Oxford Primary Care 2015

Cutting-edge research in the consulting room

18 May 2015
@OxPrimaryCare

In partnership with:

National Institute for Health Research
Clinical Research Network
Thames Valley and South Midlands
What will blood pressure management be like in 2020?

Professor Richard McManus. 18 May 2015
Disclosures

• I have received BP monitors from Lloyds Pharmacies and Omron for my research
• I chair the BHS BP monitoring sub-group
• I am funded by NIHR at the university and a part-time partner at 27 Beaumont St, Oxford
General Practice in 2015

The doctor will see you in a month! GPs' waiting times warning to patients as they claim they are so overworked that standards of care are 'dangerous'

- Doctors are warning patients will routinely wait up to a month to see a GP by this time next year due to increased demand and a shortage of doctors
- Survey asked 714 senior GPs about waiting times and standards of care
- They also said they are so overworked they are missing serious illnesses
- Conservatives and Labour have both promised to give access to GPs - but neither has set out how extra do

GPs 'too busy to see your child': Parents are swamping A&E because they feel squeezed out by family doctors, warn experts

- Thousands of children taken to A&E because GPs are prioritising adults
- Out-of-hours family doctors' contracts reward care of chronically ill adults
- These changes have 'squeezed out' the care of children, warn researchers

But don’t worry, we’re plugging the £30bn gap with £8bn and 5000 more GPs by 2020...
Hypertension care in 2020?

• How can this realistically change?
  – More self-monitoring
  – Self-management
  – New techniques
• What is the evidence base?
• What can I practically do?
SELF-MONITORING FOR CONTROL OF BLOOD PRESSURE?
Self Monitoring reduces BP

- Small reductions in blood pressure from self-monitoring:
  - SBP by 3.8 mmHg
  - DBP by 1.5 mmHg

Bray et al. *Annals of Medicine* 2010
Effect depends on what else you do...

- Most effect combined with feedback or self-management
Self-monitoring – who’s using it?

- Survey of 625 GPs via doctors.net 2011
  - 91% had patients who self monitor
  - 34% had monitor to lend and 20% monitor in waiting room
  - Self-monitoring for diagnosis - 37%
  - Self-monitoring for management - 83%

McManus et al Journal of Human Hypertension 2013
Now widespread use by people with hypertension

- Canada 78% self-monitor (Logan J Hyp 2008)
- Italy 75% self-monitor (Cuspidi Blood Pressure 2005)
- UK 30% self-monitor (Baral, IJHyp 2011)
- UK 40% with hypertension and 21% without have self-monitored their own BP (McManus West Midlands 2012)

But only about 50% ever tell their GP...
HOW CAN I USE THIS?
Using self-monitoring

- Ask patients if they self-monitor (half that monitor do not disclose to GP)
- Check they are using validated upper arm monitor and ideally that it is accurate (how old is it?)
- Targets are lower (50% of GPs don’t take this into account): 135/85 = 140/90 or 150/95 = 160/100 [all mmHg]
- Not yet enough evidence to replace ABPM for diagnosis
- Self-monitoring plus active management works best
- Consider taking part in TASMINH4 trial...
SO WHY NOT GIVE PATIENTS (MORE) CONTROL?
Telemonitoring and self-management in the control of hypertension (TASMINH2): a randomised controlled trial

Richard J McManus, Jonathan Mant, Emma P Bray, Roger Holder, Miren I Jones, Sheila Greenfield, Billingsley Kaambwa, Miriam Banting, Stirling Bryan, Paul Little, Bryan Williams, F D Richard Hobbs

McManus et al Lancet 2010
Does self management with telemonitoring and titration of antihypertensive medication by people with poorly controlled treated hypertension result in:

1. Better control of blood pressure?
2. Changes in reported adverse events or health behaviours or costs?
3. Is it achievable in routine practice and is it acceptable to patients?
The Trial

• Eligibility
  – Age 35-85
  – Treated hypertension (no more than 2 BP meds)
  – Baseline BP >140/90 mmHg
  – Willing to self monitor and self titrate medication

