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RESEARCH REPORT

Training, Policy and the Digitalisation of Healthcare in Ghana

Healthcare Workers' and Users' Perspectives on the Need for Digital Health Policy

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March 2023

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Abstract

Background: Ghana has pursued healthcare digitalisation since its 2010 national e-health strategy, yet research has concentrated on technology adoption and infrastructure. Less is known about how healthcare workers and users experience digitalisation, and what their accounts reveal about the digital skills, training and policy needed to sustain it.

Aim: To explore how healthcare workers and users in Ghana understand and experience digitalisation, and what their accounts indicate about the need for digital skills, training and digital health policy.

Methods: A qualitative design used semi-structured interviews with 41 participants between July and September 2022: 21 healthcare workers (10 public, 11 private) and 20 healthcare users (10 public, 10 private). Reflexive thematic analysis was deepened through the NASSS framework, a sociotechnical model of health information technology and the COM-B model. Policy implications were framed using the WHO–ITU National eHealth Strategy Toolkit.

Findings: Six themes were developed: uneven and fragmented digitalisation; infrastructure constraints and workarounds; digital skills and training; institutional support, leadership and policy implementation; trust, confidentiality and accountability; and healthcare users' access and digital inclusion. Workers consistently identified insufficient, short and theoretical training as a barrier. Both groups described the absence of coordinated guidance on interoperability, private-sector inclusion, data protection and digital access. Accounts also showed that skills could not be exercised without reliable infrastructure and implementation support.

Conclusions: Sustainable healthcare digitalisation in Ghana requires structured, role-appropriate training and digital health literacy support, developed together with coherent digital health policy and implementation guidance. Most gaps concerned the implementation of existing policy direction, but targeted new policy appeared warranted on interoperability, workforce training standards, private-sector inclusion and digital access.

Keywords: digital health policy; digital skills; electronic health records; Ghana; health workforce training; healthcare digitalisation; qualitative research

1. Introduction

Ghana's ambition to digitalise its health system is more than a decade old. In 2010 the Ministry of Health launched a national e-health strategy to streamline the regulatory framework for health data, build sector capacity for e-health and develop paperless records and reporting (Ministry of Health, 2010; Afarikumah, 2014). Electronic medical records, electronic insurance claims, tablet-based community health records and mobile health pilots have since been introduced at different levels of the system (Afarikumah, 2014; Lee et al., 2022). Digitalisation is therefore under way. Less clear is how it is understood and experienced by those who work in, and use, Ghana's healthcare institutions, and what their experience reveals about the skills and policies needed to sustain it.

International evidence shows that health technologies are frequently not adopted, are abandoned, or cannot be scaled and sustained, even when they work in principle (Greenhalgh et al., 2017; Abimbola et al., 2019). In sub-Saharan Africa, reviews attribute slow adoption of electronic health records to procurement and maintenance costs, unreliable electricity and connectivity, and limited computer skills among primary users (Odekunle et al., 2017). Within Ghana, qualitative studies of hospitals using electronic records report inadequate training, limited equipment and managerial support, and poor involvement of clinicians in system design (Attafuah et al., 2022; Mensah et al., 2022). Two of these recurring barriers, workforce skills and the policy environment, are also central to international guidance. The WHO–ITU National eHealth Strategy Toolkit identifies workforce and legislation, policy and compliance as core components of a national eHealth environment (WHO and ITU, 2012). The WHO global strategy on digital health calls for strengthened governance, workforce capacity and digital health literacy (WHO, 2021).

Despite this, the existing literature is incomplete in three respects. First, research on healthcare digitalisation in Africa has concentrated on technology adoption and technical infrastructure, measuring readiness, uptake or functionality (Odekunle et al., 2017; Lee et al., 2022). Second, where studies engage with situated experience, they tend to examine a single group, most often health professionals or managers in public hospitals (Attafuah et al., 2022; Mensah et al., 2022). The perspectives of healthcare users, and of staff in private facilities, are rarely examined alongside one another. Third, research on digital competence, training and organisational capacity has developed largely in high-income settings (Konttila et al., 2019; Longhini et al., 2022), and is seldom connected empirically to questions of policy and implementation in low- and middle-income health systems. This study therefore examines a proposed gap rather than an established one: that the situated accounts of healthcare workers and users, read together across public and private sectors, can illuminate how digital technologies, digital skills, institutional support and policy interact in practice.

The question matters for both training and policy. Concerning training, the common recommendation that health workers need "more training" risks treating digital capability as a deficit of individuals rather than a property of the sociotechnical system in which they work (Sittig & Singh, 2010; Michie et al., 2011). Concerning policy, Ghana's digitalisation has been led by national programmes in public facilities, while some private facilities have digitalised independently. Questions of interoperability, regulation, training standards and support therefore cannot be resolved by any one programme alone.

The study draws on 41 semi-structured interviews conducted in Ghana between July and September 2022 with healthcare workers and healthcare users in public and private settings. Using reflexive thematic analysis (Braun & Clarke, 2006; 2021), deepened through the NASSS framework (Greenhalgh et al., 2017), it examines how participants understand digitalisation, what they experience as enabling or constraining it, and what their accounts imply for digital skills, training and digital health policy. Findings

that qualify or contradict the emphasis on training and policy are reported alongside those that support it.

2. Aim and Research Questions

The study aimed to explore how healthcare workers and healthcare users in Ghana understand, experience and engage with digitalisation, and what their accounts reveal about the digital skills, training and policy needed for effective implementation. The aim is underpinned by an overarching question: *what do the situated accounts of healthcare workers and users reveal about the relationship between digital technologies, digital skills, institutional support and healthcare policy in Ghana?* Four research questions follow from it.

1. *RQ1:* How do healthcare workers and healthcare users in Ghana understand digitalisation and its role in healthcare?
2. *RQ2:* What do they experience as enabling or constraining digitalisation in everyday work and care?
3. *RQ3:* How do their accounts portray the role of digital skills and training, and how does this differ between workers and users and between public and private settings?
4. *RQ4:* What do these accounts imply for digital health policy and guidance, and where do they indicate a need for new policy rather than better implementation of existing policy direction?

3. Literature Review and Theoretical Framework

3.1 Conceptualising Healthcare Digitalisation

Healthcare digitalisation describes phenomena ranging from the conversion of paper records into electronic form to the reorganisation of care around networked information systems, mobile platforms and data-driven decision-making. In health systems thinking, information is one of six building blocks of a health system, alongside service delivery, workforce, medical products and technologies, financing, and leadership and governance (WHO, 2007). The building blocks have, however, been criticised for presenting these elements as separable rather than interacting (de Savigny & Adam, 2009). Sociotechnical models address this by treating hardware and software, clinical content, the human–computer interface, people, workflow, organisational features, external rules and regulations, and measurement as interdependent dimensions (Sittig & Singh, 2010). This study adopts that relational view: digitalisation is not a technology but a reconfiguration of work, roles and relationships that technology makes possible and, at times, constrains.

3.2 Healthcare Digitalisation in Ghana

Ghana's 2010 national e-health strategy sought to streamline the regulatory framework for health data, build capacity for e-health, use information and communication technology to reduce inequity and develop paperless records and reporting (Ministry of Health, 2010; Afarikumah, 2014). A review of e-health activity found that most early projects were donor-initiated pilots, from mobile phone programmes for community health to telemedicine (Afarikumah, 2014). At district level, the Ghana Health Service introduced a DHIS2-based District Health Information Management System (DHIMS) in 2007 for aggregate reporting, later extended through tablet-based records at community level (Lee et al., 2022). For individual patient records, the Ministry of Health adopted the Lightwave Health Information

Management System (LHIMS), which was piloted at Cape Coast Teaching Hospital from January 2018 following a ministerial policy decision (Asare et al., 2019; Boadu et al., 2021). IMANI Africa (2021) reported that in June 2021 the Ghana Health Service presented LHIMS to its senior management as the only authorised electronic medical records solution for government and mission hospitals. Alongside LHIMS and DHIMS, participants in this study referred to privately procured hospital management systems, one of which they called HAMS.

Evidence on how these systems function in practice is limited but consistent. Health leaders in nine Ghanaian hospitals reported poor record quality, inadequate training, limited workstations and a lack of frontline involvement in system development (Attafuah et al., 2022). Health workers in two hospitals in the Central Region described inadequate equipment, insufficient training and a lack of technological, logistical and managerial support after implementation (Mensah et al., 2022). Across sub-Saharan Africa, similar barriers are reported: procurement and maintenance costs, unreliable electricity and connectivity, and limited computer skills (Odekunle et al., 2017).

3.3 Healthcare Workers' and Users' Perspectives

Perspectives on digitalisation in Ghana come predominantly from health professionals and managers in public hospitals (Attafuah et al., 2022; Mensah et al., 2022). Healthcare users appear mainly as beneficiaries of mobile health programmes rather than as informants on how institutional digitalisation affects their access, waiting and privacy (Afarikumah, 2014). This is significant because the NASSS framework treats patients and carers, as well as staff, as part of the "adopter system". It argues that a technology's value proposition must be credible to all of them if it is to be sustained (Greenhalgh et al., 2017). Examining workers and users together, in public and private settings, allows tensions between their accounts to become visible.

3.4 Digital Skills, Training and Workforce Capability

International reviews identify knowledge of digital technology, digital skills for patient care and the ethical and communication dimensions of digital work as key competence areas. They emphasise regular education and organisational and collegial support as conditions for positive experiences of digitalisation (Konttila et al., 2019). A later review found that digital health competencies are measured inconsistently and that incomplete digitalisation of clinical practice is partly attributed to gaps in competence (Longhini et al., 2022). The WHO global strategy on digital health calls for digital health competencies in health workforce curricula and for improved digital health literacy among the public (WHO, 2021). The COM-B model offers a way of examining claims about training: behaviour arises from the interaction of capability, opportunity and motivation, so capability building will be ineffective where opportunity is absent (Michie et al., 2011). Research on workarounds adds that when systems are poorly matched to work, staff improvise, partly because of the importance of displaying competence to others (Debono et al., 2013).

3.5 Digital Health Policy, Governance and Implementation

The WHO–ITU National eHealth Strategy Toolkit proposes that a national eHealth environment comprises seven components: leadership and governance; strategy and investment; services and applications; standards and interoperability; infrastructure; legislation, policy and compliance; and workforce (WHO and ITU, 2012). Its premise is that, without a national strategy, digital health tends towards isolated applications unable to share information. The WHO global strategy similarly calls for national governance structures, regulatory frameworks and capacity building for leaders and policy-

makers (WHO, 2021). In Ghana, the 2010 strategy set out capacity building, regulation and paperless records as objectives (Ministry of Health, 2010). Later reviews, however, identified uncoordinated pilots (Afarikumah, 2014), and hospital studies found that training, equipment and managerial support lagged behind deployment (Attafuah et al., 2022; Mensah et al., 2022). Implementation research also shows that policy intent is rarely sufficient where contextual factors are not anticipated and managed (Damschroder et al., 2022). Fiscal policy may interact with digital health too: the Electronic Transfer Levy Act 2022 introduced a 1.5% levy on mobile money and other electronic transfers from 1 May 2022, shortly before data collection (Republic of Ghana, 2022).

3.6 Infrastructure, Interoperability and Fragmented Systems

Electricity, connectivity and devices are preconditions rather than add-ons for digital health in sub-Saharan Africa (Odekunle et al., 2017). Less attention has been paid to the organisational politics of interoperability: who procures systems, who owns data, and how public and private systems are expected to communicate. Ghana's strategy proposed a national architecture grounded in shared standards (Ministry of Health, 2010), and the WHO–ITU toolkit identifies standards and interoperability as a core component (WHO and ITU, 2012). How far either has shaped procurement in practice is unclear.

3.7 Trust, Privacy and Information Governance

Digital records promise improved confidentiality through access controls and audit trails, but they also create risks of large-scale disclosure. Ghana enacted the Data Protection Act in 2012 (Republic of Ghana, 2012), yet empirical evidence on how workers and users perceive the protection of digital health information remains sparse. Sociotechnical models place external rules and internal organisational features alongside technology as determinants of safe use (Sittig & Singh, 2010). This suggests that trust is an organisational and regulatory achievement rather than a property of software.

3.8 Theoretical Framework

Five frameworks were evaluated (Supplementary Table S5). NASSS was selected as the primary framework (Greenhalgh et al., 2017). Its seven domains (condition, technology, value proposition, adopter system, organisation, wider system, and embedding and adaptation over time) map closely onto the issues participants raised. Its distinction between simple, complicated and complex domains helps explain why digitalisation stalls. It has also been shown to support retrospective analysis of historical datasets (Abimbola et al., 2019).

Two complementary frameworks serve specific purposes. The sociotechnical model (Sittig & Singh, 2010) interprets infrastructure, workflow and workarounds at the point of care. COM-B (Michie et al., 2011) examines participants' accounts of digital skills and training, asking whether capability, opportunity or motivation is the binding constraint. The WHO–ITU National eHealth Strategy Toolkit (WHO and ITU, 2012) organises the policy implications, because its components speak directly to workforce, policy and standards. The updated CFIR (Damschroder et al., 2022) was considered but not adopted, because it overlaps substantially with NASSS for this dataset. All frameworks were introduced after initial inductive coding, so that they deepened rather than determined the themes.

4. Methodology

4.1 Research Design

The study adopted a qualitative design based on semi-structured interviews. Qualitative interviews treat the participant as a participant in meaning-making rather than a conduit from which information is retrieved, and individual in-depth interviews are suited to learning about experiences and perspectives on a defined set of issues (DiCicco-Bloom & Crabtree, 2006). A semi-structured format was appropriate for three reasons. First, digitalisation in Ghana was under-researched from the perspective of those who experience it, so open questions were needed to surface unanticipated issues. Second, the study included four participant groups (public and private healthcare workers and users), and a common set of topic areas allowed their accounts to be compared. Third, a guide with prompts and probes allowed interviewers to pursue participants' own examples, such as workarounds during power outages, while keeping each interview focused on the research aim.

The design is aligned with Kallio et al.'s (2016) framework for developing qualitative semi-structured interview guides, which identifies five phases. Table 1 shows how each phase applies to this study.

Table 1. Alignment of the interview design with Kallio et al.'s (2016) framework

Phase	Application in this study	Status
1. Identifying the prerequisites for semi-structured interviews	Topic is complex and experience-based; participants hold direct knowledge as workers or users; comparison across four groups required a shared structure	Evident from design
2. Retrieving and using previous knowledge	Topic areas reflect known e-health issues: institutional support, digitalisation, mobile solutions, efficiency and patient experience (Ministry of Health, 2010; Afarikumah, 2014)	Evident from guide topics
3. Formulating the preliminary guide	Two parallel guides (workers and users), each with five topic areas and closing questions; open questions with follow-up probes	Evident in transcripts
4. Pilot testing the guide	Not reported in this study	Not reported
5. Presenting the complete guide	Topic areas summarised below	Reported in Section 4.1

The worker guide covered digital technology challenges, institutional support, digitalisation, digital mobile technology solutions and operational efficiency. The user guide covered healthcare information, institutional support, digitalisation, digital mobile technology solutions and patient satisfaction. These topic areas structured data collection but were not treated as analytical themes.

The study adopted a social constructionist position (Burr, 2015). From this position, participants' understandings of digitalisation are treated as meanings produced through social interaction, institutional context and language, rather than as neutral reports of an external reality. The position is consistent with reflexive thematic analysis, which treats themes as constructed by the researcher in dialogue with the data (Braun & Clarke, 2021), and with the reflexive approach described in Section 4.5.

4.2 Participants and Setting

Interviews were conducted in Ghana between July and September 2022 with 41 participants: 21 healthcare workers (10 public, 11 private) and 20 healthcare users (10 public, 10 private). A healthcare user was defined as anyone currently using, or who had used, a healthcare facility within the previous 12 months. Workers included doctors, nurses, a midwife, managers, a pharmacist, an accountant and staff recorded as healthcare practitioners. Their facilities ranged from teaching and military hospitals to rural

private facilities and a village facility still using paper records. Figure 1 summarises the age profile of the two groups; full characteristics appear in Supplementary Tables S2 and S3.

