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Broken trust in the supply chain: A qualitative study of product authentication failures, procedural fragmentation, and inventory consequences in Ghana's Upper West Region public hospitals

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Abstract

Effective medical supply chain management is a critical component of health systems, particularly for patient safety in low- and middle-income countries (LMICs). Ghana's public hospitals face long-standing challenges in product authentication, transparency, and inventory control, especially in resource-constrained regions, driven by weak infrastructure, disjointed accountability, and limited digital connectivity. This study examined the lived experiences of frontline healthcare personnel managing medical supply chains in Ghana's Upper West Region, focusing on how vulnerabilities in product integrity, procedural inefficiency, and inventory mismanagement jointly affect patient safety and service delivery. A qualitative descriptive design was used, with semi-structured, face-to-face interviews conducted across three public hospitals, one referral hospital and two district/municipal hospitals in the Upper West Region between January and April 2026. Data were analyzed using Braun and Clarke's (2022) six-step thematic framework in MAXQDA 26.0. Thematic saturation was reached after the 21st interview. Twenty-one participants were interviewed, yielding three major themes: (1) Vulnerabilities in Product Integrity and Safety — no participant reported a reliable authentication method, forcing reliance on visual inspection and supplier trust; (2) Procedural and Logistical Inefficiencies, fragmented accountability, manual documentation, and mandatory central sourcing created information gaps at every handoff; and (3) Inventory Control Consequences, simultaneous shortages and overstocking eroded patient trust, triggered unplanned referrals, and disrupted surgical scheduling. These findings offer a diagnostic basis for designing sequenced, low-cost technology interventions suited to rural LMIC hospital settings. The study contributes qualitative depth to a literature dominated by quantitative stock-out research and offers practical, context-sensitive recommendations, including threshold-based procurement rules, low-cost cold-chain indicators, and standardized receiving protocols, for strengthening supply chain integrity in resource-constrained health systems.

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JEL Classification: I18, I15, I11

1. Introduction

The effectiveness and efficiency of health systems all over the world are based on effective and efficient management of medical supply chains. In most developing nations such as Ghana, public hospitals have been unable to have a consistent, safe and transparent flow of medical supplies (Williams, Kohler, & Howard, 2020). This in turn poses a direct risk to patient safety and public trust by causing counterfeit products to reach patients, critical shortages to halt surgeries and financial waste through expired products going for disposal (Syed & Milburn, 2024). Public healthcare procurement in Ghana operates within a hybrid framework whereby public hospitals are mandated to source first from the Central Medical Stores before procuring from open market from qualified private suppliers. This system of procurement is at times marred with such challenges as disjointed processes, limited digital connectivity, and overreliance on paper documents. Previous studies has reported stock-outs of key medicines in Ghana (Boateng, Renner, Petricca, Gupta, & Denburg, 2020; Poku, Owusu, Mullen, Markham, & McCurdy, 2017; Kuupiel, Tlou, Bawontuo, Drain, & Mashamba-Thompson, 2019) and the distribution of substandard pharmaceuticals in the West African markets (Chabalenge, Sahota, Ermolina, & Tanna, 2025; Macé, et al., 2024). The COVID-19 crisis impacted the global pharmaceutical supply chains and revealed weaknesses in procurement systems that were largely relying on single sourcing and a small amount of buffer stock (Takawira & Pooe, 2024; Tirivangani, Alpo, Kibuule, Gaeseb, & Adenuga, 2021). However, there has been limited literature that qualitatively investigates how the frontline hospital staff in Ghana especially in the northern part of Ghana experience and cope with these challenges especially in relation to transparency, detection of counterfeits, and management of the inventory. Despite the efforts being made by policymaker to strengthen Ghana's healthcare supply chain through policy initiatives such as the introduction of the Light Hospital Management System (LHMS) in some healthcare facilities, significant gaps remain. Public hospital staff report inability to check whether the delivered supplies are genuine or not without using them in the first place (Macé, et al., 2024; Chabalenge, Sahota, Ermolina, & Tanna, 2025). This has been explained by the fact that there are no coordinated systems of tracking procurement to patient administration. Additionally, shortages of essential medical supplies occasionally cause unintended patient referrals or out of pocket purchase of pharmacy supplies (Olaniran, et al., 2022; Nagpal & Goel, 2025). Fragmented accountability among suppliers, regulators, including Food and Drugs Authority (FDA) and hospital departments contribute to the worsening of these problems. The lack of end-to-end transparency also results in an environment where fake products can find their way

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up the healthcare value chain without being detected, and the mismanagement of inventories is what also leads to simultaneous shortages and expiries (Musamih, et al., 2021). This salient question this study therefore seeks ask is, what are the key challenges faced by public hospitals in the Upper West Region of Ghana in managing the supply chain of medical supplies with regards to transparency, counterfeit products, and inventory management?

