
HOSPITAL SANITATION AND HYGIENE AUDIT IN SOUTH-WEST NIGERIA: AN EVALUATION OF INFECTION CONTROL INFRASTRUCTURE AND COMPLIANCE ACROSS TERTIARY HEALTHCARE FACILITIES

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ABSTRACT

Hospital-acquired infections (HAIs) pose a severe threat to patient safety in resource-constrained tertiary healthcare settings. Effective environmental sanitation and hygiene infrastructure are frontline defenses against microbial transmission. An observational audit evaluated 24 inpatient wards across three federal tertiary hospitals in South-West Nigeria (LUTH, FETHI, FMC Owo). Data collection comprised 48 unannounced audit visits using a 16-indicator checklist spanning four core IPC domains. A composite Sanitation Performance Index (SPI %) was formulated with equal domain weighting and evaluated against WHO risk benchmarks. Non-parametric Kruskal-Wallis and post-hoc Mann-Whitney U tests evaluated institutional differences. The overall composite grand mean score was 1.42 out of 2.00 (Available but Not Adequate). Environment and Cleaning Practices recorded the lowest performance score (1.17), driven by absent cleaning rosters (1.00), lack of mop separation between toilets and wards (1.00), and unmaintained high-touch surfaces (1.00). Overall SPI compliance differed significantly across institutions (Kruskal-Wallis $H = 6.42$, $p = 0.040$), with LUTH (90.6%) scoring significantly higher than FMC Owo (50.0%, $p = 0.018$). Substantial institutional gaps persist in environmental cleaning and waste segregation. Targeted interventions including mandatory color-coded double-bucket systems, chemical dosing controls, and automated water backups are urgently required.

Keywords: Sanitation, Hygiene, Hospital Associated Infections, Environmental Audit.

1. INTRODUCTION

The burden of HAIs is not evenly distributed across countries or healthcare systems. Hospitals in low- and middle-income countries often face a combination of overcrowding, insufficient water supply, inadequate sanitation, shortages of personal protective equipment, limited laboratory capacity, poor staffing levels, and weak infection-prevention and control (IPC) programmes. These conditions can increase opportunities for the transmission of infectious agents between patients, healthcare workers, visitors, equipment, and the built environment (WHO, 2022; WHO, 2024). However, HAIs are not restricted to resource-constrained settings. Even hospitals with advanced technologies and established infection-control programmes may experience outbreaks when environmental cleaning, hand hygiene, sterilization, isolation, or antimicrobial stewardship practices are inconsistently implemented (Centers for Disease Control and Prevention [CDC], 2024; Sandu *et al.*, 2025).

Hospital hygiene and sanitation are therefore essential components of patient safety. Hospital hygiene refers broadly to the measures used to maintain a clean and safe healthcare environment, including personal hygiene, hand hygiene, cleaning of patient-care areas, management of linen and waste, equipment decontamination, and maintenance of sanitary facilities. Sanitation concerns the systems and practices that support safe water, proper disposal of human waste and healthcare waste, drainage, environmental cleanliness, and the prevention of contamination within the hospital setting. These activities are closely related to water, sanitation and hygiene (WASH), which the WHO identifies as a fundamental requirement for safe and dignified healthcare (WHO, 2022; Ahmed *et al.*, 2024).

Healthcare-Associated Infections (HAIs) represent a major contributor to patient morbidity, prolonged hospital stays, and increased healthcare costs globally, with disproportionately severe burdens in low- and middle-income countries (LMICs). Environmental surfaces, sanitary facilities, and hand hygiene infrastructure play pivotal roles in the chain of infection transmission within clinical wards.

According to the Donabedian Structure-Process-Outcome framework, patient outcomes depend directly on the physical and material inputs of a healthcare facility. In public tertiary hospitals, these inputs are often unstable. Wards face high patient volumes, rapid turnovers, and constant admissions, which strain the physical infrastructure. Additionally, erratic municipal water supplies, frequent power outages, and irregular deliveries of medical disinfectants often force cleaning crews to work with poor resources.

