CHAPTER 11

BLOOD PRESSURE AND PULSE

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BLOOD PRESSURE AND PULSE

11.1 INTRODUCTION

This training manual is designed to be used for the training and certification of blood pressure observers working with school age children in the Dietary Intervention Study in Children (DISC). This training/certification/monitoring program will do much to ensure that standardized high quality blood pressure measurement continues throughout the study.

All clinical staff given responsibility for taking blood pressures and recording them in each of the six Clinical Centers must be trained and certified in a standardized fashion and meet a stipulated level of performance. Recertification is required annually.

Each Clinical Center will have a designated master trainer, who will receive instruction and certification in Portland, Oregon, in August, 1987 or directly from the designated Central Master Trainer. Each center will then be provided with a full set of training materials needed to reproduce the same program for other clinical staff taking and recording blood pressures at their site. The Coordinating Center will receive documentation from the Clinical Centers of each observer's training performance and a copy of the completed Certification Checklist will be forwarded to the designated Central Master Trainer. A file will be kept at the Coordinating Center of all clinical staff who have been certified and recertified.

The overall monitoring and quality control will remain the direct responsibility of the Coordinating Center. Technical questions should be directed to the designated Central Master Trainer.

11.2 AN HISTORICAL PERSPECTIVE

Systemic arterial blood pressure is a physiologic variable that reflects the effects of cardiac output, peripheral vascular resistance, and other hemodynamic factors. It is measured indirectly by a standard sphygmomanometer, a method that is imprecise compared with intra-arterial measurements of blood pressure. Nevertheless, properly measured, elevated indirect blood pressure readings are known to be an important sign of vascular disease. This manual will point out common errors in the indirect measurement of blood pressure, indicate the means to avoid them, and recommend certain standards to increase the accuracy of measurement and recording.

If we are defining blood pressure in terms of how it is measured, we need to understand the nature of this measurement. A brief historical sketch is helpful.

Measurement of blood pressure by means of the usual mercury manometer, cuff and stethoscope is a method less than 100 years old, although Hales described experimental direct arterial pressure measurements over 200 years ago and Harvey described the circulation of the blood more than 300 years ago. The start of this century was the period when current, indirect methods were introduced--more practical than the lethal method of Hales, and qualifying as what we would today term a "non-invasive" technique. This indirect method, now almost universally employed, combines the work of Riva-Rocci, an Italian physician who developed the inflatable cuff, and Korotkoff, the Russian physician who described his auscultatory findings--heard through a stethoscope placed over the brachial artery--as an improvement over mere palpation of the radial pulse, a technique limited to detecting systolic pressure alone.

The report of Korotkoff's first observations is an informative summary of the specific sounds he described:

"On the basis of his observations the speaker has come to the conclusion, that the completely compressed artery under normal circumstances does not produce any sounds. Utilizing this phenomenon he proposes the auditory method of determining the blood pressure in man. The cuff of Riva-Rocci is placed on the middle third of the upper arm, the pressure within the cuff is quickly raised up to complete cessation of circulation below the cuff. Then letting the mercury of the manometer fall, one listens to the artery just below the cuff with a children's stethoscope. At first, no sounds are heard. With the falling of the mercury in, the manometer, down to a certain height, the first short tones appear; their appearance indicates the passage of part of the pulse wave under the cuff. It follows that the manometric figure at which the first tone appears corresponds to the maximal pressure. With the further fall of the mercury in manometer the systolic compression murmurs are heard, which pass again into tones (second). Finally all sounds disappear. The time of the cessation of sounds indicates the free passage of the pulse wave; in other words, at the moment of the disappearance of the sounds, the minimal blood pressure within the artery preponderates over the pressure in the cuff. Consequently, the manometric figures at this time correspond to the minimal blood pressure. Experiments on animals gave confirmative results. The first sound-tones appear (10 to 12 mm) earlier than the pulse, for the palpation of which

(e.g., in the radial artery) the inrush of the greater part of the pulse wave is required."[1]

With further refinement in criteria by which changes in sound quality are to be judged, we arrive very nearly--but not quite--at the level of technological advance applicable to the conventional mercury sphygmomanometer today. In summary then, we may define blood pressure as the phenomenon measured when a trained observer uses the cuff, mercury manometer, and stethoscope in the standard manner to assess the cardiovascular status of a subject.

11.3 THE SUBJECT AND THEIR ENVIRONMENT

When measuring blood pressure in children, many factors influence the accuracy of the readings: the child, the blood pressure observer, the equipment and its maintenance, and blood pressure measurement techniques. The procedures described for measuring blood pressure must be followed exactly to obtain valid comparisons of blood pressures between groups of children or the same individual child on different occasions.

Give the child a brief description of the procedure used for obtaining a blood pressure reading, making sure to cover the following points:

1. The inflation and deflation of the cuff will cause minor discomfort.
2. The measurement will be repeated three times (the first pressure establishes the peak inflation level, and the average of the next two pressures establishes the actual blood pressure).

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[1]Quoted from Ruskin, A. Classics in Arterial Hypertension, Charles C. Thomas, Springfield, 1956 (pp. 127-128).

3. A pulse rate will be taken.

Allow the child to ask questions. Remember to control for environmental and biological factors that might affect the child or the observer doing blood pressure measurement.

11.3.1 Environmental Factors

1. Noise: Choose a quiet room (avoid using a room near heavy vehicular and pedestrian traffic). Close the door.
2. Artifacts: Arrange the furniture and equipment so the equipment is free of disturbance. Arrange the equipment and the seating of the child so that when the mercury manometer is used, the center of the scale is placed at the observer's eye level to avoid the effects of parallax.
3. Lighting: Make sure the room is well-lit so that the observer can read the manometer easily but not so bright that it bothers the child.
4. Room Temperature: Make sure that the room is comfortably warm, since temperature changes can affect the dilation and constriction of the small arterioles.

11.3.2 Biological Factors

1. Stress: Make the child feel as relaxed as possible and attempt to decrease anxiety about the procedure.
2. Pain and physical discomfort: Make sure the child is not experiencing pain. Have child void prior to the procedure.
3. Smoking: Confirm that the child has not smoked in the last 30 minutes.

4. Position: Check child's sitting posture, making sure that the feet are flat on the floor or foot rest, legs not crossed, arm well supported at heart level.
5. Exercise: Confirm that the child has not exercised in the last 30 minutes.
6. Medication: Make sure the child is not taking any drugs that affect blood pressure, e.g., cold medications.
7. Drinking: Confirm that the child has had nothing to drink in the last hour that contains caffeine or alcohol.

