
Nuwa: Enhancing the Pregnancy Experience for Expectant Parents

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CHI 2014, April 26–May 1, 2014, Toronto, Ontario, Canada.

ACM 978-1-4503-2474-8/14/04.

<http://dx.doi.org/10.1145/2559206.2580928>

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Abstract

Pregnancy is a complicated and special process with many bodily changes, discomforts, and possibilities of complications. Partners of expectant mothers share a close relationship and often play an important role during pregnancy. To support a better pregnancy experience, we present Nuwa, a system that enhances self-awareness of health condition and also facilitates the communication between expectant mothers and their partners. The system is based on expectant mothers' health conditions. It provides a way for expectant parents to track and understand the maternal health, and encourages the partners to provide better support. Our study results support our design ideas and argue for the feasibility and expandability of Nuwa in helping expectant parents to have better experiences during pregnancy.

Author Keywords

Intimacy Support; Healthcare; Pregnancy; Mobile Technology; User-centered Design

ACM Classification Keywords

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



Figure 1 Part of affinity wall

Introduction

For expectant mothers, pregnancy is a complicated, special and important process. Being pregnant can be one of the most stressful experiences in a woman's life [6]. During pregnancy, a woman has to face challenges both from physical and mental tiredness [1]. Physical changes and discomforts such as morning sickness lead to inconvenience for expectant mothers and concerns about maternal and fetal health. Research suggests that they are open to becoming more aware of their health conditions and seeking health-related advice through different resources, in order to get confidence about their pregnancies [5].

As for mental aspect, expectant mothers report that they sometimes feel lonely, physically drained and emotionally fatigued, and at times resent the role and responsibility of becoming mothers [1]. Research suggests that the social support from one's partner is critical, because expectant mothers are likely to have more interactions with their partners than any other families and friends [8]. During the pregnancy, partners mainly provided three types of support: 1) instrumental support 2) informational support 3) emotional support. The first two help the expectant mother to fulfill specific tasks like housework, while emotional support relieves the mother's depression and reduces prenatal stress [4]. Therefore, continuous and effective support from their partners is important.

We believe that pregnancy is a special couple experience for most people, which involves the cooperation of both expectant parents. With this in mind, we proposed our system, Nuwa, which aims to effectively improve expectant mothers' self-awareness

about their health conditions, and to help partners better support expectant mothers.

Investigative Research

To identify our design space, we assessed the expectant parents' needs by conducting interviews and surveys. By convenient access, we interviewed six (expectant) mothers and four (expectant) partners about their pregnancy-related experiences especially in the aspects of family support, bodily changes and measurements. While all of our study participants were married heterosexual couples, we believe our findings carry to other situations. In addition, we interviewed two obstetricians and one midwife to study medical prenatal care. After all the interviews, we arranged an affinity wall to group related data from interviewees. Then we walked through the affinity wall, looking for breakdowns and discussing potential solutions. To further research on the interview findings in a larger population, we conducted online surveys to study how expectant mothers and their partners consider family support, physical and emotional changes and data tracking. We distributed the surveys to participants through Amazon's Mechanical Turk and online pregnancy forums in the U.S. We received 131 complete responses including 90 expectant mothers and 41 partners.

Measurements of maternal vital functions have been proven to be effective indicators of maternal and fetal health. According to our literature review and interviews with two obstetricians, the following physiological changes are usually measured when estimating maternal health: weight gain, blood pressure and heart rate. Also, sleep [9] and activity [7] can influence pregnancy.

"I like my wife directly tell me what to do. I don't think I can help when she had morning sickness"

-U08, Husband

"I think husband is essential in both emotional and physical aspects, but my husband does not involve much into it"

-U03, Expectant

Figure 2 User quote from interviews



Figure 3 Interview with expectant mother

Although 130 out of 131 of the expectant parents responded in the surveys that they are concerned about maternal and fetal health, we found that expectant mothers seldom track any measurements at home during pregnancy from our interviews. There are mainly two reasons. First, expectant parents consider tracking measurements effortful with only limited value. Second, it is hard for average expectant parents to make sense out of health measurements. The medical interpretation of the measurements can better facilitate expectant parents in understanding maternal and fetal health. These findings suggest that providing interpretation and customized advice should be included in the system design.

In addition, we found that some form of “communication facilitator” is needed to help with partner support in order to improve the communication within the couple. Our interviews and surveys reveal that the role of the partner is significantly different from that of other family members and friends.

