

SEATED BLOOD PRESSURE AND HEART RATE MEASUREMENT (Baseline)

1 Background and Purpose

Level of blood pressures is subject to biologic and observer variations, the latter being due to errors in measurement. The purpose of a specific protocol for the measurement of BP and a stringent certification procedure for technicians who measure BP in CHS is to minimize error in measurement.

2 Definitions and Alerts

The seated BP reading for CHS is an average of the two systolic and diastolic BP's calculated by computer. When either Blood Pressure reading is elevated, it will trigger an "alert" and subsequent participant/ physician notification.

2.1 The 1988 Report of the Joint National Committee on Detection, Evaluation, and Treatment of High Blood Pressure defines categories of BP and recommend follow-up according to the following criteria:

2.1.1 Classification of BP in Adults Aged 18 Years or Older*

BP Range, mm Hg Category**

Diastolic BP

< 85	Normal BP
85-89	High-Normal BP
90-104	Mild Hypertension
105-114	Moderate Hypertension
≥ 115	Severe Hypertension

Systolic BP, when Diastolic BP < 90 mm Hg:

< 140	Normal BP
140-159	Borderline isolated systolic hypertension
≥ 160	Isolated systolic hypertension

* Classification based on the average of two or more readings on two or more occasions. BP indicates blood pressure; DBP diastolic blood pressure; and SBP, systolic blood pressure.

** A classification of borderline isolated systolic hypertension (SBP, 140 to 159 mm Hg) or isolated systolic hypertension (SBP, ≥ 160 mm Hg) takes precedence over high-normal BP (DBP 85 to 89 mm Hg) when both occur in the same person. High-normal BP (DBP, 85 to 89 mm Hg) takes precedence over a classification of

normal BP (SBP, < 140 mm Hg) when both occur in the same person.

2.1.2 Follow-up Criteria for Initial BP Measurement for Adults Aged 18 Years or Older*

<u>BP Range, mm Hg</u>	<u>Recommended Follow-up</u>
Diastolic BP	
< 85	Recheck within 2 yr
85-89	Recheck within 1 yr
90-104	Confirm within 2 mo
105-114	Evaluate or refer promptly to source of care within 2 weeks
≥ 115	Evaluate or refer immediately to source of care
Systolic BP, when DBP < 90 mm Hg	
< 140	Recheck within 2 yr
140-199	Confirm within 2 mo
≥ 200	Evaluate or refer promptly to source of care within 2 weeks

* When recommendations for follow-up of DBP and SBP are different, the shorter recommended time for recheck and referral should take precedence.

2.1.3 "Alert" levels requiring immediate referral are:

Diastolic BP ≥ 115
Systolic BP ≥ 200

2.1.4 "Physician notification" alert levels:

BP ≥ 140/90 requires follow-up within two months time, and therefore we recommend physician notification for systolic or diastolic BP above these levels.

2.2 Blood Pressure Measurement

2.2.1 The Hawksley Random-Zero Sphygmomanometer is a mercury sphygmomanometer, with the same basic principles of operation as the standard mercury manometer. The essential distinction is a mechanism designed to produce a variable level of mercury in the manometer column when the actual pressure in the cuff is zero. This is accomplished through an adjustable-volume chamber, which is interconnected with the mercury reservoir at one end and the manometer column at the other end.

The adjustment is made by the observer, by spinning an external wheel which contacts and rotates an internal, bevelled cam; the position where the cam comes to rest after

spinning determines where the bevelled edge will meet the sliding wall of the mercury chamber; when air pressure is applied through the cuff, the wall is displaced until it rests against the cam, and only the mercury remaining after filling this new volume of the chamber is displaced into the manometer column. A valve controlled by the observer locks the chamber system after the maximum inflation pressure desired has been applied, so that at the end of the reading, and only at the end, the mercury comes to rest at its "randomly" determined zero-pressure level. When this value is subtracted from the recorded readings, the corrected readings give the corresponding actual pressure levels. Thus, by the addition of this mechanism for varying the "zero" level of mercury to the conventional device, the Random-Zero device obscures the true levels of pressure observed until after the uncorrected blood pressure is recorded and the "zero" level is read and subtracted. In this way, some of the recognized difficulties in observer performance are substantially reduced -- primarily, interference by observer bias when readings fall near critical levels of blood pressure.

