ISSN: 3048-6181 Impact Factor 5.429 2026, Volume 3, Issue 7, Page N: 8-13.

WJPHR

World Journal of
Pharmaceutical and Healthcare Research
www.wjphr.org

Research Article

CODEN: WJPHAT

IMPLEMENTATION READINESS, BARRIERS, AND ENABLERS OF BLOCKCHAIN TECHNOLOGY-BASED TRACEABILITY ADOPTION IN COMMUNITY PHARMACIES IN BAYELSA STATE, NIGERIA

Oraekeyi Anthony Uchenna[1]*, Peter Owonaro A. Owonaro[2], Nisiama Ekon-Emieyefa Kenneth[3]

[1]Department of Clinical Pharmacy, Niger Delta University, Wilberforce Island, Bayelsa State, Nigeria.
[2]Department of Social and Public Health Pharmacy, Bayelsa Medical University, Bayelsa State, Nigeria.
[3]Department of Public Health, Ahmadu Bello University, Zaria, Nigeria.

Article Info
Article Received: 01 August 2026,
Article Revised: 21 August 2026,
Published on: 01 Sept. 2026.

***Corresponding author:**

Oraekeyi Anthony Uchenna

Department of Clinical Pharmacy, Niger Delta University, Wilberforce Island, Bayelsa State, Nigeria.

https://doi.org/10.5281/zenodo.22202568

How to cite this Article:
Oraekeyi Anthony Uchenna[1]*, Peter Owonaro A. Owonaro[2], Nisiama Ekon-Emieyefa Kenneth[3]. (2026). Implementation Readiness, Barriers, And Enablers of Blockchain Technology-Based Traceability Adoption In Community Pharmacies In Bayelsa State, Nigeria. World Journal of Pharmaceutical and Healthcare Research, 3(7), 8–13.

ABSTRACT

Background: While blockchain technology offers transformative potential for pharmaceutical supply chain traceability, its successful adoption depends on the structural readiness and adoption dynamics of the stakeholders who must implement it. Understanding these factors is essential for designing realistic implementation strategies in resource-constrained settings. **Objective:** This study assessed the implementation readiness of community pharmacists in Bayelsa State, Nigeria, for blockchain technology-based traceability systems and evaluated the barriers and enablers to adoption. **Methods:** A descriptive cross-sectional survey was conducted among 119 superintendent pharmacists using a structured electronic questionnaire distributed via ACPN WhatsApp platforms. Readiness was measured across four indicators on a 5-point Likert scale. Data were analysed using descriptive statistics, Pearson correlation, and chi-square tests in IBM SPSS v26.0. **Results:** Overall implementation readiness was below average (Mean = 2.70/5.0, SD = 0.84). A critical internal tension was identified: training willingness scored highest (Mean = 3.74), while infrastructure readiness scored lowest (Mean = 1.80), with 89.9% reporting inadequate internet and power supply. Staff digital literacy ($r = 0.45$, $p < 0.01$) and management support ($r = 0.41$, $p < 0.01$) were significantly correlated with adoption readiness. Resistance to change (42.9%) and high cost (35.3%) were the leading barriers, while user-friendly applications (42.9%) and mandatory regulation (36.1%) were the strongest enablers. Practice experience significantly influenced barrier perceptions ($p < 0.01$). **Conclusion:** Community pharmacies in Bayelsa State are not structurally ready for blockchain adoption, but a receptive attitudinal environment and strong professional motivation exist. Successful adoption requires a coordinated, multi-stakeholder strategy simultaneously addressing infrastructure, capacity, regulation, and technology design.

KEYWORDS: *blockchain adoption, implementation readiness, barriers, enablers, community pharmacy, pharmaceutical traceability, technology acceptance, Nigeria.*

INTRODUCTION

The potential of blockchain technology to transform pharmaceutical supply chain management has been extensively documented in the academic literature (Casino et al., 2019; Dutta et al., 2020; Queiroz et al., 2020). By providing a decentralised, immutable, and transparent ledger for recording pharmaceutical transactions, blockchain offers the theoretical capacity to establish end-to-end traceability from manufacturer to patient, with each transfer verified and permanently recorded across a distributed network (Mackey & Nayyar, 2017; Musamih et al., 2021). International pilots, including the MediLedger Project in the United States and various European and Asian initiatives, have demonstrated the technical feasibility of blockchain-based pharmaceutical traceability (FDA, 2023; Kshetri, 2018).

