Digitalisation of Healthcare Services in Ghana: From EMR Adoption to Routinised Use and Governance

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Abstract

Electronic medical records (EMRs) are widely positioned as foundational infrastructure for digital health transformation, yet adoption and routinised use remain uneven across hospitals in many low- and middle-income settings. This qualitative study examines how interacting technological, organisational, and environmental constraints shape EMR use in five Ghanaian health facilities in the Greater Accra Region, comprising three public hospitals and two private clinics. Semi-structured interviews were conducted with 13 stakeholders, including doctors, nurses, administrators, IT and health information personnel, and policy or oversight actors between January and March 2025 and analysed using reflexive thematic analysis guided by the Technology-Organisation-Environment framework. Findings reveal a stable hybrid documentation equilibrium in which downtime, device scarcity, and system performance limitations trigger paper-first workarounds followed by delayed data entry, resulting in duplicated effort, incomplete records, and declining confidence in EMRs as authoritative clinical records. Interoperability deficits further contributed to repeated registration and testing, while governance weaknesses, including poor identity control and limited auditability, reduced trust and documentation completeness. The study contributes by modelling adoption as a routinisation process driven by interacting constraints and by operationalising Ghana's Data Protection Act, 2012 (Act 843), and Cybersecurity Act, 2020 (Act 1038), into actionable governance requirements for scalable and trustworthy EMR implementation.

Keywords: Electronic medical records (EMRs); digital health; Technology-Organisation-Environment (TOE) framework; health information governance; Ghana

Introduction

Electronic medical records (EMRs) are a core component of modern health information systems because they can improve continuity of care, clinical decision making, and performance accountability by making routine clinical data legible, retrievable, and reusable at the point of care. International guidance is explicit that digital interventions are not substitutes for functioning health systems and that their effects depend on feasibility, acceptability, resource requirements, and equity conditions during implementation (World Health Organisation, 2019). Accordingly, EMR outcomes should be analysed as socio-technical results of alignment between infrastructure reliability, workflow fit, workforce capability, sustainable financing, and information governance. Experience across Africa illustrates both the promise and the conditionality of e-health at scale. In Rwanda, a widely deployed electronic health record for HIV care has been implemented in more than 300 health facilities and is perceived by most users as improving decision-making and the quality of patient information, although availability constraints persist in a subset of sites. At the national health information level, DHIS2 has become the system of record for routine health management information in many low- and middle-income countries, supporting large-scale reporting and decision-support infrastructures across multiple African settings. These examples suggest that effectiveness is driven less by installation than by the institutional conditions that sustain routine use, interoperability, and governance.

Ghana has articulated a clear policy commitment to health sector digitalisation. The Ghana e-Health Strategy sets out a coordinated vision for health information systems and progressively paperless records and reporting, with explicit attention to interoperability, confidentiality, and national-level coordination. More recently, the Ghana Health Service Policy and Strategy on

Digital Health 2023 to 2027 reiterates interoperability, governance, and workforce capacity as priorities for an integrated digital health ecosystem and universal health coverage. Yet Ghana-specific empirical evidence continues to show uneven adoption and routinised use across facilities and regions. Multi-site studies report dissatisfaction associated with limited workstations, inadequate training, unstable connectivity and power, record-quality problems, and privacy or confidentiality concerns, while a Ghana-focused scoping review shows substantial variation in acceptance and utilisation alongside recurrent technical, financing, training, and policy or standards constraints. Taken together, these studies establish that EMRs can deliver value but do not fully explain why some facilities stabilise routinised use while others settle into persistent partial digitisation. This unresolved deployment-to-routinisation problem motivates the present study, while the detailed mechanism, governance, and cross-stakeholder gaps are synthesised at the conclusion of the Literature Review.

Guided by the Technology-Organisation-Environment (TOE) framework (Tornatzky & Fleischer, 1990), which explains adoption through interacting technological, organisational, and environmental contexts, this study asks how these conditions interact to shape EMR adoption and routinised use in Ghanaian health facilities in the Greater Accra Region and what actionable levers can strengthen scalable and secure implementation. To answer this question, the study first characterises EMR use patterns and routinisation dynamics across five facilities, comprising three public hospitals and two private clinics, based on interviews conducted between January and March 2025. Second, it identifies and explains cross-domain constraints and their interaction mechanisms, including reliability-driven workarounds and their effects on data quality and trust. Third, it compares how public and private facility contexts shape financing, support capacity, and governance practices. Fourth, it operationalises the implications of Acts 843 and 1038 for EMR access governance, auditability, breach response

readiness, and vendor accountability. The study contributes by modelling adoption as an interaction process rather than a list of barriers, specifying mechanism chains such as downtime to workarounds to data-quality erosion to trust decline. It further translates Ghana's statutory duties into implementable EMR governance requirements and provides cross-stakeholder evidence linking clinical workflow realities to procurement, standards enforcement, and vendor-contracting levers required for system-level scale-up.