2. Materials and Methods

2.1 Research Design

This study employed a qualitative descriptive design to capture the experiences and perceptions of healthcare stakeholders who manage medical supply chains (Sandelowski, 2000). A qualitative exploratory design is appropriate because the study seeks to understand the how and why of supply chain failures which cannot be measured statistically. It was a cross-sectional study where data were collected over a period of three months (January-March 2026). The six-step framework for thematic analysis proposed by Braun and Clarke (2022) was selected as a thematic analysis framework due to its systematic but flexible approach to the discovery of patterns in the accounts of participants.

2.2 Study Setting

The study was carried out in three public hospitals, the Upper West Regional Hospital, Wa Municipal hospital and St. Joseph Hospital, Jirapa within the in the Upper West Region of Ghana. These hospitals were chosen because they represent the general public-sector supply chain pathway, including the mandatory use of the Upper West Regional Medical Store as the first-line source before the open-market procurement can be permitted. Moreover, these hospitals serve mostly rural communities and have widespread infrastructural limitations. One of the highest poverty rates in Ghana is in the Upper West Region. This causes supply chain breakdowns to have particularly significant impacts on access to healthcare. The area is geographically marginal and the distances between the central distribution centres in Accra and Kumasi are very far, a structural factor that intensifies the procurement delays.

2.3 Sampling Strategy and Participant Recruitment

The participants were recruited for this study using the purposive sampling technique. Purposive sampling was used to select participants with direct experience in medical supply chain activities at various stages; procurement, storage, dispensing and administration. To be included participants required to be: (1) a current employee at one of the three study hospitals; (2) have at least two years of direct experience in procurement, pharmacy, nursing administration, or hospital management; and (3) willing to provide informed consent. The exclusion criteria were those staff members who had joined the facility within the last 12 months before this study and other staff who were in clinical position and had no supply chain responsibilities. Potential participants were identified through hospital management and approached by researchers. The purposive sampling

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process was repeated, until thematic saturation was achieved, leading to a final sample size of 21 participants. There were no substantively new codes found in the 21st interview and the final three interviews only confirmed the presence of existing codes and did not present any new codes, which proves that the sample size used was sufficient to achieve the research objective.

Table 1. Participant Characteristics (N=21)

Role	N	Years of Experience (range)
Procurement Officers	3	3–12
Pharmacists / Pharmacy Technicians	4	2–15
Nurses / Nurse Managers	6	4–18
Hospital Administrators	3	5–20
Stores Managers	5	6–14
Total	**21**	

This stakeholder diversity ensured coverage of all major supply chain stages from ordering to patient administration enabling triangulation across organizational perspectives.

2.4 Data Collection

The study employed an exploratory approach, which incorporated face-to-face semi-structured interviews in English at participants' workplaces, in their personal offices or meeting rooms to ensure confidentiality. The interview guide was developed based on the literature review with refinement being done through pilot testing of the interview guide on 3 hospital administrators, 2 supply chain managers/procurement officers, 3 pharmacists, 2 store managers, and 3 healthcare providers (nurses and doctors), at Tuna Hospital, Sawla Hospital, and Bole Hospital all within the Savanna Region. This guide consisted of five thematic areas: (1) existing processes to verify medical supplies at the time of receipt; (2) experiences with fake or low-quality products; (3) inventory tracking processes and limitations; (4) challenges with suppliers, regulators, and inter-departmental coordination; and (5) consequences of shortages or oversupply to patient care and hospital operations. The interviews took about 30 and 45 minutes, and were audio-recorded with

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informed consent of the participants. Transcriptions were done verbatim and within a span of five days of the interview. Data collection continued until thematic saturation was reached.

