Call to Action for Home Blood Pressure Monitoring

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• Advisory Board, NiCox

Goals

1. Issues with office blood pressure measurement
2. Advantages of home blood pressure monitoring
3. Key messages of the AHA Call to Action Statement on home blood pressure monitoring
Noninvasive BP measurement

Methodologies
- Auscultatory (K sound)
- Mercury
- Aneroid
- Hybrid
- Oscillometric

Locations Situations
- Upper arm - Clinic
- Wrist - Home
- Finger - Ambulatory

Blood pressure measurement: some basic points

1. Small differences of BP are increasingly important - need for accuracy of measurements
2. Blood pressure variability is high - need for multiple measurements
3. Human factors (alert reaction, poor technique) lead to unrepresentative readings - need for automated measurements
4. Office BP measurement are limited - often small number of readings

Issues with office BP measurement technique
Criteria for the ideal BP measurement technique

- Noninvasive
- Accurate in all conditions - obesity, pregnancy etc.
- Automated (eliminates observer error)
- Provides multiple readings
- Cheap
- Easy to use
What is the role of home blood pressure monitoring?

Current Usage of HBPM

Gallup Poll

How does office BP and or home BP compare with the daytime ambulatory BP?

Little et al, BMJ 2002; 325: 254
HBPM for predicts CV risk better than Office BP

<table>
<thead>
<tr>
<th>Study</th>
<th>Population</th>
<th>N of Subjects</th>
<th>30s</th>
<th>40s</th>
<th>50s</th>
<th>60s</th>
<th>70s</th>
<th>Total</th>
<th>Outcome</th>
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<tbody>
<tr>
<td>DREAM</td>
<td>576</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>120</td>
<td>Study and mortality predictors by HBPM</td>
</tr>
<tr>
<td>SHEYP</td>
<td>4,000</td>
<td>400</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2,500</td>
<td>Composite and mortality predictors by HBPM</td>
</tr>
<tr>
<td>HYLAND</td>
<td>260</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>160</td>
<td>Other lab values provided by HBPM</td>
</tr>
<tr>
<td>Systbie</td>
<td>1,000</td>
<td>500</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>500</td>
<td>Continuous 6 weeks provided by HBPM</td>
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<tr>
<td>10 year</td>
<td>1,000</td>
<td>500</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>500</td>
<td>Continuous 6 years provided by HBPM</td>
</tr>
</tbody>
</table>

HBPM is useful in diagnosing different subtypes of hypertension

140/90 Office Pressure

135/85 Home Blood Pressure

Classification by Circumstances of Measurement

Implications of white coat and masked hypertension - Traditional View - office BP

US Population 250 million

NT 185 million

HT 65 million

Number at risk 65 million
Implications of White Coat and Masked Hypertension - White Coat Hypertension (WCHT)

- US Population 250 million
- True HT 52 million
- NT 185 million
- WCHT 13 million

Number at risk 52 million

Implications of White Coat and Masked Hypertension - WCHT + Masked HT

- US Population 250 million
- True NT 170 million
- Masked HT 15 million
- WCHT 13 million
- True HT 52 million

Number at risk 67 million

Implications of White Coat and Masked Hypertension

- If HBPM were used to classify BP status instead of office BP in the general population, about 40% of hypertensive (28 million people) would be classified differently.
- Thus, conventional methods of BP screening may give as many as
  - 13 million False Positives (White Coat Hypertension)
  - 15 million False Negatives (Masked Hypertension)
HBPM is a useful adjunct in the treatment of hypertensive patients

- Better determinant of drug efficacy than office BP
- Improves blood pressure control
- May improve adherence to antihypertensive medications

Meta-analysis of HBPM for improving BP control

Cappuccio et al, BMJ 2004; 329,145
A Systematic review of the effects of HBPM on medication adherence

