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The Digitalization of Routine Data Management Processes at the Point-Of-Care: The case of e-Tracker in Ghana

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Purpose: This study explored the usability factors that influence the use of mobile technologies among healthcare staff at the point-of-care.
Methods: The study adopted an interpretive approach and employed a combination of qualitative and quantitative data collection methods, and inductive and deductive analysis. A questionnaire was adapted, and data was collected from 52 health facilities, with four interviews conducted between April and June 2018.
Results: The study found that the digitalization of data collection registers and forms has streamlined data management processes. The nurses were satisfied with e-Tracker as it has made them more efficient and productive. More importantly, the offline feature enabled them to capture data in areas with no Internet coverage. Using e-Tracker has reduced the cost and the physical effort required to collect and process data and has improved data quality. Lack of confidence in using the tablet in front of clients and poor Internet connectivity were among the challenges identified. While inevitable, these need to be addressed as they could influence the usability and continuity of use of the technology.
Conclusions: While the device has the potential to improve routine data collection, some contextual factors might hinder its usability. An important lesson from this study is that the implementation of new technology among healthcare staff, particularly those at the peripheral level, requires continuous training and support. The study contributes to the discourse on digitalization of routine data management processes at the point-of-care.

Keywords: *Usability, e-Tracker, mHealth Technology, Routine health information management, Digitalization, Ghana*

1 Introduction and Background

Manual data collection has traditionally been the mainstay of collecting and managing routine data in the healthcare sector, especially at the peripheral levels in low and middle-income countries (LMIC). However, it has high potential for human error such as incomplete records, poor recording, and underreporting of data. Manual data collection procedures can also be cumbersome and time-consuming, thus increasing the burden on already overloaded staff, and risking the quality of both the data collected and the services provided [1,2]. Poor quality data and its limited use to support decision-making characterize health management information systems (HMIS) in many LMIC, including Ghana, which was the focus of this study.

Ghana is a developing country with a population of 28,102,471 (July 2018 est.) [3]. In the country's healthcare sector, routine data is collected manually, with nurses completing several registers before attending to patients. Due to the high volume of clients, paper-based registers can be cumbersome and time-

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consuming and could result in late submission of data. In turn, this results in poor monitoring of, and delays in patient follow-up, and inability to take timely action, which could affect the delivery of primary healthcare services. To address this situation, the Ghana Health Service (GHS) decided to digitalize data management related activities by implementing mobile technology (e-Tracker). E-Tracker is used by front-line healthcare providers such as community-based Health Planning and Services (CHPS) for the management of routine data [3] at the point-of-care.

The introduction and implementation of mobile technology in the healthcare sector in general and for managing data collection related activities hold tremendous potential [4]. Features such as GPS navigation, web-browser, instant messaging, and high-speed wireless network [5] have opened up a vast space for mobile interactions in the healthcare sector. Studies have shown that mHealth can improve health systems in areas such as maternal, child, and reproductive health [6]. Mobile applications including the use of mobile devices can improve medical data collection, service delivery, and patient-doctor communication, and facilitate real-time monitoring of patients. In HMIS, mobile technology can be employed to address data collection challenges [7,8], especially in LMIC.

Using mHealth technology for data management has significantly reduced the effort expended. For example, it can be used in HMIS to track and monitor the reporting of health indicators, while the use of Personal Digital Assistant (PDAs) has increased access to data, improved accuracy (timeliness and feedback), reduced time and costs, and improved data quality [9]. In Mozambican health centers, staff who use handheld phones to send routine data to district offices reported up to 50% improvement in data quality [10].

Despite the advantages of mobile technologies, studies conducted in Nigeria and South Africa have cited poor network infrastructure as a predominant barrier to their use, especially in rural areas where there is poor network coverage [11]. The high cost of Internet access in landlocked countries hinders full implementation of mobile technology. For example, a World Bank report showed that on average, the cost of Internet access is US$206.6 per Mbit/s per month in coastal countries in Africa, compared to US$438.82 per Mbit/s per month in landlocked ones. Chad, Cameroon, Equatorial Guinea, Lesotho, Mali, and Niger have some of the highest access costs [12]. Another challenge is the lack of a regulatory framework; there is also a need to review and update existing ones to address emerging issues and new technologies. The lack of or poor implementation of laws on cybersecurity, data protection, and privacy, could slow the momentum of the growth of the African digital economy [13]. A lack of skilled human resources such as ICT professionals and electronic content developers hinders the implementation of mobile technology, especially in rural areas [14]. Other factors that can affect usability include limited Internet connectivity, high levels of power consumption, small screen sizes, limited input modalities [8], low Internet penetration, and poor mobile connectivity [15,16], which, for example, hamper the use of SMS and voice call reminders to take medication [12] and negatively impact perspectives of usability [8].

