www.ijarp.com ISSN 2456-9992 Page: 01-12

International Journal Advanced Research Publications

Case Study

Volume: 02
Issue: 08

INTERNAL FACTORS INFLUENCING THE ADOPTION OF THE INTERNET OF THINGS AMONG MEDIUM PRIVATE CLINICS IN MALAWI: A CASE STUDY OF LILONGWE CITY

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Article Received: 06 July 2026, Article Revised: 26 July 2026, Published on: 13 August 2026

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Doi: https://doi-doi.org/101555/ijarp.5486

ABSTRACT

This study examines the internal organizational factors influencing the adoption of Internet of Things (IoT) technologies among medium private clinics in Lilongwe City, Malawi, focusing specifically on ICT capability, financial capability, employee skills, and managerial commitment. Anchored in the Technology Acceptance Model (TAM), the study responds to a persistent gap in the literature, where prior research has concentrated largely on public hospitals and developed-country contexts, leaving the internal, controllable determinants of adoption among private healthcare facilities in low-income settings largely unexamined. A quantitative, explanatory research design grounded in positivist philosophy was adopted, drawing on a sample of 110 respondents selected through simple random sampling from medium private clinics in Lilongwe City. Data were collected using a structured, five-point Likert-scale questionnaire and analyzed in SPSS through descriptive statistics, reliability testing, correlation analysis, and multiple regression analysis.

The findings reveal that ICT capability, financial capability, employee skills, and managerial commitment each exert a statistically significant positive influence on IoT adoption, collectively explaining 37.6% of the variance in adoption behaviour. Managerial commitment emerged as the strongest predictor, followed by financial capability, employee skills, and ICT capability. These results suggest that IoT adoption in this context is driven less by the technology itself and more by organizational readiness and internal capacity. The study contributes context-specific empirical evidence to the digital health literature in Sub-Saharan Africa and offers practical guidance for clinic managers and policymakers, including strengthening managerial support, investing in ICT infrastructure, expanding staff training,

and increasing financial commitment to accelerate digital transformation in Malawi's private healthcare sector.

KEYWORDS: Internet of Things; IoT adoption; private clinics; Malawi; Technology Acceptance Model; healthcare technology.

1. INTRODUCTION

The Fourth Industrial Revolution has introduced a wave of digital technologies that are reshaping global industry and service delivery, and the Internet of Things (IoT) stands out among these for its capacity to enhance operational efficiency, productivity, automation, and decision-making through networks of interconnected devices (Munasser & Golshan, 2024). IoT has been broadly defined as a global network that enables communication between humans and devices, and among devices themselves, made possible by assigning each object a unique identity that supports interaction across a wide range of applications (Munasser & Golshan, 2024). Related definitions describe IoT as an integrated internet system capable of adapting to a highly dynamic network infrastructure through standard communication protocols, with every object possessing its own identifiable, intelligent interface (Miazi et al., 2016).

Within healthcare specifically, IoT-enabled devices have increasingly been applied to remote patient monitoring, clinical decision-making, and medical research by generating continuous streams of physiological data such as heart rate and blood glucose levels (Shukla et al., 2021). The expansion of Health IoT has been propelled by the demand for more efficient healthcare systems, personalized medicine, and improved patient outcomes, and it has been accelerated further by the rising burden of chronic disease, an ageing global population, and the broader push toward healthcare digitalization (Atadoga et al., 2024). Developed economies have historically led this expansion. The European Commission (2016), for example, projected that IoT connections in the European Union would grow from roughly 1.8 million in 2013 to nearly 6 billion by 2020, generating a market worth more than one trillion euros. Countries such as the Netherlands have translated this growth into practice, deploying IoT-based home health monitoring systems for people with multiple chronic conditions and recording efficiency gains of more than 20% (Shenkoya, 2025). Even so, high initial costs, limited awareness of relevant policy frameworks, and constrained research and development capacity continue to slow adoption in many settings (Jose et al., 2025).