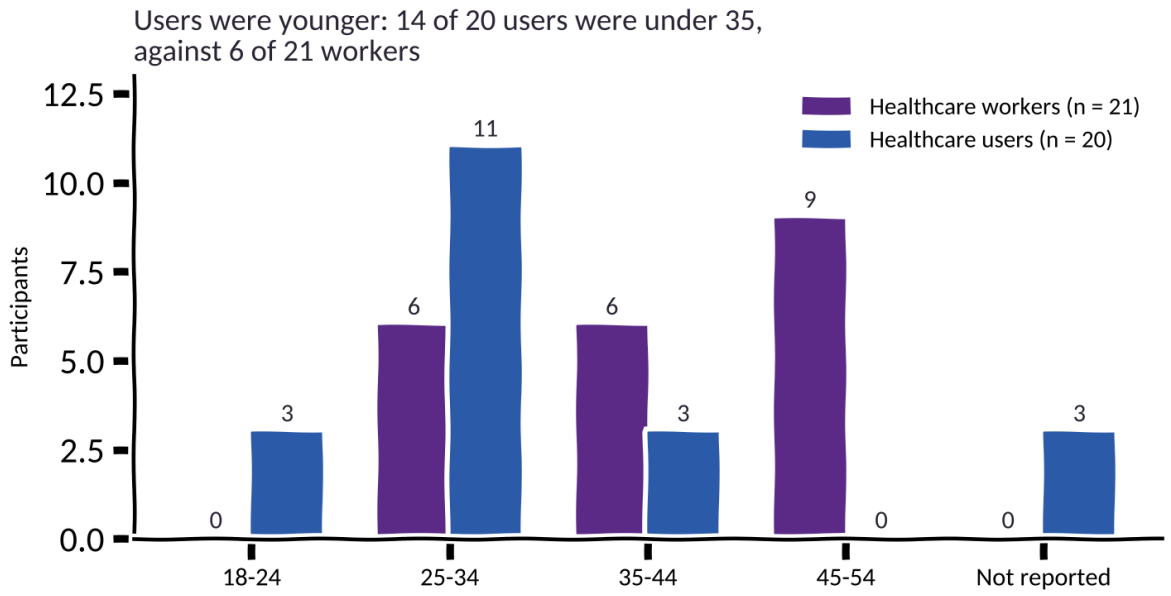

Figure 1. Participants by recorded age band and group. Workers were concentrated in the 35–54 bands and users in the 25–34 band.

Sample adequacy was judged by information power rather than saturation (Malterud et al., 2016). A broad aim and four participant groups call for a larger sample. This was offset by the specificity of participants' experience, the use of established theory in analysis, and a cross-case analytic strategy. A sample of 41 was therefore judged to hold adequate information power for the aim; saturation is not claimed. Interviews lasted between 8 and 47 minutes (median 21:26). Worker interviews had a median length of 25:01 and user interviews a median of 17:52.

4.3 Data Preparation and Audit

Data preparation and audit followed Lincoln and Guba's (1985) criteria for trustworthiness, as operationalised for thematic analysis by Nowell et al. (2017). An auditable decision trail supports the *dependability* of the process and the *confirmability* of findings by allowing a reader to trace interpretations back to the data. Transcript preparation was informed by McLellan et al.'s (2003) guidance that systematic data preparation and documentation are preconditions for rigorous analysis.

The audit comprised seven steps:

1. *Inventory:* a record of each transcript's interview code, role, facility type, demographics, duration and data quality (Supplementary Table S1).
2. *Identifier verification:* two duplicated identifiers were corrected, assigning GH-PR-HW-11 to a private-sector doctor and GH-PR-HU-3 to a private-sector user. The demographic details of GH-PR-HW-11 were confirmed by the first author.
3. *Completeness:* unanswered questions, a non-guide question added in four worker interviews, and interviewer speech retained in some transcripts were logged. Interviewer speech was excluded from the evidence.
4. *Duplication:* pairwise comparison of eight-word sequences found no duplicated content.

5. *Provenance:* four transcripts (GH-PR-HW-11, GH-PR-HU-8, GH-PR-HU-9 and GH-PR-HU-10) were transcribed from audio using automatic speech recognition and cross-checked against a second recognition model. Uncertain words are bracketed and inaudible passages marked.
6. *De-identification:* names of hospitals, a researcher and a regional capital were redacted.
7. *Quotation verification:* every published extract was checked computationally as a verbatim match against its source transcript and logged with its location (Supplementary Table S8).

Figure 2 shows how these steps connect data preparation to analysis and reporting.

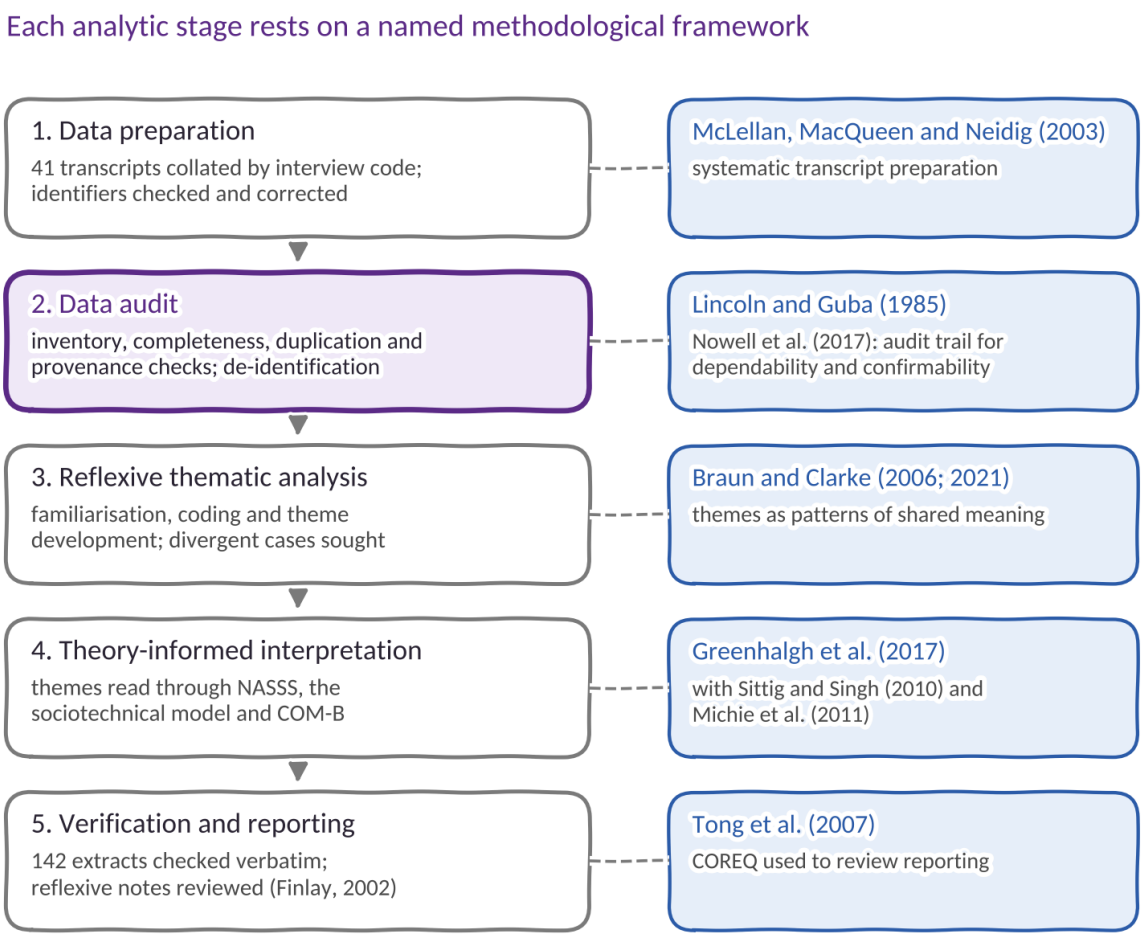

Figure 2. Data preparation, audit, analysis and reporting, with the methodological framework applied at each stage. The data audit (stage 2) provides the audit trail for dependability and confirmability.

4.4 Data Analysis

The analysis used reflexive thematic analysis (Braun & Clarke, 2006; 2021), which treats themes as patterns of shared meaning constructed by the analyst rather than summaries of interview topics. Familiarisation involved reading each transcript in full and writing an analytic memo per participant. Initial coding was data-led and combined semantic codes (for example, “power outage stops entry”) with latent codes (for example, “competence performed for patients”). Worker and user accounts were coded separately, and public–private differences were recorded where the data allowed comparison. Codes were clustered into candidate themes and reviewed against the full dataset. NASSS, the sociotechnical model and COM-B were then used to deepen interpretation, and themes were refined, named and defined (Supplementary Table S4).

Divergent accounts, such as participants who believed records were already shared nationally or who reported short waiting times, were sought deliberately and are reported alongside dominant patterns. Unanswered questions and statements such as “I have no idea” were not treated as evidence that a participant lacked knowledge or held no view. Participants’ perceptions are distinguished from independently established facts, and perceived benefits are not presented as measured effects. Saturation, independent coding and member checking are not claimed.

4.5 Reflexivity

Reflexivity was shaped by Finlay’s (2002) framework, which distinguishes five variants of reflexive practice: introspection, intersubjective reflection, mutual collaboration, social critique and discursive deconstruction. The study followed this framework throughout data collection, analysis and writing, and the variants were applied as follows.

1. *Introspection:* during fieldwork the first author kept a reflective note and daily field notes on a mobile phone. These recorded first impressions of each interview, emerging assumptions and personal reactions, and were revisited during coding to examine how the researcher’s expectations might shape interpretation.
2. *Intersubjective reflection:* the field notes were used to consider how the relationship between researcher and participant, including the researcher’s status as a UK-based academic, may have influenced what participants chose to say, particularly about government and institutional support.
3. *Mutual collaboration:* participants were not involved as co-analysts. Collaborative reflection took place instead within the authorship team, which combines a university-based organisational researcher with a Ghana-based organisation development practitioner.
4. *Social critique:* attention was paid to power differences between researcher and participants and between participant groups, for example between doctors and users waiting for care, and to how these differences might shape accounts.
5. *Discursive deconstruction:* the analysis attended to how language shaped meaning, such as the contested meanings participants attached to “digital” and the use of English as the language of interview and of digital systems.

The first author is an organisational researcher at Loughborough Business School whose previous work examined organisational culture and employee voice in health and social care, and who works in a research–practice partnership with Ho Teaching Hospital on healthcare digitalisation. The second author works in organisation development in Ghana. These positions brought familiarity with health organisations and with Ghana’s digitalisation agenda, but also a risk of over-emphasising organisational solutions such as training and policy. To counter this risk, the analysis coded explicitly for accounts that challenged that emphasis and reports them alongside supporting accounts. AI tools supported the transcription of four interviews, analysis and drafting under the authors’ direction, and all outputs were checked by the authors.

4.6 Ethical Considerations

The study received a favourable ethical opinion from the Ethics Review Sub-Committee at Loughborough University (approval number 10383). All participants gave written informed consent and are identified only by interview code.

5. Findings

Six themes were developed (Figure 3). Their definitions, codes and divergent evidence are set out in Supplementary Table S4, and coverage of every transcript is shown in Supplementary Table S6. Extracts are attributed by interview code: HW denotes healthcare workers and HU healthcare users; PB denotes public and PR private facilities.

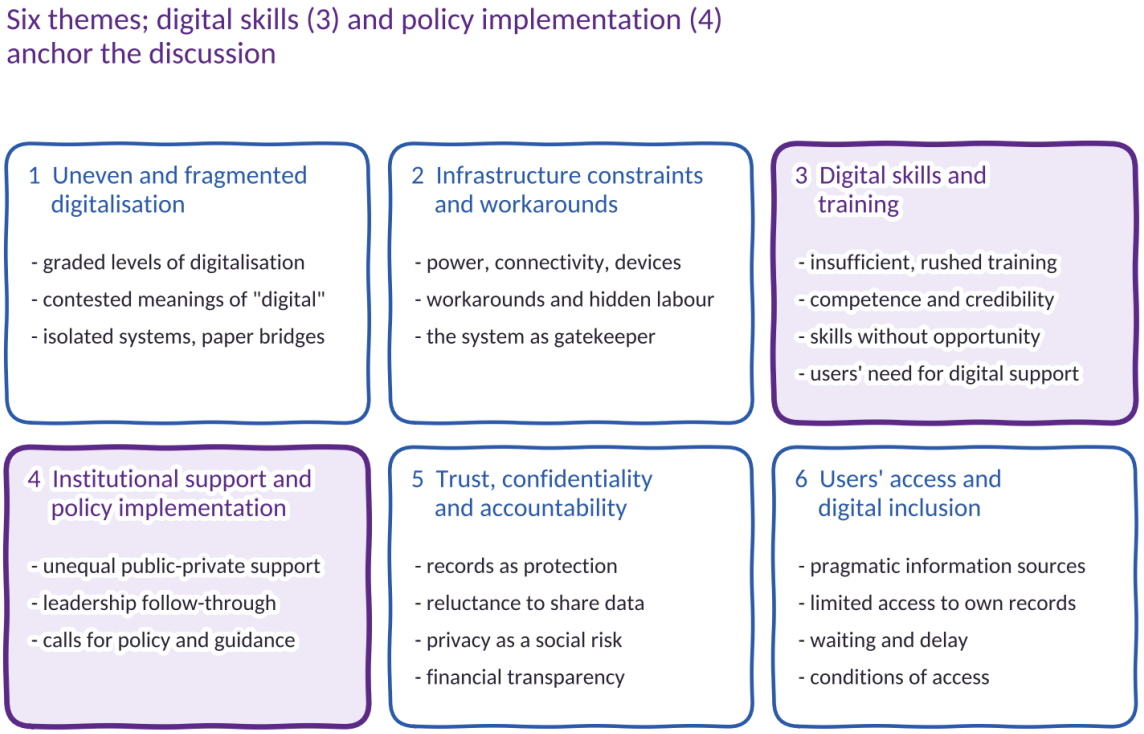

Figure 3. Thematic map of the six themes and their subthemes. Themes 3 and 4, on digital skills and policy implementation, are the focus of the discussion.

Every theme was evidenced in both groups, but with different emphasis (Figure 4). Infrastructure constraints and digital skills were raised mainly by healthcare workers, whereas access and inclusion were raised by every user. These counts indicate the presence of a theme in a participant's account, not its frequency or importance.

