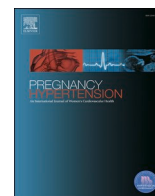




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# Pregnancy Hypertension: An International Journal of Women's Cardiovascular Health

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## Changes to management of hypertension in pregnancy, and attitudes to self-management: An online survey of obstetricians, before and following the first wave of the COVID-19 pandemic

B. Fletcher<sup>a,b</sup>, L.C. Chappell<sup>c</sup>, L. Lavalée<sup>a</sup>, H.M. Wilson<sup>c</sup>, R. Stevens<sup>a</sup>, L. Mackillop<sup>d</sup>, R. J. McManus<sup>a,1</sup>, K.L. Tucker<sup>a,\*</sup>

<sup>a</sup> Nuffield Department of Primary Care Health Sciences, University of Oxford, UK

<sup>b</sup> Centre for Patient Reported Outcomes Research, Institute for Applied Health Research, University of Birmingham, UK

<sup>c</sup> Department of Women and Children's Health, School of Life Course Sciences, King's College London, London, UK

<sup>d</sup> Nuffield Department of Women's and Reproductive Health, University of Oxford, UK

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### ABSTRACT

**Objective:** This study aimed to understand the views and practice of obstetricians regarding self-monitoring for hypertensive disorders of pregnancy (blood pressure (BP) and proteinuria), the potential for self-management (including actions taken on self-monitored parameters) and to understand the impact of the COVID-19 pandemic on such views.

**Design:** Cross-sectional online survey pre- and post- the first wave of the COVID-19 pandemic.

**Setting and Sample:** UK obstetricians recruited via an online portal.

**Methods:** A survey undertaken in two rounds: December 2019–January 2020 (pre-pandemic), and September–November 2020 (during pandemic)

**Results:** 251 responses were received across rounds one (150) and two (101). Most obstetricians considered that self-monitoring of BP and home urinalysis had a role in guiding clinical decisions and this increased significantly following the first wave of the COVID-19 pandemic (88%, (132/150) 95%CI: 83–93% first round vs 96% (95%CI: 92–94%), (97/101), second round;  $p = 0.039$ ). Following the pandemic, nearly half were agreeable to women self-managing their hypertension by using their own readings to make a pre-agreed medication change themselves (47%, 47/101 (95%CI: 37–57%)).

**Conclusions:** A substantial majority of UK obstetricians considered that self-monitoring had a role in the management of pregnancy hypertension and this increased following the pandemic. Around half are now supportive of women having a wider role in self-management of hypertensive treatment. Maximising the potential of such changes in pregnancy hypertension management requires further work to understand how to fully integrate women's own measurements into clinical care.

### 1. Introduction

Hypertensive disorders of pregnancy complicate between 5 and 10% of pregnancies, and are an important cause of morbidity and maternal death in the UK[1], USA[2 and worldwide.[3] Women with hypertensive disorders of pregnancy require close management antenatally and first few weeks after delivery. For many women this currently means attending regular and sometimes frequent appointments (up to daily) at maternity units. Self-monitoring of blood pressure (SMBP) is now well

evidenced and common place outside of pregnancy, but there is limited evidence or guidance for clinicians to follow in antenatal care.[4,5] SMBP and assessment of proteinuria present potential opportunities to involve women more in the management of their health during pregnancy, empowering women and providing more information to guide clinical decisions.[6–9]

Such self-monitoring could potentially be used to reduce repeated clinic visits and even hospital admissions, which is particularly relevant in situations where face-to-face visits are limited.[6–10] Furthermore it

\* Corresponding author at: Nuffield Department of Primary Health Care Sciences, Oxford OX2 6GG, UK.

E-mail address: [katherine.tucker@phc.ox.ac.uk](mailto:katherine.tucker@phc.ox.ac.uk) (K.L. Tucker).

<sup>1</sup> Joint senior authors.