However, the transition from technical feasibility to operational implementation introduces a fundamentally different set of challenges. While blockchain's technological capabilities are well-established, the conditions under which healthcare stakeholders can realistically adopt, integrate, and sustain blockchain-based systems remain poorly understood, particularly in resource-constrained settings in sub-Saharan Africa. The implementation science literature consistently demonstrates that even technically superior innovations fail when the contextual conditions for adoption are not adequately assessed and addressed (Kamble et al., 2019; Queiroz & Fosso Wamba, 2019).

Nigeria's pharmaceutical supply chain presents a compelling case for blockchain-based traceability due to documented counterfeit prevalence rates of 16.7% to over 40% (Akinyandenu, 2013; NAFDAC, 2022) and an estimated 68.9% of community pharmacists reporting encounters with suspected counterfeit medicines within the past year. Community pharmacies, as the most accessible formal medicine dispensing points for the Nigerian public, represent the critical terminal nodes in any national traceability system (Ugboma et al., 2024). Yet, the adoption of advanced digital technologies in these settings is constrained by infrastructural deficits, financial limitations, and capacity gaps that must be empirically characterised before implementation strategies can be designed.

Bayelsa State, located in Nigeria's Niger Delta region, presents a particularly instructive context. With approximately 150 registered community pharmacies serving a population of 2.3 million people across eight local government areas (LGAs) characterised by riverine geography, the state combines the national pharmaceutical supply chain vulnerabilities with additional challenges of physical accessibility and infrastructure reliability. Understanding the implementation readiness and adoption dynamics in this context provides insights applicable to similar resource-constrained settings across sub-Saharan Africa.

This study addressed two interconnected research objectives. First, it assessed the implementation readiness for blockchain technology-based traceability systems among stakeholders in community pharmacies in Bayelsa State, examining infrastructure, human capacity, management willingness, and training disposition. Second, it evaluated the barriers and enablers for adopting blockchain traceability within pharmaceutical supply chains in the state, identifying the factors that would hinder or facilitate adoption and examining how these vary across demographic groups.

METHODOLOGY

Study Design and Setting

A descriptive cross-sectional survey was conducted in Bayelsa State, Nigeria, across its eight LGAs. The state has approximately 150 registered community pharmacies, serving a population of 2.3 million people with distinctive riverine geography.

Population and Sampling

Superintendent pharmacists from registered community pharmacies constituted the study population. Sample size was determined using Yamane's formula (n = 110) and Cochran's formula with finite population correction (n = 109). Purposive convenience sampling via ACPN WhatsApp platforms yielded 119 valid responses (79.3% response rate) from 150 distributed questionnaires.

Data Collection Instrument

Two sections of the structured Google Forms questionnaire were relevant to this study. Section D assessed implementation readiness through four 5-point Likert scale items: stable internet and power supply, willingness to undergo training, management willingness to invest, and staff digital literacy (1 = Strongly Disagree to 5 = Strongly Agree). Section E assessed barriers (multiple-response: resistance to change, high cost, lack of expertise, poor connectivity, absence of regulatory framework) and enablers (multiple-response: user-friendly applications, mandatory regulation, government subsidies, evidence of profit/reduced losses).

Content validity was established through expert panel review. Reliability was confirmed with Cronbach's Alpha values of 0.84 (readiness construct) and 0.79 (barriers/enablers construct), both exceeding the 0.70 threshold (Nunnally & Bernstein, 1994). Overall instrument reliability was 0.85.

Data Analysis

Data were analysed using IBM SPSS v26.0. Descriptive statistics (means, standard deviations, frequencies, percentages) characterised readiness levels and barrier/enabler rankings. Pearson correlation coefficients examined relationships among readiness factors. Chi-square tests assessed associations between demographic variables and barrier perceptions. Statistical significance was set at $p < 0.05$.

