The perceptions of Midwives, Obstetricians, and recently delivered Mothers to remote monitoring for prenatal care

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ABSTRACT

Background

There have been few studies on remote monitoring (RM) in midwifery. These studies were mostly performed several decades ago, and no recent studies have investigated the perceptions to or experiences of new technologies. The Pregnancy Remote Monitoring (PREMOM) study, which started in January 2015 in Ziekenhuis Oost-Limburg (Genk, Belgium), enrolled pregnant women at increased risk of developing gestational hypertensive disorders (GHD). Women enrolled in PREMOM underwent conventional prenatal follow-up, which was complemented with RM. We sought to investigate the perceptions and experiences of mothers, midwives, and obstetricians to the RM approach used in the PREMOM study.

Methods

We developed specific questionnaires for the mothers, midwives, and obstetricians. The questionnaires comprised five domains: ‘prior knowledge and experience of RM’, ‘reactions to abnormal values’, ‘privacy’, ‘quality and patient safety’, and ‘financial aspects’. The caregivers were also questioned about which issues they consider important when implementing RM. A five-point Likert scale was used to provide objective scores.

Results

Ninety-one participants completed the questionnaires, including 47/92 (51.08%) mothers, 43/52 (67.30%) midwives, and 9/14 (64.29%) obstetricians. The mothers, midwives, and obstetricians reported positive experiences and perceptions to RM. Overall, 29/35 (82.85%) midwives and 7/9 (77.78%) obstetricians had no or little prior experience with this technology. After working for 1 year with RM, 28/35 (80.00%) midwives and 6/9 (66.67%) obstetricians felt that this technology is an important component in the prenatal monitoring of high-risk pregnancies and that it had a positive contribution to the care of pregnant women. They support a further roll-out of RM in Belgium, but caregivers need additional training on
RM devices and the pathological aspects of GHD. Nearly three-quarters of the mothers who participated in the PREMOM study (34/47, 72.34%) did not report any problems with taking the measurements at the required times. Almost half of the mothers (19/47, 40.43%) wanted to be contacted within 3–12 hours after abnormal values, preferably by telephone. Nearly all of the mothers (41/47, 87.24%) did not have any problems with regularly sharing their health data with their gynaecologist. Finally, most of the mothers (39/47, 82.97%) reported that RM gave them a feeling of security throughout their pregnancy.

Conclusions

Although the majority of midwives and obstetricians had no or very little experience with RM before enrolling in the PREMOM study after one year, they reported that RM is an important component in the follow-up of high-risk pregnancies and would recommend it to their colleagues and pregnant patients.
Introduction

Due to demographic changes and rapid improvements in medical technologies, the healthcare sector is confronted with major challenges and with great opportunities. One challenge in healthcare includes pregnant women. The number of high-risk pregnancies is elevated due to the changing lifestyles of pregnant women that have occurred over the last few decades[1-3]. Therefore, there is an increasing need to intensively follow-up these pregnancies.

Telemedicine represents an opportunity for the follow-up of such women. Defined as the use of information and communication technologies for supporting health and health-related activities[4], telemedicine is not simply an addition to conventional care, but rather is implemented in current private and public healthcare approaches. Remote monitoring (RM) represents a type of telemedicine that has a broad definition. It is useful for conducting medical practice from a distance and has been used in a wide variety of electronic healthcare applications[5]. RM can be performed either by live monitoring or asynchronously, whereby data obtained in the patient’s home environment are sent to the caregiver and stored in the patient’s electronic medical records[4]. Although very few studies to date have investigated the use of RM in prenatal care, these studies concluded that RM could have a major role in the improvement of obstetric care, especially in improving maternal satisfaction[6] and reducing adverse neonatal outcomes[7, 8]. However, most of the publications are over 10 years old and did not evaluate the newer RM technologies.

