Manual 12
Quality Assurance and Quality Control

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Study website - http://www.cscc.unc.edu/hchs/

Quality Assurance and Quality Control
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1. INTRODUCTION

1.1. Quality Assurance and Control Procedures

The distinction between quality assurance and quality control is both arbitrary and philosophical. The former is considered here as relating to activities to assure quality of data which take place prior to collection of data, while the latter relates more to efforts during the study to monitor the quality of data at identified points during data collection and processing. It is quality control on which this manual focuses, whereas quality assurance is the essence of the entire Manuals of Operation, and includes the following activities:

1) Detailed protocol development. A clear description of the study design, training, certification, and the various data collection activities provides the blueprint for the study. Each protocol is a written reference for staff and researchers. Procedures for handling the routine, as well as the exceptional, are given. Those protocols constitute the HCHS/SOL Manuals of Operation.

2) Training. Training is the transfer of the study plans in the protocol to the research staff. The process has resulted in clarification and revision of the protocol. Special materials for this purpose have been developed for HCHS/SOL and are the basis for continuing education during the study.

3) Certification. Criteria to examine the adequacy of an individual's training have been established. Individuals meeting these criteria are qualified to execute a protocol or a segment of it. Certification indicates that an acceptable performance standard has been mastered or an adequate knowledge of material has been achieved. The Coordinating Center (CC) monitors the study to ensure that the research staff performs only those functions for which they are certified.

Quality control procedures involve monitoring data collection by observation (directly and by tape recording) and quantitative assessment (using repeated measurements and statistical analysis of study data). Monitoring is performed both by personnel within the field centers and by monitoring visits from the CC. A summary of selected aspects of HCHS/SOL Study quality control follows.

1) Observation monitoring. Over-the-shoulder observations of staff by supervisors are made to identify techniques that need improvement and points where the protocol is not being followed. Also, periodic monitoring visits by CC staff are made to observe clinic activities. Immediate feedback is given on issues related to protocol adherence, and recommendations for improvements are given to the field center Principal Investigator for action.

2) Quantitative monitoring. Repeat measurements taken by the same and different technicians are used as quality control tools. Randomly re-doing a fraction of an individual's work may not only stimulate better overall quality of data, but also allows estimation of measurement reliability. At the time of reporting the results of the study, it

is important to establish that the "error" in the data is not so large as to threaten the validity of conclusions.

Mean and standard deviations of study variables, by technician, are monitored for differences among technicians or trends over time. Digit preference in anthropometry and sitting blood pressure is monitored with study data.

3) Reporting results. Two aspects of the reporting of quality control monitoring should be emphasized. First, the results must be timely. When remedial action is required, reporting must be prompt so that a return to an acceptable level of performance is not unnecessarily delayed. Second, the reporting format must be easily understood. Tabular presentations are accompanied by clear graphical displays.

4) Action on results. With conscientious and trained staff, quality control reports provide an opportunity to praise a job well done. On the other hand, a poor performance is the basis for some remedial action. Depending upon past performance and the amount of error, the appropriate action may be a simple discussion to encourage a better performance. Re-training may also be appropriate at times.

1.2. Monitoring of Data Quality and Implementing Corrective Action

The subsequent sections of this Manual describe the reports used to monitor quality control. These reports are designed to be clearly understandable and to lead to corrective actions. A Quality Control Committee (QCC) is designated by the HCHS/SOL Steering Committee to coordinate and direct the quality control activities. This committee will have regular monthly conference calls to discuss issues that arise and review QC reports.

The QCC is charged with establishing the content of the quality control reports and reviewing them with specific attention given to deviation from protocol, and trends or shifts in data over time. The QCC prepares recommendations to the Steering Committee in matters of quality assurance, and contacts field centers, reading centers, or laboratories as needed, to advise them of a problem and to discuss the mechanism for correction. The QCC has representation from the CC, field centers, reading centers, the Central Laboratory, and NHLBI.

As the repository for HCHS/SOL Study data, the CC is responsible for preparation and dissemination of QC reports. These reports consist of tabulated data and summary statistics, and identify protocol deviations, recurrent problems, or temporal trends. Each field center and reading center is asked to respond to the reports and to implement corrective action. The distribution of periodic QC reports is as follows:

1) QC reports on technician-specific performance are sent to the respective field center principal investigators, to study coordinators and to the QCC.

2) QC reports on laboratories/reading centers' performance are sent to the respective principal investigators and to the QCC.

3) Summary QC reports without technician-specific data are sent to the Steering Committee after review by the QCC.

The following individuals should respond to the reports as follows:

1) Field center PIs, study coordinators: Review each QC report including technician-specific performance measures for their field center; identify a solution to each problem; implement corrective action; report corrective action to Coordinating Center QC Committee representative.

2) Central laboratory and reading center directors: Review each QC report for their laboratory/center; identify a solution to each problem; implement corrective action; report corrective action to QCC.

3) Quality Control Committee: Review each QC report with attention to deviation from protocol, recurrent technician or field center problems, and temporal trends; contact field center, reading center, or laboratory investigators to review data quality problems and ensure solutions are proposed; monitor the implementation of corrective action.

4) Steering Committee: Review QC summary reports; monitor data quality trends; direct the QCC in areas needing special attention; propose changes to protocol when necessary.

1.3. Organization of the Quality Control Manual

What follows is a detailed list of quality assurance or quality control measures addressing each data transfer point or possible source of error. **Section 2** describes certification procedures for field center staff. **Section 3** is a placeholder. **Section 4** explains the HCHS/SOL study's system of making (blinded) repeated measurements for quality control purposes, which is used in so many areas of the study that a separate section is devoted to description of this topic. **Section 5** discusses the types and schedules of quality control reports and describes the analysis of study data for quality control purposes. Subsequent sections describe the quality control procedures for the various components of the data collection protocol.

2. CERTIFICATION PROCEDURES

Certification of study personnel is an essential aspect of effective quality assurance as well as quality control in clinical research. In order to maintain proper collection of data despite potential for personnel changes over the study period, the CC is responsible for establishing and providing the requisite minimum criteria and training and ensuring continued adherence to standards.

Although all HCHS/SOL staff members are expected to be familiar with the entire study protocol, the complexity of the design requires that study coordinators and staff designated to participate in certain areas of data collection for the study each be instructed and certified on specific data collection instruments and tasks.

Study coordinators are responsible for providing continuity from participant recruitment through exiting the study. Coordinators should be routinely involved in all aspects of the study with regard to participant and staff involvement as well as data collection. This includes recruitment

and scheduling of participant visits as well as the performance (or supervision) of many segments of the clinic examination. Coordinators also serve as the liaison between their field center, the Central Laboratory, reading centers, and the CC. They communicate with participants' physicians when necessary with regard to study procedures and examination results. The study coordinator is responsible for accurate collection of data and oversight of the shipment of blood and urine samples to the Central Laboratory, and pertinent materials to the reading centers.

The responsibilities of study technicians can vary between field centers and by staff qualifications. The study coordinator is responsible for periodically monitoring the accuracy of the work done by auxiliary personnel. **However, it should be noted that the Principal Investigator is ultimately responsible for the quality and integrity of the data collected and for the ethical standards of all staff at his/her study center.**

Central training for HCHS/SOL Visit 2 includes web-based and on-site training on biospecimen collection and processing, a sonographer training conducted on the premises of the HCHS/SOL Central Echocardiography Reading Center, and on-line training of the HCHS/SOL field center personnel on the remainder of the Visit 2 data acquisition and transfer components over the course of two weeks.