2.3 Criteria for Systolic and Diastolic Blood Pressure

To correctly identify the 1st-phase (systolic) and 5th-phase (diastolic) Korotkoff values, the observer must listen carefully via the stethoscope while reading and interpreting the mercury column.

- 2.3.1 The systolic value is the pressure level where the first of two or more sounds are heard in appropriate rhythm.
- 2.3.2 The diastolic value can be identified as the pressure level where the last of these rhythmic sounds is heard.
- 2.3.3 The mercury should be made to drop at 2 mm Hg per second, from the maximum pressure until 10 mm Hg below that of the last regular sound heard. The control of the deflation rate is essential for accurate readings and depends on handling of the bulb and its control valve.

NOTE: A single sound heard in isolation (i.e., not in rhythmic sequence) before the first of the rhythmic sounds (systolic) or following the last of the rhythmic sounds (diastolic) does not alter the interpretation of the blood pressure.

2.4 Equipment

- One or two standard mercury sphygmomanometers
- Three Hawksley Random-Zero Sphygmomanometers
- Two standard stethoscope tubing and earpieces (suggest Litman) with bell, with tubing to be a **maximum** of 14 inches long
- One double headed stethoscope
- BP cuffs in four sizes:
 - 2 large adult cuffs

- 1 thigh cuff
- 1 pediatric cuff
- 2 regular adult cuffs

3 **Methods**

3.1 Cuff Size

Proper cuff size must be used to avoid under-or-over-estimation of the correct blood pressure. Cuff Size is the size of the cuff's bladder, not the cloth. A copy of the chart below should be attached to the sphygmomanometer for easy reference.

The directions for the Arm Measurement Procedure are as follows:

- Participant removes upper garment.
- Participant stands, holding forearm horizontal to the floor.
- Measure arm length from the acromion (bony extremity of the shoulder girdle) to the olecranon (tip of the elbow), using a metric tape.
- Mark the midpoint on the dorsal surface of the arm.
- Participant relaxes arm along side of the body.
- Draw the tape snugly around the arm at the midpoint mark.
NOTE: Keep the tape horizontal. Tape should not indent the skin.
- Use the criteria below for determining cuff size. (Do not use the markings on the blood pressure cuff for reference.)

CUFF SIZE INDICATED BY MEASURED ARM CIRCUMFERENCE

<u>ARM CIRCUMFERENCE (cm)</u>	<u>CUFF'S BLADDER SIZE (cm)*</u>
Up to 5.9	2.5 ("newborn")
6.0 to 15.9	6.5 ("infant")
16.0 to 22.5	9.0 ("child" or "pediatric")
22.6 to 30.0	12.0 ("adult" or "regular")
30.1 to 37.5	15.0 ("large arm")
37.6 to 43.7	17.5 ("thigh")

* Bladder widths shown are at least 40% of the largest corresponding arm circumferences.

- Record the cuff size used on the form.

3.2 Application of Blood Pressure Cuff

- Place the appropriate cuff around the upper right arm so that:
 - The midpoint of the length of the bladder lies over the brachial artery, and
 - The mid-height of the cuff is at heart level.
- Place the lower edge of the cuff, with its tubing connections, about 1 inch above the natural crease across the inner aspect of the elbow.
- Wrap the cuff snugly about the arm, with the palm of the participant's hand turned upward.
- Secure the wrapped cuff firmly by applying pressure to the locking fabric fastener over the area where it is applied to the cuff.
- Do not wrap the cuff too tightly around the arm.

3.3 Determining the Maximal Inflation Level

For each participant determine the maximal inflation level, the pressure to which the cuff is to be inflated for systolic blood pressure measurement. This assures that the cuff pressure at the start of the reading exceeds the systolic blood pressure and thus allows the first Korotkoff sound to be heard.

