



# Information and Communication Technology usage in post-conflict maternal healthcare: Northern Uganda Referral hospital perspective

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## ABSTRACT

**Objective:** The main objective of this study was to assess Information and Communication Technology (ICT) usage in post-conflict maternal healthcare. This adds to the knowledge base as well as boosts the need to prioritize, empower and create awareness among ICT benefactors.

**Methods:** A descriptive survey design was applied to quantify and explain the findings that were obtained from Gulu Referral hospital. A set of structured questionnaires were distributed to the participants during the phase of data collection. Regression analysis was performed to assess the relational impact of the identified factors on the use of ICT with the help of Statistical Package for Social Sciences.

**Results:** Although regression has shown usefulness, ease of use, trust and awareness as the key factors that promote ICT usage in the services of maternal healthcare, a number of deterrents were identified. The deterrents include: limitation of strong ICT infrastructure, skills and knowledge.

**Conclusion:** We recommend management and Government improve ICT infrastructure and offer user training to impart knowledge and skills that are needed for handling sensitive or private health data. Adequate funding is also needed to strengthen ICT infrastructure. Due to the complex or dynamic nature of the society and advance in ICT more promoting and deterring factors should be explored in future.

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## Introduction

Information and Communication Technology (ICT) is a tool through which information can be accessed as text, voice and images or videos using diverse types of media such as internet; wireless links and satellite [1]. ICT is one of the key drivers of Sustainable Development Goals (SDGs) that has been envisioned to allow exchange of information across all the sectors of growth worldwide [2,1]. ICT has also eased communication and improved service delivery in both public and private sectors [3]. For example, mobile technology that has infiltrated the entire global sphere is efficient and flexible for both citizens and Governments [4]. Mobile systems are able to provide consultation services and controls to the public through automated alerts and reminders in a number of countries such as Uganda [5].

Uganda in specific ought to adhere to the use of ICT in diverse sectors such as maternal healthcare to enhance growth and service delivery [6]. Maternal healthcare is a type of care given to mothers during pregnancy and after delivery [7]. Although there is global

decline in the maternal death rate by 44%, the rate is still alarming in some isolated or post-conflict based regions [8]. Some of the causes of the high death rate may include: breakdown of health services, hygiene and sanitation; unsafe abortions and lack of access to clean water and food [9]. Whereas ICT has been viewed as a measure to strengthen health information and create awareness among citizens, developing countries still lag behind due to the challenges of transfer and diffusion [10]. The adoption of an innovation such as ICT in a local setting relates with the technological and institutional trends in terms of providing the finest resolution both in time and space [11]. eHealth and mHealth are the two main ICT brands that are viewed as alternative solutions for effective communication in the health sector.

The term “eHealth” refers to the means by which health information is conveyed or saved electronically with the help of a technology or computer [12]. mHealth is a fast growing brand of ICT that uses portable devices such as cell phones to convey or save health information [13]. Although mHealth and eHealth have improved communication dynamics in general, limited is still known of their usage in fragile or post-conflict regions such as Northern Uganda. The use of ICT in health sector requires some considerable effort from any Government since the wellbeing of all citizens is a critical factor for the growth of a country. Although

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the Government of Uganda in particular supports ICT usage in all sectors of growth, its level of entrance at a micro level such as post-conflict based settings is not fully known [13]. This is coupled with the limited number of studies that have been carried out to assess ICT usage in such kind of setting despite the increasing international pressure to improve health services through quality and timely access to information [12,13]. In Uganda, most of the health information systems are used for the management and surveillance of diseases [14]. The known information systems consist of: Management Information System (MIS); Integrated Diseases Surveillance and Response System (IDSR); Vital Registration Management Information System (VSR-MIS) and Health Management Information System (HMIS). MHealth in specific has rapidly grown in many developing countries such as Uganda; Bangladesh; South Sudan and Ghana.

A mobile based Logistics Information Management System (LMIS) was launched in the Republic of South Sudan to track vaccine stock level [15]. The LMIS was able to improve efficiency and response time in the management of healthcare services in the Republic of South Sudan. In Bangladesh, a mobile system was launched to collect health information from the pregnant mothers from urban and rural areas to track their risk levels [16]. The system enhanced efficiency in the use of the limited resources as well as reduction costs. In Ghana, Mobile Technology for Community Health (MOTEC) is able to bridge gaps by delivering information to nurses in remote areas.

