Babywijzer: An Application to Support Women During their Pregnancy

Anouk Wierckx, Suleman Shahid
Department of Communication and Information sciences
Tilburg University
Warandelaan 2, 5037 AB Tilburg, the Netherlands
a.c.d.g.wierckx@tilburguniversity.edu, s.shahid@uvt.nl

Abdullah Al Mahmud[1]
Faculty of Health, Arts and Design
School of Design
Swinburne University of Technology
Building PA. 144 High Street
Prahran VIC Australia 3181

CHI 2014, Apr 26 - May 01 2014, Toronto, ON, Canada
ACM 978-1-4503-2474-8/14/04.
http://dx.doi.org/10.1145/2559206.2581179

Abstract
Mobile health (mHealth) provides a new way to bridge the communication gap between patients and their primary health care providers. [1]This study investigates how a mobile application can support Dutch pregnant women. A prototype, called *Babywijzer,* was designed to support pregnant women's needs. *Babywijzer* is a mobile intervention, which enables pregnant women to search directly for an answer to their pregnancy related questions and follow current evidence based recommendations. The early evaluation showed that the *Babywijzer* app has a positive effect on the pregnant women's knowledge, awareness, confidence and satisfaction.

Author Keywords
Pregnancy; behavior change; health intervention

ACM Classification Keywords
H.5.2 [User interfaces]: prototyping, evaluation/methodology.

Introduction
The use of mobile communication in maternal health care enables pregnant women to enhance their self-care agency. Mobile technologies are being actively

[1]This project was proposed as a master thesis by the third author and was supervised by the second and third author.

Figure 1. Early prototype of the main food screen where user can check the daily schedule and her performance on health meter.

used to deliver health behavior interventions and mobile health interventions have already been applied to support the management of diabetes, hypertension, asthma, eating disorders and HIV treatment [1]. Several studies have investigated the use of mHealth in developing countries to reduce the perinatal mortality. However, a few studies investigated the improvement of maternal health care by mobile communication for middle-income or developed countries. A number of recent studies show that pregnant women in developed countries are also insecure about their pregnancies and they do feel the need for more structured, customized and reliable information for gaining confidence and self-efficacy [2].

This study extends our previous work in this area [9] and is focused on the Dutch health care system. This system is rather unique in handling pregnancies and stresses on taking overall pregnancy (and delivery) as naturally as possible. In a developed country like the Netherlands, pregnant women get obstetrician support and on average 10 antenatal visits, which should lead to healthy babies. An international comparison showed that the perinatal mortality in the Netherlands is still relatively higher than in Finland and Sweden. Furthermore, women are relatively less confident about their pregnancy and to considering that they do not always have timely access to the relevant information [3]. This study attempts to improve pregnant women's self-care agency by designing a mobile application which is tailored to their needs. Research showed that a women's self-care agency could be enhanced by proper health education [4]. Increasing the health knowledge of pregnant women will result in improved health literacy, which will positively affect their health status.

A few mobile health interventions were designed for pregnant women in the developed world. Recently in the United States and Russia an intervention program, called Text4Baby (T4B), was developed. After sending child's expected birth date, pregnant women receive three text messages a week with evidence-based information [5]. The evaluation of the program is still in progress but it is hoped that this service will result in improved health care utilization, increased birth rate and birth weight, decrease in maternal and infant mortality and improved communication with patients. In the case of the Netherlands, most of the mobile applications designed for pregnant women are not intended for above mentioned purposes. Most of the applications have been designed from a different perspective e.g. for entertainment (e.g. Baby-Namen Pro), increasing the sales of pregnancy-related products (e.g. Mom2B), too general in nature and information not tailored to a women's individual health (e.g. Zwanger.nl), inform about a very specific issue (e.g. Zwanger & Eten -inform women about what they can and cannot eat during their pregnancy) or designed for specific areas in the Netherlands (e.g. ZwangerAppassistent). In this study, we investigate how mHealth can support (e.g. increase knowledge, improve confidence, bring structure in life, etc.) pregnant women in the Netherlands.