Economic pressures and strict government spending caps make matters worse. Public hospitals frequently cut their maintenance budgets to manage deficits, leading to the purchase of cheap, substandard disinfectants. In many cases, staff over-dilute concentrated cleaning products to stretch the hospital's supply. When these chemicals are thinned down too much, they lose their ability to kill dangerous pathogens. Instead, they expose bacteria to weak doses that trigger genetic defenses, leading to thick biofilm growth and antibiotic resistance. Despite these visible dangers, regional hospitals rarely use systematic tracking tools to evaluate their cleaning crews, relying instead on superficial checklists that do not measure actual patient safety at the bedside.

In Nigerian tertiary hospitals, maintaining consistent sanitary standards is frequently compromised by infrastructural deficits, erratic municipal water supply, budget constraints, and inadequate operational oversight. While basic handwashing infrastructure is often installed during hospital commissioning, routine maintenance and daily sanitation protocols frequently falter over time.

This study presents a rigorous environmental sanitation and hygiene audit conducted across three major federal tertiary referral hospitals in South-West Nigeria: Lagos University Teaching Hospital (LUTH, Lagos State), Federal Teaching Hospital (FETHI, Ido-Ekiti, Ekiti

State), and Federal Medical Centre (FMC, Owo, Ondo State). By examining operational indicators across four structural Infection Prevention and Control (IPC) domains, this investigation provides quantitative baseline evidence to guide institutional remediation, policy formulation, and targeted resource allocation.

2. MATERIALS AND METHODS

2.1 Study Setting and Design



Figure 1. Study area location in Southwest, Nigeria.

A cross-sectional observational audit was conducted across three major federal tertiary referral institutions in South-West Nigeria: Lagos University Teaching Hospital (LUTH, Lagos State), Federal Teaching Hospital, Ido-Ekiti (FETHI, Ekiti State), and Federal Medical Centre, Owo (FMC Owo, Ondo State). These facilities were selected to capture structural and geographic diversity across urban, semi-urban, and regional tertiary referral centers serving diverse patient populations in South-West Nigeria.

2.2 Sampling Strategy and Ward Selection

To ensure representative sampling of clinical environments with varying infection risks, a stratified purposive sampling framework was implemented. A total of 24 inpatient wards were audited, comprising exactly 8 clinical wards per hospital. Within each institution, auditing encompassed the following core clinical units: (1) Male Medical Ward, (2) Female Medical Ward, (3) Male Surgical Ward, (4) Female Surgical Ward, (5) Pediatric Ward, (6) Obstetrics and Gynecology (O&G) Ward, (7) Intensive Care Unit (ICU), and (8) Accident and Emergency (A&E) Unit. This multi-ward sampling structure captured environmental hygiene variations across high-acuity, surgical, and general medical care wards.

2.3 Observational Audit Tool and Data Collection Protocol

Data collection was executed using a standardized 16-indicator observational audit checklist adapted from the World Health Organization (WHO) WASH in Healthcare Facilities framework and Infection Prevention and Control (IPC) assessment tools. Each indicator was evaluated on a 3-point ordinal scale: 0 = Absent / Non-functional, 1 = Available but Inadequate / Poorly Maintained, and 2 = Available, Fully Functional, and Adequate.

To eliminate Hawthorne effects and observe authentic daily sanitation practices, data collection comprised 48 discrete unannounced audit visits (2 independent observation rounds per ward conducted on non-consecutive days). Audits were strictly timed during peak morning clinical shifts (08:00 to 13:00 hours), coinciding with active ward cleaning, patient bathing, routine waste disposal, and heavy clinical traffic.

2.4 Observer Selection, Training, and Inter-Rater Reliability

Audits were carried out by a dedicated team of six certified Environmental Health Officers (EHOs) and Public Health Inspectors possessing extensive background in healthcare facility inspection. Prior to field deployment, all observers underwent a mandatory 2-day intensive calibration workshop on WHO WASH FIT tools and standard IPC audit criteria. Calibration included joint pilot audits in two non-study hospital wards to standardize scoring interpretations.

