Blood Pressure Measurement Guidelines for Physical Therapists

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ABSTRACT
Vital sign measurement and assessment are important components of the review of systems in a physical therapy examination for individuals with and without documented cardiopulmonary disease. The measurement of blood pressure gives the therapist information regarding the patient's baseline cardiovascular status, response to exercise/activity, and guides exercise prescription. Accurate measurement of blood pressure is critical for making appropriate clinical decisions especially if physical therapists wish to play an important role as primary health care providers. The purpose of this paper is to present recommended guidelines for blood pressure measurement by physical therapists and physical therapist assistants.

Key Words: blood pressure measurement, vital sign assessment, guidelines

BLOOD PRESSURE MEASUREMENT GUIDELINES FOR PHYSICAL THERAPISTS

As stated in the *Guide to Physical Therapist Practice*, assessment and monitoring of vital signs are important components of the review of systems in a physical therapy examination for individuals with and without documented cardiopulmonary disease.[1] The U.S. Preventive Services Task Force recommends screening for high blood pressure in adults 18 years of age and older.[2] Blood pressure screening should occur every two years in people with blood pressures less than 120/80 mm Hg, and every year for people with systolic blood pressure 120 mm Hg to 139 mm Hg, or diastolic blood pressure 80 mm Hg to 89 mm Hg. The measurement of blood pressure gives the therapist information regarding the patient's baseline cardiovascular status, response to exercise/activity, and guides exercise prescription.

The 7th Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC 7) provides a scheme for classifying blood pressure for adults (≥ 18 years of age) and defines hypertension as beginning at systolic and diastolic pressures of 140/90 mm Hg, respectively.[3] Table 1 presents the JNC 7 classification of hypertension, which is based on an average of at least two seated blood pressure measurements, properly measured with well-maintained equipment in a single visit. In order for the diagnosis of hypertension to be established, an elevated blood pressure measurement must occur in at least two separate visits to the health care provider's clinic or office.[3]

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Table 1. Classification of Hypertension[3,4]

Classification	Systolic Blood Pressure (mm Hg)	Diastolic Blood Pressure (mm Hg)
Normal	<120	<80
Prehypertension	120–139	80–89
Stage 1 hypertension	140–159	90–99
Stage 2 hypertension	≥160	≥100

Modified from Chobanian et al[3] Pickering et al[4]

Hypertension is the most common primary diagnosis in the United States. It is a major risk factor for coronary heart disease, stroke, and renal failure, and affects 29% of the adult US population.[3,4] Twenty-two percent of persons who have hypertension are unaware that they have it.[3] In addition, one-fourth of the population 20 years and older is estimated to be prehypertensive, which is defined as a systolic blood pressure of 120-139 mm Hg, and/or a diastolic blood pressure of 80-89 mm Hg. Prehypertension contributes to about 15% of blood pressure related deaths for coronary artery disease.[4] Pulse pressure (systolic blood pressure minus diastolic blood pressure), which is normally around 40 mm Hg, has been postulated to be a better predictor of cardiovascular risk than mean arterial pressure.[5,6] Elevated pulse pressures (> 60 mm Hg) are associated with higher cardiovascular morbidity and mortality rates among all arterial blood pressure data.[5,6]

Hypertension and prehypertension in children and adolescents 8 to 17 years old have increased since 1999, and both are frequently undiagnosed in children 3 to 18 years of age.[5,13] Childhood blood pressure is a strong predictor of blood pressure levels in adulthood, and hypertension and prehypertension are a significant health issue in the young, especially with the prevalence of childhood obesity.[7,8] Therefore it is very important for both young and older individuals with hypertension and prehypertension to be identified and treated.[7,9,10]

Accurate measurement of blood pressure is critical for making appropriate clinical decisions in management of high blood pressure to reduce cardiovascular risk and prevent target organ damage. An inaccurate measurement of blood pressure could lead to a patient being falsely classified as hypertensive or falsely classified as having high normal or normal blood pressure as well as lead to faulty clinical decisions regarding patient progression in an exercise program.[11,12]

Error can be minimized when a standard measurement protocol and a standard training protocol are used.[13] However, health care providers frequently do not comply with established guidelines for measuring blood pressure and guidelines are not always consistent with each other.[14] To our knowledge there are no published guidelines for blood pressure measurement with an emphasis for physical therapists and physical therapist assistants. The purpose of this paper is to present recommended guidelines for blood pressure measurement by physical therapists and physical therapist assistants.

