

Usability of UgandaEMR+ among health workers in Uganda: adaptation and evaluation of the System Usability Scale in a low- resource EMR environment

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Abstract

Background

Electronic medical record (EMR) systems are being rapidly scaled across sub-Saharan Africa, yet evidence on their usability from the perspective of frontline health workers remains limited, particularly for open-source platforms deployed in low-resource settings. UgandaEMR+ is a OpenMRS 3-based national EMR in Uganda which has been deployed in over 1,000 facilities, yet no study has assessed its usability using a validated instrument. This study adapted and applied the System Usability Scale (SUS) to evaluate UgandaEMR+ usability across four Ugandan health facilities and to identify item-level usability patterns that explain low routine adoption.

Methods

A cross-sectional survey of 302 health workers was conducted at four purposively selected facilities (two regional referral hospitals and two Health Centre IVs) in Uganda. Usability was measured using a 10-item Likert scale (US1–US10) adapted from the SUS and contextualised for UgandaEMR+. Four items were reverse-coded (complexity, inconsistency, cumbersomeness, high learning demand). Internal consistency was assessed using Cronbach's alpha. Composite scores were categorised as Low (< 3.0), Moderate (3.0–3.9), or High (≥ 4.0). Item-level response distributions were analysed descriptively and triangulated with qualitative findings from 10 semi-structured key-informant interviews to explain the usability patterns observed.

Results

The overall mean usability score was 3.44 (SD = 0.83), and the adapted scale demonstrated good internal consistency ($\alpha = 0.82$). When categorised, 28.1% of respondents fell into the low-usability group, 43.7% into moderate, and 28.1% into high. Item-level analysis revealed that the four reverse-coded items, namely Cumbersome (US8, 52.6% agreed), Complexity (US2, 44.4%), Inconsistency (US6, 49.7%), and High Learning Demand (US10, 48.3%), received the highest agreement rates, indicating that usability burden concentrates on operational friction rather than core functionality. Qualitative interviews attributed these patterns to unreliable power, hybrid paper–digital workflows, and inconsistent on-site IT support.

Conclusions

UgandaEMR+ usability is moderate but marked by specific friction points, including cumbersomeness, complexity, and inconsistency, that suppress routine adoption. Improving power infrastructure, workflow alignment, and responsive IT support would shift usability perceptions more effectively than software

redesign alone. The adapted SUS instrument ($\alpha = 0.82$) is a practical tool for usability monitoring in similar low-resource EMR settings.

Background

Electronic medical record (EMR) systems are increasingly recognised as essential infrastructure for strengthening health service delivery in low- and middle-income countries (LMICs)^[1, 2]. When implemented effectively, EMRs can improve clinical documentation, facilitate continuity of care, support data-driven decision-making, and enable integration with national health information systems such as DHIS2^[3]. However, the promise of EMRs in LMICs is frequently undermined by implementation challenges including unreliable power supply, poor internet connectivity, insufficient hardware, limited technical support, and a workforce with variable digital literacy^[4, 5].

Uganda has made significant progress in EMR deployment through its national platform, UgandaEMR, an open-source system built on OpenMRS and supported by the Ministry of Health^[6]. The current iteration, UgandaEMR+, is built on the OpenMRS 3 (O3) framework and introduces an updated user interface, expanded clinical modules, and improved interoperability features^[7]. By 2023, UgandaEMR was reported to be active in approximately 1,000 of Uganda's ~ 8,400 health facilities, representing only 16.7% coverage^[8]. Even within facilities where UgandaEMR + is deployed, studies have documented suboptimal usage, with many health workers continuing to rely on parallel paper-based documentation^[5, 9].

A key but understudied factor in this adoption gap is *usability*, defined as the degree to which a system can be used by specific users to achieve particular goals with effectiveness, efficiency, and satisfaction^[10]. Poor usability has been identified as a major barrier to EMR adoption globally^[11], and a 2019 literature review of EMR usability in sub-Saharan Africa found an overall usability score of only 66% across the region, with user satisfaction as the weakest domain^[12]. However, that review relied primarily on secondary evidence; few studies have applied validated usability instruments directly to frontline health workers using specific EMR platforms in routine clinical settings.