Literature Review

Research on health information technology adoption has commonly relied on individual-level behavioural models such as the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT), which emphasise perceived usefulness, perceived ease of use, and behavioural intention as proximal predictors of use (Davis, 1989; Venkatesh et al., 2003). Diffusion of Innovations (DoI) similarly foregrounds innovation attributes, including relative advantage, compatibility, complexity, and social influence in adoption and spread (Rogers, 2003). These approaches are valuable when the phenomenon of interest is user acceptance or intention, but they can under-specify the institutional and infrastructural conditions that determine whether adoption becomes routinised in complex service settings such as hospitals, where clinical work, patient flow, procurement, and regulatory oversight interact. The Technology-Organisation-Environment (TOE) framework was introduced by Tornatzky and Fleischer (1990) to explain adoption and implementation as a function of three organisational context domains. The technological context encompasses available technologies, system characteristics, and infrastructure; the organisational context concerns structures, resources, capabilities, and readiness; and the environmental context includes regulation, market structure, and competitive or institutional pressures. TOE is therefore appropriate here because the empirical puzzle in Ghana is not simply who intends to use EMRs, but why routinised use remains uneven despite policy commitment and deployment.

It also enables analysis of how system-level constraints such as uptime, interoperability, vendor dependence, and governance obligations shape everyday documentation practices.

However, TOE also has documented limitations in the broader technology-adoption literature. Because TOE is a high-level organisational lens, it can be overly general and often leaves key constructs and the temporal dynamics of post-adoption outcomes underspecified. A prominent critique is that TOE rarely explicates task and individual contexts, motivating integrative models that combine TOE with task- and individual-level theories when detailed behaviour is central (Awa, Ojiabo, & Orokor, 2017). Relatedly, TOE is frequently applied as a static determinant list rather than a process model, leading researchers to extend it into post-adoption and continuance settings by integrating continuance or success models to capture sustained-use dynamics (Jia, Guo, & Barnes, 2017). This study addresses these limitations by using TOE explicitly as a mechanism framework rather than a checklist, specifying interaction chains that link reliability and access constraints to workarounds, data-quality erosion, and trust decline. It also incorporates individual-level experience by analysing doctor, nursing, administrative, and IT accounts as organisational routines and practices, thereby bringing user behaviour into the organisational domain without reframing the study as an intention model. Governance is treated as an environmental determinant with operational consequences, linking regulatory requirements to access-control discipline, auditability, and incident readiness. In deployment terms, TOE informed the interview protocol and subsequently guided analysis and reporting by mapping themes to the three domains and modelling cross-domain interactions that explain routinisation outcomes (Tornatzky & Fleischer, 1990).

EMR adoption in low and middle-income settings

Across low and lower-middle-income countries, EMR implementation encounters convergent bottlenecks, including unreliable power and connectivity, device scarcity, workforce capability gaps, weak change management, and sustainability constraints linked to maintenance,

licensing, and vendor dependence. A scoping review of open-source EHR implementation synthesises organisational, socio-environmental, and technological barriers and highlights that privacy, ethics, and data protection are often treated as secondary despite their practical importance for trust and sustainability (Bostan et al., 2024). A decade-focused scoping review of EHR implementation in Sub-Saharan Africa similarly identifies infrastructure limits, financial constraints, privacy concerns, and extensive training needs as persistent determinants of adoption and routinisation (Mugauri et al., 2025). These syntheses converge on an interaction logic that is directly relevant to this study: downtime and access scarcity produce workarounds and parallel paper processes; parallel processes degrade data completeness and reliability; and declining reliability and trust further reduce consistent use, creating a reinforcing negative feedback loop. A concrete example of large-scale EMR use in a developing country underscore both the promise and the conditionality of routinisation. In Rwanda, OpenMRS-based electronic health records have been deployed for HIV care in more than 300 Ministry of Health facilities, and users in a cross-sectional study of 54 health centres largely reported improved decision making and patient-information quality while a minority experienced persistent infrastructure-related availability constraints (Fraser et al., 2022). The Rwandan experience illustrates a key point for Ghana: meaningful value can be achieved at scale, but sustained benefit depends on reliability, training and support, and governance arrangements that stabilise routine use rather than treating adoption as a one-time rollout.

Ghana's digital health strategy and governance environment

Ghana's e-Health Strategy and the Ghana Health Service Policy and Strategy on Digital Health 2023 to 2027 articulate ambitions for coordinated health information systems, progressively paperless clinical processes, and interoperable infrastructure (Ministry of Health, 2010; Ghana Health Service, 2023). Moving from strategy to outcomes, however, requires enforceable interoperability standards, procurement discipline, and sustainable financing that covers lifecycle costs rather than only initial deployment. Ghana's governance environment further

heightens the stakes of digitisation. The Data Protection Act, 2012 (Act 843), creates duties around safeguards and breach notification, while the Cybersecurity Act, 2020 (Act 1038), establishes institutional obligations for incident reporting within 24 hours of detection. These requirements matter not only for compliance but also for adoption behaviour because weak access governance, poor audit trails, or unclear incident routines can reduce staff confidence and encourage selective documentation. The relationship between governance and use therefore extends beyond legal compliance to the perceived credibility and safety of the EMR as an institutional record. This policy and statutory context motivate a governance-sensitive adoption analysis rather than a purely technical or perceptual framing.

