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Multilevel Determinants of Environmental Hygiene: Integrating Waste Management, Human Behavior, and Institutional Systems in the Prevention of Nosocomial Infections in Resource-Limited Hospitals in Yaoundé, Cameroon

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ABSTRACT

Purpose: This study investigated the standard of environmental cleanliness in hospitals that do not have sufficient resources, specifically looking at how waste is handled, how human behaviors affect those practices and how institutions can help to eliminate or prevent healthcare-associated infections in two referral hospitals in Cameroon.

Methodology: Using a converging parallel mixed method research design, the study collected both quantitative and qualitative data. Quantitative data was collected using World Health Organization (WHO) standard checklists to evaluate the level of hygiene in hospitals and qualitative data was collected during interviews and through direct observation of hospital staff at both sites.

Findings: The results of the quantitative analysis indicated low compliance with standard hygienic practices across the three areas measured: waste segregation (38% compliance), sanitary standards (41% compliance) and infection prevention and control (IPC) infrastructure (45%-52% compliance), but higher rates of compliance in controlled settings such as the operating room (70% compliance) versus a general ward setting (40%-44% compliance). Qualitative analysis of the interview data identified themes that included human behavior adaptability, institutional failure, the breakdown of waste management systems, and the normalizing of unsafe sanitation and hygiene practices.

Conclusion: The results of the research indicate that environmental hygiene failures are related to structural and cultural aspects of health care organizations as opposed to individual behaviors.

Unique contributions to theory, practice, and policy: The authors recommend a system-wide approach to reducing the risk of infection, addressing both infrastructure, governance, and organizational culture. A conceptual framework for understanding the role of environmental hygiene is also presented, emphasizing the need for multi-dimensional interventions as opposed to individual compliance with standards; and the necessity for dedicated resources to improve the IPC infrastructure and methodologies to be used to reduce the risk of healthcare-associated infections in resource constrained environments.

Keywords: *Environmental hygiene; Infection prevention and control; Nosocomial infections; Waste management; Human behavior; Multilevel determinants; Resource-limited settings; Institutional systems.*

1. INTRODUCTION

Hospital-acquired infections, which medical professionals refer to as healthcare-associated infections (HAIs), pose a worldwide risk to patient safety. Patients in medical facilities contract these infections which did not exist when they first entered the hospital. The occurrence of HAIs involves a mix of germs, healthcare environments, and the vulnerability of individuals to getting sick. The progression of HAIs results in more serious medical conditions that require extended hospitalization, while it also drives up healthcare costs and creates antibiotic-resistant bacteria. These issues should be a priority for public health globally (Abban et al., 2023; WHO, 2024a). Low- and middle-income countries (LMICs) suffer the most as a result of inadequate infection prevention and control (IPC) measures. In LMICs, infections occur at approximately twice the rate than they do in high-income countries; specifically, 15 out of 100 hospitalized patients will develop an infection. The challenges faced in the domain of environmental hygiene include inadequate infrastructure, limited human resources, weak surveillance systems, and the inconsistent application of IPC programs (Leong et al., 2024; Villanueva et al., 2022).

The core elements of IPC include multiple practices that range from environmental cleaning to waste management, sanitation processes, disinfection methods, and water, sanitation, and hygiene (WASH) system operations. Present-day evidence shows that environmental contamination acts as a major transmission route for pathogens because microorganisms can persist on surfaces for extended durations, which creates pathways for indirect disease transmission (Wißmann et al., 2021). Environmental hygiene interventions, which Peters et al., (2022) showed to be effective, resulting in a decline in pathogen transmission and patient colonization, weakens its importance as an infection prevention method. Current research studies environmental hygiene activities as more than technical work that requires specific procedures, and the system is now considered a complex socio-technical system that develops through human behavior patterns, institutional governance methods, material infrastructure, and organizational culture systems (Morgan & Pebody, 2022). Environmental hygiene results depend on system-wide control and individual healthcare worker compliance with activities (Dancer, 2014).