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might also improve management of hypertension and increase women's involvement in their own care.[9,11,12] A recent survey of pregnant women suggested that around 20% of pregnant women in the UK self-monitor their blood pressure during pregnancy, with around 50% of hypertensive pregnant women monitoring, although a substantial proportion do not share their readings with healthcare professionals.[13]

This survey was developed as the new national UK pregnancy hypertension guidelines were released for consultation, with updated guidance on BP measurement, categories of BP and proteinuria for different management approaches, and recommended medications.[5] It was re-run following the first wave of the COVID-19 pandemic to examine the changes in practice and views caused by the rapid implementation of remote monitoring driven by a need to reduce face-to-face contact. Although current National Institute for Health and Care Excellence (NICE) guidelines do not contain information for clinicians on whether, or how, to incorporate self-monitored BP into clinical decision making, in response to the COVID-19 pandemic, the Royal College of Obstetricians and Gynaecologists (RCOG) produced rapid guidance based on research to date. [10]

This study aimed to understand the views and practice of obstetricians regarding self-monitoring of pregnancy hypertension (blood pressure and proteinuria), the potential to use self-monitoring to support self-management strategies (i.e., including actions taken on self-monitored parameters) and to understand the impact of the COVID-19 pandemic on such views.

## 2. Methods

### 2.1 e. Ethical approval

The study received ethical approval from the University of Oxford Medical Sciences Interdivisional Research Ethics Committee on 12/11/2019 (R65503/RE001).

### 2.2. Participants and recruitment

An invitation to take part in the survey was made available to obstetricians on the website doctors.net.uk for 61 days from 2 December 2019 until 31 January 2020, and then again from 18 September 2020 until 21 October 2020. The survey was re-run to understand the influence of the COVID-19 pandemic, particularly regarding self-monitoring practice and views. Initial responses were accepted until there were 150 completed questionnaires with a limit of 101 responses for the re-run (limits due to funding available). Only doctors who identified themselves as obstetricians could undertake the survey. The survey was open to all obstetricians on both occasions. The doctors.net.uk platform provides information services to 212,000 UK registered doctors. Using the Doctors.net.uk platform has been previously shown to give similar results to standard sample methods, where selected individuals or groups are provided with a survey and a response rate is known.[14]

### 2.3. Questionnaire

The questionnaire was designed by the research team, including obstetricians, midwives, researchers and a primary care physician. The design aimed to ascertain current practice in the management of high BP in pregnancy. Areas covered included: demographic information; information about the responders' hospital/unit; clinic BP measurement; home BP measurement; proteinuria testing; BP medications prescribed in pregnancy; midwife involvement in prescribing; and the potential for different self-measurement and management interventions to be of use in future. When the survey was re-run a small number of additional questions were added about any changes to practice due to the COVID-19 pandemic and if these were likely to be continued. The detailed questionnaire is provided in [supplementary material](#). The practice and views of midwives will be considered in a separate survey.

Obstetricians were presented with a series of management options with increasing involvement of women and reduced visits to clinic:

Home BP	Women measure BP at home, have clear guidelines on what to do and who to contact if BP goes over threshold, otherwise bring BP results to clinic
Home BP + protein	Women measure BP and proteinuria at home, have clear instructions what to do and who to contact if BP/proteinuria over threshold, otherwise bring results to clinic
Telemonitoring	Women measure BP and proteinuria at home, and communicate results in real-time using app that connects via Bluetooth to monitor for use in next consultation
Telemonitoring Plus	Women measure BP and proteinuria at home, and communicate results in real-time using app that connects via Bluetooth to monitor, and research midwife checks all BP readings on a daily basis and takes any appropriate action (i.e. contacting women to book appointment, or changing medication dose as supplementary prescriber)
Self-management	Same as telemonitoring plus with women able to make <b>one medication change</b> if necessary in response to elevation in BP pre-agreed with obstetrician
Self-management plus	Same as telemonitoring plus with women able to make <b>one or more medication changes</b> if necessary in response to elevation in BP pre-agreed with obstetrician

Clinicians were asked whether these might be feasible alternatives for women who currently need to attend clinic on a weekly basis, and separately for women who currently need to attend every 24–48 h.

### 2.4. Statistical analysis

The primary analysis mapped current practice around BP monitoring and management. Descriptive statistics with confidence intervals (CIs) around the means are reported. Proportions were compared using a z-test.[14] All analyses were performed using Stata version 15.