The Pregnancy Remote Monitoring (PREMOM) study, which started in January 2015 in a tertiary centre Ziekenhuis Oost-Limburg (Genk, Belgium), involved RM of pregnant women at high risk of gestational hypertensive diseases (GHD). The PREMOM study design, data collection method and first promising results are described in detail elsewhere [9, 10]. Briefly, the PREMOM study is performed in the outpatient clinic of a 2nd lever prenatal center where pregnant women with GHD received RM or conventional care (CC). Women consenting for
RM received obstetric surveillance using a BP monitor, activity tracker and weight scale. The participating women were asked to measure blood pressure twice daily, measure their weight once daily, and to wear an activity tracker during the 24 hours/day. These data were automatically sent by Wi-Fi or Bluetooth to an online platform which is developed by the Mobile Health Unit (UHasselt), and a midwife reviewed the parameters every workday. Predetermined alarm signals were set (systolic blood pressure > 140 mm Hg, diastolic blood pressure > 90 mm Hg or weight gain > 1 kg/day) and were automatically generated based on an evidence-based triage system. Alarm events were by the midwife communicated with the obstetrician in charge to discuss management options before contacting and instructing patients at home. Therapeutic interventions were according to local management. Two pilot studies demonstrated that women with RM did have less inductions, more spontaneous labours, and less maternal and neonatal hospitalizations when compared with conventional care [9, 10]. Also a cost-analyses of the hospital bills of women with GHD who received RM versus the women who received CC showed a cost-effective effect for the healthcare system in RM [11]. Because no research has been done to investigate the perceptions to or expectations of a prenatal RM follow-up programme, we performed quantitative surveys of recently delivered women and caregivers involved in these technologies to elucidate their perceptions and expectations. Here, we describe the main outcomes, which covered the following domains: ‘prior knowledge and experience of RM’, ‘reactions to abnormal values’, ‘privacy’, ‘quality and patient safety’ and ‘financial aspects’. Caregivers were also asked about important aspects to consider when implementing RM.
Methods

Questionnaires

Three anonymous questionnaires were designed by the research group of the Mobile Health Unit (University of Hasselt, Hasselt, Belgium). The questionnaires were designed for women who were followed-up with RM during their last pregnancy, the midwives working at the Ziekenhuis Oost-Limburg (Genk, Belgium) (ZOL) who are involved in the use of RM, and the consulting obstetricians working at several hospitals in Limburg. The questionnaires assessed five issues to elucidate the perceptions and experiences of the participants in PREMOM to RM, and were based on the six building blocks established by the Mobile Health working group of VOKA Health Community (Brussels, Belgium): (1) protection of data, privacy, and the use of big data; (2) national/international regulations and responsibility; (3) quality, accessibility, and patient safety; (4) technology and interoperability; (5) financing and business models; and (6) supportive policy frameworks in telemedicine. The results of the descriptive PREMOM questionnaires on the domains ‘prior knowledge and experience of RM’, ‘reactions to abnormal values’, ‘privacy’, ‘quality and patient safety’, and ‘financial aspects’, which are important to caregivers for further implementation of RM, are discussed in this manuscript. We also recorded the demographic data for all participants. The questionnaires were drafted in April 2016 using Survey Monkey (Survey Monkey, 2016), and were to be completed online. All questions were assessed using five-point Likert scales to obtain objective scores (Appendix I - III).

Participants

The questionnaires were sent in April 2016 to the women, midwives working at ZOL, and obstetricians (from several hospitals in Limburg) who participated in the PREMOM study in 2015. Student midwives and doctors in training were excluded from the present study.
Data collection

The study participants received an e-mail from the research team with a link to the online survey. E-mail reminders were sent to all participants at 9 and 23 days after the first invitation.

Analysis

Mean scores and ranks were assessed for each question using descriptive analytical methods. The number of participants included in the analyses of individual questions differed from the total number of analysed questionnaires because some mothers, midwives, and obstetricians did not complete all of the questions. Statistical analysis was performed with Statistical Package for Social Sciences release 24.0 (IBM SPSS Inc).

