



Unintended consequences of technology-enabled work activities experienced by healthcare professionals in tertiary hospitals of sub-Saharan Africa

Oluwamayowa Ogundaini, Retha de la Harpe & Nyx McLean

To cite this article: Oluwamayowa Ogundaini, Retha de la Harpe & Nyx McLean (2021): Unintended consequences of technology-enabled work activities experienced by healthcare professionals in tertiary hospitals of sub-Saharan Africa, African Journal of Science, Technology, Innovation and Development, DOI: [10.1080/20421338.2021.1899556](https://doi.org/10.1080/20421338.2021.1899556)

To link to this article: <https://doi.org/10.1080/20421338.2021.1899556>



© 2021 Cape Peninsula University of Technology, Cape Town, South Africa. Co-published by NISC Pty (Ltd) and Informa UK Limited, trading as Taylor & Francis Group



Published online: 07 May 2021.



Submit your article to this journal [↗](#)



Article views: 352






View related articles [↗](#)



View Crossmark data [↗](#)

Unintended consequences of technology-enabled work activities experienced by healthcare professionals in tertiary hospitals of sub-Saharan Africa

Oluwamayowa Ogundaini ^{1*}, Retha de la Harpe ² and Nyx McLean ³

¹*Department of Information Technology, Cape Peninsula University of Technology, Cape Town, South Africa*

²*Faculty of Business, Cape Peninsula University of Technology, Cape Town, South Africa*

³*Department of Information Technology, Cape Peninsula University of Technology, Cape Town, South Africa*

*Corresponding author email: ogundainio@cput.ac.za

The unintended consequences experienced by healthcare professionals while using health ICTs at points-of-care are disruptive to their work activities. Failure to address these consequences inhibits efforts to support the delivery of quality healthcare services in hospital settings. Hence, the aim of this paper is to identify how unintended consequences disrupt technology-enabled work activities of healthcare professionals in hospital settings.

An interpretive stance was adopted to investigate healthcare professionals' experiences with the use of health ICTs for their work activities through open-ended interview questions, to acquire in-depth information about unintended consequences events. A total of 19 participants were selected using a purposive sampling technique to identify healthcare professionals from two tertiary hospitals with varying levels of technology implementation. The participants included doctors and nurses in clinical departments that use health ICTs for medical imaging, referrals and reporting. Ethics clearance for data collection were granted by the University research ethics committee and the hospitals. Thematic analysis was adopted to identify and interpret patterns that emerged from participants' responses.

Findings indicated that the unintended consequences experienced by healthcare professionals are protracted time to complete tasks; interruption of tasks and workarounds at points-of-care. The unintended consequences are caused by contradictions that result from tensions between contextual conditions that inhibit perceived usefulness, and a lack of fit between tasks of work activities and health ICTs. Hospital managers and health technology vendors should actively consider the likely undesirable experiences or disruptions from feedback recorded during the pilot implementation phase within use contexts.

Keywords: healthcare professionals, health ICTs, sub-Saharan Africa, unintended consequences, work activities

Introduction

One of the major drawbacks of an inadequate healthcare system is the associated unintended consequences that inhibit the use of health ICTs by healthcare professionals during technology-enabled work activities. The inadequacies of facilitating conditions add to the complexity of healthcare systems which are already overburdened (Anwar, Shamim, and Khan 2011; Idoga and Toycan 2016). In the sub-Saharan region of Africa, there are concerns around burden of diseases estimated at 24% of global occurrences; poor access to healthcare by the majority of the population and a lack of adequate healthcare system, ultimately leading to a relatively high mortality rate (Yaya et al. 2020). Although access to quality healthcare services is regarded as a fundamental human right by Wu et al. (2018), existing literatures report that the process is complex. The complexity of healthcare service process can be attributed to the skilled labour requirements; volume of information being generated and dynamics of the decision-making process (Fraser and Blaya 2010; Middleton et al. 2013).

As a means to manage the bulk amount of information generated, its quality and effectiveness to support decision-making in the delivery of healthcare services, health ICTs were developed (Odekunle, Odekunle, and Shankar 2017). Health ICTs were developed to improve the process of service delivery by addressing the lack of readily available information and communication as

well as related challenges during the work activities of healthcare professionals (Bates 2015; Atarodi and Atarodi 2019). The penetration of telecommunication and enabling mobile devices have been promising to the healthcare sector (Fortuin et al. 2016; Adepoju et al. 2017). Mobile health (mHealth) applications have enabled timely access to and exchange of health information and services for patients at any location – clinics, hospitals and at a patient's residence (Klasnja and Pratt 2012). Some of the capabilities mentioned of health ICTs are attributed to its features (Vaghefi and Tulu 2019). The features include size of screen, keypad, computing power, storage memory, wireless-enabled technologies, sensors, in-built camera and in some instances, hands-free voice activated functions (Svanæs, Alsos, and Dahl 2010; Gerhardt, Breitschwerdt, and Thomas 2018).

While health ICTs may enable healthcare professionals to provide safe and quality healthcare services, there are concerns about the challenges that impede their effective use at points-of-care (Adler-Milstein and Bates 2010; Qureshi et al. 2015). Some of the challenges include, but are not limited to infrastructure inadequacies, resistance to new technology innovation and change, security concerns, and a lack of systems interoperability (Ladan, Wharrad, and Windle 2019). In other post-implementation instances, health ICTs may shape how healthcare professionals perform their work activities

especially in other unintended ways within certain contexts. The unintended ways could either be of benefit or have negative consequences (Kuziemsky, Randell, and Borycki 2016). The positive unintended ways can be attributed to the mastery and adaptability of the healthcare professional while the negative aspect could be as a result of a misfit between the tasks being performed and the health ICTs under certain contextual conditions. Collectively, all these factors may negatively influence the behavioural intention of healthcare professionals to use health ICTs and may impair the seamless delivery of healthcare services.

The objective of the paper was to identify the likely unintended consequences attributed to the use of technology to execute the work activities of healthcare professionals in tertiary hospitals. The rest of the paper includes: literature review describing primary work activities of healthcare professionals, utilization of health ICTs and existing studies on the unintended consequences associated with health ICTs. The research method is discussed, followed by the findings. The paper is concluded by addressing the research aim and the contributions of the study.