Ghana-specific empirical evidence on adoption, satisfaction, and routinised use

Ghana's empirical literature reflects the broader conditionality of adoption while providing context-specific insight into implementation realities. In a multi-site qualitative study, health leaders reported dissatisfaction associated with poor record quality, inadequate staff training, limited workstations, and insufficient involvement of frontline doctors in system development, directly affecting workflow fit and perceived usefulness (Attafuah et al., 2022). Ghanaian health professionals also report perceived benefits alongside persistent frustrations linked to unstable connectivity and power and concerns about privacy and confidentiality (Mensah et al., 2024). A Ghana-focused scoping review synthesises these studies and shows substantial regional variation in acceptance and utilisation alongside recurrent technical, financing, training, and standards gaps (Alhassan et al., 2025). Recent evidence on the Lightwave Health Information Management System (LHIMS) adds a complementary perspective on use at scale. In a large cross-sectional analysis in the Central Region, efficient LHIMS use was associated with work experience and computer literacy, leading the authors to emphasise stronger general computing skills and participation across cadres (Agyemang et al., 2023). A subsequent study found positive but weak interdependencies among effectiveness, satisfaction, and efficient use, suggesting that improvements in any one usability domain may yield spillover effects but may

not fully overcome structural constraints (Agyemang et al., 2024). Collectively, this literature indicates that the central challenge is not simple acceptance but routinisation under infrastructure and governance constraints, and it reinforces the need for a qualitative explanation of how those constraints translate into everyday documentation practices.

Interoperability and integration opportunities

Interoperability is repeatedly identified as a bottleneck because fragmented systems prevent continuity across facilities and reduce the secondary value of routine data. Standards such as HL7 Fast Healthcare Interoperability Resources provide modular data-exchange resources and web-based APIs that can support integration between EMRs, laboratories, pharmacies, and insurance systems (Health Level Seven International, 2019). However, the most consequential interoperability levers are often environmental and organisational rather than purely technical, including procurement requirements, certification, data-element harmonisation, patient-identity governance, and accountability for exchange failures. Interoperability also has a governance dimension because auditability and traceability are central to trust. When exchange occurs across systems, responsibilities for access control, logging, and incident response must therefore be contractually and operationally defined. This means that interoperability should be analysed not simply as a software feature but as a socio-technical capability sustained by standards, governance arrangements, and institutional accountability.

Synthesis of Literature and Research Gap

Taken together, the reviewed literature establishes that EMR adoption in Ghana is shaped by recurring infrastructure, training, usability, financing, interoperability, privacy, and governance constraints, but three interrelated gaps remain. First, despite rich descriptive evidence about barriers and enablers, there is a limited mechanism-based explanation of how these constraints interact over time to stabilise hybrid documentation and uneven routinisation, particularly where downtime and device scarcity repeatedly trigger paper-first coping practices. What

remains insufficiently explained is the process through which a technical interruption becomes an organisational routine, subsequently degrades record completeness, and ultimately weakens trust in the EMR as the authoritative clinical record. Second, the policy-practice interface is underspecified because prior studies often acknowledge privacy and security concerns without translating Ghana's Data Protection Act, 2012 (Act 843), and Cybersecurity Act, 2020 (Act 1038), into concrete EMR requirements for access-control discipline, audit logging, breach-response readiness, incident-reporting capability, and vendor obligations. Consequently, there is limited empirical understanding of how governance readiness itself shapes documentation behaviour, institutional trust, and sustained use. Third, cross-stakeholder evidence connecting frontline workflow realities with procurement, standards enforcement, lifecycle financing, interoperability, and vendor-governance levers remains limited, especially across public and private facility contexts. Addressing these gaps requires an analysis that treats EMR adoption as a routinisation process produced by interactions among technological reliability, organisational readiness, and environmental governance rather than as a static inventory of independent barriers. The present study responds to this need by using TOE to model those interaction mechanisms and by linking the resulting explanation to actionable implementation and governance levers in Ghana's hospital ecosystem.

Methods

This study employed a qualitative, embedded multiple-case design to explain how EMR adoption and routinised use are shaped by interacting technological, organisational, and environmental conditions in hospital settings. A multiple-case approach is appropriate where the phenomenon is context-dependent and where explanatory leverage comes from comparing patterned similarities and differences across bounded settings rather than estimating population parameters (Yin, 2018). Analytically, the study adopts an interpretive and abductive stance, treating EMR use as socio-technical work embedded in documentation practices, clinical

routines, managerial coordination, and IT support arrangements. Abductive analysis supports theory development by iteratively moving between empirical observations and sensitising concepts to generate plausible explanatory mechanisms that remain grounded in participants' accounts (Timmermans & Tavory, 2012). The Technology-Organisation-Environment (TOE) framework provided the primary sensitising structure for constructing the interview protocol, organising the codebook, and modelling cross-domain interaction mechanisms that condition routinisation (Tornatzky & Fleischer, 1990). TOE was therefore used not as a rigid determinant list but as an explanatory scaffold through which inductively generated themes could be situated and connected. Reporting follows COREQ to strengthen transparency around sampling, data collection, analysis procedures, reflexivity, and evidentiary presentation (Tong et al., 2007).

The study was conducted in the Greater Accra Region, a critical implementation context with a dense concentration of public and private facilities (1830 per the Ghana Health Service database, 2025), health ICT vendors, and national-level policy and oversight institutions. The "case" was defined as facility-level EMR implementation as a socio-technical system, with embedded units of analysis defined by stakeholder role (clinical users, nursing, administration, IT or health information, and policy or regulatory actors). Five facilities were purposively selected to capture variation by ownership and service setting: three public facilities (Ga South Municipal Hospital, Accra Regional Hospital, and UPSA Clinic) and two private facilities (Nyaho Clinic and Alpha Beta Hospital). This selection logic supports analytic generalisation by enabling cross-case comparison on theoretically relevant dimensions (ownership, resourcing, procurement pathway, and operational maturity) while holding the regional policy and vendor environment broadly constant (Yin, 2018). The expectation was not that each facility would represent Ghana nationally, but that contrasts across these facilities would reveal how alignment failures and successes produce different routinisation patterns, particularly

around downtime, workflow integration, support capacity, and governance routines. Accordingly, observed contrasts are interpreted as analytically informative patterns across bounded cases rather than as estimates of prevalence for all Ghanaian health facilities.