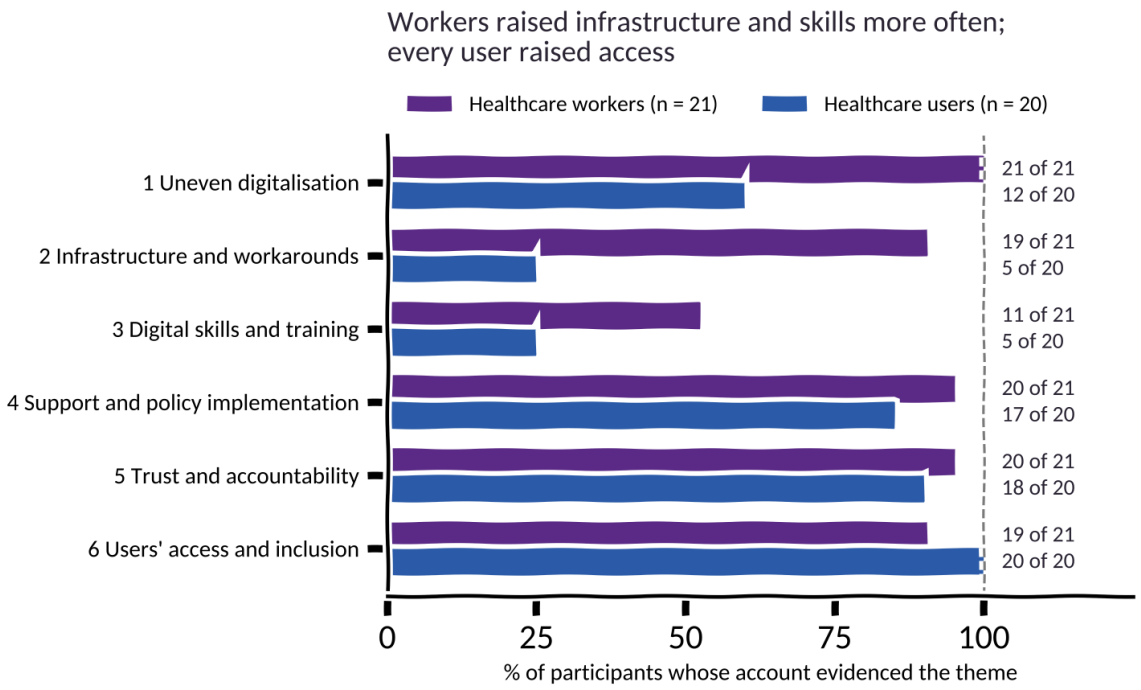

Figure 4. Proportion of workers and users whose accounts evidenced each theme. Presence in an account does not indicate frequency or importance.

5.1 Uneven and Fragmented Digitalisation

5.1.1 Graded Levels of Digitalisation

Participants did not describe a single health system undergoing digitalisation, but a landscape in which the extent of digitalisation depended on the level of care, the sector and the location of a facility. In a public teaching hospital, digital records were described as foundational:

> *"…the digital role would I say is the foundation of our healthcare system because it is the fundamentals now because you hardly get to see the folder"* **(GH-PB-HW-5)**

In rural public and private facilities, by contrast, systems were absent: *"…practically, we are still using the manual system in our village"* **(GH-PB-HW-10)**; *"The main challenge is that they are non-existent in this area"* **(GH-PR-HW-8)**. A private-sector manager mapped this gradient onto the hierarchy of care:

> *"At the regional office level, it's quite high. At the district level, I will call it medium but at the rural areas like where I am coming from and other health facilities there, it is very low or in some communities we have what we call the CHPS COMPOUND which are the smallest units of healthcare facility in the communities and over there, it doesn't exist at all."* **(GH-PR-HW-5)**

A private-sector doctor characterised the national picture as *"…kind of using a hybrid system now"*, in which some hospitals were *"still doing paper"* while others were part of government *"pilot programmes"* **(GH-PR-HW-11)**. Users described modest change: *"there is just PC where the enter your details so that they don't go through files that's all"*, an innovation now *"long overdue"* **(GH-PB-HU-5)**. Not all accounts were critical; one doctor reported that *"remote areas… are also going digital so we've come a long way"* **(GH-PB-HW-3)**. Read through NASSS, the technology domain was described as *complicated*, while the organisational and wider-system domains were *complex*: readiness, resources and coverage varied across levels in ways no single programme controlled (Greenhalgh et al., 2017).

5.1.2 Contested Meanings of "Digital"

Asked about digital products, several participants listed medical equipment rather than information systems. One private practitioner named *"a digital thermometer, digital BP apparatus and some computers"* **(GH-PR-HW-6)**; others listed ultrasound, ECG machines and MRI scanners (GH-PB-HW-3, GH-PB-HW-9, GH-PR-HW-7). Users likewise associated digitalisation with blood pressure machines and laboratory equipment (GH-PB-HU-3, GH-PB-HU-9). This variation indicates that "digitalisation" is a broad and contested category in practice. It suggests that policy and training which use the term loosely may obscure whether information systems, equipment or skills are being promised or funded.

5.1.3 Isolated Systems and Paper Bridges

Where systems existed, they rarely connected. A public-sector doctor reported that *"in Ghana, especially in the public sector, there are about three different software that we use to run our healthcare systems"* **(GH-PB-HW-4)**. A private-sector nurse explained that *"it seems the regional hospital they use LHIMS and over here we use DHIMS so you can't send the information to that facility"* **(GH-PR-HW-3)**. Fragmentation also existed within institutions: *"what we are using for clinical services now is not linked to the human resource data base"* **(GH-PB-HW-1)**. Between facilities, information therefore travelled by older routes:

> *"…before a patient gets to a facility their information is really not transferred or shared. Most times the information is discussed on phone."* **(GH-PB-HW-6)**
>
> *"We have to write a referral letter in an envelope and give to the client to send…"* **(GH-PR-HW-4)**

In some cases digital records were converted back to paper to cross institutional boundaries: *"you have to print out almost everything from your side, then you take it to the other side so that they input it into their system"* **(GH-PR-HW-11)**. Users described paper files that could be *"misplace[d]… or… lost"* during ambulance transfers **(GH-PR-HU-5)**. Accounts of integration nevertheless diverged. One nurse believed that *"Right now, all government hospitals in Ghana are using one system software so sharing information among these hospitals has become easy"* **(GH-PR-HW-7)**, while a public-sector manager was *"not very sure if that aspect is being really pursued yet"* **(GH-PB-HW-1)**. These divergent beliefs reflect variation between facilities and uneven communication about national programmes, which itself complicates implementation.

5.2 Infrastructure Constraints and Workarounds

5.2.1 Electricity, Connectivity and Devices

Infrastructure was the most frequently described constraint among workers, with a sectoral and regional pattern. In private and northern facilities, electricity dominated: *"To me, the number one challenge is about electricity"* **(GH-PR-HW-3)**; *"especially the northern side, the lighting system is just on and off because of that, the system is just not stable"* **(GH-PR-HW-4)**; *"Our generator is there but there's no fuel"* **(GH-PR-HW-5)**. In public teaching hospitals, connectivity and device shortages were more prominent:

> *"…when we have issues with the internet we lose data, we lose patients information, information that hasn't been saved…"* **(GH-PB-HW-2)**

Another doctor reported that *"the whole department might have one functional tablet"* **(GH-PB-HW-5)**, and maintenance compounded scarcity: *"the maintenance culture is bad. So the computers break down and nobody is even eager to fix them"* **(GH-PB-HW-2)**. Users recognised the same preconditions: *"you need light [electricity]… And you need internet to operate it"* **(GH-PR-HU-9)**.

5.2.2 Workarounds and Hidden Labour

Workers did not simply stop when systems failed; they improvised. A midwife described a routine safeguard:

> *"…we use our treatment sheet to copy some of the medications so that in case there's light out, we will not be wondering what medication or what dosage…"* **(GH-PR-HW-4)**

Informal arrangements produced losses: *"due to the workload, you sometimes forget that you have taken from the pharmacy and there's a need for you to enter it… making them run at a loss"* **(GH-PR-HW-2)**. Device shortages were met by personal provision: *"I go with my laptop, my iPad, so I use my gadgets. I don't depend on the hospital for these kind of gadgets"* **(GH-PB-HW-6)**. Such workarounds operate as localised acts of resilience (Debono et al., 2013), but they also impose hidden costs: duplicated documentation, personal expenditure and information held outside the system (Sittig & Singh, 2010).

5.2.3 The System as Gatekeeper

Digitalisation also created new points of failure. Because medication orders and dispensing were routed through the system, its absence could halt care: *"you need to upload it on the system before the medications will be delivered to the patient"* **(GH-PB-HW-5)**. Patients could misread these delays: *"they'll be thinking we don't want to attend to them"* **(GH-PR-HW-1)**. Workers also described new error pathways. Where one computer served many staff, a colleague might recall vitals from memory, so *"she might give me a wrong value"* **(GH-PR-HW-3)**. A doctor cautioned that *"medical errors also happen when there is too much information in the system"* **(GH-PB-HW-6)**. One practitioner rejected the premise that technology reduces error: *"We are humans so if the error will happen, it will happen"* **(GH-PR-HW-6)**. These accounts qualify the widespread belief that digital records reduce errors, suggesting that errors are changed in form rather than eliminated.

5.3 Digital Skills and Training

5.3.1 Insufficient, Theoretical and Rushed Training

The need for digital skills and training was among the most consistent themes in workers' accounts, particularly in public hospitals. A doctor identified training as the principal challenge: *"the main challenge is the training of the personnel… some of them don't know how to use it"* **(GH-PB-HW-3)**. Another observed: *"I also think there's not enough teaching as to how to go about using the software"* **(GH-PB-HW-4)**. Where training was provided, it was described as too brief, *"not enough for us to know the system well"* **(GH-PB-HW-3)**; as theoretical, *"so people don't really have the feel of the practicals"* **(GH-PB-HW-5)**; or as rushed:

> *"…most of the time, these trainings are rushed and most of the questions that come up during this training is not really answered very well"* **(GH-PB-HW-6)**

The same doctor explained that *"the trainers themselves also experience those same challenges"*, and estimated that *"about 30 to 40% of hospital workers are not so happy with the system"* **(GH-PB-HW-6)**. Participants proposed specific remedies. One called for *"a boot camp… for us to ask any questions and for us to practice more on the system"* **(GH-PB-HW-3)**; another for leaders to *"agitate for seminars to be held to provide workers with the requisite skills needed to operate the technological facilities"* **(GH-PB-HW-9)**. In the private sector, a nurse argued that *"all health providers should be taken through a training into the digitalized system"* **(GH-PR-HW-3)**, and an accountant proposed *"a standardize education"* **(GH-**

PR-HW-9). A pharmacist warned that limited proficiency could reverse the intended benefits, *"often times it leads to losses rather than gains"*, and set out a model for continuing and pre-service education:

> *"…there should be something more like a workshop or training centres that available at every district to regularly train/update workers so that they can adjust to the system. And to those who are yet to come in, I think the IT and digital system should be well incorporated into their training in the various institutions."* **(GH-PR-HW-10)**

These accounts point not only to a deficit of training but to the absence of a structured, standardised approach to digital skills across the workforce.

5.3.2 Digital Competence and Professional Credibility

Digital skills were also relational. A nurse explained that unfamiliarity with the system was visible to patients:

> *"The patients will be sitting there and will be thinking you don't even know what you're doing or you are not competent enough to take care of him or her."* **(GH-PR-HW-3)**

Digital competence had therefore become part of how professional competence was judged at the bedside, consistent with evidence that the need to display competence shapes how staff respond to systems (Debono et al., 2013).

5.3.3 Skills Without Opportunity

Three patterns qualify the emphasis on training. First, training without technology produced skills that could not be used. A worker in a village facility explained:

> *"Those in other areas are using the digital technology and we went through the same training with them… So, if we are using same digital technologies in our area, I think it will help our activities to improve"* **(GH-PB-HW-10)**

In COM-B terms, capability had been built but physical opportunity was absent (Michie et al., 2011). Second, some workers located the problem in design as well as skill: *"those who are making the software's should try and make things simple"*, because *"some of these bureaucracies in using the softwares are quite unnecessary"* **(GH-PB-HW-4)**. Third, skills appeared to accumulate through sustained use. A doctor who described himself as *"a digital doctor"* reported that with any new system *"I don't spend a lot of time learning it, because I can read and write and have operated other systems before"* **(GH-PR-HW-11)**.

5.3.4 Users' Need for Digital Support

Users also framed digital skills as essential. One argued that providing technology without trained personnel would be *"like pouring water on rocks"*, adding that government should *"also get personnel that will help them on how to use it"* **(GH-PR-HU-1)**. Others emphasised assisted use for patients: *"if you know you don't really know your way around a smartphone, someone should help you do it"* **(GH-PB-HU-5)**. Users also called for systems that are *"easy to use even if no one is around to guide you"* **(GH-PR-HU-3)**. Taken together, the accounts show that digital skills are necessary for both workers and users, and are effective only when paired with reliable infrastructure, usable design and organisational support.

5.4 Institutional Support, Leadership and Policy Implementation

5.4.1 Unequal Public and Private Support

Accounts of government support divided sharply by sector. Public-sector workers described tangible but bounded support when systems were introduced: *"they gave some desktops, some laptops and then I think they gave some servers"*, with sponsorship of the software, but *"aside that, there's nothing else"* **(GH-PB-HW-1)**. Private-sector workers described government digital support as absent: *"That one is zero"* **(GH-PR-HW-5)**. Private facilities had financed their own systems:

> *"We acquired the system ourselves from a private company, and we pay quarterly for the maintenance and everything. The government doesn't do anything about it."* **(GH-PR-HW-11)**
>
> *"Its basically a contract between the hospital and the software developers, government does not have a hand in how the system works"* **(GH-PR-HW-10)**

One private manager described a relationship in which the facility, rather than the state, sought engagement: *"It is we ourselves that are rather trying to engage ourselves with them and we haven't gotten the go ahead"* **(GH-PR-HW-1)**. Reimbursement delays limited private facilities' capacity to invest: *"it doesn't also come quickly. Sometimes it takes some months"* **(GH-PR-HW-1)**. Some private workers did report inclusion in district workshops, *"especially when there is a new policy that they want to roll out"* **(GH-PR-HW-5)**. Users' views of government support centred on the National Health Insurance Scheme, which several valued and others found limited: *"a lot of services are not covered by it"* **(GH-PB-HU-2)**.

5.4.2 Leadership and Implementation Follow-Through

Workers expected leaders to provide devices, maintenance and connectivity, but several described a gap between knowing and acting. One doctor argued that *"Most of the leaders are not properly informed"*, and that where problems were known, *"they are always several meetings held and really nothing much happens"* **(GH-PB-HW-6)**. Another located the gap between instruction and practice:

> *"…those up there have probably given the instructions for this to be done but how it's being carried out might not be as efficient as they expect it to be"* **(GH-PB-HW-5)**

A public-sector manager identified a structural constraint on local leadership. Centralised procurement had created dependence on a vendor, so that *"we don't own the data or we are not the developers of the software ourselves"*, and fixes were delayed **(GH-PB-HW-1)**.

5.4.3 Calls for Policy and Guidance

Across sectors, participants called for national direction that would connect fragmented systems and support facilities. The same public-sector manager argued that *"policy is key by the leaders of the country and they must also provide the agencies the resources"*, and called for policy that allows different systems to *"handshake"* rather than a single imposed product **(GH-PB-HW-1)**. Private-sector workers sought a common national system: *"We should all have one technology, one system so that it will run throughout the country"* **(GH-PR-HW-1)**; *"If the government is able to provide a centralized system where we can upload all information pertaining to our patients"* **(GH-PR-HW-8)**. A worker in a paper-based village facility located responsibility with government and the legislature: *"The policies and other things are with him through the legislative arm of government"*, adding *"we need it badly"* **(GH-PB-HW-10)**.

Users expressed similar expectations. One called on government to *"ensure there is database for all health that can be accessible to anyone, anywhere, that can be confidential to only the local health institution and the person involved"* **(GH-PR-HU-3)**. Another proposed that *"as soon as they scan your Ghana card, all your information should show up"* **(GH-PB-HU-5)**. A third argued that mobile channels needed formal recognition: *"they have to legalize it and then it should be approved in the health system"* **(GH-PB-HU-7)**. One user concluded: *"We need the digital system. Government as well as other opinion leaders should intervene"* **(GH-PR-HU-5)**.

Most problems described sat in NASSS's organisational and wider-system domains: rollout reaching *"only… the bigger hospitals"* while *"the smaller ones have not been done yet"* **(GH-PR-HU-8)**, together with maintenance, procurement, training and reimbursement. These are weaknesses of implementation, coordination, resourcing or enforcement rather than absences of policy direction. A smaller set of accounts pointed to policy gaps: interoperability standards across public and private systems, regulatory recognition of digital channels, and fiscal measures that conflict with digital health goals. One manager argued that taxing electronic payments for remote consultations meant that *"basically, the purpose is defeated already"* **(GH-PB-HW-1)**, a reference to the electronic transfer levy introduced months earlier (Republic of Ghana, 2022).