The System Usability Scale (SUS), developed by Brooke^[13], is a widely validated 10-item instrument for assessing perceived usability of technology systems. Originally designed for industrial software evaluation, the SUS has been adapted for health IT contexts in high-income settings^[14] but has seen limited application in LMIC health facilities, where infrastructure constraints, workflow complexity, and workforce characteristics may produce distinct usability profiles^[15]. No published study has applied the SUS or an adapted version to evaluate UgandaEMR+ specifically.

This study aimed to: (1) adapt the SUS for the UgandaEMR+ context and assess its internal consistency reliability; (2) evaluate the overall usability of UgandaEMR + as perceived by health workers across four Ugandan health facilities; (3) identify item-level usability patterns that explain where operational friction

concentrates; and (4) triangulate quantitative usability findings with qualitative interview data to generate contextualised recommendations for improving EMR usability in low-resource settings.

Methods

Study design and setting

This study employed a convergent mixed-methods design. The quantitative strand comprised a cross-sectional survey of health workers, and the qualitative strand comprised semi-structured key-informant interviews (KIIs). Data were collected concurrently between July and September 2025 at four purposively selected health facilities in Uganda: Lira Regional Referral Hospital, Hoima Regional Referral Hospital, Kyangwali Health Centre IV, and Kawaala Health Centre IV. These facilities were selected to represent variation in facility level (regional referral hospital vs. Health Centre IV), geographic context (urban, peri-urban, rural/refugee-hosting), and duration of UgandaEMR+ deployment.

Participants and sampling

For the quantitative strand, 302 health workers were sampled across the four facilities using stratified sampling by cadre (clinical officers/doctors, nurses/midwives, laboratory staff, pharmacy staff, records/data officers). Inclusion criteria were: (a) employment at a public health facility using UgandaEMR+ for at least six months; (b) direct or indirect interaction with the EMR system. Health workers under 18 years and those unable or unwilling to provide informed consent were excluded. For the qualitative strand, 10 key informants were purposively sampled to represent facility leadership, frontline clinicians, data officers, and national-level implementers.

Usability instrument: SUS adaptation

Usability was measured using a 10-item, 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree) adapted from the System Usability Scale^[13]. The original SUS items were contextualised for UgandaEMR+ by replacing generic system references with UgandaEMR+-specific wording and adjusting language to suit the health facility context. The 10 items, with their short descriptors used throughout this paper, were: US1 (Frequent use intention), US2 (Complexity, reverse-coded), US3 (Ease of use), US4 (Need for technical support, reverse-coded), US5 (Integration), US6 (Inconsistency, reverse-coded), US7 (Learnability/quick learning), US8 (Cumbersome, reverse-coded), US9 (Confidence), and US10 (High learning demand, reverse-coded). The four reverse-coded items (US2, US4, US6, US8, US10) capture negative usability dimensions; higher agreement on these items indicates greater usability burden.

Internal consistency of the adapted scale was assessed using Cronbach's alpha. The composite usability score was computed as the mean of all 10 items per respondent. Composite scores were then categorised into three levels: Low (mean < 3.0), Moderate (3.0–3.9), and High (≥ 4.0), following the

symmetric neutral-midpoint rule for 5-point agreement scales. The instrument was pilot-tested at Kawaala Health Centre IV and refined based on feedback before deployment.

Data collection

The structured questionnaire was administered via KoBoToolbox. Alongside the 10 usability items, the questionnaire captured respondent demographics (age, gender, cadre, facility), EMR experience (years of use), and training history. Qualitative data were collected through approximately 30-minute audio-recorded semi-structured interviews covering daily EMR use experiences, workflow challenges, and perceptions of system usability.

