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Title

Women's experiences of an innovative care pathway using a smart phone application to identify signs of pre-eclampsia and/or worsening blood pressure

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Abstract

Aim

To explore in depth, the experiences of pregnant women with a history of hypertension using an innovative home blood pressure service to monitor for signs of pre-eclampsia and/or worsening blood pressure.

Objectives

1. To assess participants' acceptability of home blood pressure monitoring and a reduced hospital appointment schedule.
2. To explore patient satisfaction and examine the impact a new service has on women.

Design

A qualitative study using a grounded theory approach was undertaken. Data was collected through semi-structured interviews. Data collection and data analysis was completed simultaneously using theoretical sampling and the constant comparison method.

Intervention

Women who had a diagnosed hypertensive disorder of pregnancy were given a blood pressure machine to take home and monitor their blood pressure daily. They inserted their blood pressure results on a downloadable smart phone application and answered trigger questions for signs of pre-eclampsia. Participants were followed up every 2 weeks in an antenatal hypertension clinic.

Findings

The findings produced a substantive theory that women are in pursuit of a holistic care pathway for the management of hypertension in pregnancy. A core category

and three subcategories were identified. The core category was holistic care and the subcategories were; (1) empowerment, (2) comparison of care pathways and (3) continuity of care.

Key conclusions

The traditional management of hypertension in pregnancy is not a holistic approach. The innovative home blood pressure service is accepted by women and incorporates elements of holistic care but more improvement is required to meet the standard of holistic care that women desire.

Introduction

Hypertensive disorders of pregnancy (HDP) are classified as gestational hypertension (GH), pre-existing or chronic hypertension and pre-eclampsia (PE). HDP complicate 10% of pregnancies and the incidence of PE is 2-8% (Stegers *et al.*, 2013). PE is associated with adverse maternal and fetal outcomes such as eclampsia, stroke, renal and hepatic dysfunction, intrauterine growth restriction, premature birth and stillbirth (Townsend, O'Brien and Khalil, 2015). The resources required for the monitoring of developing PE have significant cost implications (Stevens, *et al.*, 2017). However, the majority of women do not actually develop PE.

Traditionally, in the United Kingdom (UK), women attend as per NICE (2008) recommendations for their scheduled antenatal visits. If they show signs of HDP or have risk factors for developing HDP they will have extra scheduled antenatal visits to monitor for the development of PE. These extra antenatal visits could be with their general practitioner (GP), midwife or a healthcare professional from a day assessment unit and the structure of care varies from hospital to hospital. Despite this increased surveillance of blood pressure (BP), PE can manifest between antenatal visits, and therefore, the diagnosis is delayed until the next scheduled antenatal check (Waugh *et al.*, 2001). Therefore, the traditional pathway fails to capture women who may have developed PE until it is at an advanced stage. Furthermore, it appears that some women purchase their own BP machine to monitor for the progression of PE with or without the support of a healthcare professional (Lo *et al.*, 2002). The literature claims that 30% of patients in the UK and up to 60% of patients internationally monitor their own BP without the guidance of a practitioner (Grant *et al.*, 2011; McManus *et al.*, 2014). These figures highlight the need for further research of home blood pressure monitoring (HBPM) in the pregnant population to meet the expectations of women and maintain safety standards in antenatal care.

A teaching hospital in London piloted an innovative care pathway for pregnant women at risk of developing PE with the implementation of HBPM and a smart phone application (app). The advantages of HBPM in the management of hypertension are well documented (Stergiou *et al.*, 2004; Reims, Kjeldsen and Mancia, 2005; Parati *et al.*, 2010). Such advantages include (1) identification of white coat hypertension (2) an option to take multiple readings over time (3) reduced hospital appointments (4) improved BP control and (5) detecting deteriorating BP between scheduled hospital appointments. Women were given a validated Microlife® BP monitor (Stergiou *et al.*, 2007) on loan and they were trained on how to use the machine accurately by a specialist hypertension midwife. There was also a training video on the app that women could refer to a later date demonstrating how to measure BP accurately. They were instructed to monitor their BP approximately once a day depending on the severity of their hypertension. Users were required to insert their BP results into a downloadable mobile app and answer trigger questions for symptoms of PE (e.g., do you have headache?). If the user inserted any abnormal BP ranges (≥ 150 mmHg systolic or ≥ 100 mmHg diastolic) or answered yes to the trigger questions (i.e., headaches, visual disturbances or upper abdominal pain), a red message was flagged to the user's mobile screen, advising the user their results were out of normal range and to contact their midwife or hospital. These women had a reduced appointment schedule compared to the traditional schedule for someone at risk of PE (NICE, 2008) and were followed up approximately every two weeks in the midwife-led hypertension clinic. This care pathway provided continuity of care to women unlike the traditional pathway where it is common for women to see a different practitioner at each visit.