Ethical Considerations

Institutional ethical approval was obtained. Informed consent was integrated into the questionnaire, with voluntary and anonymous participation. Data collection occurred February 1 to 10, 2026.

RESULTS

Implementation Readiness Indicators

Table 1: ***Implementation Readiness Indicators (n = 119).***

Statement	Mean	Std. Dev.
Stable internet and power supply	1.80	0.88
Willingness to undergo training	3.74	1.53
Management willingness to invest	2.93	1.51
Staff digital literacy	2.34	1.34
Overall Readiness	**2.70**	**0.84**

The overall readiness score of 2.70 (SD = 0.84) falls below the neutral midpoint of 3.0, indicating that community pharmacies are, on aggregate, not yet ready for blockchain adoption. Training willingness scored highest (Mean = 3.74, SD = 1.53), reflecting strong human motivation. Infrastructure readiness was critically weak (Mean = 1.80, SD = 0.88), while staff digital literacy scored 2.34 (SD =

1.34). Management investment willingness was ambivalent at 2.93 (SD = 1.51).

4.2 Readiness Response Distribution

Table 2: ***Readiness Response Distribution (n = 119).***

Statement	SD (1)	D (2)	N (3)	A (4)	SA (5)
Stable internet/power	48 (40.3%)	59 (49.6%)	0	12 (10.1%)	0
Training willingness	23 (19.3%)	0	20 (16.8%)	18 (15.1%)	58 (48.7%)
Management invest	37 (31.1%)	0	43 (36.1%)	12 (10.1%)	27 (22.7%)
Digital literacy	57 (47.9%)	0	27 (22.7%)	35 (29.4%)	0

The distribution confirms that 89.9% of respondents disagree or strongly disagree about having stable internet and power. In contrast, 63.8% agree or strongly agree about training willingness, indicating that human motivation substantially exceeds structural capacity. Management investment views are polarised, with roughly equal proportions on either side. Nearly half (47.9%) strongly disagree that staff possess sufficient digital literacy.

Correlation among Readiness Factors

Table 3: ***Correlation Matrix of Readiness Factors.***

Variable	Staff Literacy	Mgmt Support	Adoption Readiness
Staff Digital Literacy	1.00	0.30*	0.45**
Management Support	0.30*	1.00	0.41**
Adoption Readiness	0.45**	0.41**	1.00

**p < 0.05; **p < 0.01*

Staff digital literacy correlates moderately with adoption readiness ($r = 0.45$, $p < 0.01$), while management support shows a similar relationship ($r = 0.41$, $p < 0.01$). The literacy-management correlation ($r = 0.30$, $p < 0.05$) suggests that digitally competent staff reinforce managerial willingness to adopt innovation, creating a potential virtuous cycle.

Perceived Barriers to Blockchain Adoption

Table 4: ***Perceived Barriers to Blockchain Adoption (n = 119, multiple response).***

Barrier	Frequency (n)	Percentage (%)
Resistance to change from traditional methods	51	42.9
High cost of implementation	42	35.3
Lack of technical expertise or training	32	26.9
Poor internet connectivity	30	25.2
Absence of NAFDAC/PCN regulatory framework	12	10.1

Resistance to change (42.9%) was the most frequently cited barrier, followed by high cost (35.3%), lack of technical expertise (26.9%), poor internet connectivity (25.2%), and absence of regulatory framework (10.1%). These findings suggest that attitudinal and financial barriers outweigh purely technical or regulatory obstacles.

Perceived Enablers of Blockchain Adoption

Table 5: ***Perceived Enablers of Blockchain Adoption (n = 119, multiple response).***

Enabler	Frequency (n)	Percentage (%)
User-friendly mobile/web applications	51	42.9
Mandatory regulatory requirements (PCN/NAFDAC)	43	36.1
Government subsidies for technology acquisition	31	26.1
Evidence of increased profit/reduced losses	12	10.1

User-friendly applications (42.9%) emerged as the strongest enabler, followed by mandatory regulatory requirements (36.1%), government subsidies (26.1%), and evidence of economic benefit (10.1%). System usability and regulatory direction are perceived as more powerful adoption drivers than financial incentives alone.