In Uganda, related systems such as MobileVRS and mTRAC have been used to boost health services in households [17]. MHealth is used to report disease out-break and medication stock-outs, and mTRAC helps in monitoring medicine supply. However, this doesn't give a clear insight of ICT application in maternal healthcare especially in fragile or post-conflict regions to explore challenges or opportunities that may arise in the sector [12]. Yet ICT usage in maternal health care in the less privileged settings is already a worldwide issue [18]. Therefore, this study sought to assess ICT usage in post-conflict maternal healthcare. The existing ICT and factors that promote or deter use of ICT in maternal healthcare were determined. The study adds to the existing knowledge in the area of maternal healthcare services. It informs policies, Government and agencies to set priorities as well as lay strategies to use ICT in fragile or post-conflict regions. The mothers and health staff will be empowered to support ICT usage in maternal healthcare and hence reduction of death rate.

### ICT models

The three ICT theoretical models that have underpinned this study consist of: Technology Acceptance Model (TAM); Unified theory of Acceptance and Use of Technology (UTAUT) and Health Metrics Network (HMN). UTAUT as an extension of TAM has underpinned this study with the aim of maintaining consistency [19]. The key facets of the two models include: ease of use; usefulness; intention to use; social and facilitating conditions to support decision making process by the managers [20]. Perceived ease of use (PEOU) is the use of little effort to operate a technology by individuals or organization [21]. Such kind of technology is liable to have high rate of acceptance by the users [22]. Perceived usefulness (PU) is a means that inspires an organization to use a technology [23]. Social influence is the opinion by the users that a technology should be used. An inventive interaction creates a positive pressure to use a technology by the users [24]. Facilitating condition is a belief that the existence of ICT set-up supports or motivates users to take up a technology [25]. Although TAM and UTAUT have suggested PEOU, PU, social influence and facilitating conditions as ICT usage (intention to use) factors, others have not been explored. UTAUT has not hinted on what constitutes social influence and fa-

ilitating conditions. Yet, a technology cannot be taken up exhaustively if all the needs of users are not fully understood [26].

HMN model has hinted on factors that impact the use of ICT in a health facility as reported by the World Health Organization [27]. The main independent variables of HMN include: leadership; training; funding and legal issues. HMN hints that the perception or attitude of a leadership in an organization may influence ICT usage in a positive or negative way because of their power to make decisions [28,29]. Training is a fundamental factor for confidence building to handle sensitive and private data [30]. The availability of funding strengthens the process of attaining project goals and this may involve training and recruitment of experts. The cost of ICT infrastructure is often high in terms of its setup and upkeep to support delivery of services and hence affecting its usage [31]. A strong legal system strengthens transparency and policies to use ICT in a setting [32]. The HMN model has not given an in-depth analysis of some individual and institutional factors that may impact ICT usage in a health facility.

However, the three models have not hinted on the adoption concepts of “transfer and diffusion” and “socially embeddedness” of an innovations such as ICT where contextual issues are prevalent [33]. Yet the adoption and use of an innovation in a local context is widely anchored on underlying factors that underpin the two concepts. This study therefore explored both consumer and institutional factors in post conflict and health based context.

### ICT usage factors

The study explored more of the ICT factors such as skills, knowledge, access, support, awareness, trust and electricity to ensure consistency and completeness in the findings.

#### Skills

A person who has ICT skills or talents is capable of using a system with comfort or ease [34]. Although getting skills is a costly resource, it brings out an in-depth efficacy of a system to the user [35]. ICT skills can be got by the users through education or training [30].

#### Knowledge

Knowledge about the benefits of a system creates a positive mindset for the users [36]. A well-informed person in ICT has the assurance to operate an information system in efficient manner [37]. A knowledgeable person can use information that she or he has got from the cyber space or Internet to understand or solve health problem. The knowledge of ICT that can be got through education or training makes one aware of legal or privacy issues in terms of information access [38]. Institutions or individuals need to share inventive knowledge through meetings or interaction to promote the use of ICT. This relies on how flexible a leadership can create enabling environment that can help to prioritize inventions.

#### Access

This is a process by which electronic information can be availed to the users through a well-defined ICT method that may consist of: radios; television; Internet and wireless network [39,40]. Internet in specific is a gateway or channel that has been widely used to access health information by the individuals and institutions [41].

