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The Use of Digital Register Systems and Perceived Data Quality and Reporting Timeliness at Peripheral Health Units in Nongowa Chiefdom, Kenema District, Sierra Leone

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Abstract

Routine health data support decision-making only when they are accurate, complete, and available on time. This study examined the use of digital register systems (DHIS2 and eIDSR) and the associated data quality and reporting timeliness at Peripheral Health Units (PHUs) in Nongowa Chiefdom, Kenema District, Sierra Leone. A descriptive cross-sectional survey used a Yamane (1967) sample of 100 health workers from purposively selected PHUs; 96 consented and completed a structured questionnaire (96% response rate), supported by a facility record-review checklist. Data were analyzed descriptively in SPSS. The workforce was experienced and largely trained (95.8%), operating mainly within DHIS2 but entering data monthly rather than at the point of service, with 87.5% still keeping full paper registers. Respondents perceived high accuracy and completeness, driven by validation rules and mandatory fields, and rated timeliness as the strongest dimension. Dominant barriers were unreliable power and connectivity, workload, duplication, staff turnover, and training gaps. The perceived gains remain conditional on infrastructure and workforce stability.

Keywords: data quality; DHIS2; digital register systems; eIDSR; peripheral health units; reporting timeliness; Sierra Leone

How to Cite: xxxxx

INTRODUCTION

A digital register system is an electronic platform used at the point of health-service delivery to capture, store, validate, transmit, and manage routine health data, replacing manual paper registers and tally sheets (Chukwu et al., 2022). Data quality is the degree to which health data are accurate, complete, consistent, and reliable for decision-making, while reporting timeliness is the speed with which data are recorded, transmitted, and made available to decision-makers after health events occur (Lemma et al., 2020). Together, these two attributes determine whether a health information system can genuinely support disease surveillance, programme monitoring, resource allocation, and evidence-based planning (WHO, 2021).

For clarity, this study distinguishes between DHIS2 (District Health Information Software 2), a web-based platform used mainly for monthly aggregate reporting; eIDSR (electronic Integrated Disease Surveillance and Response), a platform for weekly, case-based disease-surveillance reporting; and the broader categories of electronic point-of-care registers and other electronic reporting platforms described elsewhere in the literature but not directly assessed here. This study specifically examined the use of DHIS2 and eIDSR, the two digital-register platforms in routine use at the sampled PHUs, and refers to them collectively below as "digital register systems."

Globally, the digitalization of routine health information systems has become a central pillar of health-system strengthening, with the WHO Global Strategy on Digital Health 2020–2025 urging member states to institutionalize tools that improve the availability, quality, and use of health data (WHO, 2021). Electronic data capture is associated with fewer transcription errors, greater completeness through mandatory fields and validation rules, and shorter reporting cycles, although reviews caution that technology alone does not guarantee better data; outcomes depend on infrastructure, user capacity, supervision, and organizational support (Hoxha et al., 2022; Lemma et al., 2020). In Sub-Saharan Africa, DHIS2 is the most widely adopted platform for aggregating routine health data, and studies from Ghana, Ethiopia, Uganda, Kenya, and Tanzania report higher completeness and timeliness alongside constraints of unreliable electricity, weak connectivity, limited digital literacy, and high workloads (Alhassan et al., 2016; Kanfe et al., 2021; Ngusie et al., 2022).

In Sierra Leone, the limitations of paper-based surveillance were starkly exposed during the 2014–2015 Ebola outbreak, prompting the Ministry of Health and Sanitation to scale up DHIS2 and deploy the electronic Integrated Disease Surveillance and Response (eIDSR) system nationwide (Chukwu et al., 2022). By 2024, more than 1,500 facilities were submitting weekly surveillance data electronically, and national reporting timeliness had reached about 95% (WHO Regional Office for Africa, 2025; JIEPH, 2025). Yet challenges with interoperability, connectivity, power, and workforce digital skills continue to hinder routine use at peripheral facilities. It remains unclear how digital-register use relates to accuracy, completeness, and timeliness across the diverse categories of PHUs — Community Health Centres (CHCs), Community Health Posts (CHPs), and Maternal and Child Health Posts (MCHPs) — that form the foundation of primary care, since most evidence derives from national aggregates or short-term pilots rather than systematic, multi-facility surveys of everyday practice.

