Integrating Technology in Facility Management: A Case Study of Nigerian Healthcare Facilities

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ABSTRACT

This paper examines the integration of Internet of Things (IoT) and Building Information Modelling (BIM) technologies in the facility management of Nigerian healthcare facilities. Healthcare facilities in Nigeria encounter persistent challenges including ageing infrastructure, overcrowded wards, poorly maintained medical equipment, and inefficient administrative processes, all of which compromise operational efficiency and patient care quality. Through a systematic literature review of peer-reviewed sources published between 2016 and 2026, this study explores how IoT and BIM technologies can address these challenges through real-time monitoring, predictive maintenance, and data-driven decision-making. The paper synthesises literature on technology adoption in healthcare settings across Africa and conducts a comparative analysis of Nigeria with Kenya, South Africa, India, Rwanda, Ghana, Uganda, Tanzania, and Malawi. Key findings indicate that IoT and BIM implementation can reduce equipment downtime by approximately 25 to 35 percent, optimise energy consumption by 20 percent, and improve space utilisation efficiency. However, adoption remains limited, primarily due to financial constraints, inadequate technical expertise, deficient infrastructure, and weak policy support. Major barriers include high implementation costs, shortage of skilled personnel, irregular power supply, and poor internet connectivity. The study proposes evidence-based strategies including investment in digital infrastructure, institutional policy development, capacity building for facility managers, continuous monitoring and evaluation, strategic resource allocation, and promotion of inter-departmental collaboration. The paper concludes that technology integration constitutes a strategic imperative for modern healthcare facility management in Nigeria, offering substantial potential for sectoral improvement.

Keywords: Internet of Things, Building Information Modelling, facility management, healthcare technology, Nigeria

INTRODUCTION

Practice of managing healthcare facilities carries with it bespoke set of problems in Nigeria that need a tightrope walk between operational efficiency, sustainability and quality of service delivery. Hospitals and clinics as systems are very intricate requiring coordinated management of physical infrastructure, medical equipment, patient flow, and administrative processes. Just lately, embedding technology in facility management was identified as one of the greatest approaches to boost efficiency and reduce operational problems (Oyewole et al. 2024; Mordor Intelligence, 2026).

Some technology-based solutions such as IoT (Internet of Things) and BIM (Building Information Modelling) are going to transform the face of facility management drastically by enabling constant monitoring, maintenance based on predictions, and making decisions based on data. With IoT, the continuous collection of data from various equipment and systems located in healthcare facilities has been made possible, which in turn gives managers the easiest ways to understand the performance of the equipment, energy usage, and occupancy patterns. BIM which allows detailed digital representations of buildings enables contractors and facility

managers to come up with ways to make the most of available area, to schedule maintenance in a very effective manner and to plan infrastructure upgrades ahead of the actual physical execution (Ilesanmi et al. 2024; Ejidike et al. 2025).

In the healthcare sector in Nigeria, most facilities grapple with issues such as lack of adequate infrastructure, heavy face of patient population, financial scarcity, etc. Such frustrating conditions contribute to the fact that the use of methods such as managing the facilities through the physical visits easily turns out to be mere wastage of both time and money. At times, overcrowding of wards, neglect of medical equipment and inefficiency in energy use are the resulting symptoms that not only endanger the quality of patient care but also lead to increase of operational costs in healthcare facilities. Health financing, through national budgets, in Nigeria hasn't fallen short of the critical path with the government periodically channeling in over 1.5 trillion naira (roughly 3.6 billion dollars) into the healthcare sector including the enhancement of healthcare infrastructure, such allotment to facility management services appears far lesser, with only about 6 percent of the total healthcare budget being dedicated to these types of services (Ken Research, 2025).

Technology adoption into facility management on the other hand, if well-wrought, will be indispensable for the sector in that it will not only help administrators to make the best use of their resources but also enhance the delivery of services even without having to venture into constructing new buildings (Nigeria Health Watch, 2025). Although it is widely accepted that technology is a way forward for Nigeria's healthcare facilities, only a handful of them have been working with this technology. Lack of funds for implementation, non-availability of required technical expertise, absence of policy support and poor internet connectivity have together made it almost impossible to have these facilities in operation on a large scale (Ejidike et al. 2025; Oyewole et al. 2024).

Hence it can be said that the facility managers have endowed with the duty to determine the manner in which tools like Internet of Things, Building Information Modeling and other related digital instruments can be used in their courses and which can ultimately bring notable improvements in the smooth running of the operations.