#### Support

ICT in health needs strong infrastructure to improve delivery of services within or outside the facility. This calls for support of Government and donors towards the budget boost ICT infrastructure and social needs such as training and awareness [42].

**Table 1**  
Summary of ICT usage factors.

Factors	Source
Skills	[34,35,30]
Knowledge	[39,37,38]
Access	[40,39]
Support	[42]
Awareness	[43]
Trust	[44]
Funding	[31]
Ease of use	[21,22]
Usefulness	[23]
Internet	[41]
Electricity	[46]

### Awareness

Awareness about a system is a source of confidence or self-assurance for the users. The confidence or self-assurance of the users is a driving force that increases the usability of a system [43].

### Trust

Trust defines the degree by which a system can satisfy the needs of its users and hence misuse and uncertainty of information [44]. This can be noted in loss of privacy or data exposure for an individual or institution [32].

### Electricity

Electricity is a core component of ICT that needs constant supply to deliver regular information services for the growth of a country. The access to constant energy or electricity is still a huge challenge in developing countries such as Uganda [45]. This may have a negative influence on the use of ICT in an institution or a setting.

Table 1 shows the summary of ICT Factors as determined from related studies.

## Methods

A descriptive survey design was applied to quantify and explain the findings that were obtained from Gulu Referral hospital. Gulu Referral hospital is one of the thirteen [13] public hospitals with a centralized position to serve a huge number of patients in Northern part of Uganda. A total of 37 participants consisting of 15 health staff and 22 visiting mothers were involved in the survey. A purposive sampling technique was used for the relative depiction of the respondents whose feedbacks were got through a set of structured questionnaires and checklist. A questionnaire prevents biasness and gives privacy to the respondents to provide information on what they believe is correct. A checklist was used to determine the basic ICT modules that were available or missing in the healthcare facility to gauge the level of infrastructure at hand. The structured questionnaire was tested and reviewed for consistency with the help of Cronbach's alpha and factor analysis to remove any misfits. To avoid ethical concerns that might disrupt the confidence and trust of the respondents, their permission was first sought by giving them introduction letters containing the aim of the study. Two field assistants were trained to prevent biasness, inaccuracy and delay during the phase of data collection. The collected data was assembled and analyzed with the help of Statistical Package for Social Sciences (SPSS). The findings were then discussed in line with the related literature to make the final conclusion.

**Table 2**  
Summary of reliability of scale measures.

Construct	Cronbach's alpha	Number of items
Skills	0.436	4
Knowledge	0.314	4
Perceived usefulness	0.752	5
Perceived ease of use	0.363	3
Trust	0.758	4
Awareness	0.773	4
Funding	0.950	3
Attitude	0.782	4
Internet	0.813	4
Electricity	0.828	3
Access	0.871	3
Support	0.821	3

## Results

### Questionnaire reliability

The reliability and misfits of the questionnaire were sought through the determination of Cronbach's Alpha values of the constructs (see Table 2).

The Cronbach's Alpha values for most of the constructs are above 0.70 and hence a measure of reliability for the designed questionnaire [10].

Table 3 shows the second test in terms of principal component analysis and variance on perceived ICT factors. The first section of the Table reveals initial eigenvalues that comprises initial solution, extracted components and rotated components. The cumulative % column consists of percentage of variance as accounted for by the number of components where the first four components form an extracted solution with eigenvalues greater than 1. The second section explains variation by 69% and hence reduces the complexity of the data set with a 31% loss of information.

### Questionnaire validity

The relationship between the constructs was studied using Varimax Rotation factor analysis (Table 4). The findings show that majority of the constructs loaded higher than 0.5 except awareness and support and hence validity of the questionnaire was confirmed. There is only one cross loading for trust and hence discriminant validity is dominant. The factor loading for each ICT factor is indicated in Table 4.

Component1: behavioral factors; Component2: technological factors; Component3: cyber and privacy factors and Component4: organizational factors

### Demographics

Table 5 shows the demographic profile of the respondents who are predominantly young in the age bracket of 20–29. The majority of female respondents who constitute a huge percentage of the sampled population are the mothers. This is a reflection that mothers dominate attendance in maternal healthcare services in the region and Uganda as a whole.

### ICT usage in Gulu Referral maternal healthcare services

Table 6 shows the components of ICT that are available or missing in healthcare for Gulu Referral hospital.