## 3. Results

### 3.1. Participants

Responses were received from 251 obstetricians; 150 in round one, during which time 1,107 obstetricians and gynaecologists were active on the site, and 101 responses in round two, during which time 1844 obstetricians and gynaecologists visited the site.

Survey respondents and regional distribution were similar in both surveys with UK trained, female obstetricians, under 50 making up the majority (Table 1). Both datasets were representative of the UK obstetricians according to national workforce statistics.[15–18] (Table 1)

### 3.2. Blood pressure measurement protocols

Almost all respondents worked in settings delivering specialist hypertension care where midwives or health care assistants took the vast majority of blood pressure measurements in clinic (Table S1). This did not change following the pandemic although the proportion with access to self-monitored blood pressure did (45%, 66/150 round 1, 66%, 66/101 round 2,  $p = 0.001$ ). The BP measurements available in clinic are shown in Figure S1, with details of how readings were taken in clinic shown in Table S1.

The majority of obstetricians thought that home BP measurement had a role to play in guiding clinical decisions for the detection and management of hypertension (88%, 132/150 first and 96%, 97/101 s) (Table 2).

Perceived barriers to the use of home BP monitoring included a lack of evidence and guidelines, uncertainty over calibration and validation of devices and concern that women might become stressed. There was some evidence of variation by geographical area and by research experience (Table 2).

The most common self-monitoring regimes were consistently two readings twice daily and there was evidence of increases in variety of

**Table 1**  
Respondent characteristics.

	Round 1 Dec 2019-Jan 2020 (n = 150)	Round 2 Oct-Nov 2020 (n = 101)	Test for difference	National data
Age (n,%)				
31–40	44 (29%)	23 (23%)		40% on specialist register are aged
41–50	53 (35%)	31 (31%)		45–54
51–60	37 (25%)	33 (33%)		
60+	5 (3%)	10 (10%)		
Rather not say	11 (7%)	4 (4%)	p = 0.090	
Gender (n,%)				
Female	91 (61%)	60 (60%)		55%
Male	48 (32%)	37 (37%)		
Rather not say	11 (7%)	4 (4%)	p = 0.460	
Region				
North	40 (27%)	25 (25%)		24%
England	39 (26%)	25 (25%)		22%
Midlands and East	17 (11%)	15 (25%)		18%
England	23 (15%)	17 (25%)		19%
London	11 (7%)	6 (6%)		9%
South	13 (9%)	9 (9%)		4%
England	4 (3%)	2 (2%)		3%
Scotland	3 (2%)	2 (2%)	p = 0.994	*
Wales				
Northern Ireland				
Rather not say				
Where did you train? (n,%)				
United Kingdom	133 (89%)	91 (91%)		54% of O&G Specialist Register are international medical graduates with 14% from EEA.
Europe, outside UK	3 (2%)	3 (3%)		
Outside Europe	8 (5%)	3 (3%)	p = 0.805	
Rather not say	6 (4%)			
Annual deliveries at hospital/unit (mean, s.d.)	4,927 (2,078)	4674 (2214)	p = 0.364	4,744 (2,483)
Annual deliveries at hospital/unit (median, IQR)	5,000 [3,500 – 6,000]	4750 [3,000 – 6,000]		4,573 [3,023 – 4,573]
Currently involved in research (n,%)				
Yes	64 (43%)	44 (44%)		
No	78 (52%)	51 (50%)		
Rather not say	8 (5%)	6 (6%)	p = 0.977	

National data was obtained from the Royal College of Obstetricians and Gynaecologists Workforce Report, Health and Social Care Northern Ireland Quarterly Workforce Bulletin December 2019, NHS [England] Workforce Statistics January 2020, NHS Scotland Workforce Report 2019 and NHS Wales Workforce Statistics 2019.

EEA - European Economic Area

\* calculated from total numbers of medical staff in England, Scotland, NI and Wales.

telemonitoring techniques following the pandemic: smartphone or app (24%, 17/70 first and 26%, 20/78 s), text message (4%, 3/70 first and 19%, 15/78 s, p = 0.005) and telephone (23%, 16/70 first and 51%, 40/78 s, p < 0.001). Most used the same thresholds as clinic for diagnosis and treatment (57%, 40/70 first and 73%, 57/78 s). Almost every obstetrician said that they would repeat home measurements in clinic as part of their routine review (97%, 68/70 first and 89%, 70/78 s) (Table S3).