Environmental hygiene practices face major operational challenges because environments in Cameroon suffer from multiple systemic problems, such as faulty supply chains, lack of trained personnel, inadequate facility systems, and deficient institutional mechanisms for maintaining accountability. The results indicate that only 58% of healthcare facilities in LMICs maintain functional IPC programs, while high-income countries achieve almost 90% operational success (Villanueva et al., 2022). The implementation of IPC policies remains incomplete because organizations face resource shortages and their enforcement systems function at low effectiveness (Lee et al., 2025).

The current situation in Cameroon shows evidence of the same problems that were found in earlier studies. National assessments of IPC systems have shown critical deficiencies in infrastructure, essential supply availability, and institutional coordination, which became apparent after the -19 pandemic increased public awareness of these issues (Kabego et al.,

2023). The study results demonstrate that Cameroonian IPC problems stem from fundamental system and organizational problems instead of people being unaware of the IPC challenges.

The hospitals in Yaoundé demonstrate their systemic limitations through their existing environmental hygiene practices, which include waste management, sanitation, and routine cleaning methods. The combination of overcrowded facilities with high patient turnover and insufficient materials creates an environment that makes it hard to sustain proper IPC protocol implementation. The lack of resources in healthcare settings has led to environmental hygiene practices that develop into adaptive methods instead of following established standard procedures (Lowe et al., 2021). The research demonstrates that effective infection prevention requires multiple levels of protection, which combine structural, organizational, and behavioral elements. The WHO IPC framework demonstrates that multimodal strategies that combine infrastructure development with leadership engagement, training, and monitoring and feedback mechanisms lead to sustainable infection control improvements (Leong et al., 2024). Resource-limited settings need to implement these components as complete systems because their current approach of implementing them as separate parts reduces overall system efficiency.

Although people now recognize environmental hygiene as essential, researchers still lack empirical evidence to study waste management systems and human behavior and institutional dynamics in sub-Saharan Africa. Researchers have mostly studied individual components of IPC, such as hand hygiene compliance, without recognizing the environmental hygiene factors that connect multiple aspects of the system.

The study closes this research gap by using a multilevel framework that combines environmental, behavioral, and institutional factors to analyze how environmental hygiene practices prevent Nosocomial Infections in hospitals that face resource limitations. This paper assesses Yaoundé hospitals to demonstrate the correlation between systemic constraints and their capacity for infection prevention. Environmental hygiene requires a multilevel system of understanding, which helps create successful healthcare interventions that achieve complete system transformation through healthcare environmental changes (Braun et al., 2020).

2. STATEMENT OF THE PROBLEM

While there have been advances made at the global level regarding the implementation of IPC initiatives, there is a disproportionate amount of risk to patient safety through the provision of health care to patients with nosocomial infections, especially in LMICs (Hinson et al., 2023). World Health Organization has documented that in LMICs, in the event that 100 individuals are admitted to a hospital, approximately 15 of them would develop, as a result of healthcare, at least one HAI (Eneh et al., 2026; Odoom & Donkor, 2025). This proportion is considerably higher than would be found in HIC (High Income Countries). The overall consequences are an increase in morbidity and mortality; length of stay; total healthcare expenditures; and a worsening of antimicrobial resistance, which has now been acknowledged as a substantial risk to global health (Murray et al., 2022).

HAIs are usually preventable; however, different sectors of the health care continuum (e.g., hospitals and upstream) do not have the same degree of implementation and adoption. In many

instances, while most nations have created IPC programs within their health systems, very few have achieved minimum performance standards. There is, therefore, a substantial gap between the adoption of and evaluation of IPC policies within healthcare (Sartelli et al., 2023; WHO, 2024b). This gap is particularly troubling in developing countries where many variables contribute to a failure to comply with sustainable IPC practices (Abbas, 2024).

IPC's main function is as an integral part of environmental hygiene (EH), with waste management and sanitation, as well as cleaning the environment, being key components in the efficacy of reducing the transmission of pathogens from one host to another (Mitchell et al., 2024). Studies have demonstrated that contaminated areas in hospital environments serve as both a source and reservoir of pathogens with the potential for indirect transmission between patients and healthcare workers (Dancer, 2014; Peters et al., 2022). In addition, a significant number of LMICs lack adequate WASH infrastructure to adequately implement EH interventions, thereby substantially inhibiting the success of any EH intervention (Kmentt et al., 2021a; World Health Organization, 2020).