5.5 Trust, Confidentiality and Accountability

5.5.1 Digital Records as Protection and Discipline

Workers frequently described digital records as safer than paper. A nurse explained that with paper folders *"the patients relatives can easily pick and read"* **(GH-PR-HW-2)**, and that individual logins ended a practice in which *"someone could use your name and write for the patient"* **(GH-PR-HW-2)**. The permanence of entries was experienced as disciplining: one doctor wrote more carefully *"knowing that this same information can be accessed by the lawyers"* **(GH-PB-HW-2)**, and another observed that *"if you are not careful, you can be in trouble"* **(GH-PB-HW-5)**.

5.5.2 Institutional Reluctance to Share Data

Trust between institutions was weaker. A manager predicted that sharing *"is good but the facilities would resist it"*, because shared records could expose errors in medico-legal disputes **(GH-PB-HW-1)**. Others cited professional codes, *"If anything, we have to seek the consent of that patient"* **(GH-PB-HW-10)**, and *"lack of trust to share patient's"* data **(GH-PB-HW-8)**. Interoperability was therefore constrained by institutional and professional norms as well as by technology, which points to the need for clear guidance on consent and information sharing.

5.5.3 Privacy as a Social Risk for Users

Users' concerns centred on disclosure within their communities. One feared *"the person going around to tell people even though they said it's confidential"* **(GH-PB-HU-1)**. Another described the exposure of small places:

> *"They talk too much and they share but the thing has to be confidential… especially when you live in a small place, by the time you realize, your health data is everywhere"* **(GH-PB-HU-3)**

A private user recounted a relative's stigmatised diagnosis being disclosed by a nurse described as "service personnel": *"the family wanted to have it as a secret but at the end of the day the news was all over"* **(GH-PR-HU-1)**. These concerns shaped preferences for storing digital records:

> *"…some sicknesses come with a lot of stigmatisation. So to prevent all those things, on my phone I'm safe with that, but on the website the whole world would know what is wrong with me"* **(GH-PR-HU-9)**

Others reached the opposite conclusion because phones are shared: *"someone comes right now [and says], 'Oh please, let me borrow your phone…'"* **(GH-PR-HU-10)**. Divergent accounts expressed confidence in professional confidentiality (GH-PR-HU-4) or raised a different risk, that shared records *"may influence the choice of drugs"* prescribed for an unrelated complaint **(GH-PR-HU-7)**.

5.5.4 Accountability and Financial Transparency

Many workers associated digitalisation with financial transparency. A manager reported that after moving from manual systems *"our revenue went up. This tells you that people are pocketing money"* **(GH-PB-HW-1)**. A doctor explained that his hospital's system had been introduced mainly to curb theft, but added: *"By what percentage it has brought it down, that one I can't tell"* **(GH-PR-HW-11)**. Users connected favouritism to paper processes, describing those with connections having files fetched while *"the others have to wait for about two hours"* **(GH-PR-HU-1)**. These are perceptions, not measured effects, but they show that digitalisation was valued partly as a governance technology.

5.6 Healthcare Users' Access and Digital Inclusion

5.6.1 Pragmatic Sources of Health Information

Users assembled health information from the internet, WhatsApp groups, friends working in health, family doctors and pharmacies, and explained their choices in terms of speed, cost and trust. One described self-management as normal: *"Nowadays we mostly take cases into our own hands and prescribe medicines for ourselves"*, because the pharmacy *"is much affordable than the hospital"* **(GH-PB-HU-10)**. Trust was often produced through corroboration, whether by checking online answers with *"friends who are in health sector"* **(GH-PB-HU-5)** or by consensus in a WhatsApp group where *"two people are saying the same thing"* **(GH-PB-HU-8)**.

5.6.2 Limited Access to Personal Health Records

Users described exclusion from the information held about them: *"healthcare information is not accessible to patient"* **(GH-PR-HU-2)**; *"they'll put my data, my information, in the computer"* but *"normally I don't ask them"* **(GH-PR-HU-10)**. A public-sector doctor confirmed that results are discussed with patients *"but the patient will not have access to the information"* **(GH-PB-HW-6)**.

5.6.3 Waiting and Delay

For users, the most salient measure of digitalisation was time. A public user contrasted the prospect of a short appointment with *"coming to spend 4 to 6 hours there just to see one doctor"*, adding: *"You are already not healthy… you might end up getting sick if you were not so sick before going"* **(GH-PB-HU-5)**. Long waits deterred attendance: *"when you are sick you don't even feel like going to the hospital"* **(GH-PB-HU-3)**. One private user attributed receiving the wrong medication to *"this exchange of files issue"* **(GH-PR-HU-5)**. Waiting was not uniform, however: one public user reported waits of *"About 30minutes to one hour"* **(GH-PB-HU-6)**, and a private user described a reduction attributed to digitalisation from *"like five hours"* to *"less than thirty minutes"* **(GH-PR-HU-10)**.

5.6.4 Conditions of Access and the Limits of Remote Care

Both workers and users questioned whether digital services would reach those who most needed them. A public user warned that promoting digital services without addressing basic infrastructure would appear hollow:

> *"…they will be seeing you like you didn't provide them with the basic things to access the service and you are here telling us that we can use the service… I think if the system will brought, the basic needs have to be first addressed"* **(GH-PB-HU-8)**

A doctor predicted that benefits would accrue to *"the people who are well-to-do, the people who are educated… the people who earn good salaries"* **(GH-PR-HW-11)**. Others pointed to *"pick and call phones"* **(GH-PR-HW-5)**, older and less literate patients with *"phones, but not smartphones"* **(GH-PB-HW-2)**, data costs (GH-PR-HU-10) and language, warning that unless things are explained *"in the language they understand… implementation is affected"* **(GH-PR-HW-10)**. Participants proposed low-threshold channels: *"a basic code like how we use recharge cards"* **(GH-PB-HU-10)** and a toll-free line so that *"no call credit is needed"* **(GH-PR-HU-4)**. Users also set limits on remote care, declining to *"rely on it a hundred percent"* because *"you cannot get a blood sample with this online technology"* **(GH-PR-HU-9)**. Concerns about unregulated products shaped attitudes to online purchasing: *"it might not be approved by FDA"* **(GH-PR-HU-5)**. Conversely, one user valued digital channels for sensitive conditions *"we cant be able to face someone and talk"* about **(GH-PB-HU-4)**.

6. Discussion

This study examined what the situated accounts of healthcare workers and users reveal about healthcare digitalisation in Ghana. Participants experienced digitalisation as an uneven and fragmented process, held together by workarounds and paper bridges, within which skills, infrastructure, institutional support and trust were closely interdependent. Two needs ran through their accounts. The first was for structured development of digital skills among the workforce and of digital health literacy among users. The second was for coherent digital health policy and guidance to coordinate, resource and regulate digitalisation across public and private settings. This section relates these needs to the literature and to the frameworks adopted.

6.1 Digital Skills as a Foundation for Healthcare Digitalisation

The findings confirm, from a wider range of settings, the Ghanaian evidence that inadequate training constrains the use of electronic records (Attafuah et al., 2022; Mensah et al., 2022). Workers described training that was too short, too theoretical and delivered by trainers who could not answer system-specific questions. They estimated that a substantial share of colleagues were dissatisfied with systems they had not been prepared to use. These accounts align with international evidence that competence in digitalisation depends on regular, practical education and on organisational support (Konttila et al., 2019), and that gaps in competence contribute to incomplete digitalisation of clinical practice (Longhini et al., 2022).

The study extends this evidence in two ways. First, participants' proposals amounted to a call for a structured, national approach to digital skills rather than ad hoc system training. They asked for practical "boot camp" training, standardised education, district centres for continuing updates and integration of digital skills into pre-service curricula. These proposals correspond closely to the workforce component of the WHO–ITU National eHealth Strategy Toolkit (WHO and ITU, 2012) and to the WHO global

strategy's call for digital health competencies in health workforce education (WHO, 2021). Second, digital competence was relational: patients judged professional competence by staff members' fluency with systems. Digital skills training should therefore be understood as supporting professional confidence and credibility, not only technical operation (Debono et al., 2013).

The COM-B model clarifies the conditions under which skills translate into practice (Michie et al., 2011). Capability was built without physical opportunity in a village facility whose staff had been trained but had no system. Opportunity was constrained elsewhere by a single tablet per department or a generator without fuel. Motivation was eroded by repeated system failure. Workers' calls for simpler software also indicate that well-designed interfaces can reduce the skills burden that training must carry (Sittig & Singh, 2010). The implication is not that training matters less, but that digital skills development must be planned together with infrastructure, usable design and organisational support if it is to be effective.

6.2 The Need for Digital Health Policy and Guidance

Participants' accounts point consistently to the need for coordinated policy and guidance. Table 2 maps the findings onto the seven components of the WHO–ITU National eHealth Strategy Toolkit (WHO and ITU, 2012). It distinguishes needs that reflect weak implementation of existing policy direction from those that indicate a need for new policy or guidance.

Table 2. Findings mapped to the WHO–ITU National eHealth Strategy Toolkit components

Component	What participants described	Implementation of existing direction	New policy or guidance indicated
Leadership and governance	Leaders aware of problems but not acting; private facilities outside national programmes	Follow-through on decisions; clearer accountability	Inclusion of private facilities in national digital health governance
Strategy and investment	One tablet per department; generators without fuel; reimbursement delays	Recurrent budgets for devices, maintenance and fuel	Funding mechanisms that extend to private and rural facilities
Services and applications	Rollout limited to larger hospitals; CHPS compounds still on paper	Extension of existing programmes to lower levels of care	—
Standards and interoperability	Multiple incompatible systems; referrals by phone, envelope or printout	—	National interoperability standards spanning public and private systems
Infrastructure	Power outages, poor connectivity, device shortages	Investment in power, connectivity and maintenance	Minimum infrastructure standards for digitalised facilities
Legislation, policy and compliance	Privacy fears; reluctance to share; e-levy on remote consultations; unapproved online medicines	Enforcement of data protection law	Guidance on consent and data sharing; regulation of digital channels and online pharmacy; fiscal alignment
Workforce	Short, theoretical and rushed training; calls for district centres and pre-service integration	Adequate time and resources for existing training	National digital skills standards for pre-service and continuing education

As Table 2 shows, many gaps concern the implementation of an existing policy direction. Ghana's e-health strategy already set out capacity building, regulation and paperless records as objectives (Ministry of Health, 2010). Rollout beyond larger hospitals, maintenance, device provision, reimbursement and leadership follow-through are implementation failures, consistent with evidence that contextual factors undermine even well-planned implementation (Damschroder et al., 2022). The accounts nonetheless indicate a need for new policy and guidance in specific areas: interoperability standards, inclusion of private facilities, national digital skills standards, guidance on consent and data sharing, regulation of digital channels, and alignment of fiscal policy such as the 2022 electronic transfer levy with digital health goals (Republic of Ghana, 2022). Policy is needed not only as national strategy but also as operational

guidance on downtime procedures, training requirements and information sharing that frontline staff can follow. Additional policy will not improve practice, however, unless it is resourced, communicated and monitored.

6.3 Aligning Digital Skills and Digital Health Policy

Taken together, the findings suggest that skills and policy are mutually dependent. Figure 5 presents an interpretive typology of four configurations observed or implied in participants' accounts.

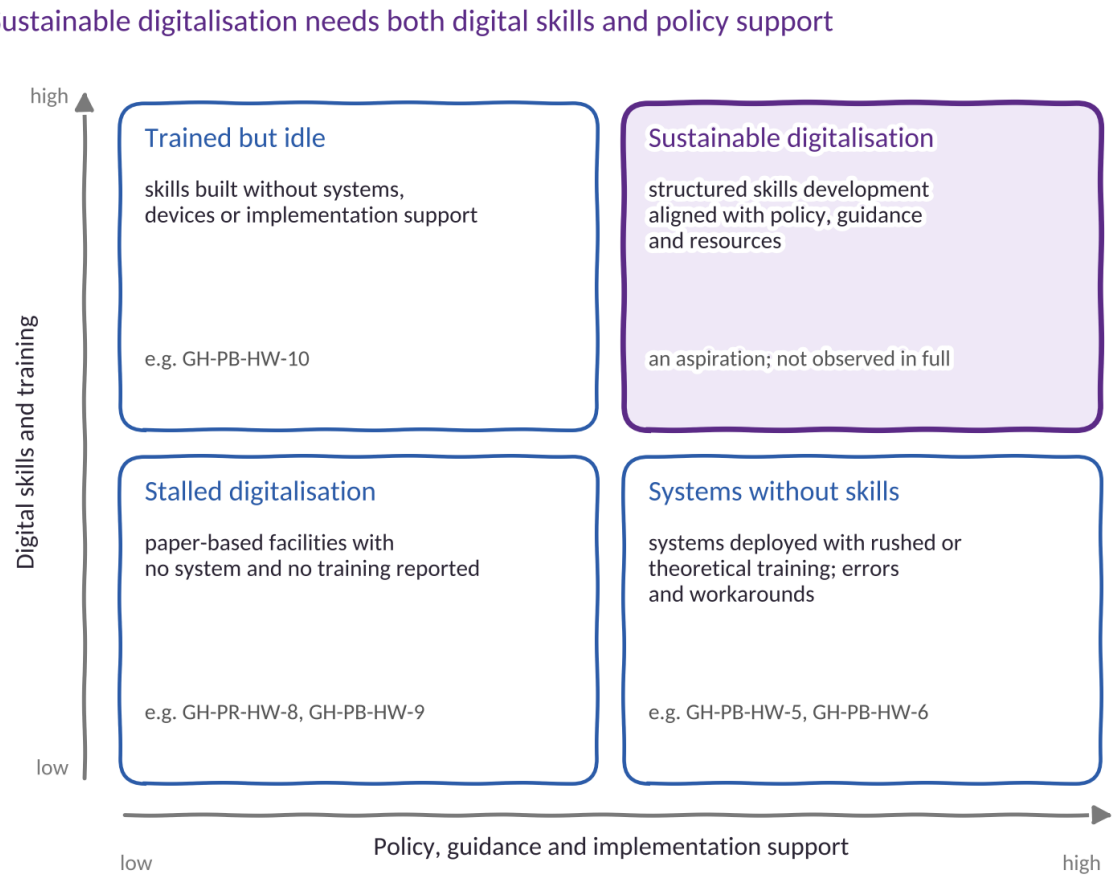

Figure 5. Configurations of digital skills and policy support suggested by participants' accounts. Interview codes indicate illustrative accounts, not measured positions.

Where neither skills nor policy support is present, digitalisation stalls, as in paper-based facilities that reported no system and no training. Where skills are built without implementation support, trained staff remain idle, as in the village facility. Where systems are deployed with policy backing but without adequate training, as in public hospitals that described rushed or theoretical training, digitalisation proceeds but with errors, workarounds and dissatisfaction. Sustainable digitalisation requires both: structured skills development aligned with policy, guidance and resources. No participant described this configuration fully, which suggests it remained an aspiration rather than a reality in 2022.

6.4 Healthcare Users, Digital Health Literacy and Inclusion

Users experienced digitalisation primarily through waiting, access and privacy. They were largely excluded from their own records. Their privacy concerns were rooted in social exposure within communities, and their information-seeking relied on pharmacies, WhatsApp groups and friends in health. From the perspective of NASSS, the value proposition of institutional digitalisation had not yet

been made credible to users, and the adopter system had been designed around staff (Greenhalgh et al., 2017). Users' calls for assisted digital use, information in local languages and low-threshold channels such as short codes and toll-free lines align with the WHO global strategy's emphasis on digital health literacy and inclusion (WHO, 2021). They also indicate that policy should address patient access to records and digital inclusion, not only institutional systems. These conclusions are grounded in Ghanaian accounts; they may be relevant elsewhere in sub-Saharan Africa where similar constraints are reported (Odekunle et al., 2017), but this study cannot establish that.

