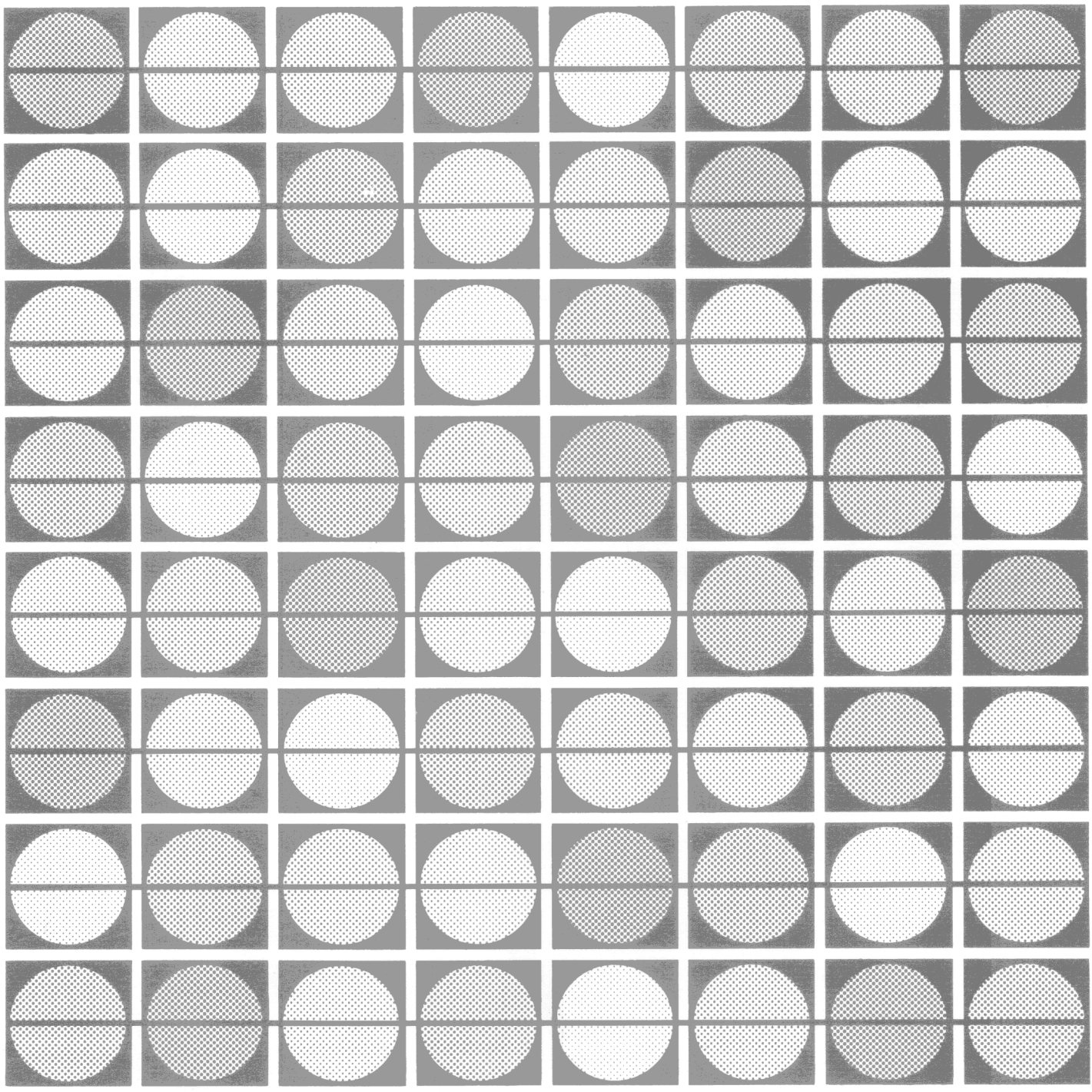




Instruction Manual Part 15a

Examination Staff Procedures Manual
for the Hispanic Health and Nutrition
Examination Survey, 1982-84

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES • Public Health Service • National Center for Health Statistics