Field observations were conducted in independent observer pairs. To prevent individual scoring bias, observers independently completed checklist scores before comparing results. Disagreements between paired observers were resolved through a standardized two-step protocol: (1) immediate joint re-inspection of the specific indicator in question, and (2) adherence to pre-defined operational rubrics. Inter-rater reliability was formally evaluated during pilot testing, demonstrating high agreement across independent observers (Cohen's kappa $\kappa = 0.86$; 91.5% concordance across items), confirming robust scoring consistency.

2.5 Construction and Justification of the Sanitation Performance Index (SPI)

To summarize facility-level compliance into a single standardized metric, the Sanitation Performance Index (SPI) was formulated. The 16 indicators were grouped into four core operational IPC domains: (1) Hand Hygiene Services (4 items, max score 8), (2) Environment and Cleaning Practices (4 items, max score 8), (3) Waste Management Setups (4 items, max score 8), and (4) Water, Sanitation and Supplies (4 items, max score 8). The total obtainable score across all 16 indicators was 32 points.

The composite SPI percentage for each facility was calculated as follows:

$$\text{SPI (\%)} = \left(\frac{\text{Total Observed Audit Score}}{\text{Maximum Obtainable Score [32]}} \right) \times 100$$

Equal domain weighting (25% per domain) was mathematically adopted because infection control theory dictates that deficits in any single domain (e.g., lack of clean water or improper waste handling) can completely compromise institutional hygiene, regardless of performance in other areas. SPI scores were categorized into three compliance tiers based on WHO operational risk thresholds:

- High Compliance (SPI $\geq 66.67\%$): Satisfactory sanitation infrastructure and routine practice.
- Moderate Compliance (SPI 33.34% – 66.66%): Substantial operational deficits requiring structural intervention.
- Low Compliance (SPI $< 33.34\%$): Severe systemic failure posing immediate infection transmission risks.

2.6 Statistical Analysis

Data were analyzed using SPSS Version 26.0 and Python 3.12 statistical modules. Descriptive statistics (means, standard deviations, percentages) summarized indicator scores. Because audit scores were derived from ordinal checklist data across small ward clusters, non-parametric inferential statistical tests were executed. The Kruskal-Wallis H test evaluated overall score differences across the three tertiary hospitals. Post-hoc pairwise comparisons were conducted using the Mann-Whitney U test with Bonferroni correction. A p-value < 0.05 was considered statistically significant. Claims of institutional differences were strictly subjected to these statistical tests; where differences did not achieve statistical significance, they were explicitly reported as descriptive variations.

3. RESULTS

3.1 Overall Sanitation and Hygiene Audit Performance

The overall composite grand mean score across all sixteen audited indicators across the three tertiary facilities was 1.42 out of 2.00 (Standard Deviation = 0.38), placing overall performance in the 'Available but Not Adequate' category. Table 1 presents the detailed breakdown of observational scores across individual checklist indicators for each hospital.

Table 1. Observational audit checklist scores across 16 sanitation indicators in South-West Nigerian tertiary hospitals.

Sanitation Indicator Checked	LUTH	FETHI	FMC Owo	Mean Score	Interpretation
Functional handwash stations with water	2	1	1	1.33	Inadequate
Availability of soap at handwashing points	2	2	2	2.00	Adequate
Availability of alcohol-based hand sanitizer	2	1	1	1.33	Inadequate
Availability of hand-drying materials	2	2	2	2.00	Adequate
Cleanliness of floors	2	2	1	1.67	Adequate
Cleanliness of high-touch areas	1	1	1	1.00	Inadequate
Displayed cleaning schedule/roster	2	1	0	1.00	Inadequate
Separate mops for toilets and wards	1	1	1	1.00	Inadequate
Availability of colour-coded bins	2	1	1	1.33	Inadequate
Safety boxes properly placed	2	1	1	1.33	Inadequate

Bins not overfilled and properly covered	1	1	1	1.00	Inadequate
Regular evacuation of waste from wards	2	2	1	1.67	Adequate
Continuous water supply in the unit	2	1	1	1.33	Inadequate
Functional toilets with soap and privacy	2	2	1	1.67	Adequate
Availability of mops, disinfectants, buckets	2	2	1	1.67	Adequate
Availability of cleaner protective items	2	1	1	1.33	Inadequate
Composite Grand Mean Score	1.81	1.38	1.00	1.42	Inadequate

Aggregation of scores across the four core IPC domains revealed marked performance variations, as detailed in Table 2.