In Table 6, mobile short messaging; call services; ultra sound and TV are the only components of ICT that are used in maternal healthcare services of Gulu Referral hospital. The maternal healthcare lacks full access to ICT infrastructure to link up all the units.

**Table 3**  
Principal component analysis and variance on ICT factors.

Component	Initial eigenvalues			Extraction sums of squared loadings		
	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
1	4.248	32.674	32.674	4.248	32.674	32.674
2	2.051	15.780	48.454	2.051	15.780	48.454
3	1.471	11.318	59.772	1.471	11.318	59.772
4	1.230	9.458	69.230	1.230	9.458	69.230
5	0.810	6.233	75.463			
6	0.694	5.335	80.797			
7	0.578	4.445	85.242			
8	0.492	3.781	89.023			
9	0.383	2.944	91.967			
10	0.340	2.618	94.585			
11	0.295	2.268	96.853			
12	0.272	2.092	98.946			
13	0.137	1.054	100.000			

Extraction method: principal component analysis.

**Table 4**  
Component factor loading on ICT factors.

Construct	Component			
	1	2	3	4
Skills	0.542			
Knowledge	0.641			
Usefulness	0.800			
Ease of use	0.689			
Trust	0.523		.613*	
Awareness				0.405
Funding				0.500
Attitude	0.705			
Internet			0.588	
Electricity	0.525			
Access		0.500		
Support	0.412			

Extraction method: principal component analysis.

\* is a sign of cross loading for Trust under component 1 and 2.

**Table 5**  
Demographic profile of survey respondents.

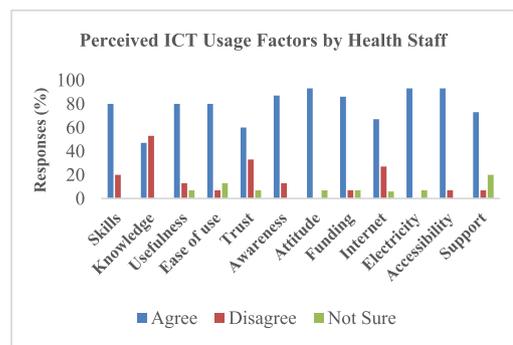
Variable	Category	Frequency (N = 37)	Percentage (%)
<b>Gender</b>	Male	3	8.0
	Female	34	92.0
<b>Total</b>		<b>37</b>	<b>100</b>
<b>Age</b>	10–19	4	10.8
	20–29	22	59.5
	30–39	6	16.0
	40–49	4	10.8
	≥50	1	2.9
<b>Profession</b>	Doctor	2	5.4
	Nurse	10	27.0
	Medical Laboratory Technician	1	2.7
	Counsellor	2	5.4
	Mother	22	59.5

*ICT usage factors in maternal healthcare services*

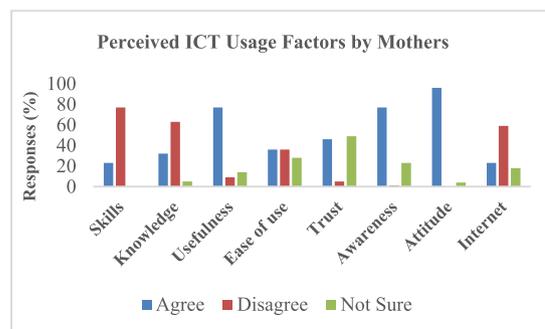
Figs. 1 and 2 show the responses of health staff and visiting mothers on factors that affect the use of ICT in maternal healthcare services. Fig. 1 consists of health staff perceptions on both behavioral and institutional factors on ICT usage. The staff are the experienced employees of the health facility and they can ably give their ICT experiences as far as their work place is concerned. Fig. 2 captures only behavioral perceptions of mothers on ICT usage as they are visitors who have limited experience on interventions of health facility. This assessment was done to plan for future engagement

**Table 6**  
Checklist of ICTs.

ICT components	Availability	
	Yes (Y)	Non (N)
Internet		N
Computers		N
e-HMIS		N
E-office services		N
Tele software		N
e-CMEs		N
e-libraries		N
e-consultations		N
Mobile SMS and call Centre	Y	
e-Records management system		N
Sonography (Ultra sound) system	Y	
Television (TV) system	Y	



**Fig. 1.** Perceived ICT usage factors by health staff.



**Fig. 2.** Perceived ICT usage factors by mothers.

with the mothers through ICT platform while ensuring that their needs are adequately met ahead of time.