In sub-Saharan Africa (including Cameroon), these factors are compounded by the presence of high patient loads, a lack of trained healthcare personnel, poor quality supply chains, and inadequate institutional capacity, as seen in studies conducted in hospitals in this region that demonstrate many have little or no functional IPC programs (including no surveillance, no consistent availability of resources, and/or no structured means to monitor efficacy of actions) (Borodova et al., 2025). As a result, healthcare facilities may serve as a source of infection transmission and contribute to the burden of healthcare-associated infections in hospitals ((Nteungue et al., 2024; Sreeramoju et al., 2025a).

The way the above-described systemic constraints have impacted the environmental hygiene practices (i.e., waste management, sanitation, and routine cleaning) of the Central and University Teaching Hospitals within Yaoundé are illustrated through two examples. The combined effect of high patient numbers and limited physical space, as well as minimal supervision from supervisors, has prevented the effective implementation of required environmental hygiene practices at these hospitals. The limited number of available resources has influenced the way healthcare providers provide care in that they will tailor their approaches and compliance rates with IPC measures in accordance with these restrictions; these variations lead to additional opportunities to transmit infections (Murhekar & Kumar, 2022; WHO, 2024a).

Formerly, most interventions have tended toward individual compliance instead of multilayered systemic influences (e.g., institutional governance, infrastructure availability, and organizational culture) that affect an institution's level of compliance with IPC. The current evidence supports the notion that the relationship between structural, behavioral, and organizational determinants are very interactive and contribute significantly to IPC outcomes; this is in contrast to prior knowledge that was primarily concerned with individual behaviors (Harb et al., 2025; van Buijtene & Foster, 2018).

Moreover, in the sub-Saharan region, insufficient empirical research exists that combines waste management systems, human behavior and institutional dynamics, as there are significant gaps in the integration of these topics into an analytical framework for examining IPC. The majority of IPC studies do not examine the full array of relationships between IPC as a whole and the healthcare system by only looking at separate parts of the IPC pie, such as hand cleaner or cleaning up after an environmental event (Peters et al., 2022). Using separate parts of the IPC to conduct research on how to improve IPC is limiting the success of any interventions and continuing to leave a burden of HAIs (van Buijtene & Foster, 2018; WHO, 2024a).

3. METHODOLOGY

3.1 Study Design

This research employs a convergent parallel design using quantitative and qualitative techniques to fully describe environmental hygiene in health facilities. Quantitative and qualitative data are collected simultaneously, analyzed independently, and then integrated during interpretation producing an enhanced and more refined understanding of the study's by investigating the same subject matter using different approaches. This design is well suited for complex health systems research requiring both measurable outcomes and contextual explanations. The use of mixed methods for research related to IPC is on the rise because it provides an opportunity to look at the level of compliance and the systemic issues that affect behavior or performance of the institution; other literature recommends this approach (Sreeramoju et al., 2025b). Since environmental hygiene is influenced by structural, behavioral and organizational aspects, utilizing both quantitative and qualitative methods for analysis provides a more comprehensive analytical capability compared to utilizing singular methodologies for analysis.

3.2 Study Setting

Yaoundé's Central and University Teaching Hospitals, the two largest referral hospitals in Cameroon, are high volume tertiary health care provider facilities, providing numerous clinical services, with complex organizational structures. The urban hospitals in Yaoundé represent exemplary study settings for this research study, having experienced the shared complexities of being overcrowded, poorly supplied, and overwhelmed by demand for health care services.

3.3 Study Population

The research participants were made up of people responsible for environmental hygiene and infection prevention, such as nurses, cleaners, ward attendants, clinicians, and infection control personnel, across various hospital units (e.g., medical wards, surgical wards, ICUs and emergency departments).

These particular healthcare workers were chosen because they have important roles in delivering environmental hygiene practices and are the most directly affected by institutional barriers to IPC performance (Peters et al., 2022). By including individuals from various

professions, researchers could obtain a full understanding of environmental hygiene practices at many different functional levels within the healthcare system.

3.4 Inclusion and Exclusion Criteria

Participants qualified for inclusion by having worked in their respective areas a minimum of six months and actively participated in any activities relating to environmental cleanliness and infection prevention; thus, ensuring all participants will have had enough experience with institutional practices to provide meaningful insights on the phenomenon studied in this research.