However, we found that there is a gap between what expectant mothers need and what expectant partners usually do. Expectant mothers need and what expectant partners usually do. Expectant partners prefer providing instrumental support such as picking up children from school than offering emotional support. Nevertheless, interviews with expectant mothers reveal that emotional support is indispensable. Many expectant mothers expect some forms of emotional support, which are extremely helpful to relieve depression and increase confidence. Therefore, we found some form of “communication facilitator” between expectant couple is necessary.

To explore existing solutions, we conducted a comparative analysis among various pregnancy-related systems. However, most existing solutions fail to provide sufficient medical interpretation based on individual conditions. They only either support thorough measurements tracking (e.g. Ovia) or provide pregnancy tips by week (e.g. BabyCenter). On the other hand, there is no solution supporting pregnancy as a couple or family experience, neglecting the expectant partner’s role. Noticing the informative value of health measurements and the important role of expectant partner, we propose a health tracking system providing both expectant parents with customized interpretation of maternal health measurements.

Design Process

Based on our research, we created four personas including two expectant mothers and two for expectant partners. These personas helped us capture the behaviors and needs of users as well as the characteristics of the information seeking behavior of an expectant couple and the communication between them. Here are the created personas:

- Hannah Carpenter, a business analyst who is 25 weeks pregnant. She has high blood pressure and is concerned that it will affect the baby during the pregnancy. Reading pregnancy-related articles and books is her biggest hobby at this time.
- Christina Koo, a university staff member who is 12 weeks pregnant. She is occupied with work and does not worry about any changes she experiences.
- David Clark, an architect whose wife is 16 weeks pregnant. He cares about the health of his wife and

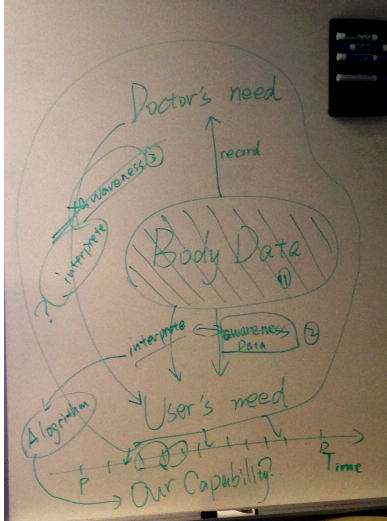


Figure 4 Screenshot of ideation process



Figure 5 Wireframe

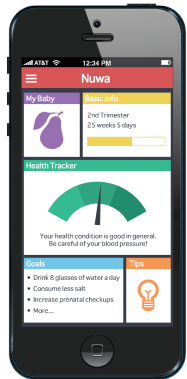


Figure 6 Mid-fi prototype

baby. But he does not know much about how to help his wife. During the day he is too busy with work and has little time to check on his wife.

- James Brown, a medical student whose wife is 29 weeks pregnant. He pays careful attention to his wife's body conditions and gives her appropriate advice.

These personas indicate that our design should give Hannah and James an easy way to frequently check the maternal health conditions. Christina needs to be empowered to check her condition more often so as to ensure a healthy pregnancy. Last, the system should be involved and supportive during his wife's pregnancy. Keeping different user needs in mind, we developed our design through the iterative process of brainstorming, sketching, prototyping and evaluation.

Our Solution: Nuwa

We propose a mobile-based system, Nuwa, which aims to enhance expectant mothers' awareness of their health conditions and their partners' participation. Nuwa consists of two separate components: a wristband with sensors and a mobile application. The expectant mother will wear the wristband while both of the couple need to install the mobile application on their smartphones. Maternal health measurements are collected by wristband and transferred to the mobile application. Nuwa explains the measurements in plain language and generates notifications for both expectant parents in a timely manner. The system utilizes the interpretation of measurements to facilitate the collaboration between expectant parents.

We researched existing technologies of convenient, non-invasive and continuous tracking of measurements

to understand the implementation feasibility. We found that heart rate, sleep and activity can already be tracked with Fitbit, and blood pressure can be tracked with CARUNDA24 [3]. Therefore, it is reasonable to envision a wristband having multiple sensors to track the above-mentioned measurements in the near future. The tracking results will be synced to the mobile application with Bluetooth. As for another important measurement – weight – a Bluetooth-enabled electronic scale can track and sync weight automatically.

