Adult & Paediatric Ambulatory Blood Pressure Monitoring

Cardiac Sciences

1. Purpose
This Guideline provides recommendations regarding best practice to support high quality ambulatory blood pressure monitoring (ABPM) throughout Queensland public health facilities.

2. Scope
This guideline provides information for all health practitioners who perform ABPM as part of their clinical duties.

Staff at central facilities will utilise this guideline in its entirety, whereas staff in regional areas will be constrained by local technical capability and should use elements of this guideline and processes, developed in consultation with the central receiving facility.

These guidelines do not relate to in-home devices such as automated blood pressure monitoring systems.

This guideline provides the minimum requirements to ensure consistency of service provision and quality control.

These guidelines encompass validated¹ devices that have met criteria for TGA approval by Clinical Resources and been safety tested by the Biomedical Technology Services at the Hospital and Health Service.

The following relates to ABPM devices that use the arterial pressures of the arm such as auscultation and cuff oscillometry.

3. Related documents
Authorising Policy and Standard/s:
- Nil

Procedures, Guidelines, Protocols
- [Queensland Health Guide to Informed Decision-making in Healthcare](#)²
- [Australian Guidelines for the prevention and control of infection in healthcare (CD33:2010)](#)³

Forms and templates
- Nil
4. Guideline for performing adult ambulatory blood pressure monitoring (ABPM)

4.1. Emergency Protocol

- Follow relevant Hospital and Health Service protocols or procedures in the event of an emergency.

4.2. Infection Control Procedures

- Australian Guidelines for the prevention and control of infection in healthcare (CD33:2010)³

4.3. Gaining Consent

- Gain consent using the Queensland Health Informed Decision-making in Healthcare document².
  - Offer the patient an option of who performs the test if gender preference is considered an issue, or requested by the patient.

  Implied consent is obtained (and adequate) if the following has occurred:
  - the medical officer has discussed the need for the procedure with the patient
  - the written letter of appointment outlines the procedure to be performed
  - the patient self presents for treatment and after an explanation has been given by the scientist, agrees to undergo the procedure.

4.4. Identifying Indications and Contraindications for performing ABPM

ABPM’s are intended for use as an aid or adjunct to diagnosis and treatment.

*Indications for performing ABPM*⁴⁻⁷

ABPM has a variety of uses, including:

- excluding "white coat" hypertension in patients with newly discovered hypertension with no evidence of end-organ damage
- borderline or labile hypertension
- assisting with blood pressure management in patients whose blood pressure is apparently poorly controlled, despite using appropriate antihypertensive therapy
- worsening end-organ damage, despite adequate blood pressure control on office blood pressure measurements
- hypotensive symptoms while taking antihypertensive medications
- assessing adequacy of blood pressure control over 24 hours in patients at particularly high risk of cardiovascular events, in whom rigorous control of blood pressure is essential (e.g. diabetes, past stroke)
- deciding on treatment for elderly patients with hypertension
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- suspected syncope or orthostatic hypotension
- symptoms or evidence of episodic hypertension
- suspected masked hypertension
- hypertension in pregnancy
- autonomic dysfunction
- non-dipper status or nocturnal hypertension
- suspected or confirmed sleep apnoea.

Contraindications

- ABPM is not recommended for the evaluation of patients with uncomplicated hypertension or to screen for hypertension.
- Oscillometric monitoring should be avoided in patients with non-compressible arteries, as this can produce pseudo hypertension.

4.5. Facilities and equipment

Standard Equipment

- computer with hardware and software suitable to analyse data obtained from the ABPM
- data obtained from the ABPM is subject to the organisation's local health information management policies and laws applicable to the organisation
- serial interface data cable
- ABPM software
- ambulatory blood pressure monitor calibrated as per manufactures instructions
- pressure cuff, various sizes and shapes
- cuff anchor pad (ECG electrodes) to secure cuff
- batteries as per manufacture instructions
- permanent marker to mark brachial artery
- pouch with shoulder strap or belt
- manual blood pressure device such as the cuff/stethoscope auscultation
- patient information and diary sheet (See appendix 3 for an example diary sheet).