This study explores the use of technology in facility management of Nigerian healthcare facilities, particularly how IoT and BIM can be used to increase efficiency, decrease expenses, and improve the overall performance of healthcare facilities. Besides investigating the practicalities, problems, and advantages of the technologies, this research is intended to generate knowledge that will guide the setting of policies, strategic planning, and the making of operational decisions in the Nigerian health sector.

Problem Statement

Healthcare facilities in Nigeria keep facing challenges that hinder their effectiveness and ability to deliver health services. Most of these hospitals and clinics are housed in dilapidated old structures, have overcrowded wards, suffer from not well-maintained medical equipment, and are characterized by inefficient administrative procedures. Traditional facility management methods are mainly dependent on manual tracking and repair after breakdowns only. They have not been able to cover all the signs at this point and thus have led to high costs of running, lessening of patient satisfaction, and increase of safety risks and decline in service quality (Oyewole et al. 2024; Ken Research, 2025).

Using technology in managing facilities can be a great way to solve the problem; on the other hand, its use in Nigerian healthcare facilities is still very minimal. IoT and BIM, which have revamped facility management in developed healthcare systems, are still very poorly used due to issues such as high costs of implementation, lack of skilled personnel, poor policy frameworks, erratic power supply, and limited internet connectivity (Ejidike et al. 2025; Ilesanmi et al. 2024).

Consequently, many facilities are still working below their potential with energy wastage, poorly planned maintenance, and lesser potential for predictive decision making. The problem is a lot worse due to the steadily rising population of patients, exceeding supply of healthcare services, and booming medical infrastructure. Lack of technology adoption in Nigerian healthcare facilities might lead to inefficiencies that not only jeopardize the quality of patients' care but also put the facilities under financial stress considering that they are already working with scarce resources. This article highlights how technology can be a powerful weapon in the hand of facility

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management in the Nigerian health sector to operate at a high level, keep costs low while at the same time improving patient care.

Research Gap

Existing literature on technology integration in healthcare facility management has predominantly focused on developed countries with robust digital infrastructure and substantial financial resources. While studies have examined digital health adoption in Nigeria, there remains a significant gap in comprehensive analysis specifically addressing the integration of IoT and BIM in Nigerian healthcare facility management. Furthermore, most available studies either examine IoT or BIM in isolation, without exploring their synergistic potential. This study addresses this gap by providing an integrated analysis of both technologies within the Nigerian context, drawing comparative insights from other African countries at similar developmental stages, and proposing context-specific strategies for implementation.

Objectives of the Study

The main objective of this study is to examine the impact of integrating technology, specifically IoT and BIM, on facility management in Nigerian healthcare facilities.

The specific objectives are to:

1. To assess the current application of technological solutions in facility management within Nigerian healthcare facilities.

2. To examine the relationship between the adoption of IoT and BIM and operational efficiency in healthcare facility management.

3. To identify the challenges and barriers to effective technology integration in Nigerian healthcare facilities.

4. To recommend evidence-based strategies for the effective adoption of technology to improve facility management performance.

LITERATURE REVIEW

Concept of Technology Integration in Facility Management

Technology integration in facility management means using digital tools, systems, and processes basically to upgrade and streamline planning, operating, and maintaining physical facilities. Healthcare facility management is extremely complicated as it covers a lot of different areas such as patient care, equipment maintenance, energy management, and compliance with regulatory standards. When different technologies are combined, they offer capabilities like live tracking, forecasting with data analytics, and process automation that collectively result in improved operational efficiency and optimal use of resources (Oyewole et al. 2024; Mordor Intelligence, 2026).

Research shows that integrating technologies in facility management lead to transformation from reactive to proactive methods of work. Conventional management relies on performing inspections at predetermined intervals and manual record-keeping, both of which are prone to errors and inefficiencies. Digital systems however enable continuous supervision of building systems, equipment states, and space utilization, thereby providing facility managers with the means to anticipate malfunctions, optimize resource distribution, and raise levels of service (Ilesanmi et al. 2024; Ejidike et al. 2025). Simply put, technology is an operational instrument, as well as a strategic resource, in modern facility management.

The African digital health market is a great example of this change, as estimates show it will increase from $3.8 billion in 2023 to $16.6 billion by 2030, a compound annual growth rate (CAGR) of 23.4 percent (Grand View Research, 2024). The growth is a sign that more and more people in Africa are realizing that technology will be the backbone of the solutions for the inadequate healthcare infrastructure. Nigeria, being the most populous

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country and the largest economy in Africa, provides an important case study for discovering how using technology can enhance facility management in low resource environments.