The following were excluded: Participants not having greater than six-months of employment; staff members considered to be administrators; and/or staff members who declined to participate in the study. These criteria were put into place to ensure valid and relevant data for this study (Creswell & Clark, 20017; Rana & Chimoriya, 2025).

3.5 Sampling Technique

In order to achieve appropriate representation from varied hospital units and from varied professions, a "stratified purposive sampling" design was used; hospital units were initially stratified by function (i.e.: functional units, such as medical, surgical, etc.) and participants' were identified based upon their roles and reporting experience using purposive sampling.

Purposive sampling is a commonly used method for sampling in qualitative or mixed-methods health research that helps ensure that participants are selected based on their specific, relevant knowledge and/or experience (Molina-Azorin & Fetters, 2022; Virginia Braun & Victoria Clarke, 2022)). Utilizing purposive sampling is useful for obtaining the range of perspectives available regarding environmental hygiene within the complexities of the hospital environment.

3.6 Sample Size Determination

Using standard methods of estimating proportions at a confidence level of 95% and a margin of error equal to 5% resulted in a determination of sample size of 150 observations for the quantitative component of this study. The sample size was determined to be an adequate size for estimating the level of compliance with environmental hygiene across various units within the hospitals.

The qualitative component included a total of 31 participants that were chosen based on the concept of saturation; this is defined as the point at which there are no longer any additional themes or ideas that can be gained from the data (Saunders et al., 2018; Virginia Braun & Victoria Clarke, 2022). Saturation is established as a well-accepted criterion for assessing whether an adequate number of samples were taken in qualitative research.

3.7 Data Collection Methods

Quantitative Data Collection

Structured observational checklists that had been adapted based on the WHO's infection prevention and control assessment tools were used to collect quantitative data on the

measurement of various key indicators of environmental hygiene such as; waste separation; sanitation; environmental cleaning; availability of IPC infrastructure.

Observational methods of data collection can be used reliably to assess actual practice and minimize the risk of bias through self-reporting (Peters et al., 2022), thus providing a valid representation of current environmental hygiene performance across the various hospital units and capturing a complete picture of performance variations.

Qualitative Data Collection

For the qualitative component of this study, participant perspectives, experiences and challenges related to hygiene and the ways in which they used IPC to create a healthy environment were gathered through semi-structured interviews and non-participant observations. The interview guide allowed researchers to capture participants' experiences of using IPC to create healthful environments; documentation of situational factors influencing IPC practices was recorded in the same way. Field notes gathered through non-participant observation supplemented the interview data and added additional support to the validity and rigor of both studies' findings. To increase the confidence / value of the findings, researchers utilized semi-structured interviews and non-participant observation to triangulate their evidence from these two qualitative approaches (Molina-Azorin & Fetters, 2022).

3.8 Data Analysis

Quantitative Analysis

To analyze the quantitative data, descriptive statistics (frequencies, percentages, and cross-tabulation) were used in order to assess how well different hospital units comply with environmental hygiene standards.

In order to understand patterns and trends in compliance with IPC, descriptive analyses are appropriate in exploratory research on health systems (Tartari et al., 2021).

Qualitative Analysis

Qualitative data analysis was conducted via the following steps: familiarization with the data set, initial coding, development of themes based on initial coding, and refinement of the developed themes for coherence and strength/robustness in terms of analytical depth.

This methodology facilitates the identification of patterns and/or meanings from qualitative data while recognizing the researcher's involvement in the interpretation of affected data (Saunders et al., 2018; Virginia Braun & Victoria Clarke, 2022). An inductive approach was taken to develop themes that reflected participants' lived experiences and contextual realities.

3.9 Integration of Data

Findings from both quantitative and qualitative studies were integrated at the analysis stage through a convergent method, allowing researchers to compare and synthesize the results from both strands and identify where there were congruences, disagreements, and where the two strands complemented each other. Combining quantitative data with qualitative explanations

improves the validity of the findings, giving the researcher a more complete and accurate view of a complex phenomenon (Creswell & Clark, 20017; Molina-Azorin & Fetters, 2022).

