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

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Submitted to: Journal of Medical Internet Research
on: April 26, 2018

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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.

Objective: 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, 35/52 (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.

(JMIR Preprints 26/04/2018:10887) DOI: https://doi.org/10.2196/preprints.10887

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Original Manuscript

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

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Keywords: remote monitoring, gestational hypertensive diseases, questionnaires

ABSTRACT

Background

The Pregnancy Remote Monitoring (PREMOM) study enrolled pregnant women at increased risk of developing hypertensive disorders of pregnancy (HDP) and investigated the effect of remote monitoring (RM) additional to their prenatal follow-up. In this study, we will investigate the perceptions and experiences of mothers, midwives, and obstetricians who participated in the PREMOM study.

Methods

Specific questionnaires for the mothers, midwives and obstetricians were developed, handling five domains: (1) prior knowledge and experience of RM; (2) reactions to abnormal values; (3) privacy; (4) quality and patient safety; and (5) 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. The mothers, midwives, and obstetricians reported positive experiences and perceptions of RM, although most of them had no or little prior experience with this technology. They support a further roll-out of RM in Belgium. Nearly three-quarters of the mothers (34/47, 72%) did not report any problems with taking the measurements at the required times. Almost half of the mothers (19/47, 40%) wanted to be contacted within 3–12 hours after abnormal measurement values, preferably by telephone.

Conclusions

Although the majority of midwives and obstetricians had no or very little experience with RM before enrolling in the PREMOM study, they reported, based on their one year experience, 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 technology, the healthcare sector is confronted with major challenges and great opportunities. The care and follow-up of a pregnant woman and (unborn) baby is an important element in healthcare. Due to the changing lifestyles of pregnant women, the number of high-risk pregnancies is elevated over the last few decades [1-3]. Therefore, there is a need to increase the efficiency of follow-up for these pregnancies without loss of quality of care. Telemedicine represents an opportunity for the follow-up of high risk pregnancies.

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 of vital parameters, or asynchronously, whereby data obtained in the patient's home environment are sent to the caregiver [4]. Examples of chronic diseases, which could benefit from RM, are (among others) diabetes, heart failure, and cardiac arrhythmias [6-8]. The Pregnancy Remote Monitoring (PREMOM) study, which started in January 2015 in a tertiary center Ziekenhuis Oost-Limburg (Genk, Belgium), involved RM of pregnant women at high risk of hypertensive disorders of pregnancy (HDP). The PREMOM study design, data collection method and first promising results are described in detail elsewhere [9, 10]. Briefly, the PREMOM study was performed in the outpatient clinic of a 2nd level prenatal center where pregnant women with HDP received RM or conventional care (CC). Women in the RM group received obstetric surveillance using a BP monitor, an activity tracker and a weight scale. They were asked to measure blood pressure twice a day, measure their weight once a week, 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 was developed by the Mobile Health Unit (UHasselt), and a midwife reviewed the parameters every workday. The activity data were tracked to investigate the influence of the daily activity (e.g. total amount of steps/day) on the development of HDP. Predetermined thresholds (systolic blood pressure > 140 mm Hg, diastolic blood pressure > 90 mm Hg or weight gain > 1 kg/day) were configured and resulted in automatically generated alarm signals.

The midwife discussed the alarm events with the obstetrician in charge to discuss the appropriate medical treatment. The midwife contacted the patients to give additional instructions about possible medical interventions like altered medication schemes. These therapeutic interventions were according to local management. Because no research has been done to investigate the perceptions or expectations of a prenatal RM follow-up program, we performed a quantitative survey on recently delivered women and caregivers (which are both the obstetricians and the midwives). Here, we describe the main outcomes, which cover 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 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 items to elucidate the perceptions and experiences of the participants in PREMOM towards 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) financial aspects 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. The questionnaires were drafted in April 2016 using Survey Monkey (Survey Monkey, 2016), and could 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 and obstetricians 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 was different from the total number of analyzed questionnaires because some mothers, midwives, and obstetricians did not complete all of the questions. At least half of the questionnaire had to be completed before the questionnaire was included in the analysis. Statistical analysis was performed with Statistical Package for Social Sciences release 24.0 (IBM SPSS Inc).

Ethical considerations

A generic link to maintain anonymity was sent to the participants to fill in the survey. A bulk e-mail was sent with the subjects' e-mail addresses included as a BCC to ensure there were no recognizable personal elements in the e-mail.

The e-mail was addressed with 'Dear Madam', or 'Dear Colleague', to remove the personal salutation to participate in this study. In addition, no personal ID of the participants was asked or electronically reported when completing the questionnaires. Unique IP addresses prevented duplicate responses to the questionnaires. The Medical Ethics Committee of Ziekenhuis Oost-Limburg approved this study (nr. 14/078U).

