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Towards Effective Healthcare Information SMS Model

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Problem: The healthcare sector uses SMS to disseminate healthcare information to a large population of people. Maternal and post-natal healthcare information is widely delivered through SMS messaging. Evidence of a structure used when sending the healthcare information via SMS, ensuring that the message received is effective, remains very limited.

Objective: This paper presents a study which was aimed at proposing a model, presenting salient factors, which can be used to effectively send healthcare information via SMS.

Methods: A total of 80 people were initially recruited. However, 63 out of the 80 people, all residing in Nairobi participated in this study. 52 respondents were interviewed over the phone using semi-structured scripts, six of them participated in a focus group discussion carried out at a Hospital in the Eastern part of Nairobi. Five respondents responded to questionnaires issued to them.

Results: Through review of literature and data analysis, five factors emerged which influence effectiveness of healthcare messages sent via SMS. The factors include: the time of day in which respondent has most access of their phone, the day of the week most preferred to receive the SMS, frequency of receiving the healthcare messages, topics of interest to the receiver and preferred language.

Conclusions: This study shows that to ensure healthcare messages sent over SMS are effective, it is important that information is sent to the recipient subject to their availability and preferences. Healthcare institutions need to consider these factors when sending healthcare information, to ensure information sent is relevant and convenient to the receiver thus resulting in expected behavior change.

The model can be adopted in other sectors which rely on SMS to send information to its beneficiaries.

Keywords : MS, mhealth, TotoHealth, MNCH

ACM Classification Keywords H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous

1 Introduction

Technology advances have seen the use of mobile devices increase significantly in the recent years in African and the whole world at large. Studies affirm that smart phones and other high-end technology gadgets appear to be increasingly used by healthcare workers [1].

The use of mobile and wireless technologies to support the achievement of health objectives (mHealth) has the potential to transform [2] the face of health service delivery across the globe. To this extent, many health organizations are designing projects that use mobile technology to support health services and health education [3].

Some of these models largely use Short Message Service (SMS) as their main communication technology.

Health information systems communicate to their intended users via various communication channels such as text messaging, calls, interactive voice response (IVR), and emails among others, to enhance medication adherence, improve health literacy and ensure appointment attendance [4].

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This paper describes a model for effectively sending healthcare information via short messaging system (SMS). We describe factors emerging from a research conducted in Nairobi, that influence effectiveness of healthcare messages sent via SMS by making the receiver at ease with the initiative. This is mainly done through choosing the correct parameter values for the SMS communication.

1.1 SMS Technology

Short messaging service (SMS) (a.k.a. text messaging) in particular is greatly preferred because it provides an opportunity to improve health knowledge, behaviors, and clinical outcomes, particularly among hard-to-reach populations. Text messaging is also easy to use and affordable.

SMS messages have a number of characteristics that make them very appropriate for use in a healthcare setting including: direct patient communication, privacy, confidentiality, swift delivery of messages and receipt of responses, convenience for health providers and patients. SMS messaging technology also allows the dispatching of substantial numbers of messages simultaneously, so reducing labor expenditure [5].

1.2 Maternal and newborn child healthcare

Each year, at least 1.16 million African babies die in the first 28 days of life – and 850,000 of these babies do not live past the week they are born. This is largely attributed to poor post-natal clinic attendance [6] [7].

Mortality in children under the age of five has been reported to have fallen from an average rate of 90 per 1000 live births in 1990 to 43 per 1000 in 2015. Maternal mortality however, has declined by 45% [8].

A number of efforts have attempted to map the state of the evidence relating maternal, newborn and child health (MNCH) in lower and middle income countries (LMIC), to technology. Numerous examples of mHealth interventions, mostly SMS-based, have been used to support mothers through safe pregnancy and childbirth and to facilitate neonatal and infant health. However, we found that there has been no rigorous systematic documentation of what structures were used to send the healthcare information via SMS. A review of most SMS based initiatives showed that various providers or initiatives have their different SMS structures with no empirical evidence of their suitability.