The African context tells a more uneven story. Widespread smartphone penetration, falling connectivity costs, and growing access to big data analytics have created fertile conditions for IoT uptake across sectors, from healthcare monitoring to utility management (Olutayo & Olaleye, 2022; Ndubuaku & Okereafor, 2015). Yet adoption remains modest, constrained by unreliable power supply, limited network capacity, low digital literacy, data management weaknesses, and a tendency toward small, project-based deployments rather than sustained, large-scale implementation (Ndubuaku & Okereafor, 2015). This matters for medium private clinics in particular, which operate under continuous pressure to deliver quality care at reasonable cost. Sensor-based monitoring, for instance, can reduce unnecessary tests and clinical visits while supporting earlier detection and intervention (Dutta et al., 2023). Malawi has registered modest progress of its own: UNICEF Malawi and Telekom Networks Malawi's Internet of Good Things (IoGT) initiative already delivers free health and emergency information, including cholera alerts, to the public (Shibi et al., 2022). Yet the research problem motivating this study remains unresolved: medium private clinics in Lilongwe City continue to rely largely on outdated administrative and patient management processes, producing inefficiencies, delayed emergency response, and weaker data-driven decision-making, even as IoT-enabled alternatives already exist elsewhere on the continent. No comparable body of evidence documents how, or how well, these clinics are adopting or using IoT technologies, a gap plausibly linked to broader data management constraints.

This absence of evidence is compounded by a narrower conceptual gap in the wider literature. Existing studies on IoT adoption in healthcare have concentrated overwhelmingly on public hospitals in developed countries, leaving private clinics and developing-country contexts more broadly largely unexamined (Jose et al., 2025; Elendu et al., 2024; Kiruthu-Kamamia et al., 2024). Where adoption factors have been studied at all, attention has centred on external conditions, such as regulatory pressure and technological infrastructure, at the expense of internal, firm-level factors that clinic managers can directly influence, including ICT capability, financial capacity, employee skills, and managerial commitment. This is a significant omission for a sector where, in an ideal scenario, IoT would enable real-time patient monitoring, more efficient records management, faster emergency response, and stronger data-driven decision-making, complementing the public health system rather than lagging behind it (Alenizi & Al-Karawi, 2023; Miazi et al., 2016; Selamat et al., 2011). Prior Malawian studies on ICT in health service delivery, moreover, have tended to be broad in scope rather than focused on IoT adoption specifically, leaving the internal drivers of adoption in this setting poorly understood (Nyasulu & Chawinga, 2016; Tung'ande, 2025).

It is against this backdrop that the present study set out to examine the internal factors influencing IoT adoption among medium private clinics in Lilongwe City, Malawi.

Specifically, the study sought to:

1. Examine the influence of ICT capability on IoT adoption;
2. Assess the influence of financial capability on IoT adoption;
3. Determine the influence of employee skills on IoT adoption; and
4. Evaluate the influence of managerial commitment on IoT adoption among medium private clinics in Lilongwe City.

Correspondingly, the study asked whether each of these four factors—ICT capability, financial capability, employee skills, and managerial commitment—significantly influences IoT adoption within this setting. By addressing these questions, the study offers a sociotechnical perspective that complements the largely technical orientation of prior IoT reviews, generating theoretical and practical insight for clinic managers, investors, and policymakers seeking to guide digital transformation in Malawi's healthcare sector.

2. Literature Review

This section reviews the literature relevant to IoT adoption in healthcare, focusing on the internal organizational factors—ICT capability, financial capability, employee skills, and managerial commitment—that form the objective of this study. It proceeds through a conceptual review of the key constructs and the framework linking them, a theoretical review of the Technology Acceptance Model (TAM) underpinning the study's hypotheses, and an empirical review of prior findings, concluding with the research gap.

2.1 Conceptual Review

IoT is understood here as a global network that facilitates communication between humans and devices, and among devices themselves, made possible by assigning each object a unique, interactive identity (Munasser & Golshan, 2024; Miazi et al., 2016). Medium private clinics are medium-sized medical institutions that operate independently of government funding or control, generally offering more personalized attention and shorter waiting times than public facilities. ICT capability denotes the technologies and tools, including internet access, data storage systems, hardware, software, and communication and analytics tools, that healthcare providers use to manage information and deliver care; well-established ICT systems reduce complexity and enhance the ease of integrating new technologies (Olushola, 2019). Financial capability refers to an organization's access to the monetary resources

needed to acquire, install, maintain, and upgrade technology; clinics with adequate funding are better positioned to procure IoT devices such as monitoring sensors and cloud-based data platforms (Faiz et al., 2024). Employee skill captures the knowledge, technical competence, and digital literacy that staff bring to operating and troubleshooting new systems (Tung'ande, 2025). Managerial commitment refers to the willingness and strategic support of clinic leadership for adopting new technologies, including allocating resources, shaping policy, and building a culture receptive to change (Wong et al., 2025; Damanpour & Schneider, 2006).