In addition, staff must be certified on the following data acquisition procedures in order to collect such data. Specific criteria and requirements for training in these areas are described in detail in Manual 2, Field Center Procedures (unless otherwise specified):

- Informed Consent – Manual 2
- Anthropometry – Manual 2
- Sitting Blood Pressure – Manual 2
- Interviewing techniques – Manual 2
- Biospecimen Collection & Processing – Manual 7
- Data Management –Manual 13
- Echocardiography-Manual 17a

Additional specialized trainings and certifications are held for technicians/examiners responsible for retention (Manual 3), Follow-up (Manual 16), and endpoints ascertainment (Manual 15).

Study technicians may train and be certified in any of the areas they have been assigned to by their Principal Investigator (PI) or Study Coordinator. Certified Study Coordinators or lead personnel may train and certify new personnel on site after initiation of the study by following the guidelines specified in Manual 2, and certification procedures described below. It should be noted that the Study Coordinator remains responsible for all data collection, data entry, and other procedures delegated to staff. Study Coordinators should frequently monitor staff members to ensure the high quality performance of all procedures.

For staff to be formally certified, Study Coordinators submit a **Certification Request Form** (0) to the CC. This form will document how, when the staff member has completed the necessary requirement for certification. The CC will assign a code number upon receipt of this form to

staff who achieves certification in the areas requested. Re-submission of this form is required to update new areas of certification for staff members.

The CC continually updates the certification records for each study site, and staff code numbers are routinely compared to data collection forms to ensure that only certified staff performs data collection on the specific procedures/interviews to which they have been assigned. Additional training and supervision is to be carried out as needed for remedial action at the field centers. Continued supervision will be the responsibility of the Study Coordinator. If at any time certification requirements are incomplete at a field center or the quality of data collection is found to be less than optimal by the Quality Control Committee, the center is notified. If the center does not institute corrective action in the time allotted, further follow-up will take place by study personnel identified by the Quality Control Committee and the Steering Committee in an attempt to resolve the issues.

3. REPEATABILITY STUDY (not done in HCHS/SOL Visit2)

PLACE HOLDER SECTION. Not done in HCHS/SOL Visit2

4. QUALITY CONTROL SYSTEM FOR REPEATED MEASUREMENTS

To estimate the reliability of laboratory and body composition measures, some participants will provide an additional sample of blood or urine, or will have anthropometric measurements repeated by a second technician on the same visit. The repeated anthropometric measurements are recorded on the "Anthropometry QC" (AQC) form. The additional QC laboratory specimens are labeled with a *phantom* participant ID that is indistinguishable from other ID numbers, so that the laboratory is blinded to the QC process. Forms belonging to the phantom participant are entered into the DMS just as regular study data. The **Phantom Form** (PHT) is used to match the phantom ID to the HCHS/SOL participant IDs contributing repeat measurements. The QC phantom participant folders are created as follows:

1) Affix a phantom ID label to the **Phantom Form**; place these in a folder.
2) Every time a participant contributes replicate data, his/her HCHS/SOL participant ID is affixed to the **Phantom Form** next to the type of data that was contributed. Multiple individuals will contribute the QC specimens under a single phantom ID.

3) After completing the **Phantom Form** for the phantom, the folder is processed along with the regular stream of participant folders as if the Exit Interview had just finished.

5. ANALYSIS OF STUDY DATA FOR QUALITY CONTROL PURPOSES

The methods to monitor the quality of the HCHS/SOL data collection process include analyses of the study data itself, overall, by center, and by technician. There will be periodic reporting by field center on:

1) status of variables in the database (no problem, skipped due to skip rule, problem with the entry), to assess the prevalence of data entry problems,
2) distribution of categorical (frequencies) and continuous variables (means, standard deviations, percentiles),

3) digit preference analysis for variables with high degree of subjective judgment by technicians, such as transcribing data for sitting blood presure or anthropometry ,
4) distribution of variables that give information on protocol adherence and the validity of data (e.g., fasting time before blood drawing).

5.1. Quality Control Reports

For a report to be of use in correcting problems, it must appear frequently and reflect as much of the collected data as possible. The frequency of reports is determined by balancing the study's need for prompt and frequent monitoring with the available resources to generate such reports and the need to accumulate enough data to have an adequate sample size. For example, analysis of adjusted means by technician is not feasible on a monthly basis, but can usefully be done each quarter. The standard monthly QC reports will contain the following information:

1) Digit Preference
   a. Anthropometry
   b. Sitting blood pressure
2) Repeated measures
   a. Anthropometry
   b. Biospecimens
3) Protocol Compliance
   a. Twelve-hour fast
4) Descriptive statistics
5) Timeliness and completeness of data entry

5.2. Replicate Data Analysis

The following modeling process will be used to analyze replicate QC data. The total variance of the study data (σ_T^2) can be partitioned into two components: the measurement error component (σ_e^2) and the true variation between and within individuals in the study population (σ_b^2), so that $\sigma_T^2 = \sigma_b^2 + \sigma_e^2$. One quantity of interest for assessing data quality is the reliability coefficient, $R = \sigma_b^2 / \left(\sigma_b^2 + \sigma_e^2\right)$, which is one minus the proportion of total variance due to error variation. The components of variance will be estimated from the replicate data using maximum likelihood (ML) or restricted maximum likelihood (REML) methods.

The estimates of reliability and error variance will be closely watched. In monitoring biospecimen data, $\hat{\sigma}_e$ for each assay is compared with the target standard deviation (SD) which the laboratory has set based on analyses of internal quality control pools. Blind replicate estimates which are more than twice the target SD are considered cause for concern. In addition, if the coefficient of variation (CV) is greater than 10%, corrective action should be requested from the laboratory.

To monitor for systematic differences between original and replicate measurements, the proportion of non-zero differences which are positive is monitored. With no systematic trend, this proportion should be one-half. A sign test is done to test for significant differences, and

significant differences which persist over several months are pointed out to the laboratory. Means and percentiles of these differences are also presented.

Before any analysis is done on the QC replicate pairs, the data are screened for possible mismatches or "strange" observations. For each biospecimen, the mean and standard deviation of the difference between repeat and original pairs are used to determine acceptable intervals.

5.3. Monitoring for Digit Preference

Monitoring for digit preference is done by the Coordinating Center for standing height, hip and waist circumferences. Summary reports are sent to the QCC, and reports on individual technicians are sent to the Field Center. The actual technician-specific frequencies of final digits recorded are not revealed to the Field Center, to prevent technicians from overcompensating to avoid digits that they had preferred in previous reports.

Final digits 0, 1, 2,... 9 are possible for anthropometry, heart rate and other measurements, whereas 0 and even digits are possible for individual blood pressure measurements (before they are averaged). To discuss the analysis of both, let k be the number of possible final digits, so k = 5 (when only even digits are possible) or 10. For a technician with no digit preference, in a large number N of studies the expected frequency of each final digit is N/k. A Pearson chi-square goodness-of-fit test is done to test the null hypothesis that all possible final digits are observed with frequency N/k. The statistic is calculated as

$$\chi^2 = \frac{\sum_{i=1}^{k}\left(O_i - \frac{N}{k}\right)^2}{N/k}, \quad \text{where } N = \sum_{i=1}^{k} O_i.$$

O_i is the observed frequency of the i^{th} possible digit. For large N, this statistic is distributed approximately as a chi-square distribution with k-1 degrees of freedom. Note that Chi-square = 0 when the observed number for each possible digit is N/k. For each calculated value of Chi-square, the p-value is calculated as the probability upon repeated sampling (N fixed) of getting a value as extreme as that actually observed. For the validity of this test, $N \geq 25$ for blood pressure and $N \geq 50$ for anthropometry are required. A cut point of $p < .05$ is used to determine if the divergence from a uniform distribution of digits is statistically significant. However, with large enough N, even small deviations from uniformity are declared statistically significant. Thus a "digit preference score" was developed:

$DPS = 100\sqrt{\chi^2 / Nk}$. This score can be shown to have values between 0 and 100. (It is 0 when all observed digit frequencies are N/k and is 100 when all observed counts are in one cell.) Arbitrarily, a cut point used in the ARIC study for marked digit preferences was $DPS \geq 20$. A technician is judged to show "strong evidence of digit preference" if all of the following are true: (1) $N \geq$ minimum N required (25 for blood pressure, 50 for anthropometry); (2) $p < .05$; and (3) the $DPS \geq 20$. If digit preference is indicated, the technician will be required to undergo re-training.