3.10 Trustworthiness and Validity

To ensure the study's rigor, several strategies were implemented. Validity was strengthened by the standardized use of the WHO tools used in the quantitative component and the use of consistent data collection techniques, with respect to data collection. Credibility, dependability, confirmability and transferability were used to ensure this qualitative component's trustworthiness.

Credibility was established with regard to triangulating data sources and methods; dependability was established as a result of extensive documentation of the research methods; confirmability was supported through the use of reflexive journaling during the study; and transferability was established through providing detailed descriptions of the context in which the study was conducted (Saunders et al., 2018; Virginia Braun & Victoria Clarke, 2022).

3.11 Ethical Considerations

The study was approved by the institutional review board (IRB) as being ethical for all participating institutions, through receipt of informed consent from all participants prior to taking part in the study, and providing assurance to one another that their identity would be protected from other participants and would remain anonymous (after data is totaled up and analyzed). There was no link between any of the data collected on participants' identity and any member of the research team, thus enabling confidentiality throughout the research process. All data collected on each participant in the study was retained in a separate location for each participant using a file for that participant (with the participant's name removed for anonymity) to keep that participant secure from any other participant during the course of this study. Thereafter, all of the data were analyzed without the participant's name identification included with the data analysis. The study adhered to all international guidelines pertaining to the ethics of conducting research on humans, as established by international health professional organizations. All of these standards fall into four basic categories: Respect for Persons-Beneficence-Nonmaleficence-Justice, and do not discriminate against a participant on the basis of gender, race, ethnicity, sexual preference, religion, culture, level of education, or any other socioeconomic status of any person.

RESULTS

4.1 Overview of Findings

A multilevel examination of the determinants of environmental hygiene and their influence on the prevention of nosocomial infections (NIs) in selected hospitals in Yaoundé was conducted with a convergent mixed-methods design. The findings from this study are organized into three components (1) demographic characteristics; (2) quantitative results; and (3) results of the qualitative thematic analysis. Both data sources (i.e., quantitative and qualitative) indicate that environmental hygiene is a systematic and context-dependent phenomenon and is influenced by structural, behavioral, and institutional determinants.

4.2 Participants' Demographic Characteristics

31 healthcare professionals from different categories such as nurses, cleaners, and others participated. Of the total sample, a majority of the respondents (58.1%) identified as female and a majority of the sample (38.7%) were between the ages of 30 and 39 years old. The respondents were primarily in the category of Nurses (35.5%) followed by Cleaners (22.6%). Many respondents identified as having been in their profession for more than 5 years (71%) suggesting that many of them were experienced and had provided routine cleaning in the environment.

4.3 Quantitative Results

Table 1 : Environmental Hygiene Compliance

Indicator	Compliance (%)
Waste segregation	38%
Color-coded bins availability	45.3%
Surface cleanliness	49.3%
Sanitation Hygiene	41.3%
Disinfectant availability	52%

Low compliance with IPC (Infection Prevention and Control) guidelines was observed in more than half (150) of the structured observation sheets that were analyzed. Waste segregation failed to meet IPC standards, indicating substantial deficiencies with fundamental infection control measures.

Table 2 : Compliance by Hospital Unit

Unit	Compliance (%)
Operating Theatre	70%
ICU	58%
Surgical Ward	44%
Emergency Unit	42%
Medical Ward	40%

Operating theatres demonstrated higher levels of compliance due in part to stricter application of protocols and the presence of more supervisory staff than in the general wards.

Table 3 : IPC Infrastructure Availability

Infrastructure	Availability: (%)
Handwashing stations	54%
Continuous water supply	46%
PPE availability	58.7%
Waste disposal systems	48%

When it came to availability of infrastructure, PPE availability came first with 58.7%, followed by hand washing stations (54%) and waste disposal systems (48%). Continuous water supply was the least with 46%.

4.4 Qualitative Results (Thematic Analysis)

Theme 1: Behavioral Adaptation Under System Constraints

Healthcare providers recognize that it is important to follow the guidelines associated with IPC in order to provide a safe working environment for all; however, as there are many barriers that exist within their systems, they are sometimes unable to comply with IPC. This makes them focus mostly on providing care at the expense of performing environmental hygiene functions.

