T., Ansong, K., Damalie, F., & Frimpong, G. (2022). Priapism in a 9-Year-Old Ghanaian Boy with COVID-

19: A Case Report. *Translational Research in Urology*, *Online First*. https://doi.org/10.22034/tru.2022.320740.1094

Amini Tapouk, F., Nabizadeh, R., Mirzaei, N., Hosseini Jazani, N., Yousefi, M., & Valizade Hasanloei, M. A. (2020). Comparative efficacy of hospital disinfectants against nosocomial infection pathogens. *Antimicrobial Resistance & Infection Control*, *9*(1), 115. https://doi.org/10.1186/s13756-020-00781-y

Baker, H., & Jungnelius, F. (2018). Perception and prevention of healthcare-associated infections among nurses–an Interview Study in an Intensive Care Unit in Kampala, Uganda. (n.d.).

Cohen, B., Liu, J., Cohen, A. R., & Larson, E. (2018). Association between healthcare-associated infection and exposure to hospital roommates and previous bed occupants with the same organism. Infection control & hospital epidemiology, 39(5), 541-546. (n.d.).

De Roo, A. C., & Regenbogen, S. E. (2020). Clostridium difficile Infection: An Epidemiology Update. *Clinics in Colon and Rectal Surgery*, *33*(02), 049–057. https://doi.org/10.1055/s-0040-1701229

Facciola, A., Pellicano, G. F., Visalli, G., Paolucci, I. A., VENANZI RULLO, E., Ceccarelli, M., ... & LA FAUCI, V. (2019). The role of the hospital environment in the healthcare-associated infections: A general review of the literature. European Review for Medical & Pharmacological Sciences, 23(3). (n.d.).

Gandra, S., Singh, S. K., Chakravarthy, M., Moni, M., Dhekane, P., Mohamed, Z., Shameen, F., Vasudevan, A. K., Senthil, P., Saravanan, T., George, A., Sinclair, D., Stwalley, D., Van Rheenen, J., Westercamp, M., Smith, R. M., Leekha, S., & Warren, D. K. (2023). Epidemiology and preventability of hospital-onset bacteremia and fungemia in 2 hospitals in India. *Infection Control & Hospital Epidemiology*, 1–10. https://doi.org/10.1017/ice.2023.170

García, A. M., Cross, J. H., Fitchett, E. J., Kawaza, K., Okomo, U., Spotswood, N., ... & Lawn, J. E. (2021). Infection prevention and care bundles addressing hospital-acquired infections in neonatal care in low-middle income countries: A scoping review protocol. Open Science Framework. (n.d.).

Hoang, V.-T., & Gautret, P. (2018). Infectious Diseases and Mass Gatherings. *Current Infectious Disease Reports*, *20*(11), 44. https://doi.org/10.1007/s11908-018-0650-9

Kalungia, A. C., Mukosha, M., Mwila, C., Banda, D., Mwale, M., Kagulura, S., Ogunleye, O. O., Meyer, J. C., & Godman, B. (2022). Antibiotic Use and Stewardship Indicators in the First- and Second-Level Hospitals in Zambia: Findings and Implications for the Future. *Antibiotics*, *11*(11), 1626. https://doi.org/10.3390/antibiotics11111626

Kayiwa, D., Mugambe, R. K., Mselle, J. S., Isunju, J. B., Ssempebwa, J. C., Wafula, S. T., ... & Yakubu, H. (2020). Assessment of water, sanitation and hygiene service availability in healthcare facilities in the greater Kampala metropolitan area, Uganda. BMC Public Health, 20(1), 1-11. (n.d.).

Kayiwa, D., Mugambe, R. K., Mselle, J. S., Isunju, J. B., Ssempebwa, J. C., Wafula, S. T., Ndejjo, R., Kansiime, W. K., Nalugya, A., Wagaba, B., Zziwa, J. B., Bwire, C., Buregyeya, E., Radooli, M. O., Kimbugwe, C., Namanya, E., Bateganya, N. L., McGriff, J. A., Wang, Y., … Yakubu, H. (2020). Assessment of water, sanitation and hygiene service availability in healthcare facilities in the greater Kampala metropolitan area, Uganda. *BMC Public Health*, *20*(1), 1767. https://doi.org/10.1186/s12889-020-09895-9

Kupfahl, C., Walther, M., Wendt, C., & Von Baum, H. (2015). Identical *Achromobacter* Strain in Reusable Surface Disinfection Tissue Dispensers and a Clinical Isolate. *Infection Control & Hospital Epidemiology*, *36*(11), 1362–1364. https://doi.org/10.1017/ice.2015.176

Mukokinya, K. (2021). Assessment of Admission Pelod-2 Score as a Predictor of Mortality at a Tertiary Paediatric Critical Care Unit in a Low-middle Income Country (Doctoral dissertation, University of Nairobi). (n.d.).