• Patients individually randomised to self-management vs usual care stratified by practice and minimised on sex, baseline SBP, DM status,

• Practice GPs determine management
Self Monitoring – 1st week of every month
**Intervention**

- **Blood Pressure Targets:**
  - NICE (140/90 or 140/80 mmHg)
  - minus 10/5 mmHg i.e. 130/85 mmHg or 130/75 mmHg

- Patients agreed titration schedule with their GP after randomisation

- Traffic Light system to adjust medication

<table>
<thead>
<tr>
<th>Level</th>
<th>Blood Pressure</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH</td>
<td>SYS 201 or more OR DIA 101 or more</td>
<td>Your BP is too high. Make an appointment within 24 hours to see your GP or nurse. Record a RED reading</td>
</tr>
<tr>
<td>RAISED</td>
<td>SYS 131-200 OR DIA 86-100</td>
<td>Your BP is raised. Record an AMBER reading. If FOUR or more AMBER readings in one week on 2 consecutive months then look at your medication change instructions.</td>
</tr>
<tr>
<td>NORMAL</td>
<td>SYS 101-130 AND DIA 85 or less</td>
<td>Your BP is normal. This is fine provided that you have no side effects. Record a GREEN reading</td>
</tr>
<tr>
<td>LOW</td>
<td>SYS 100 or less</td>
<td>Your blood pressure is too low. Make appointment to see your GP Record a RED reading</td>
</tr>
</tbody>
</table>
Outcomes

• Follow up at 6 & 12 months
• Main outcome Systolic Blood Pressure
• Secondary outcomes: Diastolic BP / costs / anxiety / health behaviours/ patient preferences / systems impact / costs
• Recruitment target 480 patients (240 x 2)
• Sufficient to detect 5mmHg difference between groups
Baseline Results

<table>
<thead>
<tr>
<th></th>
<th>Intervention (n=234)</th>
<th>Control (n=246)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>66.6 (8.8)</td>
<td>66.2 (8.8)</td>
</tr>
<tr>
<td>Men</td>
<td>110 (47%)</td>
<td>115 (47%)</td>
</tr>
<tr>
<td>Systolic blood pressure (mm Hg)</td>
<td>152.1 (11.9)</td>
<td>151.8 (11.9)</td>
</tr>
<tr>
<td>Diastolic blood pressure (mm Hg)</td>
<td>85.0 (8.5)</td>
<td>84.5 (9.6)</td>
</tr>
<tr>
<td>Ethnic origin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>223 (95%)</td>
<td>238 (97%)</td>
</tr>
<tr>
<td>Black</td>
<td>5 (2%)</td>
<td>2 (1%)</td>
</tr>
<tr>
<td>Asian</td>
<td>4 (2%)</td>
<td>6 (2%)</td>
</tr>
<tr>
<td>Other</td>
<td>2 (1%)</td>
<td>0</td>
</tr>
<tr>
<td>Body-mass index (kg/m²)</td>
<td>29.6 (5.8)</td>
<td>30.0 (5.4)</td>
</tr>
<tr>
<td>IMD 2007 score*</td>
<td>16.7 (13.3)</td>
<td>17.3 (14.0)</td>
</tr>
<tr>
<td>Current smoker</td>
<td>19 (8%)</td>
<td>14 (6%)</td>
</tr>
<tr>
<td>Anxiety score (STAI-6)†</td>
<td>10.1 (3.3)</td>
<td>9.7 (3.1)</td>
</tr>
<tr>
<td>Past medical history</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coronary heart disease</td>
<td>22 (9%)</td>
<td>24 (10%)</td>
</tr>
<tr>
<td>Cerebrovascular disease</td>
<td>12 (5%)</td>
<td>9 (4%)</td>
</tr>
<tr>
<td>Diabetes</td>
<td>18 (8%)</td>
<td>17 (7%)</td>
</tr>
<tr>
<td>Chronic kidney disease</td>
<td>17 (7%)</td>
<td>27 (11%)</td>
</tr>
<tr>
<td>Atrial fibrillation</td>
<td>19 (8%)</td>
<td>18 (7%)</td>
</tr>
<tr>
<td>Number of antihypertensive drugs</td>
<td>1.50 (0.53)</td>
<td>1.54 (0.51)</td>
</tr>
</tbody>
</table>
Results - primary outcome SBP