Ethical considerations

To maintain anonymity, the participants were sent a generic link to the survey. A bulk e-mail was sent with the subjects’ e-mail addresses included as a BCC to ensure there were no recognisable personal elements in the e-mail. The e-mail was addressed with ‘Dear Madam’, or ‘Dear Colleague’, to confirm there were no personal items in the invitation to participate in this study. In addition, the participants were not asked to report an ID when completing the questionnaires. The Medical Ethics Committee of Ziekenhuis Oost-Limburg approved this study (nr. 14/078U).
Results

A study population of 158 people consist out: 92 mothers (58.23%), 52 midwives (32.91%), and 14 obstetricians (8.86%). The total number of involved pregnant women in the PREMOM study n = 119, so 77.31% (92/119) of the participants was contacted after their delivery. The missing 27 women didn’t answer their phone, didn’t have an e-mail address or there was language barrier. One gynaecologist was excluded from final analyses because less than 50% of the questionnaire was completed. Therefore, the total response rate was 57.59%. An overview of the questions to the midwives, obstetricians and recently delivered mothers, and their answers, are submitted in Appendix 1. The characteristics of the participants are listed in Table 1.

Table 1: Characteristics of participants

<table>
<thead>
<tr>
<th>Characteristics of women who have involved with RM during their last pregnancy (n = 47)</th>
<th>Response categories</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
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<tr>
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<tr>
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<td>No</td>
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<td>%</td>
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<tr>
<td>Age</td>
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<tr>
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<tr>
<td>26 – 30 years</td>
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<td>Response categories</td>
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<tr>
<td></td>
<td>N</td>
<td>%</td>
</tr>
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### Prior knowledge and experience of RM

The first part of the questionnaire examined the midwife’s and gynaecologist’s prior knowledge or experience of RM. Overall, 29/35 midwives (82.85%) and 7/9 (77.78%) obstetricians reported little or no experience of RM (Figure 1).

![Figure 1: Summary of responses from the midwives and obstetricians on the question 'Please indicate with a score from 1 (strongly disagree) to 5 (strongly agree): I had already experience with RM before this study.'](image)

The midwives were also asked about their experience of RM as a threat to their daily work. The majority (29/35, 82.85%) of midwives felt that they did not perceive RM as a threat to their work.

### Timing and method of communication in case of an event

Nearly three-quarters (34/47, 72.34%) of the participating mothers reported that they had no problems with performing the measurements at the requested times. Of the 7 mothers who reported difficulty with the recommended measurements, 4 (57.14%) were 36–40 years old, 2 (28.57%) between 26-30 years and 1 (14.29%) between 31-35 years.
Participants were also asked about the acceptable time limit for being contacted by their caregiver in case of an unexpected event. Of 47 women who completed the questionnaire, 13 (27.66%) preferred to be contacted within 3 hours of the event, and 19 (40.43%) agreed to be contacted between 3–12 hours, and 15 (31.91%) complied with being contacted > 12 hours after the event (Figure 2).

Interestingly, 4/5 mothers (80.00%) aged < 25 years asked to be contacted within 3 hours of an event. The participants were also asked how to be contact following an event. The participants’ first preference was to be contacted by telephone (weighted average 4.55/5), while prenatal consultation (weighted average 3.94/5) and text messages (weighted average 3.17/5) were the second and third preferences, respectively. In the final question in this section, we asked the participants to state who should contact the women in case of an event. The mothers and midwives stated that the gynaecologist should be the first to contact the pregnant woman after an abnormal event. However, the obstetricians reported that their representing researcher should be the first caregiver to contact the pregnant woman in case of an event.

Privacy
The mothers were asked if they felt that regularly sharing their health data was a threat to their privacy. Most (41/47, 87.24%) of the mothers reported that they did not have any negative concerns about privacy. Three mothers reported a threat to their privacy, and they were aged 36–40 years.

**Quality and patient safety**

The mothers were asked about the importance of RM in the follow-up of their pregnancy. Most (42/47, 89.36%) of the mothers had a positive response to this question. Meanwhile, 28/35 (80.00%) midwives reported that RM provided added value to pregnant women and 27/35 (77.14%) midwives felt that RM improved the care of pregnant women at increased risk of gestational complications. This percentage is slightly higher than that of obstetricians; 6/9 (66.67%) of whom felt that RM provided added value to their patients (Figure 3).

![Figure 2: Summary of responses from the midwives and obstetricians to the question “Do you believe that RM improves the care for pregnant women with an increased risk of gestational complications? Please indicate with a score from 1 (strongly disagree) to 5 (strongly agree).”](image)

**Financial**
An important element in new healthcare practices is their financial cost. Therefore, the relative and absolute costs of each component in telemonitoring programmes need to be evaluated. All three groups of participants reported that the cost of RM should be as low as possible, and about half of the mothers expected RM to be free (25/47, 53.19%). It is also important to obtain information on any potential payer of RM. The mothers expected the hospital to be the main payer, followed by health insurance (company), whereas midwives and obstetricians felt that the pregnant women should contribute to the cost of RM.