6. ANTHROPOMETRY

6.1. Anthropometry Procedures

Anthropometry is performed with the participants wearing underwear under a scrub suit or examination gown. The measurements include standing height, body weight, and waist and hip circumferences. Weight and height are measured without shoes. Important quality assurance/control measures include clear and detailed protocols for each measure, training and certification, instrument checks, replicate measurements, observation of technicians by a supervisor, and a periodic quality review of study data by the QCC.

6.2. Training and Certification

All data collectors taking anthropometric measurements must be certified by successfully completing training requirements. Training and practice sessions will be conducted prior to certification. An examiner who attends the central training and passes certification criteria can train and certify other examiners at the field center. Certification testing requires that a minimum of 5 practice subjects be measured by both the expert trainer and the trainee. Agreement between the expert and the trainer must be within 0.5 cm for height, 0.5 kg for weight, and 2 cm for the waist and hip measurements among 4 of the 5 subjects.

6.3. Observation of Anthropometry Measurement

Technicians are observed by the clinic coordinator twice monthly for the first month and then quarterly to ensure standardization. The Checklist for Observation of Anthropometry Measurements (Appendix 3) is used to document these observations and deviations from the protocol are reviewed with the technicians. The observations are also summarized quarterly on the Summary of Observation and Equipment Checklists (**Error! Reference source not found.**). A minimum of 6 procedures every month is required in order to maintain certification. Local re-training sessions are scheduled when a lack of standardization (e.g., technicians who fail to meet the certification criteria described above) is observed among the technicians.

6.4. Maintenance of Equipment

Anthropometry equipment is calibrated frequently and results are recorded on an Anthropometry Equipment Calibration Log (Appendix 5). Scales are zero balanced daily and calibrated weekly, or when moved. Place the 10 kg calibrated weight on the scale and read the result when the digital display has stabilized. The values should be within 1.5 kg of the expected weight. If it weighs outside this range, notify the clinic coordinator to have the scale recalibrated by the manufacturer or by the appropriate institution personnel. Measuring tapes are checked monthly for wear or stretching by comparing them with the height stadiometer. If the measure falls outside the range 119.5 - 120.5 cm the tape should be replaced. Each day the headboard of the stadiometer should be checked to ensure it is properly attached and moves up and down the track smoothly. These equipment checks may be done by any certified anthropometry technician. Quarterly, the equipment logs are summarized onto the Summary of Observation and Equipment Checklist (Appendix 1), which is then sent to the Coordinating Center. Copies of the equipment logs may be requested by the Coordinating Center.

6.5. Random Replicate Measurements

Five percent of participants will be randomly selected to have anthropometry measurements repeated by a different technician. The steps in the random selection and repeat measurement process are:

1) Once the last item on the Anthropometry form (ANT) has been keyed into the DMS, the technician will be notified with a pop-up message if the participant has been selected for repeat measurements.
2) The repeat measurements should be done as soon as they can be fit in to the participant's and technician's schedules. When more than one trained technician is available, the repeat measurements should be assignment randomly to one of the certified technicians, say, by coin toss.
3) The technician who repeats the measurements completes the Anthropometry Quality Control (AQC) form, identical to the Anthropometry form, without looking at the measurement determined by the first technician.

Inter-technician agreement is analyzed by the QCC and serves as a criterion for re-certification. Re-training sessions are scheduled at the request of the Quality Control Committee when a lack of standardization is observed among the technicians.

7. SITTING BLOOD PRESSURE

The OMRON HEM-907XL sphygmomanometer is used to measure seated blood pressure. The technician explains the procedure to the participant, measures arm circumference, wraps the arm with the appropriately sized cuff, lets the participant sit quietly for 5 minutes, and then performs three measurements and records the average of the three readings. Important elements in quality assurance are training and certification, observation of data collection by the study coordinator, quarterly simultaneous blood pressure measurements by the technician and the study coordinator, and standard equipment maintenance procedures performed and summarized quarterly onto the **Summary of Observation and Equipment Checklist** (Appendix 1) and sent to the Coordinating Center. The Quality Control Committee also monitors the distribution of blood pressure readings for any irregularities.

7.1. Training and Certification

All SOL staff assigned to perform blood pressure measurements must be certified after successfully completing the training requirements. Training and practice sessions will be conducted prior to certification. After attending the central training webinar and being certified, an examiner designated by the Field Center Study Manager may train and certify other examiners at the field center.

Training requires that examiner become fully familiar with the contents on blood pressure measurements in SOL Manuals 2 and 12, with the operation of the OMRON HEM-907XL sphygmomanometer, the NeTech calibration equipment and its associated procedures, the SBP form, and the Technician’s Observation and QC logs (OMRON Maintenance and Calibration Log). Certification testing requires that the local trainer observe the examiner measuring a

minimum of 5 volunteers and performing the quarterly calibration procedure. Results are summarized in the Checklist for Observation of Blood Pressure (Appendix 4). A minimum of 6 procedures every month is required in order to maintain certification.

7.2. Observation of Blood Pressure Measurement

Technicians are observed by the clinic coordinator twice monthly for the first month and then quarterly, to reinforce adherence to standardized protocol procedures. The observer completes the checklist provided in Appendix 4. The Checklist is used to document these observations and deviations from the protocol are reviewed with the technicians.

7.3. Maintenance of Equipment

1) Availability of all sizes of cuffs: The blood pressure supervisor(s) makes certain that the field center always has the full range of blood pressure cuffs available at each blood pressure station. Field center staff report immediately to the supervisor if they cannot find all cuff sizes at the station.

2) OMRON sphygmomanometer: Each OMRON unit is checked every 3 months as described in Manual 2. The results of the calibration checks are recorded on the OMRON calibration log (together with the unit number, the date and the technician ID) and sent to the HCHS/SOL Coordinating Center for inclusion in the quality control reports. A sample copy of the maintenance and calibration log is found in Appendix 15.

7.4 Recertification/Maintaining Certification

Field center and technician-specific patterns in the data are analyzed by the QCC and serve as a criterion for re-certification. Re-training sessions are scheduled at the request of the Quality Control Committee when a lack of standardization is observed. A minimum of 6 procedures every month is required in order to maintain certification

8. ECHOCARDIOGRAPHY

8.1. Field Center Sonographer Intra- and Inter-Observer Reproducibility

Purpose: To establish the precision (repeatability) of the following key measures: LV mass index, LV end-systolic and end-diastolic volume, LV EF, tissue Doppler peak early diastolic mitral annular velocity, left atrial volume index, and average longitudinal strain.

Procedure: The specific plan for assessment of sonographer reproducibility will be made in collaboration with the SOL Steering Committee, QA Committee, and Field Center representatives on the Echo Committee. One potential approach could involve volunteers at each Field Center undergoing repeat echocardiography, by the same sonographer, using the same echocardiographic machine during the visit 2 period (as part of HCHS/SOL visit 2 study-wide reproducibility assessment). The same CICL technicians would then analyze the echo in a blinded fashion. Precision of the above key measures would be assessed for the overall study and

by Field Center. Additional inter-observer sonographer reproducibility could be performed every 3 months, where a random selection of 15 participants would undergo repeat imaging (by a different sonographer at the same Field Center) of the following select views: parasternal long-axis view, apical 4-chamber view, and apical 2-chamber view. This approach would add 5-8 minutes of scanning on top of the 40 minutes for a standard scan (total 45-48 minutes) and allow additional assessment of between-sonographer inter-observer reproducibility for the above key measures.