Sampling strategy, recruitment, and participants

Participants were recruited using purposive sampling to identify information-rich roles with direct experience of EMR procurement, implementation, use, support, or oversight (Patton, 2015). Inclusion criteria were: (i) current or recent involvement in EMR-related activities in one of the study facilities or a relevant oversight role, and (ii) the ability to provide informed commentary on adoption constraints, workflow impacts, and governance practices. Exclusion criteria were: (i) no direct exposure to EMR use or implementation decisions, or (ii) inability to provide informed consent for an audio-recorded interview. Thirteen (13) participants were interviewed, spanning doctors (4), nurses (3), administrators (2), IT and health information personnel (2), and policy or oversight actors (2). Sampling adequacy was assessed using thematic redundancy and information power rather than statistical representativeness (Guest et al., 2006; Malterud et al., 2016). Data collection was undertaken by a small, purposefully constituted research team comprising four members with complementary expertise in health informatics, qualitative research methods, public health, and digital governance. Team composition was guided by two criteria: first, demonstrable experience in qualitative interviewing or health systems research; and second, familiarity with digital health or EMR-related contexts to ensure informed probing without over-directing participant responses. One team member, who had formal training in qualitative methods and prior field experience, served as the primary interviewer to ensure consistency in data generation, while the remaining members supported protocol development, pilot testing, and ongoing analytic reflection. All interviews were conducted between January and March 2025, spanning approximately three months of fieldwork. Interviews took place on-site at participating facilities in private settings. Each interview lasted approximately 30 to 40 minutes. Interviews were conducted in English,

audio recorded with participant consent, transcribed verbatim, and de-identified by removing names, facility identifiers where necessary, and any uniquely identifying incident references. Transcripts were checked against audio recordings to correct obvious transcription errors before coding. Field notes captured contextual cues such as interruptions, workload intensity, or points of emphasis and were integrated into the analytic record. To preserve depth and reduce interviewer fatigue, the primary interviewer conducted an average of one to two interviews per day, depending on participant availability and clinical workload constraints. This pacing enabled immediate memoing and preliminary reflection after each interview, which informed iterative refinement of probes and supported an abductive analytic approach. Data collection continued until the team judged that subsequent interviews did not yield substantively new codes across the core TOE domains and role categories, and this judgement was documented in analytic memos to support transparency. A participant profile table (Table 1) reports role codes and non-identifying descriptors to support interpretive transferability while protecting anonymity (Tong et al., 2007), and summarises participants by role group, participant code, number of participants, and typical EMR touchpoints.

Table 1 *Participant Profile*

Role group	Codes	Number of Participants	Typical EMR touchpoints
Doctors	D1–D4	4	Clinical notes, orders, results review
Nurses	N1–N3	3	Triage, vitals, ward documentation
Administrators	A1–A2	2	Registration, billing, reporting, procurement
IT and HIS staff	IT1–IT2	2	Infrastructure, user support, vendor liaison
Policymakers and regulators	P1–P2	2	Standards, oversight, governance

Source: Field data (2025)

The interview guide (Appendix A) was designed to elicit both descriptive accounts and explanatory detail on routines and breakdown points and was explicitly structured by TOE domains. Technology prompts examined system usability and workflow fit, downtime and recovery routines, device availability, interoperability and integration with laboratory, pharmacy, billing or insurance processes, and data quality controls, including completeness and timeliness. Organisation prompts examined leadership support, training and super-user arrangements; change management; staffing and IT support capacity; documentation norms; and internal governance of data quality and accountability. Environment prompts examined financing and lifecycle costs, procurement and vendor contracting, standards enforcement, regulatory and audit expectations, and perceived compliance obligations. This structure ensured that participants could describe role-specific experiences while still enabling systematic domain mapping during analysis (Tornatzky & Fleischer, 1990). To reduce leading questions, the protocol included probes that invited concrete examples (for example, "walk me through what happens when the system is slow or down") and comparative prompts across time or facilities (for example, "what changed after implementation" and "what differs between units or facilities"). In addition to interviews, the study used targeted document review of national strategy instruments and relevant governance documents to contextualise participant accounts and triangulate the environmental domain (Tong et al., 2007).

Data management

Audio files, transcripts, and field notes were stored on password-protected devices and/or secure institutional storage, with access limited to the research team. Transcripts were de-identified before coding. Quotations were also reviewed to minimise deductive disclosure risk by removing rare job titles or unusual incident descriptors that could enable identification. Only role codes, for example D1, N1, and IT1, were used in reporting. Where transcript wording contained minor disfluencies that did not alter meaning, bracketed clarifications were used

sparingly and transparently. Substantive participant content was not altered during this process, thereby preserving the evidentiary integrity of the interview material.

Data were analysed using reflexive thematic analysis, combining inductive coding with deductive patterning through TOE for domain mapping and interaction modelling (Braun & Clarke, 2006; Tornatzky & Fleischer, 1990). Analysis proceeded in six stages: familiarisation with transcripts and field notes; initial inductive coding to capture barriers, enablers, workarounds, and perceived impacts; grouping codes into candidate themes; reviewing themes against the dataset to ensure coherence and boundaries; refining and naming themes; and producing an explanatory account supported by verbatim quotations (Braun & Clarke, 2006). TOE was deployed as an explanatory scaffold rather than a rigid coding frame. After inductive coding, themes were mapped to technological, organisational, and environmental contexts, and the team explicitly modelled cross-domain interactions. For example, evidence was organised into mechanism chains, such as downtime leading to paper-based workarounds, delayed back entry, record incompleteness, and declining trust in the EMR as an authoritative record. This approach addresses a common limitation in adoption studies that list determinants without specifying how constraints interact over time.