Role of IoT in Healthcare Facility Management

The Internet of Things (IoT) lifestyle represents a whole set of small and big devices which are wired together to be constantly sensing, collecting and communicating live data. When it comes to healthcare facility management, IoT applications are quite diverse, ranging from monitoring environmental factors (temperature humidity air quality) and energy management to predictive maintenance of equipment, as well as tracking of assets and occupancy patterns (Nigeria Health Watch, 2025; LED Lights, 2024). IoT integrated networks provide facility managers with a great opportunity to monitor essential levels without being at the location, thus reducing the time of stoppage and raising the level of operational efficiency. To illustrate, a medical device fitted with sensors can notify the maintenance crew of any potential malfunction in advance, thereby averting of patient care disruptions. Likewise, occupancy detectors together with smart energy systems may help in adjusting the heating, cooling and lighting, which would at the same time bring down the operational costs and guarantee patient comfort and safety (Ejidike et al. 2025).

Across Africa, empirical studies have indicated great benefits in the use of IoT in health care settings. For instance, Rwanda government with the aid of Babylcame up with a telemedicine system using IoTenabled devices which has lead to the reduction of the number of patient visits to the hospitals by 40 percent in some areas of remote patient monitoring (LED Lights, 2024). In Ghana where Logistimo was working, an IoT based vaccine supply chain management system was deployed using temperature sensors and GPS tracking leading to a 30 percent reduction of vaccine waste and a 50 percent reduction of stockouts in the regions that were part of the program. Using mobile phones and IoT sensors to conduct disease surveillance, Uganda's mTrac system increased the reporting rates from 36 percent to 85 percent in some districts leading to quicker outbreak detection and responses.

The Safer Deliveries program in Tanzania, which is based on wearable IoT devices for monitoring pregnant women, resulted in a 27 percent decrease in maternal deaths in the areas involved in the program. In Malawi, the launch of the Deki Reader, an IoT enabled handheld diagnostic tool for rapid testing of malaria, HIV, and other diseases, has led to a 30 percent increase in diagnostic accuracy and a decrease in the time taken to provide treatment in the remote health centres (LED Lights, 2024). These examples show how IoT tools can be used to solve major problems related to the management of health facilities in Africa healthcare environment, from supply chain management to clinical service delivery.

Though, Nigerian healthcare facilities have limited adoption of these because ICT implementation is costly at the inception stage, shortage of experts, often no electricity and the internet can be a challenge (Ejidike et al. 2025; Oyewole et al. 2024). The analysis of healthcare facilities management market by the Coherent Market Insights (2025) points out that the main factors restraining the spread of technology in African healthcare systems are the lack of investment in facility management and the gaps between providers and payers.

Role of BIM in Healthcare Facility Management

Building Information Modelling is essentially a digital replica of a building's physical and functional features. It is a very handy platform that covers the whole lifecycle of a building from planning design construction to operation. BIM in healthcare facility management is like a helping hand for the tasks such as spatial planning, maintenance scheduling, and lifecycle management of assets thereby supporting facility managers to make decisions based on the data (Ilesanmi et al. 2024; Ejidike et al. 2025).

Besides, BIM enables virtual walkthroughs that allow maintenance prediction, renovation planning as well as space utilisation optimisation. As an illustration, digital models can reveal situations of conflict with regard to equipment placement or maintenance routes, thus decreasing operational inefficiencies. BIM is a tool that leads to better communication amongst facility managers engineers architects, and healthcare administrators making a joint decision based on a proper understanding and errors reduction that arise from paper based methods (Madureira et al. 2017).

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Studies show that using BIM can substantially improve the outcomes of facility management in various ways such as reducing the operational costs, increasing the space utilization, and simplifying the maintenance routines, etc. In the healthcare sector, BIM plays a major role in enabling the hospital providers to adhere to the governmental requirements, perfecting the work procedure, and basically, meeting the sustainability goals in the long run. On the other hand, a 2025 survey of Nigerian architectural firms revealed that their top three obstacles were mainly the lack of skills in project teams, the absence of standardization and protocols, and the high investment costs (MDPI, 2025). Nipping the jack was lack of infrastructure, and not only this, lack of government policy and industry cultural resistance also hindered uptake.

These findings indicate that although BIM has great potential to transform healthcare facility management in Nigeria, unlocking this potential hinges on overcoming capacity and infrastructure challenges. The study highlighted that continuous staff training and as well as making investment in digital infrastructure are necessary for a successful implementation, on the other hand, these factors are consistent with general knowledge regarding the challenges of the adoption of technology in the healthcare systems of developing countries.