This study was conducted in Nairobi, Kenya, through the support of TotoHealth Limited [www.totohealth.net]. TotoHealth is a social enterprise committed to revolutionizing the maternal and child health industry in Kenya. It uses an SMS-based platform to allow parents and caregivers to record milestones in their child's physical development, which helps with the timely detection of abnormal growth in children below the age of five. To achieve their objectives, TotoHealth sends life-saving information to mothers and caregivers in Kenya particularly among rural low-income populations. The contribution of TotoHealth in our study was that they provided the participants. These participants used to receive messages every Monday on maternal and newborn health care.

1.3 Problem Statement

The key problem which this study was concerned with is the evidence of a working SMS structure. The healthcare sector uses SMS text messaging to disseminate healthcare information to a large population of people due to its low cost. Maternal and post-natal healthcare information is widely delivered using SMS text messages. Evidence of a structure used to send the healthcare SMS ensuring that the message received is effective remains very limited [9] [10].

This study was aimed at proposing a model to be used to send healthcare information using SMS, to ensure that the message sent is effective.

1.4 The organization of the paper

The rest of the paper is structured as follows: Section Two presents related work in this area, Section Three describes the process of gathering information where a mix of both qualitative and quantitative research methods were employed. Section Four presents the results from the data collected. Section Five presents a

discussion of the results of the data collected while in section Six we conclude with the current state of our work and our recommendations.

2 Related work

There are several mHealth solutions in the healthcare space, adopting SMS solutions to disseminate healthcare information. But as we had mentioned, there is very limited evidence of studies supporting the need to have a common and standardized model which ensures that healthcare information sent over SMS is effective. This section highlights some of the mHealth initiatives in the healthcare landscape and the models used to send information via SMS.

2.1 The current mHealth Landscape: Review of interventions supported by SMS applications in healthcare

There are numerous ways SMS is being used in the healthcare sector globally. Some of its uses include broadcasting of urgent and important information across a wide geographical area, increased efficiency in monitoring patient progress and condition, diet and health tips, emergency toll-free telephone services, managing emergencies and disasters, mobile telemedicine, appointment reminders, community mobilization and health promotion, treatment compliance, mobile patient records, information access, patient monitoring, health surveys and data collection, surveillance, health awareness raising, and decision support systems [11].

In 2014, the US department of health and human services conducted an environmental scan to highlight a number of text messaging initiatives that address various health issues. [<http://www.hrsa.gov/healthit/txt4tots/environmentalscan.pdf>] The scan represented text messaging initiatives in maternal and child health, tobacco control, emergency response and preparedness among others. The initiatives focused on health promotion and disease prevention. The use of SMS was seen to positively result to behavior change.

In a study conducted by the Center for Population Health to determine the impact of text messaging for sexual health promotion for young people, text messaging was found to be an effective method and improvement in sexual and health knowledge was observed [10]. This was largely attributed to the messages being short, catchy, and informative, and where possible, tied into particular events (e.g., Valentine's Day, Mother's Day).

2.2 Evidence of use of SMS to support maternal and newborn child healthcare

This section provides a summary of some of the SMS based mhealth solutions in the MNCH space that have been developed to address some of the gaps in MNCH such as patient identification, ANC reminders etc. and the models used in sending the SMS.

Wired Mothers.

Wired Mothers is a mHealth project that seeks innovative ways to ensure access to ANC and skilled attendance at delivery, and to examine the beneficial impact mobile phones can have on maternal and neonatal morbidity and mortality. It was designed with the aim of linking pregnant women to their primary health care providers throughout their pregnancy, childbirth and post-partum period [12].

During the pilot study conducted in 2009-2013, nearly 1300 pregnant Zanzibar women registered their mobile phones with the local health clinic upon their first antenatal visit. The women received a number of benefits, such as what kinds of foods to eat, how to prepare for the arrival of their babies and reminders on when to attend the next antenatal checkup. They were also given a nurse's cell phone number in case of any questions or emergencies.

Wired Mothers sends two SMS in Kiswahili, every month before 36 weeks of pregnancy; one reminding the pregnant woman of her next ante-natal care visit and another on health education. After the woman gives birth, she is put on post-pregnancy health information, where she receives reminders for her baby's vaccinations.

Interactive Alerts .