<table>
<thead>
<tr>
<th>Study</th>
<th>Design</th>
<th>Interventions</th>
<th>Patients</th>
<th>Outcomes</th>
<th>Adherence Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Miller et al. (2005)</td>
<td>6 wk</td>
<td>HBPM</td>
<td>110</td>
<td>66% 73%</td>
<td>No</td>
</tr>
<tr>
<td>Linde et al. (2005)</td>
<td>12 wk</td>
<td>HBPM</td>
<td>100</td>
<td>60% 73%</td>
<td>Yes</td>
</tr>
<tr>
<td>Ogedegbe et al. (2006)</td>
<td>6 wk</td>
<td>HBPM</td>
<td>100</td>
<td>80% 88%</td>
<td>No</td>
</tr>
<tr>
<td>Haynes et al. (2006)</td>
<td>6 wk</td>
<td>HBPM</td>
<td>100</td>
<td>80% 88%</td>
<td>Yes</td>
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<tr>
<td>Verberk et al. (2007)</td>
<td>12 wk</td>
<td>HBPM</td>
<td>100</td>
<td>90% 97%</td>
<td>Yes</td>
</tr>
<tr>
<td>Mohamed et al. (2008)</td>
<td>6 wk</td>
<td>HBPM</td>
<td>100</td>
<td>80% 88%</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Of the 11 RCTs included, six (55%) reported statistically significant improvement in medication adherence attributed to the intervention. Five of these six studies were complex interventions.


Self-measurement of Blood Pressure at home reduces the need for antihypertensive drugs: A randomized, controlled trial

![Graph showing the proportion of patients in both treatment groups in whom medication could be discontinued (left) or in whom a stable treatment was reached at target pressure during 1 year of follow-up.](image)


Cost-Effectiveness of Self Monitoring of Blood Pressure

- 430 mildly hypertensive patients in Kaiser Permanente Medical Care Program in San Francisco
- 85% were on medication
- 215 patients were randomized to HBPM
- 215 randomized to Usual Care
- Patients were followed for one year

Soghikian et al Med Care 1992, 30:855
Cost-Effectiveness of Self Monitoring of Blood Pressure

Annual Costs Per Patient

<table>
<thead>
<tr>
<th>Service</th>
<th>Home BP</th>
<th>Usual Care</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Office visit</td>
<td>$54</td>
<td>$101</td>
<td>$47</td>
</tr>
<tr>
<td>Phone call</td>
<td>$17</td>
<td>$8</td>
<td>-$8</td>
</tr>
<tr>
<td>Procedures</td>
<td>$17</td>
<td>$16</td>
<td>-$1</td>
</tr>
<tr>
<td>Total</td>
<td>$88</td>
<td>$125</td>
<td>$37</td>
</tr>
</tbody>
</table>

Soghikian et al Med Care 1992, 30:855

How do we do Home Blood Pressure Monitoring?
Purpose of AHA Statement

- This call-to-action article address the issues of the incorporation of HBPM into routine diagnosis and management of hypertensive patients.

Key Messages

1. HBPM should be a routine component of BP measurement in known or suspected hypertensives.
2. Patients should purchase validated oscillometric monitors that measure BP on the upper arm.
3. Two to 3 readings are taken AM and PM, for 7 days. Readings of the first day is discarded and 12 readings are needed for making clinical decisions.
4. HBPM is indicated in patients with newly diagnosed or suspected hypertension, to rule out WCHT.
5. In patients with prehypertension, HBPM may be useful for detecting masked hypertension.
6. HBPM is recommended for evaluating response to antihypertensive Rx and may improve adherence.
7. The target HBPM goal for treatment should be <135/85 or 130/80 mm Hg for high-risk patients.
8. HBPM is useful in the elderly, in whom both BP variability and the white-coat effect are increased.
9. HBPM is valuable in patients with diabetes, in whom tight BP control is of paramount importance.
10. HBPM may be beneficial in pregnant women, children, and patients with kidney disease.
11. HBPM may improve the quality of care while reducing costs and it should be reimbursed.
Recommendations for clinical use of HBPM: JNC VI & WHO-ISH Guidelines

<table>
<thead>
<tr>
<th>Indications</th>
<th>JNC VI</th>
<th>WHO-ISH</th>
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<tbody>
<tr>
<td>HBPM endorsed</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>White Coat HTN</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Response to treatment</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Improve adherence</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Reduce costs</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Upper limit of “Normal”</td>
<td>135/85</td>
<td>125/80</td>
</tr>
</tbody>
</table>