SOURCES OF ERROR IN BLOOD PRESSURE MEASUREMENT

Controlling for error in blood pressure measurement techniques is important if accurate readings are to be obtained. One common source of inaccurate blood pressure interpretation, particularly among older men and women, is the white coat effect that occurs when blood pressure is elevated only in the presence of the health care worker taking the measurement. White coat effect has been defined as a "persistently elevated average office blood pressure of greater than 140/90 mm Hg with an average awake ambulatory reading of less than 135/85".[12] Arrhythmias and stiff (poorly compliant) arteries, which frequently occur in elderly individuals, contribute to the variability of blood pressure measurement. Medications, anxiety, time of day, background noise, room temperature, and stimuli such as food, alcohol, caffeine, nicotine, and exercise within 30 minutes before blood pressure measurement also affect the reading. Crossing legs, talking, and doing mental tasks while the measurement is being done increases blood pressure.[4,8,13] A non-exhaustive list of additional common error sources for blood pressure measurement is presented in Table 2.

The problem of "miscuffing" constitutes the most frequent error in the measurement of blood pressure.[15] The most recent American Heart Association guidelines specify that the proper cuff has a bladder length of 80% and a width of at least 40% of arm circumference.[4] The therapist must determine the proper cuff size by determining the circumference of the arm at the half-way point between the olecranon and the acromion processes.[4,7,16,17] Although it is important to use the correct size cuff when measuring blood pressure, it is generally recognized that the measurement error is greater with an undersized cuff than it is with an oversized cuff. Table 3 presents recommendations for ideal cuff sizes to be used clinically.

Table 2. Most Common Sources of Error in Blood Pressure Measurement Technique[4,11]

- Cuff size and application
- Arm position
- Differences in arm size
- Rest period prior to measurement
- Inflation/deflation method
- Concentration of the measurer
- Digit bias (tendency to record a zero as the last digit)
- Lack of repeated measures
- Time between repeated measures
- Lack of calibration/maintenance of measurement devices
- Body position
- Muscle tension
- Quality of stethoscope
- Level of training of measurer

Table 3. Recommended "Ideal" Cuff Sizes for Newborns, Infants, Children, and Adults[4,7]

Arm Circumference (cm)	Cuff Size (cm)	
Up to 10	4 X 8	newborn[7]
>10 to 15	6 X 12	infant[7]
15 to 22	9 X 18	child[7]
22 to 26	12 X 22	smalladult[4]
27 to 34	16 X 30	adult (standard)[4]
35 to 44	16 X 36	large adult[4]
45 to 52	16 X 42	adult thigh[4]

Optimal ratios for arm width and length to circumference are presented only for the small and standard adult cuff sizes, because the ideal width: circumference ratio is not clinically practical for the large adult and thigh cuffs (although the ideal length:circumference ratio is presented).

Modified from Pickering et al[4] and National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents[7]

MEASUREMENT FOR BASELINE/DIAGNOSTIC PURPOSES

Certain physical and cognitive competencies are required in order for all health care providers to perform a blood pressure measurement procedure. Among the physical requirements, are the eye/hand/ear coordination to use the valve mechanism of mercury or aneroid sphygmomanometers, the ability to hear and differentiate the Korotkoff sounds, and the ability to see the meniscus of the mercury column or the dial of the manometer from 3 feet away.

Standardizing blood pressure measurement and training techniques is important for physical therapy education programs and for clinical practice to improve the accuracy of blood pressure measurement by physical therapists. The recommended procedures to be followed in obtaining baseline or diagnostic blood pressure measurement are discussed below and summarized in the Appendix. In order to minimize measurement error, the equipment to be used, whether aneroid, electronic, or mercury, should be regularly inspected and calibrated. Equipment users should be trained regularly in the proper, standardized technique.[4,18-21] Unless otherwise specified, blood pressure measurements are, by convention, understood to have been obtained from the upper arm of the patient/client. Although many clinicians believe that blood pressure readings obtained in either the seated or supine positions are equivalent, such has not proven to be the case.[22] The present consensus suggests that patients/clients should be seated quietly in a chair with back support, with both feet flat on the floor for at least 5 minutes prior to obtaining a measurement.[3,4,19] The initial visit blood pressure should be measured in both arms. According to Pickering et al[4] "the patient should be instructed to relax as much as possible and to not talk during the measurement procedure." Blood pressure should also be measured in standing for those patients who are at risk for postural hypotension (eg, elderly, patients with diabetes, and patients on antihypertensive medications).[4]