Data analysis

Quantitative data were analysed using descriptive statistics (frequencies, proportions, means, standard deviations) for both composite and item-level usability scores. Item-level response distributions were grouped as Disagree (1–2), Neutral (3), and Agree (4–5). Bivariate associations between respondent characteristics and usability category were explored using chi-square (χ^2) tests. Qualitative interview data were transcribed verbatim and analysed thematically, with a 20% subset double-coded to assess inter-coder reliability (Cohen's κ). The qualitative findings were integrated with the quantitative usability results through a joint-display matrix to identify convergent, complementary, and divergent patterns.

Ethical approval

Ethical approval was obtained from Busitema University Institutional Review Board/Research Ethics Committee (BUFHS-2025-97). The study was conducted in accordance with the Declaration of Helsinki. All participants provided written informed consent prior to participation. Data were de-identified and stored on encrypted, password-protected devices.

Results

Respondent characteristics

A total of 302 health workers completed the survey across the four facilities: Lira Regional Referral Hospital (n = 102, 33.8%), Hoima Regional Referral Hospital (n = 76, 25.2%), Kyangwali Health Centre IV (n = 70, 23.2%), and Kawaala Health Centre IV (n = 54, 17.9%). The majority were female (n = 173, 57.3%) and aged 36–60 years (n = 231, 76.5%). Nurses and midwives constituted the largest cadre group (n = 121, 40.1%). Notably, 43.7% of respondents (n = 132) reported zero years of EMR experience, and only 39.1% (n = 118) had received any formal EMR training.

Overall usability score and internal consistency

The adapted 10-item usability scale demonstrated good internal consistency (Cronbach’s $\alpha = 0.82$). The overall mean composite usability score was 3.44 (SD = 0.83, range 1.30–5.00), indicating moderate perceived usability with considerable inter-respondent variability. When categorised, 85 respondents (28.1%) fell into the Low usability group (mean < 3.0), 132 (43.7%) into Moderate (3.0–3.9), and 85 (28.1%) into High (≥ 4.0). (Table 1)

Table 1. Categorisation of composite usability scores (N = 302)

Usability level	n	%
Low (< 3.0)	85	28.1
Moderate (3.0–3.9)	132	43.7
High (≥ 4.0)	85	28.1
Total	302	100.0

Item-level usability patterns

Table 2 presents the item-level response distributions. Mean scores across the 10 items ranged from 3.30 (US2, Complexity) to 3.52 (US8, Cumbersome), indicating moderate usability across all dimensions. However, the response distributions revealed a critical pattern: the four reverse-coded items capturing negative usability dimensions received the *highest* agreement rates. US8 (Cumbersome) was endorsed by 52.6% of respondents, US5 (Integration) by 51.3%, US7 (Learnability) by 50.7%, US1 (Frequent use intention) by 50.3%, and US3 (Ease of use) by 50.0%. Importantly, the reverse-coded items US8 (Cumbersome, 52.6% agreed), US6 (Inconsistency, 49.7%), US10 (High learning demand, 48.3%), and US2 (Complexity, 44.4%) all received notably high endorsement, indicating that usability burden concentrates on operational friction. Specifically, the system is perceived as cumbersome, inconsistent, and demanding to learn, even where its core functions are acknowledged.

The lowest agreement was found for US2 (Complexity) at 44.4%, but this item also had the highest disagreement rate (32.8%), indicating heterogeneous usability experiences likely related to differences in cadre, digital literacy, and departmental workflow.

Table 2. Item-level distribution of EMR usability perceptions (US1–US10, N = 302)

Item (descriptor)	Mean (SD)	Disagree n (%)	Neutral n (%)	Agree n (%)
US1 (Frequent use intention)	3.48 (1.34)	81 (26.8)	69 (22.8)	152 (50.3)
US2 (Complexity) (R)	3.30 (1.37)	99 (32.8)	69 (22.8)	134 (44.4)
US3 (Ease of use)	3.42 (1.37)	95 (31.5)	56 (18.5)	151 (50.0)
US4 (Need for tech support) (R)	3.47 (1.33)	80 (26.5)	73 (24.2)	149 (49.3)
US5 (Integration)	3.48 (1.35)	87 (28.8)	60 (19.9)	155 (51.3)
US6 (Inconsistency) (R)	3.42 (1.38)	89 (29.5)	63 (20.9)	150 (49.7)
US7 (Learnability)	3.50 (1.32)	78 (25.8)	71 (23.5)	153 (50.7)
US8 (Cumbersome) (R)	3.52 (1.35)	83 (27.5)	60 (19.9)	159 (52.6)
US9 (Confidence)	3.44 (1.36)	85 (28.1)	68 (22.5)	149 (49.3)
US10 (High learning demand) (R)	3.42 (1.37)	91 (30.1)	65 (21.5)	146 (48.3)