Organizations implement mobile technology in order to increase efficiency. However, the full potential of the system and thus the benefits can only be exploited if they are used. Nielsen [17] explains that as the prevalence of mobile technology with Internet connectivity increases, so too, does the need to pay attention to the usability of these devices. Usability refers to how easy it is to use a device, or how easily it can be used to accomplish a given task. A system that is difficult to operate is likely to fail; therefore, acceptance and ease of use are factors in the successful implementation of mHealth in LMIC[12]. For example, a major challenge faced by mHealth users is lack of use acceptance of the technologies [18,19] as they are designed to be used while on the move. Therefore, ascertaining mobile technology's usability is critical for continuity of use [12,20].

Furthermore, routine data is generated at the-point-of-care (peripheral level). Studies have revealed that the use of mobile technologies at this level is influenced by multifaceted contextual factors and unanticipated challenges [18]. Ghana has a large rural healthcare sector that is nurse-driven and studies have revealed that frontline care providers lack basic IT skills [13]. The fact that users in rural healthcare settings are reluctant to accept mHealth technologies [17] motivated the study. The main objective was to understand the contextual factors that influence the usability of these technologies among frontline nurses at the point-of-care in primary healthcare facilities. The findings could serve as an important component of the pilot phase of mHealth implementation.

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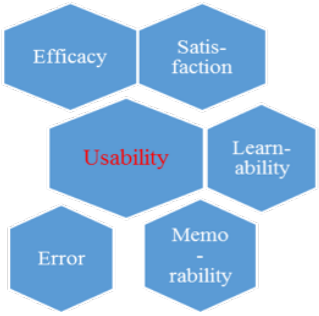

Figure 1 Usability Framework (Lin, 2013)

Definition of Concepts

The concept of usability emanates from the field of human-computer interactions (HCI) and is concerned with the relationship between humans and computers. Usability is a quality attribute that measures the ease-of-use of a user interface. It concerns the quality of a user's experience when interacting with an application, website, or mobile within a specific context [21]. Measuring usability involves a combination of factors. The International Standardization Organization (ISO) 9241-11 defines usability as "the extent to which a device can be used by a specific user to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use" [21]. In this case, the device is the e-Tracker, the users are community health nurses (CHNs), the tasks involve managing data related activities and the context of use is primary healthcare. Data related activities include data collection, analysis, interpretation, and dissemination. Figure 1 above shows the five constructs that have been used to measure usability [21]. The key constructs which guided this study were: Efficiency – a measure that assesses whether users have learned to use the device and how quickly they can perform tasks that is considered a quantitative measurement; Satisfaction – a qualitative measurement that measures how pleasant it is to use a device; Learnability – a quantitative measurement to assess how easy it is to learn the system and quickly begin to use it for work; Memorability – a measure of how well the user can re-establish proficiency after a period of not using the system; and Error – a measure that assesses how many errors users make when using a mobile device and how easy it is to recover from the error[21]. Our study did not use the error rate as a separate measurement because it can be incorporated into the learnability attributes [22]. The remainder of the article is arranged as follows: Section 2 presents the research setting and methods employed, section 3 discusses the results, section 4 presents the discussion, and section 5 concludes the article.

2 Research Setting and Methods

2.1 Research Setting

The study was conducted in two districts (Central Region Awutu Senya and the Volta Region, Ho Municipality), across 52 health facilities. These districts were selected because at the time of data collection, they had implemented e-Tracker, and nurses had been trained and had started using the mobile device. These health facilities are the first point-of-entry for most people seeking healthcare and data processing is done manually. They are under-resourced in terms of both human resources and technological and other infrastructure. The staff has limited skills, and few opportunities for further training. They also lack access to technology, experience sporadic power cuts, and have limited or no access to the Internet. This is the level where data is generated and the source of many data quality issues. Redman [23] explains that poor quality data at this level affects the entire system, and cleaning data at another level is difficult and expensive.