The main aim of this research was to explore women's experiences of using an innovative HBPM service. The secondary objectives were to assess patient satisfaction and acceptability of HBPM and a reduced hospital schedule.

Methods

This qualitative study used a grounded theory (GT) approach by Strauss and Corbin (1990). Grounded theory is indicated when there is little known about a topic and the aim of the study is a generated theory with explanatory power (Birks and Mills, 2011). This approach was indicated as most appropriate as there is a significant gap in the literature related to women's experiences of HBPM in pregnancy.

As a midwife, the researcher is interested in listening to women's stories to influence future practice. By listening to women, the researcher can delve into their world or reality and get to know and understand what women want. This interaction allows the researcher to interpret women's experiences and provide powerful information that can enhance patient satisfaction and quality of care. The researcher is therefore aligned to the interpretivist paradigm, meaning that the researcher sees reality as an interpretation of human understanding (Fossey *et al*, 2002). The GT approach by Strauss and Corbin (1990) is influenced by symbolic interactionism which means it is focused on interpreting human actions or experiences (Blumer, 1969).

Grounded theory goes beyond basic description and the end product is a rich interpretation of the data provided by the researcher from following a systematic grounded theory methodology (Denscombe, 2014). The aim of GT is to produce a substantive or formal theory (Glaser, 2007).

Setting

Women were recruited from an antenatal hypertension clinic in a London teaching hospital. In addition to the hypertension clinic, there is a day assessment unit (DAU) where women can be referred by their community midwife or GP for hypertension.

Participants

Women who had a HDP were recruited through purposive sampling. The sample size is unknown to the researcher at the beginning of GT research as the numbers required are dependent on data or theoretical saturation, when there are no new themes emerging (Charmaz, 2006). The researcher sent postal invitations with a patient information leaflet to 48 women who met the inclusion criteria. Seventeen women responded with eleven agreeing to participate and six who declined to participate. A total of eight women were interviewed as theoretical saturation was achieved with no new data emerging. The remaining three women were contacted by the researcher explaining that they were no longer needed and thanked them for their time and consideration. Six interviews took place in the participants' homes and two interviews took place at the maternity hospital as per the participants' request.

Data Collection

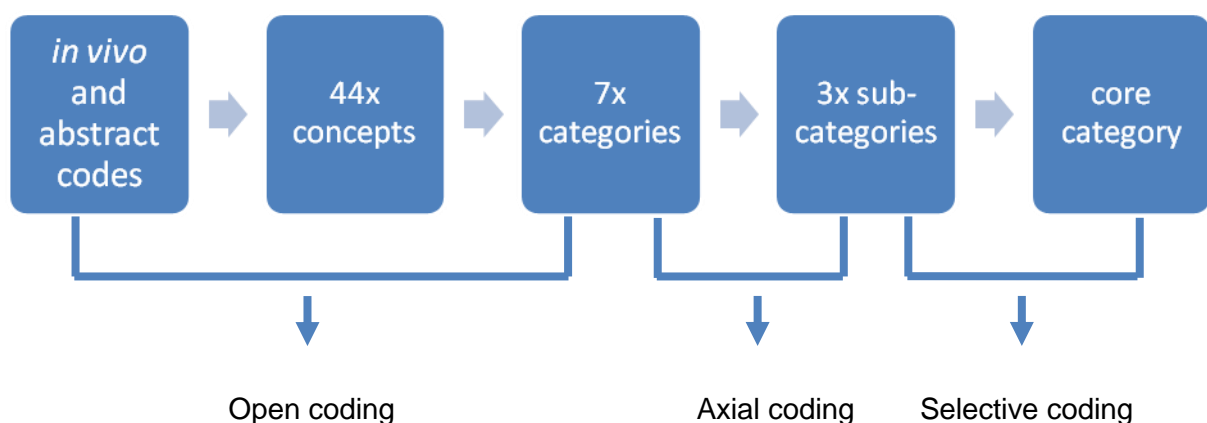
Ethics approval was granted by the East of Scotland research ethics service. Approval was sought from the NHS hospital management and risk team as the study included NHS patients.

