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Review Article

Review on hospital healthcare-associated infections in Africa: Cross-sectional analyses, hygiene perspectives, risk factors and prevention strategies

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ABSTRACT

This comprehensive review explores in depth the various aspects of hospital hygiene in Africa, focusing particularly on nosocomial infections, hospital environment, hand hygiene, and aseptic procedures. The fundamental objective of this study is to provide strategic support to the committee for the fight against nosocomial infections by developing a risk analysis methodology specifically adapted to control the dangers inherent in hand hygiene and the hospital environment. The approach employed is predicated on a biometric database with 20 scholarly articles that are all published studies on hospital hygiene in Africa. Strict inclusion and exclusion standards were used to guarantee the accuracy and dependability of the information gathered. The results obtained from this approach present themselves as an essential contribution to improving hospital hygiene in Africa. By highlighting existing gaps, challenges encountered and proposing effective operational strategies, this review aims to strengthen the prevention and control of nosocomial infections within health establishments in the region. The approach adopted highlights the importance of developing specific approaches, informed by solid data, to address the issues specific to hospital hygiene in Africa. By identifying risk factors and providing pragmatic recommendations, this review offers clear perspectives to guide efforts to improve the quality of hygiene practices in African hospital environments, thereby contributing to more effective management of nosocomial infections.

Keywords: Hospital hygiene, Nosocomial infections, Hospital environment, Aseptic procedures, Risk analysis

Introduction

Nosocomial infections, also known as healthcare-associated infections (HAIs), represent a significant threat to patient safety, affecting millions of people worldwide [1]. These infections have serious consequences, such as increased mortality, morbidity, increased length of hospital stay, and increased healthcare costs [2]. HAIs pose a major health risk not only to patients but also to healthcare workers and the community at large. This risk is particularly high in low- and middle-income countries (LMICs), where the prevalence of HAIs reaches 15.5 infections per 100 patients, compared to 4.5 per 100 patients in high-income countries [3].

The hospital environment is often colonized by a variety of opportunistic and human pathogenic microorganisms that can survive on dry and moist surfaces for several days [4]. Medical devices and surfaces can be contaminated by patients, healthcare workers, or the external environment. Contamination varies

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depending on the duration of exposure, medical services, patient characteristics, and care techniques applied. The microbial load on hospital surfaces is influenced by several factors, such as cleaning efficiency, the lifespan of microorganisms, their adhesion to surfaces, their ability to form biofilms, and their resistance to adverse conditions [5, 6].

Although bacterial species present on surfaces are not systematically pathogenic, skin bacteria such as Staphylococcus aureus or aquatic species such as Pseudomonas aeruginosa can be involved in HAIs. Commonly found pathogens include *Clostridium difficile*, *Klebsiella sp.*, *Staphylococcus aureus*, and *Acinetobacter baumannii*. Microbiological monitoring of the hospital environment is therefore essential to identify environmental risks [7-9].

Some bacteria can persist depending on the properties of surfaces, their ability to form biofilms (*Pseudomonas aeruginosa*) or produce spores (*Clostridium difficile*). It is important to adopt rigorous prevention measures to limit the risks of cross-contamination, such as strict compliance with hand hygiene and disinfection of surfaces and medical devices [10].

HAIs are a major public health problem, contributing to increased risk of death, prolonged hospital stays, and high financial costs for patients and health systems. Adherence to good hygiene practices is essential to reduce these infections, but it remains insufficient, especially in low-income countries where various barriers limit the application of these optimal practices [11, 12].

Various bacteria such as coagulase-negative Staphylococci, *Escherichia coli*, *Enterobacter cloacae*, *Klebsiella pneumoniae*, MRSA, and *Pseudomonas fluorescens* can contaminate surfaces and medical devices, increasing the risk of nosocomial infections. It becomes essential and urgent to evaluate and strengthen infection prevention practices, including following hand hygiene guidelines and implementing recommendations for surface cleaning and disinfection.

By examining the features of nosocomial or healthcare-associated infections, hospital environment, hand hygiene, and aseptic procedures, this study aims to explore aspects of hospital hygiene in Africa. Its goal is to assist the committee fighting nosocomial infections in creating a suitable risk analysis plan to manage the hazards associated with hand hygiene and the hospital setting.

