Facility Management Practices and Their Effect on Quality Healthcare Delivery in Public Hospitals in Oyo State, Nigeria

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Abstract- ***This study examined how facility management practices influence service delivery in government secondary hospitals in Oyo State, Nigeria. Guided by Donabedian's Structure–Process–Outcome model, facility management was treated as the structural platform that enables reliable clinical and operational processes and, in turn, better outcomes. A convergent parallel mixed-methods design was applied across a stratified sample of hospitals, combining a researcher-administered facility audit, staff and patient surveys, and interviews and focus groups with managers, biomedical engineers, matrons and frontline clinicians. A composite Facility Management Practices Index captured energy reliability, WASH and environmental services, biomedical equipment lifecycle, space and amenities, and digital maintenance systems, while outcomes included outpatient waiting time, cancellations attributable to utilities or equipment, hygiene spot-check pass, and a patient-experience score. Higher index scores were independently associated with shorter waits, fewer cancellations, better hygiene compliance and higher patient experience; the strongest effects related to energy reliability and equipment lifecycle, while WASH and space quality were most closely linked to experience. Qualitative data traced mechanisms to clear accountability, funded operations and maintenance, enforceable vendor service levels, and the integration of cleaning within infection prevention teams. The study concludes that disciplined facility management is a central determinant of timeliness, continuity, safety and user experience. It recommends appointing facility-management focal persons, protecting operations and maintenance budgets, enforcing equipment service agreements, embedding WASH within infection prevention and control, adopting a simple maintenance management system, and prioritising solar-battery solutions in settings with unreliable grid supply.***

Keywords: ***facility management; healthcare service delivery; Donabedian model; WASH; Nigeria***

I. INTRODUCTION

Facility management (FM) in hospitals is best understood as the orchestration of the physical environment, operational routines, and enabling systems that make clinical work possible. It spans the reliability of electricity and water, maintenance of biomedical equipment, cleanliness and waste services, ventilation and thermal comfort, and the signage, circulation and amenities that govern how patients and staff move through space. Over the past few years, scholarship has increasingly treated FM as a determinant of quality rather than a peripheral, "back-office" function, highlighting how disciplined maintenance, standards-based environmental services and coherent asset management underpin safety, timeliness and user experience (Lavy & Terzioğlu, 2023). In Nigeria, these linkages are particularly visible because infrastructure constraints press directly on service readiness. Many facilities contend with intermittent or poor-quality power that undermines diagnostics, theatre schedules and cold-chain integrity. The Powering Healthcare, Nigeria Market Assessment and Roadmap collates evidence from across the country to show that electrification gaps and weak operations and maintenance (O&M) regimes depress continuity of care; conversely, hybrid solar-battery solutions, when coupled with funded O&M and basic technician capacity, stabilise services and reduce cancellations (SEforALL, 2022). Energy reliability, therefore, is not merely an engineering issue; it is a frontline enabler of clinical productivity and patient safety, and squarely within the FM remit. Water, sanitation and hygiene (WASH) and infection prevention and control (IPC) form a second, equally critical pillar. The latest WHO/UNICEF Joint Monitoring Programme update documents persistent deficits in basic hygiene, sanitation and healthcare waste management in health facilities across low- and middle-income countries, including Nigeria (WHO/UNICEF JMP, 2024). Such deficits translate into elevated risk of healthcare-associated infections, prolonged length of stay and diminished staff morale, outcomes with immediate operational and reputational costs. Crucially, these are tractable problems: WASH standards can be embedded in FM policy, turned into

measurable indicators (for example, functionality of hand-hygiene stations at points of care), and audited routinely, with corrective maintenance logged and tracked. In practice, closing WASH gaps often yields visible, near-term gains in perceived cleanliness, dignity and trust in services.

Oyo State offers a focused lens on how FM intersects with service delivery. Evidence from a population-based study of health-system responsiveness in the state shows that overall responsiveness is low, with "prompt attention" and "communication" among the weakest domains (Adelabu et al., 2022). These are not solely "soft" attributes; they are mediated by tangible features of the care environment and by operational dependability, are waiting areas fit for purpose, is patient flow well signposted, are diagnostic machines working, are minor procedures postponed because of power or equipment failures? In short, responsiveness is co-produced by clinical and FM systems. Improvements in basic amenities, queue design and equipment uptime are therefore not cosmetic; they alter how quickly and predictably patients move through the system and how they assess the quality and fairness of the care they receive. A third FM domain, biomedical equipment lifecycle management, illustrates the importance of discipline over procurement and maintenance. Fragmented purchasing, inadequate calibration, and slow repair cycles produce avoidable downtime, cancelled appointments and safety incidents. While national policies have begun to encourage lifecycle thinking, the day-to-day work sits with hospital FM and biomedical teams: maintaining asset registers, scheduling preventive maintenance, securing spare parts, and holding vendors to service-level agreements. Where this discipline is present, equipment uptime rises and clinical throughput stabilises; where it is absent, service volatility cascades into delays, waste and frustration. For Oyo's government hospitals, adopting structured maintenance plans and simple digital work-order tools could yield disproportionate returns in reliability and patient confidence (Lavy & Terzioğlu, 2023).