(R) = reverse-coded item. Responses grouped as: Disagree (1–2), Neutral (3), Agree (4–5).

Usability and its association with EMR use

When respondents were stratified into high EMR users (daily or several-times-per-week use; $n = 132$, 43.7%) and low EMR users (rarely; $n = 170$, 56.3%), usability levels varied with use patterns. EMR use differed significantly across facilities ($\chi^2, p = 0.005$), with Kyangwali HC IV showing the highest proportion of high users (60.0%) and Kawaala HC IV the lowest (29.6%). Years of EMR experience was the strongest predictor of high use ($p < 0.001$): all respondents with zero experience were low users (100%), while all respondents with 3–5 years were high users (100%). Notably, formal EMR training was not significantly associated with use category ($p = 0.465$).

Qualitative contextualisation of usability findings

Thematic analysis of 10 key-informant interviews identified three explanatory themes for the quantitative usability patterns:

Infrastructure fragility drives perceived cumbersomeness. Interviewees consistently linked the high endorsement of US8 (Cumbersome) and US2 (Complexity) to unreliable electricity and internet connectivity. When power or network outages occurred, staff reverted to paper-based workflows, creating hybrid documentation burdens that made the EMR feel operationally cumbersome rather than technically difficult.

Weak IT escalation pathways amplify inconsistency perceptions. The high agreement on US6 (Inconsistency) was explained by interviewees' descriptions of unresolved technical issues (system slowness, module-level bugs, and delayed updates) that persisted due to the absence of structured IT support escalation. Inconsistency was thus experienced not as a design flaw but as a support-system failure.

Learning demand reflects workflow misalignment, not intrinsic complexity. Several informants noted that the high endorsement of US10 (High learning demand) stemmed not from UgandaEMR+ being inherently complex but from the mismatch between the EMR's documentation logic and existing clinical routines. Staff trained on paper-based workflows found the transition demanding because the EMR required different sequencing, not because the interface was unintuitive.

Discussion

This study provides, to our knowledge, the first systematic evaluation of UgandaEMR+ usability using an adapted System Usability Scale applied directly to frontline health workers in routine clinical settings. The key findings, notably moderate overall usability ($\alpha = 0.82$, mean 3.44) combined with specific friction points concentrated in cumbersomeness, inconsistency, and high learning demand, have important implications for EMR implementation strategy in Uganda and comparable LMIC settings.

Moderate usability does not equal adoption

The finding that 43.7% of respondents rated usability as moderate and 28.1% as high suggests that UgandaEMR+ is not a technically broken system. Yet 56.3% of respondents were categorised as low EMR users (using the system rarely). This apparent paradox, in which moderate usability coexists with low routine adoption, aligns with the sociotechnical insight, articulated in the NASSS framework^[16], that technology adoption is shaped by the interaction between the technology, the adopter, the organisation, and the wider system. In this case, infrastructure fragility and workflow misalignment suppress adoption even where the interface is rated as functionally adequate.

Usability burden concentrates on operational friction

The item-level analysis provides a more actionable picture than the composite score alone. The reverse-coded items, specifically US8 (Cumbersome, 52.6%), US6 (Inconsistency, 49.7%), US10 (High learning demand, 48.3%), and US2 (Complexity, 44.4%), consistently received the highest agreement, indicating that the usability 'problem' is not the software interface per se but the operational environment in which it is used. This pattern is consistent with Kavuma's (2019) review of EMR usability in sub-Saharan Africa, which found user satisfaction as the weakest usability domain across the region^[12], and with the broader finding from Jawhari et al. (2016) that infrastructure limitations are the primary barrier to EMR success in low-resource settings^[4].