Coding, memoing, and theme development were managed in NVivo (Lumivero, Release 1.7) to support systematic retrieval of coded segments, transparent versioning of the codebook, and maintenance of an auditable analytic record. An audit trail was maintained to support dependability and included versioned interview guides, recruitment logs, a hybrid coding approach combining inductive and deductive coding, coding memos, codebook iterations, and theme-development notes that can be provided in de-identified form if requested (Lincoln & Guba, 1985; Tong et al., 2007). Trustworthiness was addressed using established qualitative criteria (Lincoln & Guba, 1985). Credibility was strengthened through stakeholder

triangulation across embedded units, iterative probing for concrete examples during interviews, and attention to negative cases that contradicted dominant patterns. Dependability and confirmability were strengthened through the audit trail and reflexive memoing, which documented how the research team's assumptions and evolving interpretations were handled (Tong et al., 2007). Transferability was supported through clear description of the five facility contexts and participant roles, enabling readers to judge applicability to other Ghanaian regions and comparable low- and middle-income hospital settings.

Participants received an information sheet describing the study purpose, procedures, risks and benefits, confidentiality protections, and their right to withdraw without penalty. Written or recorded verbal informed consent was obtained before participation, including consent for audio recording. Given that EMR systems process sensitive health information, the study's data-handling procedures were designed to align with the principles of Ghana's Data Protection Act, 2012 (Act 843), including data minimisation, controlled access, and secure storage. Interview prompts explicitly explored operational practices relevant to Ghana's governance environment, including access-control discipline, auditability, breach and incident-response readiness, and vendor accountability. These issues were included because they are directly relevant to the institutional handling of sensitive health information and to participants' confidence in digital documentation practices. The interview design also reflected the practical salience of Ghana's Cybersecurity Act, 2020 (Act 1038) for institutional incident-reporting expectations. In this way, ethical data management for the research and governance issues within the empirical inquiry were treated as related but distinct dimensions of the study.

Findings

This section reports evident themes supported by verbatim quotations. The study generated a total of 68 initial codes, which were iteratively refined and consolidated into six final themes through the reflexive thematic analysis process. During the first stage of inductive coding, a broad set of descriptive and process-oriented codes was developed to capture participant accounts of EMR use, including downtime events, workarounds, training gaps, interoperability challenges, access control practices, and perceptions of data quality and trust. Through iterative review and constant comparison across transcripts, overlapping and redundant codes were merged, resulting in a more parsimonious and analytically meaningful coding structure. These refined codes were then organised into six higher-order themes that align with both the empirical data and the Technology–Organisation–Environment framework: (1) conditional workflow efficiency and hybrid documentation, (2) downtime-driven workarounds and data quality erosion, (3) interoperability deficits and referral information failure, (4) organisational readiness and support capacity, (5) governance, cybersecurity, and institutional trust, and (6) cross-case variation in adoption and implementation context. This progression from a relatively large set of granular codes to a smaller number of analytically robust themes is consistent with established qualitative practice and reflects the study's focus on explanatory depth rather than descriptive enumeration (Braun & Clarke, 2006). The findings are organised by Technology, Organisation, and Environment domains of the Technology–Organisation–Environment (TOE) framework, with explicit attention to interaction mechanisms that explain why hybrid documentation and uneven routinisation persist across the five study facilities (three public hospitals and two private clinics). Throughout, the emphasis is not merely on "barriers", but on *how constraints trigger coping behaviours that reshape data quality, trust, and sustained use*.

Conditional workflow efficiency and the persistence of hybrid documentation (Technology × Organisation)

Across stakeholder groups, the perceived value of the EMR was framed not as an inherent property of digitisation but as a conditional efficiency gain that depends on system availability and responsiveness at the point of care. When functioning well, the system supported faster retrieval of patient histories, smoother administrative workflows, and improved continuity of care. As one doctor explained, "when the system is up, I can see the patient history quickly, and it helps my decision-making" (D1). Administrative participants similarly associated EMR use with improved throughput and reduced duplication, with one noting that "on good days, registration and billing are faster because you do not start from scratch" (A1). At the same time, participants across roles described a persistent hybrid documentation arrangement in which paper remained an essential operational fallback during peak periods and limited computer access. A nurse explained that "during peak hours, we write on paper first because if you wait for the computer, the whole line will stop" (N1), while a doctor observed that "the frustrating part is doing the same work twice, paper now and then typing later" (D2). These accounts suggest that hybrid documentation is most likely when point-of-care access, including devices, connectivity, and uptime, is insufficient relative to patient volume. In those settings, paper-first routines become embedded as a safe operational strategy, and the EMR shifts from a real-time clinical record to a delayed administrative archive. The cross-case implication is therefore that routinisation depends on the EMR becoming the primary record at the point of care rather than a secondary system populated after the fact.