Conceptually, this study is anchored in Donabedian's Structure–Process–Outcome (SPO) model, which remains a robust framework for linking the built and managed environment to care processes and results. Recent Nigerian work has validated the model's applicability, showing that the structural conditions of care, facilities, utilities, equipment and routines, bear meaningfully on processes and outcomes in local settings (Opele & Adepoju, 2024). Applying the SPO lens clarifies the pathways through which FM delivers value: reliable power and compliant WASH (structure) enable on-time diagnostics and safer procedures (process), which in turn shorten waiting times, reduce cancellations and improve patient experience (outcomes). This logic also helps prioritise interventions: in resource-constrained environments, investments that repair the structure–process link, such as energy redundancy with funded O&M, or enforceable cleaning and waste protocols, often deliver faster, broader gains than narrow, unit-level fixes. Despite this clear rationale, empirical assessments that quantify the contribution of FM to service delivery in Nigerian state hospitals and that explain mechanisms through staff and patient narratives, remain limited. Oyo State's network of government hospitals provides an opportunity to address this gap through a mixed-methods design using primary data. Quantitatively, a facility-level audit and surveys of managers, clinical staff and patients can capture the maturity of FM practices (energy reliability, WASH/IPC compliance, equipment uptime, environmental services) and relate these to service metrics (waiting time, cancellations, satisfaction). Qualitatively, interviews and focus groups can illuminate how budgets, contracts, skills and routines actually shape day-to-day reliability, why a solar system performs in one site but falters in another; how cleaning schedules are enforced or circumvented; why equipment repairs stall and what workarounds staff devise. The integration of both strands, interpreted through an SPO-guided analytical frame, is designed to move beyond description, towards actionable priorities for state decision-makers.

The stakes are practical and immediate. If the dominant bottlenecks to prompt attention in Oyo's hospitals are structural, unstable power, non-functional water points, broken equipment, inadequate ventilation or wayfinding, then FM improvements are not optional extras but essential levers for quality, equity and resilience. By situating FM as an explicit object of measurement and governance, the study seeks to inform a shift from reactive "break-fix" habits to preventive, standards-driven operations that protect clinical time, conserve scarce resources and improve patient dignity (SEforALL, 2022; WHO/UNICEF JMP, 2024). In

doing so, it contributes to a growing body of work that reframes hospital FM as a strategic, quality-critical function, one that deserves the same managerial attention and performance discipline as clinical services themselves (Lavy & Terzioğlu, 2023; Opele & Adepoju, 2024; Adelabu et al., 2022).

II. LITERATURE REVIEW

Facility Management in Nigerian Public Hospitals: Concepts, Scope and Governance

Facility management in Nigerian public hospitals is best understood as a coordinated set of managerial and technical activities that keep the care environment functional, safe and patient centred. In practice, this spans buildings and grounds, water, sanitation and hygiene services, power and climate control, medical gas and oxygen infrastructure, fire safety, waste handling, transport, security, and the lifecycle stewardship of plant and clinical equipment. In many government facilities these responsibilities are distributed across works, procurement and clinical units, which creates gaps at the interfaces where care quality and safety are most exposed. Recent federal policy moves have begun to tighten governance at these interfaces. Notably, the Bureau of Public Procurement's 2024–2025 Approved Policy for Procurement of Health and Medical Equipment sets minimum specifications, recognised manufacturers, and documentation requirements intended to reduce equipment mismatch and downtime, and to institutionalise maintenance and safety checks from purchase through commissioning and use (Bureau of Public Procurement [BPP], 2024). The Federal Ministry of Health and Social Welfare's quality of care situational analysis similarly identifies weak facility-level quality systems, poor adherence to standards, and fragmented responsibility for preventive and corrective maintenance as cross-cutting challenges, and argues for convergent governance linking procurement, infrastructure and quality assurance (Federal Ministry of Health and Social Welfare [FMoH&SW], 2024).

Within this governance frame, two operational levers are consistently salient for Nigerian public facilities. The first is reliable power. Health services at primary and secondary levels in particular report intermittent electricity, which constrains cold chain integrity, essential diagnostics, theatre scheduling and digital health deployments. A sectoral assessment estimates that about two in five primary health centres lack grid access and those on the grid receive only a few hours of supply daily, with knock-on effects for service availability and patient experience (Sustainable Energy for All [SEforALL], 2022). The second lever is WASH. National monitoring points to persistent deficits in safe water, toilets and functional hand hygiene infrastructure in health facilities, with wide sub-national variation, which directly influences infection prevention and the perceived dignity of care (UNICEF, Federal Ministry of Water Resources, & National Bureau of Statistics, 2022). Together these constraints illustrate why facility management cannot be treated as a back-office function. In an Oyo State study of health system responsiveness, people using government facilities reported lower ratings on prompt attention and communication than peers using private providers, underlining how physical environment, utilities and flow management shape patient-facing quality domains (Adelabu et al., 2022).

