ICT Acceptance for Information Seeking Amongst Pre- and Postnatal Women in Urban Slums

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Abstract. This paper reports findings from a study aimed to understand how urban poor pre- and postnatal women in India use ICT tools like mobile phones for information seeking. The study was divided in 2 phases. In phase 1, we conducted semi-structured interviews with 66 pre- and postnatal women from urban poor slums located in 4 cities in India. In phase 2, we conducted a survey with 102 pre- and postnatal women from urban poor slum located in 9 cities in India. The aim was to understand care giving during and after pregnancy, nutrition, terminology used during pregnancy, and interpretation of visual material. This paper summarizes the findings, which include the importance of the use of appropriate terminology to design content in a multilingual country, identifying triggers for information seeking behaviour, and approaches to technology acceptance for information seeking. Based on these findings, we make suggestions for design of future ICT-based interventions in resource constraint settings.

Keywords: Digital health · Maternal heath · ICTD · Developing regions · mHealth · Healthcare

1 Introduction

Pre- and postnatal health is an important phase for every woman going through motherhood. Over the years there has been a decrease in maternal mortality, however every day approximately 830 women die during pregnancy and childbirth, of which 99% deaths occur in developing countries, including India [1]. Interventions related to safe motherhood have been a prime concern of most health agencies in India. However, due to geographical vastness and sociocultural diversity, maternal mortality varies across states of India, making uniform implementation of health-sector reforms difficult [2]. Poor literacy and lack of awareness continue to be barriers. This leads to low

utilization of maternal and reproductive healthcare services, jeopardizes women's health, and leads to poor postnatal development of children [3–5].

A significant development in the past decade has been the explosive growth of mobile phones. This has further impacted the use of ICTs in the health care sector [6]. In developing countries, adoption of mobile phones has surpassed many of structural barriers like low income, low education, and lack of social power. While basic and feature phones are popular among the poor, the popularity of smartphones is on the rise.

Mobile phones can be and are being used to provide people with timely, accurate, and specialized health information. Researchers are interested in the potential of ICTs to enable positive change in developing regions and communities in the areas of health, education, and economic status of the poor [4]. Studies include analysis of mHealth in maternal and new-born health programs [7], designing models for adapting ICT for healthcare workers [8], and understanding implications of ICT in public health [9]. In India, other studies have focused on mobile phones in the rural healthcare [10], enhancing pregnancy care [11], and understanding the role of ICT in accelerating the adoption of healthy behaviours [12]. However, healthcare and health promotions are complex human endeavours. Intille suggests four components to an effective strategy to motivate behaviour change using just-in-time information: (1) present a simple, tailored message that is easy to understand, (2) at an appropriate time, (3) at an appropriate place, and (4) using a non-irritating strategy [13].

In spite of such literature, do we understand how new ICT solutions are used and how we can design them to improve health outcomes of mothers and their children in developing countries? In this paper, we present findings on information seeking behaviour and acceptance of technology as a medium to gather information, amongst pre- and postnatal women in the urban slums of India. The aim is to provide guidelines to support researchers involved in designing of ICT based healthcare interventions.

2 The Study

The primary objective of the study was to evaluate how pre- and postnatal women use ICT tools like mobile phones for information access. The study was part of a programme called mMitra. In this programme, urban poor women are given automated voice calls twice a week from the third month of their pregnancy till the child becomes one year old. Each call lasts 2–3 min and gives information about pre- and postnatal health and nutrition that is relevant to the woman or the child at that time. The programme was initiated in 2014. When we conducted the study in 2016, mMitra had been deployed with over 100,000 women.

The study was conducted in 2 phases. Phase 1 was a qualitative study that used semi-structured interviews with poor women in urban slums. The purpose of this phase was to contextualize a woman's journey through the pre- and postnatal phases and understand their information needs related to health, nutrition, terminologies related to pregnancy, effect of visually communicating information, information seeking behaviour, and use of technology. It also aimed to understand the women's journey through pregnancy and the first year of the child. The study was conducted in 2 languages –

Hindi and Marathi. The participants were recruited with help of NGOs, hospitals, and local references. The data gathered was analysed using an affinity diagram.

Phase 2 of the study focused on a broader validation of the insights gained from the qualitative findings of phase 1. As we describe below, three main themes stood out in the findings of phase 1 – use of terminologies associated with maternal and child health, correlating these with visual representation, and technology use and acceptance. We designed a structured questionnaire focussing on these themes. There was no overlap between phases 1 and 2.