Materials and Methods

Collection of data

This review used the Pub Med database to explore published research on hospital hygiene in Africa. The choice of Africa as a subject for examination stems from the demonstration, through coherent studies, of the existence of both ineffective and effective strategies in hospital hygiene on the continent. Only 30% of African countries respected half of the WHO recommendations on hospital hygiene. In order to optimize the relevance of the results and translate the keywords used for the search, the health terminology portal, "He Top," was used to translate the terms of the Mesh (Medical Subject Headings) thesaurus of Pub Med. The primary keywords used for the search included “hospital hygiene,” “nosocomial infection,” “Africa,” “hand hygiene,” “medical devices,” “hospital environment,” “contamination,” and the Boolean operators “AND, “OR,” and “NOT” were used to make the combinations. Two filters were applied: "free full text" and "last ten years." In the first step, inappropriate studies were excluded from the retrieved titles and abstracts. To extract the data, an analysis grid was used **(Table 2)** (General characteristics of the study). To avoid any bias in the study selection process, a comprehensive search, consistent with the research topic, was carried out following the PRISMA flow diagram **(Figure 1)**.

Inclusion and exclusion

Criteria In addition to the criteria set out in **Table 1**, hospital hygiene practices linked to COVID-19, recycling, management, and recovery of liquid or solid waste are not taken into account in this systematic review [13-16].

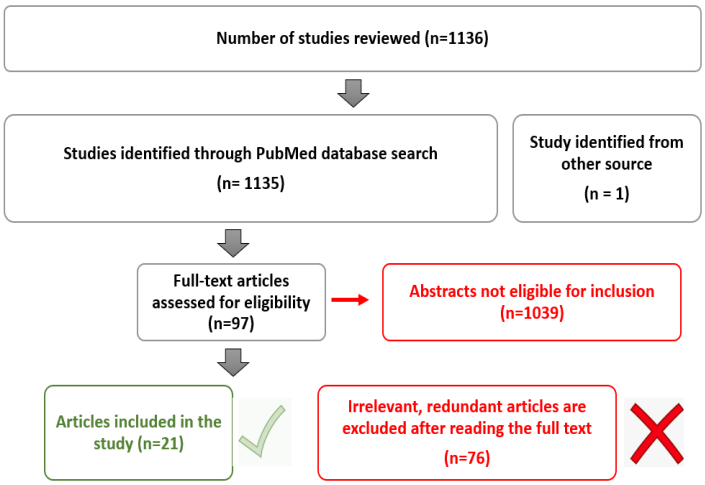

Figure 1. Flowchart for study selection.

Table 1. Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
-Public hospital, health center; -Interventions expressly aimed at improving hospital hygiene and reducing nosocomial infections; -Results relating to hospital hygiene and nosocomial infections; -Studies published in French or English and concerning Africa.	-Private clinics; -Intervention not specifically intended to improve hospital hygiene and reduce nosocomial infections; -Results which have no relation to hospital hygiene and nosocomial infections in health establishments; Studies published in another language.

Data analysis

Data extracted from the studies included in this review are analyzed using descriptive synthesis. This step consists of a structured presentation of the essential characteristics of the studies. A descriptive analysis of each included study was undertaken, covering the methodology adopted, the areas targeted by the study, and the results obtained. Then, the studies were grouped into specific categories, thus guiding the conclusions of the systematic review: grouping of results according to nosocomial or healthcare-associated infections, grouping according to hand hygiene and grouping according to the hospital environment. The synthesis of the results makes it possible to construct a summary of the conclusions, taking into account the differences between the selected studies [17, 18].

Results and Discussion

This comprehensive study scrupulously explored the various aspects of hospital hygiene in Africa by analyzing the characteristics of nosocomial and healthcare-associated infections, hospital environment, hand hygiene, and aseptic procedures. The main objective was to provide strategic support to the nosocomial infection control committee by developing a risk analysis strategy adapted to control risks related to hand hygiene and the hospital environment. A total of 20 publications were thoroughly analyzed, and the characteristics of each article are listed in detail in **Table 2**.