Accordingly, this study examined the use of digital register systems and the quality and timeliness of routine health-data reporting at PHUs in Nongowa Chiefdom. The specific objectives were: (1) to examine the accuracy and completeness of routine data recorded and reported through digital registers at the facility level; (2) to examine the extent to which reports are submitted on time from PHUs to district and national authorities; and (3) to identify the

challenges and barriers health workers face in implementing and using digital registers effectively.

LITERATURE/THEORETICAL UNDERPINNING

This study is anchored on two complementary theories. The Technology Acceptance Model (TAM), developed by Davis (1989) and extended by Venkatesh and Bala (2008), holds that perceived usefulness and perceived ease of use shape behavioural intention and hence actual system use, with external variables such as training, infrastructure, and organizational support operating through these beliefs (Holden & Karsh, 2010). TAM is relevant because the benefits of digital registers for data quality and timeliness only materialize where frontline workers accept and consistently use the systems. The Information Systems Success Model (ISSM) of DeLone and McLean (2003) links system quality, information quality, and service quality to use, user satisfaction, and net benefits, directly connecting the technical and support characteristics of DHIS2 and eIDSR to the outcomes of interest (Alhassan et al., 2016; Ngusie et al., 2022). These are supplemented by Wang and Strong's (1996) data-quality framework, which underpins the accuracy, completeness, consistency, and reliability dimensions used to operationalize the study's outcomes.

Conceptually, digital registers are theorized to improve accuracy and completeness through two mechanisms: by capturing data electronically at or near the point of service, they can eliminate error-generating steps such as manual recording, tallying, transcription, and aggregation; and by design, they can reject implausible values, flag inconsistencies, and prevent the submission of incomplete records, converting quality assurance from a retrospective activity into an automatic feature of data entry (Hoxha et al., 2022; Lemma et al., 2020). Both propositions, however, presuppose that the system is actually and correctly used - the behavioral condition emphasized by TAM.

Empirically, facilities using electronic registers in Ghana recorded higher completeness and accuracy than comparable paper-based facilities (Alhassan et al., 2016); in Ethiopia, higher DHIS2 utilization was associated with better completeness and internal consistency, with training, computer access, supervision, and management commitment the strongest correlates (Kanfe et al., 2021; Ngusie et al., 2022); and a review across eleven countries reported improved completeness following DHIS2 rollout, alongside data-entry backlogs and quality losses where staff turnover outpaced training (Dehnavieh et al., 2019). Regarding timeliness, near-real-time transmission is associated with compressed reporting cycles, from weeks to days, and dashboards and automated reminders increase on-time submission, though the binding constraint shifts from transport logistics to network availability and device functionality (Hoxha et al., 2022). In Sierra Leone, eIDSR completeness rose from below 40% under manual reporting, and pilot digitalization of maternal and child health reduced missing data from roughly 30% to below 10% and cut submission time from 10–14 days to 2–4 days (Chukwu et al., 2022).

The reviewed literature converges on a conditional conclusion: digital registers are associated with higher accuracy, completeness, and timeliness, but these gains are mediated by infrastructure, digital literacy, training, workload, system design, and organizational support, particularly in low-resource settings. The barriers most consistently documented, including unreliable power and connectivity, device shortages, limited digital literacy, high workload, parallel paper systems, weak technical support, and staff turnover, are the mirror image of the enabling factors (Dehnavieh et al., 2019; Ngusie et al., 2022; Chukwu et al., 2022). The

uniqueness of this study lies in undertaking a systematic, multi-facility survey across PHU types in one chiefdom, examining data quality and timeliness alongside their mediating challenges, and grounding the evidence in Sierra Leone's Eastern Province, where facility-level evidence is currently lacking.