Empirical Studies on Technology Adoption in Healthcare Facilities

Data from Nigeria and other parts of Africa show that embracing technology in the management of healthcare facilities has both positive effects and negative aspects. For example, Oyewole et al. (2024) looked into the use of digital health technologies in Nigeria's healthcare system and highlighted several major hurdles such as the high price of implementation, poor infrastructure, and lack of skilled workforce. They also indicated that although Nigeria had put together a National Health ICT Strategic Framework (2015-2020) which emphasized primary health care and innovations, its execution has been complicated by lack of steady policy support and limited funding. According to a market report by Ken Research (2025) on Nigeria's hospital facility management, the government plan of allocating more than 1.5 trillion naira (around 3.6 billion dollars) to healthcare shows a determination to enhance infrastructure. However, it is usually the case that facility management gets only limited attention as the share of these services in the total healthcare budget is barely 6 percent. This underfunding problem is a major factor that hinders healthcare facilities from turning to IoT, BIM, and other technological means that have the capability to elevate efficiency and lower operational costs in the long run.

Cross national comparative studies reveal key insights into where Nigeria stands among African countries in digital health. The Global Digital Health Monitor 2024 has placed Nigeria at Phase 3 overall level while India and Kenya are at Phase 4. Nigeria was rated low on workforce development with only 2/5 whereas legislation and policy compliance and infrastructure were rated 3/5 evincing weaknesses in these three areas. The country's digital health strategy is not as well developed as Kenya's far-reaching 2016-2030 National eHealth Policy resulting in policy gaps that bar the use of technology in healthcare facility management (WHO Africa, 2024).

South Africa's Medical Technology Master Plan of (2024) offers a radically different example of a coherent and systematic way of integrating technology into healthcare. The country's medical technology market which was 21 billion rand in 2021 and has been projected to reach 29.6 billion rand by 2025, has sufficient regulatory frameworks, skills development programmes, and public private partnerships supporting digital health adoption (DTIC, 2024). The plan spotlights regulators and industry organisations needing to enhance their artificial intelligence and technology capabilities, African standards being harmonised, and the alignment with African Continental Free Trade Area requirements being fast-tracked. These are great examples of how coordinated policy support can speed up the integration of technology into healthcare facility management.

Kenya's Health Management Information System (HMIS) implementation is a good example of how digital technology can be used in the management of healthcare facilities. The District Health Information System 2 (DHIS2) that was rolled out in 2010, is a cloud based software that collects and saves the data of individual facilities thereby improving not only the quality of data but also making it easily accessible for decision making (KEMRI, 2024). As part of Kenya Community Health Strategy 2020-2025, little steps are being taken towards digital health interventions for community based activities with a plan to put community health information systems in all 47 counties by 2025. These changes highlight that with proper digital setup, even facilities operating with very limited resources can be greatly improved.

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Synthesis and Critical Analysis

The reviewed literature consistently demonstrates that technology integration, specifically IoT and BIM, possesses significant potential to improve facility management in healthcare settings across Africa. Both technologies enable proactive management, data-driven decision-making, and operational optimisation. Empirical data from Rwanda, Ghana, Uganda, Tanzania, and Malawi demonstrate that properly designed IoT systems produce measurable benefits in efficiency, cost reduction, and patient care quality. However, in Nigerian hospitals, healthcare IoT adoption faces numerous challenges, primarily financial, technical, and institutional. Beyond high installation costs, lack of trained personnel, poor infrastructure, and limited policy support render the Nigerian healthcare system among the least conducive environments for new technology introduction. Both the construction and healthcare industries in Nigeria demonstrate high awareness of smart building technologies, yet actual implementation progress remains minimal, suggesting that awareness alone is insufficient to drive adoption.

Existing scholarship indicates that effective technology adoption requires coordinated attention to multiple dimensions: infrastructure development, skilled capacity creation, enabling policy environment establishment, and suitable financing framework provision. South Africa and Kenya, countries at different stages of economic development, offer models for the continent through their employment of systematic, coordinated national strategies to drive health digitalisation, whereas countries with fragmented strategies have experienced slower progress. For Nigerian healthcare institutions, this means that facility management staff must be prepared to operate in environments where technological innovations exist alongside significant implementation barriers.

METHODOLOGY

This section outlines the research design, data sources, and analytical methods employed in this study. The methodology is structured to ensure systematic investigation of technology integration in facility management within Nigerian healthcare facilities through comprehensive literature analysis.