6.5 A Study-Informed Conceptual Model

Figure 6 summarises the relationships suggested by the findings. It is an interpretive contribution derived from participants' accounts, not a validated causal model.

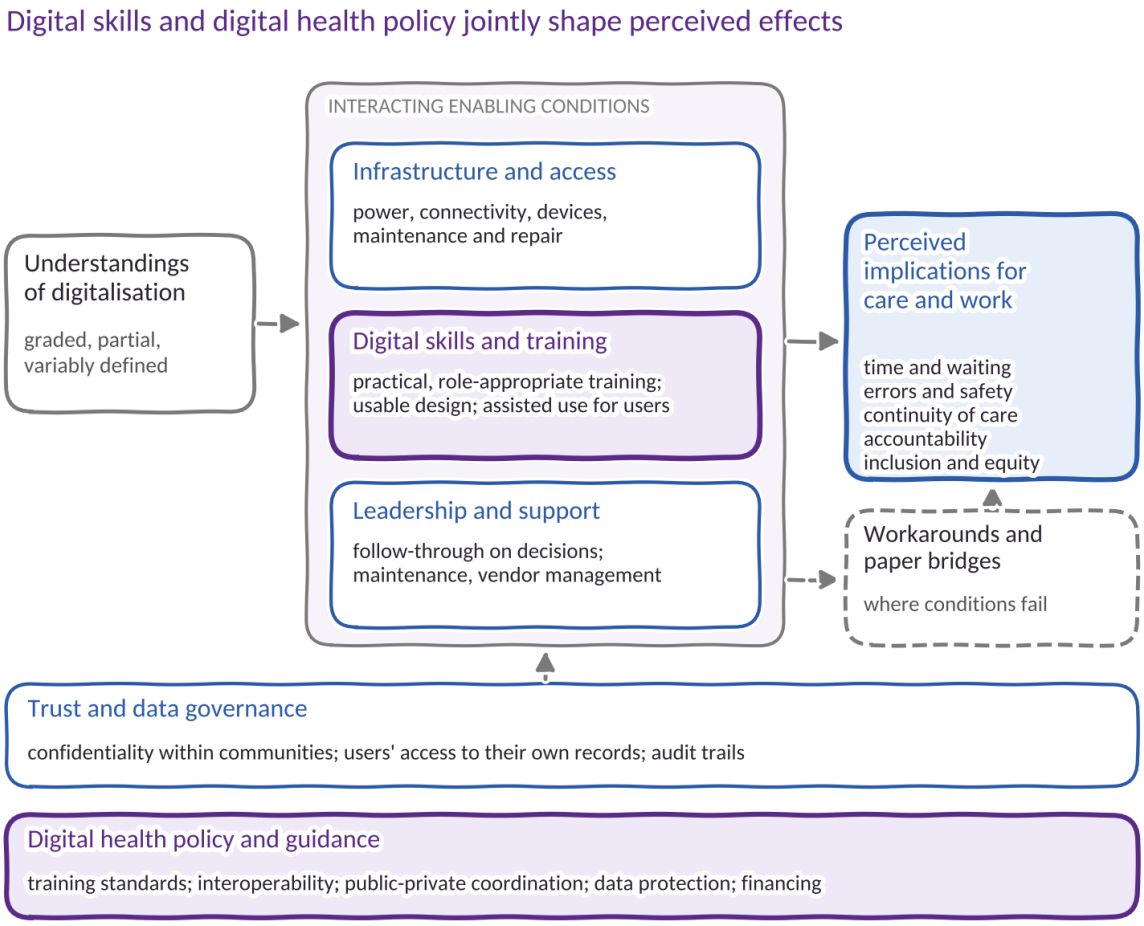

Figure 6. Study-informed conceptual model. Digital skills and training interact with infrastructure and leadership support, framed by trust and by digital health policy and guidance, to shape perceived implications for care and work. Dashed lines indicate workarounds where enabling conditions fail.

The model places participants' understandings of digitalisation at its starting point. Three enabling conditions interact at its core: infrastructure and access, digital skills and training, and leadership and organisational support. These are framed by trust and data governance and by digital health policy and guidance, including training standards, interoperability, public–private coordination and data protection. Their interaction shapes the perceived implications for care and work that participants described: time, errors, continuity, accountability and inclusion. Workarounds and paper bridges appear where enabling conditions fail.

6.6 Theoretical Contribution

The study's contributions are modest, given its reliance on transcripts from a single period, but they are meaningful in three respects. First, by analysing workers' and users' accounts across public and private settings, the study shows that NASSS's adopter-system and wider-system domains were configured asymmetrically in Ghana. A national programme coexisted with private self-provision, and staff-centred implementation coexisted with users' exclusion from their records. Second, combining NASSS with COM-B and the WHO–ITU toolkit links individual digital skills to the policy components that enable or constrain them, offering a basis for targeting both training and policy investment. Third, the concepts of *paper bridges* and *the system as gatekeeper* describe features of hybrid digital health systems that may help analyse similar transitions elsewhere.

7. Implications for Training, Practice and Policy

The implications below distinguish recommendations grounded directly in participants' accounts (D, data) from those developed through interpretation and the literature (L, literature). None implies that training alone can resolve infrastructural or institutional problems, or that additional policy will improve practice without resources and accountability.

7.1 Digital Skills and Training

Participants called for practical, hands-on and sufficiently long training, delivered by trainers able to answer system-specific questions. They also called for standardised education, district-level continuing updates and integration of digital skills into pre-service curricula (D). A national digital skills framework would give these proposals structure. It should specify role-appropriate competencies for clinical, managerial and support staff, link training to continuing professional development and be sequenced with the arrival of systems and devices (L; WHO and ITU, 2012; WHO, 2021).

7.2 Organisational Practice and Leadership

Workers described leaders who knew about problems but did not act, slow repairs and poor maintenance cultures (D). Leadership development in change management, decision follow-through and vendor management is indicated, together with local technical support and routes for users' feedback to reach developers (D, L). Facilities also need written downtime procedures so that paper fallback is safe and consistent (L).

7.3 Digital Health Policy and Guidance

Most concerns call for stronger implementation of existing policy direction: rollout beyond larger hospitals, recurrent funding for maintenance, timely reimbursement and coordination (D). Targeted new policy and guidance appear warranted on interoperability standards spanning public and private systems, inclusion of private facilities in national digital health governance, national digital skills standards, consent and data sharing, regulation of online medicine sales and teleconsultation, and alignment of fiscal measures with digital health goals (D, L).

7.4 Healthcare Users and Digital Inclusion

Users asked for assisted digital use, information in local languages, low-threshold channels that do not depend on smartphones or data, and access to their own records (D). Digital health literacy initiatives

should be paired with measures that reduce the cost of access, or they risk widening inequity (L; WHO, 2021).

Table 3. Recommendations linked to findings

Finding	Proposed action	Responsible stakeholder	Implementation considerations	Suggested evaluation indicator	Basis
Training described as short, theoretical or rushed (5.3.1)	Competency-based, hands-on onboarding with protected time; refresher cycles; ward-level "super-users"; resourced trainers	Ghana Health Service and Ministry of Health training units; hospital management; system vendors	Schedule around shifts; prepare trainers for system-specific problems; avoid one-off sessions	Share of staff passing a practical competency check; staff confidence; support requests per user	D
Absence of a standardised approach to digital skills (5.3.1)	National digital skills framework with role-specific competencies, linked to continuing professional development	Ministry of Health; Ghana Health Service; professional regulators such as the Nursing and Midwifery Council	Align with the WHO–ITU workforce component; include private-sector staff	Framework adopted; share of facilities applying it	D, L
Calls for district updating and pre-service integration (5.3.1)	District in-service update provision; digital health modules in pre-service curricula	Health training institutions; professional regulators	Curriculum review cycles; continuing professional development credit	Curricula with assessed digital competence; in-service sessions per district	D
Skills without opportunity in a village facility (5.3.3)	Sequence training with device and system deployment rather than ahead of it	Ministry of Health deployment teams; district health directorates	Joint procurement and training calendars	Interval between training and go-live; system use three months after training	D, L
Users unable to use digital services unaided (5.3.4, 5.6.4)	Assisted digital help points; local-language materials; digital health literacy programmes	Ghana Health Service health promotion; facilities	Do not design smartphone-only services; monitor who is left out	Uptake by age, location and income group	D
Leaders aware of problems but not acting; slow repairs (5.4.2)	Leadership development in change and vendor management; decision logs with tracked actions	Ghana Health Service leadership programmes; hospital boards	Link to performance review	Time from fault report to resolution; meeting actions closed	D, L
Power, connectivity and device failures; paper fallback (5.2)	Written downtime protocols; backup power with recurrent fuel budgets; minimum device-to-staff ratios; maintenance contracts	Facility management; Ministry of Health; vendors	Recurrent rather than capital-only budgets; test downtime procedures	System uptime; device-to-user ratio; recovery time after downtime	D, L
Private facilities self-financing with no digital support (5.4.1)	Include private facilities in national digital health governance, standards and support	Ministry of Health; private facility associations; National Health Insurance Authority	Avoid crowding out private investment; data-sharing agreements	Share of private facilities conforming to national standards	D, L
Incompatible systems; referrals by phone, envelope or printout (5.1.3)	National interoperability standards; a unique patient identifier linked to the national identity system; electronic referral summaries	Ministry of Health; National Identification Authority; vendors	Make standards compliance a procurement condition in both sectors	Referrals with an electronic summary; systems certified as interoperable	D, L
Privacy fears and reluctance to share (5.5)	Guidance on consent and data sharing; role-based access and audit; confidentiality training addressing community disclosure; patient access to records	Data Protection Commission; Ministry of Health; facilities	Balance access with confidentiality	Reported breaches; facilities with access audits; patients able to view records	D, L

Finding	Proposed action	Responsible stakeholder	Implementation considerations	Suggested evaluation indicator	Basis
Fiscal and regulatory misalignment (5.4.3, 5.6.4)	Review treatment of health-related electronic payments under the transfer levy; regulate online pharmacy and teleconsultation	Ministry of Finance; Food and Drugs Authority; Pharmacy Council; Ministry of Health	Consult users and providers	Transaction costs of teleconsultation; registered online medicine sellers	D

8. Strengths and Limitations

The study has three principal strengths. It analyses the accounts of both healthcare workers and healthcare users, in public and private settings, within a single dataset. All 41 transcripts were used and their coverage is demonstrated in the evidence matrix. Every published extract was verified against its source through an auditable trail.

There are also important limitations. First, recruitment and sampling procedures are not reported in detail, so transferability is difficult to judge and the sample cannot be assumed to represent Ghanaian healthcare workers or users. Second, transcripts varied in completeness: some answers were brief or condensed, several questions were unanswered or not asked, and four transcripts were produced using speech recognition. Third, the interview guides framed several questions around the potential benefits of digital technology, which may have encouraged positive accounts, and omitted direct questions on data security. Fourth, users were concentrated in the 25–34 age range and worker participants were predominantly men. Finally, accounts reflect a single period, July to September 2022, and participants' statements about policy, finance and system performance are perceptions that were not independently verified.

9. Conclusion

Healthcare workers and users in Ghana described digitalisation as an uneven and fragmented process. It was foundational in some teaching hospitals, absent in some rural facilities, divided across incompatible public and private systems, and held together by workarounds and paper bridges. Two needs ran through their accounts. Workers consistently identified insufficient, short and theoretical training as a barrier and called for structured, standardised and continuing development of digital skills, while users called for support to use digital services. Both groups also described the absence of coordinated guidance on interoperability, private-sector inclusion, data protection and digital access, and looked to government for direction.

The study concludes that sustainable healthcare digitalisation in Ghana requires investment in digital skills and training developed together with coherent digital health policy and implementation guidance. Most gaps concerned the implementation of existing policy direction, but targeted new policy appears warranted on interoperability standards, national digital skills standards, private-sector inclusion, information sharing and digital access. Training and policy are complementary rather than alternative remedies: skills cannot be exercised without infrastructure and support, and policy cannot be realised without a capable workforce and informed users. These conclusions are grounded in Ghana; their relevance to other African health systems should be examined rather than assumed.

10. Declarations

Ethics approval: The study received a favourable ethical opinion from the Ethics Review Sub-Committee at Loughborough University (approval number 10383).

Consent to participate: All participants gave written informed consent.

Funding: This research was funded by Loughborough University.

Competing interests: The authors declare no competing interests.

Data availability: De-identified interview transcripts are available and can be shared on reasonable request to the first author.

Use of AI tools: AI tools were used to assist the transcription of four interviews through automatic speech recognition and to support analysis and drafting. All outputs were reviewed by the authors, and every quotation was checked against its source transcript.

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Supplementary Materials

These tables document the dataset, participant characteristics, analysis, evidence coverage, frameworks, quotations and reporting gaps. Recommendations appear as Table 3 in the main text.

Table S1. Dataset inventory (41 transcripts)

#	Interview ID	Group	Facility type	Role (header)	Duration	Data quality notes
1	GH-PB-HW-1	Healthcare worker	Public	Manager	38:00	Duration recorded in whole minutes; Conclusions unanswered
2	GH-PB-HW-2	Healthcare worker	Public	Doctor	34:19	Names hospital (redacted); interviewer-added question; Conclusions not recorded
3	GH-PB-HW-3	Healthcare worker	Public	Doctor	35:08	—
4	GH-PB-HW-4	Healthcare worker	Public	Doctor	38:15	Interviewer-added question; military hospital context
5	GH-PB-HW-5	Healthcare worker	Public	Doctor	34:54	Names hospital and a person (redacted); interviewer-added question
6	GH-PB-HW-6	Healthcare worker	Public	Doctor	47:29	Interviewer-added question; Conclusions not recorded
7	GH-PB-HW-7	Healthcare worker	Public	Nurse	8:23	Brief answers; one answer does not address its question
8	GH-PB-HW-8	Healthcare worker	Public	Healthcare Practitioner	15:49	Refers to own duty as a nurse
9	GH-PB-HW-9	Healthcare worker	Public	Healthcare Practitioner	13:00	Duration recorded in whole minutes; brief answers; several blanks
10	GH-PB-HW-10	Healthcare worker	Public	Healthcare Practitioner	17:10	Theme 4 entirely unanswered
11	GH-PR-HW-1	Healthcare worker	Private	Manager	22:37	Refers to being “in the public sector” despite private classification
12	GH-PR-HW-2	Healthcare worker	Private	Healthcare Practitioners	31:51	Role described elsewhere as nurse
13	GH-PR-HW-3	Healthcare worker	Private	Nurse	25:01	—
14	GH-PR-HW-4	Healthcare worker	Private	Midwife	21:17	Names regional capital (redacted)
15	GH-PR-HW-5	Healthcare worker	Private	Manager	22:15	Interviewer-added question in Theme 3
16	GH-PR-HW-6	Healthcare worker	Private	Healthcare Practitioners	19:22	Brief answers
17	GH-PR-HW-7	Healthcare worker	Private	Nurse	27:41	Theme 3 Q1, Theme 4 Q5–6 and all of Theme 5 unanswered; names hospitals as examples
18	GH-PR-HW-8	Healthcare worker	Private	Healthcare Practitioners	36:34	One answer truncated (“Currently there is on”); two questions unanswered
19	GH-PR-HW-9	Healthcare worker	Private	Accountant	18:34	Several questions unanswered; interviewer text in Conclusions
20	GH-PR-HW-10	Healthcare worker	Private	Pharmacist	24:16	—
21	GH-PR-HW-11	Healthcare worker	Private	Doctor	37:55	Identifier corrected; speech-recognition-assisted transcript
22	GH-PB-HU-1	Healthcare user	Public	Healthcare User	12:27	Contains definition of healthcare user (used in Methodology)
23	GH-PB-HU-2	Healthcare user	Public	Healthcare User	14:58	—
24	GH-PB-HU-3	Healthcare user	Public	Healthcare User	20:22	—
25	GH-PB-HU-4	Healthcare user	Public	Healthcare User	13:05	One Theme 3 question unanswered
26	GH-PB-HU-5	Healthcare user	Public	Healthcare User	24:17	—