The main method of data collection was via semi-structured interviews using mainly open ended questions to allow maximum description of experiences and explanation from the participants. Semi-structured interviews are most recommended in GT (De Chesnay, 2015; Stern and Porr, 2011), as structured questions would fail to capture the natural emergence of data and unstructured questions could be confusing for a novice researcher who may not have the experience to direct the interview appropriately to gather rich data. The researcher transcribed all interviews verbatim.

Data Analysis

The first interview was analysed for concepts or emerging ideas and was compared with the other interviews by using the constant comparison method. The constant comparison method is unique to GT research, whereby data is continuously analysed and compared to previous data analysis for similarities or differences throughout the data collection and analysis process (Strauss and Corbin, 1990). Memos were created after each interview to facilitate emerging concepts and used as data. All data was analysed by a process of coding by Strauss and Corbin (1990) including open, axial and selective coding (see Figure 1, 'coding process'). At the end of open coding where the data is analysed line by line, the researcher was left with seven categories that needed to be analysed further by axial coding (Flick, 2009). This is where the researcher looks at the codes and categories from a different perspective or 'turns them on their axes' (Olshanksy, 2015) looking for different meanings. In this study, the researcher went back to the raw data again and compared the codes with the seven categories using coloured ink pens to match up the data. Selective coding is the process of refining the theory even further by selecting a core category (Strauss and Corbin, 1990). The core category was selected by identifying what most represented what the participants were saying in their interviews. The subcategories were chosen to demonstrate key topics or themes that best answered the research question. The researcher's academic supervisor also analysed the data independently and discovered similar findings.

Figure 1 Coding process



Findings

Eight women in total were interviewed. Participants completed at least eight weeks of HBPM using the innovative care pathway. All participants were aged between 30 and 41 years. See Table 1 'Participant Demographics':