Because of the importance of interpretation in raising users' awareness of the pregnancy condition, Nuwa applies medical theories [2] to analyze the measurements and provide explanations about the maternal health condition. Noticing that the normal ranges of the measurements, especially weight, would be different among individuals, the system enables the expectant mothers to customize the base values. For each measurement, it provides a trend line visualizing the collected data. The trend line will be colored: green means it is in the normal range, yellow means it is around the warning edge and red means it is in the risky range. Based on all measurements, an overview is provided as a dashboard when they are logged in.

According to medical interpretation, a notification or an alert will be generated if there are some negative signs depending on the severity of a health risk. With a severe situation where expectant mothers need to talk to their doctors as soon as possible, an alert will be sent to warn users; with a mild issue such as temporary high blood pressure, our system will send a notification to remind expectant parents with some suggestions. Since our research indicates that

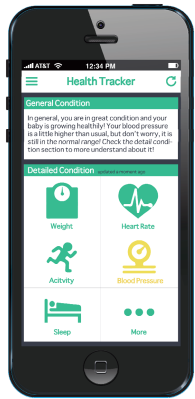


Figure 7 Mid-fi prototype: health tracker



Figure 8 Mid-fi prototype: notification and alert

expectant mothers may easily get worried, we provide options that allow expectant mothers to choose not to receive notifications. In this case, only expectant partners will receive notifications with a list of advice.

Expectant Partners' Involvement

Our system tries to enhance expectant partners' involvement by providing some different mechanisms and to facilitate them to better understand pregnant mother's feelings and needs and their expected roles in the pregnancy process.

The real time data and personalized interpretation provided by Nuwa help expectant partners understand how pregnant women change physically and emotionally in this special period. The real-time data keeps expectant partners updated and involved in the pregnancy so that they can provide better support. Based on the body condition and changes, our system also generates goal lists for both pregnant women and their partners. Especially for expectant partners, the goals directly tell them what to do and help them really make a difference to help pregnant women. Meanwhile, in order to improve emotional support between them, our system provides some several easy ways of in-depth communication, including sweet and inspiring words when the expectant mother finishes the goals or faces some worries. Nuwa bridges the gap between the emotional and instrumental needs of expectant parents' tangible support.

We found, compared to expectant mothers, their partners are less susceptible to negative information, so partners can share the burden of unnecessary stress. As notifications with mild health issues are not urgent or critical, Nuwa addresses that in two ways: (1) it provides the mother an option not receiving

notifications to avoid extra stimuli; and (2) it reminds the partner to comfort the mother when they both receive notifications.

Evaluation

Our design process included sketches, wireframe, low-fi and mid-fi prototype. Our wireframes were based on our initial design idea and were generated on Balsamiq Mockups. Our team discussed the interactive flow and functional design based on the wireframe and did performed heuristic evaluation based on Nielsen's 10 heuristics. After validating the concept and the flow, we developed our low-fi prototype and conducted our first-round usability testing. Participants were asked to think aloud and go through the interactive flow in preset scenarios using a smartphone. The test result revealed critical flow problems and some aesthetic issues. For example, participants preferred to see a simple indicator showing the general interpretation of health condition for easy access. Therefore, we replaced our original design of a text format interpretation with a dashboard widget on the homepage showing an overview of maternal health condition.

We accordingly modified the interactive flows and developed a mid-fi prototype on Axure. We conducted another round of usability testing with two pairs of expectant parents to evaluate the prototype. Most expectant mothers reported that the tips and goals from partners were considerate and easy to understand. Furthermore, expectant partners found the tips to be helpful for understanding the maternal health conditions. Through the tests, we verified that Nuwa is helpful for enhancing the pregnancy experience for expectant parents.



Figure 9 User testing

Conclusion

Pregnancy is a complicated and special process with many bodily changes, discomforts, and sometimes complications. We tried to meet the needs of expectant parents with the proposed system, Nuwa, the goal of which is to enhance the pregnancy experience for both of them.

Our research indicates that expectant parents have different roles and needs in the pregnancy period. Nuwa provides real-time health tracking and detailed interpretation to represent the maternal condition. Meanwhile, emotional support is important to expectant mother and there is an obvious gap between what they need and what expectant partners offer. Our system tries to solve that by providing new ways to communicate effectively.

With the development of sensor technologies, we predict that the measurements for pregnancy will be collected and represented easily and precisely. As for the users of the system, we realized that other stakeholders such as obstetricians are also very important for the pregnancy process and should be involved as well. This could be an improvement in our future work.

Acknowledgements

We would like to thank Professors Mark Ackerman, Mark Newman, Predrag Klasnja; our student instructor Ayse Buyuktur; and all our research participants for their invaluable input on this project.

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