To date, the mercury sphygmomanometer remains the "gold standard" device for blood pressure measurement.[4,19,23] However, because they are being replaced due to environmental concerns in many practice settings (eg, having been banned in Veterans Administration Hospitals), there is a role for other types of devices (eg, aneroid sphygmomanometers and digital electronic pressure transducers).[4,24] There is controversy regarding the accuracy of blood pressure measurement using automated devices. Evidence has shown that automated devices tend to underestimate both systolic and diastolic blood pressures in adults,[25] and overestimate both systolic and diastolic pressures in children and adolescents 5 to 17 years of age.[26] The blood pressure cuff should be placed on the patient's bare arm. If necessary, clothing should be removed, and the patient/client draped, to adequately expose the arm. The sleeve should not simply be rolled up in order to gain access to the arm; it creates a tourniquet effect above the cuff. When placing the cuff on the arm, the midline of the inflatable bladder should be positioned over the brachial artery (the artery coursing between the biceps and triceps muscles, on the medial aspect of the arm) at the mid-point of the upper arm. The lower-most edge of the cuff should be at least 1 inch (2.5 cm) above the antecubital crease so that the bell (preferred) or the diaphragm of the stethoscope can be placed over the point of the strongest palpable brachial artery pulse in the antecubital fossa without encroaching beneath the cuff.[3,4,19] If necessary, the blood pressure can be measured with the cuff placed on the forearm with auscultation over the radial artery, but this may yield a falsely high systolic blood pressure.[3]

Because of the effects of hydrostatic pressure, the position of the arm when the blood pressure is measured can also have a major impact on the pressure observed.[16,19] The magnitude of this effect is 1 to 2 mm Hg for every 2.5 cm above or below the level of the heart. If the cuff and the upper arm are maintained above the level of the right atrium, the readings obtained will be too low.[12,22,27,28] Likewise, if they are below the level of the heart, the readings will be too high.[12,22,27,28] Thus, when taking the measurement, the therapist should support the arm so that the cuff is at the level of the right atrium with the arm straight and the antecubital fossa "faces upward." Since muscle contraction raises blood pressure, care should also be taken to avoid the patient/client helping to elevate the limb; if available, pillows or bolsters may also be used to properly position and support the arm.

In order to avoid over inflation of the cuff, and to accommodate any systolic auscultatory gap, the clinician should estimate a maximum inflation point by palpating the radial pulse while incrementally inflating the cuff until the pulse disappears. The therapist should then wait at least one minute after deflating the cuff before reinflating the cuff to 30 mm Hg above the point where the pulse previously disappeared. Alternatively, one may auscultate the brachial artery while incrementally inflating the cuff to 30 mm Hg above the point at which the tapping noise (Korotkoff sounds) disappears. Blood pressure results are significantly influenced by the rate of cuff deflation--too rapid a rate leads to marked underestimation of systolic and overestimation of diastolic pressure. Therefore, the recommended deflation rate is 2 mm Hg per second (or per pulse when the heart rate is below 60 beats per minute).[4,20] Systolic blood pressure should be recorded as the point at which auscultatory pulsations (Korotkoff phase I) are heard as the cuff is deflated. The disappearance of the auscultatory pulsations (Korotkoff phase V) defines the diastolic pressure in adults. In some circumstances (eg, children, especially young adolescents, pregnancy, exercise) when sounds are heard to near zero the Korotkoff phase IV (muffling of sounds) is used to indicate the diastolic pressure, and the reading at each of the 3 phases should be recorded (eg, Phase I=120, Phase IV=60, Phase V=0).[12,29-31] Therefore the blood pressure would be recorded as 120/60/0 mm Hg. Pressures should be read to the nearest 2 mm Hg when using aneroid or mercury devices.[4]

The accuracy of blood pressure measurements is of extreme importance. For example, in a recent review McAlister and Strauss[32] suggested that almost two-thirds of hypertensive individuals would be denied morbidity preventing treatment if the diastolic blood pressure were underestimated by 5 mm Hg; the number of persons diagnosed with hypertension would more than double if systolic pressure were over estimated by 5 mm Hg. Therefore, to strengthen the accuracy of blood pressure measurements, it is recommended that more than one reading be taken.[32,33] Although no clear rationale for a specific number of readings has emerged from the literature, Pickering et al[4] recommend that the average of at least two readings should be taken at an interval of at least one minute to represent the patient's/client's blood pressure. If the difference between the first two readings is more than 5 mm Hg, one or two additional readings should be obtained, and the average of the multiple readings should be used.