Comparison of home, office, and ambulatory blood pressure

<table>
<thead>
<tr>
<th></th>
<th>Office</th>
<th>ABPM</th>
<th>Home</th>
</tr>
</thead>
<tbody>
<tr>
<td>Predicts outcome</td>
<td>Yes</td>
<td>Yes</td>
<td>?Yes</td>
</tr>
<tr>
<td>Diagnostic use</td>
<td>Yes</td>
<td>Yes</td>
<td>?Yes</td>
</tr>
<tr>
<td>“Normal”</td>
<td>&lt;140/90</td>
<td>&lt;135/85</td>
<td>&lt;135/85</td>
</tr>
<tr>
<td>Evaluation of Rx</td>
<td>Yes</td>
<td>Limited</td>
<td>Yes</td>
</tr>
<tr>
<td>Diurnal Rhythm</td>
<td>No</td>
<td>Yes</td>
<td>?Yes</td>
</tr>
<tr>
<td>Cost</td>
<td>Low</td>
<td>High</td>
<td>Low</td>
</tr>
</tbody>
</table>

Types of HBPM

- Several validated devices are available
- The standard type is an oscillometric device that records BP from the brachial artery
- Use of arm cuff is preferred over wrist or finger monitors

Locations for blood pressure measurement

- Upper arm
- Wrist
- Finger
Testing and validation of monitors

• Patients should be advised to use only monitors validated for accuracy and reliability according to standard international testing protocols
• An up-to-date list of validated monitors is available on
  – The Dabl Educational Web site (http://www.dableducational.org)
  – The British Hypertension Society Web site (http://www.bhsoc.org/default.stm)
Alphabet soup problems with interpreting validation studies

- The same monitor may be marketed under different brand names
- Manufacturers make minor changes to monitor which may or may not alter measurement accuracy
  - *How do we know if the validation of one model applies to another closely related one?*

Checking monitors for accuracy

- The fact that a device passed a validation test does not mean that it will provide accurate readings in all patients
- There are individual subjects in whom the error is consistently >5 mm Hg with a device that has achieved a passing grade
- Patients should be advised to bring their monitors to clinic to check their technique and accuracy
Protocol for testing monitors on individual patients

Alternating readings from the monitor and mercury sphygmomanometer on the same arm is preferred technique.

Sequence:

Monitor (D1)
Monitor (D2)
Mercury (M1)
Monitor (D3)
Mercury (M2)

Average of (D2 + D3) – (M1 + M2) should be within 5 mmHg.

Patient education is crucial

Patients should be made aware of the following:

- Measure arm circumference to determine the right cuff.
- Refrain from drinking coffee, smoking or exercising within the 30 minutes preceding the measurement.
- Take readings while seated after resting 5 minutes with legs uncrossed and back and arm supported on a flat surface at the level of the heart.
- Position cuff so that mid portion lies over the brachial artery.
- Take 2-3 readings at least 1 minute apart twice a day.
- Readings should be taken first thing in the morning (preferably before the subject takes medications) and evening before bedtime.
Algorithm for use of HBPM in clinical practice

• Algorithm uses both HBPM as an initial screening test and ABPM to make the definitive diagnosis
• Applies to patients who have a persistently high office BP and those with BP in the prehypertension range

Schema for Evaluating Need for Treatment

Limitations of HBPM

• Less prospective data than with ABPM
• Not all patients can or will use home monitoring
• Patients may falsify BP readings
• BP is usually taken at times of relative tranquility
• No information about nocturnal changes of BP
Hypertension Management: Traditional Model

- BP Reading
- Office Visit

Month

1
2
3

Patient

Provider

Telemonitoring connects patients & providers

1. Monitor BP at home
2. Send readings to service center
3. Immediate IVR feedback
4. BP report to Provider

Hypertension Management: The Virtual Hypertension Clinic

- Averaged BP Readings
- Office Visit

Month

1
2
3

Patient

Server

Physician
Acknowledgements

Tom Pickering, MD (1940–2009)