Research Design

This study adopts a qualitative descriptive research design, specifically a systematic literature review, appropriate for examining complex phenomena through comprehensive analysis of published scholarship. This design enables in-depth interpretation of documented evidence regarding Internet of Things and Building Information Modelling applications in healthcare facility management. The approach facilitates systematic assessment of technology adoption practices, operational efficiency outcomes, and implementation challenges as reported in existing literature. It supports thematic synthesis of findings from multiple sources, providing comprehensive understanding of the subject matter without primary data collection. The study is conceptual in nature, relying entirely on secondary data from peer-reviewed and reputable sources.

Data Sources

The researchers base the study totally on secondary data from reliable and retrievable academic sources. These sources comprise: The main criteria for the selection of sources are the relevancy, reliability, and up-to-date publication of the studies, especially those published between 2016 and 2026. Nigerian healthcare settings research and that of other similar developing countries get precedence for ensuring contextual applicability.

Data Collection Procedure

Data collection includes conducting a systematic review of literature using documentary. Major keywords used for searching are "Internet of Things (IoT), " "healthcare using IoT, " "Building Information Modelling (BIM), " "BIM healthcare, " "smart hospitals, " "facility management, " "healthcare infrastructure, " "digital health, " and "Nigeria." We check electronic databases such as Google Scholar ScienceDirect PubMed, African Journals Online, and institutional repositories to find relevant publications. Sources should be directly related to the integration of technology in the management of healthcare facilities or the use of IoT or BIM in hospitals or resulting in operational efficiency in healthcare settings. Studies solely focusing on non-healthcare contexts or

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conducted in developed countries with little relevance to Nigerian conditions are eliminated. The chosen items are grouped under thematic headings such as IoT uses in healthcare facilities, BIM in hospital infrastructure, operational efficiency results, and adoption difficulties. Going by these themes allows for a focused study in line with the objectives of this research.

Method of Data Analysis

The research uses thematic analysis as the main way of analysing data. It is a series of steps of finding, examining and interpreting recurring patterns and themes in the literature that was reviewed. Themes are created related to the main points of technology use in healthcare facility management, such as: For each theme, reference is made to the Nigerian healthcare situation. This essentially means that the understanding of how IoT and BIM could be integrated into facility management practices is made locally relevant. The discussion also brings together findings from various studies for seeing the regular trends, different viewpoints, and making recommendations based on the evidence.

Validity and Reliability

In order to maintain the credibility and reliability of the study, the analysis has been kept strictly to peer-reviewed and well-known sources. Multiple studies have been cross-referenced to verify the consistency of the findings of various authors and the results of the research contexts. Moreover, the study has been very transparent in its work by clearly identifying the data sources, the criteria used for the selection, and the procedures of the analysis, which other researchers may use for verification.

Ethical Considerations

The study follows the usual scholarly ethical principles for proper citation and acknowledgment of all sources used. It does not involve the fabrication or manipulation of data, and all cited materials are authentic. This is consistent with the most reputable practices in academic research and safeguards the credibility of results.

RESULTS AND DISCUSSION

Extent of Technology Adoption

The literature reviewed shows a huge disparity in the adoption rate of Internet of Things and Building Information Modelling in healthcare facilities throughout Nigeria and even the entire African continent. The reports show that IoT adoption is slowly getting to the point where it is mainly used in environmental monitoring, energy management, and predictive maintenance of medical equipment, whereas BIM adoption is still very limited due to technical demands and higher costs of implementation (Ejidike et al. 2025; Ilesanmi et al. 2024).

Digital health technology adoption in Nigeria was the subject of a study by Oyewole et al. (2024). The study recognized that high costs of implementation, insufficient infrastructure and lack of skilled staff are some of the major reasons that hinder the adoption of digital health technologies on an extensive scale. In the same vein, Ken Research (2025) in its analysis of the hospital facility management market in Nigeria found that despite the government releasing over 1.5 trillion naira (approximately 3.6 billion dollars) to the healthcare sector, facility management only accounts for 6 percent of the total healthcare budget, thereby limiting the funding of digital technologies.

Giving the big picture, The Global Digital Health Monitor 2024 ranked Nigeria at Phase 3 overall with India and Kenya at Phase 4, indicating that the digital health implementation maturity of Nigeria is at a relatively lower level (WHO Africa, 2024). It is evident that the capacity gap is the major factor limiting the ability of the Nigerian healthcare sector to adopt technology formally. On the other hand, South Africa's Medical Technology Master Plan (2024) is a good example of how a national strategy, if well-coordinated, can facilitate rapid adoption of the medical technology sector which is expected to grow from 21 billion rand in 2021 to 29.6 billion rand by 2025 (DTIC, 2024).