**Table 2**  
women's home BP measurement.

	Round 1 (n = 150) (n,%)	Round 2 (n = 101) (n,%)	
Does home BP measurement have role to play in guiding clinical decisions?			
Yes	132 (88%)	97 (96%)	
No	18 (12%)*	4 (4%)	p = 0.039
If yes, when?	N = 132	N = 97	
In confirming a diagnosis of hypertension in pregnancy	69 (52%)	67 (69%)	p = 0.014
In monitoring BP control in pregnancy	112 (85%)	91 (94%)	p = 0.026
It would depend on the woman and her understanding of the importance of BP measurement	94 (71%)	62 (64%)	p = 0.254
Other	6 (5%)	5 (5%)	p = 0.999
Do you specifically ask women with high BP if they monitor at home?			
No	35 (23%)	17 (17%)	
Yes, sometimes	67 (45%)	35 (35%)	
Yes, always	26 (17%)	41 (41%)	
Yes, but only if woman raises topic first	19 (13%)	8 (8%)	p = 0.001
Other	3 (2%)	0 (0%)	
What proportion of the women with high BP do you think self-measure BP?			
None	10 (7%)	4 (4%)	
Up to a quarter	79 (53%)	37 (37%)	
Between a quarter and a half	10 (7%)	14 (14%)	
More than half	5 (3%)	16 (16%)	
Don't know	45 (30%)	26 (26%)	p = 0.001
Other	1 (1%)	4 (4%)	
Have you ever recommended that women home measure BP?			
Yes	70 (47%)	78 (77%)	P < 0.001
No	80 (53%)	23 (23%)	
If no....			
Why doesn't home BP have a role to play in guiding clinical decisions?			
Not enough evidence available for use in pregnancy	10 (56%)	12 (67%)	
No guidelines for use in pregnancy	12 (67%)	13 (72%)	
Prefer to base clinical decisions on clinic BP	4 (22%)		
Other			

\* Those involved in research activity were more likely to agree (those currently involved in research (n = 64), 95% agree, those not involved in research (n = 78), 81% agree, p = 0.02)

### 3.3. Current management of hypertension

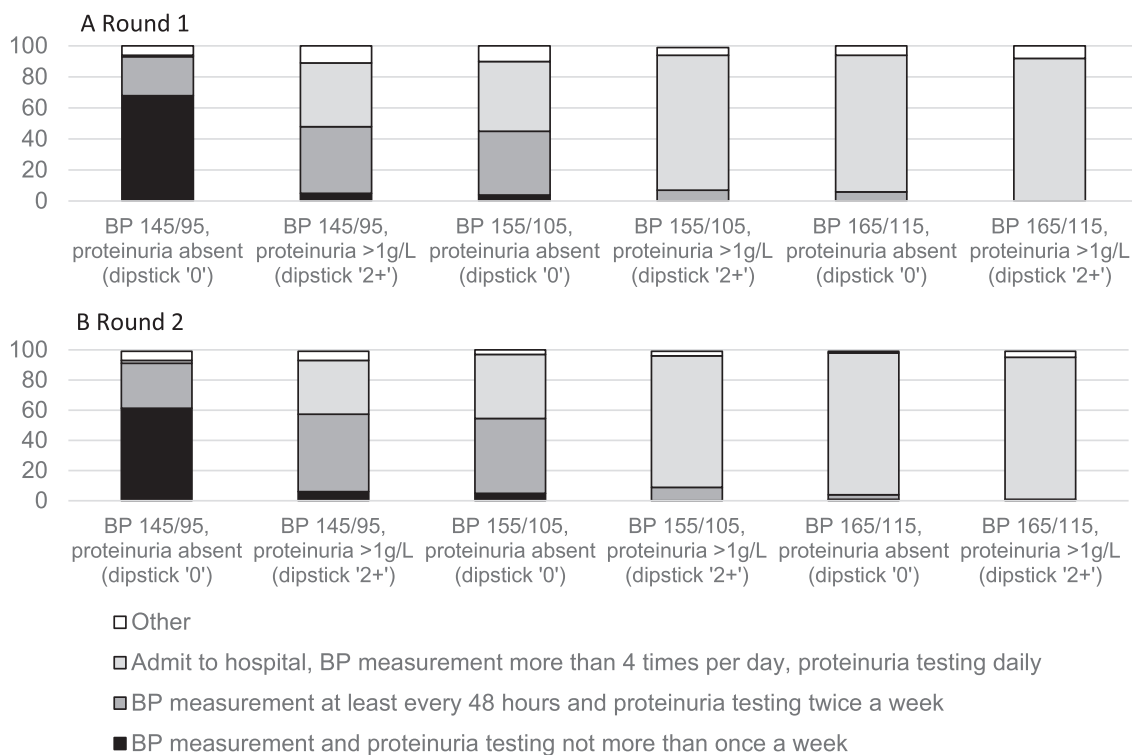
Labetalol, nifedipine and methyldopa were the most frequently reported antihypertensive drugs prescribed, with Labetalol most commonly prescribed by all respondents (Figure S2). A significant minority (45% first and 43% second) would admit women with a BP of 155/105 mmHg in the absence of proteinuria. (Fig. 1, Supplementary Materials Table S4).