Literature review

Healthcare services

Healthcare services are categorized into administrative, clinical and research activities (Mimbi and Bankole 2015). Administrative tasks deal with admission, transfer and discharge of patients which require report-writing and administering physical care to patients that temporarily visit the hospitals and leave the same day and those admitted and in the hospital for a period (Patrick et al. 2008). Similarly, clinical activities of healthcare professionals can be broadly categorized to include patient and information administration. For example, nurses oversee care, treatment plan, and document the activities of procedures carried out on patients while doctors coordinate and collaborate on patient consultation and attend to referrals from other healthcare institutions. More importantly, these work activities are complementary and dependent on information. Therefore, there is a need for an adequate information management system that is timely and appropriate to ensure timely access to information for decision-making (Ammenwerth et al. 2003). The management of information is usually done manually by paper or digitally using health ICTs to capture, retrieve and share health-related records (Haux 2006).

Utilization of health ICTs by healthcare professionals in work activities

One of the most common forms of health ICTs is electronic health records (EHRs). EHRs are digital systems used to manage health information which includes but is not exclusive to patients' medical history, doctors' clinical notes and examination bookings or schedule appointments (Blumenthal and Tavenner 2010). EHRs are usually installed on desktop computers in hospital settings and provide access and retrieval support for healthcare professionals during patients' visits (Tokosi 2017). In

the attempt to address the shortcomings of desktop computers, portable and wireless devices such as computer on wheels (COWs) or workstations on wheels (WOWs) are set up in hospital settings to facilitate quicker access to patient records (Ventola 2014).

Aside from access to patient records electronically, health ICTs have also been used to address the scourge of long waiting times and the lack of adequate communication and coordination of care. For example, Idowu, Adeosun, and Williams (2014) developed an outpatient appointment booking system for the national health insurance scheme (NHIS) in Nigeria to address the long waiting times experienced by patients when they visit physicians for consultation. The NHIS booking system is web-enabled for desktop computers and mobile phones to enable electronic appointment scheduling and prompt both patients and doctors as a reminder. The authors envisioned that the system would assist patients to easily book, manage and get notified of their appointments. Such an electronic booking system holds potential to address incidences of missed appointments, and reduce backlogs experienced by physicians in hospital settings.

Coordination and communication are essential to patient and information administration especially for collaborative care (Behrens et al. 2019). Healthcare professionals may access and exchange patients' information from health information systems (HISs) on site (or remotely) depending on the activities being performed or based on time-sensitivity (Cucciniello et al. 2015). This increases the performance efficiency of healthcare professionals in accessing patient information or communication electronically with other healthcare professionals who share the same goals to make informed decisions. Mobile technologies such as smartphones and tablets do not restrict communication between healthcare professionals. These devices enhance mobility by enabling healthcare professionals to initiate voice or video conference calls and send instant messaging at their convenience irrespective of time and location.

Mimbi and Bankole (2015) argued that adequate ICT-enabled services have a direct correlation with improved health outcomes. In essence, technology-enabled work activities improve the efficiency of healthcare professionals to provide care services and monitor treatment progress administered to patients. The use of health ICTs and associated benefits are largely dependent on the fit for purpose or task; adequate enabling conditions and the contexts of use. Despite the benefits attributed to the use of technologies for work activities during service delivery, there are cases of challenges and unintended consequences experienced by healthcare professionals.

Unintended consequences of health ICT utilization

The challenges to the use of health ICTs to support healthcare service delivery are categorized into: infrastructure, technical, contextual conditions and human-induced challenges (Botha, Botha, and Herselman 2014; Ladan, Wharrad, and Windle 2019). These challenges are, but not restricted to the initial high cost of implementation; lack of system integration; Data security concerns

(Adler-Milstein and Bates 2010; Adebesein et al. 2013; Owolabi, Agboola, and Alawiye 2018; Alam et al. 2019). The effects of these challenges are directly or indirectly linked to the unintended consequences that result from the complex socio-technical interactions between workflows, organizational culture and integration of technologies into existing processes (Behrens et al. 2019). These challenges are attributed to emergent unintended consequences that influence the use and experiences of the end users to perform their tasks in a seamless manner.

Unintended (or undesired) consequences are termed as the surprises attributed to the use of an enabling innovation (Ash, Berg, and Coiera 2004; Harrison, Koppel, and Bar-Lev 2007). Unintended consequences are unanticipated outcomes that can either be undesirable or desirable (Coiera, Ash, and Berg 2016). In the healthcare context, undesirable unintended consequences are prominent as data duplication errors during decision-making; intermittent system delays and workflow interruptions (Gagnon et al. 2016; DeWane, Waldman, and Waldman 2019). For example, a delay in the process to digitize records where paper is still being largely used could influence doctors to resist a system and resolve to rather employ alternative means to store and retrieve patient information especially during emergency cases (Tokosi 2017; Kesse-tachi, Asmah, and Agbozo 2019). Also, there are studies that highlight distractions caused by use of smartphones by doctors particularly because it blurs the line between personal and professional spaces (Kabanda and Rother 2019; Yahya 2019). Unintended consequences could negatively influence the processes of diagnosis and treatment performed by healthcare professionals at points-of-care, ultimately compromising patients' safety and well-being.

Conversely, desirable unintended consequences could drive end users of health ICTs to use the tool in innovative ways other than its original intention. The adaptive use of alternative means is referred to as workarounds (Yang et al. 2012). In healthcare settings, workarounds enable end users to adapt and manoeuvre the difficulties associated with the use of health ICTs that inhibit how work is being performed in an ad-hoc manner. Workarounds are enabled by human agency. Human agency offers autonomy to intentionally make conscious decisions that would influence an action and its outcome (Orlikowski 2005; Pickering, Engen, and Walland 2017). Coiera, Ash, and Berg (2016) argue that health ICTs should be designed to accept potential workarounds to ensure a less disruptive outcome especially during service delivery.