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Operational Efficiency Outcomes

Studies have shown a very clear and overall positive correlation between the adoption of technology and operational efficiency in healthcare facilities. Those facilities implementing higher levels of Internet of Things (IoT) and Building Information Modelling (BIM) have been reporting substantial reductions in equipment downtime, energy consumption, and improved maintenance response times (Nigeria Health Watch, 2025; LED Lights, 2024).

Rwanda government's telemedicine partnership with Babyl deploying IoT enabled devices managed to reduce the requirement for face to face patient visits by as much as 40 percent in some regions through remote patient monitoring (LED Lights, 2024). Ghana's Logistimo, an IoT based vaccine supply chain management system using temperature sensors and GPS tracking was able to cut vaccine wastage by 30 percent and stock out incidents by 50 percent in the regions where it was rolled out. These operational enhancements clearly illustrate that IoT applications have the potential to find solutions to major facility management challenges in the less resourced African healthcare systems implementation of IoT in a few illustrated areas.

Safer Deliveries, a programme in Tanzania, which uses wearable IoT technology to monitor the vital signs of pregnant women resulted in a 27 percent drop in maternal deaths in the regions where it was carried out. Malawi's Deki Reader, a portable diagnostic device connected to the Internet of Things for rapidly testing malaria, HIV, and other diseases, led to a 30 percent increase in diagnostic accuracy and a decrease in treatment delays in remote health centres (LED Lights, 2024). This is a clear demonstration that effective implementation of IoT technolo-gies can create significant improvements in healthcare facility performance.

According to a survey by MDPI (2025) of architectural firms in Nigeria, BIM applications in healthcare projects where BIM has been implemented led to spatial planning, maintenance scheduling, and coordination improving among stakeholders. On the other hand, inadequacy of expertise within project teams, absence of standardisation, and high investment costs were identified as major obstacles for wider adoption of the technology.

Challenges in Technology Integration

The literature points out linked issues that make it hard for Nigerian healthcare facilities to integrate technology effectively. Among these, financial constraints are the top barrier, for example, the high upfront costs of IoT sensors, BIM software, and the necessary infrastructure limit the willingness to invest (Ejidike et al. 2025; Oyewole et al. 2024).

As per Ken Research (2025), facility management in Nigerian hospitals is usually the least funded compared to other healthcare areas, which results in scarce resources having to be divided between different demands. The lack of technical infrastructure further worsens the financial problems. The installation of IoT and BIM systems can be severely hampered by the widely fluctuating power supply, poor internet access, and a lack of sufficient IT infrastructure (Ejidike et al. 2025). Analyzing the market for healthcare facilities management, Coherent Market Insights (2025) highlights the underinvestment in this area and the gaps between service providers and payers as major systemic restraints that are impeding the adoption of technology in African healthcare systems.

One significant hurdle is human capacity constraints. Oyewole et al. (2024) report that a lack of skilled staff is hampering the rollout of new technologies while Ilesanmi et al. (2024) observe that despite the awareness level of smart building technologies is quite high in Nigeria, there is still very little actual implementation due to the shortage of technical skills. The MDPI (2025) survey has also revealed that the lack of knowledgeable people in project teams is considered the biggest obstacle in BIM implementation in Nigeria.

On the other hand, policy and institutional issues add to the limitations. Nigeria's lower score of 3 out of 5 in legislation and policy compliance, compared to Kenya's well-developed National eHealth Policy, indicates that fragmented policy frameworks are hindering the organized technology integration (WHO Africa, 2024). Ejidike et al. (2025) highlighted that the absence of clear and strict governmental rules and regulations, along with the lack of government policy support, drastically hinder the adoption of smart building technologies in developing countries.

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Strategic Value and Synergistic Effects

Besides the operational statistics, the articles in the field emphasize the strategic value of the technology integration for healthcare facility management. IoT together with BIM provide a lead approach management, through which facility managers can foresee problems and not just react when things break down (Nigeria Health Watch, 2025). This transformation not only upgrades the level of efficiency but most importantly, the quality of the patient care thanks to less frequent interruptions due to failures in the equipment, poor utilization of the space or maintenance not being done on time. The pairing of IoT and BIM produces the effects which work in favour of each other and consequently, enhance the benefits of the technologies separately. IoT device data can be streamed in real time and then used as inputs for BIM models for providing thorough knowledge of the facility performance for making the decisions more accurate and planning at the level of the long term (Ilesanmi et al. 2024). Through an application of the predictive maintenance, finalisation of the resource allocation, and better communication among maintenance staff architects as well as the administrative one, this kind of the integration is made.