Equipment Preparation

- Ensure the room is clean and tidy, with the appropriate equipment and patient furniture. Ensure the room meets Workplace Health and Safety Standards.
- Ensure all ABPM equipment is present and ready to use.
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- Initialise the monitor with patient details and program the monitor with specific parameters based on the referring physicians’ clinical indication for performing the test.
- Inflation frequency should be set between 15-30 minutes during daytime, 15-60 minutes nocturnally\(^{13}\).
- Before calling the patient into the room ensure to wash your hands as per the Queensland Health hand washing guidelines.

4.6. Training requirements

- Training in basic life support and cardiopulmonary resuscitation as per the relevant Hospital and Health Service protocols and procedures.
- Ensure a suitably qualified medical officer reviews the results and approves the generated report.

4.7. Test Procedure

4.7.1. Preparing the monitor and verification of proper function

- Verify proper function: ensure the monitor is on and perform at least one ABPM reading.
- Ensure consistency of BP measurements: compare the average values of the ABPM to the manual device and the readings should not differ by more than +/- 5mmHg\(^{5}\).
- If these measurements differ, perform a maintenance check consisting of: inspecting the monitor, battery check, hoses/connections and cuff for any signs of damage.
- Device calibration may need to be performed according to manufacturer instructions.

4.7.2. Patient Preparation

Cuff selection for manual BP measurement and ABPM:

- Proper cuff size selection is critical to accurate measurement. Follow manufacturer’s specifications for cuff size selection.
- Fit the cuff securely to manufacturer’s specifications with the arterial marker aligned with the brachial artery\(^{14}\).
- Measure the blood pressure in both arms. If the systolic blood pressure differs by greater than 10mmHg the arm with the higher pressure should be used\(^6\).

Record baseline blood pressure using a manual sphygmomanometer

- Allow the patient to be quiet and comfortably seated for at least five minutes\(^4\) before performing a blood pressure reading. Ensure their back and arms are supported, legs are uncrossed and upper arms are at the level of the right atrium\(^8\).
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- Blood pressure measurement in a recumbent (supine) position is acceptable also. The diastolic blood pressure can be about 5mmHg higher in the sitting position.
- Obtain three blood pressure measurements, performed at least one minute apart.

4.7.3. ABPM fitting

- Use a permanent marker to mark the brachial artery position on the patient’s non-dominant arm with a cross.
- Some ABPM cuffs come with an anchor strap attached to the cuff. If the cuff to be used has an anchor strap then secure the anchor strap to the patient’s arm using an ECG electrode.
- Connect the hoses from the cuff to the monitor.
- Position the hose comfortably on the patient ensuring the hose is not kinked. Drape the hose over the patient’s shoulders, across the back of the neck and over to the contralateral side of the body. See figure 1.
- Put monitor into its pouch. Attach the pouch to the patient using a shoulder strap or belt.

Figure 1. Taken from American Family Physician (2003)
4.7.4. Patient instructions and information

- Give the patient an appropriate information and diary sheet. (See appendix 3 for an example diary sheet)

Provide a verbal explanation of this information which includes:

- monitor operation – inflation frequency, repeat attempts for readings starting/stoppping a measurement
- avoiding movement during cuff inflation – the patient should let the cuffed arm hang loose, no flexing of the elbow or moving the hand and fingers
- cuff position - the arterial marker on the cuff should align with the brachial artery indicator (drawn cross)
- monitor care – avoid getting the monitor wet (ensure the patient is instructed to avoid having a shower/bath whilst wearing the monitor), avoid twisting/kinking hose, avoid powders/other substances, do not drop monitor
- how to remove the cuff and put the cuff back on correctly
- turning the monitor off – if the monitor causes extreme pain or the patient wishes to discontinue the test, they may turn off the monitor and remove the cuff
- filling out the patient diary with the time, and brief summary of activities performed during cuff inflations as well as retiring and waking times
- a contact phone number provided for problems or queries.

4.7.5. Data retrieval and reporting

- Refer to device instructions to download the data.
- Enter any patient diary comments and altered parameters such as the time the patient went to sleep and awoke.
- Review the study data.
- Create a customised report (with consideration of – nocturnal dip, BP load, classification values) (see Appendix 1 for further considerations) and print the report.
- Obtain confirmation of the results by a medical officer.