The biggest IT challenge in the health and medical fields continues to be the ability to identify patients. As mobile phone availability becomes ubiquitous around the world, the use of Near Field Communication (NFC) with mobile phones has emerged as a promising solution to this challenge. Interactive Alerts offers child tracking and referral via general packet radio service (GPRS) using NFC mobile phones and radio frequency identification (RFID) tags. A child's caregiver first enrolls onto a system during a visit to an immunization center. The care giver then receives SMS reminders about vaccination appointments. To assure each child completes the scheduled vaccines on time, health workers also individually track enrolled children using the mobile phone-based RFID system. The amount of cash the caregiver is compensated is dependent with each subsequent vaccine their child completes.

Caregivers receive higher cash amounts for vaccinations that are administered at the recommended age. Interactive alerts enrolled more than 14,000 infants over a period of 6 months [13]. IRD's Interactive Alerts application sends SMS reminders about vaccination appointments to caregivers.

M-chanjo.

M-chanjo is a mobile based system that creates awareness on child immunization schedules and provides basic health facts. It is a mobile based system that seeks to reduce the rate of child mortality especially in the developing world.

The idea was born out of the realization that out of the 8.1 million children under 5 years of age who die every year, a large percentage dies from preventable diseases such as pneumonia, measles and diarrhea. These diseases can be prevented by administering vaccinations which are given free for all children under five years. Still, the rate remains high. The millennium development goal 4 was geared towards reducing the rate of child mortality by two-thirds by the year 2015 [14].

The M-chanjo system works by sending automated reminders via SMS to parents to keep them informed on any future immunization dates and appointments for their children. The text messages also include basic health care tips to manage common diseases.

M-chanjo banks on the negligible costs in sending text messages and on the high mobile phone penetration rate. The use of mobile phones and SMS is thus efficient and in the long run reduces costs on outreach and treatment of diseases that could otherwise have been prevented. [<http://healthmarketinnovations.org/program/m-chanjo>]

ChildCount+.

ChildCount+ is a mHealth platform developed by the Millennium Villages Project aimed at empowering communities to improve child survival and maternal health. The main program goal is to register every child under 5 and pregnant woman and record the MUAC indicators of every child from 6 months to 5 years every 90 days for malnutrition. The child is also monitored for diarrhea, malaria and pneumonia, the three major preventable causes of death in children under 5.

The program uses SMS messages to facilitate and coordinate the activities of community-based healthcare providers, and to register patients and their health status on a central web dashboard that provides a real-time view of the health of a community. Automated alerts help reduce gaps in treatment. [<http://healthmarketinnovations.org/program/childcount>]

WelTel Kenya.

WelTel Kenya conducted a randomized controlled trial to test the clinical effectiveness of text message support for HIV treatment adherence in Kenya. This trial showed that patients receiving text message support had significantly improved treatment adherence and viral suppression, than patients who received standard care alone [15].

The WelTel intervention involved sending weekly SMS using the WelTel Kenya1 model and an automated text-messaging platform (WelTel and Vertical Labs). Each week for 6 months during the study period (January to December 2012), enrolled participants were sent a text message asking, "How are you?" Responses were categorized into those that were reassuring and those that required follow-up by clinic staff. Participants who indicated a problem or question were either texted or called. If participants had not responded within 48 hours of the first text, a second text was sent asking, "Haven't heard from you ...how's

it going?" Mobile phones and phone plan support were provided to participants without a phone: 15 participants owned a mobile phone at baseline and 10 were provided with phones and phone plans. In addition, 4 participants who had their own phones had their plans upgraded for unlimited texting.

Table 1 provides a summary of the models used in sending healthcare messages from the review of literature listed above. The table confirms that there exist many versions of models used when sending healthcare information over SMS. There is therefore the need to have a common and standardized model which considers all the relevant factors thus ensuring that healthcare information sent over SMS is effective.

Intervention	Frequency	Type of SMS	Preferred Language
Wired Mothers	2	Health Education, Ante-natal visit reminders, baby vaccination reminders	Kiswahili (predominantly native language)
Interactive Alerts		Vaccination	English
WelTel	Weekly	Follow up on ART medication, Reminders for next ART visit	Kiswahili
ChildCount		CHWs receive SMS notifications to conduct follow-up visits and to remind women and children in their catchment area of upcoming clinic visits	

Table 1. Summary of models used

This therefore brought about our need to find out the factors that make up an SMS model that would be effective in meeting the intended objectives.