METHODOLOGY

The study adopted a descriptive cross-sectional survey design to describe the use of digital register systems and the associated data quality and reporting timeliness at PHUs in Nongowa Chiefdom, Kenema District, without manipulating any variable. It was conducted in Nongowa Chiefdom, one of the chiefdoms of Kenema District in the Eastern Province of Sierra Leone, whose health services are coordinated by the District Health Management Team (DHMT). The district, with a population of approximately 609,873 in the 2015 census (Statistics Sierra Leone, 2016), was severely affected by the 2014–2015 Ebola outbreak, an experience that accelerated investment in disease surveillance and digital reporting; its PHUs submit weekly eIDSR and monthly DHIS2 reports to the DHMT.

The study population comprised health workers and health-data managers directly involved in the use, management, and supervision of digital registers at PHUs: Community Health Officers (CHOs), Community Health Assistants (CHAs), nurses, midwives, Maternal and Child Health Aides, vaccinators, data clerks, and facility in-charges, together with DHMT monitoring-and-evaluation personnel. Study PHUs were first purposively selected on the basis of active digital-register use, service level, and geographical location, to capture variation in infrastructure, workload, and digital readiness across urban, peri-urban, and rural settings; this purposive step defined the eligible sampling frame of N = 134 health workers and health-data managers across the selected PHUs.

The overall sample size was then determined from this frame using the Yamane (1967) formula for a finite population, $n = N / (1 + Ne^2)$. This formula was selected because it provides a simple, widely used method for estimating an adequate sample from a known finite population without requiring prior estimates of population variance, and is well suited to a descriptive cross-sectional design of this kind. N = 134 is the combined total of eligible health workers and health data managers pooled across all purposively selected PHUs, not the count at any single facility. With N = 134 and a 5% margin of error (e = 0.05): $n = 134 / (1 + 134 \times 0.05^2) = 134 / (1 + 0.335) = 134 / 1.335 \approx 100.4$, rounded to a target sample of 100. Because the Yamane formula assumes a single homogeneous sampling frame, it does not itself allocate the sample across facilities or build in a separate margin for non-response; the multi-facility structure was instead addressed by the purposive selection of PHUs described above and by the cadre-based apportionment described below, and no additional non-response allowance beyond the 5% margin of error was built into the calculation. This target of 100 was then apportioned across the selected PHUs by cadre: within each PHU, respondents were drawn by simple random selection when a cadre had more than two eligible staff members, and by purposive selection otherwise. In effect, complete enumeration of the cadre was used where only one or two staff held that role, since random sampling was not meaningful for such small strata. All 100 selected respondents were approached; 96 consented and completed the questionnaire, while 4 declined.

Data were collected using a structured questionnaire of closed-ended and five-point Likert-scale items covering demographic information, exposure to and use of digital registers, data accuracy and completeness, reporting timeliness, system usability, and operational challenges, complemented by a facility record-review checklist capturing record-based indicators from

DHIS2 and eIDSR. Face validity was established through consultation with experienced health workers and supervisors, and content validity was ensured by covering all three objectives and the full set of constructs, guided by supervisor and subject-matter-expert review. The internal consistency of the multi-item Likert-scale sections was assessed using Cronbach's alpha computed from the 96 completed questionnaires: data accuracy and completeness (7 items, $\alpha = 0.76$), reporting timeliness (6 items, $\alpha = 0.77$), and system usability and satisfaction (6 items, $\alpha = 0.89$), indicating acceptable to good internal reliability across all three subscales.

The instruments were pilot-tested on about ten health workers at a non-sampled PHU to refine clarity, flow, and timing. Data were analyzed descriptively in SPSS, with Microsoft Excel used for tabulation and charting, using frequencies, percentages, means, and standard deviations, and presented in tables, cross-tabulations, and charts. Ethical standards were observed throughout: all participants gave informed consent, participation was voluntary with the right to withdraw, personal identifiers were anonymized, data were securely stored, and no patient-identifiable information was extracted during document review.

RESULTS/FINDINGS

Of 100 health workers approached, 96 (96.0%) gave informed consent and completed the questionnaire, while 4 (4.0%) declined and were excluded from the analysis; all subsequent analyses are based on these 96 respondents. All 96 respondents provided a complete response to every item in the questionnaire, so the denominator for every percentage reported below in the text, tables, and figures is 96, unless a note beneath a table states otherwise. Their profile and their exposure to the digital systems are summarized in Table 1.