Results

The study population consisted out of 158 people: 92 mothers (58 %), 52 midwives (33%), and 14 obstetricians (9%). The total number of involved pregnant women in the PREMOM study n = 119, so 77% (92/119) of the participants were contacted after their delivery. The missing 27 women didn't answer their phone, didn't have an e-mail address or there was a language barrier. One obstetrician was excluded from final analyses because less than 50% of the questionnaire was completed. Therefore, the total response rate was 58%. An overview of the questions to the midwives, obstetricians and recently delivered mothers, and their answers, are submitted in Appendix 1. The demographics of the participants are listed in Table 1.

Table 1: Characteristics of participants

Characteristics of women who have involved with RM during their last pregnancy (n = 47)	**Response categories**	**Results**	
		N	**%**
Age	< 20 year	0	0
	20 – 25 years	5	10.64
	26 – 30 years	16	34.04
	31 – 35 years	21	44.68
	36 – 40 years	4	8.51
	> 40 year	1	2.13
Primigravidity	Primipara	21	44.68
	Multipara	26	55.32
History of hypertensive disorders of pregnancy	Yes	17	36.17
	No	10	21.28
	N/A	20	42.55
Level of education	Lower secondary school	4	8.51
	Higher secondary school	12	25.53
	High school	20	42.55
	University	11	23.40
Characteristics of the midwives (n = 35)	**Response categories**	**Results**	
		N	**%**
Age	20 – 25 years	3	8.57
	26 – 30 years	8	22.86
	31 – 35 years	7	20.00
	36 – 40 years	3	8.57
	> 40 year	14	40.00
Years of experience	< 5 year	4	11.43
	5 – 15 years	15	42.86
	16 – 25 years	8	22.86

	> 25 year	8	22.86
Main activity on nurse unit	Delivery unit	11	31.43
	Maternity	8	22.86
	Maternal Intensive Care	10	28.57
	Prenatal visits	6	17.14
Characteristics of the obstetricians (n = 9)	**Response categories**	**Results**	
		N	**%**
Years of experience	< 5 year	1	11.11
	5 – 15 years	6	66.66
	16 – 25 years	0	0.00
	> 25 year	2	22.22
Main activity on their specialism	Delivery unit	4	44.44
	Obstetrician	4	44.44
	Oncology	1	11.11

Table 1: Characteristics of respondents

RM = remote monitoring; N/A = not applicable

Prior knowledge and experience of RM

The first part of the questionnaire examined the midwife's and obstetrician's prior knowledge or experience of RM. Overall, 29/35 midwives (83%) and 7/9 (78%) obstetricians reported little or no experience of RM (Figure 1).

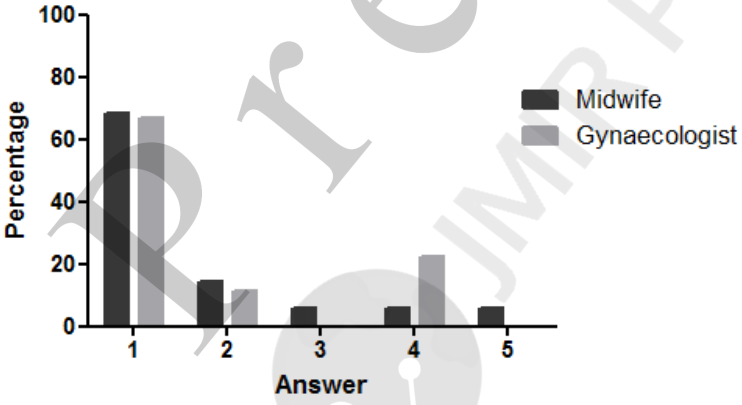

Figure 1: Summary of responses from the midwives and obstetricians on the question 'Please indicate with a score from 1 (strongly disagree) to 5 (strongly agree): I had already experience with RM before this study.'

The midwives were also asked about their experience of RM as a threat to their daily work. The majority (29/35, 83%) of midwives 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%) of the participating mothers reported that they had no

problems with performing the measurements at the requested times. Of the 7 mothers (14.89%) who reported difficulties with the recommended measurements, 4 (57%) were 36–40 years old, 2 (29%) between 26-30 years and 1 (14%) 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 (28%) preferred to be contacted within 3 hours of the event, 19 (40%) agreed to be contacted between 3–12 hours, and 15 (32%) complied with being contacted > 12 hours after the event (Figure 2).