11.4 THE OBSERVER

The observer should be personable and experienced in dealing with children. There are specific items to be checked or standardized for the observer:

1. Hearing
2. Sight
3. Demeanor
4. Digit preference

11.4.1 Hearing Test

All observers will have a standard hearing test. Only moderate hearing loss for low frequency sounds would preclude an observer from being certified because Korotkoff sounds are low in frequency. Some loss of high frequency hearing is quite common in adults.

11.4.2 Vision Test

Accurate visualization of the numbers and mercury level of the manometer is essential. The observer must undergo a reading site test to assess their near vision. If vision is inadequate (> 20/40 by Snellen chart at 16 inches), the observer must be fit for prescription glasses.

11.4.3 Demeanor

Observer demeanor is very difficult to standardize. Because no two subjects are the same, the interaction between observer and subject will differ from subject to subject. The observer needs to present a nondiscriminatory, reassuring and professional approach. The observer should: (a) be comfortable communicating with children in a relaxed, reassuring manner, and (b) before starting the procedure, explain all aspects of the measurement in a way that children can understand and by which they will not be frightened.

11.4.4 Digit Preference

When different observers make blood pressure measurements or when one person makes many such measurements certain end digits may be recorded more often than others. For example, a preference for zeros is common. But if this phenomenon (digit preference) is pointed out to the observers during training, they may simply switch to choosing some other end digit more frequently. With any sphygmomanometer that uses a mercury column or observer-read dial, this phenomenon can be minimized by concentrating intently to synchronize the Korotkoff sounds exactly with the position of the mercury column. This is best done by lowering the mercury slowly at 2 mm per second. This study is using a Random Zero manometer to help decrease observer bias but, its' use has no effect on digit preference.

11.5 EQUIPMENT

11.5.1 Metric Tape Measure

A fiberglass type of metric tape measure will be used to measure the arm, ensuring use of an accurate cuff size.

11.5.2 Stethoscope

Use a pediatric Littman stethoscope with a bell. Because of their low pitch, Korotkoff sounds are best heard with the bell. An additional advantage of using the bell is that it takes up less space than the diaphragm when applied to the arm immediately below the cuff. This can be important in measuring blood pressure in children, who have short upper arms. Stethoscope tubing should be about 10-12 inches from the bell piece to the "Y" branching. This length allows the observer to hear best and to read the sphygmomanometer at eye level and in a comfortable position. Earpieces should fit comfortably and snugly in the ears. Special attention should be paid to four points in using the stethoscope:

1. the ear pieces should be directed downwards and forwards into the ear canal;
2. the ear pieces should be tight enough to exclude outside sound but not so tight as to cause discomfort;
3. the valve between the bell and the diaphragm should be turned in the correct direction; and
4. the bell of the stethoscope should be placed lightly on the skin over the brachial artery. Pressing too hard with the stethoscope over the brachial artery causes turbulent flow in the artery and a murmur can be heard which may prolong the apparent duration of phase 4. This will yield a falsely low phase 5 reading.

11.5.3 Conventional Mercury Sphygmomanometer

The design and operation of the standard Baum sphygmomanometer is based on the combined principle of compression over the brachial artery under an inflatable cuff; direct auscultation of the Korotkoff sounds

through a standard stethoscope; and direct registration of pressure levels by a mercury manometer. The observer inflates the cuff, listens for the first, fourth, and fifth phase Korotkoff sounds, reads the mercury level in the column, deflates the cuff, and records the readings.

11.5.4 The Random-Zero Mercury Sphygmomanometer

The Hawksley Random-Zero sphygmomanometer is a mercury sphygmomanometer. It has 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 observer makes the adjustment by turning an external wheel that contacts and rotates an internal, beveled cam. The position where the cam comes to rest after turning determines where the beveled 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 bias are substantially reduced.

11.5.5 Blood Pressure Cuff and Bulb

The V-lock brand cuff is composed of a rubber bladder encased in a firm-material cover. The ends of the cover are fixed in place by self-adhesive Velcro. The material of the cuff is relied on to transmit pressure equally over the entire circumference of the arm. If the cuff is too narrow, inaccurately high pressure readings will be obtained because greater pressures are required to collapse the brachial artery. Cuffs that are too wide will produce inaccurately low readings. Cuffs with long tapering cloth covers should be avoided. Each different-sized cuff contains a bladder of a different size. The size of the cuff to be used depends on the size of the arm of the person whose blood pressure is going to be measured. Consult the chart of arm circumference measurements and corresponding cuff sizes for correct sizing. Markings found on blood pressure cuffs should not be used for reference, as they may be incorrect. The bladder should be long enough to encircle the circumference of the arm completely, without overlap, and wide enough to cover approximately 75 percent of the upper arm.

CUFF SIZE INDICATED BY MEASURED ARM CIRCUMFERENCE

Cuff Name	Fits Bag With Dimensions	Range of Limb Circumferences
Newborn	2.5 cm X 5 cm	6 cm to 10 cm
Infant	6 cm X 12 cm	10.1 cm to 18 cm
Child	9 cm X 18 cm	18.1 cm to 25 cm
Adult	12 cm X 23 cm	25.1 cm to 34 cm
Large Arm	15 cm X 33 cm	34.1 cm to 47 cm
Thigh	18 cm X 36 cm	47.1 cm to 66 cm

Adapted from Baumanometer - WA Baum Co.

11.6 KOROTKOFF SOUNDS

The sounds are heard when the stethoscope is placed over the main or brachial artery in the upper arm. When the cuff is inflated enough it compresses the brachial artery so that no blood flows through it. When the artery is thus completely occluded and the stethoscope placed over it immediately below the cuff, no sound can be heard.

As the cuff pressure is released the first spurt of blood gets through the artery beneath the cuff, producing the first Korotkoff sound. These sounds are produced by vibrations in the walls of the brachial artery below the cuff and by turbulent flow of blood through the constricted artery. The sounds are, therefore, generated entirely in the artery and are not the same as heart sounds heard when listening over the chest. The arterial sounds are named after Korotkoff, a Russian surgeon who first described this indirect technique for blood pressure measurement in 1905. The main features of any sound are characterized by loudness and pitch. The pitch is affected by the number of sound waves that reach the ear each second, called frequency, and measured in cycles (or waves) per second. As frequency increases, the pitch is higher. The frequency of the Korotkoff sounds by which blood pressure is measured is mostly in the range of 60 to 180 cycles per second. They are low-pitched sounds, compared with ordinary speech.

Korotkoff sounds have been shown to comprise two main elements: first, a tapping element; second, a sound like blowing air, called a "murmur."