Building on these constructs, the study's conceptual framework treats ICT capability, financial capability, employee skills, and managerial commitment as independent variables and IoT adoption as the dependent variable. Within this framework, private clinics are expected to benefit from practices such as training staff, acquiring user-friendly systems, and cultivating management that welcomes employee feedback, all of which support IoT-enabled functions including data analytics, remote patient monitoring through wearable devices, chronic disease monitoring, and improved elderly care and medication adherence (Isowo et al., 2025; Adeoye & Adams, 2024; Al-Shargabi & Abuarqoub, 2020; Al-Shammri et al., 2024).

2.2 Theoretical Review

The study is anchored in the Technology Acceptance Model (TAM), which holds that an individual's decision to adopt a new technology is shaped principally by two beliefs: perceived usefulness (the degree to which a person believes a technology will improve job performance) and perceived ease of use (the degree to which a person believes using the technology will require minimal effort) (Olushola, 2019). Adoption requires that a technology be perceived as both useful and manageable to use. TAM further recognizes that ease of use and usefulness are not the whole story; human behaviour is also subject to fear, peer pressure, and habit. Management is therefore expected to lead any change process through communication that helps employees see the value of new technologies.

On this theoretical basis, the study advances four hypotheses:

H1: ICT capability positively influences IoT adoption.

H2: Financial capability positively influences IoT adoption.

H3: Managerial commitment positively influences IoT adoption.

H4: Employee skills positively influence IoT adoption.

2.3 Empirical Review

Empirical evidence on these internal factors comes almost entirely from outside Africa and from non-healthcare settings. A qualitative study of Swedish manufacturing SMEs identified ICT infrastructure as the critical backbone enabling real-time data processing and device connectivity (Munasser & Golshan, 2024). In Indonesia, studies examining drivers of digital technology adoption within TOE and management frameworks found that high adoption costs discourage uptake but can be offset by strong top-management support, partner pressure, and strong staff competencies (Faiz et al., 2024; Sudirman & Astuty, 2025). Evidence from Malaysian SMEs similarly positioned top-management support as the single strongest enabler of IoT adoption (Wong et al., 2025).

Taken together, this body of evidence consistently identifies ICT infrastructure, financial capacity, employee competence, and managerial support as decisive internal drivers. However, because these studies were conducted almost exclusively outside Africa and in non-healthcare settings, their findings cannot be reliably generalized to medium private clinics operating in Malawi. Existing studies on IoT adoption in healthcare have concentrated overwhelmingly on public hospitals in developed countries (Jose et al., 2025; Elendu et al., 2024; Kiruthu-Kamamia et al., 2024). Correspondingly, there remains limited empirical research on how these internal factors shape IoT adoption within private healthcare facilities in Malawi.

3. METHODOLOGY

This study adopted a quantitative, explanatory research design grounded in positivist philosophy to generate unbiased statistical predictions and test hypotheses regarding internal factors influencing IoT adoption among medium private clinics in Lilongwe City (Kiradoo, 2023). Lilongwe City was selected due to its high concentration of medium private clinics with growing interest in digital health innovation.

The target population comprised administrative, medical, ICT, finance, and general clinical staff across medium private clinics in Lilongwe. Simple random sampling was used to select respondents based on a sampling frame obtained from the Medical Council of Malawi's 2025 database, executed using Microsoft Excel (Kothari, 2004). Sample size was determined using Cochran's formula:

$n=E2Z2\cdot p\cdot(1-p)$

Using Z=1.96 (95% confidence level), an estimated proportion p=0.078, and a margin of error E=0.05, the required sample size was calculated as n=110 respondents.

Data were gathered using a structured Google Forms questionnaire with items measured on a 5-point Likert scale (1=Strongly Disagree to 5=Strongly Agree). A pilot study was conducted prior to full deployment to establish construct clarity and scale reliability, ensuring Cronbach's alpha coefficients met the $\alpha \geq 0.70$ threshold (Judijanto et al., 2024). Data analysis was executed in SPSS, encompassing descriptive statistics, reliability tests, Pearson correlation analysis, and multiple linear regression modelling. Ethical approval was secured from the Lilongwe District Health Office Research Committee, with informed consent, anonymity, and voluntary participation strictly maintained.

4. RESULTS AND FINDINGS

A total of 110 questionnaires were distributed and returned complete and usable, representing a 100% response rate.