Demographic Associations with Barrier Perceptions

Table 6: ***Association between Years of Practice and Perceived Barriers.***

Variable	Chi-Square	df	p-value
Years of Practice vs. High-Cost Barrier	10.94	2	0.004*
Years of Practice vs. Lack of Expertise	12.67	2	0.002**

*$p < 0.05$; **$p < 0.01$

Statistically significant associations exist between practice experience and both cost perceptions (Chi-square = 10.94, p = 0.004) and technical expertise concerns (Chi-square = 12.67, p = 0.002), indicating that barrier perceptions vary systematically by career stage.

DISCUSSION

The Readiness Paradox: Human Willingness versus Structural Capacity

The most striking finding of this study is the critical internal tension within the readiness profile: strong human motivation coexisting with severely deficient structural foundations. The overall readiness score of 2.70 falls below the neutral midpoint, indicating aggregate unreadiness. However, this score conceals a fundamental paradox. Training willingness (Mean = 3.74) demonstrates that pharmacists are personally motivated to engage with blockchain technology, while infrastructure readiness (Mean = 1.80) reveals that the physical and digital foundations for such engagement are almost entirely absent.

This paradox has important strategic implications. It indicates that resistance to change, while identified as a barrier by 42.9%, does not reflect entrenched opposition to innovation but rather a more nuanced stance in which pharmacists are willing to adapt if appropriate support is provided. The Technology Acceptance Model (Davis, 1989) is instructive here: pharmacists who express willingness to undergo training are implicitly acknowledging that they do not currently find blockchain easy to use but are open to acquiring competencies that would reduce this barrier.

The infrastructure deficit, with 89.9% reporting inadequate internet and power supply, represents a fundamental structural constraint that training and attitude change cannot overcome. Even if every pharmacist were fully trained, enthusiastic, and digitally literate, the absence of reliable connectivity and electrical power would render blockchain-based systems inoperable in the vast majority of pharmacies. This deficit is consistent with the broader infrastructure challenges documented across the Niger Delta region (Nkengasong & Tambo, 2019).

Interdependencies among Readiness Factors

The significant positive correlations among readiness factors, specifically staff digital literacy with adoption readiness ($r = 0.45$, $p < 0.01$) and management support with adoption readiness ($r = 0.41$, $p < 0.01$), provide empirical evidence of the interdependencies that the UTAUT framework (Venkatesh et al., 2003) predicts. These correlations suggest that adoption readiness is not determined by any single factor but emerges from the interaction of multiple enabling conditions, each needing to reach a threshold level for the system to achieve adoption readiness.

The additional correlation between staff digital literacy and management support ($r = 0.30$, $p < 0.05$) introduces a dynamic that has both positive and negative implications. On the positive side, pharmacies with digitally literate staff may cultivate more innovation-receptive management cultures, creating a virtuous cycle that accelerates readiness. Conversely, pharmacies where both literacy and management support are low may become trapped in a low-readiness equilibrium from which escape is difficult without external intervention. This suggests that interventions targeting staff digital literacy could have multiplier effects on overall readiness through their indirect influence on management attitudes.

Barriers: The Interplay of Attitude, Finance, and Infrastructure

The identification of resistance to change as the most frequently cited barrier (42.9%) requires careful interpretation. In the context of community pharmacy operations in Bayelsa State, this resistance likely reflects a rational assessment of the risks and uncertainties associated with adopting a technology that pharmacists do not fully understand, that requires infrastructure they do not possess, and that carries costs they may not be able to bear. Institutional Theory (Meyer & Rowan, 1977; DiMaggio & Powell, 1983) provides a useful lens: in the absence of clear institutional signals, whether regulatory mandates from NAFDAC, professional standards from PCN, or visible adoption by respected peers, individual pharmacists face a high-uncertainty decision environment in which maintaining existing practices is the rational default.

