Inclusion Criteria
All patients greater than 1 year old on acute care and ambulatory clinics

Exclusion Criteria
Patients in ICU and patients less than one year old

Blood Pressure Measurement

Executive Summary

Test Your Knowledge

Citation Information

Conduct Automatic Blood Pressure Assessment

Results Within Normal Limits?

Yes

Blood Pressure Within Normal Limits
- Continue with current plan of care.

No

Hypertension?

Yes

Hypertension
- Automatic blood pressure units overestimate up to 10 mmHg.
- Manual blood pressure cuff is indicated for verification of hypertension.

Conduct MANUAL Blood Pressure Assessment

Hypertension Verified?

Yes

Hypertension Verified with Manual Cuff
- Call provider to determine treatment plan

No

No

Hypotension
- Interpret the BP in the clinical context of the patient.
- Verify proper cuff size and placement were used
- Verify with automatic blood pressure cuff.

Conduct AUTOMATIC Blood Pressure Assessment

Hypotension Verified?

Yes

Hypotension Verified with Automatic Cuff
- Call provider to determine treatment plan

No

No
Definitions

<table>
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<tr>
<th>Manual Blood Pressure Measurements:</th>
<th>Automated Oscillometric Blood Pressure Measurements:</th>
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<td>Measures <em>mean arterial</em> BP (MAP). Systolic and diastolic BPs are calculated or determined from the MAP based on manufacturer calculation.</td>
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How is a Manual BP Measured?

1. Verify the cuff has been calibrated (see previous slide)
2. Appropriate sized cuff placed on extremity
3. Stethoscope placed over brachial artery on antecubital fossa
   a. No sound should be audible
4. Cuff is inflated to pressure above the systolic BP
   a. Blood flow is occluded in the artery
5. Deflate the cuff slowly noting when first Korotkoff sound is heard (Systolic BP)
   a. The blood flows in spurts, creating turbulence, producing sounds
6. Continue to slowly deflate cuff noting when final Korotkoff sound is heard (Diastolic BP)
   a. As the cuff pressure no longer restricts flow, the sounds disappear
## Definitions

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When to Verify With a Manual BP

- Manual BPs are considered **more accurate** and should be used as verification for **patients with hypertension** because automated devices tend to over-estimate BP.
- Automated devices tended to overestimate BP by approximately 10 mmHg.

**IMPORTANT!**
When measurements read low, there is **NOT** valid reason to re-check with a manual cuff since the automated device typically over-estimates BP.

- If the measurement reads low, interpret the BP in the clinical context of the patient and verify the proper cuff size and placement were used.
Choosing the appropriate cuff size

Wong's Standards:

- Cuff size is based on the internal bladder length determined by markings on the cuff or feeling for the bladder inside the cuff.
  - **Bladder length**: should be 80-100% of diameter of the extremity
  - **Bladder width**: should be 40% of diameter of the extremity

Incorrect Cuff Size Results/Measures:

- A cuff that is too large will provide a false low reading
- A cuff that is too small will provide a false high reading

Where to place the cuff:

- Lower extremity BPs are typically higher in children greater than 6 months of age.
  - For this reason, it is important to document which extremity was used for the BP measurement.

*It is best to measure BPs in upper extremities for all patients.*

- Lower extremity BPs are appropriate for patients less than 6 months of age or those with contraindications to upper extremity BPs.
- Please note the importance of extremity selection for coarctation of the aorta.
Pearls to Take Home

- Use automated BPs for routine monitoring.
- When possible, BPs should be measured in upper extremities.
  - In infants less than 6 months, it is appropriate to use lower extremity BPs.
- If the patient has a low BP, use clinical judgement and verify proper cuff size and placement were used.
- Verify with a manual BP if the patient has hypertension.
  - Manual BPs are difficult in patients less than 12 months.
- Accurately document all pieces of BP measurement in IView.
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How is an Automatic BP Measured?

1. Appropriate sized cuff placed on extremity
2. Start button triggers inflation followed by slow deflation of the cuff.
   a. Cuff sensor detects the oscillations of the pulse to determine the **mean arterial BP** (MAP)

Each manufacturer uses their own algorithm to determine the systolic and diastolic BP.

- **Example:** 18 different automated devices were evaluated for a simulated BP of 120/80.
  - Systolic BP varied between 112.6 to 126.6 mmHg.
  - Diastolic BP varied between 74.8 to 86.9 mmHg. No sound

Source: American Diagnostic Corporation, 2006
Completion qualifies you for 1 hour of Category II CME credit. If you are taking this self-assessment as a part of required departmental training at Seattle Children's Hospital, you MUST logon to Learning Center.