4.7.6. Alternate protocols

- Workplace instructions for each facility will be necessary to complement this procedure, dependent on the equipment in use and its clinical functionality.
- Appendix 2 outlines paediatric variations.
4.8. Quality Control Procedures

- Cuff size/fitting – Errors in readings are generally worse in cuffs that are too small vs those that are too large. If a cuff is too small, BP readings may be falsely high; if a cuff is too large, they may be falsely low.

5. Review

This Guideline is due for review on: 07/12/2016

Date of Last Review: New Document

Supersedes: Nil

6. Business Area Contact

Dane Enkera - Statewide Clinical Measurements Network (Chair)

7. Definitions of terms used in the policy and supporting documents

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition / Explanation / Details</th>
<th>Source</th>
</tr>
</thead>
</table>

8. Approval and Implementation

Policy Custodian:
Julie Hulcombe – Chief Allied Health Officer

Responsible Executive Team Member:
Dr Michael Cleary
Deputy Director General
Health Services and Clinical Innovation

Approving Officer:
Dane Enkera – Statewide Clinical Measurements Network (Chair)

Consulting stakeholders:
Key stakeholders (position and business area) who reviewed this version are:
Cardiac Sciences Working Party:
Department of Health: Adult & Paediatric Ambulatory Blood Pressure Monitoring (ABPM)

- Dane Enkera – Senior Cardiac Scientist, Princess Alexandra Hospital
- Kellie Homann – Cardiac Scientist, The Royal Brisbane & Women’s Hospital
- Barry Kochevatkin – Director Clinical Measurements Unit, Mackay Hospital
- Elissa Ulett – A/Director Cardiac Investigations Unit, The Townsville Hospital
- Daniel Wright – Cardiac Scientist, The Prince Charles Hospital
- Oscar Davison – Cardiac Scientist, The Prince Charles Hospital
- Justin Gordon – Paediatric Cardiac Scientist, QLD Paediatric Cardiac Services

Primary stakeholders as identified in the Stakeholder analysis:
- State-wide Clinical Measurements Network (SWCMN)
- State-wide Cardiac Clinical Network
- Northern, Central & Southern Cardiac Networks
- Professionals in Cardiac Sciences Australia (PiCSA)
- Cardiology Department Directors
- Allied Health Professions Office Queensland
- Cardiac Sciences Department Directors

Approval date: 07/12/2013
Effective from: 07/12/2013
Department of Health: Adult & Paediatric Ambulatory Blood Pressure Monitoring (ABPM)

9. Appendices

Appendix 1 - Reporting considerations in Adult ABPM studies.

Table 1 Values suggested by the National Heart Foundation for daytime, night time, and 24-hour average blood pressure:

<table>
<thead>
<tr>
<th></th>
<th>Normal</th>
<th>Abnormal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daytime</td>
<td>&lt;120/80 mm Hg</td>
<td>≥135/85 mm Hg</td>
</tr>
<tr>
<td>Night-time</td>
<td>&lt;105/65 mm Hg</td>
<td>≥120/70 mm Hg</td>
</tr>
<tr>
<td>24-hour</td>
<td>&lt;115/75 mm Hg</td>
<td>≥130/80 mm Hg</td>
</tr>
</tbody>
</table>

Nocturnal dip
Nocturnal dipping is a significant day-night difference in blood pressure of more than 10% or more than 10/5 mmHg.

Blood Pressure Load
Blood pressure load is an integrated measure of the 24-hour blood pressure. It is defined as the proportion of 24-hour blood pressure recordings that are increased relative to the thresholds for waking and sleep blood pressure (usually higher than 140/90 mm Hg during the awake period and higher than 120/80 mm Hg during the sleep hours).

Suggested Clinical Interpretation Reporting template

24hr ambulatory blood pressure monitor demonstrates *(refer to Table 1)

The average awake blood pressure was * mmHg
The average asleep blood pressure was * mmHg

Maximum blood pressure was * mmHg @ * whilst *
Minimum blood pressure was * mmHg @ * whilst *

Awake BP Load: *% of awake systolic BP’s were greater than 140 mmHg
*% of awake diastolic BP’s was greater than 90 mmHg
Asleep BP Load: *% of asleep systolic BP’s were greater than 120 mmHg
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*% of asleep diastolic BP’s were greater than 80 mmHg

Nocturnal dip noted/ No nocturnal dip noted.

Blood pressure is (adequately/inadequately) controlled.