The tap is due to abrupt displacement of the arterial wall and surrounding tissues below the cuff by the advancing pulse wave. The tap commences when the arterial pressure wave is sufficient to overcome the collapsing force of the cuff and a little blood is projected into the

artery below. As the cuff pressure continues to fall, the loudness of the tap increases. As the cuff pressure is released, the pressure difference in the upper and lower artery lessens with each pulse or heart beat. Consequently, as the cuff pressure finally approaches the diastolic or resting heart level, the tap decreases in intensity and eventually disappears.

The murmur is probably produced by the flow of blood from the narrowed artery underneath the cuff into the wider artery distal to the cuff. The change in artery size from a narrow to a wider caliber creates eddies that set the blood and the vessel wall into vibration, producing the murmur. The greater the pressure differential between the blood under the cuff and the blood in the artery below the cuff, the greater the flow of blood and the longer and louder the murmur.

On the basis of their presence or absence and quality, the Korotkoff sounds can be distinguished in 5 phases. It is from these phases that systolic and diastolic blood pressure are measured.

11.6.1 The Five Phases

The first phase is the onset of the tapping sound, which gradually increases in pitch and intensity.

In the second phase, the tap is followed by a murmur. Note that the addition of the murmur makes the tap less evident. In the normal individual, the second phase usually starts 10 to 15 mm below the onset of the first phase and lasts for 10 to 20 mm.

The third phase consists of the tapping sound alone, which now is comparatively loud and high-pitched. There is no murmur. The third phase ends when the tap rather suddenly becomes lower-pitched and less intense.

This lower-pitched, or so-called muffled sound, constitutes the fourth phase. The disappearance of the sound is the fifth phase. On occasion, Phases 4 and 5 may be heard at nearly the same point.

11.6.2 Recording Blood Pressure

The systolic blood pressure level is recorded by noting the level of the mercury column when Phase 1 sounds are first heard. Diastolic blood pressure can be recorded at two points: at the beginning of Phase 4 with muffling and at the beginning of Phase 5 with disappearance of sounds. Fourth phase diastolic blood pressure corresponds with the first point of muffling. Fifth phase diastolic pressure corresponds with the point of disappearance of sounds. In DISC, we will be recording both the fourth and fifth phase diastolic pressures on children. Sounds may still be heard over the brachial artery when the cuff pressure has reached "0". In this instance the Phase 5 pressure should be recorded as "0".

Practice listening for each of these phases whenever you record a blood pressure measurement. In this way you become accustomed to the peculiarities of the quality of sound at each phase and are warned of the approach of the beginning of Phase 4 and Phase 5, which must be recorded.

11.6.3 Variations in the Sequence of Sounds

(Note: Not all 5 Phases of Korotkoff sounds are heard in every person.)

11.6.3.1 Respiratory Variation

Inspiration (or breathing in) lowers the pressure in the chest, delaying slightly the return of blood for the heart to pump with the next heart beat, and causes the blood pressure to fall. If during

recording of the blood pressure a change from expiration (or breathing out) to inspiration occurs just at the onset of the first tapping sounds, the sounds may be temporarily delayed until the cuff pressure falls below the peak systolic level during inspiration. Similarly, a change in respiration at the beginning or end of any phase may cause the disappearance of the sounds of one phase and the appearance of the sounds of another phase. This phenomenon seldom causes a problem for more than one or two heart beats. Also, this variation with breathing will not be noticed in all people.

11.6.3.2 Absence of Phase 5 or Prolongation of Phase 4

The second common variation in blood pressure sounds is the absence of Phase 5. In this instance the muffled sounds of Phase 4 continue to be heard, sometimes even after the cuff pressure has returned to zero. This is a common finding in children and can occur in normal adults.

11.6.3.3 Absence of Phase 4

In some instances, the muffled sounds of Phase 4 may not be heard. In this case the cessation of sounds will occur at the end of the tapping sounds of Phase 3. The loudness of the sounds in Phase 3 will diminish before Phase 5 but no muffled sounds will be heard. In such a case, only systolic and fifth phase diastolic blood pressures can be recorded. Phase 4 and phase 5 mm Hg will be the same.

11.6.3.4 Auscultatory Gap

The tapping sounds of Phase 1 may be interrupted by a variable period of silence. That is to say, a sequence of tapping sounds will be heard, commencing with the onset of systolic blood pressure. Then there will be a period of silence, called the auscultatory gap, as the pressure in the cuff diminishes and the mercury column continues to

fall. This period may last for 5-10 seconds. Then the tapping sounds of Phase 1 will resume, to be followed sequentially by the sounds of Phase 3 through Phase 5. Sometimes the whole of Phase 2 may be absent. Avoidance of measurement errors due to the presence of the auscultatory gap will be discussed in Section 11.7.1.

11.6.3.5 Artifactual Sounds

1. Moving the fingers that are holding the stethoscope may produce crackling sounds that can obscure the Korotkoff sounds or be mistaken for tapping sounds. Other such sounds may be produced when the stethoscope touches the cuff, or when the stethoscope tubing bumps against an object.
2. Pressing too heavily with the stethoscope over the brachial artery will also produce sounds that can be heard by the observer, by reducing the internal diameter of the brachial artery in the same manner as the pressure cuff. This causes turbulent blood flow in the artery and an audible murmur, and may prolong the apparent duration of Phase 4.
3. The sound of voices or equipment operating nearby can obscure the several Korotkoff sounds.

11.7 RECORDING THE BLOOD PRESSURE MEASUREMENT

11.7.1 Avoiding Respiratory Variation

Usually the change in blood pressure sounds occurs only once, e.g., from muffling to silence to muffling. If the silence lasts for only one heart beat, ignore it. Record systolic blood pressure at the point of hearing the first of two consecutive tapping sounds of Phase 1, occurring at the rate of the pulse, and diastolic fifth phase at the point of the last sound heard before the first of two consecutive silent

beats. In other words, ignore an isolated single tapping sound or silence as indicating the beginning of Phase 1 or Phase 5 respectively.

11.7.2 Writing the Numbers

When the cuff is attached to a mercury sphygmomanometer or any machine that registers the pressure change within the cuff you will be able to synchronize the beginning of each phase of Korotkoff sounds with a reading on the sphygmomanometer. You will write down the value at the beginnings of Phase 1, Phase 4, and Phase 5. When the top of the mercury meniscus falls between two marks on the column, record the next higher number.

Record systolic blood pressure first, followed by a slash, then Phase 4 followed by a slash and then Phase 5 diastolic blood pressure level. A recording of 130/72/68 would indicate a systolic blood pressure of 130 mm Hg, a fourth phase diastolic of 72 mm Hg, and a fifth phase diastolic blood pressure of 68 mm Hg. The notation, "mm Hg" stands for millimeters of mercury and is the unit for recording blood pressure level regardless of the type of sphygmomanometer used. It is the force or pressure in the cuff required to hold a standard column of mercury at a particular level against gravity.