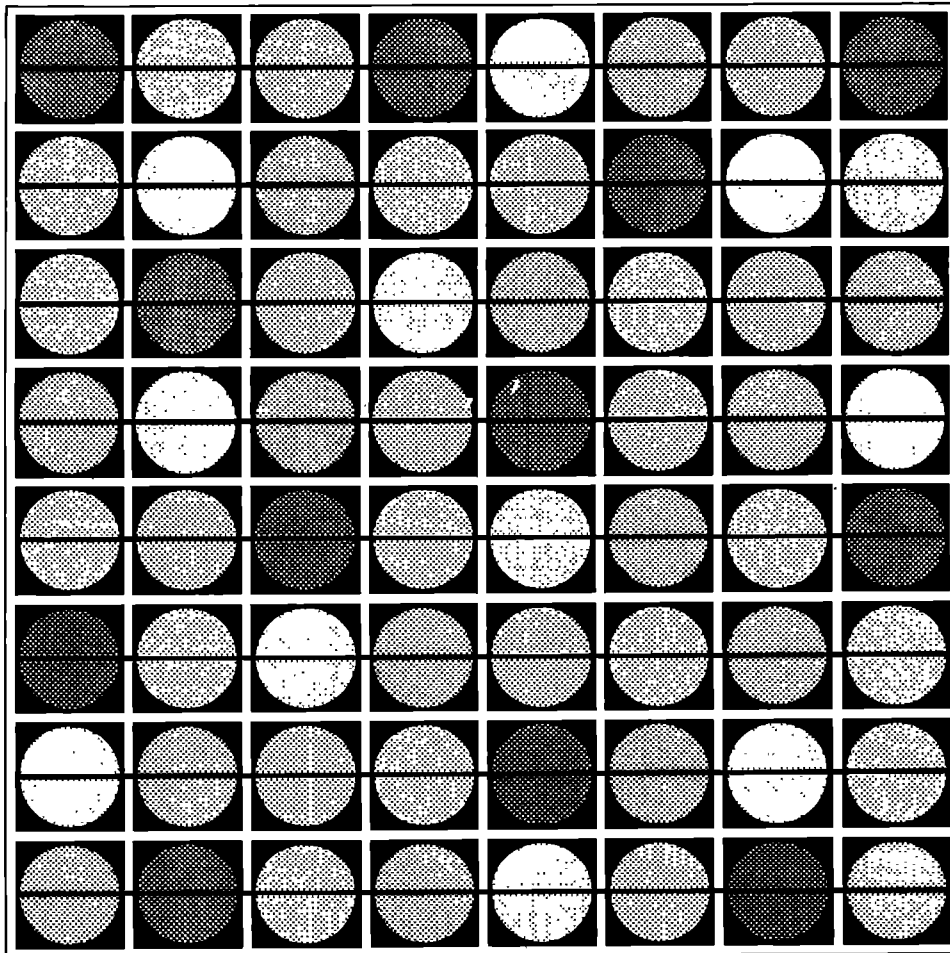


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Examination Survey, 1982-84

HHANES Data Collection



U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
National Center for Health Statistics

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PART I. INTRODUCTION

Chapter 1

THE HISPANIC HEALTH AND NUTRITION EXAMINATION SURVEY

History

In 1956 the Congress authorized the U.S. Public Health Service to conduct a continuing National Health Survey to obtain information on the health of the American people. This information is obtained in several ways, a household health interview survey, a family of surveys of health resources, and a health examination survey. In the latter, actual health examinations and tests can yield morbidity information that is unobtainable through the other programs of the National Health Survey.

There are several advantages to such a survey. Information can be obtained about diagnosed conditions which persons may fail to report or may be incapable of reporting in a survey based upon individual interviews and about previously undiagnosed, unattended, and nonmanifested chronic diseases. In addition, all procedures, tests, and measurements can be carried out in a uniform and standard manner.

The data collected by this survey are useful for a variety of reasons. The obvious are to determine the prevalence of specific diseases and to obtain baseline data on certain nutritional, physical, psychological, and physiological measurements for better understanding of departures from norms. The data also help public officials and medical care providers make more efficient use of health funds in planning for medical and health care services, research, and education.