User research

The goal of user research was to discover different issues which Dutch women face during their pregnancy and to find out the key information gaps. We decided to focus on the first-time pregnant women because of their insufficient experience in handling pregnancy and high insecurity. In total, thirteen women and three obstetricians participated in semi-structured interviews

Figure 1. Screen for viewing local (pregnant) friends. Users can communicate and make appointments for f2f meetings.

Translation of menu from Dutch to English:
Week: Week, Voeding = Food, Risico's = Risks, Meer = More

to share their experiences. We asked women about the awareness of their own health, their babies' health, their information needs, and their experience with mobile applications. Each interview took about 40 minutes and was recorded. A qualitative data analysis technique was used and the recorded interviews were transcribed and finally analyzed using open, axial and selective coding [6]. A very brief summary of main themes discovered from the interviews are given below:

Food, Nutrition and weight gain
The interviews showed that almost all pregnant women are insecure about food and nutrition. In particular the products and ingredients that women should not eat, because those could harm the development of the unborn baby. *"So then it is still questionable, as with shrimp. Can you eat that anyway? Because it says you cannot" (P.* #7). During the consultation with their obstetrician the weight gain of the pregnant women is stored. However, the women experienced difficulties with the amount of weight they should gain during their pregnancy. *"I did not want to gain 20 kilo if I could avoid it. So I have searched on the Internet what was the average weight you gain during your pregnancy. And that was 12 kilo I have read. So sometimes I asked other pregnant women on forums how much they gained weight to check if I was on schedule or not"* (p. #2). They mentioned that asking other women gives them a kind of reassurance that all are good.

Risky behaviors
In addition, they had a lot of uncertainties about the risks of a pregnancy and how they should behave to avoid these. *"I have experienced that someone was riding on her horse and got a miscarriage. Did it happen because she was riding on her horse?"* (p. #7). They said they would ask their obstetrician during their consultations if they were unsure about anything, but in the early stage of pregnancy there are only few moments for consultation. They also mentioned that it would be nice to get help from experienced women (someone they know personally) who have gone through the process of giving birth.

Pregnancy ailments
Women preferred information about pregnancy ailments to recognize their symptoms, and find a potential remedy to make the pregnancy more comfortable. In case they knew which ailment they were suffering from, they often had no idea what could help them. *"One person says you must do this, but the other says you should do that and then I think about my baby and do not want to take medications"* (p. #6).

Keeping track of pregnancy
Women also faced difficulties in keeping track of their pregnancies e.g. where are they now? What happens during a particular week? Is there a mismatch between what is normal and what is happening in their body? They also said that before a meeting with obstetrician they have a lot questions in mind but they usually forget to ask all questions. "During the day, I think about a lot of things and want to ask obstetrician about them but I cannot always record these questions in the diary given by our obstetrician. The ones I have in mind, I usually forget during the consultation session". Although the obstetrician will advise them about all their queries, they would also like the ability to directly access this information. A consultation with their obstetrician is often very short and the pregnant women have difficulty to remember what has been

Figure 3. The food screen where user can see the recommendations. Voeding: food, Risico's: risks, Meer: more.

said. The ability to record the conversation notes and consult them when required was a big plus for them. Women mentioned that they try to browse forums but on different forums people have different point of views (too many 'I think' answers). They also mentioned many issues while browsing forums e.g. language issues, user account creation issue for each forum, inability to browse on mobile/tablets, trust factor, and too unstructured information.

Additional support

Many women also consistently felt of the need for connecting with other pregnant women using social media or private groups. For example, they showed an interest in making an online group of all those women who visit a particular healthcare center for discussing problems and sharing updates. Women also mentioned variety of other issues. For example, they indicated that they had doubts about when they should call their obstetrician, and the obstetricians underpinned the importance of this information. *"So they know now labor has begun, and that they should call. Or when they did not feel their baby all day. That they know it is important to contact us"* (p. #14). The obstetricians mentioned that pregnant women should be informed about food intake, vitamin use, the social rules relating to activities, prenatal testing, birth plan and get advice when they should call. *"Health gain from better nutrition, healthy, varied food, possibly a multivitamin, that vitamin D, stop smoking. These are actually the most important things in terms of information provision"* (p. #14).