11.8 BLOOD PRESSURE MEASUREMENT

In this section the step-by-step procedures for blood pressure measurement are presented. The steps outlined here can be satisfactorily followed for the vast majority of children. Exceptions do occur, however. It is important to encourage observers to note exceptional circumstances on the "Blood Pressure Form."

11.8.1 Explanation

Explain to the child that you will be taking his blood pressure twice after a five minute rest period. Between each blood pressure you will be asking him to raise his blood pressure arm over his head for five seconds and then return it to the table for an additional 25 seconds. He must not talk or move around during the entire procedure.

11.8.2 Arm Measurement

The proper cuff size must be used to avoid under- or over-estimating the correct blood pressure. To determine the proper cuff size, the observer must measure the arm circumference at the midpoint of the arm. The measurement should be taken on the right arm which has been bared from the shoulder. On average, blood pressure measured from the right arm is slightly higher than the left. With the participant standing, holding the forearm horizontally across the chest, the arm length is measured from the acromion (boney extremity of the shoulder girdle) to the olecranon (or tip of the elbow) with a fiberglass measuring tape. Identify the midpoint by dividing the acromion to the olecranon exactly in half and mark it with an erasable marker. The participant should then relax the arm alongside the body. The arm circumference is measured by drawing the tape snugly around the arm at the level of the midpoint without making an indentation in the skin and being careful to keep the tape horizontal. Consult the chart of arm circumference measurements and corresponding cuff sizes (Section 11.5.5). A copy of the chart should be attached to the sphygmomanometer for easy reference.

Indicate the cuff size on the study form. This chart should be consulted for each arm measurement. Do not use the markings on blood pressure cuffs as they may be incorrect.

11.8.3 Application of the Blood Pressure Cuff

Palpate for the antecubital brachial pulse and mark with a washable marker. The cuff is then placed around the upper right arm so that the midpoint of the bladder inside the cuff lies over the brachial artery and the mid height of the cuff is at heart level. The lower edge of the cuff, with its tubing connections, should be placed about 1" above the natural crease across the inner aspect of the elbow. The cuff is wrapped snugly around the arm, with the palm of the hand turned upward. The cuff should be secured firmly by applying pressure to the fabric fastener over the area where it is applied to the cuff. Attach the connecting tube to the standard manometer. Next have the child sit quietly, with feet flat on the floor or foot rest for five minutes. A stop watch is helpful for timing the rest period and the pulse measurement.

Caution the child not to talk, move around or cross his legs until both blood pressures are completed.

11.8.4 Pulse Measurement

Part of the blood pressure measurement procedure is the measurement of the pulse, as observed by palpation of the radial artery at the wrist. For simplicity, the right arm should be used consistently for measurement of both pulse and blood pressure. 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 the interpretation of the blood pressure readings.

Measure the pulse only after the child has been seated quietly, with feet flat on the floor, in an erect but comfortable posture, for at

least five minutes. The elbow and forearm should rest comfortably on the table. With the palm of the child's hand turned upward, palpate the radial pulse and count for 30 seconds exactly. Record the number of beats in 30 seconds and record the value on the "Blood Pressure Form." If you note any irregularities, bring them to the attention of the provider doing the physical exam.

11.8.5 Determining the Peak Inflation

It is necessary to determine, for each participant, the pressure level to which the cuff is to be inflated for accurate measurement of systolic pressure. This is because the pressure at the start of the reading should always exceed the systolic pressure--otherwise the first of the Korotkoff sounds will be missed. This starting pressure is called the "peak inflation pressure" and is determined as follows: the cuff tubing should be attached to a standard manometer and while the cuff is being inflated, the radial pulse is being palpated and the mercury column is watched closely. When sufficient pressure has been applied, the pulse will no longer be felt because the brachial artery has been collapsed. Note the level of the meniscus of the mercury column at the point where the radial pulse disappears on the "Blood Pressure Form." Then immediately deflate the cuff by disconnecting the fitting joining the cuff and sphygmomanometer. The maximum rate of fall using the valve on the bulb is too slow and causes unnecessary discomfort or engorgement of the arm. To this POP number, add 30 plus the "maximum" zero reading for the machine you are using. Write down the sum, which is called the peak inflation level. The peak inflation level, or PIL, will be the level to which the pressure will be raised at the next step when the first blood pressure reading is taken. Adding 30 mm Hg. assures that an auscultatory gap will not be missed. The peak

inflation level, established at the time of the first visit where a blood pressure is taken, will remain that child's PIL throughout the duration of the study. Do not repeat this process on subsequent visits.

After recording the PIL, connect the cuff to the random zero sphygmomanometer. Wait for at least 30 seconds before reinflating the cuff. This allows the venous blood in the forearm to flow back toward the heart. Whenever the cuff is inflated, it causes engorgement of the tissues of the forearm and this in turn results in increased pressure in the forearm and that can diminish the impact of the flow of blood from the brachial artery. This may cause the Korotkoff sounds to become fainter and cause a higher reading of DBP-5 than actually exists. After every cuff inflation, have the child raise the arm on which the blood pressure is being measured for 5 seconds and rest on the table for an additional 25 seconds.

11.8.6 Blood Pressure Reading

Next, proceed to carry out the blood pressure reading. Detailed instructions are given below for measuring blood pressure with a Random-Zero sphygmomanometer.

After waiting at least 30 seconds, proceed with the first blood pressure reading. Gently turn the wheel of the Random-Zero 2-3 times with the valve in the OPEN position. Place the earpieces of the stethoscope pointing forward into your ears. Apply the bell over the brachial artery where you feel the strongest pulse. This is usually found just above the elbow crease slightly toward the subject's chest. Apply the bell of the stethoscope so as to make broad contact with the skin but not to compress the artery beneath. The bell should be just below but not touching the cuff; keep the stethoscope parts away from the bladder tubing. Inflate the cuff at a rapid but smooth, continuous

rate to the peak inflation level or to 180 mm Hg, whichever is higher. By closing the thumb valve, maintain this pressure level for five seconds. Deflate very slowly, maintaining a constant rate of deflation at approximately 2 mm Hg per second. This is the best way to ensure accuracy.

First, identify the systolic blood pressure level, which is recognized for children the same way it is for adults. Listen carefully for the first appearance of faint clear tapping sounds in a regular sequence. The first sound heard represents the systolic pressure level, known as Korotkoff Phase 1. Make mental note of this systolic level and continue the same slow deflation of the cuff at 2 mm Hg per second.