1. What is the difference between a manual blood pressure (BP) measurement and an automatic BP measurement?
   a. Manual BPs are always better to use than automatic BPs.
   b. Manual BPs measure the systolic and diastolic where automatic BPs measure the mean arterial pressure.
   c. Manual BPs use an algorithm to determine the blood pressure measurement and automatic BPs do not.
   d. There is no difference.

2. How is a systolic BP noted during a manual BP measurement?
   a. The first Korotkoff sound that is heard
   b. The last Korotkoff sound that is heard
   c. By the pressure the patient feels after 5 seconds
   d. In the middle of the first and last Korotkoff sounds

3. When should a manual BP be used to verify an automatic BP measurement?
   a. When the patient has a low blood pressure
   b. When the patient is less than 6 months of age
   c. When the patient is moving or crying
   d. When the patient has hypertension

4. If a patient has a low BP when measured with an automated device I should...
   a. Call the provider to come to the bedside immediately
   b. Look at the clinical context to determine if the value is accurate
   c. Verify the proper cuff size and placement were used
   d. Both b and c

5. What determines the appropriate cuff size?
   a. Bladder length and width are 50% of the diameter of the extremity
   b. The entire cuff length is 75% of the diameter of the extremity
   c. Bladder length is 80-100% and bladder width is 40% of the diameter of the extremity
   d. It looks right

6. What items must be documented for all BP measurements?
   a. The systolic and diastolic BP, BP extremity, manual or automatic, and BP cuff size
   b. Where the patient was at the time of the BP measurement
   c. The mean arterial pressure
   d. None of the above
1. (b) Manual BPs measure the systolic and diastolic where automatic BPs measure the mean arterial pressure.
2. (a) The first Korotkoff sound that is heard
3. (d) When the patient has hypertension
4. (d) Both b and c
5. (c) Bladder length is 80-100% and bladder width is 40% of the diameter of the extremity
6. (a) The systolic and diastolic BP, BP extremity, manual or automatic, and BP cuff size
Executive Summary

EBP - Blood Pressure Comparison  February 2014

Objective
To determine best practice for blood pressure measurement in patients less than 18 years old (excluding infants cared for in the NICU).

1. Determine the reliability of automatic blood pressure measurement versus manual blood pressure measurement
2. Determine best practice for selecting correct blood pressure cuff size regardless of method of measurement
3. Determine best practice for selecting correct blood pressure cuff location for accurate blood pressure measurement regardless of method of measurement

Recommendations

- Manual blood pressure measures systolic and diastolic blood pressure by the clinician listening for Korotkoff sounds. Automatic blood pressure detects the oscillations of the pulse to determine the mean arterial blood pressure then the systolic and diastolic blood pressures are calculated based on the manufacturer programmed algorithm.
- Automatic blood pressure devices OVER estimate measurement by up to 10mmHg making verification of hypotension, noted on an automatic device, with a manual cuff clinically unnecessary. The 10mmhg over estimate may require confirmation of hypertension using a manual blood pressure cuff.
- Manual blood pressure is usually not feasible for patients less than 12 month of age due to cuff size and the difficulty hearing Korotkoff sounds.
- Choosing appropriate blood pressure cuff size and location of measurement if vital in obtaining accuracy. Upper extremity measurement is preferred but lower extremity is acceptable in infants less than 6 months of age.

Rationale

- Safety: Calibration of devices used to measure manual versus automatic BP are addressed in training and recommendations. The accuracy of measurements along with clinical assessment is vital in providing timely intervention to our patients.
- Quality: of care will improve through standard blood pressure measurement
  - Standard measurement device
  - Appropriate cuff size
  - Appropriate cuff location
- Delivery: of care will improve with assessment standards
- Engagement: Clinical tension may occur between nursing and providers when there is a clinical question answered with opinion rather than evidence. The evidence presented in this executive summary provides clinical rationale which promotes communication.
- Patient/Family Satisfaction: will be improved through standard expectations and shared understanding of clinical relevance of blood pressure monitoring as one aspect of a clinical assessment.
Evidence
Under the guidance of Susan Klawansky a search of electronic databases was accomplished using the search terms blood pressure determination, sphygmomanometers, manual, automated, conventional, auscultatory. Additional articles were reviewed as identified by team members. A total of 65 records were identified. Of those 65 records 50 records were excluded as they did not address the clinical questions. Of these 15 records 6 were excluded as they did not meet the identified quality threshold or provide evidence toward the question being asked. 9 articles were then reviewed. The remaining 9 articles were reviewed by 2 RN’s and rated for level of evidence. Summary of the 9 articles can be found in the evidence and recommendation document.