### 3.4. Urinalysis

While most reported currently testing spot urine samples by visual or automated reader (and this was similar following the pandemic), the majority would value self-testing of urine by women in certain scenarios, and became more positive about home testing following the first waves of the pandemic, (79%, 119/150 first, vs 89%, 89/101 s, p = 0.002) (Table S6).

### 3.5. Potential for self-monitoring and self-management

The majority of obstetricians saw a potential role for self- and tele-



Results presented as %

Fig. 1. Management of pregnant women based on blood pressure and proteinuria.

monitoring of BP and urine in women who would usually attend clinic weekly, especially when combined with support from a midwife to action any above threshold measurements (Fig. 2, Table S2). For those women who currently attended clinic every 24–48 h, obstetricians saw a role for home and telemonitoring, but were less likely to support self-titration. For each home monitoring option, responses became more positive following the pandemic (Fig. 2, Table S2).

### 3.6. Which pregnant women were viewed as most likely to benefit?

Respondents were more likely to think about self-monitoring/management if the woman had suspected white coat hypertension (86%, 129/150 first and 84%, 85/101 s), experience of self-monitoring (85%, 128/150 first and 88%, 89/101 s), a Placental Growth Factor-based test had been performed to rule out pre-eclampsia (70%, 105/150 first and 73%, 74/101 s) or the hospital/unit had facilities for video consultation (66%, 99/150 first and 67%, 68/101 s). They were less likely to support new models of care if the woman had chaotic lifestyle (less likely: 69%, 104/150 first and 79%, 80/101 s) or lived alone (less likely: 49%, 74/150 first and 40%, 40/101).

### 3.7. Changes to practice following the COVID-19 pandemic

Following the first wave of the COVID-19 pandemic, 66% (67/101) of respondents reported using home monitoring more often, with many maternity units lending monitors to women (63%, 64/101) and some using an app to support monitoring (20%, 20/101). Following the pandemic obstetricians were more likely to ask about self-monitoring, (17%, 26/150 first, 41%, 41/101 s ( $p = 0.001$ )) to recommend self-monitoring (47%, 70/150 first, 77%, 78/101 s,  $p < 0.001$  Table 2), and more likely to use self-monitoring to make decisions (33%, 49/150 first and 64%, 65/101 s,  $p < 0.001$ ) (Figure S1). Most felt that some changes would be maintained following the pandemic (72%, 73/101).

Proteinuria self-testing remained less common than BP self-monitoring with 21% (21/101) reporting using more home testing and most (78%, 79/150) continuing with practice as before.