At CHPS, routine data is gathered from patients who seek different healthcare like outpatient, immunization, and maternal care and recorded on different registers and forms. Next, the data is manually compiled and aggregated weekly, monthly or quarterly, and forwarded to the next level of reporting. At the highest level, the data is analyzed using the District Health Management Information System (DHMIS2),

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an open source software platform for reporting, analysis and dissemination of routine data. Each district has a district health directorate, with a district information manager. At the health centers, nurses have poor access to information because the books are out of date, there is no access to journals and the Internet, and the information available is not appropriate for the local situation.

2.2 Methods

This qualitative study adopted an interpretive stance to understand the phenomenon of digitalization of routine data management at the point-of-care through the meaning that people ascribe to it [24]. Behaviors that stem from experiences help to describe realty. The interpretive stance was chosen because the study aimed to descriptively understand the contextual factors that influence frontline healthcare staff's use of mobile technology in delivering healthcare services from their own perspective. Interpretive studies aim to produce "an understanding of the context of IS, and the process whereby the information system influences and is influenced by the context" [24, pp.4-5]. Walsham [24] notes that interpretive studies in information systems (IS) research incorporate thick descriptions of human interactions in the use of IS. Data was collected from 52 health facilities using a combination of data collection techniques including questionnaires, interviews, and document analysis [25].

A questionnaire was the primary source of data collection. This is a well-established tool to acquire information on public knowledge and perceptions. It enables respondents to consider their responses carefully without interference from, for example, an interviewer and it is possible to access a large audience within a short period of time and to compare the data [26]. In addition, questionnaire is particularly useful when participants wish to remain anonymous and more comfortable way for participants to divulge information that would make them uncomfortable in a face-to-face setting. In this case, the purpose is to understand nurses' perception of e-Tracker (mobile health) and to rate how they feel about using the device. In addition, we sought to compare the data from the two districts to establish any differences in experiences of using e-Tracker at Awutu Senya (urban) and Ho municipality (rural).

The team adapted a usability questionnaire to meet the needs of the study. The questions were closed-ended and were scored on a 5 point Likert-type scale ranging from strongly agree to strongly disagree. Space was provided for nurses to add their comments after each question and to express their views on using e-Tracker. For validating and administering of the questionnaire, it was cross-checked by IT students at Lucas College in Accra, under the supervision of the fourth author and senior health information department staff to validate the content. It was pre-tested with five surveillance officers at Ho municipality. Pre-testing a questionnaire helps to determine if the respondents understand the questions and provides the most direct evidence of the validity of the questionnaire data [27]. Feedback from the pre-test led to the modification and clarification of some questions. The questionnaire was paper-based and one questionnaire was administered per facility.

2.3 Data collection

This study focused on the e-Tracker on the tablet, with the nurse in charge of the tablet at each health facility responding to the questionnaire. Data was collected between April and June 2018. The questionnaires were handed to the CHNs in charge at the district office while they were attending the monthly data management review meeting. At the meeting, the district manager introduced the researchers to the CHNs in charge and the researchers were given ten minutes to present the study's aims and purpose. At the end of the meeting, an envelope containing a questionnaire, a covering letter that explained the study's objectives, and a consent form for the CHN in charge to sign was handed to the CHNs in charge. Envelopes for CHNs in charge who were absent from the meeting were later given to the Health Information Officer (HIO) at Awutu Senya and the Public Health Officer at Ho to deliver at the health facility, as they visit facilities in the district on a weekly basis. Sixty-two questionnaires were distributed, 40 to Ho Municipality and 22 in Awutu-Senya. The facilities were given approximately a month and-a-half to complete the questionnaire and two reminders were sent in the space of two weeks to increase the response rate.

While a questionnaire is an effective data collection tool, it is not always comprehensive. Hence, the questionnaire was supplemented with interviews and document analysis. Interviews were conducted after the health facilities had returned the questionnaires. They probed why the nurses held the opinions recorded on the questionnaires. Interviews were conducted with four individuals charged with overseeing the implementation and use of e-Tracker in these districts, namely, the district health director, two information

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managers, and a public health officer. The interviews were semi-structured with broad and open-ended questions to allow the respondents to explain the issues they encountered in trying to get the nurses to use e-Tracker. Before the start of each interview, time was dedicated to building trust that helped to set the tone for the rest of the discussion and for the respondents to read the information sheet and sign the consent form. The interviews were conducted at the respondents' offices and lasted 30 minutes. They were auto-taped, and transcribed verbatim. Printed and electronic documents were also analyzed. These included strategic plans, project reports, quarterly reviews, and bulletins. They provided contextual information on health care practices and strategies in Ghana. Collecting data from multiple sources increased the study's internal validity [28]. Written informed consent was obtained from those interviewed after they had read the covering letter explaining the study's objectives. Ethical approval was obtained from the Ghana Health Services Review Committee, Reference 017/11/17 and permission was obtained from the relevant authorities.