<table>
<thead>
<tr>
<th></th>
<th>Mean blood pressure (mm Hg)</th>
<th>Effect size (mm Hg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline</td>
<td>6 months</td>
</tr>
<tr>
<td><strong>Systolic blood pressure; unadjusted</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intervention</td>
<td>152.1 (150.6 to 153.6)</td>
<td>139.0 (137.0 to 141.0)</td>
</tr>
<tr>
<td>Control</td>
<td>151.8 (150.3 to 153.3)</td>
<td>142.4 (140.2 to 144.6)</td>
</tr>
<tr>
<td><strong>Systolic blood pressure; adjusted</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intervention</td>
<td>151.9 (150.8 to 153.1)</td>
<td>138.8 (136.6 to 141.0)</td>
</tr>
<tr>
<td>Control</td>
<td>152.0 (150.9 to 153.2)</td>
<td>142.6 (140.5 to 144.8)</td>
</tr>
</tbody>
</table>
Results - medications

- 212 (80%) self managed for full 12 months
- 148 (70%) made at least one medication change
- At 12m intervention group prescribed 0.46 (0.34, 0.58) additional antiHT (p=0.001)
- Main changes seen in thiazides and calcium channel blockers
  (60% on ACEI/ARB at baseline)
Results – side effects

- Similar side effects in intervention vs control

<table>
<thead>
<tr>
<th></th>
<th>Intervention (n=234)</th>
<th>Control (n=246)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stiff joints</td>
<td>95 (41%)</td>
<td>104 (42%)</td>
<td>0.709</td>
</tr>
<tr>
<td>Pain</td>
<td>89 (38%)</td>
<td>84 (34%)</td>
<td>0.375</td>
</tr>
<tr>
<td>Fatigue</td>
<td>84 (36%)</td>
<td>78 (32%)</td>
<td>0.332</td>
</tr>
<tr>
<td>Swelling of legs</td>
<td>74 (32%)</td>
<td>55 (22%)</td>
<td>0.022</td>
</tr>
<tr>
<td>Sleep difficulties</td>
<td>72 (31%)</td>
<td>80 (33%)</td>
<td>0.680</td>
</tr>
<tr>
<td>Dry mouth</td>
<td>68 (29%)</td>
<td>59 (24%)</td>
<td>0.208</td>
</tr>
<tr>
<td>Feeling flushed</td>
<td>61 (26%)</td>
<td>57 (23%)</td>
<td>0.461</td>
</tr>
<tr>
<td>Cough</td>
<td>61 (26%)</td>
<td>60 (24%)</td>
<td>0.672</td>
</tr>
<tr>
<td>Breathlessness</td>
<td>53 (23%)</td>
<td>59 (24%)</td>
<td>0.730</td>
</tr>
<tr>
<td>Sore eyes</td>
<td>48 (21%)</td>
<td>58 (24%)</td>
<td>0.419</td>
</tr>
</tbody>
</table>
BUT WHAT ABOUT HIGH RISK PATIENTS?
Original Investigation

Effect of Self-monitoring and Medication Self-titration on Systolic Blood Pressure in Hypertensive Patients at High Risk of Cardiovascular Disease
The TASMIN-SR Randomized Clinical Trial

Richard J. McManus, FRCGP; Jonathan Mant, MD; M. Sayeed Haque, PhD; Emma P. Bray, PhD; Stirling Bryan, PhD; Sheila M. Greenfield, PhD; Miren I. Jones, PhD; Sue Jowett, PhD; Paul Little, MD; Cristina Penalosa, MA; Claire Schwartz, PhD; Helen Shackleford, RGN; Claire Shovelton, PhD; Jinu Varghese, RGN; Bryan Williams, MD; F.D. Richard Hobbs, FMedSci
Primary Outcome - SBP