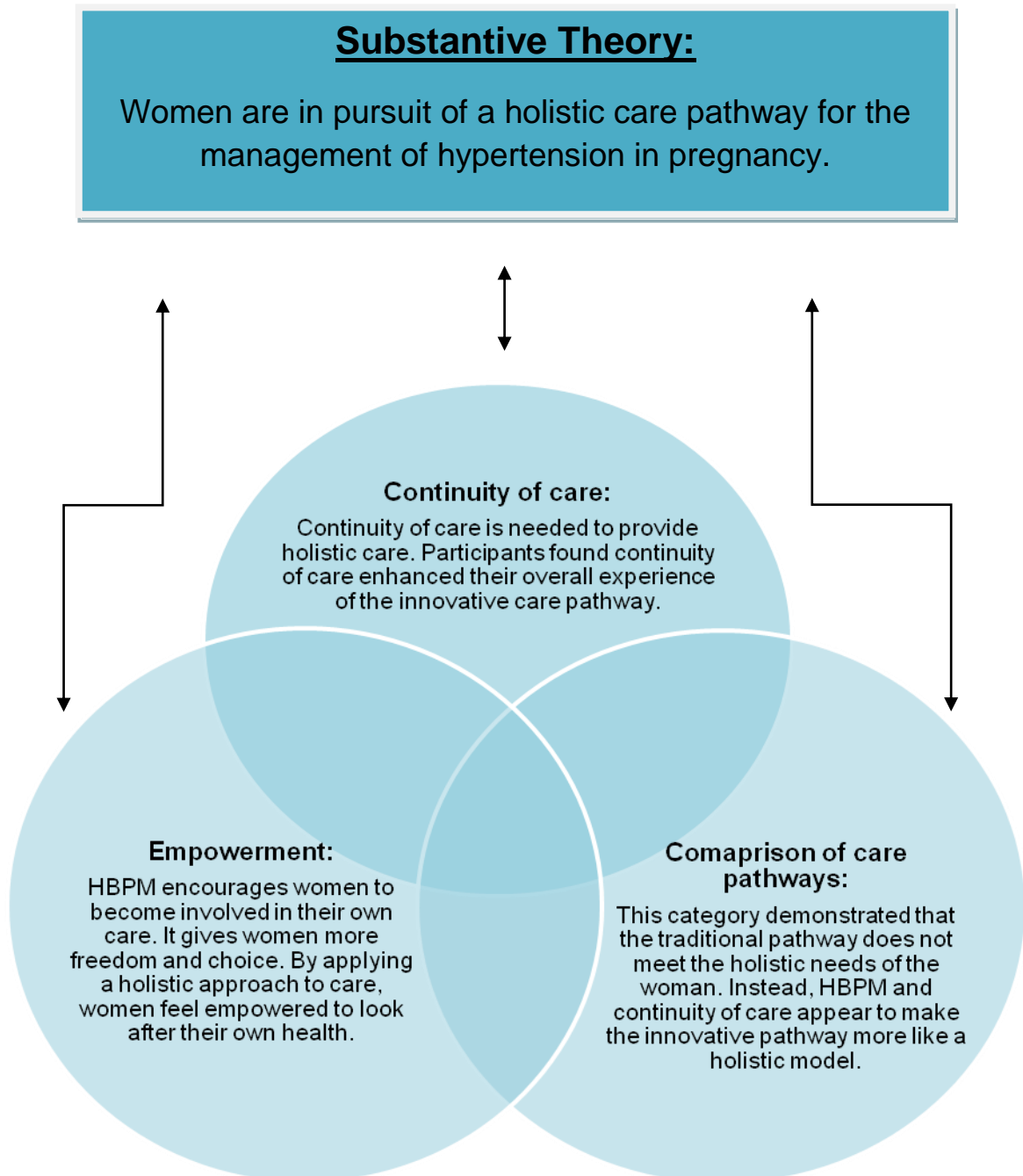
Table 1 Participant Demographics

Participant ID	Age	Ethnicity	Parity	Diagnosis
#1	37	Caucasian	0	Chronic Hypertension
#2	38	Caucasian	0	White coat hypertension
#3	35	Asian	1	Previous severe PE
#4	34	Caucasian	0	Gestational hypertension
#5	30	Black	1	Chronic hypertension
#6	41	Caucasian	2	White coat hypertension
#7	32	Caucasian	0	Gestational hypertension
#8	36	Caucasian	1	Previous HELLP syndrome

The core category was identified as 'holistic care' with empowerment, comparison of care pathways and continuity of care emerging as the subcategories. Holistic care was identified as having the most explanatory power for the subcategories, whilst the subcategories reflected what the women focused on when sharing their experiences of an innovative care pathway. The substantive theory was interpreted by the researcher as 'women are in pursuit of a holistic care package for the management of hypertension in pregnancy' (see Figure 2,

'relationship between subcategories and substantive theory'). This emergent theory formed the foundation of the core category, 'holistic care'.

Figure 2 Relationship between subcategories and substantive theory



Core Category: Holistic Care

The researcher interpreted from the participants' interviews that women are in pursuit of a holistic care pathway for the management of their hypertension. Although participants described mainly positive experiences with the innovative care pathway, they also highlighted what could be improved. For example, some participants described inadequate postnatal care. They would have liked to continue seeing the same midwife or team during the postnatal period.

The prenatal care was much better than the postnatal care for lots of different reasons...I do think there is a cut off...I think it would be nice to close the loop.

(Participant #7)

Holistic care would mean providing care into the postnatal period for these women.

They put all that money into seeing me during pregnancy to make sure I got to that point ok and I'm very happy, but we had a really tricky start...I would have liked to have gone back and seen the same team.