This comprehensive review looked at a wide range of variables for an in-depth understanding of hospital hygiene practices **(Figure 2)**, challenges, and opportunities in Africa. The main categories of variables examined include adherence to hand hygiene (HH) parameters, use of the “My 5 Moments for HH” tool, HH techniques and duration, and availability of resources for hand hygiene (HH). Hand hygiene, hand hygiene knowledge, critical times for hand hygiene, and overall compliance with hand hygiene in hospital wards [19, 20]. The in-depth analysis of hand hygiene practices included overall compliance, nurses' knowledge, practices based on the "five moments of hand hygiene", as well as factors associated with hand hygiene compliance by nurses [21]. Individual factors such as knowledge, skills, education, perceived risks, memory, and social influence have been thoroughly explored, as have institutional factors, encompassing environment, resources, workload, and staffing levels [22]. Regarding healthcare safety, several variables were studied, including the use of protective gloves, the safety of injections and blood sampling, disinfection of reusable equipment, and waste sorting. Dependent variables included hand washing, glove use, disposal of used sharps, waste disposal, patient isolation, and cleaning of healthcare facilities [23]. The independent variables involved age, gender, continuing education, qualification of health personnel, and ownership of the health facility [24]. In parallel, our study examined variables linked to standard precaution, such as knowledge and information, the attitude of doctors and laboratory scientists, the presence of nosocomial infections, and the practice of standard precaution by health workers [25]. Health, as well as the factors that promote, restrict, and advise adherence to recommended safety measures. Aspects of the hospital environment that were studied included hospital storage, disposal, biosafety procedures, bacterial loads in hospitals, and the recovery of germs from high-touch surfaces. The microbiological quality of surgical linens was studied in relation to variables such as factors linked to the departments processing the linens, technical factors linked to the linen management system, and the association between professional experience, technical control, and the quality of sterilization of operating linen. Other variables addressed include the disinfection protocols used, microbiological sampling before and after disinfection and sterilization, training of medical and paramedical staff, and means of surveillance and infection control [26-29].

Table 2. General characteristics of the publications in this study.

Authors	Study Type	Location & Environment	Population	Variables Studied
Yehouénou *et al.* (2020) [30]	Prospective Observational	Surgical units in six public hospitals, in Benin	Healthcare workers	(A) Compliance with basic HH parameters, (B) "My 5 Moments for HH" tool, (C) Techniques and duration of HH
Nzanga *et al.* (2022) [31]	Cross-sectional Quantitative	Chiradzulu District Hospital, Malawi	On-call nurses and clinicians	(A) Availability of HH resources, (B) HH knowledge, (C) Critical HH moments, (D) Compliance in hospital wards
Umar *et al.* (2022) [32]	Cross-sectional	Oromia region, Eastern Ethiopia	Nurses	(A) Overall HH compliance, (B) HH knowledge, (C) Practices based on “5 moments”, (D) Associated factors