Training alone is insufficient

The absence of a significant association between formal training and high EMR use ($p = 0.465$) is a critical finding. Combined with the qualitative evidence that 'learning demand' reflects workflow misalignment rather than interface difficulty, this suggests that one-off training events are insufficient and that Uganda's EMR capacity-building strategy should shift toward continuous, workflow-embedded learning, including peer-champion programmes, structured mentorship, and on-the-job coaching tied to actual clinical tasks.

Comparison with global SUS benchmarks

While the adapted scale prevents direct numeric comparison with the original SUS (which uses a 0–100 scoring), the pattern of findings is informative. Bangor et al. (2009)^[17] established that SUS scores below 50 indicate 'unacceptable' usability. Our moderate scores, combined with high endorsement of negative usability dimensions, suggest that UgandaEMR+ sits in the 'marginal' to 'acceptable' range, meaning functional but not yet optimised for sustained daily use. This positioning is consistent with the '66%' overall usability score reported across sub-Saharan African EMR systems by Kavuma^[12].

Practical implications

The finding that usability burden is environmental rather than intrinsic has direct implications for Uganda's national EMR scale-up strategy: (1) *Power and connectivity must be treated as clinical safety infrastructure*, not as background assumptions; (2) *Responsive IT support with clear escalation pathways* is needed to reduce the inconsistency that erodes user trust; (3) *Workflow redesign to eliminate duplicate paper–digital documentation* will address the cumbersomeness perceived by over half of respondents; and (4) *The adapted SUS instrument* ($\alpha = 0.82$) can be deployed as a routine monitoring tool at facility level to track usability trends over time and flag emerging friction points before they suppress adoption.

Limitations

This study has several limitations. First, four purposively selected facilities limit generalisability to the broader Ugandan health system. Second, self-reported usability data are subject to recall and social-desirability bias. Third, while the adapted SUS demonstrated good internal consistency ($\alpha = 0.82$), formal Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) were not conducted; future psychometric work on a larger multi-region sample should formally validate the scale's dimensionality. Finally, the study did not include objective usability measures (e.g., task-completion time, error rates); complementary observational usability testing would strengthen future evaluations.

Conclusions

UgandaEMR+ demonstrates moderate usability among health workers, with good internal consistency of the adapted SUS instrument ($\alpha = 0.82$). However, item-level analysis reveals that usability burden concentrates on cumbersomeness, inconsistency, and high learning demand. These are dimensions driven more by the operational environment (infrastructure, workflows, IT support) than by the software interface itself. These findings imply that improving EMR usability in low-resource settings requires investment in implementation ecology, specifically power, connectivity, workflow alignment, and responsive support systems, rather than interface redesign alone. The adapted SUS is recommended as a practical, low-cost tool for ongoing usability monitoring in similar LMIC EMR environments.

Abbreviations

EMR: Electronic Medical Record; SUS: System Usability Scale; LMIC: Low- and Middle-Income Country; HC IV: Health Centre IV; RRH: Regional Referral Hospital; KII: Key Informant Interview; DHIS2: District Health Information Software 2; NASSS: Non-adoption, Abandonment, Scale-up, Spread, and Sustainability framework; AOR: Adjusted Odds Ratio; CI: Confidence Interval; SD: Standard Deviation; O3: OpenMRS 3 platform.

Declarations

Ethics approval and consent to participate: Ethical approval was obtained from the relevant Busitema University Institutional Review Board/Research Ethics Committee (BUFHS-2025-97). The study was conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from all participants.

Consent for publication: Not applicable.

Availability of data and materials: The datasets used and analysed during the current study are available from the corresponding author on reasonable request.

Competing interests: The authors declare that they have no competing interests.

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Authors' contributions: MM, NP conceived the study, designed the instrument, collected and analysed the data, and drafted the manuscript. XD supervised the study and reviewed the manuscript. WD provided methodological guidance and reviewed the manuscript. All authors read and approved the final manuscript.

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