(Participant #1)

It appears patient satisfaction could have been improved if this participant received continuity of care in the postnatal period. The researcher interpreted that a holistic care pathway could address this concern.

One participant explained how the innovative pathway was tailored to her individual needs.

I felt like I was looked after holistically and I was seen as an individual... especially when I came in, I was always given a chance to allow my BP to calm down and recheck it or even check it at home as well.

(Participant #7)

By creating a care plan that reflects what women want will not only increase patient satisfaction but will empower women to become actively involved in their care.

Empowerment

Empowerment emerged as a subcategory to reflect how the HBPM pathway made women feel. It was evident from the data that women want to be involved in their own care and they want to see and know what their BP measurement is. The HBPM pathway demonstrated it's ability to reassure women about their BP and alleviate their anxieties.

I felt happier knowing that I checked it everyday...For me actually knowing what it (BP) is, was such peace of mind...I could rationalise it and think it's alright, there isn't actually a problem here... so yeah it helped me hugely.

(Participant #2)

Women felt that HBPM gave them some control over their care, reflecting their willingness to be involved in their hypertension management.

It didn't make me feel nervous, if anything it made me feel in control of my own health and knowing what was low and high and what to do and that could be any day or time that you like.

(Participant #7)

All participants referred to self-awareness of their hypertension or knowledge they had acquired from HBPM. The researcher interpreted that this knowledge women spoke of is what empowered them to become involved in their own care. This empowerment explained how and why women are in a position to take on an active role in managing their hypertension. It is important for healthcare professionals to acknowledge these abilities and

encourage women to feel empowered to enhance patient experience. In doing so, women will feel like their holistic needs are being met and thus increase patient satisfaction.

Comparison of Care Pathways: HBPM model versus traditional model

The researcher did not intend to compare the innovative care pathway with the traditional care pathway for the management of hypertension. However, this subcategory emerged purely from the raw data itself. Although the participants completed the innovative care pathway, some women recalled their previous experiences with other pregnancies when they were under the traditional pathway. Likewise, the participants in their first pregnancy recalled experiences in early pregnancy before they were referred to the innovative care pathway, where they experienced the traditional model of care.

Participants described their experiences with the traditional model and compared their experiences with the innovative model:

There was no place for them to take us, so I remember being sat in this corridor while they took my BP... and telling them I don't think having it (BP) read in this busy corridor full of lots of people, some of them very stressed... I don't think this is the most appropriate place to be taking my BP and won't give a clear reading anyway.

(Participant #2)

Soon after this experience the patient was referred to the innovative care pathway where she was allowed to monitor her BP at home and have follow up in the specialist hypertension clinic instead with a continuity of carer. The same participant reported on the HBPM pathway:

I was so so grateful for the (hypertension) clinic existing and having that option (HBPM)... I mean this isn't over the top but I think it really made a huge difference to my whole experience of pregnancy and being pregnant.

(Participant #2)

It is evident how the switch from the traditional care model to a holistic approach enhanced this participant's experience.

Similarly, another participant was advised to have weekly BP checks with her GP between routine hospital appointments before she was started on the innovative HBPM pathway. The GP was unable to accommodate the patient and advised a walk in centre.

"It (HBPM) did make a difference because prior to the HBPM... my GP sent me for a walk in once and I had to wait like 2 or 3 hours and that was just stressful because I was pregnant and there was coughing and sick people everywhere and it was just horrible... it was stressful before I got the app... it absolutely made a difference"

(Participant #4)

The accounts of women's experiences prior to HBPM demonstrate fragmented care with no one taking responsibility or taking the woman's needs into consideration.

Continuity of Care

The topic 'continuity of care' had a strong presence in the data. The innovative care pathway meant women had continuity of care with one midwife during their pregnancy. However, once they gave birth their postnatal care was under the traditional shared care model between community midwives and their GP. It appeared continuity of care is what women valued the most from being under the innovative care pathway:

What I found fantastic which was really key to me was the continuity of care with seeing the same two midwives in my case was excellent and I felt like I was in good hands... if anything were to go wrong at least there will be qualified people to help me and that just made all the difference.