Tang *et al.* (2019) [33]	Mixed Methods	Rural Hospital, Madarounfa, Niger	Healthcare workers	(A) HH observations, (B) Qualitative interviews, (C) Environmental sampling
Engdaw *et al.* (2019) [34]	Cross-sectional	Public hospitals, Gondar, Ethiopia	Healthcare workers	(A) Compliance, (B) Training, (C) Availability of water, soap, and alcohol-based solutions, (D) Attitudes
Ataiyero *et al.* (2023) [35]	Qualitative Interviews	Public Hospital, Nigeria	Nurses and doctors	(A) Knowledge, (B) Perception of infection risk, (C) Environment, (D) Workload
Bedoya *et al.* (2017) [36]	Observational & Monitoring	Primary Healthcare, Kenya	Patients and staff	(A) HH, (B) Use of gloves, (C) Injection safety, (D) Equipment disinfection, (E) Waste segregation
Wasswa *et al.* (2015) [37]	Cross-sectional	Health facilities, Arua, Uganda	Healthcare workers	(A) Hand washing, (B) Glove use, (C) Waste disposal, (D) Patient isolation
Ndu and Arinze-Onyia (2017) [38]	Cross-sectional	University Hospital, Nigeria	Laboratory scientists	(A) Knowledge, (B) Attitudes, (C) Practices, (D) Exposure factors
Odoyo *et al.* (2021) [39]	Descriptive	Five Hospitals, Kenya	Environmental samples	(A) Bacterial loads on surfaces, (B) Infection control practices, (C) Biosafety practices
Yehouénou *et al.* (2020) [40]	Cross-sectional	Six Public Hospitals, Benin	Pus samples	(A) Pathogen profiles, (B) Resistance patterns, (C) Prevalence of strains
Dégbey *et al.* (2020) [41]	Cross-sectional	Hubert Koutoukou Maga Hospital, Benin	Sterilized linens	(A) Microbiological quality, (B) Sterilization procedures, (C) Technical controls
Baghdadi *et al.* (2020) [42]	Descriptive	Rouïba Hospital, Algeria	Microbiological samples	(A) Protocol effectiveness, (B) Training, (C) Monitoring
Haddad *et al.* (2019) [43]	Cross-sectional	Habib Thameur Hospital, Tunisia	Stethoscope samples	(A) Germ distribution, (B) Contamination rates
Nokubonga *et al.* (2019) [44]	Quantitative Descriptive	KwaZulu-Natal, South Africa	Audiologists	(A) Prevention measures, (B) Training, (C) Waste management
Firesbhat *et al.* (2021) [45]	Cross-sectional	Gondar Hospital, Ethiopia	384 samples	(A) Bacterial identification, (B) Antimicrobial resistance
Fekadu and Getachewu (2015) [46]	Cross-sectional	Jimma University Hospital, Ethiopia	Air samples	(A) Bacterial & fungal aerosol levels, (B) Microbial air quality
Jaouhar *et al.* (2020) [47]	Descriptive	Regional Hospital, Meknès, Morocco	High-risk units surfaces	(A) Contamination after biocleaning
Afle *et al.* (2019) [48]	Analytical Cross-sectional	Abomey-Calavi Hospital, Benin	160 samples	(A) Bacterial isolation, (B) Species distribution
Mohamed Abdoul-Latif *et al.* (2021) [49]	Retrospective Study	Peltier Hospital, Djibouti	300 dialysis patients	(A) Infection prevalence, (B) Resistant strains, (C) Sampling techniques

Figure 2. Mind map of the variables of general characteristics of the study. (created by www.map-this.com)