4.1 Respondent Profile

Table 1 outlines the demographic profile of the participants.

Table 1: Demographic profile of respondents. (*N*=110)

Variable	category	Frequency(n)	Percentage (%)
Gender	Male	58	52.7
	Female	52	47.3
Age group	36–45 years	45	40.9
	26–35 / 46–55 years	23 each	20.9 each
Position	Nurse / clinical staff	68	61.8
	Medical officer/doctor	18	16.4
Education	Diploma	53	48.2
	Bachelor's degree	24	21.8
Experience	6–10 years	51	46.4
	2–5 years	29	26.4

4.2 Reliability, Multicollinearity, and Normality

As shown in Table 2, all measurement scales demonstrated strong internal consistency exceeding the 0.70 threshold (Hair et al., 2021). Correlation analysis indicated no severe multicollinearity, as all inter-variable correlation coefficients remained below 0.80 (highest r=0.729 between ICT capability and employee skills) (Studenmund, 2014). Shapiro-Wilk test p-values (0.061 to 0.152) confirmed the normality of data distribution.

Table 2: Scale Reliability Statistics.

Variable	Number of items	Cronbach's Alpha (a)
ICT capability	6	0.896
Financial capability	6	0.771
Employee skills	6	0.786
Managerial commitment	6	0.799

4.3 Regression Model Summary and Significance

The multiple regression model yielded R=0.613, $R2$=0.376, and Adjusted $R2$=0.326 (Table 3), demonstrating that the four independent variables collectively account for 37.6% of the variance in IoT adoption.

Table 3: Regression Model Summary.

Model	R	R^2	Adjusted R^2	Std. Error of estimate
1	0.613	0.376	0.326	0.562

The ANOVA test (Table 4) verified the statistical significance of the overall regression model (F=61.236, p=0.000).

Table 4: ANOVA Results.

Source	Sum of Squares	Degrees of Freedom (*df*)	Mean Square	*F*	Significance (*p*)
Regression	78.805	4	19.701	61.236	0.000
Residual	56.569	105	0.539		
Total	135.374	109			

4.4 Hypothesis Testing

Standardized regression coefficients (β) confirmed that all four hypotheses were supported (Table 5). Managerial commitment was the strongest predictor (β=0.651, p=0.011), followed by employee skills (β=0.465, p=0.046), ICT capability (β=0.176, p=0.032), and financial capability (β=0.156, p=0.021).

Table 5: Hypotheses Testing Results.

Predictor variable	Standardized Beta (β)	Significance (p)	Hypothesis status
ICT capability	0.176	0.032	H1 Supported
Financial capability	0.156	0.021	H2 Supported
Managerial commitment	0.651	0.011	H3 Supported
Employee skills	0.465	0.046	H4 Supported

5. DISCUSSION

The significant positive effect of ICT capability (β=0.176, p=0.032) aligns with the TOE framework, affirming that existing digital infrastructure lowers integration barriers and elevates perceived ease of use (Tareh et al., 2023; Rudawska et al., 2024; Jose et al., 2025). Financial capability also significantly drove adoption (β=0.156, p=0.021), supporting resource-based views that internal funding is vital where external capital is scarce (Rohaeni et al., 2025).

Employee skills exerted a substantial positive effect (β=0.465, p=0.046). In private clinics with flat hierarchy structures, frontline competence directly converts into operational technology adoption. Crucially, managerial commitment emerged as the single dominant driver of adoption (β=0.651, p=0.011). This demonstrates that executive leadership acts as the core catalyst required to allocate funding, prioritize training, and modernize ICT infrastructure (Alenizi & Al-Karawi, 2023). Overall, the findings confirm TAM predictions while illustrating that TAM's core dimensions (perceived usefulness and ease of use) are structural outcomes of firm-level readiness.

6. CONCLUSION AND IMPLICATIONS

This study demonstrates that internal organizational factors—specifically managerial commitment, employee skills, ICT capability, and financial capability—explain 37.6% of the variance in IoT adoption among medium private clinics in Lilongwe. Managerial commitment is the primary force driving digital adoption.

Practically, clinic administrators must actively champion digital strategies, prioritize staff development, and budget strategically for IoT maintenance. Policy interventions, such as financial grants or tax subsidies for digital health technology, can further alleviate financial bottlenecks. Future research should broaden geographical boundaries beyond Lilongwe, assess rural contexts, and integrate external environmental forces (e.g., regulations, vendor support) using longitudinal qualitative designs.

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