<table>
<thead>
<tr>
<th>Blood Pressure, mm Hg</th>
<th>Baseline</th>
<th>6 Month</th>
<th>12 Month</th>
<th>Difference(^b)</th>
<th>6 Month</th>
<th>12 Month</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. of Patients</td>
<td>Mean (95% CI)(^a)</td>
<td>No. of Patients</td>
<td>Mean (95% CI)(^a)</td>
<td>No. of Patients</td>
<td>Mean (95% CI)(^a)</td>
</tr>
<tr>
<td>Systolic Blood Pressure Complete Case</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Usual care</td>
<td>230</td>
<td>143.6 (141.9-145.4)</td>
<td>225(^c)</td>
<td>138.1 (136.0-140.3)</td>
<td>230</td>
<td>137.8 (135.4-140.3)</td>
</tr>
<tr>
<td>Intervention</td>
<td>220</td>
<td>143.1 (141.4-144.9)</td>
<td>215</td>
<td>131.8 (129.6-134.1)</td>
<td>220</td>
<td>128.2 (125.9-130.4)</td>
</tr>
<tr>
<td>Systolic Blood Pressure With Multiple Imputation for Missing Values</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Usual care</td>
<td>276</td>
<td>144.2 (142.3-146.1)</td>
<td>276</td>
<td>138.4 (136.3-140.5)</td>
<td>276</td>
<td>138.2 (136.1-140.2)</td>
</tr>
<tr>
<td>Intervention</td>
<td>276</td>
<td>143.5 (141.6-145.4)</td>
<td>276</td>
<td>132.1 (129.8-134.4)</td>
<td>276</td>
<td>128.6 (126.5-130.7)</td>
</tr>
</tbody>
</table>
IS IT COST EFFECTIVE?
Self-management cost effective

£1624 per QALY for men & £4923 per QALY for women

Kaambwa et al EJPC 2013
Even more so in higher risk patients

Increased QALYs and Cost saving

99% probability of being cost-effective at NICE threshold
WHAT DO PATIENTS THINK?
Results – Interviews (Monitoring)

• Patients generally positive about self-monitoring

• Surprised at difference between home and surgery readings

• Majority thought that monitoring for 1 week/month was ‘about right’, but some found it excessive

• Most managed telemonitoring but failure in app 10%
Results – Interviews (Medication)

• Patients did not like having to take medication but accepted they had to

• All said they took their medication regularly

• Patients more comfortable about making a medication change if their BP readings were substantially above target

• Patients reluctant to implement a medication change if only just raised and several chose not to
I found the project of self-monitoring my Blood Pressure measurements very interesting and informative. In respect of my own situation whenever I had my Blood Pressure checked prior to this project I was always being told that my readings were too high (in the 140 range and even 150/90). Nothing was done about this problem other than advice to control my weight and exercise.

Participating in this project with the facility of medication changes, I had these changes, has reduced my Blood Pressure from 140/90 at the start of the project to 120/75 today. As a result of the information gained from this project I am continuing monitoring my own Blood Pressure.

The frustrating aspect of this project was the need to complete the diary, giving the same answers to the same questions month after month.

Meetings with researchers I always found to be pleasant, friendly, helpful and unpressurised. I have always been able to read and answer question sheets and raise any concerns that I wanted to discuss.

Please return to the research team using the previously provided address.

I would especially like to mention the cooperation of the staff at the practice, and the assistance of the practice nurses in ensuring that the project ran smoothly.

Please return to the research team using the previously provided address.