Design and Development

Based on above results, we finalized the list of design requirements and decided to go for a mobile app after testing a couple of design alternatives. In the first round of development we mainly paid good attention to contents. Users emphasized that the mobile application should be structured and unlike forums, all information should be available in an easily searchable/browseable format. The application should be customizable for every women and obstetrician should be able to set the roadmap for pregnant women. The key requirements and features of the app are:1) a complete personal health record system customized by the user for the duration of pregnancy and verified by the obstetrician, 2) women can monitor their own health records (weight gain and blood pressure) in different charts and compare them with average (obstetricians provided a standard plan which can be entered in the application based on the women's condition e.g. current weight, first or second pregnancy etc.), 3) a health meter gives them an indication of their eating habits e.g. enough fruits and vegetables per day (obstetricians provided a list of foods with negative impact on health), 4) a push notification system for accomplishing different tasks (e.g. reminding about eating healthy, giving information about pregnancy weeks, appointment with obstetricians, etc.), 5) an alarm system for warnings (e.g. high blood pressure, abnormal weight gain, bad eating habits, etc.), 6) a journal module (enable women to browse existing information anytime, record their queries for consultation visits and notes after visits), 7) a module to send health records to obstetricians, 8) a section on social rules that prevent women from risky behaviors, and 9) a module to connect with other pregnant women (social media community - primarily enrolled with the same healthcare organization). The initial design of the final prototype was created using Balsamiq Mockups (Figure 1), and was tested with end users. Based on the

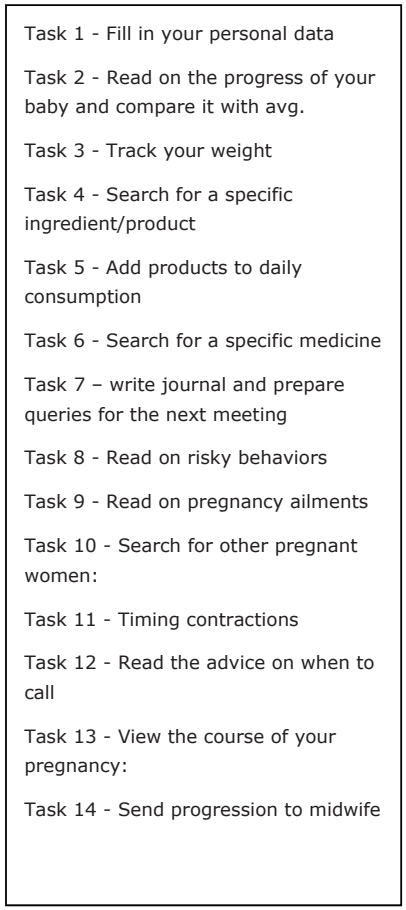

Figure 4. Major tasks for usability evaluation

feedback, the design and flow was improved. The final application was designed using HTML5 and Adobe Photoshop (Figure 2).

Evaluation

The usability test was conducted to evaluate the usefulness of the application. Eleven pregnant women and one obstetrician took part in the evaluation. Five women and one obstetrician from the user research participated in the evaluation phase. During the usability test participants had to perform 14 tasks (figure 4) on the iPhone. After completing the tasks, every participant filled a UX questionnaire (on Likert scale 1 to 5 where 5 is very good). At the end, a semi-structured interview was conducted to know overall experience of using the app, and how they think the app would influence their lives. The qualitative data such as video recording of user interaction, verbal protocol, and critical incidents w ere gathered and analyzed.

Results

Majority of the participants indicated that the application was easy to use (*M*=3.82*, SD*=.98), the functions were well integrated (*M*=3.91*, SD*=.70), the structure was intuitive and easy to remember (*M*=4.36*, SD*=.67) and they would like to use the application frequently (*M*=4.36*, SD*=.81). Almost all participants thought that the app will allow them to follow the course of their pregnancy in a better way that otherwise would be possible (*M* = 4.45 *, SD* = .93). Participants were not sure if their overall lifestyle would improve due to the app (*M*=2.91*, SD*=1.04). However, participants thought that using the app will make them more satisfied during their pregnancy (*M*=4.09*, SD*=.83), and gives them more confidence about their choices during their pregnancy (*M*=3.91*, SD*=1.30). They were happy that the app would allow them to better inform their midwife about the course of their pregnancy and improves overall communication (*M*= 4.00*, SD* = 1.34).