The procedures for determining Maximal Inflation Level are as follows:

- Attach the cuff tubing to the standard mercury sphygmomanometer.
- Palpate the radial pulse.
- Inflate the cuff until the radial pulse is no longer felt (palpated systolic) by inflating rapidly to 70 mm Hg, then inflating by 10 mm Hg increments.
- Deflate the cuff quickly and completely.
- Inflate the cuff to 30 mm Hg above the palpated systolic pressure for all readings, plus the maximum zero level.

3.4 Guidelines for Random Zero Readings

- All readings are made to the nearest even digit.
- Any reading which appears to fall exactly between markings on the mercury column should be read to the next higher marking i.e., 2, 4, 6, 8 or 0.
- All readings are made at the top of the meniscus, or rounded surface of the mercury column.

- When the pressure is released quickly from a high level, a vacuum is formed above the mercury and the meniscus is distorted. Allow a few moments for it to reappear before reading the manometer.

3.5 Heart rate Measurement

Part of the blood pressure measurement procedure is radial pulse measurement. This measurement serves two purposes: (1) to document the resting heart rate at the time of examination; and (2) to permit detection of gross irregularities of heart rhythm which may affect interpretation of the blood pressure readings.

- Measure pulse on the right arm after the participant has been seated quietly, with both feet flat on the floor, in an erect but comfortable posture, for at least five minutes.
- No smoking is allowed during this period.
- Participant rests the elbow and forearm comfortably on the table.
- Palpate the radial pulse with the palm of the hand turned upward and count for exactly for 30 seconds.
- Record the number of beats in 30 seconds.
- Any marked irregularity observed during this period should be called to the attention of the supervisor, or clinic physician.

3.6 Blood Pressure Readings

Detailed instructions are given below for measuring blood pressure with a Random-Zero sphygmomanometer.

- Connect the cuff to the Random-Zero device.
- Ensure that the mercury reservoir lever is in the operating position by turning the control valve on the face of the device to the right, to the position marked "OPEN."
- Turn the wheel (downstroke only) at the right side of the device, by stroking it a few times with the extended fingertips of the right hand.
- Inflate cuff to the previously determined maximal inflation level.
- Hold the pressure at this level for 5 seconds (count to 5 slowly), by closing the thumb valve, then turn the control valve to the left, to the position marked

"CLOSED."

- Deflate the cuff in the same manner as for the conventional device, (2-3 mm HG per second) by carefully controlling the thumb valve, until the mercury level is 10 mm below the diastolic reading (that is, 10 mm below the level where the last regular sound was heard).
- Open the thumb valve fully and disconnect the tubing from the cuff, allowing the mercury to fall to its "zero" level for this reading.
- Record the uncorrected systolic and diastolic readings.
- Record the "zero" level for the reading.
- By subtraction, calculate and record the actual systolic and diastolic readings in the spaces provided. NOTE: This will be done by the computer.

3.7 Second Readings

- Hold the participants arm vertical for full 5 seconds.
- Wait at least 25 seconds before proceeding with second readings.
- Repeat the steps in Section 3.6 to obtain the second blood pressure readings.

4 **References**

- 1) 1988 Joint National Committee, The 1988 Report of the Joint National Committee on Detection, Evaluation, and Treatment of High Blood Pressure. Arch Intern Med, 148, 1988, pp.1023-1037.
- 2) Working Group on Hypertension in the Elderly, Statement on Hypertension in the Elderly. JAMA, 1986, 256, No. 1, pp. 70-74.
- 3) Labarthe DR, Palmer M. Measurement of Blood Pressure: A Manual for Training and Certification. Adapted for the Systolic Hypertension in the Elderly Program (SHEP). June 5, 1985.
- 4) Borhani No, LaBaw F, Dunkle S. Blood pressure measurement in an ambulatory setting. In: Ambulatory blood pressure monitoring. New York: Springer-Verlag, 1984: 75-81.
- 5) Frohlich EC, Grim C, Labarthe DR, et al. Recommendations for human blood pressure determination by sphygmomanometers. Hypertension 1988; 11: pp. 209A-222A.

- 6) Atherosclerosis Risk in Communities Study (ARIC) Protocol, Manual 2: Cohort Component Procedures, Version 2.0 1/88. ARIC Coordinating Center, Suite 203 NCNC Plaza, 137 E. Franklin St, Chapel Hill, NC 27514.