[Address]

[Date]
What patients thought (intervention)

Empowerment

• *I have felt much better during my participation and have been able to lead a much higher quality of life* (01175)

• *It made me feel in control in managing my blood pressure* (199)

Understanding

• *...it made me go into it more, looked it up on the computer and made me aware of how important the blood pressure is.* (01606)

• *...it has highlighted examples of what I think affects my blood* (01554)
What patients thought (intervention)

**Trial triggered BP reduction**

- *..whenever I had my blood pressure checked prior to this project I was always being told that my readings were too high (in the 140 range and even 150/90). Nothing was done about this problem other than advice to control my weight and exercise. Participating in this project with the facility of medication changes, I had three changes, has reduced my blood pressure from 140/84 at the start of the project to 129/75 today... (00912)*

**Motivation to rethink aspects of lifestyle**

- *Taking part in the TASMINH trial has caused me to re-evaluate my lifestyle. I feel that I am very active for my age-only my back problem stops me from doing more. Whilst my diet is not bad, I feel there is room for improvement and will try to eat more fruit, veg and fish* (00040)
HOW CAN I USE THIS?
How can I use self-management?

- Usual self-monitoring issues as previously
- Set a target – usually 135/85mmHg – and tell the patient
- Make a plan for them to follow “a recipe”
  - Up to three steps
  - Write it down? Add to repeat list “medication change 1,2…”
  - Organise blood tests if needed
- Ask patient to adjust medication vs BP (colour chart?)
- Can titrate vs side effects to (impotence)
WHAT NEXT?
Multiple clinic readings

- Multiple clinic readings predict which patients are likely to have a significant white coat or masked *effect* on home monitored BP.

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**A) White coat effect group**
- $n = 92$
- Mean HBP ± 95% CI

**B) Normal group**
- $n = 95$
- Mean HBP ± 95% CI

**C) Masked effect group**
- $n = 33$
- Mean HBP ± 95% CI

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**Objectives:** Identification of people with lower (white-coat effect) or higher (masked effect) blood pressure at home compared to the clinic usually requires ambulatory or home monitoring. This study assessed whether changes in SBP with repeated measurement at a single clinic predict subsequent differences between clinic and home.

**INTRODUCTION**

Hypertension is an important risk factor for cardiovascular disease [1], which is the major cause of morbidity and mortality worldwide [2]. In those with established hypertension, effective management depends on accurate measurement of blood pressure in...

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The future – no cuffs?

[Diagram of wristband]

- **Display**: LED dot display
- **Sensor**: Pressure sensor, 3-axis acc sensor (activity tracking), Oscillometric sensor
- **Size**: 20 x 9 x 210mm (M size)
- **Material of Band**: Silicone
- **Embossing Band**: Improves wearing sensation, Anti-sweat
- **Changeable Band Size**: L/XL, 20 x 9 x 190mm / 210mm / 240mm
- **Band**: S/M/L: 20 x 9 x 180mm / 210mm / 240mm
  - S/M, 1.5mm each: L, M, XL
- **Weight**: 120g
- **Battery**: Lithium 1200mAh, use only: Blood pressure gauge, 7 days: Battery life: Blood pressure gauge and pedometer at the same time
- **Alarm**: Select time to measure blood pressure
- **Bluetooth**: BLE (2.4GHz)
Bottom line

• Self-titration & telemonitoring results in significantly lower blood pressure than usual care which is sustained after 12 months
• Increased medication likely to be main mechanism
• Cost effective under UK criteria
• Effective in hypertension and higher risk
• Impact of telemonitoring largely as safety net
• Patients are willing to be more involved in decisions on medication
Final Plug!

• TASMINH4 study currently recruiting
• Usual care vs self-monitoring vs telemonitoring
• We need 150 + practices nationally so all welcome
• See me or tasminh4@phc.ox.ac.uk
Acknowledgements

Prof Jonathan Mant
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Dr Miren Jones
Dr Claire Schwartz
Dr James Sheppard
Dr Kath Tucker
Dr Claire O’Brien
Amanda Davies
Miriam Banting
Helen Shackleford
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Dr Sayeed Haque
Roger Holder
Dr Sue Jowett
Cristina Penaloza
Dr Billy Kaambwa
Prof Sheila Greenfield
Prof Paul Little
Prof Stirling Bryan
Prof Bryan Williams
Prof Richard Hobbs
This work received joint funding from the NIHR Programme Grants, Policy Research Programme, National School Primary Care Research, National Coordinating Centre for Research Capacity Development and Midlands Research Practices Consortium / Primary Care Research Network. The work would not have been possible without the collaboration of both patients and practices.
Self-Monitoring of Blood Pressure during Pregnancy

Dr Katherine Tucker. 18 May 2015
Background

Hypertensive disorders during pregnancy are a leading cause of direct maternal deaths in the UK.