The results of the studies presented highlight the major challenges related to hand hygiene adherence and the prevention of nosocomial infections in various hospital settings, mainly in Africa. These works, carried out in low-resource environments, show often insufficient compliance rates and put forward recommendations to improve patient safety and quality of care. The study conducted by Yehouénou *et al*. (2020) [30, 50] in Benin showed an overall hand hygiene compliance rate of 33.3% in surgical departments. The results highlight significant differences between obstetric and gastrointestinal surgery departments, highlighting the need for specific strategies to improve the situation. Despite a preference for handwashing, the duration and technique do not always respect the guidelines, aggravated by the lack of adequate infrastructure, such as sinks and soap. This study highlights the need for infrastructure strengthening and targeted interventions to improve compliance. Similarly, Nzanga *et al*. (2022) [31, 51] in Malawi assessed compliance with hand hygiene guidelines among nurses and clinicians in a hospital in the Chiradzulu district. The study found low adherence, with reported practices higher than actual practices. These findings indicate an urgent need for behavior change interventions and the provision of basic resources, such as soap and clean water. In Ethiopia, Umar *et al*. (2022) [32] analyzed nurses' adherence in public hospitals in the Oromia region and observed a compliance rate of only 37.4%. Factors such as gender, work experience, training, and water availability influenced these results. These findings indicate the importance of increased awareness and organizational measures to improve compliance. In a rural hospital in Niger, Tang *et al*. (2019) [33, 52] observed a low rate of compliance with hand hygiene practices (11% in the off-peak season and 36% in the peak season), despite good theoretical knowledge. In addition, high contamination by Gram-negative bacilli (45%) was observed, particularly during busy periods. The results show that these rural hospital environments require tailored interventions to reduce the risk of nosocomial infections. In Ethiopia, Engdaw *et al*. (2019) [34, 53] showed that only 14.9% of 335 healthcare workers observed complied with recommended hand hygiene practices. The gaps were mainly due to insufficient training and a lack of resources. Ataiyero *et al*. (2023) [35, 54] identified individual and institutional barriers to adherence to hand hygiene practices in Nigeria. The study recommended practical interventions, such as the use of mild soap and basic training. In Kenya, Bedoya *et al*. (2017) [36] found low compliance with infection prevention practices in primary care facilities, with an average rate of 31.8%. The findings highlight the need for a behavioral approach to improve compliance. Wasswa *et al*. (2015) [37] in Uganda revealed that although most health workers were aware of infection control measures, 93.8% of facilities lacked infection control committees and adequate supplies, highlighting the urgent need to provide resources to improve prevention. Ndu and Arinze-Onyia (2017) [38] compared knowledge of standard precautions between doctors and laboratory scientists in Nigeria, revealing that lack of protective equipment negatively affected compliance with recommendations. Odoyo *et al*. (2021) [39] assessed microbial contamination of surfaces in five hospitals in Kenya and found that rigorous cleaning practices reduced bacterial loads. However, gaps in waste management contributed to increased contamination. Yehouénou *et al*. (2020) [40] observed a high prevalence of multidrug-resistant bacteria in surgical site infections in Benin, highlighting the importance of surveillance and good hygiene practices to prevent their spread. Dégbey *et al*. (2020) [41] showed gaps in the sterilization of surgical fields, with the presence of *Acinetobacter spp.* in 45% of samples, indicating that the quality of sterilization is influenced by the control of procedures. Baghdadi *et al*. (2020) [42] found high contamination of hospital surfaces in Algeria (80%), requiring corrective measures, such as bio-cleaning and continuous training. In Tunisia, Haddad *et al*. (2019) [43] showed that 38% of stethoscopes were contaminated, highlighting the importance of their disinfection. Nokubonga *et al*. (2019) [44] observed low adherence to infection prevention measures in South Africa, despite training, recommending continued training. Firesbhat *et al*. (2021) [45] revealed high bacterial contamination of hospital surfaces and medications in Ethiopia, indicating a need for strict infection control. Fekadu and Getachewu (2015) [46] showed high bacterial and fungal contamination of indoor air in a hospital in Ethiopia, highlighting the importance of environmental control measures to limit microbial proliferation. Jaouhar *et al*. (2020) [47] in Morocco highlighted high contamination of hospital surfaces (40%), requiring rigorous evaluation of disinfection protocols. Afle *et al*. (2019) [48] in Benin observed that 65% of tested hospital surfaces were contaminated, mainly by Staphylococcus aureus, highlighting the need to strengthen hospital hygiene measures. Mohamed Abdoul-Latif *et al*. (2021) [49] showed a high prevalence of multidrug-resistant pathogens in dialysis patients in Djibouti, highlighting the need for strict antibiotic management.

Cross-sectional investigations, constituting an essential basis for proactive management of health safety in hospital establishments, offer an in-depth look at hygiene practices, risk factors, and prevention strategies, placing particular emphasis on nosocomial issues. These analyses serve as essential snapshots, capturing both challenges and opportunities to strengthen the protection of patients and medical staff. In this discussion, we will explore the ins and outs of these investigations, highlighting their strengths, their weaknesses, the advantages they bring, the potential disadvantages, and the solutions envisaged to overcome these challenges. Within the hospital world, Transversal Analyzes stand out as an immersive exploration of hygiene practices. They comprehensively examine cleaning protocols, sterilization procedures, waste management, and other important aspects. This careful approach aims to establish an accurate picture of current strengths and weaknesses in the context of hospital hygiene. Among the strong points of this methodology, we distinguish above all the precision of the evaluation it offers. Cross-sectional analyses stand out by providing a detailed and accurate assessment of hygiene practices, highlighting areas where standards are rigorously maintained and where

improvements are needed. In addition, they allow careful identification of strengths, providing the opportunity to identify hygiene practices that have successfully maintained high standards, thus serving as exemplary models for other hospital departments. However, some vulnerabilities should be considered. These analyses, despite their depth, are intrinsically limited in time. They only capture a temporal window, making it impossible to assess the consistency of practices over time. Furthermore, the quality of the results obtained strongly depends on the rigor of the observations carried out, thus introducing a potentially fluctuating variable from one study to another. This reliance on observations highlights the need for standardization and rigorous methodology to ensure the reliability of the conclusions drawn from these analyses. Within the panorama of cross-sectional analyses, prevention strategies emerge as essential tools to strengthen the barriers against nosocomial infections, aiming to eliminate or reduce the identified risks. These strategies embrace diverse approaches, from training programs to the adoption of innovative technologies to the implementation of stricter policies.