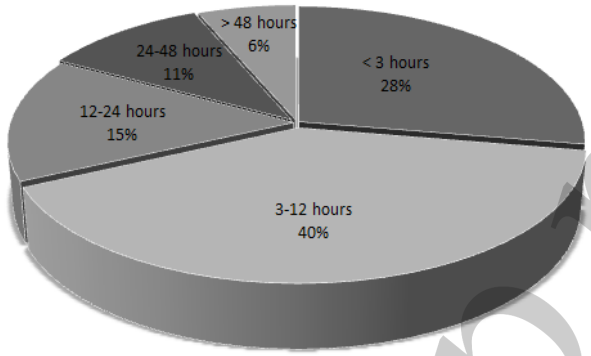

Figure 1: Summary of responses to the question 'Within how much time do you want to be contacted about events?'

Interestingly, 4/5 mothers (80%) aged < 25 years asked to be contacted within 3 hours of an event. The participants were also asked how to be contacted following an event. The participants' first preference was to be contacted by telephone (weighted average 4.55/5), second preference was during a prenatal consultation (weighted average 3.94/5) and the third preference was contacted by using text messages (weighted average 3.17/5). Finally we asked the participants who should contact the women in case of an event. The mothers and midwives stated that the obstetrician 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%) of the mothers reported that they did not have any negative concerns about privacy. Three mothers (aged 36-40 years) reported sharing health data as a threat to their privacy.

Quality and patient safety

The mothers were asked about the importance of RM in the follow-up of their pregnancy. Most (42/47, 89 %) of the mothers had a positive response to this question. Meanwhile, 28/35 (80%) midwives reported that RM provided added value to pregnant women and 27/35 (77%) midwives felt that RM improved the care for high risk pregnancies . This percentage is slightly higher than that of obstetricians; 6/9 (67%) of whom felt that RM provided added value to their patients (Figure 3).

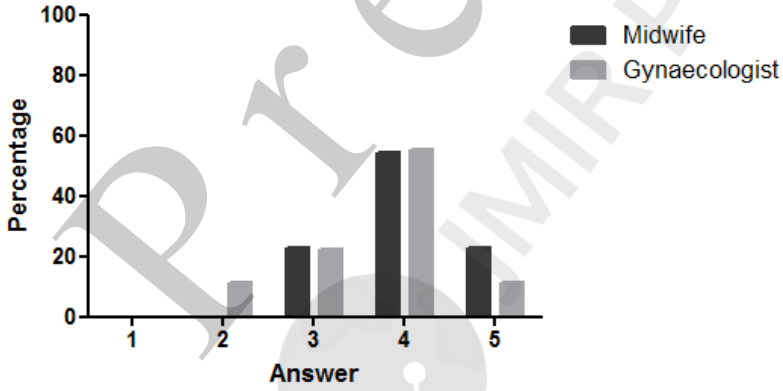

Figure 2: Summary of responses from the midwives and obstetricians to the question "Do you believe that RM improves the care for pregnant women with an increased risk of gestational complications? Please indicate with a score from 1 (strongly disagree) to 5 (strongly agree).

Moreover, 8/9 (89%) obstetricians responded, based on their experience of the PREMOM study, that the pregnant women did not request additional prenatal consultations for the purpose of viewing their own vital parameters. Finally, 39/47 (83%) mothers reported that

RM gave them a feeling of safety.

Financial aspect

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 for free, so no personal contribution by the patiënt (25/47, 53%). 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 also personally 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, 89%) felt that it is important to receive additional training on “the information that must be given to pregnant women about HDP and the added value of RM for this disease”. Obstetricians (7/9, 78%) considered this 11% less necessary compared to the midwives. The obstetricians (8/9, 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%) 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 (67%) obstetricians supported this service and would recommend it to their patients while 7/9 (78%) obstetricians would recommend RM to their colleagues. Finally, 6/9 (67%) obstetricians recommended that this follow-up should be expanded to all pregnant women in Belgium who are at increased risk of HDP.