Infrastructure, energy and WASH as mediators of service quality and safety

Infrastructure condition and utilities availability mediate whether clinical teams can deliver safe, timely and dignified care. In Nigeria's primary care network, limited electricity, poor lighting and absent climate control are repeatedly associated with stock losses, damaged equipment and interrupted opening hours, all of which depress utilisation and erode trust. The Nigeria Powering Healthcare market assessment highlights that PHC electrification gaps prolong vaccine stock-outs, reduce diagnostic throughput and increase operating costs due to diesel dependence, reinforcing a cycle in which constrained budgets defer maintenance and procure suboptimal stopgaps (SEforALL, 2022). Interventions that pair equipment upgrades with fit-for-purpose power solutions therefore function as facility-management reforms as much as they do "health" investments. Recent efforts by Oyo State to upgrade 66 PHCs, each with 10 kVA solar inverter systems, red-brick medical-waste incinerators and basic equipment kits, are an explicit attempt to break that cycle by protecting cold chains, ensuring lighting for out-of-hours care and restoring routine environmental services such as safe waste handling (Oyo State Ministry of Health, 2025).

WASH conditions provide a second, equally important mediation pathway. The 2021 WASHNORM report documents that many facilities still lack basic sanitation and functional hand hygiene stations at points of care, with implications for

healthcare-associated infection risk and staff behaviours (UNICEF et al., 2022). Qualitative research with Nigerian surgical ward staff shows that when water and supplies are unreliable and workloads high, even motivated clinicians struggle to sustain hand hygiene, which normalises workarounds and raises risk for patients and staff (Ataiyero et al., 2023). Facility management that addresses water security, fixture reliability and flow for cleaning and waste zones is therefore not ancillary to quality; it is the substrate for infection prevention and occupational safety. National quality policy work echoes this, calling for whole-facility quality systems that tie infrastructure, maintenance and supplies to routine measurement and improvement cycles, rather than treating them as episodic projects (FMoH&SW, 2024). In short, energy and WASH are not simply inputs. In the Nigerian public sector context they are the operational determinants that enable or disable core quality functions across the care continuum.

Maintenance regimes, asset stewardship and environmental services

The durability and performance of plant and equipment depend on documentation, routines and skilled people. Evidence from Nigeria shows that weak maintenance documentation, absence of standard operating procedures and limited use of planned preventive maintenance cause avoidable downtime in hospital assets, compromising both safety and service continuity (Ebiloma, Aigbavboa, & Anumba, 2023). Strategic facility management in public hospitals therefore requires moving from reactive repairs to asset-lifecycle stewardship. That includes asset registers linked to maintenance logs, service-level agreements that bind vendors to uptime targets, and training for in-house teams who can carry out first-line fault finding. The 2024–2025 federal procurement policy embeds several of these expectations at purchase, such as technical specs matched to local utilities, mandatory spares and commissioning tests, which can reduce the long tail of idle equipment if enforced in routine tendering and acceptance procedures (BPP, 2024).

Environmental services are a parallel pillar. Studies from Nigerian primary care settings report low availability of formal medical-waste policies, inadequate training and the widespread use of crude burn-and-bury disposal, with staff dissatisfaction about safety and environmental risks (Omoleke et al., 2021). Facility management reforms that provide appropriate segregation supplies, secure storage, on-site low-emission incineration where feasible, and contracted off-site treatment where volumes justify it, directly reduce risk and improve worker morale. Infection prevention capacity building complements these measures. Since 2020 the Nigeria Centre for Disease Control and Prevention, with partners, has convened an Orange Network of public hospitals to strengthen facility-level IPC teams, use the WHO assessment tool to track progress and share practices across the network. Reports note improvements in IPC programme establishment and surveillance, with several hospitals demonstrating gains in assessment scores, showing how structured routines and mentorship can institutionalise the environmental and behavioural elements of safe care (Centers for Disease Control and Prevention, 2024). In sum, Nigerian evidence indicates that hospitals that codify maintenance and environmental services as managed systems perform better on safety and uptime than those relying on ad-hoc fixes.

Patient experience, staff productivity and equity implications

Well-managed facilities influence how patients perceive care and how staff can perform. In Oyo State, health system responsiveness analysis found that prompt attention and communication scored lowest in public facilities, suggesting that patient flow, wayfinding, queueing environments, ventilation and acoustics all contribute to perceived quality alongside interpersonal conduct (Adelabu et al., 2022). Patient-reported outcomes from Ibadan echo this: a 2024 survey in a teaching hospital found satisfaction tied not only to the conduct and competence of nurses but also to waiting time and the physical condition of units, which are quintessential facility-management concerns (Mgboro, Nasir, & Ogundeji, 2024). For paediatric services at University College Hospital, caregiver ratings of courtesy, privacy and coordination point to the salience of layout, privacy screens, functioning toilets and clear signage for dignity in care, again linking environmental features to human experience (Ojewale, Akingbohungbe, Akinokun, & Akingbade, 2022).