2.4 Quantitative and Qualitative Data Analysis

Data analysis for this study was twofold. Firstly, the questionnaires were sorted and entered on the Statistical Package for the Social Sciences (SPSS), with descriptive analyses employed to summarize the deductive results. The data was analyzed based on usability concepts. Secondly, the interviews (qualitative analysis) were transcribed and analyzed. Analysis of the data from the interviews was cyclic [27], with the researcher going back and forth from the data to the analysis and from the analysis back to the data to gain a good understanding of what the participants were saying. An inductive approach to thematic analysis was adopted based on Braun and Clarke's [29] process. The transcripts were read and codes that gathered similar data together were developed. Phrases were written in the transcripts that placed similar data together. After identifying the phrases, the researchers reviewed the transcripts and started developing interpretive codes. The coding process was done manually using colored pens to highlight key themes while inserting comments in the margins to record the researchers' thoughts. Thereafter, the themes were charted to link key phrases from the respondents and identify patterns of phrases. As an inductive process of coding and categorizing was adopted, the themes that emerged are rooted in the participants' own words.

3 Results and Analysis

This section presents the results from the qualitative and quantitative analysis. Where appropriate, comments and verbatim quotes are inserted.

3.1 Characteristics of Study Participants

Of the 62 questionnaires administered, Awutu-Senya returned all 22 while Ho municipality returned 30. In total, 52 health centers returned the questionnaires. Of the 52 nurses who participated in the study, 43 (83%) were female and 9 (17%) were male. This affirms that nursing is still regarded as "the quintessential" female profession [30]. Most (96%) of the nurses were CHNs with more than three years' work experience. The majority (63%) of the participants were in the age bracket 31 to 40 years, while 23% were aged 15 to 30. Approximately 75% of the participants had worked at the facility for more than two years. There was no significant difference between nurses' use of e-Tracker in the rural and urban districts.

3.2 e-Tracker Usage

Each health facility has a desktop computer and one tablet and both have e-Tracker installed. The tablet is used by the CHN in charge. E-Tracker is used to collect routine data and to track clients on different health programs such as family planning, immunization, child health, maternal health, and post-natal health services, and to send SMSs to remind mothers of their appointments. It is also used to manage data; i.e., to capture, calculate coverage, analyze trends, compile data, and submit data to the DHMIS2 platform, where facility reports are generated.

Comparing the data collection process before and after the implementation of e-Tracker

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The nurses reported that before the implementation of e-Tracker, a nurse, for example, was required to manually complete an average of five registers or forms before attending to a patient. S/he had to juggle between examining the mother and the baby, and completing the forms. A nurse explained the challenges they encountered on a daily basis:

> *"Mothers come very early to the clinic to have their babies vaccinated before starting their day's activities. At the clinic, we have to examine both mother and child, weigh and check the baby's vital signs. If the mother is still breastfeeding the child, we have to verify …* [that] *the baby is eating properly. All information is written down. Also, one has to fill in about five registers. Mothers are getting angry, complaining that we are wasting their time." (HO_2)*

Another nurse added that at month end, when data has to be submitted, they had to flip through tens of pages of the registers and the tally sheet to verify and validate the data, then capture it on an excel file, and perform the necessary validation, before the data was sent to the next level. This participant described manual data collection as cumbersome and time consuming. Using e-Tracker and the digitalization of registers, including the use of the Unique Patient Identifier (UPI) has reduced duplication of processes, enabling nurses to perform their tasks more quickly. A feature of e-Tracker that facilitates ease of use is the device's interface. Around 75% of the participants agreed that the e-Tracker interface is pleasant to work with. They explained that the organization of information on the device is very clear and easy to grasp. The HIO added that data management was easier and faster as nurses submitted data almost daily, making it easy to manage and validate and provide timeous feedback. This resulted in improved efficiency. Although most of the nurses said that they were happy with using the device, around 30% said that they did not feel comfortable using it in front of patients.

3.3 Satisfaction

More than half (59%) of the nurses expressed satisfaction with using the device and 64% agreed that it made them more productive. The participants noted that digitalization increased the speed with which data was processed, because e-Tracker enables reports to be generated instantly. This function was previously done at the district office, and took a couple of days after the data had been submitted.