The strengths of these strategies lie largely in their ability to evolve continuously. They adapt over time, adjusting preventative measures based on changes in medical practices and emerging microbial threats. Another major asset lies in the active mobilization of medical staff. Successful implementation of these strategies is largely dependent on ongoing staff involvement and training, highlighting the importance of maintaining consistent engagement.

However, some weak points should be considered. Some of these preventive measures can generate substantial costs, particularly when the adoption of new technologies is involved. Managing these costs can represent a significant challenge for healthcare organizations. Additionally, resistance to change among medical staff can be a barrier. Some practitioners may be reluctant to incorporate new strategies, emphasizing the need for transparent communication and ongoing education to facilitate acceptance and adherence. Cross-sectional analyses, hygiene perspectives, identification of risk factors, and prevention strategies are essential pillars aimed at ensuring a secure hospital environment. Their strengths are found in their capacity to offer precise evaluations, direct future thinking, and lower the danger of nosocomial infections. However, the existence of flaws like reluctance to adapt, related expenses, and reliance on observations clearly shows how important proactive management is. Perseverance in implementing the solutions envisaged will significantly contribute to building a safer hospital future, promoting the continued protection of patients and medical staff.

In Africa, nosocomial problems, such as hospital-acquired infections, present a complex picture with varied implications. The increasing prevalence of these infections in health facilities across the region creates a major challenge, exacerbated by limited resources. Medical structures, sometimes faced with infrastructural constraints, struggle to implement effective preventive measures. Antimicrobial resistance, fueled by inappropriate antibiotic use, adds a layer of complexity to fighting these infections, threatening the ability to effectively treat certain diseases. Challenges related to infrastructure and hygiene standards persist, with health facilities that may lack adequate facilities and rigorous protocols. Yet technological solutions are emerging, such as electronic infection monitoring and advanced sterilization, promising to improve the prevention and management of nosocomial infections in Africa. Continuing training of health personnel and patient awareness are emerging as good interventions. Well-designed educational programs are needed to improve hygiene practices, strengthen monitoring, and promote transparent communication between healthcare providers and patients.

The socio-economic fallout of nosocomial infections in Africa reflects a profound impact on public health, individual costs, and the overall economy of the region. These infections lead to a significant increase in morbidity and mortality, placing considerable pressure on already overburdened health systems. The expenses related to treating nosocomial infections are high from an economic standpoint. Extended hospital stays, extra medicine, and surgical procedures cost a lot of money for people and their families. These costs can also place financial pressure on health systems, limiting their ability to provide quality care. The overall impact on the economy is also marked by reduced productivity due to illness and premature death of the active workforce. Social challenges, such as stigmatization of affected individuals and distrust of healthcare facilities, contribute to additional complexity. These socio-economic challenges highlight the need for significant investments in health infrastructure, training of medical personnel, research, and the development of innovative solutions to prevent nosocomial infections. A holistic approach, focused on awareness, prevention, and public health promotion, is imperative to mitigate this socioeconomic fallout and foster a safer medical environment in Africa.

Conclusion

This in-depth review of aspects of hospital hygiene in Africa focuses on nosocomial infections, hospital environment, hand hygiene, and aseptic procedures, aiming to strategically support the hospital-acquired infection control committee. The methodology, based on a biometric database of 20 scientific articles, applied rigorous inclusion and exclusion criteria. The findings, which are critical for enhancing hospital hygiene in Africa, point out weaknesses and difficulties while offering workable solutions. This review emphasizes how important it is to use particular strategies that are supported by reliable data in order to address the problems unique to hospital hygiene in Africa. It contributes to more efficient management of nosocomial infections by providing distinct viewpoints through the identification of risk variables and the formulation of workable suggestions. These results provide a solid foundation for targeted interventions aimed at improving patient safety and

reducing the socioeconomic impact of nosocomial infections in Africa.

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