8.2. Echocardiography Reading Center Technician Intra- and Inter-Observer Reproducibility

Purpose: The Reading Center will employ a modular analysis model, whereby each Reading Center technician will be responsible for specific quantitative measures for each echocardiogram. As a result, each quantitative measure will be performed by a single technician for all Visit 2 echocardiograms, minimizing inter-observer variability. The focus of the Reading Center quality assurance procedures therefore will be to quantify and minimize intra-observer variability and temporal drift.

The purpose of the Reading Center quality assurance procedures is to: (1) quantify intra-observer reproducibility, (2) quantify interobserver reproducibility, and (3) quantify and mitigate temporal drift in echocardiographic analysis over the study period.

Intra- and Inter-Observer Variability – For the assessment of intra-observer variability, the primary study technician repeats study analysis in a blinded fashion. Each technician will perform duplicate blind re-reads of approximately 40 studies every 3 months. For the assessment of inter-observer variability, each technician will also perform analysis of the views for which s/he is not primarily responsible. Of the 40 studies analyzed, 20 studies will be the same studies throughout the visit period (to allow for assessment of temporal drift – see below). The remaining 20 studies will be randomly selected from each 3 month period for re-analysis. Technicians will be blinded as to original study ID. Inter-observer variability will be documented prior to any transitions in technicians performing measurements.

Temporal Drift – To assess for temporal drift for both established and 2D speckle-tracking measures, each technician will be required to perform blind re-reads on same set of 20 studies at 3month intervals. Reproducibility of the above key measures will be assessed for each technician using the Bland-Altman method to compare repeated measures, with the coefficient of variation and bias reported as described above.

8.3. Reporting of QA Assessments

Data on intra-observer variability for key echocardiographic measures will be reported to the Coordinating Center every 3-4 months or as agreed with HCHS/SOL steering committee and Coordinating Center. Data regarding temporal drift will be reported to the Coordinating Center every 3-4 months or as agreed with HCHS/SOL steering committee and Coordinating Center.

Reproducibility results will be reported primarily as the coefficient of variation, bias, and limits of agreement.

9. BIOSPECIMEN COLLECTION AND PROCESSING

9.1. Blood Collection and Processing

At the time of the telephone contact, participants are requested to fast for 12 hours before field center visit unless they are diabetics taking insulin or have other medical reasons that make fasting inadvisable. The specific steps to be taken in blood drawing and processing are described in Manual 2 (sections 9, 13). Blood samples are either shipped refrigerated on the same day as collection or frozen at -70^{o}C for weekly shipment to the Central Laboratory. All shipments to the Central Laboratory are made by courier or overnight delivery services. These steps are performed by technicians trained in the HCHS/SOL protocol and certified to have adequately mastered its details.

The first step in quality assurance for blood drawing consists in the training and certification process. Other steps include maintaining logs of equipment checks; observation of technicians (by other technicians and by CC staff on monitoring visits) as they go through the sequence of steps in blood drawing and processing; review of the condition of samples received at central laboratories for problems in shipment; and periodic analysis of the study data for participant compliance with fasting and for signs of problems in drawing or processing, such as hemolysis or delays in completing processing.

Quarterly, the field center supervisor observes each technician responsible for collection, processing, and shipping of the bio-specimens using the checklist given in Appendix 6. These observations are summarized quarterly on the Summary of Observation and Equipment Checklists (Appendix 1).

9.2. Training and Certification

To be certified, technicians will first participate in a web-based training session taught by certified laboratory staff which includes bio-specimen (blood, urine) collection, processing, packaging and shipping as well as quality control measures such as phantom specimens and blind replicate matching. Then, technicians will be trained and certified at on-site training on biospecimen collection and processing. Each technician must complete the training and pass both written and practical exams before becoming certified for the HCHS/SOL study. Certification requirements for personnel who do not attend the centralized training are:

- Collection, processing, and shipping bio-specimens for 3 volunteers under the supervision of the certified lead bio-specimen technician at the field center, and
- Completion and submission to the CC of the written exam

Those learning phlebotomy must also conform to their own institution's requirements and State laws for certification in this area. Once certified, each technician should draw and process at least once per week to maintain their certification status.

9.3. Maintenance of Equipment

Each field center performs daily temperature checks on the refrigerators, freezers and the refrigerated centrifuge as well as the rooms in which these are located. The actual speed of the centrifuge is checked and recorded annually with a tachometer. The results of these checks are recorded on the **Daily Centrifuge, Freezer, Refrigerator and Room Temperature Log** (Appendix 9) kept at the blood processing station, and are summarized onto the **Summary of Observation and Equipment Checklist** (Appendix 1) quarterly and sent to the Coordinating Center.

In addition, each technician is responsible for maintaining his/her pipettes for blood processing. Certificates should be purchased with each pipette and filed. Pipettes should be calibrated and cleaned professionally on an annual basis. Monthly calibrations can also be done professionally.

9.4. Monitoring by the Central Laboratory

The Central Laboratory reviews the drawing and processing time, as recorded on the **Laboratory Collection Form** (LAB). If there are extreme values that raise questions about the validity of laboratory results, the field center is alerted to the problems.

9.5. Packing Samples for Shipment to the Central Laboratory

All vials of blood samples as well as the plastic bags in which the samples for a given participant are packed for shipment to the laboratories are labeled with the laboratory ID. To avoid delays in transit to the laboratories which might cause samples to be warmed or thawed in shipping, all samples are shipped by an overnight delivery service. One tube is shipped to the Central Laboratory the same day as it is collected. All frozen plasma, sera, packed cells, urine, and Paxgene tubes collected and stored within the last work week are shipped to the Central Laboratory on Monday with the exception of Quality Control aliquots, as discussed in the Quality Control section below. Samples can be shipped on Tuesday if the Field Center is closed on Monday, but the contact person at the Central Laboratory must be notified that the shipment will arrive one day later than usual.

A shipping list is enclosed with each shipment to the Central Laboratory giving the IDs for all sets of samples that are enclosed (see **Biospecimen Shipping** Form in HCHS/SOL Laboratory & Biospecimens Manual 7). The person unpacking these samples at the Central Laboratory verifies that the IDs on the vials match the ID on the plastic bag and checks both against the shipping list. If any discrepancies are detected, the Central Laboratory contacts the field center to resolve the problem.

For samples that are shipped weekly to the Central Laboratory, the staff receiving the shipment will monitor that the shipment was delivered overnight. If delays are found, the Laboratory notifies the field center to alert them. If the problem persists, and fault lies with the delivery service, the field center will change to an alternate delivery service. If delays are due to protocol violations at the field center, the Coordinating Center is contacted in addition to the field center.

Blood vials shipped to the Central Laboratory must be packed securely to avoid both breakage and warming. Full instructions for packing samples are specified in the **Biospecimen Collection**

and Processing manual. The laboratories monitor the arrival condition of the samples sent from each field center on the **Biospecimen Shipping Form**. If problems are encountered, the laboratories notify the field centers involved. If a pattern of sample damage becomes apparent that suggests a need to modify the materials used to ship samples (e.g., excessive leakage of a certain type of vial) or how samples are packed, the QCC should be alerted to ensure appropriate action is taken.

9.6. Urine Collection and Processing

After a participant is greeted at the clinic, he/she is asked to provide a urine specimen at the participant's convenience. When the participant is ready to void, a specimen cup (labeled with the laboratory ID) is provided, and the participant is instructed to fill the cup if possible. If the sample is insufficient for processing, the participant is requested to void again in a clean container prior to leaving the field center. Prior to processing, the technician records on the **Laboratory Collection Form** whether a urine sample was obtained, the collection time of the initial (if more than one) urine sample, and adequacy of volume.