Reporting Physician: Dr DD/MM/YYYY

Cardiac Scientist:

*Normal ABP readings*

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>24-h average</td>
<td>&lt;15/75mmHg</td>
</tr>
<tr>
<td>Daytime average</td>
<td>&lt;120/80mmHg</td>
</tr>
<tr>
<td>Night-time average</td>
<td>&lt;105/65mmHg</td>
</tr>
</tbody>
</table>
Appendix 2 - Paediatric protocols procedure variations

ABPM has been gaining acceptance as a useful modality for the evaluation of BP levels in children and adolescents. Many recommendations and procedures for ABPM in adults are applicable in the paediatric population; however important variations in patient preparation and analysis of the results exist.

The American Heart Association Scientific Statement on ABPM in Children and Adolescents \(^\text{17}\) outlines the necessary criteria for accurate and valid ABPM in this population. These include:

- ABPM should only be performed by personnel with specific training in the application of the device and interpretation of ABPM data in paediatric patients.
- Use of an appropriately sized cuff (Figure 2) \(^\text{18}\).
- The device should be programmable to record every 15-20mins throughout the 24 hours. As a minimum at least 1 valid reading per hour is required for an interpretable study.
- Sleep-wake times are to be recorded and programmed into the software before analysis to divide the ABPM study into awake and asleep periods.
- Children undergoing ABPM should continue their normal activities but refrain from contact sports and vigorous exercise.
- In paediatric patients, normal BP standards are to be adjusted and based on gender, age and height with ABPM levels being interpreted using the appropriate paediatric normative data. This data can be found in the AHA scientific statement \(^\text{17}\). The ABPM software must be adaptable to include the paediatric reference data.

It is essential that centres performing ABPM within the paediatric population work within the recommendations set out within the AHA scientific statement to ensure accurate interpretation of the ABPM data. Interpretation of ABPM data in the paediatric population is outside the scope of this guideline and has not been included.
<table>
<thead>
<tr>
<th>Age Range</th>
<th>Width (cm)</th>
<th>Length (cm)</th>
<th>Maximum Arm Circumference (cm)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newborn</td>
<td>4</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>Infant</td>
<td>6</td>
<td>12</td>
<td>15</td>
</tr>
<tr>
<td>Child</td>
<td>9</td>
<td>18</td>
<td>22</td>
</tr>
<tr>
<td>Small adult</td>
<td>10</td>
<td>24</td>
<td>26</td>
</tr>
<tr>
<td>Adult</td>
<td>13</td>
<td>30</td>
<td>34</td>
</tr>
<tr>
<td>Large adult</td>
<td>16</td>
<td>38</td>
<td>44</td>
</tr>
<tr>
<td>Thigh</td>
<td>20</td>
<td>42</td>
<td>52</td>
</tr>
</tbody>
</table>

* Calculated so that the largest arm would still allow bladder to encircle arm by at least 80 percent.

Figure 2: Taken from the fourth report on the diagnosis, evaluation and treatment of high blood pressure in children and adolescents.
24 HR AMBULATORY BLOOD PRESSURE MONITOR EVENT DIARY

Name:_______________________________            UR:_____________________

Date:__________ Time:__________ Bedtime :______  Time you woke up:______

ARM on which cuff was applied: _______ Baseline BP: ____________

Please note any strenuous activity, as well as activity that you were doing at the time of any events. Activities of particular interest to note are, but not limited to: Sitting, standing, lying down, talking, relaxing, eating, walking, driving, stress, exercise etc.

Please ensure that the monitor does not get wet.

IF YOU FIND THE BLOOD PRESSURE MONITOR IS TOO UNCOMFORTABLE AND DO NOT WISH TO CONTINUE WITH THE MEASUREMENTS OR HAVE ANY FURTHER CONCERNS OR QUESTIONS: Please contact__________________

<table>
<thead>
<tr>
<th>TIME</th>
<th>SYMPTOM</th>
<th>ACTIVITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eg 2:10pm</td>
<td>Felt dizzy</td>
<td>Walking up stairs</td>
</tr>
</tbody>
</table>

When the blood pressure cuff inflates, keep your arm relaxed and still by your side

You can initiate extra readings or stop a reading at any time by pressing the “START” button once
10. Suggested Readings and References

10.1. Suggested Readings


10.2. References