Table 1: Respondent profile and exposure to digital register systems (n = 96)

Characteristic	Category	Freq.	%
Facility type	CHC	37	38.5
	CHP	27	28.1
	MCHP	27	28.1
	Other	5	5.2
Cadre	CHO	27	28.1
	MCH Aide	26	27.1
	CHA	21	21.9
	Data Clerk	11	11.5
	Nurse / Midwife	8	8.4
	SECHN / DHMT M&E	3	3.1
Age group	18–29	12	12.5
	30–39	43	44.8
	40–49	25	26.0
	50 & above	16	16.7
Qualification	Certificate	61	63.5
	Diploma	26	27.1
	Degree / Postgraduate	9	9.4

Experience	≤ 5 years	20	20.8
	6–10 years	39	40.6
	> 10 years	37	38.5
System used (primary platform)*	DHIS2	70	72.9
	eIDSR	22	22.9
	None (paper-based only)	4	4.2
Trained on system	Yes	92	95.8
Keeps paper registers	Yes, all data	84	87.5
	Yes, some data	2	2.1
	No	10	10.4

Data source: 2026 Survey

The workforce was experienced (79.1% with more than five years of service) and overwhelmingly trained (95.8%). As shown in Table 1, 92 of 96 respondents (95.8%) reported DHIS2 or eIDSR as their facility's main digital platform, confirming that digital registers are an established part of routine practice for nearly all respondents.

The questionnaire captured two distinct dimensions of routine practice that should not be read as a single measure. On frequency of electronic data entry, respondents reported entering data daily (13.5%), weekly (21.9%), monthly (60.4%, mirroring the monthly DHIS2 reporting cycle), or never (4.2%); electronic entry is therefore a periodic reporting task for most respondents rather than a continuous, point-of-care activity. On timing relative to service delivery, a separate item asked how often data were entered at the point of service itself: only 33.3% of respondents reported doing so "always," while 61.5% did so "sometimes," 1.0% "rarely," and 4.2% "never." In addition, 87.5% of respondents reported maintaining a full paper register alongside the electronic system, a further 2.1% kept paper for some data, and only 10.4% no longer used paper at all. Read together, these findings point to a widespread delayed-entry workflow in which service data are typically first recorded by hand in the paper register at the point of care and subsequently transcribed into DHIS2 or eIDSR in batches, most often at the end of the reporting month, rather than captured electronically in real time. This dual-system reality is pivotal for interpreting the remaining findings, because the error-reducing and time-saving mechanisms attributed to digital capture are only partially operative where transcription is retained.

Data accuracy and completeness

Perceptions of data quality were broadly positive (Table 2). Agreement was very high that the register captures data accurately (87.6%) and that digital figures match the source registers (89.6%), and was strongest for the two design-enforced controls: 98.0% agreed that validation rules reject implausible values and 96.9% that mandatory fields prevent incomplete submissions. This supports the proposition that digital registers are perceived to improve quality chiefly by making it enforceable by design rather than by relying on retrospective supervision. The clear exception concerned error reduction relative to paper: although 76.1% agreed, this item drew the highest dissent (20.9% disagreed or strongly disagreed), consistent with delayed, off-site entry and the retention of parallel paper. Overall, 94.8% agreed that the digital register had improved data quality.

Table 2: Respondents' perceptions of data accuracy and completeness (%)

Statement	SD	D	N	A	SA
Captures health-service data accurately	–	4.2	8.3	43.8	43.8
Figures match the source / paper registers	–	4.2	6.2	54.2	35.4
Validation rules reject out-of-range values	–	2.1	–	54.2	43.8
Mandatory fields prevent incomplete records	–	3.1	–	35.4	61.5
Fewer transcription / calculation errors than paper	2.1	18.8	3.1	54.2	21.9
All required fields completed before submission	–	11.5	9.4	26.0	53.1
Overall, the register has improved data quality	–	2.1	3.1	50.0	44.8

Data Source: 2026 Survey

Reporting Timeliness

Timeliness was the strongest-performing dimension in the study (Figure 1). Agreement was near-universal that weekly eIDSR (96.8%) and monthly DHIS2 (97.9%) deadlines are met, and the most emphatic single result was that electronic submission is perceived as faster than paper (94.7%, with 81.2% strongly agreeing). Automated reminders and dashboards were widely credited with aiding on-time submission (95.9%), and 95.9% agreed overall that timeliness had improved.