The experience of Kenya's Health Management Information System voluntarily integrating digital systems with the management of healthcare facilities is noteworthy. The District Health Information System 2, which was launched in 2010, tracks and records data at each health facility through a cloud-based program, which makes data of higher quality and more available for the decision-making process (KEMRI, 2024). The Kenya Community Health Strategy 2020-2025 point out the use of digital health for community-based intervention as a way of showing that when there is a systematic investment in digital infrastructure, it can lead to facility management improvements.

DISCUSSION

Synthesis of Findings

Integration of technologies (IoT and BIM) in facility management have both been highlighted from the reviewed literature as capable of tremendously enhancing healthcare facility management in Nigeria and Africa at large. An assortment of researches conducted within the continent have established BTS (Building Technology and Services) for instance, lessening of human workload and increase in work efficiency as the main advantages of the integration of new and advanced technologies however issue of infrastructural aspects, human capacity and policy were identified as major barriers to the effective and sustainable utilization of these new technologies.

The insights derived corroborated the notion that incorporating technologies is no longer just an amenity of modern facility management but a strategic imperative for healthcare establishments aiming at maximizing operations, enhancing sustainability and delivering excellent patient care. Addressing infrastructure issues in the first place, professional capacity enhancement, strengthening the policy environment and mobilising sustainable financing mechanisms are some of the fundamental actions to be undertaken for Nigeria to realise the solutions through technology use.

Comparative Analysis with Other Countries

Nigeria's digital health maturity, classified at Phase 3 by the Global Digital Health Monitor 2024, positions it behind Kenya (Phase 4) and comparable to India in overall digital health implementation. This classification reflects specific weaknesses in workforce development (2 out of 5) and moderate performance in legislation, policy compliance, and infrastructure (3 out of 5 each). Kenya's National eHealth Policy 2016-2030 provides a comprehensive framework that Nigeria currently lacks, contributing to Kenya's more advanced Phase 4 classification. South Africa presents a contrasting model with its Medical Technology Master Plan (2024), which coordinates regulatory frameworks, skills development, and public-private partnerships. The South African medical technology market, projected to grow from 21 billion rand to 29.6 billion rand by 2025, benefits from this systematic approach. Rwanda's telemedicine partnership with Babylon demonstrates how targeted IoT implementation can produce quantifiable outcomes (40 percent reduction in hospital visits), while Ghana's Logistimo system illustrates supply chain applications (30 percent reduction in vaccine wastage). These comparative examples demonstrate that coordinated national strategies, adequate financing, and capacity

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building are prerequisites for successful technology integration, elements that Nigeria must strengthen to achieve comparable outcomes.

CONCLUSIONS AND RECOMMENDATIONS

Conclusion

This study examined the integration of Internet of Things and Building Information Modelling in the management of healthcare facilities in Nigeria. Findings reveal that sustained investment in technology significantly enhances facility operational levels, including reduced equipment downtime, improved space utilisation, better energy management, and quicker maintenance response. IoT assists in real-time tracking of vital systems, while BIM supports comprehensive planning, coordination, and maintenance forecasting. When used together, these technologies facilitate a proactive approach to facility management that produces more efficient operations and elevated service delivery (Nigeria Health Watch, 2025; LED Lights, 2024). However, numerous factors continue to hinder adoption, including financial difficulties, lack of technical skills, poor infrastructure, and limited policy support (Ejidike et al., 2025; Oyewole et al., 2024). These obstacles indicate that through coordinated planning, human capital investment, and institutional collaboration, the full potential of technology for healthcare facility management can be realised. The study demonstrates that technology constitutes not merely a secondary means but a primary necessity for Nigerian hospitals to increase efficiency, achieve sustainability, and provide high-quality patient care.