One participant compared using e-Tracker on a desk-top computer to using it on the mobile device. It was noted that the mobile device offered mobility and an offline feature enables nurses to capture data without necessarily being connected to the Internet. This feature is not possible with a laptop. The Information Manager concurred:

> "…using e-Tracker on the desktop was difficult as compared to the one on the tablet. This version on the tablet is user-friendly. But an additional advantage is the offline feature which allows nurses to capture, save data and then send it later. One does not need to have access to the Internet during data capturing" (AS_4)

Another nurse added that e-Tracker enables instant generation of clients' schedules and they are able to send text messages from the device as reminders to clients anywhere at any time. The participants expressed satisfaction with the device as they can do everything on it. Similarly, the HIO noted that the introduction of e-Tracker had reduced the cost and the physical effort required to collect and process data. For example, the amount spent on paper, printing reports and phone calls has decreased significantly. The HIO added that data timeliness and submission rates have improved and because data is submitted daily, so too is the quality of data because nurses have more time to look at the data before it is submitted.

However, it was interesting to note that, 40% of the nurses expressed reluctance to use e-Tracker because it was time-consuming. A further reason was that they had to do double data capturing, i.e., on paper-based registers and the device. However, the HIO explained that the MoH requested this as the digitalization process is in its initial stages and that, in order to ensure that no data is missed, CHNs should continue capturing data manually. This will ensure a smooth transition. Once the system is stable, the CHNs will only use the e-Tracker.

3.4 Learnability and Error

Before nurses started using e-Tracker, they attended a two-day training course on how to use the tablet. Fifty-two percent of the nurses reported that it was easy to learn how to use the e-Tracker and 50% added

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that it was easy to rectify an error. The HIO added that the MoH is aware that the training was brief; however, health centers are visited on a regular basis by HIOs who provide on-site support and supervision to ensure that the device is used properly and functioning well. Furthermore, the fact that the nurses found the interface easy to use and were able to navigate the various features easily implies that the e-Tracker was memorable.

3.5 Factors that Influence Nurses' Use of e-Tracker

Inadequate Skills and Lack of Support

The nurses were of the view that they required more training and support on how to use the device and to ensure that it is functioning. For example, three health facilities in Ho municipality did not complete the questionnaire because the device was not functional. From the deductive results presented above, it would seem that e-Tracker offers exciting new opportunities to nurses to satisfy high demand for healthcare delivery, and to be able to work faster, and be more flexible and effective. However, a lack of adequate skills and support to use the device effectively can cause frustration, with negative impacts on their motivation. Training is an important component when implementing new IS and at the rural health facilities, continuous training and support is even more crucial due to the dearth of skills [1,2].

Lack of Resources

Lack of mobile device - as noted previously, there is only one device per facility. The nurses expressed the need for more devices, as having one tablet per facility with many consulting points does not reduce the workload. There is also a lack of finance for fuel and to purchase data for the device. The HIOs and nurses need fuel for the vehicles and motorcycles they use to travel to health facilities for supervision and to provide on-site support and the device need mobile data. A lack of resources such as finance and equipment, are among the biggest challenges hindering the implementation of a new IS in low and middle-income countries (LMIC) [1].

Lack of Confidence to Use e-Tracker Device

The nurses reported that they lacked confidence to use the device on a daily basis. One explained:

> *"When we stand in front of the clients talking to them with this device in our hand, some of them feel that instead of attending to them instead we are chatting so I do not feel confident"(HO_1).*

Another commented:

> *"…though nurses are happy with the device, most of them are still reluctant to use [it]. … They prefer to capture data on the paper registers and when the facility is less busy, they transfer the data on the device…" (AS_5).*

Limited Internet Coverage

Furthermore, the nurses reported poor Internet coverage at some health facilities, especially those in deep rural areas. They noted that after capturing routine data they have to drive long distances to obtain Internet coverage to send it, meaning that they spend more on fuel.

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4 Discussion

The study aimed to understand the contextual factors that influence the usability of e-Tracker (mHealth technologies) among frontline nurses at the point-of-care. Quantitative and qualitative data collection methods were employed. To measure usability, we used Lin's [21] concepts, namely, efficiency, satisfaction, learnability, error, and memorability. Our quantitative analysis to measure the concepts of usability revealed that four concepts (efficiency, satisfaction, learnability, and error) were evident in this study. Due to lack of data, we were unable to measure the concept memorability.