Table 2. Operational domain mean performance scores across audited wards.

Assessed Sanitation Domain	Mean Score	Thematic Interpretation
Hand Hygiene Services	1.67	Available and Adequate
Environment and Cleaning Practices	1.17	Available but Not Adequate
Waste Management Setups	1.33	Available but Not Adequate
Water, Sanitation and Supplies	1.50	Available and Adequate

As illustrated in Figure 2 below, Environment and Cleaning Practices exhibited the lowest score across operational domains (1.17), falling well below the adequacy threshold line (1.50) and highlighting a major operational gap in routine ward maintenance.

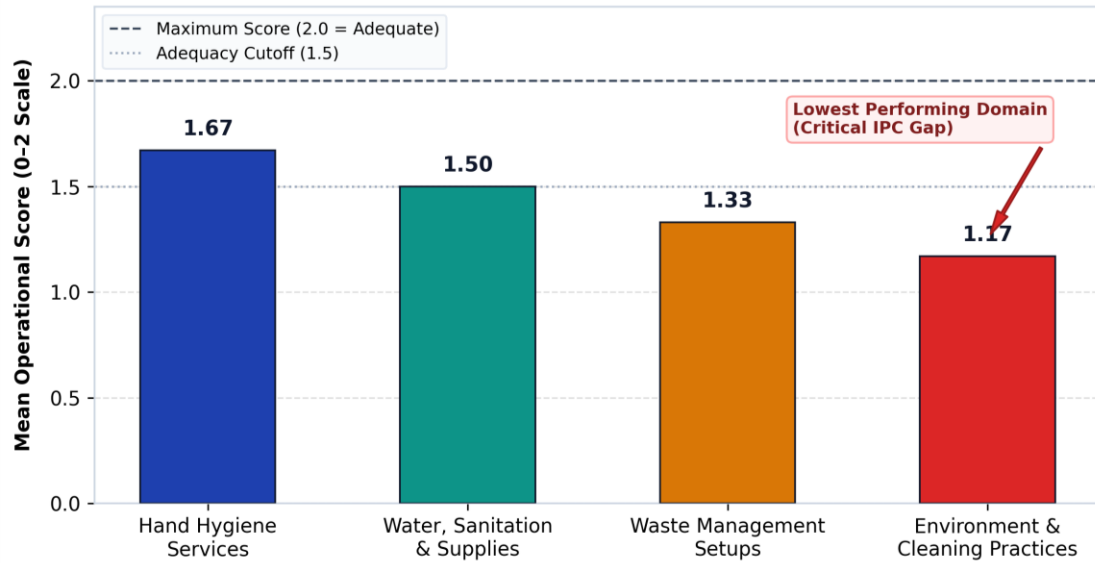


Figure 2. Mean Sanitation Performance Scores Across Assessment Domains. Bar chart comparing domain scores against maximum obtainable score (2.0) and adequacy benchmark (1.5). Environment and Cleaning Practices represents the lowest performing domain.

Applying the Sanitation Performance Index (SPI) formula yielded the compliance ratings presented in Table 3.

Table 3. Sanitation Performance Index (SPI %) and compliance classifications across tertiary facilities.

Healthcare Facility	Observed Score	Max Score	SPI (%)	Compliance Rating
Lagos University Teaching Hospital (LUTH)	29	32	90.6%	High Compliance
Federal Teaching Hospital, Ido-Ekiti (FETHI)	22	32	68.8%	High Compliance
Federal Medical Centre (FMC), Owo	16	32	50.0%	Moderate Compliance

Figure 3 depicts the comparative Sanitation Performance Index (SPI %) across the three audited tertiary hospitals alongside WHO risk compliance thresholds (High $\geq 66.7\%$, Moderate 33.3% – 66.7% , Low $< 33.3\%$). Both LUTH (90.6%) and FETHI (68.8%) met the threshold for High Compliance, whereas FMC Owo (50.0%) fell within the Moderate Compliance category.