These user-facing outcomes sit alongside staff productivity effects. Reliable power, thermal comfort and functioning lifts reduce avoidable downtime and physical strain, and they enable longer service windows without compromising safety. Conversely,

chronic breakdowns cause workarounds that absorb nurse and technician time, depress morale and amplify absenteeism. Facility-management investments are therefore equity investments. They expand service availability in peri-urban and rural facilities that serve poorer populations, reduce catastrophic costs linked to repeat visits, and make it more feasible to retain staff outside metropolitan hubs. Nigeria's national quality policy process explicitly positions infrastructure, maintenance and supplies as enablers of equitable quality, calling for state-level quality plans that integrate facility management into performance contracts and supervision (FMoH&SW, 2024). Oyo State's PHC upgrade programme, with solar power, basic equipment kits and improved waste zones, offers a practical illustration of how targeted facility-management packages can lift the floor on quality and patient experience in government facilities when designed with maintenance and operations in mind (Oyo State Ministry of Health, 2025).

Theoretical Underpinning

Donabedian's Structure–Process–Outcome (SPO) Model

This study is anchored on Donabedian's Structure–Process–Outcome (SPO) model, which explains how the conditions of care shape what providers do and, in turn, what patients experience. In this framing, structure comprises the built and managed environment of care, including reliable electricity and water, WASH and environmental cleaning routines, space quality, and the lifecycle stewardship of biomedical equipment. Process refers to day-to-day clinical and operational activities that depend on those structures, such as safe procedures, on-time diagnostics, effective infection prevention, and orderly patient flow. Outcomes capture results that matter to users and managers, including safety, timeliness, continuity of services, and patient experience. The central proposition is that strong structures enable reliable processes, which then yield better outcomes. The model is well-suited to Nigerian public hospitals because it makes explicit the mechanisms through which facility management influences quality. When electricity is stable, water points function, cleaning standards are enforced, and equipment is maintained according to schedule, the structural platform is strong. This enables smoother processes, for example shorter diagnostic turnaround times, fewer theatre cancellations, and more predictable clinic sessions. These process gains then materialise as improved responsiveness, reduced risk of healthcare-associated infection, and higher patient satisfaction. Recent Nigerian evidence has validated the applicability of the SPO constructs, confirming that structure, process, and outcome are empirically coherent in local settings and thus appropriate for measurement and improvement efforts (Opele & Adepoju, 2024). More broadly, contemporary work continues to apply the SPO model to examine how organisational conditions and workflow reliability drive patient outcomes, reinforcing its utility as an organising framework for mixed-methods health services research (Moayed et al., 2022). Guided by SPO, this study maps facility-management domains to structure, measures workflow reliability as process, and links both to timeliness, continuity, and user-reported experience as outcomes in Oyo State government hospitals.

III. METHODOLOGY

This study employed a convergent parallel mixed-methods design in which quantitative and qualitative strands were undertaken within the same period, analysed independently and integrated at interpretation. The setting comprised state-owned secondary hospitals across Oyo State. Hospitals were first stratified by senatorial district and by urban or peri-urban location to achieve geographic balance; a random selection within strata yielded the final sample. Within each hospital, three respondent groups were recruited to capture structural, process and user perspectives: facility-management or biomedical personnel and clinical staff were purposively sampled for operational knowledge, while adult out-patients were selected consecutively during clinic sessions to minimise selection bias. Primary data were collected using four instruments. A researcher-administered facility audit documented objective indicators of energy reliability, water, sanitation and hygiene, environmental cleaning and waste handling, ventilation and space, and the functionality of priority biomedical equipment. Parallel questionnaires for facility-management staff and clinical staff recorded policies, preventive-maintenance practice, downtime logs, work-order handling and perceived workflow disruption using five-point Likert items and factual counts. A brief patient survey measured waiting time, prompt attention, communication and basic amenities. Semi-structured interview and focus-group guides explored

mechanisms behind reliability or failure with managers, engineers, matrons and frontline staff.

From audit and survey indicators a Facility Management Practices Index was constructed with domain scores for energy, WASH and environmental services, equipment lifecycle, space and amenities, and digital maintenance systems. Service outcomes were outpatient waiting time, cancellations attributable to utilities or equipment, ward-level hygiene spot-check pass and a composite patient-experience score. Quantitative analysis included data cleaning, descriptive statistics, reliability testing and multivariable models with hospital random intercepts and robust standard errors, adjusting for bed size, outpatient volume, staffing and location. Qualitative data were transcribed verbatim and analysed using reflexive thematic analysis. Integration employed joint displays to align quantitative signals with qualitative explanations. Ethical approval was obtained from the Oyo State Ministry of Health Ethics Review Committee; written consent, anonymisation and secure data handling were ensured.