The one relative soft spot was the capacity to report suspected outbreaks within twenty-four hours: although 84.4% agreed, this item carried the lowest strong agreement (12.5%) and the highest disagreement (10.4%), indicating that the most time-critical function remains exposed to the connectivity and power constraints identified below.

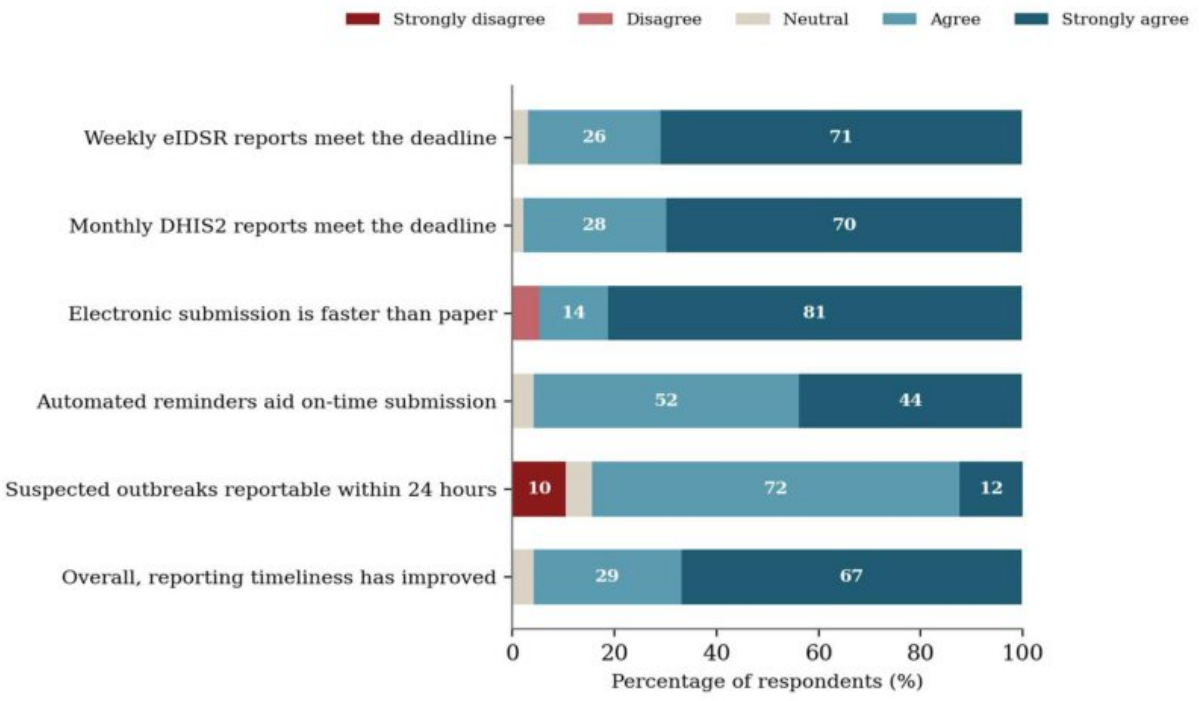

Figure 1: Respondents' perceptions of reporting timeliness

System Usability and Satisfaction

Overall perceptions of usability and satisfaction were positive (Table 3). System reliability was rated most highly (97.9% agreeing the system does not crash or freeze often), technical support was seen as available and responsive by 90.7%, and overall satisfaction stood at 89.6%. A large majority (81.3%) also agreed that the system improves their job performance.

Two items revealed the limits of this picture. Ease of use, endorsed by 78.1% of respondents, drew the highest level of dissent of any usability item (15.6% disagreed or strongly disagreed), higher than the dissent recorded for any other statement in Table 3. The survey did not statistically test the reasons for this dissent, so no claim is made here about which respondent subgroups (e.g., by age or qualification) accounted for it; this would require inferential analysis beyond the descriptive scope of the study. A related but smaller concern was that, while 85.5% agreed the system reduces paperwork and workload, 12.5% disagreed, a pattern plausibly linked to the near-universal maintenance of parallel paper registers described above. In ISSM terms, high system and service quality translate into satisfaction, but perceived ease of use, a central TAM adoption lever, remains weaker for a meaningful minority.