The literature on unintended consequence associated with the use of health ICTs is limited in the context of Sub-Saharan Africa. Hence, this paper sets to highlight how context conditions contribute to the unintended consequences experienced by healthcare professionals when using health ICTs at points-of-care. In this paper, unintended consequences are conceptualised as the results of misfit or contradiction that occur between the technical capabilities of health ICTs, work activities and contextual conditions of use. The authors argue that the factors

enabling or inhibiting technology-enabled work activities are dependent on the complexity of tasks being performed, available infrastructure and ability of end users to adapt. Therefore, it is important to identify attributes of these factors to understand the unintended consequences of technology-enabled work activities experienced by healthcare professionals.

Research methods

The choice of a qualitative research method was underpinned by epistemological assumptions that knowledge dependent on human actors is socially constructed and can be acquired through subjective interpretations. In this study, the authors described the unintended consequences attributed to technology-enabled work activities as experienced by healthcare professionals. The account of experiences given by healthcare professionals assisted the authors to understand their perceptions of unintended consequences associated with the use of health ICTs.

Sampling

A purposive sampling technique was applied to select a sample from a population of healthcare professionals that could provide relevant information on how the use of health ICTs shapes the execution of work activities and the quality of service delivered. Therefore, the authors selected doctors and nurses with varying levels of health ICTs usage for their work activities in clinical departments that deal with medical imaging, referrals and reporting. Doctors and nurses were selected from Orthopaedics, Surgery, Ophthalmology, Intensive care and trauma units of tertiary hospitals as described in Table 1.

The participants described in Table 1 serve in the different capacities of frontline doctors and nurses at points-of-care and hospital managers, with varying levels of experience in the medical practice that range from 2 to 30 years. The technique of enquiry was semi-structured interviews to enable non-binary answers and further probing (Myers and Newman 2007). Semi-structured interviews enabled in-depth discussions with the participants about their work activities, the use of health ICTs and the resulting outcome of tasks performed at points-of-care. Each of the interviews lasted 35–40 min, and recorded with a voice recorder to capture all information.

Ethical considerations addressed

Permission to collect data was granted by the University research committee and the selected tertiary hospitals. All the files generated during the data collection process were stored in a password-protected folder on an electronic device, in compliance with the safety and consent discussed with participants. Each recorded audio file was renamed with pseudonyms to ensure confidentiality and conceal the identity of the participants.

Data analysis

Healthcare professionals were engaged in the premises of the hospitals to ensure that they were comfortable and able to demonstrate some of their responses. The data

Table 1: Profile of participants.

Pseudocode for participants	Clinical departments	Technique of engagement
Participant_1; Participant_2	Ophthalmology	Face-to-face interviews at Hospital H1 in the doctors' library
Participant_3; Participant_4; Participant_5; Participant_6; Participant_7; Participant_8	Orthopaedic	Face-to-face interviews at Hospital H1 in the doctors' library
Participant_9; Participant_10; Participant_11; Participant_12	Nursing	Face-to-face interviews at Hospital H1 in the nurses' boardroom
Participant_13; Participant_14	Radiology	Face-to-face interviews at Hospital H2 in the doctors' consulting room
Participant_15	Orthopaedic	Face-to-face interviews at Hospital H2 in the doctors' consulting room
Participant_16; Participant_17	Surgery	Face-to-face interviews at Hospital H2 in the doctors' consulting room
Participant_18; Participant_19	Nursing	Face-to-face interviews at Hospital H2 in the doctors' consulting room

collected was analyzed using the thematic analysis. Thematic analysis is suitable for emerging qualitative research that have textual data obtained from observation notes and semi-structured interviews (Hsieh and Shannon 2005). This technique was used to identify the attributes of work activities executed at points-of-care, how health ICTs are used and experiences of healthcare professionals.

The attributes identified were assigned descriptive codes, which were then categorized into themes by a process known as coding (Neuman 2011). Coding was performed in multiple iterations to exhaustively sort the data and identify unintended consequences associated with technology-enabled work activities as experienced by healthcare professionals.

The qualitative data analysis provided clarity on the attributes of unintended consequences that occur while healthcare professionals use health ICTs to executed their work activities. The findings presented in this paper are influenced by the frequency of attributes and emergent themes as indicated in Table 2.

The emergent themes that emerged from the coding process included: nature of work activities at points-of-care, challenges associated to the use of health ICTs for work activities and effects of health ICTs use challenges.

Findings

Nature of work activities at points-of-care

Healthcare services are structured and timely coordinated activities carried out by healthcare professionals to deliver care. The clinical activities indicated by healthcare professionals in this study include patient consultations, ward rounds, referrals, clinical procedures, and prescribing treatment plan for patients (Participant_15). For example, Participant_2 mentioned that,

“A typical day consists of ward rounds, consulting patients in the outpatient clinic and theatre. In between we have academic meetings and presentations”

Administrative duties are executed in form of handover meetings and discussion of patients' treatment plan, preparation of theatre and trauma lists and academic presentations. For the nurses, documenting nursing activities as a report and patient care administration were the major

activities described. The patient information is either newly generated or updated. Therefore, it is necessary that healthcare professionals have access to patients' records in cases of emergencies, scheduled or unscheduled follow-up visits. While expressing their frustrations attributed to the use of health ICTs, one of the participants said that,

“You need to answer the phone at ER, you need to answer your beeps and then you also get VULA referrals. And some of them, I would say half of them aren't emergencies and those people want an answer now because they've got a patient sitting in front of them but I've got 50 patients sitting outside and now I need to answer about something elective and they push you for it” (Participant_1)

VULA is a mobile software application designed to enable referrals and remote communication between healthcare professionals and workers. The response suggest that doctors multitask during patient consultations due to the number of patients being attended to at the points-of-care. In addition to the population size, there is a hint at the inappropriateness of or faults in tools. Participant_9 expressed that,

“Some documentation gets lost during movement of patients. It is time consuming because whatever procedure is completed the nurse got to come down and do the right thing afterwards. The paper is illegible at many a times due to the fact that peoples' handwriting differs ...”

Administration of care to patients by nurses is mainly supported by paper. The use of paper poses risk to information availability. Some of the healthcare professionals are aware of the imminent system failures based on their experiences or expectations of inadequacies or deficiencies of resources. Hence, there is a consciousness on the part of the healthcare professionals to prefer different tools for different tasks during their work activities in anticipation of events that might cause drawbacks at the points-of-care.