Downtime as a trigger event: workarounds, data quality erosion, and declining trust (Technology → Organisation)

Downtime and system instability were consistently identified as the points at which EMR-first intentions gave way to paper-first coping practices. Participants described interruptions as immediate workflow failures that disrupted documentation and forced rapid adaptation. As one

doctor explained, “sometimes you are documenting and the system freezes, then the network drops, so you switch to paper” (D3). Administrative staff described these breakdowns as service-delivery shocks that produced queues and shifted labour toward reconciliation, with one noting that “when the EMR goes down, the queue grows immediately, and later you spend hours reconciling entries” (A2). IT personnel further emphasised the data-integrity consequences of delayed entry, observing that “back entry is not perfect, people miss fields, and you end up with two versions of the same encounter” (IT1). The mechanism indicated by these accounts is a chain in which downtime leads to paper-first documentation, delayed or selective back entry, missing and inconsistent records, reduced clinical reliability, declining trust, and weaker routinised use. Improving acceptance alone is therefore insufficient because persistent instability can cause users to reclassify the EMR from a primary clinical record to an optional archive. This mechanism is structurally shaped by the environment through power and connectivity, by the technology stack through responsiveness and recovery, and by organisational support capacity through the speed and effectiveness of downtime resolution. Across cases, routinisation is thus best understood as an alignment outcome: unless reliability is stabilised, hybrid documentation can become a persistent equilibrium rather than a temporary transition.

Interoperability deficits as referral-time information failure and transaction cost (Technology × Environment)

Interoperability constraints were experienced as concrete referral-time information failures with direct consequences for cost, delay, and duplication. One doctor noted that “a referred patient comes and you cannot see the last lab result, so you repeat the test” (D4). Administrative participants described similar disruptions, with one explaining that “if we cannot pull the record, patients re-register and we capture the same details again” (A1). Policy stakeholders framed this as a governance issue, with one observing that “unless standards are enforced in procurement, we will continue to have systems that do not talk to each other” (P1). The

mechanism is that non-interoperable systems create data silos that lead to missing prior results at referral, repeated registration and testing, and increased delays and costs. These consequences reduce perceived system value and can weaken institutional commitment to scale, causing EMRs to function as facility-level repositories rather than continuity infrastructure. Interoperability is therefore not only a technical capability but also an outcome shaped by vendor market structure, procurement discipline, standards, and policy enforcement. The cross-case implication is that improvement requires environmental levers, including standards enforcement, certification requirements, and contractual exchange obligations, alongside technical integration work. This interaction between technology and environment explains why technically functional systems may still fail to support system-wide continuity of care.

Organisational readiness: training continuity, staff rotation, and support capacity (Organisation)

Participants consistently reframed resistance as a function of organisational readiness constraints rather than simple unwillingness to use the system. A nurse explained that "we were trained once, but when something changes, there is no refresher, so errors become normal" (N2). An administrator added that "staff rotate and the knowledge goes with them, so performance depends on who is on duty" (A2). IT staff highlighted capacity constraints, with one noting that "we are a small team, we handle network, hardware, user issues, and vendors, so response is not always fast" (IT2). Together, these accounts position EMR inconsistency as a readiness problem in which limited training continuity and thin support capacity increase cognitive burden and slow issue resolution. The resulting mechanism is that weak onboarding, refresher training, and support lead to workarounds, partial use, and incomplete records, which in turn reduce perceived usefulness and sustain hybrid documentation. This represents an organisational routinisation failure because skills, support arrangements, and documentation norms do not stabilise EMR-first behaviour. Public-private differences in procurement cycles,

resourcing, staffing models, and support capacity may therefore shape the intensity and persistence of these problems. Where the data support such contrasts, they indicate differing institutional abilities to finance continuous training or maintain dedicated IT support rather than fundamentally different user attitudes. The cross-case implication is that routinisation requires recurrent capability-building and support structures that survive staff rotation and system change.

Governance and trust: operational implications of Act 843 and Act 1038 (Environment → Technology/Organisation)

Governance concerns shaped both documentation behaviour and institutional trust. A clinician explained that "if I am not confident about who can access sensitive notes, I will write less detail than I should" (D2). IT staff similarly noted that "shared accounts happen when people are rushing, but then the audit trail is weak and you cannot attribute actions" (IT2). These concerns are materially significant in Ghana's statutory context because the Data Protection Act, 2012 (Act 843), requires notification where there are reasonable grounds to believe personal data have been accessed or acquired by an unauthorised person and requires steps to restore the integrity of the information system. The Cybersecurity Act, 2020 (Act 1038), also requires a person in charge of an institution to report a cybersecurity incident within 24 hours after detection and provides incident-reporting and response structures to support that obligation. Operationally, these duties imply the need for unique user identities, auditable access controls, retained logs, monitoring capability, and clear escalation workflows. The mechanism identified in the data is that weak access discipline and auditability create uncertainty about confidentiality and accountability, which can lead to selective under-documentation, poorer data completeness, and reduced trust. These effects diminish the clinical utility and routinised use of the EMR while simultaneously increasing compliance risk. Governance therefore operates as a core determinant of documentation behaviour rather than as a peripheral legal concern.

TOE interaction mechanism map and implementation levers (evidence-based synthesis)

Table 2 consolidates the principal mechanisms and implementation levers implied by the data. It links each trigger, such as downtime, access scarcity, non-interoperability, training discontinuity, weak access discipline, or limited incident readiness, to the behavioural or organisational adaptation that follows. The table then identifies the relevant TOE locus to make clear whether the mechanism originates within technology, organisation, environment, or an interaction among domains. Illustrative evidence codes show the empirical basis for each mechanism without implying quantitative prevalence. The final column identifies implementation levers that could plausibly interrupt the observed chain, including infrastructure resilience, workflow redesign, procurement requirements, recurrent training, role-based access control, audit-log review, and tested incident procedures. The purpose is therefore explanatory as well as practical: the table translates qualitative patterns into mechanism-oriented intervention points while preserving the distinction between participant evidence and analytic synthesis.