## 4. Discussion

### 4.1. Main findings

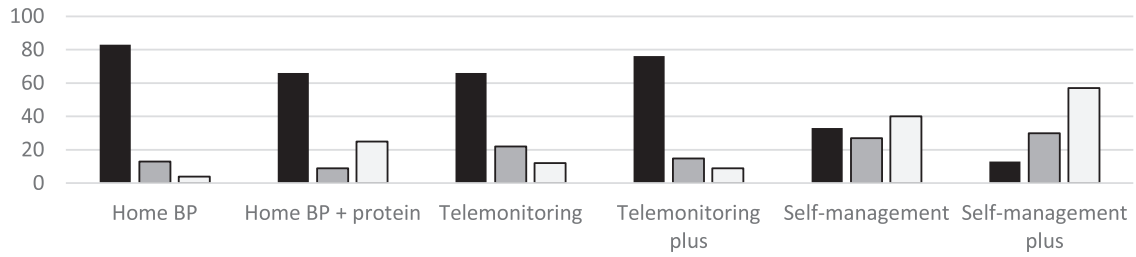
These surveys report novel data about current preferences for management of pregnancy hypertension in the UK and the influence of the COVID-19 pandemic. Obstetricians were mostly positive about a role for self-monitoring of BP and its integration into usual care, and this increased following the pandemic. There was also an increase in the acceptability of self-management; in which women would titrate anti-hypertensive medication based on home readings to a pre-agreed plan. The use of self-testing of proteinuria was less common, with more reluctance for change.

### 4.2. Current monitoring and management practice

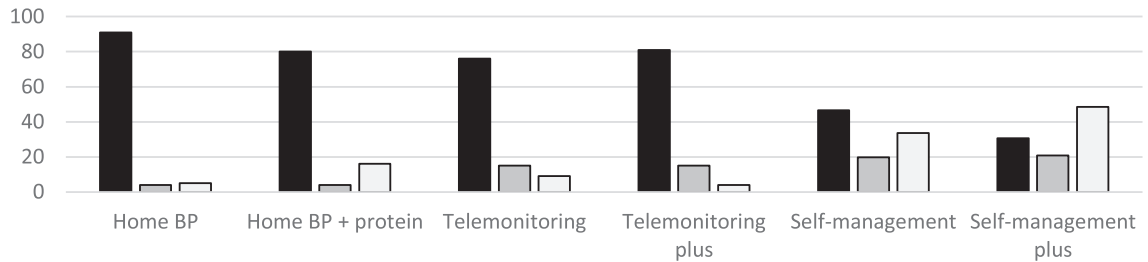
Obstetricians generally reported managing women conservatively compared to current guidelines, often choosing to admit women with hypertension and proteinuria when they might be managed as outpatients with regular review. In keeping with practice outside of pregnancy, respondents measured BP once if BP was normal in clinic, and three times if raised.[5]

The current level of home monitoring estimated in this study is similar to levels reported by pregnant women themselves; around 20% overall, rising to 50% in hypertensive women.[13] Many obstetricians initially reported not asking about home readings and previous research shows that pregnant women often do not share their home readings.[13] The pandemic saw the rapid introduction of new models of care where healthcare professionals needed to consult remotely with pregnant