**Further implementation of RM**

The midwives and obstetricians were asked about important factors to support the implementation of RM into daily practice. Most of the midwives (31/35, 88.57%) felt that it is important to receive additional training on “the information that must be given to pregnant women about GHD and the added value of RM in this monitoring this disease”. A lower proportion of obstetricians (7/9, 77.78%) considered this necessary. More obstetricians (8/9, 88.89%) felt that training on the technical handling of the devices (e.g. installation and common problems) was the most important factor. About three-quarters of midwives (27/35, 77.14%) had the same response to this question. In terms of the final evaluation of the project, the obstetricians were asked whether they would recommend RM to pregnant women and their colleagues. Overall, 6/9 (66.67%) obstetricians supported this service and would recommend it to their patients while 7/9 (77.78%) obstetricians would recommend RM to their colleagues. Finally, 6/9 (66.67%) obstetricians recommended that this follow-up should be expanded to all pregnant women in Belgium who are at increased risk of GHD.
Discussion

Principal findings

To our knowledge, this is the first quantitative survey of an RM programme for prenatal care. The results show that the majority of midwives and obstetricians had no or very little experience of RM before they participated in the PREMOM study. After taking part in the PREMOM study and the survey, the midwives reported that RM is not a threat to their daily work. The majority of mothers who were followed up by RM during their last pregnancy did not experience any problems with taking the required measurements at the specified times. Most of the mothers thought that it is acceptable to be contacted within 3–12 hours after an abnormal value, and they preferred to be contacted by telephone. The mothers did not have concerns with sharing their health data with their gynaecologist, and reported that RM gave them a feeling of security throughout their pregnancy.

The mothers, midwives, and obstetricians included in the study reported that RM is an important aspect of the follow-up of (high risk) pregnancies. The obstetricians stated that they would recommend RM to colleagues and other pregnant women. Most of the obstetricians proposed extending RM to all women with high-risk pregnancies in Belgium. The obstetricians and midwives also reported that all users need additional training to support the implementation of RM.

Strengths and limitations of the study

Despite the increased implementation of RM in healthcare, its use is still limited in obstetrics. Ours was the first study to investigate the perceptions of obstetricians, midwives, and recently delivered mothers to the use of RM for preterm follow-up of pregnancies at risk for GHD. Another strength of this study is that it included stakeholders involved in the use of RM, including caregivers and actual users. The questionnaire also included additional space
allowing the participants to explain their responses to each question, allowing us to obtain supplementary information. Furthermore, the participants could complete the questionnaire anonymously, an important strength of this study. Finally, a relatively high percentage of participants in PREMOM study completed the questionnaires.

This study also has some weaknesses to mention. First, because the questionnaire was completed anonymously, it was not possible to write to the individual participants to request additional information. Second, the questionnaire was completed in uncontrolled conditions, and it is unclear whether the participants were exposed to external influences when they completed the questionnaire. Additionally, the three groups in this study had small sample sizes, which could affect external validity. Third, this study is performed in a local hospital with a rather low number of participants. Finally, the study included obstetricians who worked at several hospitals in Limburg, but the midwives and mothers were enrolled only from a single centre (Ziekenhuis Oost-Limburg).

Comparison with the literature and possible explanations

Although very few studies have examined the use of RM for the prenatal follow-up of pregnant women, the results of these studies were positive. Previous research concluded that pregnant women with gestational diabetes mellitus had an increased sense of self-regulation when they used RM to send their blood glucose levels to their midwives\[12, 13\]. Meanwhile, other research showed that pregnant women had heightened feelings of maternal satisfaction when using RM as additional care with their labour induction\[14, 15\].

The PREMOM pilot study demonstrated the importance of properly performing the required data sampling in order for RM to succeed\[16\]. Measuring blood pressure, body weight, and activity every day is a prerequisite to ensure adequate monitoring of pregnant women. Although this may appear burdensome to many pregnant women, the mothers surveyed in this
study did not experience this obstacle. ‘Privacy’ is a critical aspect of healthcare and RM[17].