IV. RESULTS

Quantitative Results

Table 1. Sample and facility characteristics

Characteristic	Value
Number of hospitals	10
Senatorial districts represented	3
Urban or peri-urban mix	Balanced
Median bed size, n [IQR]	145 [110–210]
Median daily outpatient attendance, n [IQR]	238 [170–320]
Participants, total n	452
Facility management or biomedical staff, n	52
Clinical staff, n	101
Adult out-patients, n	299
Respondent median age, years	37
Female respondents, n (%)	265 (58.6)
Male respondents, n (%)	187 (41.4)

IQR is interquartile range.

Table 1 shows that the sample covers 10 state hospitals across all three senatorial districts with a balanced urban–peri-urban mix, giving good state-wide coverage. Facilities are medium sized (median 145 beds, IQR 110–210) with busy outpatient flow (median 238/day, IQR 170–320). The 452 respondents include 52 FM/biomedical staff, 101 clinical staff, and 299 adult patients, providing structural, process, and user perspectives. Median age is 37; 58.6% female and 41.4% male. Overall, the dataset is diverse and adequate to examine how facility management relates to operational performance and patient experience.

Table 2. Reliability and validity of the Facility Management Practices Index (FMPI)

Scale or sub-scale	Items (n)	α	ω	Evidence of validity
FMPI overall	28	0.91	0.92	EFA 4-factor solution, 67% variance explained; audit and perception indicators r = 0.46–0.62
Energy reliability	6	0.88	0.88	Factor loadings > 0.60
WASH and environmental services	7	0.86	0.86	Loadings > 0.55
Biomedical equipment lifecycle	6	0.83	0.83	Loadings > 0.55
Environmental space and amenities	5	0.80	0.80	Loadings > 0.50
Digital FM tools	4	0.79	0.79	Loadings > 0.50

α is Cronbach's alpha. ω is McDonald's omega. EFA is exploratory factor analysis

Table 2 indicates that the Facility Management Practices Index exhibits excellent internal consistency overall (α = 0.91, ω = 0.92), with all sub-scales performing in the acceptable to excellent range (α and ω = 0.79–0.88). Exploratory factor analysis supports a coherent latent structure, yielding a four-factor solution that explains 67% of variance, and item loadings exceed 0.50 across domains, indicating strong construct representation. Convergent validity is demonstrated by moderate correlations between audit and perception indicators (r = 0.46–0.62), suggesting alignment without redundancy. Taken together, these metrics justify use of both a single composite FMPI score and domain-specific scores in subsequent modelling and group comparisons.

Table 3. Descriptive indicators by domain

Domain and indicator	
Energy and utilities	Value
Effective grid power, median hours per day [IQR]	7.2 [5.0–10.0]
Hospitals operating diesel generators, n	8 of 10
Hospitals with any hybrid solar area, n	4 of 10
Energy-related service disruptions in last 30 days, median [IQR]	9 [5–14]
WASH and cleaning	
Functional hand-hygiene stations at points of care, %	68
Correct waste segregation at observation points, %	61
Compliance with documented cleaning schedule, median %	78
Biomedical equipment	
Functional at audit: patient monitors, %	78
Functional at audit: suction units, %	74
Functional at audit: autoclaves, %	70
Functional at audit: oxygen concentrators, %	64
Hospitals with current vendor service contracts, n	3 of 10
Space and environment	
Ventilation adequate, theatres, %	85
Ventilation adequate, wards, %	72
Ventilation adequate, outpatient waiting halls, %	58
Digital FM	
Hospitals using basic CMMS, n	2 of 10
Service delivery outcomes	
Outpatient waiting time, minutes, median [IQR]	92 [61–137]
Cancellations due to utilities or equipment, per 1,000 attendances, mean [IQR]	7.6 [4.3–11.1]
Patient experience score, 0–100, mean (SD)	63.4 (12.5)
Wards passing hygiene spot-check, %	64

CMMS: Computerised Maintenance Management System, IQR: Interquartile Range, SD: Standard Deviation.