The regular sounds become louder and more firm, sometimes referred to as a hard tapping. The best index of diastolic pressure in children, unlike adults, is the onset of muffling, a point defined as the beginning of the Korotkoff Phase 4. This diastolic level is marked by the distinct abrupt muffling of the tapping sound so that its blowing quality is then heard. This has been described as the point marked by the sudden decrease of sound energy of the middle-upper frequencies, or the point at which the quality of the sounds ceases to be tapping. The first sound heard with this change in quality reflects the level of diastolic Phase 4. Make mental note of the point at which you heard Phase 4.

Then proceed to identify Phase 5, the point at which regular sounds disappear entirely. Diastolic Phase 5 corresponds to the pressure level when the last regular sound was heard. This point should also be noted mentally.

The cuff should then be fully deflated to the "zero" level and disconnected. Ask the child to raise his blood pressure arm over his

head for 5 seconds. You should promptly record the three values you have just observed.

Then lower the arm and allow it to rest on the table an additional 25 seconds.

Record the "zero" value, turn the valve to OPEN, allow mercury to settle and reset the "zero" by turning the wheel.

Repeat the blood pressure measurement exactly as before, after making sure 30 seconds have elapsed since the last blood pressure measurement.

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.

11.8.7 Adult Blood Pressure Procedure

Blood pressures taken on DISC parents are the same as those taken on DISC children with a few exceptions.

1. Explain to the participant that you will be taking his blood pressure twice after a five minute rest period. Between each blood pressure you will be asking him to raise his blood pressure arm over his head for five seconds and then return it to the table for an additional 25 seconds. Tell him that research blood pressures are slower and more accurate than routine "doctor's office" blood pressures and that the cuff may be at a higher pressure than they are used to.
2. Measure the arm the same as for children.
3. Apply the cuff 1-2" above the palpated brachial artery mark.
4. Have the participant sit quietly with both feet flat on the floor for five minutes. Caution the participant not to talk,

cross legs or move around until the blood pressures are completed.

5. Count a 30 second pulse.
6. Determine the level of inflation (PIL) required by connecting the participant's cuff to a standard sphygmomanometer. Inflate to 80 mm Hg while palpating the radial pulse. Continue to inflate in 10 mm increments until the pulse disappears. This is the Pulse Obliteration Point (POP). Add the POP + 60 to determine the Peak Inflation Level (PIL) for this participant. When taking the RZ blood pressure, inflate the cuff to 180 mm Hg or the PIL which ever is higher.
7. Determine the participant's blood pressure according to the child protocol listening for the first sound (Korotkoff phase 1) and the last regular sound (Korotkoff phase 5). Phase 4 is not recorded for adults.
8. Record and calculate results the same as for the children.
9. Give the participant a record of his blood pressure.

11.9 EQUIPMENT MAINTENANCE

The objective of maintenance of sphygmomanometers is to ensure their accuracy for blood pressure measurement. The condition of the instruments for blood pressure measurement is too often ignored in common practice and should be a special responsibility of the training supervisor or other designated staff member. For the cuffs, bulbs and stethoscope, cleanliness and general working order can usually be determined by simple inspection. For the manometers, handling of breakable parts, mercury, and oxidized waste require more careful attention. Therefore, suggested maintenance procedures for the manometers themselves are outlined here in some detail.

11.9.1 General Guidelines

1. The objective of maintenance of all sphygmomanometers is to ensure their accuracy for blood pressure measurement. The manometer column must be clean and the system free of mercury leakage. The zero level for the conventional device should be accurately read as 0 mm Hg at the top of the mercury meniscus. The zero level for RZ in the OPEN position should rest between 36 and 40 mm of mercury.
2. The sphygmomanometer should be cleaned and checked thoroughly on a quarterly basis when in use. Inspections should be made to ensure there has been no mercury spillage or leakage and no obvious malfunction of the device. Instruments used in clinics should be inspected weekly. All inspections should include a check of zero levels, mercury leakage, manometer columns for dirt or mercury oxide deposit, condition of all tubing and fittings, operation of valves and bulbs.
3. The manometer portions of the instruments are distributed by W. A. Baum Company (Copiague, New York 11726, 516-226-3940). Maintenance for this portion of the two devices is the same, as is the case for cuffs, bulbs, and air control valves. Instructions covering these parts are provided in the Baumanometer Service Manual, which is available from the W. A. Baum Company.

11.9.2 Establishment of RZ "Zero" Range

The "zero" range for a particular instrument is unique. The range must be established and labeled for each machine. "Zero" values for routine blood pressures exceeding this range by more than 2 mm indicate a change in mercury quantity or malfunction of the machine.

1. Remove the back casing.
2. Rotate the inner cannula to it's widest setting.
3. Wrap the cuff around a one pound coffee can and connect the cuff.
4. Pump the cuff up to 200 mm Hg.
5. Hold 5 seconds and close valve.
6. Disconnect the cuff allowing the mercury to fall rapidly.
7. Repeat the procedure three times.
8. The highest reading obtained is the "Maximum Zero" for that machine.
9. Repeat the procedure with the cannula set at it's narrowest part to establish it's "Minimum Zero."
10. Record these two values on a label visible from the front of the machine.

11.9.3 Common Problems and Solutions

1. Problem: Dirty manometer column.

   Reason: This is due to dirty or oxidized mercury and is usually evident near the zero.

   Solution: Clean the glass column from its top towards its zero, with the "super" pipe cleaners available from Baum. Tilt manometer on right side to insert pipe cleaner to base of column, avoiding the mercury.

2. Problem: Leaked mercury.

   Reasons:

   1. Loose or leaky screw cap at top of manometer.
   2. Manometer column cracked or chipped, or improperly seated.
   3. Leaky manometer column gaskets.

Solution: Send to Baum or a local repair company familiar with the Random Zero instrument.

3. Problem: The mercury level will not remain constant when the bulb valve is closed.

   Reason: Air leak in cuff unit.

   Solutions:

   1. Connect the manometer to a cuff which is around a one pound coffee can. Pump up the cuff and begin to pinch the tubing closed, starting at the manometer tubing.
   2. By a process of pinching the tubing at 1-2 inch intervals up to the cuff and then down to the bulb, you will locate an air leak.
   3. If an air leak is found to be in the cuff bladder or the tubing other than the connections, the bladder may need to be replaced.
   4. If the air leak is found in the connections or in the bulb valve, a little silicone spray may alleviate the problem.

4. Problem: Changes in zero levels.

   Reason: Changes of zero levels are due either to loss of mercury or to air leakage at the bellows air bleed screw; accuracy of readings is not affected.

   Solution: Adjust zero levels by removing or adding mercury to the system as needed.