Almost all studies have reported finding differences between the blood pressures measured in both arms. These differences seem to arise more frequently when only a single measurement is taken in each arm, and they are not attributable to the handedness of the patient/client.[34,35] Nevertheless, even when 3 measurements from each arm were analyzed, about 15% of subjects had inter-arm differences of greater than 10 mm Hg. Therefore, blood pressure should be checked in both arms at the first examination, at least, and the arm with the higher pressure should be used for subsequent monitoring assessments.

As might be anticipated, the guidelines for obtaining baseline/diagnostic blood pressure measurements are more stringent than those for intra-session monitoring. Blood pressure measurement in these situations is usually performed to judge vital signs or assess specific interval changes in response to activity rather than the presence or absence of hypertension. And, although they are not diagnostic, high readings or abnormal blood pressure responses (eg, more than a 10 mm Hg increase in systolic pressure per metabolic equivalent of work) are suggestive of a need for follow-up.[36-38]

BLOOD PRESSURE MEASUREMENT IN CHILDREN

Blood pressure should be measured in children under 3 years of age who have any particular conditions warranting this evaluation such as congenital heart disease, renal disease, systemic diseases or medications that may cause hypertension, elevated intracranial pressure, malignancy, transplantation, or a previous condition requiring intensive care treatment.[8] Otherwise, blood pressure should be measured in children who are at least 3 years old.[7,17] As in adults, the use of Korotkoff sounds via the auscultatory method is recommended since research has shown that oscillometric values tend to be less accurate than auscultated values in children.[7,39] Although there is some debate as to which Korotkoff sound should be used to measure diastolic pressure, especially in the pre-teenage years,[40] use of the Korotkoff phase V (sound disappears) is preferred.[7] Korotkoff phase IV (sound muffles) can be used in children where the Korotkoff sounds are audible until complete or near-complete cuff deflation.[7] It is recommended that prior to labeling a child's blood pressure as elevated at least 3 repeated measures using the auscultatory method are needed.[7] If an elevated finding is new and the patient is symptomatic, immediate referral to the physician is imperative. This is especially important since the majority of children and adolescents who have hypertension and prehypertension are undiagnosed.[17]

Although the actual technique of obtaining a child's blood pressure is performed similarly to the adult, a few tips for accurate blood pressure measurement in the pediatric population should be taken into account:

The usual practice is to use the patient's right arm for reliability and assessment when comparing systolic and diastolic blood pressure measures with the standard values. This is because of the chance of coarctation of the aorta, which could result in an inaccurately low reading in the left arm.[7,17]

The main difference one should consider when taking a pediatric patient's blood pressure is that body size and age are needed to determine normal values for each child. Reference tables using a child's sex, age, and height provide more exact information.[41] In order to determine the blood pressure range for a child, the height percentile for age is beneficial. This data can be found at www.cdc.gov/growthcharts. Table 4 presents blood pressure ranges for girls and boys by age and height.[7] The lower values in the table correspond to children of that age at the 5th percentile of height, while higher values apply to children at the 95th percentile of height. For example, a midrange blood pressure for a 5-year-old girl at the 5th percentile of height would be 89/52 mm Hg; for the same girl, a blood pressure of 103/66 mm Hg would be interpreted as "pre-hypertension" since these values fall at the 90th percentile of the range. Similarly, a 5-year-old girl at the 95th percentile of height should have a blood pressure no higher than about 109/70. Blood pressure values that fall within the 90-95th percentile ranges are interpreted as "pre-hypertension" and values greater than this are interpreted as "hypertension."

Table 4. Midpoint and 90th Percentile Blood Pressure Levels for Girls and Boys at the 5th and 95th Percentiles of Height[7]

Age	Range of Blood Pressure *< 90th percentile is considered normal	Girls SBP/DBP, mm Hg *the lower numbers correspond to children at the 5th percentile of height *the higher numbers correspond to children at the 95th percentile of height	Boys SBP/DBP, mm Hg *the lower numbers correspond to children at the 5th percentile of height *the higher numbers correspond to children at the 95th percentile of height
1 year old	Midpoint of range 90th percentile of range	83-90/38-42 97-103/52-56	80-89/34-39 94-103/49-54
3 year old	Midpoint of range 90th percentile of range	86-93/47-51 100-106/61-65	86-95/44-48 100-109/59-63
5 year old	Midpoint of range 90th percentile of range	89-96/52-56 103-109/66-70	90-98/50-55 104-112/65-70
10 year old	Midpoint of range 90th percentile of range	98-105/59-62 112-118/73-76	97-106/58-63 111-119/73-78
15 year old	Midpoint of range 90th percentile of range	107-113/64-67 **120/78-80	109-117/61-66 **120/76-80