The profile depicts hospitals operating with recurrent structural constraints that plausibly depress performance. Grid electricity averages 7.2 hours per day, most facilities depend on diesel backup, only four report any hybrid solar, and energy-related disruptions occur a median nine times monthly. WASH indicators are mixed: compliance with cleaning schedules is relatively high (78 per cent), yet functional hand-hygiene stations are present at only 68 per cent of points of care and correct waste segregation at 61 per cent, suggesting gaps in infection-prevention readiness. Biomedical equipment functionality is uneven, with lower availability for oxygen concentrators (64 per cent) and autoclaves (70 per cent) than for monitors and suction units, and only three hospitals maintain current vendor service contracts, indicating a largely reactive maintenance posture. Environmental conditions favour theatres (adequate ventilation in 85 per cent) more than wards (72 per cent) and outpatient waiting halls (58 per cent), where heat and crowding likely accumulate. Digital enablement of maintenance is rare, with two facilities using a CMMS. These structural patterns align with

outcomes: median outpatient waiting time is prolonged at 92 minutes, cancellations attributable to utilities or equipment average 7.6 per 1,000 attendances, the mean patient experience score is modest at 63.4, and only 64 per cent of wards pass hygiene spot-checks.

Table 4. Bivariate associations between FMPI and service outcomes

Outcome	Association with FMPI	Test statistic	p value
Waiting time, minutes	$\rho = -0.52$	Spearman	< 0.001
Cancellations per 1,000 attendances	$\rho = -0.49$	Spearman	< 0.001
Patient experience score, 0–100	$\rho = 0.45$	Spearman	< 0.001
Hygiene spot-check pass, %	$\rho = 0.41$	Spearman	< 0.001

Table 4 shows consistent, moderate and highly significant bivariate relationships between facility-management maturity and service performance. Higher FMPI correlates with shorter waiting times ($\rho = -0.52$, $p < 0.001$) and fewer cancellations per 1,000 attendances ($\rho = -0.49$, $p < 0.001$), indicating that better managed infrastructure and routines are associated with timelier, more reliable care. FMPI also correlates positively with patient experience ($\rho = 0.45$, $p < 0.001$) and with the probability of passing hygiene spot checks ($\rho = 0.41$, $p < 0.001$), suggesting that stronger facility practices coincide with cleaner, more dignified environments and better user-reported quality. Spearman coefficients indicate robust monotonic associations without assuming normality, and the uniformly low p values imply that these patterns are unlikely to be due to chance. As these are bivariate tests, they do not establish causality or account for confounding; however, they justify the subsequent multivariable modelling and point to facility management as a plausible lever for improvements in timeliness, continuity, hygiene and patient experience.

Table 5. Multivariable models with hospital random intercepts

Outcome and model	Effect per 1 SD increase in FMPI	95% CI	p value	Model fit
Waiting time, minutes (linear)	$\beta = -14.8$	−20.9 to −8.7	< 0.001	R^2 marginal = 0.31, ICC = 0.12
Energy reliability sub-scale	$\beta = -6.2$	−9.4 to −3.0	< 0.001	
Environmental space and amenities	$\beta = -5.0$	−8.1 to −2.0	0.001	
Cancellations per 1,000 (negative binomial)	IRR = 0.72	0.63 to 0.83	< 0.001	Pearson χ^2/df = 0.96
Energy reliability sub-scale	IRR = 0.79	0.68 to 0.92	0.002	
Biomedical equipment lifecycle	IRR = 0.77	0.66 to 0.90	0.001	
Patient experience, 0–100 (linear)	$\beta = 6.1$	3.7 to 8.5	< 0.001	R^2 marginal = 0.28, ICC = 0.10
WASH and environmental services	$\beta = 3.0$	1.6 to 4.3	< 0.001	
Environmental space and amenities	$\beta = 2.2$	0.9 to 3.5	0.001	
Hygiene spot-check pass (logistic)	aOR = 1.85	1.34 to 2.56	< 0.001	AUC = 0.78

All models adjust for bed size, outpatient volume, staffing ratio and urban location. SD is standard deviation. ICC is intraclass correlation coefficient. IRR is incidence rate ratio. aOR is adjusted odds ratio. AUC is area under the ROC curve.

The multivariable results indicate that facility management maturity is independently and meaningfully associated with better service performance after adjustment for bed size, outpatient volume, staffing and urban location. A one standard deviation increase in the overall FMPI is linked to a

14.8-minute reduction in waiting time (β = −14.8; 95% CI −20.9 to −8.7; $p < 0.001$). Within this, energy reliability (β = −6.2; $p < 0.001$) and the quality of space and amenities (β = −5.0; $p = 0.001$) account for much of the effect, underscoring the operational value of power stability and well-kept patient areas. The model's marginal R^2 of 0.31 and ICC of 0.12 suggest a substantive explanatory contribution of facility management with modest between-hospital clustering. For service continuity, higher FMPI scores correspond to fewer cancellations, with an incidence rate ratio of 0.72 (95% CI 0.63–0.83; $p < 0.001$), implying a 28 per cent reduction per standard deviation. Domain estimates highlight energy reliability (IRR 0.79; $p = 0.002$) and biomedical equipment lifecycle discipline (IRR 0.77; $p = 0.001$) as key levers. The negative binomial model fits well (Pearson $\chi^2/df = 0.96$). Patient-reported experience increases by 6.1 points on a 0–100 scale per standard deviation of FMPI (β = 6.1; $p < 0.001$), driven chiefly by WASH and environmental services (β = 3.0; $p < 0.001$) and by space and amenities (β = 2.2; $p = 0.001$). Model fit is acceptable (R^2 marginal = 0.28; ICC = 0.10). Hygiene performance also improves, with 85 per cent higher odds of passing spot checks (aOR 1.85; $p < 0.001$; AUC = 0.78). Overall, energy reliability, equipment lifecycle management, and WASH plus environmental quality emerge as the most actionable domains to achieve shorter waits, fewer cancellations, better hygiene compliance and improved patient experience. While causal inference is limited by design, the patterns are strong and policy relevant.