(Participant #8)

...when you're pregnant, it's a weird vulnerable state, there's a massive change in your life and in your body... and just being able to see the same person, you build up a kind of relationship and they know your situation and they know you, and they don't have to read over your notes... it was really nice.

(Participant #2)

It is also evident in the literature that continuity of care is something women want regardless of having a history of hypertension (Homer, *et al.*, 2002).

Some participants felt more strongly than others about continuity of care for managing their hypertension and for postnatal care also.

...when you're out of hospital there didn't seem to be a clear BP postnatal sort of system...you're high risk and have all these complicated stuff going on, my team know what's going on and what's been happening and then it feels like you can't really access that stuff again so that continuity seems a bit pointless...

(Participant #1)

This participant is evidently frustrated with the postnatal approach to managing her hypertension. A holistic approach would have addressed this woman's concerns by providing access to continuity of care into the postnatal period.

Discussion

The researcher's interpretation of the raw data found that women want a holistic approach to the management of their hypertension. Some participants reported that their postnatal care was inadequate and they suggested how having continuity of care in the postnatal period

could address this. In contrast, other participants reported they did in fact feel like they were looked after holistically. HBPM was identified as a factor in yielding holistic care as it addressed the needs of women with WCH. HBPM allows WCH to be identified and managed appropriately by avoiding long waiting times in a day assessment unit. HBPM also provides reassurance to women with hypertension that their BP is within target or alternatively, it is not within target and advises them to contact their hospital. It addresses uncertainty and anxiety that women may have if under the traditional pathway, whilst waiting between scheduled antenatal appointments to know their BP reading.

When interpreting women's experiences of the service, all data linked back to holistic care. There were certain aspects of the service women liked such as tailored individualised care plans specific to their hypertension diagnosis. In contrast, there were other aspects that women did not like, such as lack of continuity of care in the postnatal period. It is thus evident, that the innovative care pathway possesses some traits of holistic care but is lacking in others. However, this study has highlighted that where it is lacking can feasibly be addressed. Healthcare providers are therefore encouraged to listen to service users and aim to provide a holistic care package that addresses the needs of women for the future management of hypertension in pregnancy.

Empowerment

The researcher found that the innovative care pathway empowered women to become involved in their own care. Women reported feeling confident in managing their own health at home. Women explained that this confidence was linked to self-awareness or knowing themselves best. Participants demonstrated a willingness to be involved in their care and were content to do so. This fits with the findings of the Fletcher *et al.*, (2015) study that patients felt empowered to manage their BP and showed that these patients were less likely to attend their GP for management of their hypertension. Similarly, in this current study, the participants were also content in having reduced hospital follow up appointments. However, Fletcher *et al* (2015) reported that both patients and clinicians felt uncomfortable in

interpreting BP results. This was not suggested in the current findings and was plausibly down to a smaller sample, continuity of care and a holistic approach. Continuity of care limits multiple clinicians caring for patients and therefore less opinions and different interpretation of results. A holistic approach in this study ensured that women were informed of their target BP and the app triggered an alert if their BP did not meet this target. Furthermore, women were assessed on their understanding of how to check their BP and what to do on discovering a high reading before they were allowed to participate in the innovative pathway.

Comparison of Pathways

Participants shared their experiences of both the innovative and traditional care pathways. It was evident that all participants were strongly in favour of the innovative care pathway. Women associated the traditional pathway with long waiting times, multiple carers and sub-optimal management of hypertension. Women were keen to stay out of hospital and manage their hypertension as an outpatient for these reasons. This is similar to findings in the literature where the majority of participants had preference to outpatient management of their hypertension instead of frequent hospital follow up appointments. Ross-McGill *et al.* (2000) found that most women accept HBPM and tend to prefer a reduced appointment schedule with HBPM in future pregnancies. In fact, studies found in the literature for the non-pregnant population investigating acceptability of HBPM, have found that majority of participants prefer reduced schedules and HBPM (Ganapathy, Grewal and Castleman, 2016; Lan, Hyett and Gillin, 2017). Although it is speculative, it is worth noting that in research, women have a choice to participate and thus, acceptability of HBPM in these studies does not reflect the opinion of women who chose not to participate. However, with advances in technology and the majority of women of childbearing age owning a smart phone, it is no surprise that women are accepting of this innovative service and technology. It is an era that is powerfully influenced by technology and perhaps now is the time to take advantage of this opportunity and start transforming traditional pathways no longer fit for purpose to innovative pathways that meet the holistic needs of women.