Implementation Items
1. Learning center module describing the EBP question, summarizing the findings, and listing the practice changes as an outcome of reviewing the evidence. This module is required by all acute care and outpatient nurses and will be tracked for compliance as part of annual performance evaluation.
2. Return demonstration of blood pressure measurement (manual) will be required of all acute care RN’s as part of their 2014 competency review.
3. RISK nurses will review the learning module to assure understanding of practice change in support of the acute care nurses.
4. Housewide operations council (nursing) will audit and maintain manual blood pressure equipment on each unit.
5. Summarize findings and present to general medical residents.

Metrics Plan
1. Count of Inpatient/observation discharges
2. Median Inpatient/Observation Length of Stay

PDCA Plan
The CSW blood pressure CNS owner and EBP committee will follow metrics, continue to review medical literature, and make alterations to the recommendations as needed.

Revision History
Date Approved: February 2014
Next Review Date: February 2017
Approved by the EBP Council and the CSW Team in February 2014

EBP Team:

Medical Unit CNS: Kristi Klee, MSN, RN-BC (CSW Owner)
Surgical Unit CNS: Ashley Wagner, MN, RN, PCNS-BC, CPN
EBP Council Members

Clinical Effectiveness Team:

Consultant: Jean Popalsky, DNP
Project Leader: Pauline O’Hare, RN, MBA
KM Analyst: Suzanne Spencer, MBA, MHA
CIS Informatician: Mike Leu, MD, MPH
Librarian: Susan Klawansky, MLS
Program Coordinator: Ashlea Tade
Blood Pressure Measurement

Title: Blood Pressure Measurement

Authors:
- Seattle Children’s Hospital
- Deb Ridling
- Kristi Klee
- Ashley Wagner
- Pauline O’Hare
- Jean Popalisky

Date: February 2014

Retrieval Website: http://www.seattlechildrens.org/pdf/blood-pressure-measurement-pathway.pdf

We used the GRADE method of rating evidence quality. Evidence is first assessed as to whether it is from randomized trial, or observational studies. The rating is then adjusted in the following manner:

Quality ratings are *downgraded* if studies:
- Have serious limitations
- Have inconsistent results
- If evidence does not directly address clinical questions
- If estimates are imprecise OR
- If it is felt that there is substantial publication bias

Quality ratings can be *upgraded* if it is felt that:
- The effect size is large
- If studies are designed in a way that confounding would likely underreport the magnitude of the effect OR
- If a dose-response gradient is evident

**Quality of Evidence:**
- 🌟🌟🌟🌟 High quality
- 🌟🌟🌟 Moderate quality
- 🌟🌟 Low quality
- 🌟 Low quality
- 🌟🌟🌟🌟 Very low quality

Expert Opinion (E)

Version 1 (02/18/2014): Go live
Medical Disclaimer

Medicine is an ever-changing science. As new research and clinical experience broaden our knowledge, changes in treatment and drug therapy are required.

The authors have checked with sources believed to be reliable in their efforts to provide information that is complete and generally in accord with the standards accepted at the time of publication.

However, in view of the possibility of human error or changes in medical sciences, neither the authors nor Seattle Children’s Healthcare System nor any other party who has been involved in the preparation or publication of this work warrants that the information contained herein is in every respect accurate or complete, and they are not responsible for any errors or omissions or for the results obtained from the use of such information.

Readers should confirm the information contained herein with other sources and are encouraged to consult with their health care provider before making any health care decision.
Literature Search Strategy

Search Methods, Blood Pressure Comparison, Clinical Standard Work
Studies were identified by searching electronic databases using search strategies developed and executed by a medical librarian, Susan Klawansky. Searches were performed in March 2013 in the following databases: on the Ovid platform – Medline, Cochrane Database of Systematic Reviews, Cochrane Central Register of Controlled Trials; elsewhere – EMBASE, CINAHL, National Guideline Clearinghouse, TRIP and Cincinnati Children’s Evidence-Based Care Guidelines. Retrieval was limited to ages 0 – 18, English language and 1996 to current. In Medline, EMBASE and CINAHL, appropriate Medical Subject Headings (MeSH), Emtree headings and CINAHL subject headings were used respectively, along with text words, and the search strategy was adapted for other databases as appropriate. Concepts searched were blood pressure determination, sphygmomanometers, manual, automated, conventional, auscultatory. All retrieval was further limited to certain evidence categories, such as relevant publication types, Clinical Queries, index terms for study types and other similar limits. Additional articles were identified and added to results by team members.

Susan Klawansky, MLS, AHIP
September 9, 2013

Flow diagram adapted from Moher D et al. BMJ 2009;339:b2535