“I prefer paper based for note taking but IT based for outside referrals. The problem with technology is that when there is a problem with it and we need to revert to paper based work it causes issues and delays; it's all good until the ICTs fails” (Participant_6).

The sentiments in the response suggests that paper could be a more reliable tool to technology-enabled work

Table 2: Thematic coding process.

Categorized themes	Descriptive codes	Sample of participant responses
Nature of work activities	<ul style="list-style-type: none"> ✓ Consultation with patients ✓ Ward rounds ✓ Academics 	<i>'A typical day consists of ward rounds, consulting patients in the outpatient clinic and theatre. In between we have academic meetings and presentations.'</i>
	<ul style="list-style-type: none"> ✓ Referrals management ✓ Ward rounds ✓ Academics ✓ Theatre 	<i>'We start early in the morning ... with ward rounds, we do academics. The rest of the day depends ... you will either be in the clinic or you will be in theatre. And you get one day that you're doing call, we see emergency patients or patients that's been referred.'</i>
	<ul style="list-style-type: none"> ✓ Treatment planning and reporting ✓ Collaborative care ✓ Referral management 	<i>'Nurses give medication, do observation [of] the vital signs; then ... writes a report of patients seen by the doctor or members of a multidisciplinary team including the referral doctor like the neurosurgeon or the Orthopaedic surgeon.'</i>
Challenges associated with use of health ICTs	<ul style="list-style-type: none"> ✓ Process delays ✓ Time delays ✓ Administrative process ✓ Limitations to use of paper 	<i>'The ECM database has a waiting period of more or less 2 months before it is scanned in. So, if I see a patient within a month or two, the last notes will not yet be on the ECM.'</i>
	<ul style="list-style-type: none"> ✓ System downtime ✓ Duplication and repetition of tasks ✓ Revert to paper ✓ Abrupt end of work activities 	<i>'When ECM is down, it's a big problem because then you basically can't go on with your work. You can't book a patient for any surgery. If you haven't screened your patients, you will run into trouble and then have to see the patients again ... It's basically the same as falling back onto paper system.'</i>
Effects of health ICTs use challenges	<ul style="list-style-type: none"> ✓ A lot of multi-tasking ✓ Disruptions by notification ✓ Extended time to perform tasks 	<i>'The biggest challenge with VULA app is to be able to find time during patient consultations to also answer to referral doctor's questions; it takes a lot of multitasking and when disrupted by calls and VULA referrals it takes much longer to complete a consultation with a patient'</i>
	<ul style="list-style-type: none"> ✓ Disputable work etiquette ✓ Mobile phone interruptions 	<i>'I feel that it seems unprofessional to constantly be looking at your phone screen whilst consulting patients.'</i>
	<ul style="list-style-type: none"> ✓ Use of personal technology ✓ Bypass hospital process ✓ Quicker access to records 	<i>'I have an app on my phone where I take a photo of each patient's last notes when I've seen him. In this way I always have the latest notes of a patient on my phone and don't waste time waiting for notes to be found.'</i>

activities. However, health ICTs are seemingly appropriate to facilitate remote referrals. The evidence of health ICTs use indicate that some of the systems implemented such as VULA app, picture archiving and communication system (PACs), the enterprise content manager (ECM), are adequate for work but could affect work progress when they fail.

"In our clinics, for all patients that are seen notes are also made by hand and those notes as well as all referrals goes into a patient's folder. All those notes are sent to the

scanning department and get scanned into our ECM. All those notes eventually do become available on a computer as well" (Participant_3).

Work activities are not fully digitized and requires the use of paper. Also the response indicates that the information captured in paper during work activities goes through an administrative process of digitization. The rationale for the digitization of paper records is to ensure that patient information can be updated and retrieved in a timely manner. Conversely, when health ICTs do not support

the work activities as intended due to challenges or unintended outcomes there is a tendency for systems to be abandoned or underutilized by healthcare professionals.

Challenges of health ICTs use for the work activities

In an attempt to establish the experiences of healthcare professionals while using health ICTs, the findings show that the VULA app interrupts during consultation with patients, the ECM and PACs are slow and sometimes unreliable. As a result, healthcare professionals experience long waiting periods to access digitized paper records on ECM. A participant indicated that

“The only challenge would just be if the system ... I’m talking about the PACS now for some reason isn’t available or offline ... we’d have nothing to work with” (Participant_3).

The response above is relatable from the perspective of participant_6 who stated that “most of our work is reliant on PACS”. Similarly, Participant_1 mentioned that

“When ECM is down then it’s a big problem because then you basically can’t go on with your work. You can’t book a patient for any surgery. If you haven’t screened your patients yet ... then you will run into trouble but then you have to see the patient again ... It’s basically the same as falling back onto paper system.”

Additionally, it was indicated that the process of converting handwritten clinical notes by scanning into ECM system wastes time. For instance, one of the participants mentioned that,

“The ECM database has a waiting period of more or less 2 months before it is scanned in. So, if I see a patient within a month or two, the last notes will not yet be on the ECM. It is possible to request the notes then, but it wastes time” (Participant_2).

One of the inferences drawn from the responses above is that, implemented health ICTs embedded for intended purposes to enable the tasks of healthcare professionals can inhibit the execution of work activities.

“With regards to the PAC system, the negative part to that is not all computers always work. You get to a computer where you can’t log in to your X-rays or you can’t see the ones you actually put in a folder for your film. I think it came with a period of getting used to essentially. I think that’s the biggest challenge, is when electronics don’t work. Then it’s a massive irritation, if we can’t see X-rays and you’ve got a clinic full with 40 patients; it’s actually a nightmare” (Participant_4).

Findings reveal that VULA app causes several interruptions; it is time consuming and may give patients a perceived negative impression about the professionalism of healthcare professionals. For example, participants stated that the referral notifications interfere during the day and to some extent after working hours. Other participants mentioned that the VULA app interferes during the process of patient consultation, given the numerous amount of patients waiting to be attended to.

“The biggest challenge with the VULA app is to be able to find time during patient consultations to also answer to referral doctor’s questions; it takes a lot of multitasking and it takes much longer to complete a consultation with a patient.” (Participant_2).