2.4 Data Analysis

Thematic analysis followed the Braun and Clarke's (2022) six step framework for thematic analysis: (1) familiarization which involve reading transcripts and noting initial impressions; (2) generating initial codes by labeling semantic content units; (3) searching for themes which involve clustering codes into potential themes; (4) reviewing themes by checking coherence across transcripts; (5) defining and naming themes, and (6) producing the report. MAXQDA 26.0, qualitative data analysis software, was used to analyze the data. In improving the levels of trustworthiness, one researcher coded three purposively chosen transcripts, representing various roles, independently. Review of the coded transcripts was done independently by two members and any discrepancy was resolved through discussion and consensus. This was done without formal inter-rater reliability statistics which are not universally recommended in thematic analysis (Braun & Clarke, 2006). Member checking was conducted on five participants, who looked at a summary of interpreted themes, and verified their correctness. Analysis of negative cases was done directly: we actively sought participants who claimed to have successfully authenticated or effective end-to-end tracking systems. None was found, and itself is reported as a substantive finding. To capture the changing analytical decisions, a log of reflexivity was kept during analysis.

2.5 Methodological Rigor and Trustworthiness

Prolonged engagement in the field (a three month period), triangulation of roles of the stakeholders, member checking, and negative case analysis were used to enhance credibility. Detailed description of the context of the study setting and the characteristics of the participants supports transferability. This will enable assessment of applicability to similar settings. The transparency in reporting the analytic procedures and the independent coding process contributed towards confirmability.

Although this study used mainly interview data, we incorporated contextual triangulation of data across different types of hospitals (regional and district/municipal) and roles of stakeholders in order to reach data triangulation. Nevertheless, we acknowledge that triangulation might have been further strengthened by observation of receiving procedures, document analysis of procurement records and quantitative data of stock-out information.

2.6 Ethical Considerations

Ethical approval was obtained from the Research Ethics Review Board ethical and a research permit was also secured from the Ghana Health Service regional directorate. Informed consent was given in writing by all participants after being informed verbally and in writing about the purposes of the study. The participants were made aware that they are free to participate in the study and that they are free to withdraw their participation in the study. They were also assure of

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the confidentiality of the information they give. The anonymity of the participants is maintained throughout the study by use of anonymous role-based codes (PRO1 first procurement officer, Pharm3 third pharmacist). No monetary rewards were given to attend the interviews. All audio recordings and transcripts were stored in a personal device with passwords that was only be known to the research team.

3. Results

The thematic analysis revealed three general themes, each having a number of sub-themes. None of the participants reported any dependable system of verifying medical supplies upon receipt, and no system of effective end to end tracking was found in any of the three institutions. The thematic framework is given in Table 2.

Table 2. Thematic Framework

Theme 1: Product Integrity Vulnerabilities	Theme 2: Procedural Inefficiencies	Theme 3: Inventory Consequences
1.1 Authentication verification failure	2.1 Fragmented accountability	3.1 Simultaneous shortages and overstocking
1.2 Institutional capacity limitations	2.2 Procurement-to-patient disconnect	3.2 Loss of patient trust and hospital reputation
1.3 Reliance on trust and visual inspection	2.3 Supply chain integration gaps	3.3 Operational disruption

3.1 Theme 1: Vulnerabilities in Product Integrity and Safety

This theme reflects systemic vulnerabilities within the medical supply chain that exposes the supply chain to fake, sub-standard or improperly supplied products in all three facilities.

Sub-theme 1.1: Pharmaceutical Authenticity Verification Failure

Participants were in unison that there was no systematic, technology based approach of authenticating medical supplies when they arrived. Of special significance was the difference between medical devices and pharmaceuticals. As was explained by one of the Stores Managers:

> *ST1: "There is no system in place, however, when it comes to machines or devices like computers, we have engineers, they know the machines. So when they deliver we call them to come then assess before."*

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In the case of pharmaceuticals, which comprise the majority of the healthcare volumes of supply chain, there is no similar expertise or technology in the receiving end, where verification is required. The most eye-opening was that sometimes hospitals only find counterfeit or low-quality products when they are used or when they have been administered to patients:

NO2: "Unless we use the items before we can say it's not the right one. If not, we will not know whether it's fake or not. So it is a difficult to confirm on the surface."

This is a basic patient safety risk, as this post-use detection pattern is a fundamental patient safety risk element. A certain incident was described by an administrator:

Admin1: "Last time we had an instance where we had an issue with savlon. We had some issues reported by the user department. So together with the user department we visited the stores and we tested it. We had to let them send it back."