Regular self-monitoring of blood pressure could improve detection of gestational hypertension.
Why is early detection important?

(Currently no cure for Pre-eclampsia)

- Anti-hypertensive medication
- Problems can escalate rapidly
- Detect difficulties with the baby
Considerations

- Thresholds for home readings
- Differences through the trimesters
- Feasibility (variability, monitors)
- Protocols (how often /when)
Systematic review

Aim
Find all available literature comparing Home and Clinic readings to assess the current evidence regarding thresholds

The Systematic review
1512 journal articles identified

19 papers appeared to have carried out both home and clinic monitoring

8 studies included or provided data on home and clinic readings
## Table of included studies

<table>
<thead>
<tr>
<th>Author, Year, Country</th>
<th>Population</th>
<th>Number</th>
<th>Gestation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IPD</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chandiramani (2006) UK</td>
<td>Suspected hypertension</td>
<td>100</td>
<td>unknown</td>
</tr>
<tr>
<td>Lo (2002) New Zealand</td>
<td>1) Healthy pregnancy at booking</td>
<td>101</td>
<td>Throughout pregnancy</td>
</tr>
<tr>
<td></td>
<td>2) women with pre-eclampsia</td>
<td>+45</td>
<td>&gt;38 weeks</td>
</tr>
<tr>
<td>Rey (2007) Canada</td>
<td>1) Hypertensive</td>
<td>100</td>
<td>Throughout pregnancy</td>
</tr>
<tr>
<td></td>
<td>2) normotensive high risk of pre-eclampsia</td>
<td>+20</td>
<td>&lt;20 to &gt;36 weeks</td>
</tr>
<tr>
<td>Rey (2009) Canada</td>
<td>1) Chronic hypertension</td>
<td>111</td>
<td>Third trimester</td>
</tr>
<tr>
<td></td>
<td>2) Pre-eclampsia</td>
<td>41</td>
<td>(28-38 weeks gestation)</td>
</tr>
<tr>
<td></td>
<td>3) Isolated Office Hypertension (White coat)</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td><strong>Summary Data only</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ishikuro (2013) Japan</td>
<td>Healthy singleton pregnancy with no history of hypertension</td>
<td>575</td>
<td>20 weeks till 4 weeks postpartum</td>
</tr>
<tr>
<td>Mooney (1991) UK</td>
<td>Any Pregnancy</td>
<td>35</td>
<td>30 weeks</td>
</tr>
<tr>
<td>Homuth (1993) Germany</td>
<td>Gestational hypertension</td>
<td>26</td>
<td>unknown</td>
</tr>
</tbody>
</table>
Average Home and Clinic readings are similar through pregnancy
Clinic vs Home Systolic BP through pregnancy

Office vs Home Systolic BP 5-14 weeks

Office vs Home Systolic BP 15-22 weeks

Office vs Home Systolic BP 23-32 weeks

Office vs Home Systolic BP at 32-42 weeks
Difference in home and clinic SBP through pregnancy

A. Mean Difference in Clinic-Home Systolic BP 5-14 Weeks Gestation

<table>
<thead>
<tr>
<th>Study</th>
<th>WMD (95% CI)</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPD data</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lo 2002</td>
<td>1.38 (-1.09, 3.84)</td>
<td>33.18</td>
</tr>
<tr>
<td>Rey 2007 &amp; 2009</td>
<td>-1.28 (-6.80, 4.24)</td>
<td>23.15</td>
</tr>
<tr>
<td>Brown 2004</td>
<td>2.15 (-4.57, 8.88)</td>
<td>19.58</td>
</tr>
<tr>
<td>Chandiramani 2006</td>
<td>-7.65 (-12.88, -2.42)</td>
<td>0.08</td>
</tr>
<tr>
<td>Subtotal (I-squared=70.0%, p=0.019)</td>
<td>-1.26 (-5.58, 3.06)</td>
<td>100.00</td>
</tr>
</tbody>
</table>