CAUTION: Mercury vapor is very toxic. Tiny droplets vaporize more rapidly than bulk. Wear gloves and protective clothing when handling mercury. All loose mercury must be collected and inactivated or disposed of according to local hazardous waste regulations. One effective and convenient product for mercury

vapor inactivation is "HgX," a powder produced by Acton Associates, 1180 Raymond Blvd., Newark, NJ 07102. It is recommended that all work be done in a container such as a plastic dish pan when mercury is to be transferred.

If the zero levels are too low:

1) Open the bellows control valve and the valve at the top of the mercury reservoir, unscrew and remove the knurled cap at the top of the manometer column, and remove the air bleed screw at the top of the bellows chamber. Some newer machines are self-bleeding and do not have an air bleed screw.
2) Pour clean mercury into the top of the manometer tube, using a hypodermic syringe barrel or small funnel. About 400 grams (or 14 ounces) of mercury are needed to fill an instrument to an OPEN level of 36-40 mm of mercury.
3) Firmly screw the knurled cap onto the top of the manometer column, and apply pressure to the mercury reservoir until the mercury rises into the vertical air column at the top of the bellows chamber. Tighten the air bleed screw quickly and firmly, while the mercury is a short distance into the vertical air column.
4) Apply enough additional pressure to raise the mercury to near the top of the manometer column (if it is not already that high); then release the pressure, thus to collect mercury droplets and clear the column of air bubbles. There are likely to be air bubbles trapped on the walls of the plastic tube at the bottom rear; these can sometimes be removed by tapping the tube gently, but they are, at any rate, of no consequence.

If the zero levels are too high:

1) Unscrew and remove the knurled cap from the top of the manometer column. Using a syringe with a small tube, such as a catheter, remove the mercury from the manometer.

11.9.4 Maintenance Logs Required (See Exhibits 11.11 and 11.12)

1. Random-Zero Sphygmomanometer weekly inspection and maintenance should be recorded on the DISC Weekly R-Z Inspection and Maintenance Log. The quarterly cleaning and inspection should be recorded on the DISC R-Z Quarterly Cleaning and Inspection Log.
2. Standard sphygmomanometers weekly inspection and maintenance should be recorded on the DISC Weekly Standard Manometer Inspection and Maintenance Log. The quarterly cleaning and inspection should be recorded on the DISC Standard Manometer Quarterly Cleaning and Inspection Log.
3. Keep these logs on file at the local center. They should be available for a site visit inspection.

11.10 DISC BLOOD PRESSURE-PULSE CERTIFICATION/RECERTIFICATION

Certification and recertification must be directly supervised by the local master trainer. Certification may also be completed by participation in a DISC training session as was done for the master trainers. New master trainers may be trained at a central training session or individually by the Central Master Trainer.

11.10.1 Training

1. Read the Protocol and the most recent version of the Manual of Operations (Chapter 11) on blood pressure.

2. Participate in DISC training session on blood pressure and pulse or training by a certified master trainer.
3. Achieve a 100% score on the written test, passing score on the video tape, and complete screening for visual and auditory activity as outlined in the Manual of Operations, Section 11.4 (see Appendix).
4. Successfully complete the procedure under direct observation using the Live Performance Checklist. Performance may be observed using an adult subject but, double stethoscope comparisons must be done on a DISC age child. The sum of two double stethoscope blood pressures taken by the trainee must match the trainer within 4 mm Hg for each phase recorded.

11.10.2 Certification

1. Completion of training.
2. Scores on tests verified by an independent observer (see Appendix for scoring).
3. Completed certification checklist sent to Coordinating Center and the Central Master Trainer.

11.10.3 Recertification

1. Previous certification.
2. Repetition of all tests required for certification with the exception of the vision and hearing tests.

Acknowledgments

This training program was initially developed for the Hypertension and Follow-up Program (HDFP). It was revised for the Systolic Hypertension in the Elderly Program (SHEP). It was then adapted for the

Program on the Epidemiology of Blood Pressure in Children, Youth and Early Adulthood.

We wish to thank Darwin R. LaBarthe, M.D., Ph.D., et al., for their work in developing these training materials and for graciously allowing us to use them as our guide.

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Adapted from: Program on the Epidemiology of Blood Pressure in Childhood, Youth and Early Adulthood by Darwin R. LaBarthe, M.D., Ph.D., University of Texas Health Science Center at Houston, School of Public Health Epidemiology Research Center (1985).

EXHIBIT 11.1

DISC FOLLOW-UP VISIT BLOOD PRESSURE PROCEDURE

1. Measure arm.
2. Put cuff on.
3. Seat child for five minutes.
4. Look up SV2 peak inflation (or do peak inflation for adults).
5. Take 30 sec. pulse.
6. Pump cuff to 180 or the peak inflation (which ever is higher).
7. Deflate at 2 mm/ seconds.
8. Note Phase 1, 4 and 5 (phase 1 and 5 for adults).
9. Raise arm five seconds.
10. Wait 25 seconds.
11. Repeat steps 6 through 9.

EXHIBIT 11.2

DISC BLOOD PRESSURE CERTIFICATION CHECKLIST

Trainee Name: _____

Trainee Code: _____

	Initial Certification (Date & Initials)	Re-Certification (Date & Initials)
1. Written Test	_____	_____
2. Video Test	_____	_____
3. Y-Stethoscope Certification	_____	_____
4. Live-Performance Evaluation	_____	_____
5. Hearing Test	_____	
6. Vision Test	_____	

Trainer Name: _____

Trainer Code: _____

EXHIBIT 11.3

WRITTEN TEST

1. The arterial sounds heard when taking a blood pressure are called _____, named after a Russian surgeon who first described this indirect technique of measuring blood pressure in 1905.

2. Insert the letter that best describes the following phases of blood pressure sounds:

A.	Silence	Phase 1	_____
B.	Tap and Murmur	Phase 2	_____
C.	Muffling	Phase 3	_____
D.	Tapping	Phase 4	_____
E.	Higher Frequency Tapping	Phase 5	_____

3. Not all five phases of Korotkoff sounds are heard in every person. Name two variations that cause a change in sequence of sound.
_____, _____

4. During measurement of blood pressure, the mercury column should be placed:

   A. So that center of mercury column is at heart level
   B. So that mercury column is at observer's eye level

5. Name three environmental factors which may affect the child or observer during blood pressure measurement:

   A. _____
   B. _____
   C. _____

6. Name three biological factors which may affect the child during blood pressure measurement:

   A. _____
   B. _____
   C. _____

7. The cuff should be placed so that the lower edge is: _____

   A. One to one and one-half inches above the cubital fossa.
   B. Placed level with the heart.

8. What is the purpose for using the bell of the stethoscope?

_____
_____
_____

EXHIBIT 11.3 (Continued)

WRITTEN TEST

9. How many mm Hg should be added to the pressure reading made at palpatory obliteration of the pulse wave? _____. This sum is called the _____.