3   Phase 1 Findings

In the first phase, we interviewed 66 participants in 4 cities (Mumbai, Delhi, Bhopal, and Nashik). Among these, 36 were enrolled in the mMitra programme, while 30 were not enrolled. There were 41 pregnant women and 25 new mothers. Their age ranged from 18 to 38. Their education ranged from none to under-graduate level. Among these, 5 participants had no education, while 3 were had a bachelor's degree. 36 participants reported that they owned a phone of their own, of which 18 were basic phones, 1 feature phone, and 17 smart phones. Other participants relied on a shared device with the husband or other family members. 21 participants described their occupation as "housewives". Other occupations included helping husband in shop, working as a housekeeping staff in an office, police, doing embroidery, cooking, and as saleswomen in an automobile showroom. Two participants were taking courses in tailoring and nursing.

We found that terminology plays a very important role when designing audio-based information. This is especially so for a population that is diverse, multilingual, multicultural, less educated, and when the users are unfamiliar with the content. We found that users of mMitra often found it difficult to follow the formal terms used in the phone calls. Further, several people in urban India tend to be multi-lingual. This implies that their comprehension in the language they choose to receive communication in may not be very high. Many people did not understand the formal terms used in mMitra such as terms for breastfeeding (स्तनपान *stanpan*), periods (माहवारी *mahwari*), delivery (प्रसव *prasav*/प्रसूति *prasuti*), and sex (संभोग *sambhog*). Users suggested alternative, more colloquial terms, which might be better suited. A related problem was that in the same language a thing may be known by a different name in a different place. For example, finger millet is referred as *nachni* in Maharashtra and *ragi* in Northern India. Participants in Bhopal, Mumbai and Nashik used the term "*sonography*", while in Delhi participants called it "*ultrasound*". It may be possible to use multiple terminologies to cover regional diversity. However, in voice messages, this would make the messages lengthier. An alternative would be to use visual representations to complement audio messages.

By and large, users of mMitra were comfortable to receive voice calls, especially as they could listen to the content privately. Several women only had access to a shared phone used by multiple users, including children in the household. A phone call enabled them to attend to the information privately.

However, we found that certain kinds of information are best communicated visually. To stimulate conversations during the interviews, we used visuals from existing pregnancy and child-care books. Participants found the visuals engaging as it made the information more relatable to their own experiences. Visuals and illustrated books are "browsable" allowing users to pay attention only to those bits that catch their attention. In contrast, audio must be heard completely from start to finish. It is difficult to browse audio information in a similar way. This causes attention to drift while listening to long messages in audio alone. In particular, we found that procedural information works best with visuals, animations or videos. For example, a message in mMitra turned out to be particularly confusing. It advised pregnant women to sleep on the side with a pillow "between their legs". Several women did not understand what this exactly meant until they saw the image in Fig. 1. Other examples of such procedural information were how to hold a baby, or how to breastfeed.

Fig. 1. Correct posture for sleeping was best demonstrated with the help of a visual. Such procedural information is difficult to communicate through audio alone.

Thirdly, visuals help users understand things that are not normally visible. For example, how a baby turns in the womb, or how the umbilical cord is cut are not common sights. "*If a book like this is there, one can understand. I have never seen like that. One gets to know how baby stays in stomach. The conceptual idea of how the baby grows with the other abdominal organs intact in a mother's body helps us understand how systems work independently*", explained one participant. Visuals also help give references when terminologies are unfamiliar. The terminologies that users were not familiar with, but could be easily understood with the help of visuals, include terms for food items from a different region, sex, private parts, and medical procedures.

Visuals trigger curiosity and encourage users to ask questions. There were instances when the women, while flipping through the books, paused on pages referring to sex during pregnancy. This made them curious to ask questions such as "*if one has sex during pregnancy, will it harm the baby?*". They find it difficult to discuss such topics openly otherwise.

Visuals also have some drawbacks. Sometimes standalone visuals could be misleading and need verbal explanation. For example, a demonstration of how a pregnant woman should lift a baby (or any other weight) was interpreted as "playing with a baby". Secondly, visuals need to be localised. Some of our images were from an international book. One such image showed a woman with short hair, and some users misunderstood it as a picture of a man.

While broadcasting information helps mMitra reach out to women easily, it can help more if the women could also choose information of their interest. The information that

is communicated to the women through traditional means (such as brochures or leaflets) can be scrutinized by family members. This takes away women's privacy. Many times women hide such issues or wait for a long time before asking for help. Examples where women postponed seeking help included white discharge, spotting, nipple cracks, or inverted nipples. ICTs can offer the women the opportunity to choose a topic and access the information discretely. We observed that women were more interested in understanding the well-being of their baby than caring about themselves. They were motivated towards understanding food and nutrition for the new-born.