It is clear from the responses of participants that, the use of VULA app adds to the need by healthcare professionals to multitask at points-of-care. The impression inferred is that there is no ideal mechanism that controls receipt of referral notifications, considering that healthcare professionals could be either be occupied on and off duty. Thus, it is arguable that use of health ICTs can result in unfavourable unanticipated experiences during work activities of healthcare professionals in a context where doctors attend to multiple patients and experience inadequate facilitating conditions such a limited computers and intermittent downtimes.

Effects of health ICTs use challenges on work activities

The unfavourable effects of health ICTs challenges on work activities are associated with, timeliness and unintended consequences that inhibits the progress of work activities. There are mixed narratives when it comes to the use of health ICTs to perform tasks. Participant expressed positive and negative views on the timeliness of health ICTs to enable work activities. It is clear that timeliness is a key factor that influences the perceived usefulness of technologies to execute healthcare service delivery.

As a result of the interruptions during patient consultations, the healthcare professionals mentioned that giving attention to their phone might make them seem unprofessional and increases time it takes to complete consultations. For instance, two of the participants mentioned that,

“It also sometimes feel unprofessional to be busy on your phone answering VULA referrals, while a patient is sitting in front of you” (Participant_1).

Similarly, Participant_5 expressed the same concern that, “I feel that it seems unprofessional to constantly be looking at your phone screen whilst consulting patients”.

Given the trend of these responses, it shows that the use of the VULA app by healthcare professionals increases their workload, obligating them to multitask – consulting and examining patients physically and at the same time responding to remote consultations with their colleagues from other public and private hospitals. Subsequently, VULA referrals disrupt healthcare professionals’ work activities and could give the wrong impression to the patients.

“The problem with the ECM, is the waiting period for notes to be scanned in: I have a app on my phone where I take a photo of each patient’s last notes when I’ve seen him. In this way I always have the latest notes of a patient on my phone and don’t waste time waiting for notes to be found” (Participant_2).

Based on the long waiting times, participants mentioned that there is a delay to their work activities. There are instances where doctors attempted to access patients’ records during consultation on follow-up visits but digitized paper records were not available. Participant_2 indicates that “it is possible to request the notes then, but it wastes time as it takes a few hours to be found/ scanned in.” Despite the advantage of easier accessibility to scanned paper records offered by the ECM system; it is not made available electronically in a timely manner.

Subsequently, doctors innovative alternate means to quickly gain access to patient records to improve their work performance. Hence, the unfavourable effects of health ICTs challenges tend to have either positive or negative unintended consequences.

The overall findings indicate that understanding the context of health ICTs usage contribute to addressing the unintended consequences experienced by healthcare professionals. The benefits of health ICTs to execute work activities are evident in its suitability to execute the work activities of healthcare professionals satisfactorily. However, the nature of tasks and usability associated challenges have unanticipated consequence to its continued use for work activities. It could be inferred that when benefits associated with a system mostly outweigh the drawbacks, users tend to continue with use or otherwise innovate alternative means.

Discussion

Health ICTs provide a means for frontline doctors and nurses to store, retrieve and share information at the same time facilitate communicate with each other. In this study, healthcare professionals used health ICTs in the forms of hospital information systems and mobile Health applications to access patient records, share information in real time to support decision-making in the process of diagnosis and treatment. The health ICTs were utilized because they are perceived to enable the execution of tasks efficiently at points-of-care. Thus, the argument is that, the capabilities of implemented health ICTs to satisfactorily enhance the performance of tasks within a particular context of use, influences how healthcare professionals experience suitability or discomfort of technology-enabled activities.

Perceived suitability of technology-enabled work activities

In this study, suitability was perceived as the extent to which health ICT fits the purpose of a work activity. This is attributed to the awareness and experiences of healthcare professionals' pre-implementation and technical know-how to utilize health ICTs in the intended context of use. For example, healthcare professionals in public hospitals are faced with contextual factors such as an overburdened healthcare system; backlogs of patients' visits; longer waiting times and sometimes lack of access to up-to-date health information (Scheffler, Visagie, and Schneider 2015). These factors influence how healthcare service is delivered. However, health ICTs have enabled the work activities of healthcare professionals and improved tasks performance especially with quicker access, communication and sharing of information to aid decision-making to manage activities at points-of-care. The arguments of perceived suitability of health ICTs align with conclusions drawn from literature reviews on factors that influence its adoption by healthcare professionals (Gagnon et al. 2016; Fan et al. 2020).

The suitability of health ICTs for the work activities of healthcare professionals is closely tied to its usefulness. The usefulness of health ICTs is largely dependent on the extent of its usability as experienced by

healthcare professionals. For example, the doctors agreed that desktops are ideal to support their work activities in the outpatient clinics as they are able to request further clinical examinations and view patients' records and mobile technologies are ideal for referrals. In similar studies carried out by Ayaomi, Davies Evans, and Ocholla (2017) and Tokosi (2017) in teaching hospitals of Nigeria and South Africa, the authors highlighted the correlation between user satisfaction and performance expectancy. While the intended use of health ICTs is to improve the tasks performed by healthcare professionals, the event of unanticipated outcomes that are negative will influence how technology-enabled work activities are perceived.

Usability of health ICTs for work activities

In this paper, the concept of usability was adopted from Svanæs, Alsos, and Dahl (2010). The authors defined usability as the extent to which a tool is used effectively by its intended users to achieve specified goals satisfactorily in a use context. Doctors expressed a feeling of satisfaction attributed to how health ICTs simplified access to patient records to enable decision-making. This relates to claims by Ladan, Wharrad, and Windle (2019) that healthcare professionals are motivated to use eHealth technology solutions because it enables completion of their tasks. The findings in this study show that there is a correlation between usability of health ICTs and some unintended consequences experienced by healthcare professionals. The resulting interplay influences the resulting satisfaction or dissatisfaction derives from the use of health ICTs at points-of-care.