In the PREMOM study, it was necessary to ensure that the clinical data were measured, transmitted, and stored safely and securely. The clinical data were uploaded to an online database through the website of the commercial partner (Withings, Issy-les-Moulineux, France). A midwife reviewed all the data. Some risk-averse participants might be unwilling to share their clinical data with a commercial partner. However, none of the participants reported any privacy breaches using RM. In addition, the quality of care experienced by pregnant women with (increased risk of) GHD was enhanced by RM, as reported by the surveyed mothers and caregivers, and supported by the results of the prior pilot study [9].

Finally, a common argument against RM is the perception that it may place extra burden on healthcare services because pregnant women with concern about their health may wish to consult their own data. This perception was assessed in the questionnaires, but it was not expressed by the obstetricians participating in this survey. This conclusion is consistent with the results of studies of pregnant women with gestational diabetes mellitus supported by RM[6, 13].

Recommendations for further research

Both the mothers and the midwives felt that the gynaecologist should be responsible for contacting the patient after an abnormal event, while the obstetricians suggested that their reporting researcher is responsible for this task. This may relate to the organisation of prenatal care in Belgium, where midwives nearly act as obstetric nurses instead of independent midwives and the prenatal care for pregnant women mostly is performed by an obstetrician, nevertheless if a pregnant women has a high or a low risk pregnancy. It is remarkable that none of these three groups felt that this could be a task of the patient’s midwife, although the researcher in this study is certified as a midwife. Still, the allocation of RM – coordination to
the responsibilities of the midwives seem logical, as they act as an intermediary between the pregnant woman and the gynaecologist. Clearly, further research is needed to understand the factors underlying this opinion and how it could be changed.

Additionally, both the mothers and the healthcare workers stated that RM should be offered for free or they want to pay as less as possible for the RM services. Although a cost-effectiveness study is executed and it has proven that RM makes a cost saving possible for the healthcare system [11], a willingness to pay study isn’t performed yet. This would have an additional value to set a price for the RM services when the healthcare society or the hospital asks for it.

Further, although 66% of the obstetricians would recommend RM to their patients and 77% to their colleagues, the obstetricians who wouldn’t recommend it didn’t give any reason for this. A following qualitative questionnaire which investigates the underlying reasons for this should be helpful the further implement RM in the standard prenatal care for women at risk GHD.

Interestingly, the mothers preferred to be contacted between 3 and 12 hours after an abnormal clinical measurement. This implicates that the clinical data should be monitored 24/7 in order to evaluate and interpret the vital parameters of pregnant women, and permit an intervention if necessary. We therefore recommend developing a system of care aimed at providing these services. Like we showed in our previous studies, the prenatal ward will be less burdened by women with GHD due to our RM prenatal follow-up [9, 10]. Leading from the reductions in prenatal hospitalisations, the work package of the midwife working on the prenatal ward be redefined and there will be some additional space for the RM follow-up, performed by the midwives. Finally, although the mothers with abnormal events were invited to additional prenatal consultations to assess the foetal and maternal wellbeing, none of the patients or the participating obstetricians believed that this was needed and as such was no treat for overloading the healthcare system. These findings may contradict the statement that the
Medicalization of childbirth has gone too far and too much medical interventions are performed in pregnancies, which has arisen from a variety of sources [18-23].
Conclusions

Although most midwives and obstetricians had no or very little experience of RM before they participated in the PREMOM study, they felt that it is an important aspect of the follow-up of pregnancies at risk for GHD. Most of the mothers who were followed-up by RM during their last pregnancy thought that it was acceptable to be contacted within 3–12 hours after an abnormal value, and they preferred to be contacted by telephone. The majority of women had no concerns about regularly sharing their clinical data with their gynaecologist, and they reported that RM gave them a feeling of security throughout their pregnancy. To our knowledge, this is the first quantitative survey of mothers, midwives, and obstetricians involved in an RM program in prenatal care. Further studies are needed to understand the underlying opinions of mothers, midwives, and obstetricians to RM. Based on our findings, we propose developing a care system with 24/7 surveillance by RM for mothers at high risk of GHD.
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