Analysis of the data can also be made in relation to numerous socioeconomic and demographic data to determine such things as missing nutrients from the diets of parts of our population and differing health patterns between areas of the United States, to name but two. Since the first survey began in 1959, some 65,000 Americans of all ages have participated voluntarily in five separate surveys. Each of the first three surveys had a target population of a specific age group with the examination content focused on certain specified health aspects of that subpopulation.

The fourth survey differed in its intent and purpose from the first three in that persons between the ages of 1 and 74 were surveyed rather than those of a smaller age segment and that for the first time an extensive evaluation was made of the nutritional status of that population. In addition, measures were taken of the prevalences of chronic pulmonary disease, disabling arthritis of the hip and knee, and cardiovascular disease in adults from 25 to 74 years old. This survey, named the National Health and Nutrition Examination Survey I (NHANES I), was completed in late 1975.

The fifth survey, NHANES II, provided the first look at changes in the nutritional status of the population over time through data on dietary intake, laboratory tests, body measurements, and clinical assessments of persons 6 months to 74 years old. In addition, the prevalences of the following conditions in certain age segments of the population were measured: diabetes, kidney disease, heart disease, liver disease, hypertension, allergies, disc degeneration in the cervical and lumbar spines, pulmonary malfunction, and hearing and speech problems.

The individuals in all of these surveys were selected through the use of a nationwide probability sample of the civilian noninstitutionalized population of the United States. The use of such a procedure makes it possible to obtain the desired statistics efficiently, economically, and in such a manner that the statistical reliability of the results is determinable. In all, more than 140 reports relating to findings of these surveys have been published and widely distributed.

Current Program

The Hispanic Health and Nutrition Examination Survey (HHANES) differs from the previous five surveys in that it does not use a national probability sample. Instead for the Hispanic HANES only about 230 counties that contain about 80 percent of the Hispanic population of the United States have a probability of selection. Within the counties selected from the total, all in the southwestern states of California, Arizona, Colorado, New Mexico, and Texas, and the New York and Miami metropolitan areas, a sample of the civilian, noninstitutionalized population of those of Mexican, Cuban, and Puerto Rican descent is selected. Hispanic HANES will be the first survey to produce data for the Mexican-American, Cuban-American, and Puerto Rican populations from 6 months to 74 years old on illness, disability, need for treatment, and nutritional status as well as data on patterns of growth and development and on measures of health and well-being. Prevalences of diabetes, heart disease, liver disease, gallbladder disease, hypertension, and hearing and vision problems will also be determined.

Description of the Examination

Examinations are given in two mobile health examination centers, each of which consists of three specially built and equipped trailers. The examination teams include physicians, dentists, nurses, dietary and other interviewers, and medical and laboratory technicians. There is no cost to participants, and transportation to and from the examination is provided. Questionnaires are used to obtain basic demographic and socioeconomic characteristics, medical history data, and information on dietary intake for all persons in the sample.

The examination consists of a general medical examination by a physician, a dental examination by a dentist, a dietary interview, and anthropometric and tympanometric measurements. Then depending on age, some or all of the following are done: an electrocardiograph, X-rays of the chest, an ultrasound test for gallstones, audiometry, a vision test, and a glucose tolerance test. For women there is an optional breast examination. In addition, numerous laboratory tests are performed on whole blood, serum, plasma, and urine. At the mobile examination center (MEC), urine specimens are screened for the presence of glucose, albumin, blood, urobilinogen, bilirubin, nitrite, and ketones. Hematological tests are performed including determination of hemoglobin, hematocrit, and red and white cell counts. Biochemical analyses performed on specimens of serum or plasma include assays for vitamin A, chemical profile, folates, serum cholesterol, triglycerides, thiocyanate, lead, zinc, copper, iron, iron binding capacity, ferritin, protoporphyrin, carboxyhemoglobin, pesticides, and syphilis. Biochemical testing is performed in a thoroughly standardized manner at the laboratories of the Centers for Disease Control in Atlanta, Georgia. Personnel of the Centers also assist in developing procedures for obtaining and shipping specimens and for the laboratory quality control procedures used in the field. Pesticide measures are performed by the Environmental Protection Agency, and lipids are measured at Johns Hopkins University.