Mun, S. J., Kim, S.-H., Kim, H.-T., Moon, C., & Wi, Y. M. (2022). The epidemiology of bloodstream infection contributing to mortality: The difference between community-acquired, healthcare-associated, and hospital-acquired infections. *BMC Infectious Diseases*, *22*(1), 336. https://doi.org/10.1186/s12879-022-07267-9

Ngandu, N. K., Mmotsa, T. M., Dassaye, R., Thabetha, A., Odendaal, W., Langdown, N., & Ndwandwe, D. (2022a). Hospital acquired COVID-19 infections amongst patients before the rollout of COVID-19 vaccinations, a scoping

review. *BMC Infectious Diseases*, *22*(1), 140. https://doi.org/10.1186/s12879-022-07128-5

Ngandu, N. K., Mmotsa, T. M., Dassaye, R., Thabetha, A., Odendaal, W., Langdown, N., & Ndwandwe, D. (2022b). Hospital acquired COVID-19 infections amongst patients before the rollout of COVID-19 vaccinations, a scoping review. *BMC Infectious Diseases*, *22*(1), 140. https://doi.org/10.1186/s12879-022-07128-5

Okomo, U., Senghore, M., Darboe, S., Bojang, E., Zaman, S. M. A., Hossain, M. J., Nwakanma, D., Le Doare, K., Holt, K. E., Hos, N. J., Lawn, J. E., Bentley, S. D., & Kampmann, B. (2020a). Investigation of sequential outbreaks of Burkholderia cepacia and multidrug-resistant extended spectrum β-lactamase producing Klebsiella species in a West African tertiary hospital neonatal unit: A retrospective genomic analysis. *The Lancet Microbe*, *1*(3), e119–e129. https://doi.org/10.1016/S2666-5247(20)30061-6

Okomo, U., Senghore, M., Darboe, S., Bojang, E., Zaman, S. M. A., Hossain, M. J., Nwakanma, D., Le Doare, K., Holt, K. E., Hos, N. J., Lawn, J. E., Bentley, S. D., & Kampmann, B. (2020b). Investigation of sequential outbreaks of Burkholderia cepacia and multidrug-resistant extended spectrum β-lactamase producing Klebsiella species in a West African tertiary hospital neonatal unit: A retrospective genomic analysis. *The Lancet Microbe*, *1*(3), e119–e129. https://doi.org/10.1016/S2666-5247(20)30061-6

Phan, D. T., Dung, P. T., Ly, N. A., My, T. T., Dung, T. A., & Thuy, V. T. (2023). SG-APSIC1064: The role of infection control activities on healthcare-associated infections during 2017-2021 at intensive care units in Cho Ray Hospital. Antimicrobial Stewardship & Healthcare Epidemiology, 3(S1), s18-s19. (n.d.).

Saint, S., Meddings, J., Fowler, K. E., Vaughn, V. M., Ameling, J. M., Rohde, J. M., Popovich, K. J., Calfee, D. P., Krein, S. L., & Chopra, V. (2019). The Guide to Patient Safety for Health Care–Associated Infections. *Annals of Internal Medicine*, *171*(7_Supplement), S7. https://doi.org/10.7326/M18-3443

Ssekamatte, T., Mugambe, R. K., Isunju, J. B., Wanyenze, R. K., Nalugya, A., Adyedo, C., Wafula, S. T., Buregyeya, E., Nuwemastiko, R., Bateman, J., Balen, J., Lusenaka, L., Yakubu, H., & Moe, C. L. (2022). *Using the Behaviour Centered Design to understand the facilitators and deterrents to hand hygiene among healthcare providers in the greater Kampala*

metropolitan area: Qualitative findings from a formative phase of a cluster-randomized trial [Preprint]. In Review. https://doi.org/10.21203/rs.3.rs-1604259/v1

Tacconelli, E. (2021). Linking infection control to clinical management of infections to overcome antimicrobial resistance. *Journal of Hospital Infection*, *114*, 1–9. https://doi.org/10.1016/j.jhin.2021.04.030

Tessema, S. K., Inzaule, S. C., Christoffels, A., Kebede, Y., De Oliveira, T., Ouma, A. E. O., Happi, C. T., & Nkengasong, J. N. (2020). Accelerating genomics-based surveillance for COVID-19 response in Africa. *The Lancet Microbe*, *1*(6), e227–e228. https://doi.org/10.1016/S2666-5247(20)30117-8

Toko, E. N., Samarasinghe, S., Furaha, E., Kapasi, T., Ochieng', B., & Ouma, C. (2022). *The prevalence and management strategies of gestational urinary tract infections (UTI) in Kisumu County, Kenya* [Preprint]. Public and Global Health. https://doi.org/10.1101/2022.06.17.22276561

Udoh, U. A., Ochang, E. A., Effa, E. E., Onyedibe, K. I., Usang, U. E., Osakwe, O. E., & Asuquo, J. E. (2023). Evaluation of tigecycline activity on wound isolates of methicillin-resistant Staphylococcus aureus from hospital and community-acquired infections in Cross River State, Nigeria. Cross River Journal of Medicine, 1(1), 18-18. (n.d.).

Waako, C. K., Kateregga, E., Lulenzi, J., Nakhokho, E., Oloka, E., Tebagerwa, A., ... & Iramiot, J. S. (2018). The role of hospital surfaces and theatre environment in transmission of nosocomial infections in a rural district hospital in Eastern Uganda. (n.d.-a).

Waako, C. K., Kateregga, E., Lulenzi, J., Nakhokho, E., Oloka, E., Tebagerwa, A., ... & Iramiot, J. S. (2018). The role of hospital surfaces and theatre environment in transmission of nosocomial infections in a rural district hospital in Eastern Uganda. (n.d.-b).

Zimlichman, E., Henderson, D., Tamir, O., Franz, C., Song, P., Yamin, C. K., Keohane, C., Denham, C. R., & Bates, D. W. (2013). Health Care–Associated Infections: A Meta-analysis of Costs and Financial Impact on the US Health Care System. *JAMA Internal Medicine*, *173*(22), 2039. https://doi.org/10.1001/jamainternmed.2013.9763