Qualitative results

Thirty one key informant interviews with facility managers, biomedical engineers, matrons, heads of diagnostics and administrators, together with six focus groups of frontline nurses and clinicians, yielded a coherent set of themes. Data saturation was reached when additional interviews produced confirmatory rather than novel insights. Open text remarks from the patient survey were used to triangulate staff accounts. Participants consistently framed power stability as the precondition for safe and timely care. Where hospitals named a responsible officer, kept basic logs of outages, and budgeted for fuel, batteries and minor parts, services were steadier. In these sites, theatres and laboratories reported fewer late starts and rescheduling. Conversely, facilities that had acquired solar arrays without clear operations and maintenance budgets described rapid performance decay, particularly through battery failure after the first year. Managers emphasised that "owning" the system meant planning for predictable replacements and holding vendors to response times. Frontline staff linked power lapses to patient frustration, especially when queues had to be reformed after interruptions. This theme helps to explain the quantitative association between the energy domain and both cancellations and waiting time.

A strong distinction emerged between hospitals with a preventive maintenance culture and those relying on repairs after breakdowns. Higher performing sites kept simple asset registers, scheduled checks, and stored a small stock of common spares. They also insisted on service-level agreements with uptime clauses for high-impact devices such as suction, monitors, autoclaves and concentrators. Staff in these hospitals described shorter fault-to-fix intervals and fewer repeat failures. In contrast, reactive sites reported extended downtime due to procurement delays, missing documentation and lack of technician cover, which pushed staff to improvise workarounds or refer patients. Several informants noted that acceptance testing at purchase, user training, and basic calibration routines were often skipped when equipment arrived through donation, which undermined reliability later. These narratives are congruent with the quantitative finding that equipment lifecycle discipline is associated with lower cancellation rates.

Cleanliness, functioning toilets, running water at points of care, and reliable supply of detergents and bags were repeatedly linked to infection prevention and to patient dignity. The strongest examples came from hospitals where environmental services were integrated with the infection prevention and control team, cleaners had written task lists, and supervisors conducted visible checks. Staff said this arrangement made cleaning "part of clinical safety" rather than a background chore. Where water pressure was variable or toilets were out of order, nurses described missed hand hygiene opportunities and increased complaints from patients and carers. Patient comments most often praised courteous communication, but negative remarks clustered around hot, crowded waiting spaces and toilets. Waste segregation was better in wards than in outpatient areas, which staff attributed to unclear ownership. Overall, these accounts map closely to the

measured gaps in hygiene spot checks and to the positive association between WASH and patient experience.

Participants identified the layout and condition of public spaces as important drivers of perceived prompt attention. Simple changes such as separating triage from registration, adding shade and seating, and improving signage reduced conflict at queues and allowed staff to communicate delays. In facilities that reconfigured waiting areas and improved ventilation, staff reported calmer interactions and fewer informal bypasses of the queue. In contrast, cramped corridors and poor acoustics were said to amplify tension and discourage explanations during surges. This theme aligns with the quantitative role of environmental space and amenities in both waiting time and experience scores. Only two hospitals reported using a computerised maintenance system. In both, staff described greater visibility of outstanding jobs, easier tracking of repeat faults, and a clearer basis for budget requests. Elsewhere, paper logs were inconsistent and were not used to prioritise. Managers in non-digital sites nevertheless expressed interest in simple, low-cost tools if they could be integrated with existing supervision. Participants suggested monthly dashboards that link outages, faults and cleaning non-compliance to waiting time and cancellations, to make accountability routine. There were a few countervailing cases. One urban hospital with relatively strong facility practices still reported long waits due to physician shortages and very high attendance, illustrating that management of structure cannot fully offset workforce gaps. A peri-urban hospital with modest infrastructure achieved good patient experience through active queue management and courteous communication, showing that process improvements can partially buffer structural limits. Gendered concerns appeared in patient comments about privacy and toilets, particularly from women accompanying children. Night staff emphasised safety and lighting around wards and waste zones.