9.7. Replicate Blood and Urine Specimens

A replicate sample is obtained by either drawing 1 to 2 additional tube(s) of blood, or by dividing a urine sample into separate containers. The replicate samples are then processed using the same method as for the original samples. The Central Laboratory staff processing the samples should be unable to distinguish original samples from replicate samples. Each Field Center will collect QC samples from approximately 25% of the participants. QC samples are drawn daily. Initially, we will try to collect a QC sample from every participant to have more QC data available at the start of the study. After a period of time (to be determined by the QC Committee), the central laboratory staff will ask each Field Center to collect QC samples on fewer participants.

The plan for collecting the QC samples each day is as follows: From the first participant of the day, draw tubes #1; from the second participant of the day draw tube #2; from the third participant, draw tube #3 and #4; from the fourth participant draw tubes #5; from the fifth participant draw tube #6; from the sixth participant, draw tube #7 and #8; use a urine sample with sufficient volume to provide 2 sets of aliquots (one for the QC duplicate) from one participant each day. This could be urine from a participant who has also volunteered to donate additional blood.

To reduce the burden on any single participant, extra blood is drawn from several participants and sent out under the same QC ID number. For data analysis, results on each laboratory measurement are matched to the appropriate participant results at the Coordinating Center from the QC Phantom ID Form (PHT form) that is completed by Field Center technicians. If extra QC blood is drawn for a tube that is processed for weekly shipment (Tubes #1, 2, 3, 5, 6, 7, or 8), the aliquots are stored at the Field Center for an extra week and then sent to the Central Laboratory with a regular shipment. If extra QC blood is drawn for a tube that is processed for daily shipment (Tube #4), the tube is sent to the Central Laboratory with the regular daily shipment. See the **Biospecimen Collection Form and Processing Manual** #7 for further information. The extra specimen(s) will be labeled with a laboratory ID corresponding to a phantom participant ID. Eventually, a single phantom ID will have a complete collection of blood, and urine,

contributed by several participants. Each month, the Coordinating Center reviews the number of QC phantom forms completed to ensure the procedures for obtaining replicate samples is being followed.

10. BIOSPECIMEN PROCESSING AT THE CENTRAL LABORATORY

10.1. Procedures for Central Laboratory Analyte Determinations

Blood samples are collected and processed at the field centers for shipment to a single central laboratory for several analytical tests. In the present section, the emphasis is on quality assurance in the central laboratories, beginning with the receipt of samples. This section differs from other chapters of this manual in being more of a general overview and summary of quality assurance measures. These matters receive careful and detailed discussion in the central laboratory manual, which covers procedures for: receiving samples and storing them at a proper temperature until analysis; schedules of equipment maintenance; storage and handling of reagents, calibration standards, and quality control materials; internal and external quality control programs; and transcription and reporting of measurement results. This section of the manual supplements the laboratory manual by its discussion of reporting on the effectiveness of laboratory quality assurance procedures and of the utilization for quality control of (1) analyses of study data and (2) blind replicate samples from participants sent to the laboratory.

10.2. Receiving Samples at Laboratory

At the Central Laboratory, a record in the local data base is created using the laboratory ID number for each specimen when it arrives. It is important in handling HCHS/SOL frozen blood samples to avoid any unnecessary exposure to room temperature. Clear procedures for unpacking specimens upon arrival are set out in the Central Laboratory's protocol to minimize such exposure. While awaiting analysis, specimens are to be kept in storage at -70^0C. The laboratory has provisions for (1) prompt detection of power failure or of failure of freezer to maintain the proper temperature, including both local alarms and alarm signals to a central security office that will notify appropriate laboratory personnel if a problem develops after hours; (2) back-up power supplies in the event of power failure; (3) plans for the use of dry ice to maintain the sample temperature until any problems with the freezer can be repaired.

The probable stability of different analytes in frozen storage has been assessed and standards set for how soon analyses will be performed after the arrival of specimens at the laboratory.

10.3. Maintenance Procedures at the Central Laboratory

Maintenance procedures for laboratory equipment are fully specified in the laboratory protocols or in manufacturers' manuals referenced in the protocols. Technicians are fully instructed in these procedures.

A regular schedule is set up for routine maintenance procedures, with logbooks kept on their performance. The laboratory supervisors review these logs on a regular basis to verify that proper maintenance procedures are being carried out according to the schedule set and that any special maintenance procedures needed are carried out.

The laboratory protocol fully specifies the reagents used, the sources from which they are procured, and the procedures used to prepare and store reagents to guarantee the stability of the reagent and the accuracy of the assay. The laboratory protocol also fully specifies the sources of calibration standards and quality control materials, the procedures used to prepare and store calibration standards and quality control materials to guarantee the stability of the material and the accuracy of the assay. To maintain the comparability of measurements using new and old calibration standards and controls, an overlap period is carried out, during which concentration values for the new standard are determined using the standard which is being replaced.

10.4. Internal Quality Control Pools

The Central Laboratory maintains an internal quality control program involving the analysis of multiple samples from quality control pools in each analysis run in which HCHS/SOL study samples are analyzed. Results on these samples are used to decide whether the measurement process is in control and whether the results on the study samples will be accepted or whether the measurements should be repeated after taking corrective action. Quarterly, the Central Laboratory provides a summary of the internal quality control results to the Coordinating Center, including the following information for each assay: (1) monthly summary statistics (n, mean, and standard deviation) on all quality control pools, including new pools being overlapped to replace established QC pools; (2) summaries of any unusual problems or conditions noted. The Coordinating Center reviews these reports for evidence of trends with time in results on these pools.

Results on analyses of quality control pools are analyzed by the Coordinating Center for trends over time that may represent either (1) shifts in measurement or (2) changes over time in the concentration of the analyte in a given pool. To determine which of these is the case, trends in a given pool can be compared with (1) trends in other pools (if any) used to control analyses of a given analyte; (2) trends in differences on measurements of samples from quality control phantom participant duplicates which are repeated several months apart; (3) trends in the study data. If there is evidence of changes in the concentration of a control pool over time, it should be replaced.

10.5. External Quality Control

For many of the assays performed in the HCHS/SOL study, the Central Laboratory participates in various standardization or certification programs run by outside agencies, such as the College of American Pathologists or the CDC Lipid Standardization Program. The Central Laboratory should continue to maintain acceptable results in these programs and promptly provide the Coordinating Center with copies of any reports on their performance generated by these programs. Should any of the results achieved in these programs appear problematic, they are reviewed by the Coordinating Center and the Laboratory Committee together with other quality control information on the assay in question to determine what action is appropriate.

11. PARTICIPANT INTERVIEW

Establishing quality control for interviews is critical in ascertaining whether interviews are conducted according to protocol. If all interviews are not conducted according to protocol, then

the information that one interviewer obtains from a participant may be different from the information another interviewer might have obtained from the same participant. Audio recording and observation are used to monitor the quality of the data that interviewers collected as described below.

11.1. Certification on Interviewing Technique

Requirements for certification or re-certification on interviewing techniques include:

- Attending central webinar training, or reviewing the training materials on Interviewing Techniques (posted on the SOL website)
- Round-robin (explained below) or Reading Center review of taped interviews, covering all questionnaires.
- Adequate frequency of interviews with each instrument
- Acceptable performance on quality and completeness of the interview data, per analyses by the Quality Control Committee.
- Certification and audiotape review is handled separately for some procedures.

Completed written exams are sent to the CC for evaluation.

11.2. Assessment of Interviewing Technique

Field center supervisor or the interviewer supervisor periodically assess interviewing technique and adherence to protocol by reviewing a sample of recorded interviews conducted during a time period specified by the Quality Control Committee. Interviewers will not know in advance which interviews will be monitored for quality control purposes. The study coordinator will rate the interviewer's performance using standard criteria from a checklist (Appendix 2) and give the interviewer immediate feedback. These interviews should be summarized on the Summary of Observation and Equipment Checklists (Appendix 1).