10. When taking a blood pressure reading the column of mercury should fall at a rate of _____.

    A. 1 mm/per second
    B. 2 mm/per second
    C. 3 mm/per second
    D. 4 mm/per second
    E. 5 mm/per second

11. When the meniscus is half way between two digits, blood pressure is measured: _____.

    A. To the digit above the meniscus
    B. To the digit below the meniscus

12. Between the successive blood pressure measurements on one subject the observer should wait:

    A. 1 minute
    B. 30 seconds
    C. 15 seconds

13. Whenever the pulse is measured, it must be counted for _____ seconds.

14. With any sphygmomanometer that uses a mercury column or observer-read dial the digit preference can be minimized by

    1. _____
    2. _____.

15. If the cuff is too narrow in relation to the size of the arm which of the following will occur? _____

    A. Falsely low blood pressure readings will be obtained.
    B. Falsely high blood pressure readings will be obtained.
    C. Blood pressure readings will not be affected.

16. Pressing too hard with the stethoscope causes turbulent flow in the artery. What is the effect of this on Korotkoff Phase 4?

    _____

17. How long should the peak inflation level be held, giving the RZ time to readjust to its zero level, before deflation is begun?

    _____

EXHIBIT 11.4

ANSWERS TO WRITTEN TEST (EXHIBIT 11.3)

1. Korotkoff sounds.

2. Phase 1 - D
   Phase 2 - B
   Phase 3 - E
   Phase 4 - C
   Phase 5 - A

3. Respiratory, Auscultatory, Arrhythmia

4. B.

5. Noise, lighting, room temperature, placement of manometer, equipment noise, improper seating of child, child's dangling feet.

6. Stress
   Physical discomfort (full bladder)
   Smoking
   Position
   Exercise
   Medication
   Drinking
   Not sitting quietly for five minutes

7. A

8. To better hear low pitched sounds

9. 30 mm Hg.
   Peak inflation

10. B.

11. A.

12. B.

13. 30

14. Concentrate intently to synchronize the Korotkoff sounds exactly with the position of the mercury column. Lowering the mercury slowly at 2 mm per second.

15. B.

16. A murmur can be heard which may prolong the apparent duration of Phase 4 and give a falsely low Phase 5 reading.

17. 5 seconds

EXHIBIT 11.5

DISC BLOOD PRESSURE VIDEO TAPE* TEST

Name: _____

DISC Center: _____

Date: _____ Attempt # _____

Number	Systolic	Diastolic 4th phase	Diastolic 5th phase
1	___|___|___	___|___|___	___|___|___
2	___|___|___	___|___|___	___|___|___
3	Delete all		
4	___|___|___	___|___|___	___|___|___
5	Delete SBP	___|___|___	___|___|___
6	___|___|___	___|___|___	___|___|___
7	___|___|___	___|___|___	___|___|___
8	Delete SBP	___|___|___	___|___|___
9	___|___|___	___|___|___	___|___|___
10	___|___|___	___|___|___	___|___|___
11	___|___|___	___|___|___	___|___|___
12	___|___|___	___|___|___	___|___|___

*Emory Videotape (Kahn and Pullen, 1982).

EXHIBIT 11.6

SCORING INSTRUCTIONS FOR THE EMORY VIDEOTAPE (KAHN AND PULLEN, 1982)

The following procedures provide for the scoring of the values for SBP, DBP4, and DBP5 for sequences 1-2 and 4-12 (3 is deleted due to poor quality). In sequences 5 and 8, SBP have proved difficult to score. Several otherwise well-qualified observers persistently score both 5 and 8 SBP at 122 instead of the correct value of 112. Therefore, sequences 5 and 8 are also excluded from scoring but only for SBP.

It has proven difficult in the amount of training time allotted for DISC to achieve the within pair agreement (1, 10; 2, 9; 5, 8; and 6, 11). The requirement adopted is as follows: (1) The sum of three of four pairs must agree with the actual BP within +/- 4 mm Hg. (2) One pair may differ by greater than 4 mm Hg. (3) These criteria apply separately for SBP, DBP4 and DBP5.

See Exhibit 11.8 for Scoring Tool.

EXHIBIT 11.7

VIDEOTAPE ANSWER KEY

SCENE	SBP	K4	K5
1	100	80	64
2	116	82	80
(3)	(?)	(80)	(80)
4	86	62	58
5	(112)	88	86
6	94	70	60
7	98	84	78
8	(112)	88	86
9	116	82	80
10	100	80	64
11	94	70	60
12	96	74	74
	---	---	---
$\Sigma/11$	102.2	78.2	71.8

Pairs: 1,10; 2,9; 5,8; 6,11

Deleted from scoring: 3.

EXHIBIT 11.8

DISC BLOOD PRESSURE VIDEO SCORING SHEET

NAME: _____ CENTER: _____

Certified: Y N Reason: _____

BP #	SBP		DBP4		DBP5	
1,10	100	- +	80	- +	64	- +
1	_____	___	_____	___	_____	___
10	_____	___	_____	___	_____	___
DIFFERENCE		___		___		___
2,9	116	- +	82	- +	80	- +
2	_____	___	_____	___	_____	___
9	_____	___	_____	___	_____	___
DIFFERENCE		___		___		___
5,8	deleted		88	- +	86	- +
5	xxxx		_____	___	_____	___
8	xxxx		_____	___	_____	___
DIFFERENCE		___		___		___
6,11	94	- +	70	- +	60	- +
6	_____	___	_____	___	_____	___
11	_____	___	_____	___	_____	___
DIFFERENCE		___		___		___

Criteria:

1. Total differences of three of the four pairs must agree with the actual BP within +/- 4 mm Hg.
2. One pair may differ by greater than 4 mm Hg.
3. These criteria apply separately for SBP, DBP4 and DBP5.

EXHIBIT 11.9

DIETARY INTERVENTION STUDY IN CHILDREN

Live Blood Pressure Reading Performance Evaluation Checklist

Trainee's Name and Code: _____

Date _____ _____ _____

Note: The training supervisor is to verify the correct procedure by observing the trainee in one or more complete and uninterrupted exercises of the full procedure. Observations may be carried out with an adult or child subject. When carried out without procedural errors, this record should be completed, signed, and included with the certification packet for the trainee. Errors of procedure should be reviewed, discussed and corrected, until one completed determination is accomplished without error. Provision is made for simultaneous reading by split stethoscopes, as well, at the end of this record. Split stethoscope readings must be carried out with a DISC age subject.