"I know exactly what I should be doing, but I am juggling far too many people's care and am not provided the necessary tools; therefore, I will do my best to care for my patients." (Nurse, Medical Unit)

Theme 2: Institutional Weaknesses in Supervision and Training

Participants reported that there were weak institutional structures, including insufficient supervision, lack of training refreshers, and inadequate enforcement of IPC guidelines. A number of gaps in the system resulted in environmental hygiene being based predominantly upon individual motivation rather than institutional responsibility. One participant stated,

"Nobody is here to check whether or not we are really following the rules of hygiene; we do what we do because of our experience." (Nurse, ICU)

Theme 3: Breakdown of Waste Management Systems

The waste management process continues to be a significant failure because there are not enough waste bins or proper segregation of waste and the collection of waste has been delayed. These systemic failures have resulted in unsafe environmental conditions and an increased risk for transmitting infection in hospital units.

“Sometimes all of the waste goes in the same bin because we do not have separate containers for each type of waste, so we are unable to apply the rules correctly” (Cleaner, Operating Room).

Theme 4: Normalization of Substandard Practices

Over time, there was an institutional development of poor standards of hygiene leading to the normalization of unsafe practices for workers due to their daily experiences of low standards; they became desensitized to hazards, especially the risk of infections.

"For me, it used to feel wrong but now it is totally normal; everyone assumes that is the way we operate." (Ward attendant).

4.5 Integration of Findings

There is convergence between the structural explanations provided by participants and the existence of low compliance rates as demonstrated through the integration of qualitative and quantitative data (e.g., reported no bins and low waste segregation [38 percent] and reported poor sanitation compliance with both infrastructure (e.g., insufficient number of toilets) and workload pressures). Overall, environmental hygiene behavior is influenced by the interaction of institutional, behavioral, and resource factors as opposed to just individual negligence.

4. DISCUSSION

This study illustrates how environmental hygiene is influenced by a number of factors including structure, institution (or building) and behavior within hospital settings. This study finds that inadequate hygiene continues to be present partly through available resources and partly because there are systemic dysfunctions present in resource poor areas as part of the healthcare delivery systems

5.1 Behavioral Adaptation Under System Constraints

The study's findings reinforce previous research showing that health care staff often modify their infection prevention/control measures based on pressures from workloads and deficits in available resources. The findings also match up with existing research that has shown that these adjustments occur primarily due to situational limitations and not due to lack of knowledge on the part of individual health care staff (Allegranzi et al., 2011). Studies have demonstrated that frontline health care personnel prioritize clinically related needs over environmental cleaning products and cleaning procedures when there are shortages of resource availability (Peters et al., 2022; van Buijtene & Foster, 2018).

Modifying one's standard practices represents a means of adapting to ongoing pressures being placed upon health care systems, and through these health care systems the guidelines for best practice and exemplary standards are continuously modified by the daily practice of the health care staff.

5.3 Institutional Weaknesses

According to the study, weak supervision, lack of training, and poor enforcement are major barriers to effective environmental hygiene. These findings are thought to be consistent with other global evidence, which indicates that effectively carried out IPC quite certainly depends highly on institutional leadership and governance structures (Borodova et al., 2025; Tartari et

al., 2021). Absent a reliable oversight mechanism, compliance becomes inconsistent and based on individual motivation rather than any systematic enforcement.

5.4 Waste Management System Failures

The lack of segregation & proper disposal of waste has become a serious problem. Inadequate hospital waste systems contribute to increased environmental pollution and a higher risk of spreading infections (Dancer, 2014; Kmentt et al., 2021b). Poor management of waste throughout this study correlates with other systemic weaknesses as established within LMIC healthcare systems.

5.5. Normalization of Unsafe Practices

One of the most notable discoveries was the establishment of below-standard practices in hospital culture as the norm over time through being repeatedly subjected to poor behaviour. As a result, the level of risk to which individuals, hospital staff and hospitals are exposed to has become so normalized that the sense of urgency to address any of these risks within an institutional context has decreased significantly. Research has been conducted previously to confirm this observation and demonstrate how the culture of an organization prolongs the presence of unsafe clinical practices (Mitchell et al., 2024).