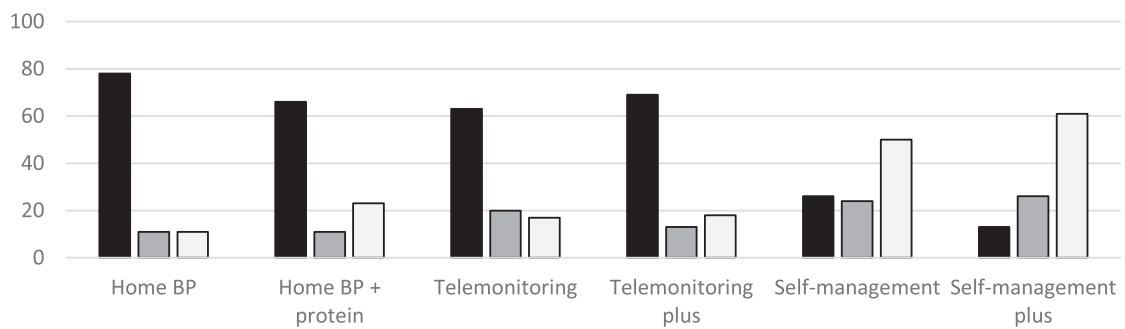
A) Women who attend weekly – round 1



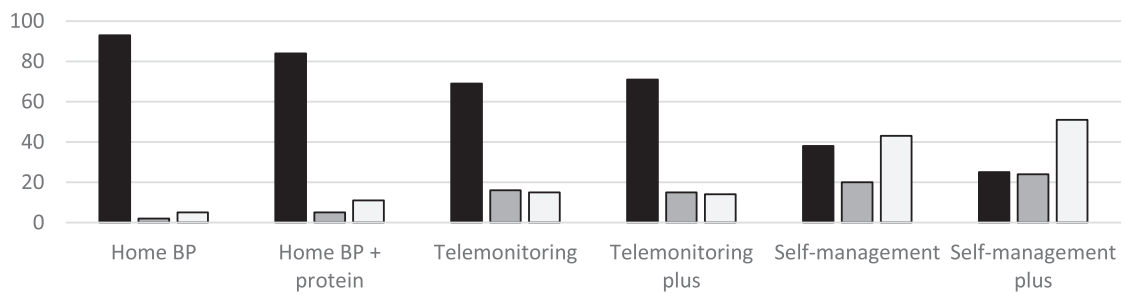
B) Women who attend weekly – round 2



C) Women who attend every 24/48 hours – Round 1



D) Women who attend every 24/48 hours – Round 2



- Yes, I think this would be a good option
- I am unsure whether this would be useful or not
- No, I would prefer women to come in as usual

For women attending weekly: A significant difference was found for home BP + protein between round 1 and round 2 ( $p=0.044$ ) and for self-management plus (round 1 vs round 2)  $p = 0.003$   
 For women attending every 24/48 hours: A significant difference was found for Home BP (round 1 vs round 2)  $p = 0.003$  and for Home BP + protein (round 1 vs round 2)  $p = 0.006$ .

Fig. 2. Suitability of new models of care for management of hypertension in pregnancy.

women. These findings suggest that there has been a change in practice and perception with regard to self-monitoring and management of BP with obstetricians using home readings more in their practice; they were more likely to recommend, ask about and use home readings in their decisions.

#### 4.3. The future for home BP monitoring and management during pregnancy

Home readings could add information about a woman's BP outside of the clinic setting, this could be used alongside clinic readings to support shared decision making. A recent systematic review of studies that used home BP monitoring and included pregnancy outcomes showed that home monitoring was associated with reduced risk of induction of labour, reduced antenatal visits and hospital admissions, and a reduction in the diagnosis of preeclampsia, though no significant differences were seen in maternal or fetal outcomes.[19] Although there was support for home BP guiding clinical decisions, the practice of repeating measurements in clinic, suggested that clinic readings are prioritised to guide treatment. This has a potential to lead to disempowerment without careful explanation. Following the rapid implementation of home monitoring during the pandemic, views became more positive about all forms of home BP monitoring, proteinuria self-testing and the prospect of self-management; where home readings could guide a single change in medication. Some aspects of these changes seem likely to be carried forward, with continued use of self-monitoring in usual care. During the pandemic hospitals in the UK were able to obtain BP monitors validated for use in pregnancy from NHS England. Future implementation may involve hospitals providing validated monitors or perhaps checking that women's own devices are suitable.[20]

#### 4.4. Monitoring schedules and thresholds

Blood pressure monitoring during pregnancy is different to hypertension outside of pregnancy because serious problems can develop rapidly and so more regular monitoring is indicated. Previous work has suggested monitoring for three days per week for pregnant women at risk of hypertension, or daily for those with hypertension was acceptable.[7,11] In this study most obstetricians recommended monitoring frequency in line with new guidelines from Royal College of Obstetricians and Gynaecologists and for the general population both before and after the pandemic.[10]

Most used the same BP thresholds for home and clinic readings. There is little evidence around home BP monitoring thresholds in pregnancy, but the limited evidence that exists suggests that there is little difference between home and clinic in the general pregnant population; however, there is some evidence of a greater white coat effect (where clinic readings are higher than home) in hypertensive pregnant women and this should be investigated further.[4,21]

#### 4.5. Which women should monitor?

The most influential factor reported as supporting the use of home monitoring was suspected white coat hypertension (where clinic BP readings are over the diagnostic threshold for hypertension but home readings are not). Research suggests that levels of white coat hypertension may be high in pregnancy, particularly in the third trimester.[4,21] White coat hypertension is associated with worse perinatal and maternal outcomes when compared to normotensive women.[22] Home monitoring could be used to confirm white coat hypertension and enable subsequent monitoring to be tailored in this group.