In Figs. 1 and 2, the responses from both health staff and mothers show that usefulness, ease of use, trust, awareness and attitude are the factors that promote ICT usage in maternal healthcare. They agreed that using ICT is convenient and time saving. Although majority of the respondents were aware of ICT benefits, mothers were limited by the skills and knowledge to use internet and social media.

However, the health staff agreed that a number of institutional factors have deterred ICT usage in maternal health care (see Fig. 1). The factors consist of: inadequate funding and support; unreliable Internet and electricity; lack of access to training and computers. Regression was done to identify critical factors that promote and deter ICT usage in maternal health care. The findings show skills ( $P = .036$ ), knowledge ( $P = .000$ ), trust ( $P = .024$ ), awareness ( $P = .030$ ), electricity ( $P = .037$ ), funding ( $P = .016$ ) and access ( $P = .024$ ) as the key factors that impact on ICT usage.

## Discussion

The findings show usefulness, ease of use, trust, awareness and attitude as behavioral factors that promote ICT usage in maternal healthcare. Most of the respondents (health staff and mothers) applauded ICT usage in maternal services probably due to the experiences they have in using mobile devices such as cell phones [13,43]. This is evidenced by the approval of ICT benefits in terms of convenience and time saving by both health staff and mothers. However, the mothers believed that they were constrained by the required skills and knowledge to explore Internet and social media services. The mothers might lack exposure to ICT training before and after marriage as most of them could have been born during the twenty years of Lord's Resistance Army (LRA) conflict in Northern Uganda. The prolonged LRA conflict had negative effects on the girl child in terms of rapes or early pregnancies that denied them access to formal education and skills [47]. Yet a secure handling of sensitive and private health data in cyber space needs some specialized skills and knowledge [48,38]. The technical handling of such sensitive and private data can be achieved through adequate training on legal issues [32].

However, in the findings, the factors that deter ICT usage in maternal health care were found to be more institutional than individual. The institutional factors include: electricity; funding and access to training and computers. Electricity is an engine that keeps all ICT services and components such as hardware and software in an active or running mode [49]. The use of electricity to power ICT components with the aim of boosting decisions that are bound by space and time has become a legislative issue in many developed countries [50]. The trend is still limited in developing countries such as Uganda where constant access to electricity is still a challenge [51]. This is an indication that when electricity is unreliable, the chance of using in a specific facility ICT also reduces.

Funding is a core resource that helps to strengthen and update ICT infrastructure in any organization. But funding level is influenced by the cost of ICT components that often appears high in terms of its setup and upkeep to support delivery of services and hence affecting its usage [31]. The chance to use ICT becomes low if the funding level is inadequate to acquire high hardware and software components that are expensive [42].

Access to infrastructure in terms of computers, software, wireless network and training by the users is a very essential stage for using ICT as affirmed by the perception of the health staff in the study. A strong ICT infrastructure provides a platform to enhance skills, transfer and control data [51,40,52].

Overall, the missing ICTs (see Table 6) in the checklist shows affordability challenge that limits delivery of services in a flexible manner. Yet most of the critical maternal interventions in such kind of post-conflict region that is based on accuracy and time are greatly supported by the availability of the missing ICTs.

## Conclusion

In the study checklist, mobile short messaging; call services; ultra sound and TV were found to be the only components of ICT in the maternal healthcare facility. The basic components of ICT such as computers and internet were not available in the maternal units. Quick access to data that may be shared and used by the units for handling emergencies is still a challenge. Although the study has shown usefulness, ease of use, trust, awareness and attitude as the key individual factors that promote ICT usage in maternal services, skills and knowledge still remain a challenge to the mothers. The institutional factors that deter the use of ICT in maternal health care consist of: unreliable electricity; inadequate funding and lack of access to computers, Internet and user training. We recommend that management, Government and agencies need to improve electricity; offer user training and sensitization; subsidize the costs of Internet and devices to boost ICT usage in maternal services. Funding needs to be prioritized in the budget to develop strong ICT infrastructure for maternal services in addition to adequate training on legal issues to handle sensitive and private health data. Due to the complexity of society and advance in ICT, more promoting and deterring factors should be explored in future.

## Author statements

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### Competing interest

None declared.

### Ethical approval

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### Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.hlpt.2019.05.005.

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