Table 3: Respondents' perceptions of system usability and satisfaction (%)

Statement	SD	D	N	A	SA
Improves my job performance	–	11.5	7.3	77.1	4.2
Reduces my paperwork and workload	5.2	7.3	2.1	43.8	41.7
Is easy to learn and use	1.0	14.6	6.2	69.8	8.3
Is reliable; does not crash or freeze often	–	–	2.1	28.1	69.8
Technical support is available and responsive	–	2.1	7.3	46.9	43.8
Satisfied with the system overall	–	3.1	7.3	61.5	28.1

Data Source: 2026 Survey

Challenges and Barriers

Infrastructure constraints dominated the barrier profile (Figure 2). Poor connectivity was the most widely reported problem (98.0% agreement, no respondent disagreeing), followed by unreliable electricity (94.8%, of which 79.2% strongly agreed). High patient workload (94.8%) and the duplication created by maintaining both paper and electronic systems (96.9%, 66.7% strongly agreeing) directly corroborated the parallel-paper finding, while frequent staff turnover (95.9%), insufficient or infrequent training (92.7%), and device shortage or breakdown (93.8%) were also strongly felt. A more nuanced result concerned technical support: whereas the usability section found support generally available, 70.8% here regarded it as weak, slow, or too far away, and the item drew the section's highest disagreement (21.9%). The tension is best read as a distinction between the existence of support and its speed and proximity. These barriers map closely onto the mediating variables of the conceptual framework.

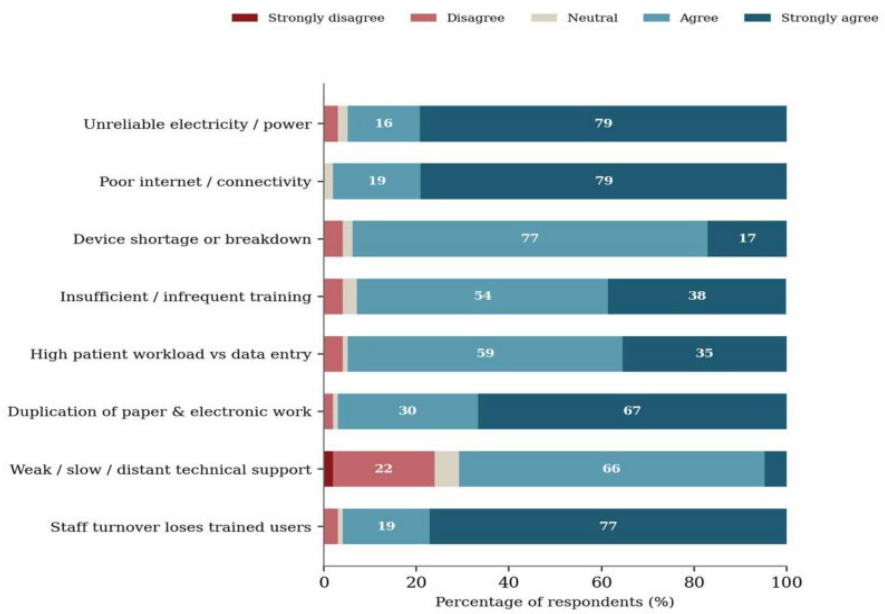

Figure 2: Respondents' perceptions of challenges and barriers

DISCUSSION

Read together, the findings describe a digital reporting system that is genuinely embedded and associated with real perceived benefits, yet resting on a fragile and effortful foundation. On accuracy and completeness, the evidence points to strong perceived improvements driven above all by the system's design controls, validation rules and mandatory fields, which attracted the highest agreement of any items, consistent with the global and regional literature (Hoxha et al., 2022; Lemma et al., 2020) and with Sierra Leone's eIDSR and DHIS2 scale-up (Chukwu et al., 2022). The main qualification is the more guarded view on error reduction relative to paper, explained by the parallel-paper and delayed-entry findings: where transcription is retained in the workflow, the mechanism that should eliminate it cannot fully operate.