11.3. Recording of Interview

For a one week period starting on a date specified by the Quality Control Committee, interview components listed in **Table 16.3.1** (see below,) will be audio recorded with a handheld digital recorder and recordings tracked on an inventory list. Prior to recording, participants must be asked for their authorization to have record the interview, and told that interviews are used for quality control purposes. The recorded information will not be stored by the study and destroyed after review by the supervisor.

Table 16.3. 1-Interview components to be recorded

FORM ACRONYM	INTERVIEW COMPONENT
To be determined	To be determined

Each digital recording for a single participant visit should contain recordings for interview components listed in **Table 16.3.1.** Recordings will be labeled and organized by staff-ID,

participant-ID, date and content. If the same staff member is administering multiple questionnaires consecutively to the same participant, he/she does not need to make a separate recording for each questionnaire, but can make one continuous recording.
The label/name of the recorded file(s) should look like:

111_	X1234567_	8-20-10	_general interview
Staff ID	***Part-ID***	***Date***	***component***

One recorded participant interview file will be randomly selected and reviewed by the interview supervisor, checking for adherence to protocol, using the observation checklist. These reviews should be summarized on the Checklist for Review of Audio Recorded Interviews (Appendix 13).

Round-robin review: Quarterly, the CC will randomly select three participant interview recordings from each field center for review using the observation checklist. These reviews will be documented on the Quarterly Checklist for Interviews (Appendix 14). Notes about any inconsistencies in implementing the interview protocol will be documented and sent to the CC. The CC will distribute to the QC Committee a summary of the comments, protocol violations and discrepancies in interview methods and the summary will be discussed on a QC conference call with interview coordinators.

The CC will run periodic reports to see if there are staff who have not been part of the monthly recording and quarterly reviews. In this case, the CC and the Field Center will work together in order to insure that all staff are recorded during the next quarterly review.

11.4. Analysis of Study Data

Study data will be analyzed periodically to assess frequency of interviews for each interviewer, for each questionnaire. Minimum levels will be set to allow for continued certification. Levels of missing data will also be assessed by interviewer, and maximum acceptable levels set.

Appendix 1. Summary of Observation and Equipment Checklist

Instructions: *This form should be completed quarterly and sent to the Coordinating Center.*

Field Center: _____ Date: ___ / ___ / _____
(mm/ dd/ yyyy)

Quarterly Reporting period:Jan - Mar 20____ Apr - Jun 20____ July - Sep 20____ Oct - Dec 20____

A. Observation Checklist

	Technician ID	Supervisor ID	Date (mm/dd/yy)
General interview techniques	_____	_____	_____
	_____	_____	_____
	_____	_____	_____
	_____	_____	_____
	_____	_____	_____
	_____	_____	_____
	_____	_____	_____
	_____	_____	_____
	_____	_____	_____
	_____	_____	_____
	_____	_____	_____
Anthropometry observation	_____	_____	_____
	_____	_____	_____
	_____	_____	_____
	_____	_____	_____
	_____	_____	_____
Blood pressure observation	_____	_____	_____
	_____	_____	_____
	_____	_____	_____
	_____	_____	_____
	_____	_____	_____
Biospecimen collection	_____	_____	_____
	_____	_____	_____
	_____	_____	_____
	_____	_____	_____
	_____	_____	_____

B. Equipment Checklist

	Frequency	No. times assessed	No. times within calibration
Anthropometry			
(1) Scale read zero	Daily	_____	_____
(2) Headboard of stadiometer	Daily	_____	_____
(3) Weight scales	Weekly	_____	_____
(4) Measuring tape	Monthly	_____	_____
Blood Pressure equipment			
(1) Sphygmomanometer inspection	Quarterly	_____	_____
(2) Calibration checks of sphygmomanometer	Quarterly	_____	_____
Biospecimen collection			
(1) Refrigerators, freezers, room temp	Daily	_____	_____
(2) Speed of centrifuge	Annually	_____	_____
(3) Pipettes	Annually	_____	_____

Comments: _____

_____

_____

_____

Appendix 2. Checklist for Observation of General Interviewing Techniques

Field Center: _____ Tech ID: _____Supervisor ID:_____ Date: ___/___/___

Interviews Observed (Check all that apply) NEEDS TO BE UPDATED

Alcohol (ALE/ALS)	☐	Personal Information (PIE/PIS)	☐
Dietary behavior (DBE/DBS)	☐	Physical Activity (PAE/PAS)	☐
Economic (ECE/ECS)	☐		☐
Health care use (HCE/HCS)	☐	SF-12 Health Survey (SFE/SFS)	☐
	☐	Sleep (SLE/SLS)	☐
Hearing Hx (HHE/HHS)	☐	Social Network Index (SNE/SNS)	☐
Medical Hx (MHE/MHS)	☐	Sociocultural (SCE/SCS)	☐
Medication Use (MUE/MUS)	☐	Tobacco Use (TBE/TBS)	☐
Occupation (OCE/OCS)	☐	Weight Hx (WHE/WHS)	☐
	☐	Well Being (WBE/WBS)	☐
Personal Identifiers (IDE/IDS)	☐		

Item		Yes	No	Comments
1	Introduces her/himself at beginning of the interview; thanks participant at the end.			
2	Verifies participant's name			
3	Explains purpose of interview when appropriate,e.g., reads introductions or transition statements when included on form.			
4	Reads questions exactly as written, stressing time frame and key elements.			
5	Demonstrates familiarity with content, flow, definitions, and skip patterns.			
6	Uses standardized tone of voice with supportive, non - judgmental statements.			
7	Paces interview in response to participant's level of comprehension/comfort.			
8	Trains participant in response patterns when appropriate.			
9	Refrains from probing except to clarify ambiguous, unclear, untrue, or inconsistent, responses.			
10	Uses standardized definitions when asked for clarification.			
11	Repeats questions stressing portions of question which were misunderstood.			
12	Selects appropriate type of probe.			
13	Accurately records participants' responses.			

Comments: _____

_____

Appendix 3. Checklist for Observation of Anthropometry Measurement

Instructions: *This checklist documents observation of anthropometry technicians by supervisors. Quarterly, checklists and logs are summarized onto the* ***Summary of Observation and Equipment Checklists*** *(Appendix 1). Copies of this log may be requested by the CC.*

Field Center: _____ Tech ID: _____Supervisor ID:_____ Date: ___/___/___

	Yes	No	Comments
1. Anthropometry is done BEFORE the snack.	_____	_____	_____
2. If the participant is wearing any nylon hose other than knee highs, the participant is instructed to remove hose.	_____	_____	_____
3. Participant is wearing light-weight, non-constricting underwear.	_____	_____	_____
4. Participant is wearing a light clothes or scrub suit.	_____	_____	_____
5. Participant has removed shoes.	_____	_____	_____
6. Participant has emptied bladder.	_____	_____	_____

Standing Height Measurement

1. Procedure is explained to participant.	_____	_____	_____
2. Participant's spine and heels are placed against the wall.	_____	_____	_____
3. Participant's eye to ear plane is horizontal [i.e., Frankfort plane].	_____	_____	_____
4. Measurement is taken with triangle or measuring block.	_____	_____	_____
5. Data recorded accurately in cm	_____	_____	_____

Technician's measurement of participant height: _____ cm
Supervisor's measurement of participant height: _____ cm