The study found that the digitalization of numerous paper-based registers and forms has reduced the time spent on data management processes. The user-friendliness of the e-Tracker interface facilitates easy access to different components and data management has become flexible and faster. Using e-Tracker gave nurses the freedom to perform their duties (to collect routine data) easier and faster, hence giving them more time to validate data before it is submitted, consequently improving data quality (data timeliness and submission rates have improved). The mobility of the device and availability of the offline feature facilitate data capture and analysis even when there is no connectivity, which improves performance. While using e-Tracker has made nurses more productive and efficient, from a management perspective, it has reduced the cost and the physical effort required to collect and process data.

Apart from establishing whether e-Tracker is usable or not, the study also aimed to identify the challenges encountered by nurses in using it. This is important as challenges can affect usability. The findings show that nurses lacked confidence to use the device daily to complete their tasks. They also point to the challenge of undermining clients' trust, as some clients assume that nurses are using the e-Tracker device for fun. This finding is consistent with Velez et al.'s [31] study that found that because nurses were not confident about using the device, they reverted to paper-based registers and forms to collect routine data.

Self-confidence is related to uncertainty [32]. Bearden [32] notes that when individuals are confronted with an intricate situation, self-confidence plays a significant role in backing their actions or decisions, and can determine their attitude. There are two types of self-confidence; general self-confidence and specific self-confidence. Specific self-confidence implies that the individual has ample information and knowledge that makes them confident about handling the specific device. General self-confidence involves negative and positive attitudes towards a particular object or individual. Bearden [32] contends that general self-confidence is associated with a person's decisions and behavior, and is often associated with non-users with little or no experience of a particular product. In this study, the nurses lack general self-confidence. Individuals with high levels of general self-confidence are accustomed to using new technologies and willing to take risks [33]. In contrast, those with low levels of general self-confidence feel that they are insignificant and their fallibilities make them uncomfortable, and uncertain that they can successfully manipulate a new technology.

A lack of general self-confidence to use a technology in an organization could have a serious impact on the workforce [34]. As noted above, a lack of self-confidence is the result of a lack of skills. In the IS domain, an important objective of the implementation of a new technology is to ensure that its users are equipped with the skills required to properly use it [35]. However, building staff confidence to use technology, particularly among staff at the peripheral level [36], requires continuous and contextual training because it empowers staff by giving them the confidence they need to keep abreast of the new technology, and pushes them to perform better.

Although the managers acknowledged that the two-day initial training given to nurses was not sufficient and noted the need for on-going on-site support and supervision, performing these services might be challenged due to the lack of financial resources to cover items such as fuel to travel to health facilities to provide such. Lack of finance and poor Internet connectivity hamper the development and sustainability of IS in LMIC. While IS implementation is complex and challenges are inevitable [37], it is important to manage them because they are key to continuity of use of the technology[38].

5 Conclusion

The study found that the implementation of mobile technology has enhanced and improved the processes of data collection and use at the point-of-care. The digitalization of data collection registers and forms significantly reduced the data management processes. These findings are consistent with those of

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[9,10,13,19]. However, the implementation of mobile technology was not without challenges. While these are unavoidable, they need to be attended to because if they persist, they might affect usability; that is, nurses might abandon the device. An important lesson from this study is that the implementation of new technology among healthcare staff, particularly those at the peripheral level requires continuous training and support. The traditional two-day HIS training is inadequate because it does not provide staff with the necessary skills to adequately use the technology. In order to develop staff skills and self-confidence to use the new technology properly, the two-day training should be complemented with on-site support and supervision. Overall, the positive effects of e-Tracker outweigh the challenges. However, to gain the full benefits, it is important to focus more resources on building staff capacity.

This study contributes to the discourse on digitalization of routine data management processes at the point-of-care. While it was conducted in two health districts, its findings raise issues that have wider applicability to the implementation of information technology in resource-constrained settings. The primary concerns relating to qualitative research revolve around validity and reliability [27]. To address these concerns, in terms of validity, we employed triangulation; that is, a variety of data sources (questionnaires, interviews, and documents analysis) as opposed to relying solely on one source. We also included verbatim quotations [39] in the analysis section. To ensure reliability, the interviews were recorded and transcribed, and at the end of data collection, a preliminary report was written and presented at the district information meeting [40]. In terms of future research, while there is a rich body of literature on data management in health facilities, very little attention has been paid to nurses at the peripheral level who generate this data. We recommend that further study is conducted to check the validity and quality of the data since data quality problems arise at the point-of-care.

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Statement on Conflicts of interest

No conflict of interest

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