We also found that there is tension between "modern" and "traditional" information. A common conflict that a pregnant woman experiences is related to the difference between the information she gets from family members and that given by doctors, NGOs, peer group, or through a technology-mediated intervention. Where some participants confessed to getting confused between the two, others tried to balance seemingly contradictory information. If someone disagreed with the traditional information, she tried to inculcate the modern advice. On the other hand, a participant thought that information coming from her mother-in-law was outdated though the mother-in-law is a nurse and gave a useful, practical suggestion. ICT systems need to acknowledge both viewpoints, and point out the known problems with the traditional practices. For example, it is a tradition to feed a new-born baby honey or goat's milk at birth, while the current medical practice in India advises exclusive breastfeeding till the baby becomes 6 months old [14]. A system needs to acknowledge that such traditions exist in society, but instead of merely saying "don't do it", should also elaborate how it could harm the baby. We must remember that the pregnant woman is not the only person in the household engaged with the pregnancy. We found that it will be particularly useful to engage the husband and the mother-in-law in the communication.

We found that the users had mixed opinions about accepting technology for seeking information about pregnancy or neonatal care. This was often dependant on the level of privacy the woman had while using the phone. As noted above, 38 out of 66 women had phones of their own, while the rest used a phone shared either with their husband, or with other members of the family. Shared phone use put additional constraints on when women could access the phone calls, especially in "joint" families, where the couple resided with parents and siblings of the husband. Often, users were not comfortable listening to the messages when family members (other than the husband) were around and would disconnect the calls.

On the other hand, the attitude towards technology adoption was quite different in "nuclear" families (wherein the couple lived by themselves or with their children), even if phones were shared. Getting calls on the husband's device was fine for most women as it provided the husband an opportunity to understand what is going on in their life and be empathetic. Here, the technology delivered authenticated information in privacy. In fact, users found that technology was more approachable for certain information that one couldn't perhaps ask the doctor easily, such as methods of contraception, if it is it okay to have sex during pregnancy, and when is it OK to start having sex after delivery. Once technology was acceptable, people were happy to go beyond one-way automated calls. They wanted to ask questions rather than just get broadcasted information, and some had follow-up questions after getting some information.

The feature appreciated the most in mMitra was delivery of the right message at the right time. Hence people could find a context for the messages and could relate it to their current situation. mMitra messages were considered important, but at times they were long, and included multiple levels of information. Sometimes messages were not clear on the first go and the users wanted to hear them again. In several instances, participants remembered the concepts and actions, but forgot the terms used for those concepts or actions. They tried to remember things about which they are convinced and found actionable. Messages related to nutrition and baby care had the maximum recall. We repeated some messages for some users during the interview. Repetition of the messages helped them recall and reinforce the information. Some mMitra users told us that they recorded information to use later, or to share with peers.

4   Phase 2 Findings

From the insights generated from the phase 1, we developed a structured questionnaire focusing on terminology and technology usage. The objective of this phase was to inform the design of future interventions and to base the findings in a broader geographical area of India. We conducted the survey with 102 pre- and postnatal women from urban slums located in 9 cities (Allahabad, Bhopal, Delhi, Indore, Mumbai, Nanded, Nashik, Pune, and Ranchi). Among these, 36 were enrolled in the mMitra programme, while 66 were not enrolled. Their age ranged from 18 to 35. At the time of the survey, 42 women were pregnant and 60 were new mothers who had delivered less than a year ago. Education ranged from none to undergraduate. 11 participants had no education and 11 participants had a bachelor's degree. In terms of occupations, 83 reported themselves as housewives (of which 12 were working till they got married), 3 had a temporary job, 9 were self-employed, and 7 women had a permanent job.

As part of the technology test, we tried to find out the kind of devices used by the participants and their attitudes towards technology use. 58/102 women had their own phones while the rest shared their devices with their husband (most commonly) or with other family members. 36/102 women had a basic phone, 41 women had a feature phone and 24 women had a smartphone. Marriage seems play an important role in device usage both ways. Some participants said that they had a phone, but it was taken away from them after they got married. On the other hand, some women reported that they were gifted a phone at the time of their wedding.

We asked participants to perform some common tasks on their own devices. While 101/102 participants could make a call by dialling the number, only 48 could save a contact. Some said that they would delegate the task of saving contacts to members of their family. Among other tasks, 58 participants could listen to music (including FM radio or music stored on the phone), 50 participants could take pictures or browse pictures, 30 participants could watch videos (including YouTube videos), and 24 participants could use the internet for searching or Whatsapp. One issue was that while most participants were not fluent with English, most phones were set in English. Only 4/102 participants used the phone in Hindi or Marathi, and only 2 participants could switch languages in their phones. Usage of technology varied geographically. People

living in the large cities of Mumbai and Delhi could use phones more deftly, while people in smaller cities were not so familiar with them.