B. Mean Difference in Clinic-Home Systolic BP 15-22 Weeks Gestation

<table>
<thead>
<tr>
<th>Study</th>
<th>WMD (95% CI)</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPD data</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lo 2002</td>
<td>3.02 (1.41, 5.90)</td>
<td>33.85</td>
</tr>
<tr>
<td>Rey 2007 &amp; 2009</td>
<td>-2.26 (-6.11, 1.59)</td>
<td>25.71</td>
</tr>
<tr>
<td>Brown 2004</td>
<td>2.70 (-2.71, 8.11)</td>
<td>16.82</td>
</tr>
<tr>
<td>Chandiramani 2006</td>
<td>-0.36 (-4.51, 3.80)</td>
<td>23.62</td>
</tr>
<tr>
<td>Subtotal (I-squared=44.8%, p=0.143)</td>
<td>0.81 (-1.84, 3.46)</td>
<td>100.00</td>
</tr>
</tbody>
</table>

C. Mean Difference in Clinic-Home BP at 23-32 Weeks Gestation

<table>
<thead>
<tr>
<th>Study</th>
<th>WMD (95% CI)</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPD data</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lo 2002</td>
<td>2.35 (-0.56, 5.26)</td>
<td>29.43</td>
</tr>
<tr>
<td>Rey 2007 &amp; 2009</td>
<td>-0.85 (-3.19, 2.09)</td>
<td>29.28</td>
</tr>
<tr>
<td>Brown 2004</td>
<td>1.48 (-3.59, 6.55)</td>
<td>18.46</td>
</tr>
<tr>
<td>Chandiramani 2006</td>
<td>-4.54 (-8.65, -0.43)</td>
<td>22.83</td>
</tr>
<tr>
<td>Subtotal (I-squared=%, p=0)</td>
<td>-0.32 (-3.24, 2.60)</td>
<td>100.00</td>
</tr>
</tbody>
</table>

D. Mean Difference in Clinic-Home Systolic BP 33-42 Weeks Gestation

<table>
<thead>
<tr>
<th>Study</th>
<th>WMD (95% CI)</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPD data</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lo 2002</td>
<td>3.09 (-0.06, 6.24)</td>
<td>29.40</td>
</tr>
<tr>
<td>Rey 2007 &amp; 2009</td>
<td>-1.58 (-4.46, 1.31)</td>
<td>30.20</td>
</tr>
<tr>
<td>Brown 2004</td>
<td>-3.00 (-12.49, 6.49)</td>
<td>12.72</td>
</tr>
<tr>
<td>Chandiramani 2006</td>
<td>-5.92 (-9.62, -2.21)</td>
<td>27.62</td>
</tr>
<tr>
<td>Subtotal (I-squared=77.8%, p=0.004)</td>
<td>-1.59 (-5.82, 2.65)</td>
<td>100.00</td>
</tr>
</tbody>
</table>

Note: Weights are from random effect analysis.
White coat and Masked Hypertension

There is more white coat hypertension than masked hypertension

There is as much WCH as true hypertension!