The high cost barrier (35.3%) represents a tangible economic constraint consistent with the operating environment of community pharmacies in Nigeria. These typically operate as small-to-medium enterprises with modest revenue margins and limited access to business credit. Resource Dependency Theory (Pfeffer & Salancik, 1978) illuminates the structural dimension: community pharmacies are resource-dependent organisations whose investment capacity is constrained by their revenue model, and adoption of capital-intensive technology requires either enhanced revenue, external financial support, or a regulatory mandate that transforms adoption from an optional investment into a compliance cost.

The statistically significant associations between practice experience and barrier perceptions indicate that intervention strategies should be career-stage-differentiated. Earlier-career pharmacists may benefit most from technical training and mentorship, while more established practitioners may require financial support mechanisms and clear demonstrations of return on investment. This differentiation is consistent with both Rogers' adopter categories (1962) and UTAUT's identification of experience as a moderating variable (Venkatesh et al., 2003).

Enablers: Usability, Regulation, and Financial Support

The emergence of user-friendly applications as the strongest enabler (42.9%) is critically important for technology design. This finding resonates with TAM's identification of perceived ease of use as a primary adoption determinant (Davis, 1989). Pharmacists are communicating that adoption is most likely when blockchain is presented through familiar, intuitive, mobile-friendly interfaces that abstract technical complexity. This should guide technology developers toward mobile-first design with front-end simplicity, integrating seamlessly into existing pharmacy workflows.

The strong showing of mandatory regulatory requirements (36.1%) as an enabler supports the Institutional Theory interpretation of the resistance barrier. Pharmacists are indicating that clear regulatory direction would resolve the uncertainty currently inhibiting adoption. This finding suggests that NAFDAC and PCN could accelerate adoption significantly by developing and disseminating a phased regulatory framework that articulates timelines, compliance milestones, and minimum technical requirements. The combination of usability-focused design and regulatory clarity could address both the attitudinal and institutional dimensions of the adoption challenge simultaneously.

Government subsidies (26.1%) directly address the financial barrier. The relatively lower ranking of economic benefit evidence (10.1%) suggests that usability and regulatory direction are more powerful motivators than financial return arguments, indicating that persuasion-based approaches emphasising profitability may be less effective than policy-based and design-based approaches.

CONCLUSION AND RECOMMENDATIONS

This study demonstrates that community pharmacies in Bayelsa State are not structurally ready for blockchain-based traceability (overall readiness = 2.70/5.0), but that a receptive attitudinal environment and strong professional motivation exist to support a phased transition. The critical tension between human willingness (training willingness = 3.74) and infrastructure deficiency (infrastructure readiness = 1.80) defines the central challenge. The adoption landscape is shaped by interacting attitudinal barriers (resistance to change, 42.9%), financial constraints (high cost, 35.3%), and capacity deficits (lack of expertise, 26.9%), while usability-focused design (42.9%), regulatory mandates (36.1%), and government financial support (26.1%) are the most powerful enablers.

Blockchain adoption in this context cannot be achieved through any single intervention but requires a coordinated, multi-stakeholder strategy. First, the Bayelsa State Government, in collaboration with federal agencies and telecommunications providers, should prioritise broadband internet and electricity infrastructure expansion in areas where community pharmacies operate. Second, NAFDAC and PCN should develop a phased regulatory framework providing institutional clarity on adoption timelines and compliance requirements. Third, the PCN should integrate blockchain literacy and digital health modules into mandatory Continuing Professional Development. Fourth, government should establish funding mechanisms, including subsidies, tax incentives, and technology loans, to support pharmacy digitisation. Fifth, technology developers should prioritise mobile-first, user-friendly design with offline capability and compatibility with existing NAFDAC systems. Sixth, professional associations should leverage existing communication channels to organise awareness campaigns and identify blockchain "champions" among early adopters. These recommendations, implemented in concert, would systematically address the infrastructure, regulatory, capacity, and design dimensions of the adoption challenge identified in this study.