For the terminology test, we identified 11 commonly used mMitra terms in Hindi and Marathi. We first asked the user the meaning of the standalone term. If the participant did not understand the standalone term, we gave them three hints. First, we placed the term in a meaningful sentence to provide context. If the term was still not understood, we provided a longer second sentence with even more context than the first. Finally, we showed the participant a visual related to some of the terms. Table 1 summarises our findings of the terminology test. We can see that while more women could recognise a term when used in a meaningful sentence than just the standalone term, providing visuals helped even more. The two cases where visuals did not help were "contraception" (an abstract term) and bladder (an unrecognisable part of the body). We can see that visuals help in comprehension, but the users must be familiar with the visual. Further, we cannot use visuals every time. It was difficult for us to give appropriate visual references for terms such as menstruation, colostrum, and discharge.

Table 1. Results of the terminology tests for Hindi (N = 62) and Marathi (N = 40). The numbers indicate the percentage of people who understood the term after getting more information.

English	Hindi	% understood by 62 Hindi speakers			
		As a term	In context 1	In context 2	With visuals
Breastfeeding	स्तनपान	32%	45%	53%	98%
Menstruation	महावारी	44%	53%	68%	-
Contraception	गर्भ-निरोध	31%	39%	50%	63%
Uterus	गर्भाशय	16%	19%	29%	44%
Delivery	प्रसूति	16%	35%	45%	-
Sex	संभोग	19%	56%	60%	84%
Colostrum	खीस	0%	8%	55%	-
Bladder	मूत्राशय	15%	29%	39%	39%
Discharge	रिसाव	56%	60%	-	-
Vagina	योनि	13%	42%	45%	-

English	Marathi	% understood by 40 Marathi speakers			
		As a term	In context 1	In context 2	With visuals
Breastfeeding	स्तनपान	60%	73%	80%	100%
Menstruation	पाळी	100%	-	-	-
Contraception	संततिनियमन	13%	30%	58%	75%
Uterus	गर्भाशय	35%	38%	45%	55%
Delivery	बाळंतपण	95%	98%	98%	-
Sex	लैंगिक संबंध	53%	68%	80%	88%
Colostrum	चीक	65%	78%	88%	-
Bladder	मूत्राशय	23%	33%	38%	40%
Discharge	स्राव	20%	78%	-	-
Vagina	योनि	38%	45%	60%	63%

Hindi and Marathi are "near" languages and share many words. Even then, carrying a term that is understood in one language to the other may not work. The terms for breastfeeding, uterus, bladder and vagina are common between Marathi and Hindi. They were understood by a higher proportion of Marathi speakers without context, while they did not do so well among Hindi speakers. Hindi is also a much more widespread language than Marathi geographically. This probably explains why Marathi speaking users generally understood more terms than Hindi speakers.

5   Discussion and Conclusions

We conducted qualitative interviews with 66 urban poor pre- and postnatal women in several cities in India followed by structured surveys with 102 similar participants. 36 participants in each group were enrolled with mMitra, a service that provides information related to pregnancy and child care through automated calls. On the whole, the users of mMitra found the provided information useful and they believe it will be good for themselves and their baby. Without such services, women have a limited access to authentic information on these topics. Further, users prefer to access some kinds of information (e.g. sex during pregnancy) from the privacy of their phones rather than asking a doctor at a clinic.

While mobile phones are permeating in the society, many women still struggle to use several available features. The fact that phones are often shared mean that some women don't have exclusive access to a device. In the context of a service related to maternal health, this leads to privacy concerns, especially if the phones are shared with family members other than the husband. On the other hand, our study also identifies the need to engage with the broader ecosystem of the pre- and postnatal woman, especially the husband and the mother-in-law. At times information received from mMitra is inconsistent with traditional information received from the family members or others in the society. Future efforts are needed to help the users resolve such contradictions and make practical choices confidently.

Content should be formulated using multiple commonly used terminologies to cover regional diversity. Users could not understand some "formal" Hindi or Marathi words used in mMitra. This includes terms related to parts of the body, sex, breast-feeding, contraception, and terms used for food items. Users suggested several collo-quial alternatives. In a communication that is predominantly based on audio, using multiple colloquial terms might increase the length of the audio making it harder to follow. One option is to do more extensive localisation (beyond just language). Another option is using visuals. Visuals (photographs, illustrations, animations or videos) could help clarify some of these terms, and especially procedural content such as breastfeeding, sleeping with a pillow, or lifting weights. Visuals should be familiar to the users and many will still need to be localised. We should also be mindful that visuals could cause more privacy concerns.

Our study identifies the need and the opportunity to go beyond only broadcasting information. Users cannot absorb all audio information in the first go. They need options to repeat information and to share it with peers or family members. Users would also like to ask questions of their own, or questions arising after listening to the

provided information. Such interactivity needs to be added without introducing complexity and keeping in mind the technology abilities of the users.

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