#	Interview ID	Group	Facility type	Role (header)	Duration	Data quality notes
27	GH-PB-HU-6	Healthcare user	Public	Healthcare User	14:04	—
28	GH-PB-HU-7	Healthcare user	Public	Healthcare User	17:21	—
29	GH-PB-HU-8	Healthcare user	Public	Healthcare User	21:50	Conclusions blank
30	GH-PB-HU-9	Healthcare user	Public	Healthcare User	13:33	Several blanks; Conclusions blank
31	GH-PB-HU-10	Healthcare user	Public	Healthcare User	17:49	—
32	GH-PR-HU-1	Healthcare user	Private	Healthcare user - Patient	19:13	One Theme 2 question unanswered; interviewer text in Conclusions
33	GH-PR-HU-2	Healthcare user	Private	Healthcare user - Patient	17:56	One Theme 3 question unanswered
34	GH-PR-HU-3	Healthcare user	Private	Healthcare user - Patient	16:00	Identifier corrected: header duplicated GH-PR-HU-2
35	GH-PR-HU-4	Healthcare user	Private	Healthcare user - Patient	32:46	Names hospitals (redacted in use); one hospital name appears mis-transcribed
36	GH-PR-HU-5	Healthcare user	Private	Healthcare user - Patient	21:26	—
37	GH-PR-HU-6	Healthcare user	Private	Healthcare user - Patient	12:26	Several “Not applicable” answers; Conclusions blank
38	GH-PR-HU-7	Healthcare user	Private	Healthcare user - Patient	22:16	—
39	GH-PR-HU-8	Healthcare user	Private	Healthcare user - Patient	22:47	Speech-recognition-assisted transcript; gender and age not stated
40	GH-PR-HU-9	Healthcare user	Private	Healthcare user - Patient	29:53	Speech-recognition-assisted; gender and age not stated; one question without substantive answer
41	GH-PR-HU-10	Healthcare user	Private	Healthcare user - Patient	11:00	Speech-recognition-assisted; gender and age not stated; one question without answer

Table S2. Participant-level characteristics (as recorded in transcript headers)

Interview ID	Participant (as recorded)	Age range	Interview length	Country	Facility type	Role
GH-PB-HW-1	Man	45-54	38:00	Ghana	Public healthcare	Healthcare worker – Manager
GH-PB-HW-2	Woman	25-34	34:19	Ghana	Public healthcare	Healthcare worker – Doctor
GH-PB-HW-3	Woman	25-34	35:08	Ghana	Public healthcare	Healthcare worker – Doctor
GH-PB-HW-4	Man	45-54	38:15	Ghana	Public healthcare	Healthcare worker – Doctor
GH-PB-HW-5	Woman	25-34	34:54	Ghana	Public healthcare	Healthcare worker – Doctor
GH-PB-HW-6	Man	45-54	47:29	Ghana	Public healthcare	Healthcare worker – Doctor
GH-PB-HW-7	Man	35-44	8:23	Ghana	Public healthcare	Healthcare worker – Nurse
GH-PB-HW-8	Man	45-54	15:49	Ghana	Public healthcare	Healthcare worker – Healthcare Practitioner
GH-PB-HW-9	Man	35-44	13:00	Ghana	Public healthcare	Healthcare worker – Healthcare Practitioner
GH-PB-HW-10	Man	45-54	17:10	Ghana	Public healthcare	Healthcare worker – Healthcare Practitioner
GH-PR-HW-1	Man	45-54	22:37	Ghana	Private healthcare	Healthcare worker – Manager
GH-PR-HW-2	Man	35-44	31:51	Ghana	Private healthcare	Healthcare worker – Healthcare Practitioners
GH-PR-HW-3	Woman	25-34	25:01	Ghana	Private healthcare	Healthcare worker – Nurse
GH-PR-HW-4	Women	25-34	21:17	Ghana	Private healthcare	Healthcare worker – Midwife

Interview ID	Participant (as recorded)	Age range	Interview length	Country	Facility type	Role
GH-PR-HW-5	Man	45-54	22:15	Ghana	Private healthcare	Healthcare worker – Manager
GH-PR-HW-6	Man	25-34	19:22	Ghana	Private healthcare	Healthcare worker – Healthcare Practitioners
GH-PR-HW-7	Woman	35-44	27:41	Ghana	Private healthcare	Healthcare worker – Nurse
GH-PR-HW-8	Man	45-54	36:34	Ghana	Private healthcare	Healthcare worker – Healthcare Practitioners
GH-PR-HW-9	Man	35-44	18:34	Ghana	Private healthcare	Healthcare worker – Accountant
GH-PR-HW-10	Man	35-44	24:16	Ghana	Private healthcare	Healthcare worker – Pharmacist
GH-PR-HW-11	Man	45-54	37:55	Ghana	Private healthcare	Healthcare worker – Doctor
GH-PB-HU-1	Woman	18-24	12:27	Ghana	Public healthcare	Healthcare User
GH-PB-HU-2	Man	25-34	14:58	Ghana	Public healthcare	Healthcare User
GH-PB-HU-3	Woman	18-24	20:22	Ghana	Public healthcare	Healthcare User
GH-PB-HU-4	Woman	25-34	13:05	Ghana	Public healthcare	Healthcare User
GH-PB-HU-5	Woman	25-34	24:17	Ghana	Public healthcare	Healthcare User
GH-PB-HU-6	Man	35-44	14:04	Ghana	Public healthcare	Healthcare User
GH-PB-HU-7	man	25-34	17:21	Ghana	Public healthcare	Healthcare User
GH-PB-HU-8	Man	18-24	21:50	Ghana	Public healthcare	Healthcare User
GH-PB-HU-9	Woman	35-44	13:33	Ghana	Public healthcare	Healthcare User
GH-PB-HU-10	Man	35-44	17:49	Ghana	Public healthcare	Healthcare User
GH-PR-HU-1	Women	25-34	19:13	Ghana	Private healthcare	Healthcare user - Patient
GH-PR-HU-2	Women	25-34	17:56	Ghana	Private healthcare	Healthcare user - Patient
GH-PR-HU-3	Men	25-34	16:00	Ghana	Private healthcare	Healthcare user - Patient
GH-PR-HU-4	Man	25-34	32:46	Ghana	Private healthcare	Healthcare user - Patient
GH-PR-HU-5	Man	25-34	21:26	Ghana	Private healthcare	Healthcare user - Patient
GH-PR-HU-6	Women	25-34	12:26	Ghana	Private healthcare	Healthcare user - Patient
GH-PR-HU-7	Women	25-34	22:16	Ghana	Private healthcare	Healthcare user - Patient
GH-PR-HU-8	Not reported	Not reported	22:47	Ghana	Private healthcare	Healthcare user - Patient
GH-PR-HU-9	Not reported	Not reported	29:53	Ghana	Private healthcare	Healthcare user - Patient
GH-PR-HU-10	Not reported	Not reported	11:00	Ghana	Private healthcare	Healthcare user - Patient

The identifier of GH-PR-HW-11 was corrected and its demographic details were confirmed by the first author.

Table S3. Aggregate characteristics (counts and percentages within group)

Characteristic	Healthcare workers (n = 21)	Healthcare users (n = 20)	All (n = 41)
Facility type: public	10 (48%)	10 (50%)	20 (49%)
Facility type: private	11 (52%)	10 (50%)	21 (51%)
Gender: woman (recorded as Woman/Women)	6 (29%)	9 (45%)	15 (37%)
Gender: man (recorded as Man/Men/man)	15 (71%)	8 (40%)	23 (56%)
Gender: not reported	0 (0%)	3 (15%)	3 (7%)
Age 18–24	0 (0%)	3 (15%)	3 (7%)
Age 25–34	6 (29%)	11 (55%)	17 (41%)
Age 35–44	6 (29%)	3 (15%)	9 (22%)
Age 45–54	9 (43%)	0 (0%)	9 (22%)
Age not reported	0 (0%)	3 (15%)	3 (7%)
Worker role: doctor	6 (29%)	—	—
Worker role: nurse	3 (14%)	—	—
Worker role: midwife	1 (5%)	—	—
Worker role: manager	3 (14%)	—	—
Worker role: pharmacist	1 (5%)	—	—
Worker role: accountant	1 (5%)	—	—
Worker role: recorded as healthcare practitioner(s)	6 (29%)	—	—
Interview length, median (range)	25:01 (8:23–47:29); n = 21	17:52 (11:00–32:46); n = 20	21:26 (8:23–47:29); n = 41

Gender labels are harmonised only for aggregation; Table S2 reports labels exactly as recorded. Two worker interview lengths were recorded in whole minutes (38 and 13 minutes). No mean age is calculated from age bands, and percentages may not sum to 100 because of rounding.

Sample narrative. The 41 participants were evenly split between public and private settings. Healthcare workers spanned clinical (doctors, nurses, a midwife, a pharmacist), managerial and finance roles, and facilities from teaching and military hospitals to rural private facilities and a paper-based village facility. Recorded worker participants were mostly men and aged 35–54. Users were younger, with 11 of 20 aged 25–34, and gender was more balanced where recorded. Worker interviews were longer than user interviews.

Table S4. Coding and thematic analysis

Extract codes refer to Table S8. IDs drop the “GH-” prefix for space.

Theme	Subtheme	Working definition and boundaries	Illustrative codes	Supporting IDs	Extract	Interpretation	Divergent or qualifying evidence
T1 Patchwork	1.1 A graded landscape	Accounts of how far digitalisation extends by level of care, sector and location. Excludes specific failures (T2).	paperless teaching hospital; manual in village; CHPS absent; hybrid system; "just PC"	PB-HW-5, PB-HW-8, PB-HW-10, PR-HW-5, PR-HW-7, PR-HW-8, PR-HW-11, PB-HU-5, PR-HU-8	Q01	Complexity sits in NASSS organisation and wider-system domains	PB-HW-3 "we've come a long way" (Q138); PB-HW-4 "not doing bad"
T1 Patchwork	1.2 What counts as "digital"	Examples participants gave of digital technology.	equipment as digital; consumer devices; records system	PR-HW-6, PB-HW-3, PB-HW-7, PB-HW-9, PR-HW-7, PB-HU-3, PB-HU-9, PR-HU-3	Q19	"Digital" is a broad, contested category; value propositions differ	Workers in hospitals with records systems equated digital with records (PB-HW-5, PB-HW-6)
T1 Patchwork	1.3 Islands of systems and paper bridges	Whether information moves across units and facilities.	different software; phone referral; referral envelope; print and re-enter; HR and radiology unlinked	PB-HW-1, PB-HW-4, PB-HW-5, PB-HW-6, PR-HW-1, PR-HW-3, PR-HW-4, PR-HW-5, PR-HW-10, PR-HW-11, PB-HU-5, PR-HU-5	Q11, Q12	Interoperability as governance as well as technology	PR-HW-7 one system (Q15); PB-HW-3 "very smooth" (Q16); PR-HU-7 records "synced"
T2 Infrastructure	2.1 Power, connectivity and devices	Physical preconditions for using systems.	lights off; no fuel; one tablet; network down; maintenance culture	PB-HW-2, PB-HW-5, PB-HW-6, PB-HW-8, PR-HW-1–6, PR-HW-9, PR-HW-10, PB-HU-2, PB-HU-8, PB-HU-9, PR-HU-3, PR-HU-9	Q21	Preconditions, with a sectoral and regional pattern	PB-HW-2 praises responsive IT staff
T2 Infrastructure	2.2 Workarounds and hidden labour	Improvised practices when systems fail or are scarce.	copy to treatment sheet; dispense then enter; own devices; paper then re-enter	PB-HW-1, PB-HW-5, PB-HW-6, PR-HW-2, PR-HW-3, PR-HW-4, PR-HW-5	Q27	Resilience with hidden costs and risks (Debono et al., 2013)	Workarounds produced losses (PR-HW-2)
T2 Infrastructure	2.3 The system as gatekeeper	New failure points and error pathways created by digital dependence.	upload before medication; recalled vitals; information overload; rigid template; unseen lab order	PB-HW-2, PB-HW-3, PB-HW-5, PB-HW-6, PR-HW-1, PR-HW-2, PR-HW-3, PR-HW-10	Q29, Q32	Errors relocated rather than eliminated (Sittig & Singh, 2010)	Most participants expected fewer errors; PR-HW-6 sceptical either way (Q128)
T3 Capability	3.1 Training short, theoretical or rushed	Accounts of the content, length and quality of training.	too short; boot camp; theory not practice; trainers lack answers; pre-service gap	PB-HW-3, PB-HW-4, PB-HW-5, PB-HW-6, PB-HW-9, PR-HW-3, PR-HW-7, PR-HW-10	Q39	Capability gap is real but partly a product of training design	Government workshop seen as helpful (PB-HW-3); PR-HW-11 learns systems quickly
T3 Capability	3.2 Competence on display	Digital skill judged by patients as professional competence.	patients think you are incompetent; delays read as neglect	PR-HW-1, PR-HW-3	Q45	Capability is relational and tied to professional identity	—
T3 Capability	3.3 The limits of training	Accounts showing training is insufficient without opportunity, design or user support.	trained but no system; simplify software; assisted use; usable without guide	PB-HW-4, PB-HW-10, PR-HW-11, PR-HU-1, PR-HU-2, PR-HU-3, PB-HU-5, PB-HU-10	Q48	COM-B: opportunity and design constrain capability	PR-HU-1 frames trained personnel as essential (Q51)
T4 Support and policy	4.1 Public provision, private self-reliance	Support received from government, by sector.	devices at rollout; "zero"; own coffers; insurance delays; district logistics	PB-HW-1, PB-HW-2, PB-HW-3, PB-HW-7, PR-HW-1, PR-HW-2, PR-HW-3, PR-HW-5, PR-HW-6, PR-HW-8, PR-HW-9, PR-HW-10, PR-HW-11, PB-HU-1, PB-HU-2, PR-HU-2, PR-HU-4, PR-HU-7, PR-HU-8	Q56	Dual-track digitalisation	PR-HW-5 included in policy workshops (Q73); PR-HW-7 credits government
T4 Support and policy	4.2 Leadership: awareness without action	Leaders' knowledge of, and response to, problems.	uninformed leaders; meetings without action; instructions not carried out; vendor dependence	PB-HW-1, PB-HW-2, PB-HW-5, PB-HW-6, PR-HW-6	Q63	Implementation follow-through as the binding constraint	Regional coordination to buy devices described (PB-HW-6)
T4 Support and policy	4.3 New policy or better implementation	Whether problems reflect absent policy or weak implementation.	rollout to big hospitals only; handshake standards; e-levy; legalise mobile; FDA approval	PB-HW-1, PB-HW-6, PR-HW-11, PB-HU-7, PR-HU-5, PR-HU-8	Q67, Q69	Mainly implementation; targeted policy gaps	Several workers could not comment on government support (PB-HW-2, PB-HW-4)