Timeliness is the clearest success in respondents' own perceptions. Near-universal agreement that weekly and monthly deadlines are met, and that electronic submission is faster than paper, aligns closely with the national timeliness figure of roughly 95% reported for eIDSR (WHO Regional Office for Africa, 2025; JIEPH, 2025). The relative weakness in twenty-four-hour outbreak notification indicates that the most time-critical function remains exposed to connectivity and power failures, precisely the constraints the barriers profile identifies as most severe, and mirrors the national picture in which high average timeliness is partly sustained by workaround measures when real-time submission falters. The usability results reinforce this reading in ISSM terms: high system quality (reliability) and service quality (support) yield high satisfaction, but perceived ease of use, the TAM adoption lever, is weaker for a minority, and the perceived reduction in workload is undercut by the duplication inherent in dual systems.

The overarching interpretation is one of conditional success. Digital registers in Nongowa Chiefdom are associated with substantial, health-worker-perceived gains in the quality and timeliness of routine data, consistent with theory and the wider evidence base. Those gains, however, appear to be achieved at a high human cost and remain contingent on infrastructure

and workforce stability; the persistence of full parallel paper systems both signals residual mistrust or workflow inertia and imposes a duplication burden that is itself one of the most strongly felt barriers.

Implication to Research and Practice

The findings carry direct implications for policy and practice. The Ministry of Health and Sanitation, the DHMT, and development partners should prioritize reliable power (including solar installations and backup batteries) and network connectivity (including data allowances and network extension), since unreliable electricity and connectivity were the two most severe barriers and the main threat to time-critical outbreak reporting, and should institute a programme of device provision, timely repair, and planned replacement so that shortages do not force reversion to paper or telephone reporting. Because recency and regularity of training, rather than its mere occurrence, appear to drive confident use, training should be delivered as a continuous, cadre-sensitive cycle, with particular attention to the fifth of staff last trained over a year ago or never trained, and to older and certificate-level workers who found the system harder to use. These priorities are consistent with the goals set out in Sierra Leone's National Health Sector Strategic Plan 2021–2025 (Ministry of Health and Sanitation, 2021).

Improving interoperability between DHIS2, eIDSR, and patient-level tools, together with a clear, staged policy for retiring redundant paper registers once electronic capture is trusted, would relieve the duplication burden and restore the workload- and error-reduction benefits the system is intended to deliver. Workflow redesign and light-weight mobile tools should encourage entry at or near the point of care so that validation and transcription-elimination benefits are realized rather than bypassed by delayed batch entry. The DHMT should reinforce local, quickly reachable support, facility-level focal persons and a responsive district help desk, to address the finding that support, while available, is often too slow or distant, and should adopt measures to retain trained staff, or to re-train rapidly when they move, to counter the strongly felt barrier of turnover.

CONCLUSION

This study concludes that digital register systems are associated with substantial, health-worker-perceived improvements in both the quality and the timeliness of routine health data at the periphery of Kenema District, strongest where the technology enforces quality by design and collapses the reporting chain, with timeliness in particular matching Sierra Leone's strong national surveillance performance. These gains are, however, conditional rather than automatic: they appear to depend on reliable electricity, connectivity, and functioning devices; on a trained and stable workforce; and on responsive, proximate support, the very conditions respondents identified as most lacking. The near-universal persistence of parallel paper registers is the clearest symptom of this incomplete transition. The digital transformation of routine health information at the periphery is therefore real and valuable but unfinished, sustained at present by considerable frontline effort, and consolidating it will require targeted investment in the mediating conditions rather than in the technology alone.

Future Research

Future research should extend this descriptive, single-chiefdom study in three directions. First, comparative studies across multiple chiefdoms and districts would test how far these patterns generalize. Second, longitudinal designs could track data quality and timeliness over time and

around specific interventions, moving beyond the snapshot a cross-sectional survey provides. Third, mixed-methods work combining objective record-verification audits with in-depth interviews would triangulate self-reported perceptions against measured accuracy and completeness, and would probe the human and organizational reasons why parallel paper systems persist.

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