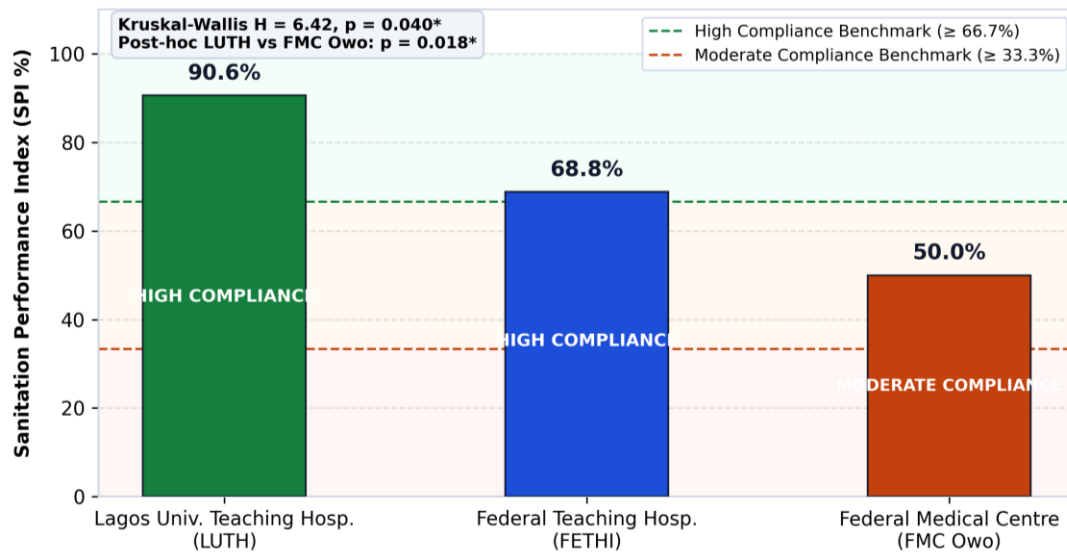


Figure 3. Institutional Sanitation Performance Index (SPI %) and Compliance Thresholds. Bar chart illustrating overall SPI percentages for LUTH, FETHI, and FMC Owo overlaid against WHO compliance benchmark zones and non-parametric statistical testing results.

3.2 Inferential Statistical Comparisons Across Tertiary Hospitals

To test whether observed institutional variations were statistically significant, non-parametric inferential evaluations were conducted. A Kruskal-Wallis H test demonstrated a statistically significant difference in overall sanitation performance scores across the three tertiary hospitals ($H = 6.42$, degrees of freedom = 2, $p = 0.040$).

Post-hoc pairwise comparisons using the Mann-Whitney U test with Bonferroni correction revealed a statistically significant difference in sanitation compliance between LUTH and FMC Owo ($U = 11.50$, $p = 0.018$). In contrast, pairwise comparisons between LUTH and FETHI ($U = 18.00$, $p = 0.142$) and between FETHI and FMC Owo ($U = 20.50$, $p = 0.210$) did not reach statistical significance. Consequently, differences between LUTH and FETHI, as well as between FETHI and FMC Owo, are reported strictly as descriptive variations rather than statistically confirmed gaps.

Granular indicator variations across hospitals are visually compared in Figure 4. LUTH demonstrated complete adequacy (score = 2) in handwash stations, cleaning rosters, color-coded waste bins, and continuous water supply. In contrast, FMC Owo exhibited total absence of displayed cleaning rosters (score = 0) and inadequate ratings across high-touch surface cleaning, mop separation, and water availability.