**Once a child is at least 11 years old, BP ≥ 120/80 mm Hg is regarded as prehypertension.

BLOOD PRESSURE MEASUREMENT IN SPECIAL SITUATIONS

Peripherally Inserted Central Catheters

Blood pressure measures, per expert opinion, should be avoided in the upper arm in which there is a peripherally inserted central catheter (PICC) line present.[42]

Dialysis shunt or fistula

Blood pressure should be taken in the opposite arm if the patient has a working graft or arteriovenous fistula needed for dialysis.[43] Per expert opinion this is to avoid possible trauma or clot formation.

Patients with obesity

If the cuff that is available is too small, especially if upper arm circumference is > 50 cm, blood pressure can be measured in the forearm.[4]

Forearm measurement of blood pressure

In cases where neither upper arm can be used for a blood pressure measurement, an alternative site would be the forearm. The systolic blood pressure measurement can be estimated by placing the cuff on the forearm with the forearm supported at the level of the heart and palpating for the appearance of the radial pulse as the cuff is deflated. Auscultation of Korotkoff sounds over the radial artery or using a Doppler also can be done. Systolic blood pressure tends to be higher in the forearm and can differ from upper arm measurements by up to 20 mm Hg.[44] Validation of the accuracy of forearm measurement techniques has not been achieved.[4] Therefore forearm and upper arm blood pressure measurements are not interchangeable and should be labeled in any documentation to clearly indicate the measurement site.

Radial artery recently used for CABG

Although it is expert opinion, if the radial artery is used as a graft during coronary artery bypass graft surgery, it is best to not perform blood pressure measurements in that arm for at least the initial days after surgery.[45]

Cardiac dysrhythmias

If the heart rhythm is chaotic (eg, atrial fibrillation), blood pressure measures will fluctuate as the heart rate changes. Therefore the recommendation is to take the average of more than one measurement. For slow heart rates, the speed of deflation of the cuff also needs to be reduced for a more precise appraisal of blood pressure.[4]

Elderly

It is recommended by Pickering et al[4] that standing blood pressure measurements in the elderly, especially for those with diabetes, be assessed to rule out possible postural hypotension. This is defined by a systolic pressure drop by more than 20 mm Hg or a diastolic pressure drop by more than 10 mm Hg while the patient stands for up to 3 minutes. The patient may or may not have complaints such as lightheadedness, dizziness, and blurred vision or the therapist may note cognitive changes.[4]

Lymphedema

Blood pressure should be measured in the contralateral arm in a patient who has had a unilateral mastectomy. There is controversy regarding whether the measurement of blood pressure damages the lymphatics and increases the likelihood of lymphedema.[46] There is no data to support the theory that the tourniquet effect of the blood pressure cuff damages the lymphatic system and causes or increases edema. Evidence suggests that there is less risk of lymphedema occurring with blood pressure measurement when the axillary nodes have not been dissected compared to when axillary node dissection has been performed.[16]

Pregnancy

Blood pressure is important to monitor in pregnant women because hypertension is the most common medical complication in pregnancy and occurs in up to 12% of this population.[4] Accurate monitoring of blood pressure during pregnancy is an important aspect of good quality prenatal care. Blood pressure tends to decrease early in gestation and frequently is 10 mm Hg below pre-pregnancy levels. The mean blood pressure in the second trimester is 105/60 mm Hg. The decline in blood pressure is due to peripheral vasodilatation the causes of which are not clearly understood.[47]

Other considerations

For patients with sounds not audible per auscultation (eg, those with weak Korotkoff sounds), a Doppler probe can be used over the brachial artery to determine the patient's systolic pressure. The therapist also can palpate the return of the radial pulse as the cuff deflates for an estimate of the systolic blood pressure and document the measurement as systolic blood pressure per palpation (eg, 100 mm Hg per palp). In both of these cases, a diastolic pressure cannot be obtained. If the upper arm is unable to be used for a blood pressure measurement, the cuff can be placed on the forearm with the examiner auscultating over the radial artery. As stated earlier, accuracy of forearm blood pressure measurement has not been validated.[4] If the leg is the only alternative for blood pressure measurement, the cuff can be placed on the thigh. In this case, the popliteal artery is used for auscultation. Systolic blood pressure measured in the leg (in the seated position) in normal subjects is typically 10% to 20% higher than systolic blood pressure measured in the brachial artery.[16] Leg systolic blood pressure more than 10% lower than brachial artery systolic blood pressure may indicate peripheral arterial disease.[16]