Sub-theme 1.2: Institutional Capacity Limitations

Respondents identified the manual systems that were fragmented as a fundamental institutional vulnerability that could not support the assurance of quality. According to one procurement officer, the tracking infrastructure can be described as follows:

> *PRO3:"There is no unified trail for tracking. It is fragmented processes, we often rely on excel spreadsheets, paper purchase orders and ledger books keep information about supplies. When we receive delivery of medical supplies, we usually have to manually cross check against purchase orders and delivery notes."*

In case of verification uncertainties, hospitals generally resort to redress by external regulators, such as the Food and Drug Authority, and this is an unsustainable dependence:

> *Pharm3: "We cannot really verify supplies or these documents instantly, we have to sometimes reach out to regulators like FDA or Standard Authority to authenticate them."*

One of the most important gaps is the temperature-sensitive product integrity. According to one procurement officer:

> *PRO2: "We lack the capacity to track supplies on transit especially for temperature sensitive products. We receive them but we cannot verify if they were kept cold throughout the transit."*

Sub-theme 1.3: Reliance on Trust and Visual Inspection

Without technological authentication solutions, hospitals will fall back to relational trust and the senses. Pharmacists have acknowledged that the following strategies are not sufficient:

> *Pharm3: "We have a standard operating procedure... It involves an inspection team conducting random sampling for stability if something is off. So basically, it is*

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visual inspection, paperwork audit and hope. But honestly a well-made counterfeit can sail through visual check."

There is tracking system fragmentation at the point of ward distribution. Therefore, verification process entails a mixture of digital and manual systems that are disintegrated:

PRO3: "A combination of semi-digital and paper. We use the LHMs software to generate POs and record receipts however, the moment items leaves the main stores for the ward, tracking reverts to paper requisitions books or tally cards"

This forces hospitals into supplier loyalty strategies at premium prices:

Pharm4: "Trust and long-standing relationships is our primary method. We are forced rely on few tried and tested suppliers even when their prices are higher, because the risk of fake products is too great."

3.2 Theme 2: Procedural and Logistical Inefficiencies

Sub-theme 2.1: Fragmented Accountability

Responsibility for the supply chain is divided by organizational boundaries with accountability transferred at each physical hand off. One of the procurement officers explained the handoff model:

PRO1: "It is the supplier's responsibility from wherever it's coming from to our stores. Once we inspect and we are satisfied, we take responsibility from there. So it is now our duty to make sure they are properly kept and then distributed to where they are needed."

Once the medical supplies have been handed over to the ward, procurement becomes virtually without any tracking capability. This fragmentation is enhanced by manual, paper-based documentation:

PRO3: "We have an electronic system but most of the procurement activities involve a lot manual documentations which is prone to errors and time consuming."

One of the pharmacists explained the last disconnect on patient administration:

Pharm3: "the final tracking is done at the ward during administration to a specific patient which involves recording usage in the nursing notes and prescription charts, which are completely separate from the supply chain logs."

Sub-theme 2.2: Procurement-to-Patient Information Disconnect

The prescription records are separate of the supply chain records, and thus an audit of batch-level traceability would be a formidable forensic task:

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Pharm3 "It is easy to know what was prescribed and the reason, but I cannot trace the specific batch of medicine or supplies back through its journey along the supply chain. It is important to say that if a client reacts to a drug, tracing the exact batch is a manual, forensic exercise that can take several hours if not days."

A nurse described the disconnection between clinical and supply chain records:

NO3: "When used for a patient, it is recorded in the patient's treatment chart. However, there is no link between the patient's chart and that stock book."

Such disconnection has a direct negative impact on pharmacovigilance and investigation of adverse reactions.