Weight Measurement	**Yes**	**No**	**Comments**
A. Equipment			
1. Scale firm on floor.	_____	_____	_____
2. 10 kg standard weight available.	_____	_____	_____
3. Anthropometry Equipment Calibration log up-to-date.	_____	_____	_____
B. Procedure			
1. Participant prepared and procedure explained.	_____	_____	_____
2. Participant is bare-foot.	_____	_____	_____
3. Position of participant on center of scale.	_____	_____	_____
4. Balance achieved.	_____	_____	_____
5. Recordings completed.	_____	_____	_____
6. Data recorded accurately in kg	_____	_____	_____

Technician's measurement of participant weight: _____ kg
Supervisor's measurement of participant weight: _____ kg

Waist Measurement	**Yes**	**No**	**Comments**
1. Procedure is explained to participant.	_____	_____	_____
2. Subject stands erect, yet relaxed, with weight equally distributed on both feet, and feet together.	_____	_____	_____
3. Measuring tape is placed around subject's waist using lateral border of ilium as bony landmark.	_____	_____	_____
4. Subject takes a normal breath and gently exhales, holding breath in a relaxed manner at the end of exhalation.	_____	_____	_____
5. Tape is horizontal and snug, but not tight enough to compress tissue. [Invert tape, if needed, to insure reading edge of tape is snug to skin for measurement.]	_____	_____	_____
6. Reading is recorded to the nearest centimeter, rounding down.	_____	_____	_____

Technician's measurement of participant waist: _____ cm

Supervisor's measurement of participant waist: _____ cm

Comments: _____

_____

_____

_____

Appendix 4. Checklist for Observation of Blood Pressure

Instructions: *This checklist documents observation of blood pressure technicians by supervisors. Quarterly, checklists and logs are summarized onto the* ***Summary of Observation and Equipment Checklists*** *(Appendix 1). Copies of this log may be requested by the CC.*

Field Center: _____ Tech ID: _____Supervisor ID:_____ Date: ___/___/___

Blood Pressure Measurement	**Yes**	**No**	**Comments**
1. Checks function settings on OMRON unit (ENTER, 3 inflations, 30)	_____	_____	_____
2. Checks Mode and P-setting on OMRON unit	_____	_____	_____
3. Makes sure AC adapter for OMRON unit is securely connected (tends disconnect from unit)	_____	_____	_____
4. Checks AC adapter cord and tubing for cracks	_____	_____	_____
5. Cleans all the equipment	_____	_____	_____
6. Allows subject to rest for five full minutes	_____	_____	_____
7. Performs arm measurement and cuff selection properly	_____	_____	_____
8. Identified brachial pulse location properly	_____	_____	_____
9. Proper cuff placement	_____	_____	_____
10. Attaches cuff to monitor	_____	_____	_____
11. Uses proper settings on OMRON unit	_____	_____	_____
12. Turns monitor on with ON/OFF button	_____	_____	_____
13. Sets MODE selector to AVG	_____	_____	_____
14. Sets P-SET knob to AUTO	_____	_____	_____
15. Pushes START button	_____	_____	_____
16. Records 1st, 2nd, 3rd systolic and diastolic BP readings and average heart rate	_____	_____	_____
17. Instructions to participant are clear	_____	_____	_____
18. Holds arm vertically for 5 seconds between readings	_____	_____	_____
19. Informs participant of average readings	_____	_____	_____

Comments: _____

_____

_____

Checklist for Observation of Biospecimen Collection and Processing

Instructions: *This checklist documents observation of technicians responsible for biospecimen collection, processing, and shipping by supervisors. Quarterly, checklists and logs are summarized onto the* ***Summary of Observation and Equipment Checklists*** *(Appendix 1). Copies of this log may be requested by the CC.*

Field Center: _____ Tech ID: _____Supervisor ID:_____ Date: ___/___/___

Biospecimen Collection	**Satisfactory/ Unsatisfactory**	**Comments**
1. Labels checked	___	_____
2. Participant prepared and procedure explained	___	_____
3. Tourniquet application and release	___	_____
4. Venipuncture technique	___	_____
5. Tube collection sequence	___	_____
6. Inversion technique	___	_____
7. Tube incubation location	___	_____
8. Stasis obtained	___	_____
9. Needle disposal	___	_____
10. Laboratory Collection form completion	___	_____
Biospecimen Processing		
1. Knowledge of centrifuge operation	___	_____
2. Aliquotting supply set-up	___	_____
3. Stage 1 tube spin	___	_____
4. Stage 2 aliquotting	___	_____
5. Stage 3 tube spin and processing	___	_____
6. Stage 4 tube spin and processing	___	_____
7. Urine processing	___	_____
8. Vials sealed	___	_____
9. V-Form completed	___	_____
10. Freezer organization	___	_____
11. Time constraints	___	_____
12. Disposal of contaminated supplies	___	_____
13. Paxgene tube freezing	___	_____
Biospecimen packing and shipping		
1. Specimens bagged	___	_____
2. Adequate dry ice used in shipping	___	_____
3. Shipping paperwork	___	_____
Miscellaneous		
1. Incident Form	___	_____
2. QC Procedure	___	_____
3. Containers correctly labeled for shipping	___	_____

Comments: _____

_____

_____

Appendix 5. Anthropometry Equipment Calibration Log

Instructions: *This checklist documents the daily, weekly, and monthly calibration of anthropometry measurement equipment. Quarterly, checklists and logs are summarized onto the* ***Summary of Observation and Equipment Checklists*** *(Appendix 1). Copies of this log may be requested by the CC. There should be one such log done each week, though the monthly portion will be filled out only in the weeks that it is needed. If there is more than one piece of equipment used for a particular function, indicate the checks for each piece on the same log.*

Week of:_____ Field Center:_____ Tech ID:____
[Monday's Date]

Daily Checks:

Scales read zero ___ ___ ___ ___ ___ ___ ___
M T W Th F Sa Su

Headboard of the stadiometer moves up and down the track smoothly

___ ___ ___ ___ ___ ___ ___
M T W Th F Sa Su

Weekly Checks

A. Reading of scale with 10 kg weight

Date: ___/___/___ Time: _____ Reading: _____

*If reading outside of 8.5 to 11.5 range, the scale should be serviced.

Date service REQUESTED, Date: ____/____/____ Time: _____

Date RECALIBRATED by service technician. Date: ____/____/____ Time: _____

B. Repeat calibration because of moving scales

Date: ____/____/____ Time: _____ Reading: _____

Date: ____/____/____ Time: _____ Reading: _____

C. Height Rule (rounding down)

a. Touches hard-surfaced platform which measures are done _____
b. Perpendicular to the floor _____

Monthly Checks

Week of:_____ Tech ID:_____
[Monday's Date]

A. Measuring tape

Excess wear or damage found? Yes Y No N

When the 0 mark of the tape is aligned with the 150 cm mark of the height rule,
1. Height (to nearest cm) on height rule of the 30 cm mark of the tape _____cm
* If reading is outside the 119.5 – 120.5 cm range, the tape should be replaced.

2. Height (to nearest cm) on height rule of the 100 cm mark of the tape_____cm
* If this measure is outside the 49.5 – 50.5 cm range, the tape should be replaced.

Date tape replaced: ____/____/____

Appendix 6. Daily Centrifuge, Freezer, Refrigerator and Room Temperature Log

Tech ID	Date	Centrifuge	Freezer	Refrigerator	Room
______	___/___/___				
______	___/___/___				
______	___/___/___				
______	___/___/___				
______	___/___/___				
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______	___/___/___				
______	___/___/___				

Appendix 7. Sample Written Exams for Certification

HCHS/SOL BLOOD DRAWING TECHNICIAN PRACTICAL EXAM

1. Place the following blood collection tubes in the correct set-up order and location for the venipuncture: 2-9 mL red top, 2-10 mL lavender top, 2-4.5 mL blue top, 1-4 mL lavendar top, and 2 Paxgene tubes.

2. Specify which tube(s) remain at room temperature after collection, which are put into a cup with ice slush, which are stored in the refrigerator.