Discussion

Principal findings

RM is a relatively new field in the obstetrical research. Earlier studies of TM which included cervical dilatation/preterm labor as the main outcome, demonstrated that transmitting uterine activity by telecommunication resulted in significantly prolonged pregnancy survivals [11, 12]. Articles of TM for GDM demonstrated lower levels of frustration and concerns about their diabetes, and a better acceptance of their diabetic condition [13], elated feelings of self-efficacy [14] and a reduction in (unscheduled) face-to-face visits [15, 16] in the TM group compared with the control group. On top, a cost reduction [17, 18] and elevated feelings of maternal satisfaction [14, 19, 20] were obtained when TM was used in obstetrical care. The newborns had a higher gestational age at delivery [18] and were less likely to have a low birth weight [11, 18] or to be admitted to the Neontal Intensive Care Unit (NICU) [11, 18] when the TM group was compared with a control group. Fetuses with abnormal versus normal fetal heart rate at home monitoring were more likely to have an earlier gestational age [21]. Recent studies about RM in women at risk for HDP demonstrated that those women did have less inductions, more spontaneous labors, and less maternal and neonatal hospitalizations when compared with conventional care [9, 10]. Also, a cost-effective effect for the healthcare system was shown on women at risk for HDP who received RM [22]. 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 supervised 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 study of Giardina et al. showed the duality of feedback after an (abnormal) test. Nearly two-thirds of clinicians agreed that patients should receive direct feedback after a normal test. However, the majority of physicians expressed concerns about direct notification of clinically abnormal test results based on patient's anxiety, confusion, lack of expertise to interpret the results, seeking of unreliable information to understand the results, and concerns that the patient would seek care without consulting their provider. The results of the study showed that doctors would be comfortable with a time interval of 24-48h for contacting a patient after an abnormal test result [23].

'Privacy' is a critical aspect of healthcare and RM [24]. The mothers did not have concerns about sharing their health data with their obstetrician. As mentioned by Piwek et al. [25] data security and patients' privacy are essential elements for the adoption of digital smartphone research methods. 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 during this study.

The quality of care experienced by pregnant women with (increased risk of) HDP was enhanced by RM, as reported by the surveyed mothers and caregivers, and supported by the results of the prior pilot study [26]. Mothers who were involved in the project reported that RM gave them a feeling of security throughout their pregnancy. 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 [14, 27]. Meanwhile, other research showed that pregnant women had heightened feelings of maternal satisfaction when using RM as additional care with their labor induction [28, 29].

The mothers, midwives, and obstetricians included in this study reported that RM is an important aspect of the follow-up of (high risk) pregnancies. An issue that raises important questions in telemedicine is the rather low adherence rate to remote monitoring, especially

during long-term monitoring [30-33]

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. However, the mothers surveyed in this study did not experience this obstacle.

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. Earlier research already mentioned the challenging in terms of training these obstetricians and midwives in the collection and interpretation of results, as wel as incorporation of the remote patient data into routine clinical practice [34].

Strengths and limitations of the study

Despite the increased implementation of RM in healthcare, its use is still limited in obstetrics. To our knowledge, this 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 HDP. Another strength of this study is that it included stakeholders involved in the use of RM, including caregivers and actual users. The questionnaires also allowed the participants to explain their responses to each question, allowing us to obtain supplementary information. Furthermore, the participants could complete the questionnaire anonymously. Finally, a relatively high percentage of participants in the PREMOM study completed the questionnaires.

Although the results of this study are encouraging, there are several limitations that should be considered for future research. First, because the questionnaire was completed anonymously,

it was not possible to contact the individual participants to request additional information. Second, the questionnaire was digital and completed in an uncontrolled condition, so 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 can reduce the generalization of the results. Finally, the study included obstetricians who worked at several hospitals in Limburg, but the midwives and mothers were enrolled only from a single center (Ziekenhuis Oost-Limburg).

Recommendations for further research

Both the mothers and the midwives felt that the obstetrician 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 organization 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 woman 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 logic, as they act as an intermediary between the pregnant woman and the obstetrician. Clearly, further research is needed to understand the factors underlying this opinion and how it could be changed.

Additionally, both the mothers as 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 [22], a willingness to pay study is not performed yet. This study 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 would not recommend it did not 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 for HDP.

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. Therefore, we recommend developing a system of care aimed at providing these services. As been shown in our previous studies, the prenatal ward will be less burdened by women with HDP due to our RM prenatal follow-up [10, 26]. Finally, although the mothers with abnormal events were invited to additional prenatal consultations to assess the fetal and maternal well-being, 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 many medical interventions are performed in pregnancies, which has arisen from a variety of sources [35-40].

Conclusions

Although most midwives and obstetricians had no or very little experience with 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 HDP. Most of the mothers who were supervised 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 obstetrician, 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 HDP.

Acknowledgements

This study is part of the Limburg Clinical Research Program (LCRP) UHasselt-ZOL-Jessa, supported by the foundation Limburg Sterk Merk, province of Limburg, Flemish government, Hasselt University, Ziekenhuis Oost-Limburg and Jessa Hospital.

Sources of funding

No specific funding was provided for the publication of this study.

Conflict(s) of interest/disclosure(s) statement: none

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