Sub-theme 2.3: Supply Chain Integration Gaps

Respondents consistently reported poor visibility of the status of medical supplies before physical delivery:

> *PRO3: "We mostly don't know the state of critical supplies until they are supplier physically delivers them."*

There is also a structural barrier of a mandatory sequential sourcing in government facilities:

> *Pharm2: "As a government facility, we source our products from Upper West regional medical stores which is government entity. That is a policy, if they don't have, you then have to now come and start a process of procurement to the open market."*

The issues of supply chain integration faced by hospitals is more revealing during emergency situations. A nurse described the workaround:

NO1: "Even if it is an emergency, and you need supplies urgently, there is a book you have to enter your name and borrow then later you request"

3.3 Theme 3: Inventory Control and Its Consequences

Sub-theme 3.1: Simultaneous Shortages and Overstocking

The paradox of concurrent shortages and overstocking, which is a typical manifestation of the bullwhip effect in a low-visibility supply chain, was experienced in all three hospitals

> *PRO3: "Shortages, we experience it once in a while and it cripples healthcare delivery. Overstocking is like our revenue siting down idle, it ties up scarce capital, takes storage space we don't have and inevitably leads to expire or unused supplies that must be destroyed."*

Delays in making payments to suppliers create to disruptions in supply which exacerbate shortage cycles:

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PRO2: "Overstocking? No. Shortages, sometimes yes. Due to bureaucracy or due to delayed payment, you can have shortages. So if you owe people and we are not able to pay anything the suppliers sometimes have issues doing business with us."

A pharmacist captured the operational 'web' this creates:

> *Pharm3: "Inefficient inventory management sometimes places us in a web between shortages and expiries."*

Sub-theme 3.2: Loss of Patient Trust and Threat to Hospital Image

In cases where hospitals are faced with shortage of medical supplies, the impacts extend beyond being inconveniencing to the safety of patients and the reputation of the hospitals. An administrator reported a medication error that occurred as a result of external pharmacy referral:

> *Admin2: "If you are attending to a patient and the medication prescribed is not there and you ask the patient to go and buy, some will not even go... We had an incident where a patient was given a prescription, he went to a pharmacy outside and they served a different medication. You get the point? So this can bring about issues."*

There are also shortages that occasionally drive unplanned referrals with reputational impacts:

> *PRO1*: *"Sometimes if you run short of essential medicines, you would have no choice than to refer a case that could have been managed in your facility to another facility."*

A Store Manager emphasized the view shared by participant PRO1:

> *ST1: "Patients won't get the needed services and they will be frustrated. So imagine patients comes and you are not able to serve them. They will definitely go to different hospital. That means you are losing customers."*

Sub-theme 3.3: Operational Disruption

Supply chain failures translate directly into clinical service disruptions:

> *"There can be difficulty scheduling procedures. For instance, if we are not sure of delivery of sutures when there is shortage, we cannot schedule cases for theater." (NO3)*

The severity of impact is underscored by this procurement officer's account:

> *"Supply chain interruptions have severe effect on our operations. Patient treatment may have to be postponed and that puts the patient's life at risk." (PRO3)*

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4. Discussion

This paper has discussed the major issues that the public hospitals in the Upper West Region of Ghana are grappling with in managing the medical supply chains. Our findings revealed a system that had been influenced by three interlocking structural defects: (1) verification without validation where the authenticity of products is measured by visual inspection and relational trust instead of technological authentication; (2) fragmented visibility, where the information about products is lost at every organisational handoff between supplier and stores wards and patients; (3) reactive inventory management—shortages and overstocking coexist because real-time consumption data do not inform procurement decisions. All three deficits are mutually reinforcing of each other, creating conditions that put patient safety at risk which may strain institutional capacity, and undermines trust in the public health system. The fact that hospitals use packaging inspection to authenticate medical products, according to our finding, are consistent with the systematic review of (Salami, et al., 2023), which found that poor-quality and falsified antimalarials could explain 10-40% of the overall annual malaria expenditures in LMICs, with the rural and low-socioeconomic-status populations bearing these burdens disproportionately. Our research builds upon this literature by showing that post-use detection of counterfeits is not just a resource gap but a normalised systemic phenomenon. The usage experience has been a common strategy of quality assurance that frontline staff have resorted to. This normalisation is a systemic patient safety failure that is largely not sufficiently reflected in quantitative research that focuses on stockout. On the same note, in a concurrent mixed-methods study conducted by (Atiga, Walters, & Pisa, 2023) in the Upper East Region of Ghana, significant disparities in the availability of medical commodities between the public and the private facilities were found. Their analysis showed that patients in government hospitals regularly bought the unavailable or unverifiable drugs that were sold at the privately owned pharmacies. Their patient-centred view is similar to our frontline staff reports of shortages and their downstream effects on patient safety and trust.