A. Equipment and Supplies

The trainee should indicate that all equipment and supplies needed for blood pressure measurements are present. Check each item as identified:

____ 1) sphygmomanometer
____ 2) cuffs - full set of 5 (excluding "newborn" or 2.0 cm)
____ 3) inflation bulb
____ 4) stethoscope
____ 5) watch/second hand on display
____ 6) fiberglass measuring tape
____ 7) ball point pen
____ 8) study forms
____ 9) record maximum zero level for specific machine (Item #12 on form)
____ 10) record RZ instrument number (Item #13)
____ 11) record room temperature (Item #14)

B. Explanation

____ 1) five minute wait, no talking or moving
____ 2) two blood pressures to be taken
____ 3) arm raised between blood pressure
____ 4) feet flat on the floor

EXHIBIT 11.9 (Continued)

DIETARY INTERVENTION STUDY IN CHILDREN

Live Blood Pressure Reading Performance Evaluation Checklist

C. Arm Measurement

The following steps are properly carried out:

____ 1) subject standing, arm at 90 degrees, arm bare from elbow to shoulder
____ 2) arm length measured, value recorded
____ 3) midpoint of arm marked at dorsal aspect
____ 4) arm relaxed at side
____ 5) circumference measured with tape horizontal through mark at midpoint, no indentation of skin, value recorded (Item #6)

D. Preparation for BP Readings

____ 1) antecubital brachial artery palpated and marked with pen
____ 2) midpoint of bladder located
____ 3) cuff applied with midpoint of bladder over brachial artery
____ 4) arm positioned with midpoint of cuff width at "heart level" and lower edge 2-3 cm above crease
____ 5) have participant sit quietly for five minutes
____ 6) sphygmomanometer scale (midpoint) is at eye level

E. Measurement of Pulse

____ 1) radial artery palpated
____ 2) counting with watch, full 30 seconds
____ 3) recording of 30-second count

F. Measurement of Blood Pressure

____ 1) brachial artery palpated
____ 2) wheel of the RZ turned several times (valve open)
____ 3) stethoscope in ears
____ 4) bell over artery, without cuff or tubing contact
____ 5) cuff inflated quickly, smoothly to 180 mm Hg or to the peak inflation pressure, whichever is greater
____ 6) this pressure is maintained for five seconds
____ 7) valve is turned to CLOSE
____ 8) deflation at 2 mm Hg/second to 10 mm Hg below DBP5
____ 9) cuff quickly and completely deflated
____ 10) cuff disconnected

G. Between readings (30 seconds total)

____ 1) arm raised passively overhead for 05 seconds
____ 2) record SBP, DBP4, DBP5, and "zero"
____ 3) arm lowered for 25 seconds
____ 4) cuff reconnected

EXHIBIT 11.9 (Continued)

DIETARY INTERVENTION STUDY IN CHILDREN

Live Blood Pressure Reading Performance Evaluation Checklist

H. Second Blood Pressure Reading

____ 1) Conforms with procedures above
____ 2) "zero" value is subtracted to give corrected SBP, DBP4, DBP5

I. Completion

____ Signature and code on recording form

J. Observed Blood Pressure Levels by Trainee and Trainer
(delete phase 4 for adult blood pressures)

Trainee	SBP	DBP 4	DBP 5
Reading 1	_____	_____	_____
Reading 2	_____	_____	_____
Total	_____	_____	_____
Trainer			
Reading 1	_____	_____	_____
Reading 2	_____	_____	_____
Total	_____	_____	_____
Trainee total	_____	_____	_____
Difference	_____	_____	_____

The total for each phase must match within +/- 4 mm Hg for a trainee to be certified.

I certify that this trainee has completed all procedures correctly.

Supervisor's Signature and Code: _____

Date: _____

Remarks: _____

EXHIBIT 11.10

DIETARY INTERVENTION STUDY IN CHILDREN

BLOOD PRESSURE SITE VISIT CHECKLIST

DISC Center: _____

Site Visitor: _____

Individual Observed: _____

Date of Visit: _____

Observer should be familiar with the DISC blood pressure section of the Manual of Operations but, not necessarily blood pressure certified.

ITEMS TO OBSERVE

A. MANUAL OF OPERATIONS

1. Is the DISC Manual of Operations available in the clinic area?

   Yes _____ No _____

   Comments: _____

2. Is the 4/93 section on blood pressure in the manual?

   Yes _____ No _____

   Comments: _____

B. EQUIPMENT MAINTENANCE RECORDS

Note: Maintenance records on another study's form are also acceptable, i.e., TOHP, SHEP.

1. RZ Quarterly Cleaning: Yes _____ No _____

2. Weekly Inspection: Yes _____ No _____

   Comments: _____

C. PERSONNEL

Name	DISC Number	Date of Latest Certification
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

EXHIBIT 11.10 (Continued)

DIETARY INTERVENTION STUDY IN CHILDREN

BLOOD PRESSURE SITE VISIT CHECKLIST

D. EXAMINATION OF CERTIFICATION RECORDS

1. Written test: Yes _____ No _____

   Comments: _____

2. Video test: Yes _____ No _____

   Comments: _____

3. Live performance: Yes _____ No _____

   Comments: _____

4. Hearing test: Yes _____ No _____

   Comments: _____

5. Vision test: Yes _____ No _____

   Comments: _____

E. LIVE PERFORMANCE

Perform a "Live Performance" observation on as many certified staff as possible. Do not use study participants or a double stethoscope.

Use the "Live Performance" checklist (see DISC Manual of Operations, Exhibit 11.9), for recording observations.

EXHIBIT 11.11

WEEKLY RZ INSPECTION AND MAINTENANCE LOG

Device #: _____ Location: _____

Date										
"OPEN" Mercury Level in glass tubing 36 - 40 mm Hg										
Screw cap secure?										
Bellows valve O.K.?										
Clean glass column										
Mercury leaks?										
Cuff leaks?										
Rubber tubing/metal connectors?										
Tech initials										

Reference: Section 11.9 of DISC Manual of Operations

EXHIBIT 11.11 (Continued)

WEEKLY RZ INSPECTION AND MAINTENANCE LOG

Device #: _____ Location: _____

Date	Problem Noted	Corrective Action Taken	Initial

Make a photocopy of this log sheet prior to use for additional sheets.

EXHIBIT 11.12

RZ QUARTERLY CLEANING AND INSPECTION LOG

Device #: _____ Location: _____

Date										
Column Cleaned										
Maximum Zero mm Hg										
Minimum Zero mm Hg										
OPEN mercury level (36 - 40)										
Initials										

Reference: Section 11.9 of DISC Manual of Operations

EXHIBIT 11.12 (Continued)

RZ QUARTERLY CLEANING AND INSPECTION LOG

Device #: _____ Location: _____

Date	Problem Noted	Corrective Action Taken	Initial

Make a photocopy of this log sheet prior to use for additional sheets.