Theme	Subtheme	Working definition and boundaries	Illustrative codes	Supporting IDs	Extract	Interpretation	Divergent or qualifying evidence
T5 Trust	5.1 Digital records as protective and disciplining	Workers' views of confidentiality and accountability within facilities.	relatives read folders; logins; lawyers can see; cannot edit	PB-HW-1, PB-HW-2, PB-HW-3, PB-HW-4, PB-HW-5, PR-HW-2, PR-HW-9	Q74	Audit trails as accountability, possibly defensive	Phones and websites seen as vulnerable (PB-HW-8, PB-HW-9)
T5 Trust	5.2 Institutional reluctance to share	Barriers to sharing between institutions.	medico-legal blame; consent; approval delays; lack of trust	PB-HW-1, PB-HW-7, PB-HW-8, PB-HW-10, PR-HW-4	Q78	Interoperability constrained by professional norms	—
T5 Trust	5.3 Privacy as social risk	Users' concerns about disclosure.	gossip; small places; stigma; teasing; crowded rooms; shared phones; anonymity	PB-HU-1, PB-HU-3, PB-HU-4, PB-HU-7, PB-HU-8, PB-HU-9, PB-HU-10, PR-HU-1, PR-HU-5, PR-HU-6, PR-HU-8, PR-HU-9, PR-HU-10	Q82	Trust is social and organisational, not only technical	Confidence in confidentiality (PR-HU-4, Q96); "no challenge" (PB-HU-2); records may bias prescribing (PR-HU-7, Q97)
T5 Trust	5.4 Accountability and finance	Digitalisation as a check on leakage and favouritism.	revenue rose; drug losses fell; theft; favouritism in file retrieval	PB-HW-1, PB-HW-2, PB-HW-3, PB-HW-5, PB-HW-6, PB-HW-7, PB-HW-10, PR-HW-1, PR-HW-2, PR-HW-8, PR-HW-9, PR-HW-11, PR-HU-1	Q92	Valued as a governance technology (perceived, not measured)	Effects not quantified (Q93); finances seen as well managed (PB-HW-6)
T6 Users	6.1 Pragmatic information ecologies	Where users get health information and why.	Google; WhatsApp groups; friends in health; pharmacy first; self-medication	All 20 users	Q98	Trust through corroboration, speed and cost	Long-standing family doctor (PB-HU-2)
T6 Users	6.2 Outsiders to their own records	Users' access to records held about them.	not accessible; doctor authorises; folder held by hospital	PB-HU-3, PB-HU-4, PB-HU-7, PB-HU-8, PB-HU-10, PR-HU-2, PR-HU-6, PR-HU-10, PB-HW-6	Q103	Adopter system designed around staff	Results received by email (PR-HU-9)
T6 Users	6.3 Waiting	Time spent obtaining care.	4–6 hours; queues for cards; repeat details; wrong file	PB-HU-2, PB-HU-3, PB-HU-5, PR-HU-1, PR-HU-5, PR-HU-6, PR-HU-7, PR-HU-8, PB-HW-10	Q106	Time as users' measure of digital value	30–60 minutes (PB-HU-6, Q111); reported fall to under 30 minutes (PR-HU-10, Q112)
T6 Users	6.4 Conditions of access and limits of remote care	Who can use digital channels and when they are appropriate.	basic needs first; pick-and-call phones; data costs; language; toll-free; blood samples; FDA approval	PB-HW-1, PB-HW-2, PB-HW-6, PR-HW-5, PR-HW-10, PR-HW-11, PB-HU-8, PB-HU-10, PR-HU-4, PR-HU-5, PR-HU-9, PR-HU-10	Q114	Risk of widening inequity	Digital preferred for sensitive conditions (PB-HU-4); smartphones assumed common (PB-HU-1)

Table S5. Framework comparison

Framework	Relevance to this dataset	Limitations	Role in this paper
NASSS (Greenhalgh et al., 2017)	Domains (technology, value proposition, adopter system, organisation, wider system, time) map onto participants' concerns; explains non-adoption and abandonment; supports retrospective analysis of historical data (Abimbola et al., 2019)	Broad and sensitising rather than predictive; less granular on point-of-care workflow	Primary: used to interpret themes after inductive coding
Sociotechnical model (Sittig & Singh, 2010)	Eight interacting dimensions capture power, devices, interface, workflow and rules at the point of care	Developed in high-income hospital settings; less attention to users and wider policy	Complementary: used to interpret Theme 2
COM-B (Michie et al., 2011)	Distinguishes capability, opportunity and motivation, testing whether training is the binding constraint	Individual-behaviour focus; can obscure organisational causes if used alone	Complementary: used to interpret Theme 3 on digital skills
WHO–ITU National eHealth Strategy Toolkit (WHO and ITU, 2012)	Seven components, including workforce, standards and interoperability, and legislation, policy and compliance, speak directly to the policy questions	A normative planning tool, not designed for analysing interview data	Policy framing: used to map findings to policy components (Table 2)

Framework	Relevance to this dataset	Limitations	Role in this paper
CFIR, updated (Damschroder et al., 2022)	Comprehensive implementation determinants, including equity and innovation recipients	Designed for a defined innovation in defined settings; overlaps with NASSS here	Considered, not used
WHO building blocks (WHO, 2007)	System-level language familiar to policy audiences	Treats blocks as separable; not suited to analysing interview data	Context only: situates information within the health system (section 3.1)

Table S6. Cross-case evidence matrix (every transcript)

● theme evidenced; ○ divergent or qualifying evidence only; – not evidenced, which is not taken to mean the participant held no view. T1 patchwork; T2 infrastructure and workarounds; T3 capability; T4 institutional support and policy; T5 trust, confidentiality and accountability; T6 users at the margins.

Interview ID	Group / sector	T1	T2	T3	T4	T5	T6	Illustrative extract (audit code)
GH-PB-HW-1	Worker / Public	●	●	–	●	●	●	“we don’t own the data or we are not the developers of the software…” (Q66)
GH-PB-HW-2	Worker / Public	●	●	–	●	●	●	“when we have issues with the internet we lose data, we lose patients information,…” (Q26)
GH-PB-HW-3	Worker / Public	●	●	●	●	●	●	“Sometimes I think the main challenge is the training of the personnel, health workers…” (Q37)
GH-PB-HW-4	Worker / Public	●	●	●	–	●	●	“in Ghana, especially in the public sector, there are about three different software that…” (Q08)
GH-PB-HW-5	Worker / Public	●	●	●	●	●	●	“Usually these in course trainings that we do in terms of these technological advancements…” (Q39)
GH-PB-HW-6	Worker / Public	●	●	●	●	●	●	“Most of these decisions are not taking and they are always several meetings held…” (Q63)
GH-PB-HW-7	Worker / Public	●	●	●	●	●	–	“Confidentiality is not assured and it takes time before the patient’s data can be…” (Q80)
GH-PB-HW-8	Worker / Public	●	●	–	●	●	●	“Frankly speaking, our healthcare does not effectively and efficiently use those systems.” (Q130)
GH-PB-HW-9	Worker / Public	●	●	●	●	●	●	“Makes my work tedious since I would have to collect, process, store and retrieve…” (Q36)
GH-PB-HW-10	Worker / Public	●	●	●	●	●	●	“Those in other areas are using the digital technology and we went through the…” (Q48)
GH-PR-HW-1	Worker / Private	●	●	–	●	●	●	“I think the government has not engaged us into the digital technology. It is…” (Q59)
GH-PR-HW-2	Worker / Private	●	●	–	●	●	●	“When it was in the folders form, any they write in the folder, the…” (Q74)
GH-PR-HW-3	Worker / Private	●	●	●	●	●	–	“The patients will be sitting there and will be thinking you don’t even know…” (Q45)
GH-PR-HW-4	Worker / Private	●	●	–	●	●	●	“we use our treatment sheet to copy some of the medications so that in…” (Q27)
GH-PR-HW-5	Worker / Private	●	●	–	●	●	●	“At the regional office level, it’s quite high. At the district level, I will…” (Q01)
GH-PR-HW-6	Worker / Private	●	●	–	●	●	●	“We are humans so if the error will happen, it will happen. It doesn’t…” (Q128)
GH-PR-HW-7	Worker / Private	●	–	●	●	–	●	“Right now, all government hospitals in Ghana are using one system software so sharing…” (Q15)
GH-PR-HW-8	Worker / Private	●	●	–	●	●	●	“The main challenge is that they are non-existent in this area.” (Q05)
GH-PR-HW-9	Worker / Private	●	●	–	●	●	●	“Can digitization bring the level patient security we seek in the country? I’ve realized…” (Q91)
GH-PR-HW-10	Worker / Private	●	●	●	●	●	●	“I think there should be something more like a workshop or training centres that…” (Q43)
GH-PR-HW-11	Worker / Private	●	–	●	●	●	●	“We acquired the system ourselves from a private company, and we pay quarterly for…” (Q56)
GH-PB-HU-1	User / Public	–	–	○	●	●	●	“Sometimes like privacy is kind of breached in a way and then the fear…” (Q131)
GH-PB-HU-2	User / Public	●	●	–	●	○	●	“even overcrowding of the people does not encourage people to go to the hospital” (Q132)

Interview ID	Group / sector	T1	T2	T3	T4	T5	T6	Illustrative extract (audit code)
GH-PB-HU-3	User / Public	●	–	–	●	●	●	“They talk too much and they share but the thing has to be confidential,…” (Q82)
GH-PB-HU-4	User / Public	–	–	–	●	●	●	“the kind of sickness we have, we cant be able to face someone and…” (Q127)
GH-PB-HU-5	User / Public	●	–	●	●	●	●	“rather coming to spend 4 to 6 hours there just to see one doctor” (Q106)
GH-PB-HU-6	User / Public	●	–	–	●	●	●	“About 30minutes to one hour” (Q111)
GH-PB-HU-7	User / Public	●	–	–	●	●	●	“mobile phones and all of that are part of it so they have to…” (Q71)
GH-PB-HU-8	User / Public	●	●	–	●	●	●	“I think if the system will brought, the basic needs have to be first…” (Q115)
GH-PB-HU-9	User / Public	–	●	–	–	●	●	“Maybe people may get to know your sickness and they will tease you about…” (Q84)
GH-PB-HU-10	User / Public	–	–	●	●	●	●	“they should make it easier for everyone to access whether poor or rich. It…” (Q119)
GH-PR-HU-1	User / Private	●	–	●	●	●	●	“it will just be like pouring water on rocks and that will not yield…” (Q51)
GH-PR-HU-2	User / Private	–	–	●	●	–	●	“From my end healthcare information is not accessible to patient, if you get to…” (Q103)
GH-PR-HU-3	User / Private	–	●	●	●	●	●	“digital technologies should be flexible and easy to use even if no one is…” (Q53)
GH-PR-HU-4	User / Private	●	–	–	●	●	●	“A toll free will mean no call credit is needed to place the call…” (Q120)
GH-PR-HU-5	User / Private	●	–	–	●	●	●	“I was onetime given medications contrary to my complaints because of this exchange of…” (Q113)
GH-PR-HU-6	User / Private	●	–	–	–	●	●	“each time I have to give my information all over again and take vitals…” (Q110)
GH-PR-HU-7	User / Private	●	–	–	●	●	●	“sometimes the records may influence the choice of drugs that will be prescribed by…” (Q97)
GH-PR-HU-8	User / Private	●	–	–	●	●	●	“they have implemented it only in the bigger hospitals. The smaller ones have not…” (Q69)
GH-PR-HU-9	User / Private	–	●	–	–	●	●	“some sicknesses come with a lot of stigmatisation. So to prevent all those things,…” (Q85)
GH-PR-HU-10	User / Private	–	–	–	●	●	●	“At first, when you went there, you could even spend like five hours. But…” (Q112)

Table S7. Recommendations. See Table 3 in the main text, which links each finding to a proposed action, responsible stakeholder, implementation considerations and evaluation indicator.

Table S8. Quotation audit

Every extract below was matched verbatim against its source transcript; shorter fragments quoted in the text are substrings of these entries. Transcripts are identified by interview code (Table S1). Location = interview-guide topic area (T1–T5, or Conclusions) › first words of the question › paragraph number counted from the start of the transcript. “challenges facing healthcare institutions…” is the second line of the worker guide’s leadership question. Q40, Q41 and Q137 answer an interviewer-added question placed under the departments question. Q35 and Q88 contain bracketed insertions made during transcription.

Code	Interview ID	Location	Words	Opening words
Q01	GH-PR-HW-5	T3 › Generally, what role do you think… › ¶14	68	At the regional office level, it’s quite…
Q02	GH-PB-HW-10	T1 › What are the main digital technology… › ¶1	11	practically, we are still using the manual…
Q03	GH-PR-HW-11	T1 › What are the main digital technology… › ¶1	35	So it’s like we are kind of…
Q04	GH-PB-HW-5	T3 › Generally, what role do you think… › ¶13	27	the digital role would I say is…

Code	Interview ID	Location	Words	Opening words
Q05	GH-PR-HW-8	T1 › What are the main digital technology… › ¶1	11	The main challenge is that they are…
Q06	GH-PB-HU-5	T3 › What role do you think digital… › ¶9	18	there is just PC where the enter…
Q07	GH-PB-HU-5	T3 › What role do you think digital… › ¶9	14	it's time they introduced more good things…
Q08	GH-PB-HW-4	T1 › What are the main digital technology… › ¶1	21	in Ghana, especially in the public sector,…
Q09	GH-PR-HW-3	T2 › How can information sharing among different… › ¶8	23	it seems the regional hospital they use…
Q10	GH-PR-HW-4	T2 › How can information sharing among different… › ¶8	17	We have to write a referral letter…
Q11	GH-PB-HW-6	T2 › How can information sharing among different… › ¶10	23	before a patient gets to a facility…
Q12	GH-PR-HW-11	T3 › What might be some of the… › ¶17	26	you have to print out almost everything…
Q13	GH-PB-HW-1	T1 › challenges facing healthcare institutions in your… › ¶5	17	what we are using for clinical services…
Q14	GH-PR-HU-5	T4 › What role can digital mobile technology… › ¶13	26	carrying along the file whiles in the…
Q15	GH-PR-HW-7	T2 › How can information sharing among different… › ¶7	21	Right now, all government hospitals in Ghana…
Q16	GH-PB-HW-3	T2 › How can information sharing among different… › ¶7	10	we have a very smooth information sharing…
Q17	GH-PB-HW-6	T3 › What might be some of the… › ¶24	24	some facilities prefer using their software because…
Q18	GH-PB-HW-1	T2 › How can information sharing among different… › ¶8	15	as we speak, I'm not very sure…
Q19	GH-PR-HW-6	T3 › What types of digital technology products… › ¶11	11	We have a digital thermometer, digital BP…
Q20	GH-PR-HW-3	T1 › What are the main digital technology… › ¶1	9	To me, the number one challenge is…
Q21	GH-PR-HW-4	T1 › What are the main digital technology… › ¶1	23	In Ghana, especially the northern side, the…
Q22	GH-PR-HW-5	T1 › How do these challenges impact your… › ¶3	8	Our generator is there but there's no…
Q23	GH-PB-HW-5	T1 › What are the main digital technology… › ¶2	8	the whole department might have one functional…
Q24	GH-PB-HW-5	T1 › What are the main digital technology… › ¶2	10	Probably get your own tablet, and then…
Q25	GH-PB-HW-6	T1 › challenges facing healthcare institutions in your… › ¶5	23	I go with my laptop, my iPad,…
Q26	GH-PB-HW-2	T1 › What are the main digital technology… › ¶1	19	when we have issues with the internet…
Q27	GH-PR-HW-4	T2 › What is the process of getting… › ¶6	28	we use our treatment sheet to copy…
Q28	GH-PR-HW-2	T1 › How do these challenges impact your… › ¶4	35	due to the workload, you sometimes forget…
Q29	GH-PB-HW-5	T1 › How do these challenges impact patients? › ¶4	17	you need to upload it on the…
Q30	GH-PR-HW-1	T1 › How do these challenges impact patients? › ¶2	27	the clients or the patients will not…
Q31	GH-PR-HW-3	T5 › Generally, what role do you think… › ¶22	16	she might give me a wrong value…
Q32	GH-PB-HW-6	T5 › Generally, what role do you think… › ¶33	16	I think that medical errors also happen…
Q33	GH-PR-HW-10	T1 › How do these challenges impact patients? › ¶2	23	it looks more restricted because you find…
Q34	GH-PB-HW-2	T1 › challenges facing healthcare institutions in your… › ¶4	18	the maintenance culture is bad. So the…
Q35	GH-PR-HU-9	T3 › What might be some of the… › ¶12	35	you need light [electricity]. So if there…
Q36	GH-PB-HW-9	T1 › How do these challenges impact your… › ¶3	17	Makes my work tedious since I would…
Q37	GH-PB-HW-3	T1 › What are the main digital technology… › ¶1	29	Sometimes I think the main challenge is…