Taken together, the narratives describe a credible mechanism for the statistical results. Where energy reliability, preventive maintenance and professionalised environmental services were in place, staff experienced fewer disruptions, communicated better, and moved patients through more predictably. Where these practices were weak, workarounds accumulated, delays multiplied and hygiene slipped. Participants' recommendations converged on a small set of actionable steps: ring-fence operations and maintenance budgets, assign a facility management focal person, enforce vendor service levels, integrate cleaners within infection prevention teams, and adopt a simple work-order and dashboard routine. These suggestions directly target the domains with the largest quantitative effects and offer an implementation pathway for Oyo State hospitals.

V. DISCUSSION OF FINDINGS

The multivariable models indicate that higher facility-management maturity is independently associated with better performance: shorter waiting times, fewer cancellations, improved hygiene compliance, and higher patient experience. The strongest effects arise in energy reliability and equipment lifecycle management, which plausibly reduce theatre and diagnostic downtime and thus cancellations. These patterns are consistent with national evidence showing that electrification paired with funded operations and maintenance, technician capacity, and lifecycle planning stabilises service continuity in Nigerian facilities (Sustainable Energy for All [SEforALL], 2022). Gains in patient experience are most closely tied to WASH and environmental quality, aligning with Nigeria's WASHNORM findings and the recent WHO/UNICEF update that document persistent gaps in hand-hygiene infrastructure and waste services that affect safety and dignity of care (UNICEF, Federal Ministry of Water Resources, & National Bureau of Statistics, 2022; WHO/UNICEF Joint Monitoring Programme [JMP], 2024). Improvements in timeliness also echo state data from Oyo, where prompt attention and communication were weak in public facilities (Adelabu, Akinyemi, Adebayo, & Oladokun, 2022). While the cross-sectional design limits causal inference, effect sizes remain robust after adjustment, supporting a pragmatic interpretation: targeted FM improvements are likely to yield measurable operational and experiential benefits.

Interviews and focus groups explain the mechanisms behind these associations. Hospitals that named a responsible officer for energy, logged outages, funded batteries and minor parts, and enforced vendor response times described steadier services and fewer reschedules, mirroring national guidance

that links capital provision to lifecycle financing and performance management (SEforALL, 2022). A preventive-maintenance culture, with asset registers, scheduled checks, spares on hand and service-level agreements, was linked to shorter fault-to-fix intervals, echoing Nigerian evidence that documentation and even lightweight computerised maintenance systems reduce downtime (Ebiloma, Aigbavboa, & Anumba, 2023). Professionalised environmental services integrated with IPC teams, with task lists, supervision and supplies, were associated with fewer complaints and better hygiene, consistent with WASHNORM and JMP signals on infrastructure and practice gaps (UNICEF et al., 2022; WHO/UNICEF JMP, 2024). Counterpoints emerged: strong FM could not fully offset clinician shortages in one high-volume urban site, aligning with national analyses that emphasise workforce constraints (Abubakar et al., 2022). Overall, the narratives provide credible pathways from FM practices to timeliness, continuity and dignity, and clarify why energy reliability, equipment lifecycle discipline and WASH-environmental services are the most actionable levers.

VI. CONCLUSION

The study demonstrates that facility management is a core determinant of healthcare performance in Oyo State's government hospitals rather than a peripheral support function. Quantitatively, higher facility-management maturity was associated with shorter waiting times, lower rates of FM-related cancellations, better hygiene compliance and higher patient-experience scores. Qualitatively, hospitals that treated energy reliability, equipment care and environmental services as managed routines, assigning responsibility, funding operations and maintenance, enforcing vendor obligations, integrating cleaning with infection prevention and using simple work-order logs, reported steadier clinics, calmer waiting areas and clearer communication. Interpreted through the Structure–Process–Outcome lens, improving the structural platform (power, WASH, equipment lifecycle, space) reliably enabled smoother processes (on-time diagnostics, fewer reschedules, cleaner and more navigable spaces) and yielded better outcomes (timeliness, continuity, safety and experience). While the cross-sectional design limits causal claims and workforce constraints remain relevant, the consistency across methods supports a practical conclusion: disciplined facility management is a high-yield route to near-term, measurable gains in public hospital performance.

VII. RECOMMENDATIONS

From the findings, the study recommended that

i. The Oyo State Hospitals Management Board should mandate the FM focal role, and each hospital Chief Medical Director should appoint a qualified officer within 30 days.
ii. The State Ministry of Health should set aside an annual operations and maintenance budget line, and hospitals should track spending and file monthly reports.
iii. State energy and health agencies should procure hybrid solar and battery systems for hospitals with unreliable grid supply, and hospital engineers should implement funded upkeep plans.
iv. The Hospitals Management Board should require asset registers and preventive maintenance schedules, and hospitals should enforce vendor service level agreements with uptime and calibration clauses.
v. Each hospital Chief Medical Director should place environmental cleaning under the IPC committee, meet national WASH standards, and conduct routine audits with corrective actions.
vi. The Hospitals Management Board should mandate a simple CMMS and a monthly dashboard, and hospitals should report FM metrics alongside waits, cancellations, hygiene and patient experience.

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