The procurement-to-patient records that was found in this study is similar to information silo issues described by (Yadav, 2015) and (Vries & Huijsman, 2011). Our qualitative data introduces a degree of specificity of the organisation that is not reflected in quantitative studies. That is fragmentation is not only a technical non-existence but it embodies accountability boundaries that actively prevent traceability. (Mekonen, Cho, & Fenta, 2025), evaluation of the data quality of the Logistics Management Information System (LMIS) in the Ethiopian Region of Amhara can be considered a directly similar case. They found that the mean physical and electronic inventory accuracy rates were only 74.7% and 70.6% respectively. This according to their study is driven by paper-based reporting, inadequate infrastructure, and insufficient human resources. These inconsistencies fit our results precisely, which are that parallel documentation systems (LHMS software at receiving, paper tally cards at ward level and nursing charts at administration) are structurally incompatible and can produce irreversible gap information. The idea that digitisation

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is necessary, yet it should be supported by infrastructure investment and specific training, expressed in Mekonen et al. (2025) conclusion, is in line with our sequenced suggestions.

Also, our discovery that hospitals are first approach the Central Medical Stores reflects a policy-induced inefficiency that can be echoed by coordination failures that are recorded in LMIC settings ((Yadav, 2015); (Privett & Gonsalvez, 2014). Olaniran et al.'s (2022) systematic review of the essential medicine stock-outs among community health workers across LMICs confirmed this last-mile dynamic. They revealed that stock-out rates of over 50% are a normal occurrence, thus leading to worker demotivation, reputational damage, and out-of-pocket expenses by frontline employees to maintain stocks. The borrowing system that has evolved as a workaround, shows adaptive resiliency among frontline personnel. This informal adaptation however, influences institutional goodwill, is not documented and may create equity risks where there is a disproportionate distribution of borrowing capacity across facilities. More so, Yadav (2024) offers a systematic framework that shows that digital interventions can enhance product availability and affordability in healthcare supply chains when deployed with deliberate focus on the infrastructure compatibility and workflow integration. Our study's findings are consistent with this framework. Participants were at the same time both admitting to the inadequacy of current manual systems, and expressing rational doubts about the replacement of manual systems by digital systems, due to past implementation failures, and limited technical support. This paradox of digital readiness is representative of a bigger issue reported in LMICs, where the difference between high and low technology usage is not a matter of awareness but the necessary infrastructure conditions (Yadav, 2024; Mekonen et al., 2025). This paradox will have to be resolved through sequential investment (infrastructure preceding software). Although our data were gathered in 2026, the descriptions of fragile, manual supply chains by participants echo the findings of research conducted during COVID-19 that showed that low-visibility systems could enhance disruption during demand shocks. A qualitative study of the primary health care units in Ethiopia conducted by Mitike et al. (2023) found that low-resourced facilities that use manual supply processes were more likely to experience increased shortages of personal protective equipment and essential medicines during the pandemic. This occurs as their supply chains were not equipped with buffers, visibility, and digital responsiveness to adapt according to Mitike et al. This observation has direct implications on the Upper West Region where geographic remoteness implies that disruptions that can be solved in days in urban centres can take weeks in our study sites. Pandemic resilience, however, does not only entail an emergency-specific planning but also the same underlining investments that the current study proposes in the case of routine operations.

4.1 Contextual Factors Shaping Findings

The Upper West Region presents a specific combination of structural factors that interact to amplify supply chain vulnerabilities. These factors interact in non-additive ways. For instance, distance amplifies the cost of mandatory central sourcing delays, resource constraint means

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hospitals cannot maintain large buffer stocks, electricity intermittency makes Enterprise Resource Planning (ERP) systems unreliable even when internet connectivity is present, and staff shortages mean manual reconciliation falls behind actual stock movements. The similarities with the results of the study by Atiga et al. (2023) in the Upper East Region, along with cross-LMIC evidence on last-mile stock-outs by Olaniran et al. (2022), and the findings of the study by Mitike et al. (2023) on the subject of primary care in Ethiopia imply that the structural vulnerabilities identified in this study are not exclusive to northern Ghana. Thus, it is anticipated that similar patterns of vulnerability would be observed within facilities with similar geographic features, limited digital infrastructure, and mandatory central sourcing policies. But the particular mix of factors in the Upper West Region, especially its extreme distance to Accra probably makes this one of the more acute manifestations of these problems within Ghana. The interventions that have been effective in the urban Ghanaian hospitals or in the other LMICs might not translate without a close contextual adjustment.