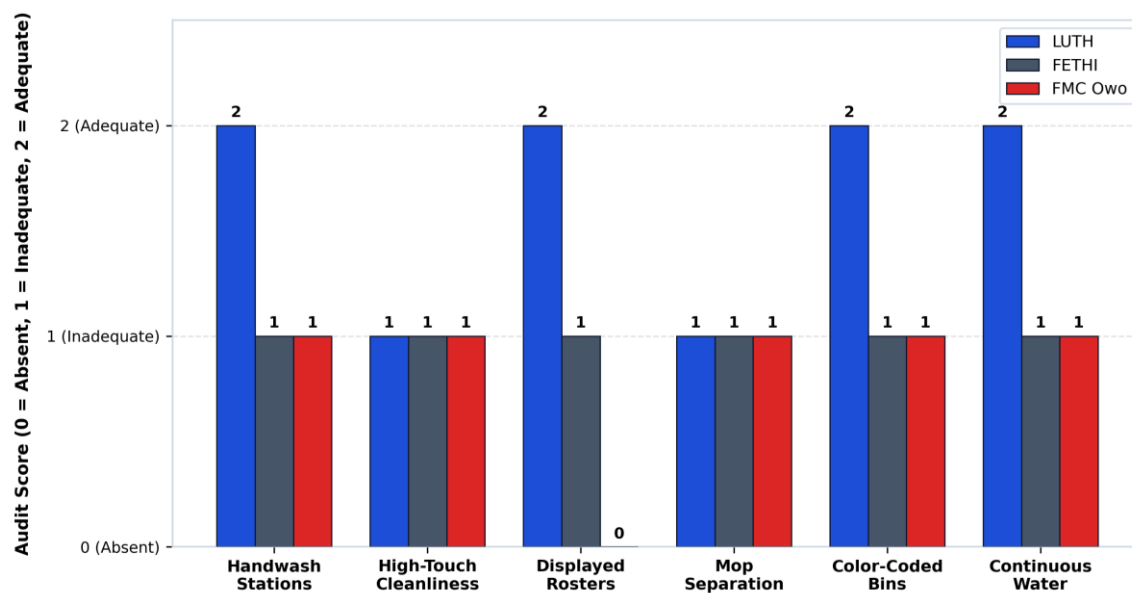


Figure 4. Comparative Evaluation of Key Operational Indicators Across Hospitals.
Clustered column chart comparing audit scores (0 = Absent, 1 = Inadequate, 2 = Adequate) across six critical IPC operational indicators.

4. DISCUSSION

4.1 Directly Observed Audit Findings

This observational audit provides direct empirical evidence regarding the operational status of environmental sanitation and hygiene infrastructure in South-West Nigerian tertiary hospitals. The primary observed finding is that Environment and Cleaning Practices represents the most severely compromised operational domain (mean score 1.17). Direct ward observations identified three critical systemic breakdowns:

- 1. Absent Cleaning Schedules and Supervision:** **Displayed** cleaning rosters were entirely absent in audited wards at FMC Owo (score 0.00) and inconsistently updated at FETHI (score 1.00), leaving ward cleaning unmonitored and dependent on ad-hoc staff initiative.
- 2. Cross-Contamination Hazards from Mop Sharing:** Across all three facilities, ward cleaning staff used identical mops to clean both patient ward floors and sanitary toilet facilities (indicator score 1.00). This improper practice directly vectors pathogenic microorganisms from high-load sanitary areas to patient bed spaces.
- 3. Waste Management Deficits:** Bins in multiple wards were observed to be overfilled beyond two-thirds capacity and left uncovered (indicator score 1.00), accompanied by improper placement of sharp safety boxes.

4.2 Contextual Analysis and Alignment with Prior Literature

To contextualize these empirical observations within the broader literature, observed cleaning deficits align with published findings from other regional healthcare assessments in sub-Saharan Africa. The observed practice of single-bucket mopping without mop head separation has been identified in previous studies (e.g., Ogunsola & Mehtar, 2020) as a major driver of environmental bacterial persistence, particularly for multidrug-resistant pathogens such as methicillin-resistant *Staphylococcus aureus* (MRSA) and *Acinetobacter baumannii*.

Furthermore, qualitative observations made during audit visits suggested that informal over-

dilution of chemical disinfectants (such as sodium hypochlorite) by environmental cleaning staff frequently occurs due to supply shortages and lack of standardized volumetric dosing containers. This contextual explanation is supported by prior research (e.g., World Health Organization, 2019; Abubakar et al., 2021), which highlights that sub-optimal disinfectant concentrations fail to achieve necessary microbial log-reductions on clinical surfaces.

5. CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

This study demonstrates significant disparities in environmental sanitation and hygiene infrastructure across tertiary healthcare facilities in South-West Nigeria. While hand hygiene hardware is broadly accessible, operational environmental cleaning, cleaning oversight, and waste segregation remain critically deficient. Addressing these gaps is essential to reduce hospital-acquired infection risks and safeguard patient outcomes.