REFERENCES

1. Akinyandenu, O. Counterfeit drugs in Nigeria: A threat to public health. African Journal of Pharmacy and Pharmacology, 2013; 7(36): 2571-2576.
2. Casino, F., Dasaklis, T. K., & Patsakis, C. A systematic literature review of blockchain-based applications. Telematics and Informatics, 2019; 36: 55-81.
3. Davis, F. D. Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS Quarterly, 1989; 13(3): 319-340.
4. DiMaggio, P. J., & Powell, W. W. The iron cage revisited: Institutional isomorphism and collective rationality. American Sociological Review, 1983; 48(2): 147-160.
5. Dutta, P., Choi, T. M., Somani, S., & Butala, R. Blockchain technology in supply chain operations. Transportation Research Part E., 2020; 142: 102067.
6. Food and Drug Administration. Drug Supply Chain Security Act (DSCSA): Overview and implementation progress. U.S. FDA., 2023.
7. Iqbal, M., & Matulevičius, R. Blockchain-based application security risks: A systematic literature review. Journal of Systems and Software, 2021; 177: 110946.
8. Kamble, S. S., Gunasekaran, A., & Arha, H. Understanding blockchain technology adoption in supply chains-Indian context. International Journal of Production Research, 2019; 57(7): 2009-2033.

9. Knaflic, S., & Tomic, I. Adoption readiness of blockchain in pharmaceutical supply chains. Journal of Pharmaceutical Innovation, 2020; 15(4): 482-495.
10. Kshetri, N. Blockchain's roles in meeting key supply chain management objectives. International Journal of Information Management, 2018; 39: 80-89.
11. Kumar, A., Liu, R., & Shan, Z. Is blockchain a silver bullet for supply chain management? Decision Sciences, 2020; 51(1): 8-37.
12. Mackey, T. K., & Nayyar, G. A review of existing and emerging digital technologies to combat the global trade in fake medicines. Expert Opinion on Drug Safety, 2017; 16(5): 587-602.
13. Meyer, J. W., & Rowan, B. Institutionalized organizations: Formal structure as myth and ceremony. American Journal of Sociology, 1977; 83(2): 340-363.
14. Moubarak, J., & Filali, Y. Blockchain adoption barriers in healthcare: A systematic review. Health Policy and Technology, 2022; 11(2): 100606.
15. Musamih, A., Salah, K., Jayaraman, R., et al. A blockchain-based approach for drug traceability. IEEE Access, 2021; 9: 9728-9743.
16. NAFDAC. Combating counterfeit medicines in Nigeria: Strategic framework. NAFDAC, 2022.
17. Nkengasong, J. N., & Tambo, E. Strengthening laboratory systems in resource-limited settings. The Lancet Global Health, 2019; 7(6): e749-e750.
18. Nunnally, J. C., & Bernstein, I. H. Psychometric theory (3rd ed.). McGraw-Hill, 1994.
19. Pfeffer, J., & Salancik, G. R. The external control of organizations: A resource dependence perspective. Harper & Row, 1978.
20. Queiroz, M. M., & Fosso Wamba, S. Blockchain adoption challenges in supply chain. International Journal of Information Management, 2019; 46: 80-95.
21. Queiroz, M. M., Telles, R., & Bonilla, S. H. Blockchain and supply chain management integration. Supply Chain Management, 2020; 25(2): 241-254.
22. Rogers, E. M. Diffusion of innovations. Free Press, 1962.
23. Saberi, S., Kouhizadeh, M., Sarkis, J., & Shen, L. Blockchain technology and sustainable supply chain management. International Journal of Production Research, 2019; 57(7): 2117-2135.
24. Tornatzky, L. G., & Fleischer, M. (1990). The processes of technological innovation. Lexington Books.
25. Treiblmaier, H. The impact of blockchain on the supply chain. Supply Chain Management, 2018; 23(6): 545-559.
26. Ugboma, E. J., et al. Towards effective healthcare delivery: An assessment of public perception of pharmacists' role in Nigeria. Journal of Advances in Medical and Pharmaceutical Sciences, 2024; 26(7): 35-48.
27. Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. User acceptance of information technology: Toward a unified view. MIS Quarterly, 2003; 27(3): 425-478.
28. Yadav, S., & Singh, S. P. Blockchain critical success factors for sustainable supply chain. Resources, Conservation and Recycling, 2020; 152: 104505.