In the following sections, we present selected examples from the interviews.

Convenience. Ten women are very willing to use the application as it is. Seven women think it is much easier to follow their progression with a mobile phone. *"Well you can follow everything exactly, and you do not have to write it down in a book. It is just so easy to do it with your phone"* (p. #1). Besides, women think it better enables them to contact their obstetrician when they are in a situation they need to. For example, one participant said, "*The app is very convenient to use. All risks are clearly indicated on one app, but also what nutrition you should have, which week you are in. I think the risks of certain behaviors are the finest, you can realize those without calling your obstetrician or you can see if that is necessary"* (p. #8). However, obstetricians were a little reluctant to contact by using the application. They were afraid that they have to do a lot of extra work and *pregnant women can associate* wrong expectations (e.g. too quick response) while sharing their personal information. Although, they thought that sharing information could be valuable, but should be integrated to their existing midwifery information system (as a policy) to make it workable. Nine women appreciate the ease of getting an answer in just a few minutes through the personalized information. *"It's personal, because you can do more with your own data and simply more practical to apply, less reading"* (p. #4). In addition, they thought the application would be a lot more applicable when outside

the home or at times when they cannot open a computer (e.g. on bed) or read a book. *"For example, you're out to dinner and want something. To see if I can eat it or not. You have to go searching or Googling in advance and sometimes it takes quite some time "* (p. #3). [7] also highlighted that women are not always pleased with existing information sources and a mobile system can be useful in this regard.

Satisfaction & confidence. Women think they would be more confident, because the babywijzer application can serve as a reference point. *"You have everything at your fingertips.* You can keep record of what is happening with your body and compare with the avg. provided by the obstetrician" (p. #10). Women also value the connection with other women. "*You do not feel that you are alone. You realize that other have gone through it and are ready to help you - someone you also know personally".* This finding is in line with previous findings where it has been shown that new mothers gain confidence from the fact that other women also went through difficulties [8].

Conclusion and Future Work

We conducted a field study with pregnant women and obstetricians to examine the information needs among this group. Our field research findings strengthen the existing findings where it has been shown that pregnant women from developed countries are also insecure and a mobile intervention solution can be beneficial. Our first design provides a good starting point for the introduction of a mobile application in Dutch maternal health care. Participants indicated that the application will increase their knowledge and awareness about their behavior during their pregnancy, they would feel confident and satisfied during their pregnancy while using the app. We plan to run a longitudinal study to examine the impact of the app on the behavior of pregnant women.

References

[1] Cole-Lewis, H. & Kershaw, T. (2010). Text messaging as a tool for behaviour change in disease prevention and management. *Epidemiologic Reviews, 32*(56).

[2] Gibson, L., & Hanson, V. L. (2013). Digital motherhood: how does technology support new mothers. In *CHI '13.* (pp. 313-322). New York

[3] Achterberg, P. W. (2005). Measuring up to the best. International differences in perinatal mortality. National Institute of Public health and the Environment report.

[4] Nutbeam, D. (2000). Health literacy as a public health goal: a challenge for contemporary health education and communication strategies into the 21st century. Health Promotion International,15(3): 259-267.

[5] Parker, R.M., et al. (2012). Text4baby in the United States and Russia: An Opportunity for Understanding How mHealth Affects Maternal and Child Health. Journal of Health Communication: International Perspectives. 17(1): p. 30-36.

[6] Corbin, J. M., & Strauss, A. (1990). Grounded theory research: Procedures, canons, and evaluative criteria. Qualitative sociology, 13(1), 3-21.

[7] Larsson, M. (2009). A descriptive study of the use of the Internet by women seeking pregnancy-related information. *Midwifery*, 25, 14-20.

[8] Madge, C., and O'Connor, H. (2006). Parenting gone wired: empowerment of new mothers on the internet? Social & Cultural Geography, 7:02, 199-220.

[9] Al Mahmud, A. & Keyson, D.V. (2013). Supporting improved maternity care by midwives: Design opportunities and lessons learned. INTERACT (4) 2013: 635-642.