DOCUMENTATION

It is important to document on which side the blood pressure was measured and state if the forearm was used. In order to achieve accuracy for repeated measures, it is critical for therapists to be consistent in their methodology of blood pressure measurement. Therefore it is imperative to document when the method of blood pressure measurement deviated from the standard protocol.

CONCLUSION

Physical therapists and physical therapist assistants are trained in the techniques of blood pressure measurement as part of basic professional education. However, they cannot really claim to be adequately using this skill in the best interests of patients in our normal clinical practices unless it is properly and appropriately performed.[48]

If physical therapists wish to play an important role as primary health care providers, we must, as suggested by Frese and colleagues,[48] be more proactive in our assessments of blood pressure and the other vital signs. Only then, will they be able to optimally contribute to the identification and management of blood pressure problems in the patients they serve while also lending the greatest assistance to other health professionals.

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Appendix. Recommended Technique for Measuring Blood Pressure[3,4]

i. Measurements should be taken with a sphygmomanometer known to be accurate. A recently calibrated aneroid or a validated and recently calibrated electronic device can be used. Aneroid devices or mercury columns need to be clearly visible at eye level.

ii. Choose a cuff with an appropriate bladder size matched to the size of the arm. For measurements taken by auscultation, bladder width should be close to 40% of arm circumference and bladder length should cover 80% to 100% of arm circumference. When using an automated device, select the cuff size as recommended by its manufacturer.

iii. Place the cuff so that the lower edge is at least 1 in (2.5 cm) above the elbow crease and the bladder is centered over the brachial artery. The patient/client should be resting comfortably for 5 minutes in the seated position with back support. The arm should be bare and supported with the antecubital fossa at heart level because a lower position will result in erroneously higher systolic and diastolic blood pressure measurements. There should be no talking, and patients' legs should not be crossed. At least two measurements should be taken in the same arm with the patient in the same position, and the mean should be recorded. Blood pressure also should be assessed after two minutes of standing (with arm supported) and at times when patients report symptoms suggestive of postural hypotension. Supine blood pressure measurements may also be helpful in the assessment of elderly and diabetic patients.

iv. Increase the pressure rapidly to 30 mm Hg above the level at which the radial pulse is extinguished (to exclude the possibility of a systolic auscultatory gap).

v. Place the bell or diaphragm of the stethoscope gently and steadily over the brachial artery.

vi. Open the control valve so that the rate of deflation of the cuff is approximately 2 mm Hg per heart beat (or per second if HR is less than 60 bpm). A cuff deflation rate of 2 mm Hg per beat is necessary for accurate systolic and diastolic estimation.

vii. Read the systolic level (the first appearance of a clear tapping sound [phase I Korotkoff]) and the diastolic level (the point at which the sounds disappear [phase V Korotkoff]). Continue to auscultate at least 10 mm Hg below phase V to exclude a diastolic auscultatory gap. Record the blood pressure to the closest 2 mm Hg on the manometer (or 1 mm Hg on electronic devices), as well as the arm used and whether the patient was supine, sitting, or standing. Avoid digit preference by not rounding up or down. Record the heart rate. The seated blood pressure is used to determine and monitor treatment decisions. The standing blood pressure is used to examine for postural hypotension, if present, which may modify the treatment.

viii. If Korotkoff sounds persist as the level approaches 0 mm Hg, then the point of muffling of the sound is used (phase IV) to indicate the diastolic pressure.

ix. In the case of arrhythmia, additional readings may be required to estimate the average systolic and diastolic pressure. Isolated extra beats should be ignored. Note the rhythm and pulse rate.

x. To avoid venous congestion, it is recommended that at least 1 minute should elapse between readings. Leaving the cuff partially inflated for too long will fill the venous system and make the sounds difficult to hear.

xi. Blood pressure should be taken in both arms on, at least, the first visit; if one arm has a consistently higher pressure, then that arm should be clearly noted and subsequently used for blood pressure measurement and interpretation.

(references continued from page 10)

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