#### 4.6. Urinalysis

There were differences in practice regarding methods of urinalysis and thresholds used in clinical settings. Self-testing was not common

though most respondents thought that women would find self-testing acceptable, which fits with other research in the area.[23] While self-testing was valued, nearly all of those supporting home-testing would repeat the measurement in clinic, typically in order to perform an up-to-date reading. Practice and views became more positive with the implementation of remote monitoring due to the pandemic, though with much lower levels of acceptability than BP self-monitoring. Including both BP monitoring and urine testing, could better support reducing face to face visits.

#### 4.7. Strengths and limitations

This survey was designed with a range of stakeholders including obstetricians, midwives, quantitative and qualitative researchers with expertise in hypertension research in pregnancy, and tested with obstetric clinicians and researchers. The obstetricians who took part were from across the UK, and were representative compared to national workforce statistics, suggesting content validity and reliability (table 1). Furthermore, the findings around most clinical practice were largely consistent from the first and second round of the survey again suggesting validity. The anonymous format provides a platform for honest responses.

When conducting internet based surveys, it is difficult to calculate a response rate. While the respondents closely matched nationally available demographic data, the majority of respondents reported being trained in the UK, underrepresenting those obstetricians who trained abroad. These professionals may have different experiences affecting practice and views. Additionally, taking part in this survey could have appealed to doctors who already have an interest in BP management and those who are research active in this area. However this method of surveying has been previously shown to give similar results to a standard sampling methods.[14]

#### 4.8. Clinical implications

The use of self-monitoring of BP in pregnancy is now relatively high and has increased following the COVID-19 pandemic, with some hospital trusts implementing self-monitoring with or without support from an app.[24–26] New recommendations from the Royal College of Obstetricians and Gynaecologists have provided guidance for obstetric care teams across the UK in response to the COVID-19 pandemic but our results continue to show ongoing significant heterogeneity of practice.[10]

The role of self-monitoring will become clearer as the results from adequately powered trials become available, and as recent rapid implementation becomes established.[27] Levels of self-monitoring in hypertensive pregnancy may be higher than perceived by clinicians, suggesting that consultations could benefit from asking a women if they are self-monitoring which could also increase empowerment of the woman.

Suspected white coat hypertension was the most common factor supporting the decision to recommend home monitoring, suggesting that home readings may support not increasing, or perhaps reducing, antihypertensive medication in some women. However as emerging evidence suggests that white coat hypertension is associated with poorer neonatal and maternal outcomes when compared to normotensive women, further research into how these women should be best monitored and managed is needed.[22]

This research has helped understand the engagement of clinicians in relation to self-monitoring of BP during pregnancy and the potential to use telemonitoring (with clinical oversight) to allow out of clinic medication changes, this will help inform future innovations to support or implement self-monitoring and self-management interventions into practice.

#### 4.9. Conclusions (practical and research recommendations)

A substantial majority of UK obstetricians considered that self-monitoring had a role in the management of pregnancy hypertension and this increased following the pandemic. Around half are now supportive of women having a wider role in self-management. Maximising the potential of such changes in pregnancy hypertension management requires further work to identify the women most likely to benefit from home monitoring, and to understand how to fully integrate women's own measurements into clinical care in a way that improves outcomes.

#### 5. Authors' contributions

KT, BF and RM conceived the study and gained the funding. The protocols were developed by BF and KT, with the advice and support of all authors. Analysis was carried out by BF with support from KT. The first draft of the paper was written by BF and KT and subsequently edited and approved by all co-authors. All authors have read, provided critical revision and approved the final version of the manuscript. KT will act as guarantor.

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#### Competing interests

Richard McManus has received BP monitors for research use from Omron and is working with them to develop a telemonitoring system for use in primary care. He receives no personal payment for such work. Sensyne Health has licenced a digital BP monitoring application for use with pregnant women.

#### Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.preghy.2021.08.117>.

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