Table 2 *Evidence-Based TOE Mechanism Map*

Trigger	Mechanism chain	TOE locus	Illustrative evidence	Implementation level
Power or connectivity instability	Downtime leads to paper-first documentation, delayed entry, incomplete records, and reduced trust	Technology to Organisation	D3; A2; IT1	Backup power and network resilience, downtime protocol, and recovery drills
Peak load and access scarcity	Queue pressure leads to paper-first coping and later typing, duplicated effort, and incomplete digital records	Technology and Organisation	N1; D2	Point of care access planning, workflow redesign to reduce duplicate entry

Non-interoperable systems	Information silos lead to repeat registration and tests, delays, and higher transaction costs	Technology and Environment	D4; A1; P1	Interoperability requirements in procurement and contracts, shared data element standards
Training discontinuity and rotation	One-off training and turnover normalise errors, variable performance across shifts	Organisation	N2; A2	Competency-based onboarding, refresher cycles, super user model
Weak access discipline and auditability	Credential sharing reduces accountability, increases perceived privacy risk, and under-documentation	Organisation and Technology	D2; IT2	Unique user IDs, RBAC, periodic access review, audit log retention and review routines
Incident readiness gap	Weak monitoring delays detection and undermines the 24-hour reporting capability	Environment to Organisation and Technology	IT2; Act 1038 section 47(5)	Monitoring and alerting, tested incident runbooks, vendor incident SLAs

Cross-case synthesis: which TOE domains dominated and why?

Across the dataset, technological and organisational domains were most salient in participants' accounts because they determine whether EMRs can be used at the point of care under routine workload conditions. Technology constraints, including uptime, connectivity, device access, and interoperability, created immediate breakdowns that triggered workarounds. Organisational conditions, particularly training continuity, staff rotation, and IT support capacity, determined whether these workarounds became normalised or were progressively reduced. The environmental domain remained analytically decisive because procurement rules, standards enforcement, lifecycle financing, and statutory governance obligations shape whether reliability, interoperability, and auditability can realistically be improved and

sustained. Overall, the findings support an alignment interpretation in which routinisation is strongest where technology reliability and usability, organisational readiness, and environmental governance reinforce one another. Where any one domain lags, especially reliability or access discipline, participants described predictable cascades that sustain hybrid documentation and reduce confidence in digital records. This mechanism-focused synthesis therefore explains how deployment can coexist with low routinisation and why governance readiness is simultaneously a compliance necessity and an adoption determinant.

Discussion of Results

This study advances the understanding of EMR adoption in Ghanaian hospitals by demonstrating that routinisation is not a linear outcome of deployment but an institutional alignment process shaped by interacting technological, organisational, and environmental conditions. Consistent with contemporary digital-health guidance, EMRs should be understood as socio-technical interventions whose effects depend on feasibility, reliability, organisational readiness, and governance capacity rather than installation alone (World Health Organisation, 2019). In the Greater Accra facilities studied, this conditionality manifested as a stable hybrid documentation equilibrium in which EMRs were valued yet not consistently embedded as the primary clinical record. When system uptime and point-of-care access were sufficient, participants described informational and administrative gains, including faster retrieval of patient histories and smoother billing cycles. However, recurrent downtime, slow performance, and device scarcity triggered rational coping strategies such as paper-first documentation followed by delayed electronic entry. Although these adaptations preserved immediate patient flow, they generated reconciliation burdens, incomplete digital records, and discordant versions of encounters. Over time, those inconsistencies eroded confidence in the EMR as the authoritative record and reinforced partial reliance. Hybrid documentation therefore, emerged

not as a temporary transitional behaviour but as a stabilised response to repeated reliability disruptions.

The study's theoretical contribution lies in modelling these dynamics as interaction mechanisms rather than listing barriers. Within the Technology-Organisation-Environment framework, technological instability acts as a trigger event, organisational capacity determines whether coping behaviours are corrected or normalised, and environmental structures shape the feasibility of sustained improvement. Infrastructure instability and device scarcity precipitate paper-first workarounds; delayed entry degrades completeness and concordance; degraded data quality reduces perceived system authority; and reduced authority reinforces partial use. This feedback loop clarifies why routinisation can stagnate even after substantial investments in deployment and training. It also explains why user-acceptance interventions alone are insufficient when reliability constraints remain unresolved. In this respect, the findings refine TOE from a static categorisation of determinants into a process-oriented account of how conditions across domains interact and reproduce post-adoption outcomes over time.

Interoperability was similarly reframed by participants as a referral-time information failure rather than a technical feature. Repeat registration and repeated diagnostic testing were described as consequences of information immobility across facilities. This finding underscores that interoperability functions as a clinical continuity infrastructure: its absence generates direct patient and administrative transaction costs. While standards such as HL7 FHIR provide the technical grammar for exchange, fragmentation persists where procurement rules, certification conditions, and contractual arrangements do not enforce exchange capabilities or data portability. In TOE terms, interoperability failure is sustained at the intersection of technology and environment, requiring regulatory and market-level levers

alongside technical integration. This interpretation is consistent with the findings that interoperability failures are sustained jointly by technical fragmentation and by procurement and governance arrangements that do not enforce exchange.