<table>
<thead>
<tr>
<th>Gestation (weeks)</th>
<th>5-14</th>
<th>15-22</th>
<th>23-32</th>
<th>33-42</th>
</tr>
</thead>
<tbody>
<tr>
<td>True Normotensive</td>
<td>81.97</td>
<td>85.33</td>
<td>78.50</td>
<td>61.92</td>
</tr>
<tr>
<td>Masked Hypertension</td>
<td>3.83</td>
<td>2.32</td>
<td>2.18</td>
<td>5.57</td>
</tr>
<tr>
<td>White Coat Hypertension</td>
<td>8.74</td>
<td>6.95</td>
<td>11.53</td>
<td>16.10</td>
</tr>
<tr>
<td>True Hypertension</td>
<td>5.46</td>
<td>5.41</td>
<td>7.79</td>
<td>16.41</td>
</tr>
</tbody>
</table>
Conclusions

• SM has potential to be useful in early detection of GH and rule out WCH

• Based on current evidence a threshold of 140/90 would seem appropriate

• We need a large scale study to compare home and clinic readings using a validated monitor.
Self-monitoring of blood pressure in pregnancy: The BuMP study

**Aim:** Establish a suitable monitoring protocol and clear diagnostic thresholds for home BP monitoring in pregnancy

**Design:** Prospective observational feasibility study of self-monitoring BP in pregnancy.
Population:

higher risk women

• previous incident of pre-eclampsia
• First pregnancy
• age 40 years or older
• pregnancy interval of more than 10 years
• body mass index (BMI) of 30 kg/m² or more at first visit
• family history of pre-eclampsia
• multiple pregnancy

Intervention:

3 days a week (morning and evening)
Study Flow Chart

Baseline (12 or 16 weeks) → 28 weeks → 36 weeks → 6 weeks Postpartum
### Patients’ chart for interpreting blood pressure reading

<table>
<thead>
<tr>
<th>Level</th>
<th>Blood Pressure</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HIGH</strong></td>
<td>SYS 150 or over OR DIA 100 or over</td>
<td>Your blood pressure is high, repeat once more in 5 minutes. If your blood pressure reading is still high you should contact the community midwife, GP surgery or out of hours service as soon as possible (within 4 hours).</td>
</tr>
<tr>
<td><strong>RAISED</strong></td>
<td>140-149 OR 90-99</td>
<td>Repeat the BP measurement after 4 hours. If it remains raised or you have any symptoms associated with pre-eclampsia (see below) contact a midwife or GP within 12 hours</td>
</tr>
<tr>
<td><strong>NORMAL</strong></td>
<td>SYS 85-139 OR DIA 90 or less</td>
<td>Your BP is normal. This is fine provided that you have no other symptoms Routine ANC (standard visits)</td>
</tr>
<tr>
<td><strong>LOW</strong></td>
<td>SYS 85 or less</td>
<td>Your blood pressure is low. Contact midwife within 24 hours or within 4 hours if symptomatic</td>
</tr>
</tbody>
</table>
Patient text message system ‘Florence’

http://www.getflorence.co.uk/
201 women were recruited over 9 months. 80% were recruited at secondary care sites.
Baseline Characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>31.4 (5.5)</td>
</tr>
<tr>
<td>BMI</td>
<td>28.2 (6.8)</td>
</tr>
<tr>
<td>BP</td>
<td>116/70mmHg</td>
</tr>
</tbody>
</table>

Results

- 22% raised BP
- 15% Gestational hypertension
- 7% Pre-eclampsia

Home vs clinic BP

Stage of pregnancy (weeks)

- Systolic BP (mmHg)
  - Mean clinic BP
  - LowerCI
  - UpperCI
  - Mean home BP
Conclusions

• Self-monitoring of BP in pregnancy is feasible and could:
  - improve the detection of GH
  - rule out WCH
  - allow re-organisation of care.

• home and clinic blood pressure was similar

• Large RCT needed!
Take home messages

• There may be high levels of white coat hypertension in pregnancy.

• Self-monitoring of BP may improve the detection of gestational hypertension and white coat hypertension.

• Few automated BP monitors have been validated for use in pregnancy.
Thank you for listening!

Thank you to the research team:
Carole Crawford, James Hodgkinson, Clare Bankhead, Richard Stevens, Kathryn Taylor, Nia Roberts…. and all of the BuMP study team lead by Richard McManus.

Thank you to:
Midwives, GP’s and the research network and the Women who took part!

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