Continuity of Care

Continuity of care is very important to women and it appears to be the primary cause of patient satisfaction with the service. Although this was an unexpected finding, it is equally not surprising as women's preference for continuity of care is well documented in the literature (Homer *et al.*, 2002; Roberts, Davis and Homer, 2017). Women found that continuity of care in the antenatal period was the key to their overall satisfaction and experience of the innovative model. However, some women also felt it lacked continuity of care in the postnatal period highlighting women's pursuit of a holistic care pathway. This is keeping in line with findings from Roberts, Davis and Homer's (2017) study which found that continuity of care positively influenced their experience. They recommend that women with high risk pregnancies such as hypertension should be cared for through a multi-disciplinary, continuity of care model. This is similar to the model of care provided to women in this study. Furthermore, this study demonstrates that such a model of care can be realistically achieved.

Relevance to practice

This study has identified inconsistencies with the traditional management of hypertension in pregnancy. It is the role of the midwife to provide holistic care for the women in their care (Nursing and Midwifery Council, 2015). Midwives cannot fulfil this task under the current guidance of the traditional care model as it is not reflective of holistic care. Women are in pursuit of a holistic care pathway that will meet their physical, emotional, social, economic and spiritual needs. The findings from this study provide an evidence base to transform the traditional model to a holistic model. The findings from this study could feasibly be utilised to improve the provision of care for women with hypertension by implementing continuity of care into the postnatal period. Furthermore, these findings will support the proposal to implement HBPM into local hospital guidelines for the management of hypertension in pregnancy.

Limitations

This was a small single centre study. The approach to the management of hypertension in pregnancy will be different to some extent in each hospital and therefore the traditional model in this study may not be representative of other hospitals' management of hypertension. This study was not randomised and thus women had a choice to participate in the innovative care model, meaning the findings are from women who may have had a preference for HBPM and reduced hospital appointments. Furthermore, as a novice researcher who did not have any experience in interview technique, it is plausible that the researcher did not capture as much rich data as an experienced grounded theorist would.

Recommendations for further research

Only one woman developed mild PE in this study which is keeping in line with a small study sample and the fact that the majority of women do not develop PE. This study therefore did not capture the impact of identifying signs of PE at home and the implications this has for pregnancy outcomes. A large clinical trial is recommended to assess the association between HBPM and mortality and morbidity in a high risk pregnant population. A larger qualitative study could also capture the experiences of women with sub-optimal outcomes (excluded in this study), as these women may bring a different perspective to HBPM and the innovative care pathway.

Conclusion

Women's experience of an innovative care pathway with the use a smart phone app is overall a positive one. Women accept HBPM and welcome a reduced hospital schedule. There is increased patient satisfaction associated with the innovative care pathway in comparison to the traditional pathway. Women's experiences were enhanced by the innovative model mainly due to continuity of care and reduced hospital appointments. The traditional care pathway is associated with long waiting times, busy and stressful environments and multiple carers leading to multiple different opinions on the management

of hypertension in pregnancy. This leaves women confused, anxious and stressed. The innovative care model is associated with continuity of care, reduced hospital appointments and empowerment of women to become involved in their care. However, it currently lacks the provision of continuity of care in the postnatal period, leaving women unsure about the management of their hypertension.

Women are in pursuit of a holistic care pathway that will manage their hypertension appropriately. Participants have highlighted what works and what does not work. The issues associated with the traditional pathway are now transparent. The traditional pathway is no longer fit for purpose as it does not meet the holistic needs of women. The innovative model is not perfect and it needs improvement, but it is a step in the right direction towards holistic care. The findings have contributed to the knowledge and evidence for future developments in the management of hypertension in pregnancy. This evidence has implications for future practice that can be addressed at both a local and national level. This study has demonstrated that the provision of a holistic care model for the management of hypertension in pregnancy is realistic and achievable.

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