3. Remove the appropriate tubes from the tray and place them in the centrifuge in balanced positions. How long do they spin? At what speed?

4. Set up a sponge tray with the appropriate number and order of specimen storage tubes. Indicate the colors of screw caps and the types of specimen put into these tubes.

5. Place the collection tubes in front of their respective sample tubes. Describe what further processing is required of each collection tube before it is aliquotted into its respective sample tube.

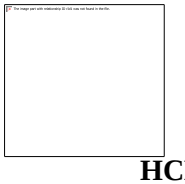
6. Organize the color-capped sample tubes and prepare them for shipment.

7. Describe the quality control for each piece of equipment.

8. Describe the steps for freezing the Paxgene tubes.

9. Using the MLA D tipper pipetter, add 30 uL of 6 N HCl into a 1.5 mL aliquot of a urine specimen. What should you do if a drop of acid comes in contact with your skin or clothes?

10. Where on the test strip should you place the drop of blood, and how can you ensure that you have an adequate amount of blood on the strip?



HCHS/SOL BIOSPECIMEN COLLECTION & PROCESSING TECHNICIAN WRITTEN EXAM

Name: (please print):_____ Field Center:_____
DATE:

1.

HCHS/SOL Certification Request Form

Instructions: *This form documents which procedures/interviews a staff member is certified for and how they received certification. The field center* ***Trainer*** *or* ***Study Coordinator*** *(SC) will submit this form to the Coordinating Center (CC),* ***Site Monitor (SM)****, for final evaluation and certification. The CC SM will assign a staff code number once they are certified. This form is re-submitted to the CC to document quality control methods carried out on procedures/interviews for certified staff members since their original training.*

1. Submitted by _____ at the _____ field center on _____
   (name of trainer) (date)

2. Requesting a staff code number for _____
   (name of the staff- please print)

3. Staff code number (if any) (3-digit number)
   (Leave this field blank if the staff does not have an existing code number)

4. Specify for which procedure/interviews the staff member has completed certification or quality control requirements and describe specific actions that were taken to achieve these steps (including supervisors or certified staff members who observed the process).

Procedure & Interview	**Date Certified**	**Certification Method** (select ALL that applies) *1 = Attended central training presentation* *2 = Certified by central trainer* *3 = Direct observation by the local certified lead staff member in specified area* *4 = Completed written exam* *5 = Completed practice. Specify how many sets of practice were performed, and the differences of the measurements compared to the local trainer's for local certification.* *6 = Other (specify)* *7 = N/A (not applicable to the staff member)*
Anthropometry		
Seated BP		
Echocardiography		
Data Management		
Biospecimen collection, processing		
Interviewing Techniques		
Medication and		
Endpoints ascertainment		

Coordinating Center Use Only

Assigned staff code number: _____

Certified for procedures/interviews (circle ALL that apply)
A, B, C, D, E, F, G, H, I, J, K, L, M, N, O

Date Received: _____, Processed by _____ (Staff initial)____

Appendix 8. Checklist for Review of Audio Recorded Interviews

Instructions: *This checklist documents the monthly checks regarding the interviews. There should be one such log done each month.*

Month/Year: ___/______

Technician ID	Supervisor ID	Date (mm/dd/yy)
________	________	________
________	________	________
________	________	________
________	________	________
________	________	________
________	________	________
________	________	________
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________	________	________

Appendix 9. Bimonthly Checklist for Interviews

Instructions: *This checklist documents the bimonthly checks of the interviews. There should be one such log done every two months.*

Month/Year **___/_____ and ___/_____**

	Technician ID	Supervisor ID	Date (mm/dd/yy)
Two interviews randomly selected and sent to another field center	_____	_____	_____
	_____	_____	_____
	_____	_____	_____
	_____	_____	_____
	_____	_____	_____
	_____	_____	_____
	_____	_____	_____
	_____	_____	_____
	_____	_____	_____
	_____	_____	_____
	_____	_____	_____
	_____	_____	_____
	_____	_____	_____
	_____	_____	_____
	_____	_____	_____
	_____	_____	_____

Appendix 15. OMRON Maintenance and Calibration Log

Instructions: *This checklist documents the quarterly checks for the OMRON. There should be one such log done every quarter. If there is more than one sphygmomanometer used, indicate the checks with a separate log for each sphygmomanometer.*

Tech ID: _____ Field Center: _____ Date: _____ OMRON unit #:_____

Cracking?	Yes	Y	No	N	Action: _____
Holes?	Yes	Y	No	N	Action:_____
Worn outer cloth of Velcro?	Yes	Y	No	N	Action:_____
Leakage of cuff bladder?	Yes	Y	No	N	Action:_____

Calibration Check with Pressure-Vacuum Meter (see Manual 2, section 12.7.2)

Smooth descent of OMRON LED mm Hg from 280 to 20 mm Hg? Yes Y No N

Observed pressure values on the Pressure-Vacuum Meter and the OMRON from 250 to 20 mmHg, in approximant decrements of 20 mm Hg:

Measurement Number	Pressure-Vacuum Meter	OMRON
1	☐☐☐☐.☐ mmHg	☐☐☐☐.☐ mmHg
2	☐☐☐☐.☐ mmHg	☐☐☐☐.☐ mmHg
3	☐☐☐☐.☐ mmHg	☐☐☐☐.☐ mmHg
4	☐☐☐☐.☐ mmHg	☐☐☐☐.☐ mmHg
5	☐☐☐☐.☐ mmHg	☐☐☐☐.☐ mmHg
6	☐☐☐☐.☐ mmHg	☐☐☐☐.☐ mmHg
7	☐☐☐☐.☐ mmHg	☐☐☐☐.☐ mmHg
8	☐☐☐☐.☐ mmHg	☐☐☐☐.☐ mmHg
9	☐☐☐☐.☐ mmHg	☐☐☐☐.☐ mmHg
10	☐☐☐☐.☐ mmHg	☐☐☐☐.☐ mmHg
11	☐☐☐☐.☐ mmHg	☐☐☐☐.☐ mmHg
12	☐☐☐☐.☐ mmHg	☐☐☐☐.☐ mmHg

Appendix 10. Timeline for Supervisor Checking of Technicians

Table 1: Frequency of Regular Checks and Observations (with section number where task description can be found)	
Daily	Anthropometry scales balanced to read zero (Appendix 8) – **6.4** Headboard of the stadiometer checked (Appendix 8) –**6.4** Temperature check in refrigerators, freezers, etc. (Appendix 9) **– 10.3**
Weekly	Anthropometry scales calibrated or when scaled moved (Appendix 8) **– 6.4**
Monthly	Measuring tapes checked for wear or stretching (Appendix 8) **– 6.4** One audio recorded interview selected and reviewed by coordinator (Appendix 2), recorded (Appendix 13) **– 16.3**
Quarterly	Anthropometry technicians observed (Appendix 3), recorded (Appendix 1) **– 6.3** Anthropometry equipment checks summarized, info sent to CC (Appendix 1) **– 6.4** Calibration and inspection of the OMRON (Appendix 15), recorded (Appendix 1) – **7.3** Biospecimen technicians collecting, processing and shipping observed (Appendix 6), recorded (Appendix 1) **– 10.1** Biospecimen equipment checks summarized, info sent to CC (Appendix 1) **– 10.3** Supervisor observes interviewer twice (Appendix 2), recorded (Appendix 1) **– 16.2 – 18.2**
Annually	Checking of the actual speed of the centrifuge (Appendix 1) **– 10.3** Calibration and professional cleaning of pipettes (Appendix 1) **– 10.3**

Table 2: Frequency of Additional Checks and Observations During the First Three Months of Study	
Twice during the first month	Anthropometry technicians observed (Appendix 3) **– 6.3**