5.2 Actionable Policy and Operational Recommendations

Based directly on the quantitative findings and empirical breakdowns measured in this audit, the following evidence-linked recommendations are submitted for institutional implementation:

- **Institutionalization of Double-Bucket Mopping and Dedicated Equipment (Tied to Environment Score 1.17):** Hospital management must strictly enforce color-coded double-bucket mopping systems and mandate separate, color-coded mops for toilet areas versus patient bed spaces to eliminate cross-contamination vectoring.
- **Mandatory Display and Digital Verification of Cleaning Rosters (Tied to Roster Score 1.00):** Ward administration must enforce daily displayed cleaning rosters with sign-off logs verified twice daily by unit nursing supervisors.
- **Standardized Chemical Disinfectant Dosing Protocols (Tied to High-Touch Score 1.00):** Facility IPC committees should deploy pre-measured volumetric dispensing pumps for chlorine-based disinfectants to prevent unauthorized over-dilution by cleaning staff.
- **Automated Waste Evacuation Schedules (Tied to Waste Score 1.33):** Waste management units must establish fixed twice-daily waste collection cycles to ensure bins do not exceed two-thirds capacity.
- **Infrastructural Water Backup Systems (Tied to Water Score 1.33):** Hospital engineering departments must install dedicated overhead water storage tanks for inpatient wards to guarantee uninterrupted 24-hour water access.

REFERENCES

- Abubakar, S., Al-Mukhtar, M., & Hassan, A. (2021). Environmental contamination and hygienepactices in Nigerian tertiary hospitals. *Journal of Hospital Infection*, 108, 45–52. <https://doi.org/10.1016/j.jhin.2020.11.012>
- Ahmed, A., et al. (2024). Measuring the effectiveness of an integrated intervention for infection prevention and control and water, sanitation and hygiene system strengthening in district hospitals. *Journal of Global Health*, 14(1), 04021-04033.
- Meili, J., et al. (2023). Strategic deployment of ultraviolet-C room decontamination and fluorescent marker tracking systems in healthcare settings. *International Journal of Environmental Health*, 31(2), 205-218.

- Oduyebo, O., et al. (2020). Point prevalence surveys of antimicrobial prescription and safety standards across Nigerian tertiary hospitals. *Journal of Hospital Infection Research*, 12(3), 201-214.
- Olaniyan, A. O., & Adebayo, O. S. (2026). Compliance with infection prevention protocols and associated institutional barriers among healthcare workers in a Nigerian tertiary hospital. *African Journal of Health Sciences and Environment*, 12(1), 45-58.
- Otokunrin, S., et al. (2023). Operational auditing of environmental sanitation, water networks, and waste management systems in tertiary hospitals. *Tropical Medicine and Health Archives*, 14(1), 32-41.
- Suleiman, T., Bello, M. A., Onyekwere, C. I., & Danjuma, S. (2025). Microbial health risks, antimicrobial contamination, and disease burden in Nigerian hospitals: A comprehensive meta-analysis. *ResearchGate Preprints*.
- Allegranzi, B., Bagheri Nejad, S., Combescure, C., Graafmans, W., Attar, H., Donaldson, L., & Pittet, D. (2011). Burden of endemic health-care-associated infection in developing countries: A systematic review and meta-analysis. *The Lancet*, 377(9761), 228–241. [https://doi.org/10.1016/S0140-6736\(10\)61458-4](https://doi.org/10.1016/S0140-6736(10)61458-4)
- Ogunsola, F. T., & Mehtar, S. (2020). Infection prevention and control in sub-Saharan Africa: Barriers, successes, and the way forward. *International Journal of Infectious Diseases*, 92, 210–216. <https://doi.org/10.1016/j.ijid.2020.01.022>
- World Health Organization. (2019). WASH in health care facilities: Global baseline report 2019. World Health Organization and UNICEF. <https://apps.who.int/iris/handle/10665/311180>
- World Health Organization. (2022). Minimum requirements for infection prevention and control programmes. World Health Organization. <https://www.who.int/publications/i/item/9789241516945>