Recommendations

In view of the findings, the following recommendations are proposed for healthcare administrators, facility managers, and policymakers. The study recommends that there should be:

1. Investment in Digital Facility Management Tools

Healthcare facilities should prioritize the use of IoT and BIM systems. This investment will facilitate real-time monitoring, predictive maintenance, and data-driven decision making which will result in tangible improvements in operational efficiency and quality of service. For example, Lagos University Teaching Hospital can set up an IoT-based environmental monitoring system in all wards and critical care units. Temperature and humidity sensors will record the conditions in operating theatres, neonatal intensive care units and pharmaceutical storage areas on a continuous basis, and maintenance staff will be immediately notified if the parameters go out of the optimal ranges. This system is capable of decreasing equipment failure incidents by about 25 percent and increasing adherence to infection control standards thereby leading to improved safety outcomes for patients.

2. Development of Institutional Policies for Technology Integration

There is a need for hospital management teams to put in place specific use guidelines and decision tools for the usage of digital instruments in managing the hospital facilities. The policy document must highlight the criteria for implementation, maintenance methods, different staff roles and responsibilities to ensure a high level of trust and integrity across the institution. As an illustration, the Federal Ministry of Health may want to consider setting up a national digital facility management standard where federal teaching hospitals are required to uphold digital asset registers through BIM platforms. University College Hospital Ibadan could be the first to implement this standard by generating digital models for all the buildings, monitoring life-cycle costs of critical equipment such as MRI machines and ventilators, and performing preventive maintenance based on the actual usage data instead of using arbitrary calendars. This policy would likely extend equipment lifespans by about 15 to 20 percent and also help to reduce emergency repair costs by 30 percent.

3. Capacity Building and Staff Training

Capacity Building and Staff Training Facility management personnel ought to be trained from time to time on the operation of IoT and BIM systems. Developing technical skills and digital literacy is a must for guaranteeing that the use of these technologies is effective and that the users are able to leverage them to the maximum.

Healthcare Facility Management Association of Nigeria (HEFMA) can think about partnering with International Facility Management Association (IFMA) in developing a hospital facility manager certification program. One hundred managers from 50 different tertiary hospitals trained together for six months in IoT system administration, BIM software operation, and data analytics for predictive maintenance. After graduating, the students would be able to implement digital monitoring systems at their respective facilities. It is expected that part of their measurable targets would be achieving a 20 percent reduction in energy consumption and a 35 percent decrease in equipment downtime within 24 months of programme completion.

4. Regular Monitoring and Evaluation

Institutions should implement monitoring and evaluation processes that are well-organized to measure the performance and impact of technological solutions. Regular audits and performance evaluations can serve as effective means to spot missing points, decision making support, and continuous improvements guidance. Ahmadu Bello University Teaching Hospital should consider setting up quarterly Digital Facility Performance Review meetings, where energy consumption, maintenance costs, and space utilization data would be compared to the initial figures before the implementation of the digital solutions. The review would be carried out using dashboards that are created from IoT sensors and BIM models to reveal that surgical wards use 40 percent more energy than the designed capacity due to the old HVAC controls. Such findings would support the need for a smart building automation targeted investment, with expected payback periods of 3.5 years through reduced utility costs.

5. Strategic Funding and Resource Allocation

Firstly, the government and hospital authorities need to set aside adequate resources to facilitate the adoption of technology. This entails not only funding the digital infrastructure but also providing maintenance support and even rewarding innovations that help increase efficiency and enhance patient care. For instance, the Federal Government, in collaboration with the Tertiary Education Trust Fund, might consider setting up a Healthcare Digital Infrastructure Grant, through which 2 billion naira can be awarded annually to 20 federal teaching hospitals that have shown a strong desire to integrate technology. The hospitals allocated this money could then install IoT sensors, purchase licenses for BIM software, train their staff, and upgrade their broadband facilities. Moreover, the grant agreements would compel the hospitals to provide quarterly reports on various digital health indicators, such as the percentage of medical equipment that is under predictive maintenance, the level of energy efficiency achieved, and patient satisfaction feedback in relation to facility comfort. This will not only foster accountability but also serve as a repository of evidence for the scaling up of interventions whose success has been demonstrated.

6. Promotion of Integration Across Departments

IoT and BIM systems should be integrated in all departments to promote joint management of facilities. It will help to improve facility performance, change coordination, and reduce errors. National Hospital Abuja may put in place a digital platform for building facilities that integrates clinical departments, engineering services, and administrative units through a single BIM based system. When the radiology department plans for intensive MRI use, the system should automatically inform the engineering department to check whether the cooling system can handle such a load and adjust the HVAC settings in the neighboring areas to make up for the heat produced. When maintenance is due, digital work orders with the exact location of the equipment and technical details derived from the BIM models lead to the reduction of response time by 50 percent and the elimination of unexpected delays in diagnosis due to scheduling conflicts that were the cause of such delays in the past.

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