3 Methods

3.1 Information Gathering

A mix of both qualitative and quantitative research methods were used to verify the hypothesis that sending healthcare information via SMS requires certain parameters to ensure effectiveness. These methods are briefly described next.

3.2 Sampling

Sample Size

The population in this study are all people who have been receiving TotoHealth maternal and child care SMS for more than 6 months. They were selected from a population of 600 people within the TotoHealth database. To determine the sample size, we use Slovincs formula [16].

$$n = \frac{N}{1 + N(e)^2}$$

Where:

n = sample size

N = population size

e = margin of error 10.41%

n= 600/ (1+600(0.104²) = 80.11

Sample size for the study was 80 respondents; consisting of 11 males and 69 females from Nairobi's urban center and low resource setting areas such as Kibera, Mukuru wa Njenga and Embakasi. These areas are regarded as either low or medium income earning sections within Nairobi city.

3.3 Data Collection Techniques

A preliminary review and study of literature on existing models used to send healthcare messages using SMS was conducted. This process helped to inform the design of data collection tools. The data collection tools contained questions on time of day in which participants had most access of their phone, day of the week most preferred to receive the SMS, frequency of receiving the healthcare messages, topics of interest to the receiver and preferred language of receiving the healthcare messages among other questions.

Interviews: 52 respondents were interviewed over the phone using semi-structured scripts. Interview topics included time of day in which respondent has most access of their phone, day of the week most preferred to receive the SMS, frequency of receiving the healthcare messages, topics of interest to the receiver, preferred language, education level and general demographic of the receiver such as age, cadre (father, mother, young mother). Interviews were conducted over the phone due to of the geographical location of the respondents who were in various places around the city. Each interview lasted approximately 10 - 20 minutes, were tape recorded and transcribed verbatim. The interviews were conducted in either English or Swahili. The interview consisted of 34 mothers between the ages of 25 and 40, 11 young mothers between the ages of 16 and 24 and 8 fathers.

Focus Group Discussions: A focus group discussion consisting of six participants was held at Kayole II Hospital Center in Kayole, Nairobi. The discussion topics included time of day in which participants had most access of their phone, day of the week most preferred to receive the SMS, frequency of receiving the healthcare messages, topics of interest to the receiver and preferred language of receiving the healthcare messages. Participants received Kshs 200 as a compensation for their time.

Questionnaires: Questionnaires were used to collect demographic characteristics, respondent's access and use of mobile phones and general perception of the SMS intervention. Questionnaires were filled at the Kayole II Hospital Center. Just like in our focus group discussions, the participants were given Kshs 200 (approximately 2 USD) as a compensation for their time.

Observations - The researcher subscribed to TotoHealth service to receive the SMS' containing healthcare information. This was done in order to gauge the messages received and understand their effect to the recipient.

3.4 Data Analysis and Interpretation.

The analysis framework was based on the factors identified during the literature review and discussions that included favorable day and time to receive healthcare information via SMS, how frequently they would like to receive the SMS, preferred language and which topics of interest. The quantitative data was statistically analyzed using Microsoft Excel. For the qualitative data, obtained from the interviews, focus group discussions and observations, the data was coded and themes identified, grouped, analyzed and interpreted.

3.5 Ethical issues

The study reported here was carried out under the umbrella of TotoHealth. As a result, all the ethical issues were dealt with by TotoHealth. Being an already established organization, they extended the permission already obtained to use the respondent's details to our study. Respondents were informed that their participation was voluntary, that they could withdraw at any time and that all information provided/used was going to be confidential.

4 Results

The structure of the existing TotoHealth system captured the preferred language of the recipient, the names of the users and expected delivery date. We therefore set to assess the factors that needed to be considered to ensure the messages sent were effective.

From the sample of 80 selected, only 63 participants responded to the study, which is approximately 79%. The other 21% were not available to take the interview due to lack of availability.

Even though 100% of the respondents owned a personal cell phone, only 21% of the 63 respondents contacted for this study, had access to their phones in the morning hours only, while 29% had access to their phones in the evening.