Code	Interview ID	Location	Words	Opening words
Q38	GH-PB-HW-3	T1 › challenges facing healthcare institutions in your… › ¶4	37	maybe a boot camp or something that…
Q39	GH-PB-HW-5	T1 › What are the main digital technology… › ¶1	34	Usually these in course trainings that we…
Q40	GH-PB-HW-6	T3 › Which departments/wards in your healthcare institution… › ¶21	25	most of the time, these trainings are…
Q41	GH-PB-HW-6	T3 › Which departments/wards in your healthcare institution… › ¶21	15	specific answers are usually not given because…
Q42	GH-PR-HW-10	T1 › What are the main digital technology… › ¶1	28	most people in the health sector are…
Q43	GH-PR-HW-10	T1 › challenges facing healthcare institutions in your… › ¶4	57	I think there should be something more…
Q44	GH-PR-HW-7	T3 › What might be some of the… › ¶11	24	Those handling the digital aspect of healthcare…
Q45	GH-PR-HW-3	T1 › How do these challenges impact your… › ¶4	30	The patients will be sitting there and…
Q46	GH-PB-HW-4	T1 › challenges facing healthcare institutions in your… › ¶5	12	those who are making the software's should…
Q47	GH-PB-HW-4	T1 › challenges facing healthcare institutions in your… › ¶5	13	I think some of these bureaucracies in…
Q48	GH-PB-HW-10	T3 › Generally, what role do you think… › ¶10	49	Those in other areas are using the…
Q49	GH-PR-HW-11	T5 › In what ways do you think… › ¶33	27	once they have a new system, I…
Q50	GH-PR-HU-1	Conclusions › Do you have any other comments… › ¶23	24	not only are they supposed to provide…
Q51	GH-PR-HU-1	Conclusions › Do you have any other comments… › ¶23	16	it will just be like pouring water…
Q52	GH-PB-HU-5	T5 › What role do you think digital… › ¶19	18	if you know you don't really know…
Q53	GH-PR-HU-3	T5 › What role do you think digital… › ¶19	18	digital technologies should be flexible and easy…
Q54	GH-PB-HW-1	T2 › What level of government does your… › ¶9	20	the support they gave was that they…
Q55	GH-PB-HW-1	T2 › What level of government does your… › ¶9	5	aside that, there's nothing else.
Q56	GH-PR-HW-11	T2 › What role does government play in… › ¶13	25	We acquired the system ourselves from a…
Q57	GH-PR-HW-10	T2 › What role does government play in… › ¶9	22	Its basically a contract between the hospital…
Q58	GH-PR-HW-5	T2 › What role does government play in… › ¶10	4	That one is zero.
Q59	GH-PR-HW-1	T2 › What role does government play in… › ¶9	32	I think the government has not engaged…
Q60	GH-PR-HW-2	T2 › What level of government does your… › ¶10	21	I've not seen any support from the…
Q61	GH-PR-HW-1	T2 › What level of government does your… › ¶8	20	The health insurance people later pay to…
Q62	GH-PB-HW-6	T1 › challenges facing healthcare institutions in your… › ¶5	8	Most of the leaders are not properly…
Q63	GH-PB-HW-6	T1 › challenges facing healthcare institutions in your… › ¶5	19	Most of these decisions are not taking…
Q64	GH-PB-HW-5	T1 › challenges facing healthcare institutions in your… › ¶6	30	those up there have probably given the…
Q65	GH-PB-HW-1	T1 › challenges facing healthcare institutions in your… › ¶5	30	in a situation where the ministry procures…
Q66	GH-PB-HW-1	T1 › How do these challenges impact patients? › ¶3	37	we don't own the data or we…
Q67	GH-PB-HW-1	T4 › How would you feel about using… › ¶16	25	where the government is making him pay…
Q68	GH-PR-HU-8	T2 › What types of support do you… › ¶7	15	But this process is slow. Before you…
Q69	GH-PR-HU-8	T2 › What role do you think the… › ¶8	17	they have implemented it only in the…
Q70	GH-PR-HW-11	T1 › challenges facing healthcare institutions in your… › ¶6	39	when you go to the private sector,…

Code	Interview ID	Location	Words	Opening words
Q71	GH-PB-HU-7	T2 › What role do you think the… › ¶8	26	mobile phones and all of that are…
Q72	GH-PB-HU-2	T2 › What types of support do you… › ¶7	23	I think the health insurance is not…
Q73	GH-PR-HW-5	T2 › What level of government does your… › ¶9	31	There are times when they are organising…
Q74	GH-PR-HW-2	T3 › Generally, what role do you think… › ¶12	21	When it was in the folders form,…
Q75	GH-PB-HW-5	T5 › Generally, what role do you think… › ¶26	10	if you are not careful, you can…
Q76	GH-PB-HW-2	T5 › Generally, what role do you think… › ¶24	11	knowing that this same information can be…
Q77	GH-PR-HW-2	T5 › In what ways do you think… › ¶28	18	At first, someone could use your name…
Q78	GH-PB-HW-1	T3 › What might be some of the… › ¶13	17	So if you are sharing information, to…
Q79	GH-PB-HW-10	T3 › What might be some of the… › ¶13	26	it goes against our code of conduct…
Q80	GH-PB-HW-7	T3 › What might be some of the… › ¶13	35	Confidentiality is not assured and it takes…
Q81	GH-PB-HW-8	T3 › What might be some of the… › ¶13	9	lack of trust to share patient's is…
Q82	GH-PB-HU-3	T3 › What might be some of the… › ¶12	38	They talk too much and they share…
Q83	GH-PR-HU-1	T3 › What might be some of the… › ¶11	31	because of the stigma that is associated…
Q84	GH-PB-HU-9	T3 › What might be some of the… › ¶12	15	Maybe people may get to know your…
Q85	GH-PR-HU-9	T4 › Would you prefer to store your… › ¶16	35	some sicknesses come with a lot of…
Q86	GH-PB-HU-8	T4 › Would you prefer to store your… › ¶16	30	there are some conditions when you are…
Q87	GH-PB-HU-10	T3 › What might be some of the… › ¶12	33	sometimes the consulting rooms are not really…
Q88	GH-PR-HU-10	T4 › Would you prefer to store your… › ¶16	39	let's say I have my phone and…
Q89	GH-PB-HU-7	T3 › What might be some of the… › ¶12	40	Some of them have this poor storage…
Q90	GH-PR-HU-8	T5 › What role do you think digital… › ¶19	19	maybe the person transferring it might just…
Q91	GH-PR-HW-9	Conclusions › Do you have any other comments… › ¶21	20	Can digitization bring the level patient security…
Q92	GH-PB-HW-1	T5 › How efficiently do you think/perceive your… › ¶22	21	when we rolled out the software we…
Q93	GH-PR-HW-11	T5 › How efficiently do you think/perceive your… › ¶31	13	By what percentage it has brought it…
Q94	GH-PR-HW-2	T5 › How efficiently do you think/perceive your… › ¶26	12	It has reduced some kind of losses…
Q95	GH-PR-HU-1	T5 › How quickly do you get attended… › ¶20	31	you know someone that works in the…
Q96	GH-PR-HU-4	T3 › What might be some of the… › ¶12	18	most of the patients get much confidence…
Q97	GH-PR-HU-7	T3 › What might be some of the… › ¶12	33	sometimes the records may influence the choice…
Q98	GH-PB-HU-10	T1 › When you are unwell, where do… › ¶3	21	Nowadays we mostly take cases into our…
Q99	GH-PB-HU-10	T1 › Why do you choose to get… › ¶4	25	It is much affordable than the hospital,…
Q100	GH-PB-HU-7	T1 › Why do you choose to get… › ¶4	28	With the pharmacy, accessibility, it is close…
Q101	GH-PB-HU-8	T1 › Why do you choose to get… › ¶4	41	there are a lot of health workers…
Q102	GH-PB-HU-5	T1 › Why do you trust those specific… › ¶2	26	Sometimes it's not like I trust them…
Q103	GH-PR-HU-2	T2 › What is the process of getting… › ¶5	29	From my end healthcare information is not…

Code	Interview ID	Location	Words	Opening words
Q104	GH-PB-HW-6	T3 › What types of digital technology products… › ¶17	17	All that will be discussed with you…
Q105	GH-PR-HU-10	T2 › What is the process of getting… › ¶5	16	No, normally I don't ask them. But…
Q106	GH-PB-HU-5	T5 › How do you think digitalisation can… › ¶21	14	rather coming to spend 4 to 6…
Q107	GH-PB-HU-5	T5 › How do you think digitalisation can… › ¶21	29	You are already not healthy, sometimes you…
Q108	GH-PB-HU-3	T5 › How do you think digitalisation can… › ¶22	13	when you are sick you don't even…
Q109	GH-PB-HW-10	T5 › How many patients do you see… › ¶17	32	for maybe 8hours, only 50 people out…
Q110	GH-PR-HU-6	T5 › How quickly do you get attended… › ¶21	17	each time I have to give my…
Q111	GH-PB-HU-6	T5 › How quickly do you get attended… › ¶20	5	About 30minutes to one hour
Q112	GH-PR-HU-10	T5 › How quickly do you get attended… › ¶21	35	At first, when you went there, you…
Q113	GH-PR-HU-5	T5 › What role do you think digital… › ¶20	16	I was onetime given medications contrary to…
Q114	GH-PB-HU-8	T4 › What might be some of the… › ¶18	30	they will be seeing you like you…
Q115	GH-PB-HU-8	T4 › What might be some of the… › ¶18	15	I think if the system will brought,…
Q116	GH-PR-HW-11	T4 › What might be some of the… › ¶26	33	the people who are well-to-do, the people…
Q117	GH-PR-HW-5	T4 › What might be some of the… › ¶22	18	most of the phones that are used…
Q118	GH-PB-HW-2	T4 › What might be some of the… › ¶22	27	A lot of the people that come…
Q119	GH-PB-HU-10	T4 › What strategies could be deployed to… › ¶17	28	they should make it easier for everyone…
Q120	GH-PR-HU-4	T4 › What role can mobile technology play… › ¶14	18	A toll free will mean no call…
Q121	GH-PR-HW-10	T4 › What might be some of the… › ¶18	23	Because you're unable to say exactly what…
Q122	GH-PR-HU-9	T4 › How would you feel about using… › ¶15	8	I wouldn't rely on it a hundred…
Q123	GH-PR-HU-9	T4 › How would you feel about using… › ¶15	10	you cannot get a blood sample with…
Q124	GH-PB-HW-1	T4 › What role can mobile technology play… › ¶15	19	health, we normally say is labour intensive…
Q125	GH-PR-HU-5	T4 › How would you feel about using… › ¶15	13	Sometimes a product maybe online but it…
Q126	GH-PR-HW-5	T4 › How would you feel about using… › ¶19	20	most of these health facilities are taking…
Q127	GH-PB-HU-4	T5 › What role do you think digital… › ¶18	24	the kind of sickness we have, we…
Q128	GH-PR-HW-6	T5 › Generally, what role do you think… › ¶19	21	We are humans so if the error…
Q129	GH-PR-HW-11	T5 › How many patients do you see… › ¶32	16	I am a digital child. I am…
Q130	GH-PB-HW-8	T3 › What types of digital technology products… › ¶11	12	Frankly speaking, our healthcare does not effectively…
Q131	GH-PB-HU-1	T3 › What might be some of the… › ¶12	28	Sometimes like privacy is kind of breached…
Q132	GH-PB-HU-2	T5 › What role do you think digital… › ¶22	14	even overcrowding of the people does not…
Q133	GH-PB-HU-6	Conclusions › Do you have any other comments… › ¶24	20	inform the government to improve the digitalization…
Q134	GH-PR-HU-6	T2 › What is the process of getting… › ¶5	12	you don't get hold of your local…
Q135	GH-PR-HW-8	T5 › How efficiently do you think/perceive your… › ¶20	13	There's wide spread corruption in virtually every…
Q136	GH-PB-HW-3	T1 › challenges facing healthcare institutions in your… › ¶4	22	the duration or the time they use…

Code	Interview ID	Location	Words	Opening words
Q137	GH-PB-HW-6	T3 › Which departments/wards in your healthcare institution… › ¶21	14	about 30 to 40% of hospital workers…
Q138	GH-PB-HW-3	T3 › Generally, what role do you think… › ¶10	30	there are some places in Ghana let…
Q139	GH-PR-HW-3	Conclusions › Do you have any other comments… › ¶27	12	So apart from the electricity problem, the…
Q140	GH-PB-HW-6	T4 › What role can digital mobile phone… › ¶25	34	since it's not everybody that can afford…
Q141	GH-PB-HW-2	T1 › challenges facing healthcare institutions in your… › ¶4	6	we have very efficient IT guys
Q142	GH-PB-HW-1	T1 › challenges facing healthcare institutions in your… › ¶5	1	handshake

Table S8 (continued). Extracts added in this revision

Code	Interview ID	Location	Words	Opening words
Q143	GH-PB-HW-1	T1 › challenges facing healthcare institutions in your… › ¶5	18	policy is key by the leaders of…
Q144	GH-PR-HW-1	T2 › How can information sharing among different… › ¶7	16	We should all have one technology, one…
Q145	GH-PR-HW-8	T2 › How can information sharing among different… › ¶7	20	If the government is able to provide…
Q146	GH-PB-HW-10	T2 › What role does government play in… › ¶9	14	The policies and other things are with…
Q147	GH-PR-HU-3	T2 › What role do you think the… › ¶8	31	The government should ensure there is database…
Q148	GH-PB-HU-5	T2 › What role do you think the… › ¶8	20	there should be a technology that as…
Q149	GH-PB-HW-9	T1 › challenges facing healthcare institutions in your… › ¶4	22	Healthcare leaders can agitate for seminars to…
Q150	GH-PB-HW-4	T1 › What are the main digital technology… › ¶1	16	I also think there's not enough teaching…
Q152	GH-PR-HW-3	T1 › challenges facing healthcare institutions in your… › ¶5	13	all health providers should be taken through…
Q153	GH-PR-HW-9	T4 › What strategies could be deployed to… › ¶13	14	I think there should a standardize education…
Q154	GH-PB-HW-10	T2 › What role does government play in… › ¶9	4	we need it badly
Q155	GH-PR-HU-5	Conclusions › Do you have any other comments… › ¶25	14	We need the digital system. Government as…

Table S9. Reporting against COREQ

COREQ (Tong et al., 2007) was used to review the completeness of reporting.

COREQ domain	Items	How reported in this study
Research team and reflexivity	1–8: interviewer identity, credentials, occupation, gender, experience and training; relationship with participants; participants' knowledge of the interviewer; interviewer characteristics	Authors' positions and reflexive practice reported (Section 4.5); reflective note and daily field notes kept by the first author
Study design: theory and sampling	9–13: methodological orientation; sampling; method of approach; sample size; non-participation	Social constructionist position and reflexive thematic analysis (Sections 4.1 and 4.4); sample adequacy judged by information power (Section 4.2)
Study design: setting and data	14–22: setting; non-participants present; sample description; interview guide and piloting; repeat interviews; recording; field notes; duration; saturation; transcripts returned	Sample described (Tables S1–S3); guide topics and durations reported; field notes kept; saturation not claimed

COREQ domain	Items	How reported in this study
Analysis and findings	23–32: number of coders; coding tree; derivation of themes; software; participant checking; quotations; consistency; major and minor themes	Themes developed inductively then theory-informed; coding in text memos without software; no participant checking; extracts audited (Table S8); divergent cases reported

Loughborough University

Training, Policy and the Digitalisation of Healthcare in Ghana

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This report presents findings from interviews with 41 healthcare workers and users in public and private healthcare in Ghana, conducted between July and September 2022. It examines what their experiences reveal about the digital skills, training and digital health policy needed to sustain healthcare digitalisation.

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Ethics approval: Loughborough University Ethics Review Sub-Committee, 10383

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