A distinctive contribution of this study is the positioning of governance readiness as an adoption determinant rather than a peripheral compliance issue. Participants described under-documentation of sensitive cases when access discipline and auditability were weak, revealing a behavioural pathway from governance uncertainty to reduced record completeness. Under Ghana's Data Protection Act, 2012 (Act 843, section 31), institutions must notify the Data Protection Commission and affected data subjects when there are reasonable grounds to believe personal data have been accessed by an unauthorised person and must restore system integrity as soon as reasonably practicable. The Cybersecurity Act, 2020 (Act 1038, section 47(5)) further requires institutional reporting of cybersecurity incidents within 24 hours of detection. These statutory duties presuppose identity management, role-based access control, audit logging sufficient for attribution, monitoring capability, and rehearsed incident response routines. When such controls are weak, compliance exposure increases and doctors' trust declines, shaping documentation behaviour. Governance readiness, therefore, holds dual materiality: it is legally required and behaviourally consequential for routinised EMR use.

Implications

This study offers both theoretical and managerial implications by advancing understanding of EMR adoption as a routinisation problem shaped by interacting institutional conditions. Theoretically, the findings extend the Technology-Organisation-Environment framework (Tornatzky & Fleischer, 1990) by demonstrating that adoption outcomes are not determined solely by the presence of technological, organisational, or environmental factors, but by the

mechanisms through which these factors interact over time. Prior studies have largely treated barriers such as infrastructure, training, and governance as independent determinants (Attafuah et al., 2022; Alhassan et al., 2025). In contrast, this study shows that reliability failures trigger behavioural adaptations that degrade data quality and reduce trust, thereby reinforcing partial use. In doing so, the study contributes a process-based refinement of TOE by incorporating feedback loops and by positioning governance not as an external constraint but as a cross-cutting mechanism that shapes both behaviour and system legitimacy. This also advances digital health implementation literature by linking statutory governance requirements directly to adoption outcomes, an area that remains underdeveloped in existing empirical work.

Managerially, the findings indicate that EMR implementation should be prioritised as an operational alignment task rather than a technology deployment exercise. First, reliability must be treated as a primary design and investment priority. Without stable power, connectivity, and sufficient access points, clinicians adopt paper-first workarounds that undermine system use. Second, interoperability requires enforceable procurement and contracting mechanisms rather than aspirational policy statements. Embedding exchange standards, data portability, and accountability clauses in vendor contracts is essential to reduce fragmentation. Third, organisational readiness must be institutionalised through continuous training, structured support systems, and workflow redesign to sustain correct system use. Finally, governance should be embedded in routine operations through access control discipline, audit processes, and incident readiness, ensuring both compliance and sustained user confidence. Together, these implications emphasise that sustainable EMR scale-up depends on coordinated action across technological reliability, organisational capability, and enforceable governance structures.

Conclusion

This study advances the EMR adoption literature by moving beyond descriptive accounts of barriers to provide a mechanism-based explanation of uneven routinisation in Ghanaian hospitals. While prior Ghana-focused studies have identified recurring constraints such as infrastructure limitations, training gaps, and user dissatisfaction (Attafuah et al., 2022; Mensah et al., 2024; Alhassan et al., 2025), they largely treat these factors as independent challenges. In contrast, this study demonstrates how these constraints interact dynamically to produce a stable hybrid documentation equilibrium. Specifically, it identifies and evidences a self-reinforcing pathway in which downtime leads to workarounds, workarounds degrade data quality, data-quality erosion reduces trust, and reduced trust weakens sustained system use, thereby explaining why deployment does not necessarily translate into routinisation. A second contribution is the repositioning of governance as an active determinant of EMR use rather than a peripheral compliance issue. Existing studies typically reference privacy and security concerns without specifying their operational implications, whereas this study translates Ghana's Data Protection Act, 2012 (Act 843), and Cybersecurity Act, 2020 (Act 1038), into concrete requirements for access control, auditability, breach response, and incident reporting. The findings further show how weaknesses in these areas can shape clinician behaviour, including under-documentation of sensitive cases, thereby linking governance readiness directly to record completeness and institutional trust. Together, these contributions extend the Technology-Organisation-Environment framework by demonstrating that adoption outcomes are shaped not only by contextual factors but also by their interaction mechanisms and governance conditions. The study therefore provides both theoretical refinement and actionable insight for achieving scalable and trustworthy EMR implementation in Ghana and comparable health systems.

Limitations and Future Research

This study prioritised explanatory depth and cross-stakeholder triangulation over statistical representativeness. The purposive sample of 13 participants across five facilities supports mechanism-oriented inference but does not capture the full diversity of Ghanaian hospitals, including mission facilities and rural settings where infrastructural constraints may be more pronounced. Findings are based on self-reported experiences and may therefore reflect role-based emphasis or recall limitations. Future research should test the proposed mechanism model using longitudinal and mixed-method designs. Tracking uptime, hybrid-documentation prevalence, record completeness, referral-duplication rates, and governance-readiness indicators over time would enable empirical testing of the feedback loops identified here. Comparative research across ownership types and regions could clarify distributional effects and equity implications. Governance-focused inquiry should also translate statutory obligations under Act 843 and Act 1038 into measurable readiness metrics and examine how these controls influence doctor trust and documentation behaviour. Such work would strengthen causal inference and further refine the deployment-to-routinisation model advanced in this study.

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