On selecting the best time during a day when respondents would like to receive the healthcare SMS, 46% of the respondents preferred to receive the messages in the morning hours between 8:00am – 12:00 noon, 4.8% preferred to receive the messages in the afternoon between noon and 5:00 PM. 28.5% preferred receiving the SMS in the evening, between 5:00 PM and after 7 PM. 20.6% preferred to receive the messages anytime.

On selecting which day of the week the respondents preferred to receive the healthcare message, 58.7% of the respondents preferred receiving the healthcare messages on Monday, 7.9% on Tuesday, 4.8% on Wednesday and Friday, 0% on Thursday, 9.5% on Saturday and 3.2% on Sunday.

44.4% of the respondents prefer to receive healthcare messages once in a week, while 29% preferred to receive the messages at least twice in a week. 22.2% preferred to receive the SMS as frequently as possible. Data from the young mothers interviewed showed that they preferred to receive the messages as frequently as possible. This can be explained by the fact that they needed a lot of information given that they were new mothers and felt that they knew very little regarding motherhood.

On finding out which topics the respondents were interested in receiving SMS on, 77.8% of the respondents were interested in receiving SMS on child development and stimulation. 71.4% were interested in SMS on breastfeeding and nutrition. It was however noted that the respondents were least interested in health pregnancy and safe delivery information.

Young mothers were interested in receiving information on child development and stimulation, breastfeeding and nutrition and parenting by 91.7%.

Six out of the eight fathers interviewed were seen to be interested in receiving messages on first aid, child development and stimulation, immunization reminders and parenting.

When the language the respondents preferred to receive the healthcare messages from TotoHealth was assessed, 60% of the participants preferred to receive the messages in English while 40% preferred to receive the messages in Swahili. No respondent selected a native language as their preferred language.

5 Discussions

The TotoHealth system which was under study sends messages to its users but does not send when the recipient is most available. During the registration process, the system only captures the preferred language and the names of the users amongst other things, which do not contribute to the quality of the message.

The new solution extends the structure of the messages send by TotoHealth system, to enable the user to

- *Propose day of the week*

The system enables the user to select which day of the week they would like to receive the messages. This enables the user to create a habit of expecting the healthcare message on a particular day when he/she is most available.

- *Propose the time of day*

This function enables the user to select which time of day selected they had most access to their phones and preferred to receive the message. This is the time the recipient is most free with little or no distractions.

- *Propose frequency of receiving the messages*

This function enables the user to determine how frequently they would like to receive the healthcare messages. According to the data collected, new and young mothers preferred to receive the healthcare messages as frequently as possible compared to older and more experienced mothers.

- *Propose topics of interest*

Although the topics covered by TotoHealth were all important, young mothers and fathers were seen to prefer receiving specific messages compared to experienced mothers.

6 Conclusion and recommendations

6.1 Contribution to the study

It has become clear in this study that several versions of models have been used to send healthcare information over SMS. This was seen from review of literature. There is need to have a common and standardized model which considers all the relevant factors which ensure that healthcare information sent over SMS is effective. From the data collected in this study, the following model was derived.

The table 2 below shows the factors that need to be considered when sending healthcare information via SMS and compares preferences and availability of a young mother and a working mother.

Factors to be considered	Young Mother	Working mother
Best Time of Day	Prefers to receive the SMS at 2:00pm probably because that's when the child is asleep and she is relaxing at home	Prefers to receive the message in the evening at 8:00pm – after feeding her child and preparing to watch 9:00pm news. TotoHealth can target to send the healthcare messages just before 9pm news with the intention of catching many viewers when ready to watch
Best Day (s) of the week	Wednesday	On Saturday when she is not working
Frequency	Twice a week because she is a new mom	Once a week
Topic (s) of Interest	child development and stimulation	immunization reminders
Language	Swahili	English

Table 2. Factors considered when sending healthcare information via SMS

6.2 Recommendations for future work

The parameters identified in this research are generic and potentially recognizable in any other healthcare environments. However, upon close inspection, it is apparent that other factors need to be considered to ensure that healthcare information sent over SMS is effective. These additional factors include persons reading level, reader's level of comprehension, use of simplified messaging, understandability of the healthcare information and presentation of the message; i.e. have a clear organizational structure and follow the grammar and spelling rule, consideration to disability. These, we propose as future work.

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