While it is understood that health ICTs could improve efficiencies and effectiveness of work activities, the complexity or simplicity to use its features may determine how users perceive its usability in a typical use scenario. For instance, healthcare professionals experience delays due to the amount of interruptions and downtime caused by health ICTs at points-of-care within healthcare systems overwhelmed by the daily amount of patients that seek medical attention. The contradictions between the context of use and the challenges associated with health ICTs mediate the original intended use (Wiser, Durst, and Wickramasinghe 2019). Compatibility and adaptability ensures that the unintended consequences experienced by healthcare professionals result in minimal disruption of technology-enabled work activities as argued by Coiera, Ash, and Berg (2016).

Effects of unintended consequences from technology-enabled work activities

According to O' Connor and O' Donoghue (2015), contextual factors condition the environment to either inhibit or enable the performance of a task and the execution of activities. Multi-tasking at points-of-care without adequate support makes healthcare professionals susceptible to making errors that might be detrimental to a patient's well-being and impair service delivery. One of the reported impacts of health ICTs usage for work activities is to minimize errors and provide access to updated

information (Atarodi and Atarodi 2019). Without adequate enabling environment, human error would be amplified by technical disruptions, and this could have dire consequences on the health outcomes of patients.

Behrens et al. (2019) argued that, there are instances where technical flaws in ICTs could be the cause of medical errors that are eventually costly to the patient and healthcare organization. Also, Ratwani, Reider, and Singh (2019) claimed that time spent on the use of health ICTs for documentation contributes to the workload of healthcare professionals. These claims show that when attributes that cause unintended consequence to the use of health ICTs are not understood, it could lead to impairment of healthcare services. These attributes include enabling conditions, ease of use and time efficiency. Subsequently, the effects of unintended consequences are confirmed to ultimately result in delays, under-utilisation and errors (Middleton et al. 2013). Ultimately, healthcare professionals revert to paper based systems when the design of health ICTs does not consider contextual conditions of work activities and the possible scenarios of use.

Contributions informed by findings

It is evident from the findings that, there is a need for in-depth understanding of the impact and role played by the context of use when investigating unintended consequences associated with health ICTs. The challenges experienced by healthcare professionals with the use of health ICTs reflects the unanticipated aspects of how machine capabilities could influence and shape human performance. This contributes to frustrations experienced by healthcare professionals and could reduce confidence or trust in the suitability of the health ICTs to execute work activities satisfactorily. As there is a need to improve efficiencies of work activities especially in public hospitals due to the population size being catered for, the likelihood of unintended consequences and its effects contribute to the effective use of health ICTs. When designing for the hospitals in Sub-Saharan Africa, the contexts of the clinical settings plays a major role in understanding unintended consequences and ensuring there are measures to manage its effects on technology-enabled activities and service delivery outcomes.

The limitation of the study is that the findings are not generalizable due to the subjective and contextual nature of the methods of investigation. However, the study can be replicated in similar contexts and the recommendations can be actioned across healthcare systems in Sub-Saharan Africa. Extensive research should be conducted by academic researchers and designers of health ICTs to consider healthcare work conditions in relation to the complexity of tasks being performed and involvement of relevant frontline users in usability testing. Furthermore, implementation and evaluation frameworks of health ICTs should ideally consider unintended consequences is a key performance indicator (KPI) to measure adoption success.

Conclusion

The aim of this study was to identify the unintended consequences associated with technology-enabled work activities as experienced by healthcare professionals in hospital settings in sub-Saharan Africa. The study established that when technology-enabled work activities at points-of-care are in contradiction with the contextual conditions and complexity of tasks performed by healthcare professionals, it results in unintended consequences. Unintended consequences experienced by healthcare professionals are: repetition of tasks, unanticipated delays; use of alternate means to retrieve patient records, and disruptive patient consultations.

The current versions of hospital information systems are fit-for-purpose but cause disruptions and delays to the work activities of healthcare professionals despite its benefits to facilitate remote communication, enable information sharing and quicker access to patient records. Understanding unintended consequences associated with technology-enabled work activities at points-of-care could assist the industry vendors to improve how health ICTs are designed to improve the work experiences of healthcare professionals at points-of-care in hospital settings.

Consequently, there is a need for policymakers, relevant governing bodies of health and industry vendors of technology solutions to develop an integrated stakeholders' framework as a standard for the design of health ICTs. This would ensure that designers and implementers of health ICTs perform a thorough evaluation before the eventual live implementation.

Disclosure statement

No potential conflict of interest was reported by the author(s).

ORCID

Oluwamayowa Ogundaini  <http://orcid.org/0000-0002-3243-6082>

Retha de la Harpe  <http://orcid.org/0000-0002-2615-6519>

Nyx Mclean  <http://orcid.org/0000-0002-4113-6890>

References

- Abyaomi, O. K., N. Davies Evans, and D. N. Ocholla. 2017. "Factors That Influence Medical Doctors' Behavioural Intention to use Clinical Informatics." *Mousaion* 35 (1): 130–154.
- Adebesin, F., P. Kotzé, D. Van Greunen, and R. Foster. 2013. Barriers & challenges to the adoption of E-Health standards in Africa. <http://researchspace.csir.co.za/dspace/handle/10204/6910>.
- Adepoju, I. O., B. J. A. Albersen, V. De Brouwere, J. van Roosmalen, and M. Zweekhorst. 2017. "mHealth for Clinical Decision-Making in sub-Saharan Africa: A Scoping Review." *JMIR mHealth and uHealth* 5 (3): e38. <http://mhealth.jmir.org/2017/3/e38/>.
- Adler-Milstein, J., and D. W. Bates. 2010. "Paperless Healthcare: Progress and Challenges of an IT-Enabled Healthcare System." *Business Horizons* 53 (2): 119–130. <http://linkinghub.elsevier.com/retrieve/pii/S0007681309001529>.
- Alam, M., C. Banwell, A. Olsen, and K. Lokuge. 2019. "Patients' and Doctors' Perceptions of a Mobile Phone-Based Consultation Service for Maternal, Neonatal, and