4.2 Negative Cases and Contradictions

We explicitly searched for participants who reported that they had successfully gone through the authentication process or had effective end-to-end tracking, but none were found. The fact that this was uniform across all of the 21 participants, and across all three facilities of different types and sizes, further supports the conclusion that the described failures are not facility-specific, but systemic instead. The fact that there is not a single positive case cannot be attributed to selective reporting. Since social desirability bias would, if anything, lead participants to exaggerate success rather than uniformly report failure.

Although participants were aware of the low effectiveness of visual inspection as a form of authentication, participants were highly unwilling to diversify their supplier base, even when alternative suppliers were able to offer lower prices. This trust premium makes sense in the absence of verification technology, but it makes single points of supply chain failure. Such contradiction can never be solved with improving visibility alone. It requires investing in authentication infrastructure that renders supplier trust verifiable, as opposed to relational. Mobile-based drug verification systems, demonstrated in Ghana and Nigeria through such initiatives as mPedigree and the NAFDAC Mobile Authentication Service have shown that low-cost authentication can be implemented in the West African setting and requires piloting at the receiving points of hospitals. Also, participants simultaneously described severe operational burdens from manual reconciliation while expressing skepticism about digital systems due to past implementation failures and electricity unreliability. This digital readiness paradox reflects a rational response to an environment where technology adoption without infrastructure support has historically failed. Successful intervention must address this uncertainty directly through sequenced, low-cost pilots that demonstrate reliability before institutional commitment is made.

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5. Conclusion and Recommendations

This qualitative study of public hospitals in Ghana's Upper West Region reveals a medical supply chain operating with three fundamental, interlocking challenges: (1) inability to verify product authenticity at receipt, leading to post-use detection of counterfeits; (2) fragmented accountability and manual processes that sever information links between procurement, stores, wards, and patients; and (3) reactive inventory management producing simultaneous shortages and overstocking. These challenges are systemic and are embedded in organizational fragmentation, policy constraints, and infrastructural deficits. The theoretical contributions offer new conceptual tools for the health supply chain literature.

5.1 Recommendations

Based on our findings, we recommend the following sequenced, low-cost pilots. We note that these recommendations emerge from participant-identified needs and the study's diagnostic findings; rigorous piloting with implementation science methods is required before wider adoption.

A 48-hour bypass rule for mandatory central sourcing: Policymakers should revise procurement regulations to allow hospitals to purchase from accredited open-market suppliers after 48 hours of non-response from the Regional Medical Store. This threshold-based rule would reduce delays while maintaining central coordination.

Introduction of low-cost cold chain data loggers: Steps should be taken introduce chemical time-temperature indicators for temperature-sensitive products. Staff confirm at receipt whether a temperature excursion occurred without electronic infrastructure.

Establishment of standardized receiving protocols: Ministry of Health should design and introduce a standard receiving protocol that will ensure mandate documentation of batch numbers and expiry dates.

Supply chain performance metrics in administrator evaluations: Incorporate stock-out duration, expiry rates, and supplier delivery compliance into hospital administrator Key Performance Indicators. This creates accountability for supply chain outcomes at the management level.

5.2 Limitations and Future Research

This study has limitations that should inform interpretation. First, data were collected in three public hospitals in one region hence, findings cannot be transferred to urban, private, or southern Ghanaian facilities where infrastructure, supplier access, and procurement autonomy may differ substantially. Second, we did not interview suppliers, FDA officials, or Regional Medical Store staff, whose perspectives on verification challenges, counterfeit prevalence, and regulatory compliance would have substantially enrich understanding. Third, we did not conduct observations of receiving procedures or document analysis of procurement records. This limits, triangulation. Fourth, social desirability bias may have led participants to emphasize system failures; however,

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the absence of any reported successful authentication across 21 participants makes systematic over-reporting of failure unlikely.

Future Research should: (1) quantitatively assess counterfeit prevalence using validated testing protocols at receiving points; (2) evaluate the cost-effectiveness of different verification technologies in this specific infrastructure context; (3) conduct implementation research on linking ward consumption data to procurement systems; (4) include supplier and regulatory stakeholders to understand supply-side perspectives on authentication and accountability; and (6) replicate this study in urban Ghanaian hospitals to enable systematic comparison.

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