5. CONCLUSION

The degree of environmental cleanliness maintained in hospitals located in the city of Yaoundé, Cameroon, represents a significant challenge to both fundamental infection control efforts and the ability of health providers to protect themselves against nosocomial infections. A variety of organizational, institutional, and behavioral factors have coalesced to generate subpar conditions of environmental cleanliness in Yaoundé hospitals along with high rates of nosocomial infections (for example, the lack of adherence to key infection prevention indicators is likely due to inadequate infrastructure, lack of access to necessary supplies, poor supervisory oversight, and inadequate training; healthcare providers commonly adjust their practices to accommodate resource constraints or workload pressures, resulting in the later normalization of unsafe practices). Environmental cleanliness issues are not simply about a lack of individual knowledge or behavior; they constitute systemic issues stemming from the healthcare delivery system which require global, multi-level interventions to (1) improve institutional governance, (2) assure consistent availability of resources for infection prevention, and (3) develop an infection prevention culture throughout the healthcare delivery system.

6. RECOMMENDATIONS

6.1.Strengthening Institutional Governance and Leadership in the IPC

The study's results illustrate that the failure to maintain a healthy environment in hospitals is due to a lack of institutional capacity rather than failure on the part of individuals. In response, hospital management, particularly in low-resource settings, should concentrate on strengthening their IPC governance systems by developing an active IPC committee, providing a clear mandate and responsibilities for monitoring, and empowering committee members to

implement guidelines. Administrators should include the performance of IPC indicators as part of the general management performance appraisal system.

6.2.Improving Infrastructure and Resource Allocation

Given the low compliance rates for waste segregation, general standards of sanitation, and IPC infrastructure, improvements should focus on targeted capital investment to the hospital structure; this will include consistent maintenance of all supplies such as waste bins that are coded according to the color-coding system of waste segregation, personnel protective equipment (PPE), a properly functioning sterilization machine and adequate toilet facilities. This should be implemented together with specific budget lines for IPC so that there is no diversion of resources and no more shortages will occur again.

6.3.Standardizing and Enforcing Waste Management Systems

The failed waste management systems that came to light necessitate the establishment of a uniform waste management protocol at the hospital-wide level that clearly indicates all steps from segregation, transportation, to storage and final disposal; supervision and auditing should be done regularly to enforce this protocol, with severe penalties if deviations from it are identified; also, training on waste segregation should be continuous and hands-on.

6.4.Behavioral change and staff capacity development

While the study emphasized structural and institutional determinants of the failure to maintain a healthy environment in hospitals, human behavior remains a mediating influence. Continuous staff training programs, targeting all cadres of health workers, should be introduced on IPC, including strategies for behavioral change through a mentoring approach, the establishment of peer learning groups, and providing real-time feedback to staff on their current practices; breaking the habit of normalization of unsafe practices must be addressed.

6.5.Developing a culture of IPC within the hospital

The normalization of unsafe sanitation practices in the hospital has been a major impediment toward maintaining a healthy environment, indicating that it is crucial for a change in hospital culture to occur whereby the idea of having an IPC system integrated as part of the values of the hospital rather than merely as a set of tasks must be instituted; hospital management must champion adherence by modeling behaviors that reinforce adherence and recognizing compliance, while staff must be made to believe they are responsible for their patients' health in its totality.

6.6.Focus on Strengthening IPC in High-Risk Areas

Higher IPC compliance was demonstrated in the controlled environment of the operating theatre compared to general wards. While high-risk areas are important to focus on, the same level of care, supervision and resource allocation must be given to all areas of the hospital to ensure that IPC is maintained throughout the establishment of health care institutions, including outpatient departments, general wards and the emergency unit by using the same standard operating procedure for all areas.

6.7.National Policy and Government Back-up

Health policy makers should draft and enforce updateable IPC standards suitable for low-resource areas, which should address issues such as basic hospital sanitation standards, mandatory reporting of IPC practices and the provision of funds specifically set aside for the practice, with a mechanism for coordination between the hospital, training institutions and government.

6.8.Operationalizing a multilevel framework

Finally, a multilevel intervention framework which would combine structural, organizational, and behavioral aspects should be put into practice, to combat the problems affecting environmental hygiene in the hospital by targeting a combination of factors that contributed to the observed failed practices.

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