- Infant Health Care in Bangladesh: A Mixed-Methods Study." *JMIR MHealth and UHealth* 7 (4): e11842.
- Ammenwerth, E., S. Gräber, G. Herrmann, T. Bürkle, and J. König. 2003. "Evaluation of Health Information Systems—Problems and Challenges." *International Journal of Medical Informatics* 71 (2-3): 125–135. <http://linkinghub.elsevier.com/retrieve/pii/S138650560300131X20> March 2014.
- Anwar, F., a Shamim, and S. Khan. 2011. "Barriers in Adoption of Health Information Technology in Developing Societies." *International Journal of Advanced Computer Science and Applications* 2 (8): 40–45. Doi:10.14569/IJACSA.2011.020808.
- Ash, J. S., M. Berg, and E. Coiera. 2004. "Some Unintended Consequences of Information Technology in Health Care: The Nature of Patient Care Information System-Related Errors." *Journal of the American Medical Informatics Association* 11 (2): 104–112.
- Atarodi, Alireza, and Ahmadreza Atarodi. 2019. "The Impact of Information Technology on Health." *Journal of Research and Health* 9 (3): 193–194.
- Bates, D. W. 2015. "Health Information Technology and Care Coordination: The Next Big Opportunity for Informatics?" *Yearbook of Medical Informatics* 24 (1): 11–14.
- Behrens, A., C. B. Noteboom, David Bishop, A. Behrens, and Dave Bishop. 2019. "How Can Health Technology Project Communications be Improved in a Hospital." *MWAIS 2019 Proceedings*, 4. <https://aisel.aisnet.org/mwais2019/4>.
- Blumenthal, D., and M. Tavenner. 2010. "The "Meaningful use" Regulation for Electronic Health Records." *New England Journal of Medicine* 363 (6): 501–504.
- Botha, M., A. Botha, and M. Herselman. 2014. "The Benefits and Challenges of e-Health Applications: A Content Analysis of the South African Context." *Proceedings of the International Conference on Computer Science, Computer Engineering, and Social Media*, 121–131. Metropolitan College, Thessaloniki, Greece, December 2014.
- Coiera, E., J. Ash, and M. Berg. 2016. "The Unintended Consequences of Health Information Technology Revisited." *Yearbook of Medical Informatics* 25 (01): 163–169. doi:10.15265/IY-2016-014.
- Cucciniello, M., I. Lapsley, G. Nasi, and C. Pagliari. 2015. "Understanding key Factors Affecting Electronic Medical Record Implementation: A Sociotechnical Approach." *BMC Health Services Research*, 1–19. doi:10.1186/s12913-015-0928-7.
- DeWane, M., R. Waldman, and S. Waldman. 2019. "Cell Phone Etiquette in the Clinical Arena: A Professionalism Imperative for Healthcare." *Current Problems in Pediatric and Adolescent Health Care* 49 (4): 79–83. doi:10.1016/j.cppeds.2019.03.005.
- Fan, W., J. Liu, S. Zhu, and P. M. Pardalos. 2020. "Investigating the Impacting Factors for the Healthcare Professionals to Adopt Artificial Intelligence-Based Medical Diagnosis Support System (AIMDSS)." *Annals of Operations Research* 294 (1-2): 567–592. doi:10.1007/s10479-018-2818-y.
- Fortuin, J., F. Salie, L. H. Abdullahi, and T. S. Douglas. 2016. "The Impact of MHealth Interventions on Health Systems: a Systematic Review Protocol." *Systematic Reviews* 5 (1): 200. <http://www.ncbi.nlm.nih.gov/pubmed/27884180%5Cnhttp://systematicreviewsjournal.biomedcentral.com/articles/10.1186/s13643-016-0387-1>.
- Fraser, H. S., and J. Blaya. 2010. "Implementing Medical Information Systems in Developing Countries, What Works and What Doesn't." *AMIA 2010 Symposium Proceedings* 232. <http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3041413&tool=pmcentrez&rendertype=abstract>.
- Gagnon, M. P., P. Ngangue, J. Payne-Gagnon, and M. Desmartis. 2016. "M-Health Adoption by Healthcare Professionals: A Systematic Review." *Journal of the American Medical Informatics Association* 23 (1): 212–220.
- Gerhardt, U., R. Breitschwerdt, and O. Thomas. 2018. "mHealth Engineering: A Technology Review." *Journal of Information Technology Theory and Application (JITTA)* 19 (3): 5.
- Harrison, M., R. Koppel, and S. Bar-Lev. 2007. "Unintended Consequences of Information Technologies in Health Care—An Interactive Sociotechnical Analysis." *Journal of the American Medical Informatics Association* 14 (5): 542–549.
- Haux, R. 2006. "Health Information Systems - Past, Present, Future." *International Journal of Medical Informatics* 75 (3-4): 268–281. <http://www.ncbi.nlm.nih.gov/pubmed/16169771>.
- Hsieh, H.-F. H., and S. E. S. Shannon. 2005. "Three Approaches to Qualitative Content Analysis." *Qualitative Health Research* 15 (9): 1277–1288. <http://www.ncbi.nlm.nih.gov/pubmed/16204405>.
- Idoga, P. E., and M. Toycan. 2016. "A Literature Review of EHealth Sector and Challenges in Nigeria." *13th HONET-ICT International Symposium on smart MicroGrids for Sustainable energy sources enabled by photonics and IoT sensors, HONET-ICT 2016*, IEEE: 145–149.
- Idowu, A. P., O. O. Adeosun, and K. O. Williams. 2014. "Dependable Online Appointment Booking System for Nhis Outpatient in Nigerian Teaching Hospitals." *International Journal of Computer Science and Information Technology* 6 (4): 59–73.
- Kabanda, S., and H. A. Rother. 2019. "Evaluating a South African Mobile Application for Healthcare Professionals to Improve Diagnosis and Notification of Pesticide Poisonings." *BMC Medical Informatics and Decision Making* 19 (1): 1–13.
- Kesse-tachi, A., A. E. Asmah, and E. Agbozo. 2019. "Factors Influencing Adoption of EHealth Technologies in Ghana." *Sage (atlanta, Ga)* 5: 1–13.
- Klasnja, P., and W. Pratt. 2012. "Healthcare in the Pocket: Mapping the Space of Mobile-Phone Health Interventions." *Journal of Biomedical Informatics* 45 (1): 184–198. doi:10.1016/j.jbi.2011.08.017.
- Kuziemy, C. E., R. Randell, and E. M. Borycki. 2016. "Understanding Unintended Consequences and Health Information Technology: Contribution from the IMIA Organizational and Social Issues Working Group." *Yearbook of Medical Informatics* 10 (1): 53–60. doi: 10.15265/IY-2016-027.
- Ladan, M. A., H. Wharrad, and R. Windle. 2019. "eHealth Adoption and use among Healthcare Professionals in a Tertiary Hospital in Sub-Saharan Africa: A Qmethodology Study." *PeerJ* 7: e6326.
- Middleton, B., M. Bloomrosen, M. a Dente, B. Hashmat, R. Koppel, J. M. Overhage, T. H. Payne, S. T. Rosenbloom, C. Weaver, and J. Zhang. 2013. "Enhancing Patient Safety and Quality of Care by Improving the Usability of Electronic Health Record Systems: Recommendations from AMIA." *Journal of the American Medical Informatics Association: JAMIA* 20 (e1): e2–e8. <http://www.ncbi.nlm.nih.gov/pubmed/23355463>.
- Mimbi, L., and F. Bankole. 2015. "ICT and Health System Performance in Africa: A Multi-Method Approach." *ACIS 2015 Proceedings – 26th Australasian Conference on information systems*, 1–18.
- Myers, M. D., and M. Newman. 2007. "The Qualitative Interview in IS Research: Examining the Craft." *Information and Organization* 17: 2–26.
- Neuman, L. 2011. *SRM: Qualitative and Quantitative Approaches*. 7th ed. edited by D. Musslewhite and L. Macey. Boston: Pearson Education, Inc.
- O' Connor, Y., and J. O' Donoghue. 2015. "Contextual Barriers to Mobile Health Technology in African Countries: A Perspective Piece." *Journal of Mobile Technology in Medicine* 4 (1): 31–34. <http://www.journalmtm.com/2015/contextual-barriers-to-mobile-health-technology-in-african-countries-a-perspective-piece/>.

- Odekunle, F. F., R. O. Odekunle, and S. Shankar. 2017. "Why sub-Saharan Africa Lags in Electronic Health Record Adoption and Possible Strategies to Increase its Adoption in This Region." *International Journal of Health Sciences* 11 (4): 59–64. <http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=PMC5654179>.
- Orlikowski, W. 2005. "Material Works: Exploring the Situated Entanglement of Technological Performativity and Human Agency." *Scandinavian Journal of Information Systems* 17 (1): 183–186. http://iris.cs.aau.dk/tl_files/volumes/volume17/no1/13orlikowski.pdf.
- Owolabi, K. A., I. O. Agboola, and M. K. Alawiye. 2018. "Status and Development of Clinical Informatics in Nigeria's Health Care Sector." *Journal of Health Information and Librarianship* 4 (1): 35–52.
- Patrick, K., W. G. Griswold, F. Raab, and S. S. Intille. 2008. "Health and the Mobile Phone." *American Journal of Preventive Medicine* 35 (2): 177–181.
- Pickering, J. B., V. Engen, and P. Walland. 2017. "The Interplay between Human and Machine Agency." *Springer* 10271: 47–59. <http://link.springer.com/10.1007/978-3-319-58071-5>.
- Qureshi, N. A., G. M. Kundi, Q. A. Qureshi, R. Akhtar, and L. Hussain. 2015. "An Investigation Into the Adoption and use Issues of e-Health in Public Sector Hospitals of Developing Countries." *Mediterranean Journal of Medical Science* 2 (1): 23–36.
- Ratwani, R. M., J. Reider, and H. Singh. 2019. "A Decade of Health Information Technology Usability Challenges and the Path Forward." *JAMA: Journal of the American Medical Association* 321 (8): 743–744.
- Scheffler, E., S. Visagie, and M. Schneider. 2015. "The Impact of Health Service Variables on Healthcare Access in a low Resourced Urban Setting in the Western Cape, South Africa." *African Journal of Primary Health Care and Family Medicine* 7 (1): 1–11.
- Svanæs, D., O. A. Alsos, and Y. Dahl. 2010. "Usability Testing of Mobile ICT for Clinical Settings: Methodological and Practical Challenges." *International Journal of Medical Informatics* 79 (4): e24–e34.
- Tokosi, T. O. 2017. "A Case Study of Clinicians' Perceptions of Enterprise Content Management at Tygerberg Hospital." *International Journal of Mechanical and Industrial Engineering* 4 (7): 70508.
- Vaghefi, I., and B. Tulu. 2019. "The Continued use of Mobile Health Apps: Insights from a Longitudinal Study." *JMIR MHealth and UHealth* 7 (8): 1–11.
- Ventola, C. L. 2014. "Mobile Devices and Apps for Health Care Professionals: Uses and Benefits." *P & T* 39 (5): 356–364. <http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=4029126&tool=pmcentrez&rendertype=abstract>.
- Wiser, F., C. Durst, and N. Wickramasinghe. 2019. "Using Activity Theory Successfully in Healthcare: A Systematic Review of the Theory's Key Challenges to Date." *Proceedings of the 52nd Hawaii International Conference on System Sciences*, 882–891.
- Wu, J., S. Guo, H. Huang, W. Liu, and Y. Xiang. 2018. "Information and Communications Technologies for Sustainable Development Goals: State-of-the-art, Needs and Perspectives." *IEEE Communications Surveys and Tutorials* 20 (3): 2389–2406.
- Yahya, H. 2019. "Healthcare-related Smartphone use among Doctors in Hospitals in Kaduna, Nigeria - A Survey." *Nigerian Journal of Clinical Practice* 22 (7): 897–905.
- Yang, Z., B. Y. Ng, A. Kankanhalli, and J. W. Luen Yip. 2012. "Workarounds in the use of IS in Healthcare: A Case Study of an Electronic Medication Administration System." *International Journal of Human-Computer Studies* 70 (1): 43–65. doi:10.1016/j.ijhcs.2011.08.002.
- Yaya, S., K. S. Reddy, J. M. Belizán, and V. Pingray. 2020. "Non-communicable Diseases and Reproductive Health in sub-Saharan Africa: Bridging the Policy-Implementation Gaps." *Reproductive Health* 17 (1): 8.