All information collected is held in strict confidence. Clinical and laboratory data from the examination are mailed to the examinee's physician or medical facility if authorized by the examinee. No treatments or medical advice are given to the examinees by the examining staff. It is hoped that any necessary follow-up care will be directed by the examinee's own physician.

Scope of this Manual

This manual includes discussion of and instruction for all procedures done by the health technicians, nurse, and coordinator. These staff members are all employees of the National Center for Health Statistics (NCHS) as are the laboratory technicians.

The other examination staff members are employed by private contractors to NCHS. The procedures done by these staff members are described in separate manuals which cover the physician's and dental examinations, vision test, dietary interview, and MEC interview. These manuals are called the Physician's Manual for HHANES, the HHANES Dental Examiner's Manual (including instructions for the vision test), the Dental Recorders Manual, the Dietary Interviewer's Manual, and the MEC Interviewer's Manual.

There is one other manual available, the HHANES Field Laboratory Manual, which gives instructions for all the laboratory and shipping procedures done in the mobile examination centers by the NCHS field laboratory technicians.

Chapter 2

QUALITY CONTROL IN DATA COLLECTION

Control of Nonsampling Error

There are two sources of error that may enter into a sample survey, sampling error and nonsampling error. The sampling error, error due to making measurements on a sample rather than on the entire population, can be quantified and is the concern of all statisticians in sample survey design.

The less heralded but equally important nonsampling error is often neglected in sampling texts but is infallibly present in all data gathering ventures. It is on the control of nonsampling error that quality control centers. Much time and effort in the National Health and Nutrition Examination Survey are devoted to reducing nonsampling error and to collecting data that are of high quality.

One type of nonsampling error which occurs in voluntary surveys is the bias introduced by nonresponse. For the three surveys done in the 1960's before the NHANES I program, the examination response rates were 86.5%, 96.0%, and 90.1%, respectively. These high response rates resulted from advance planning and publicity, from much diligent work by interview personnel, by proper handling of examinees by the entire staff, the young age groups in Cycles II and III, and the generally favorable attitude of the public toward surveys and government programs.

When in the 1970's it became harder and harder during NHANES I to approach the high examination rates attained during the three previous surveys, we found that we could increase response rates significantly by giving examined sample persons a small token of our appreciation. This token, a \$10 bill, was given them at the end of their examinations. Partly because of this remuneration we achieved a final examination rate of 74% for NHANES I.

One significant change in the design of NHANES II that helped to increase its examination rate was a reduction in the geographic size of the sample area from which the sample persons were selected. This resulted in decreasing for many examinees the travel time and distance from their residences to the examination center. Improvements in interviewing procedures, follow-up procedures, visual aids, and an increase in the remuneration to \$20 per examinee also helped NHANES II attain an examination rate of over 73% in an era when government and surveys were becoming less and less popular.

For HHANES a special change from previous surveys that probably is helping improve response rates is that the questionnaires are printed in English and Spanish and our household interviewers and most of our examining staff members are bilingual and of Hispanic heritage.

More closely related to the purposes of this manual are the nonsampling errors which may be introduced by variabilities and biases associated with the examiners and the mechanical and electronic devices used. Many machines, some simple and some complex, are used in Hispanic HANES. With proper calibration and maintenance the errors associated with these devices can be controlled. Instructions for the calibration and maintenance of equipment are found in this manual. Bearing in mind the potential uses of the data we adopt procedures that will reduce examiner and subject errors; but, in general, we cannot design procedures that will eliminate errors. However, certain types of examiner and subject errors can be readily identified and controlled.

Several measures are taken to assure completeness and consistency in the recording process. All questionnaires are reviewed for omissions and inconsistencies. If errors are noted, correct information is obtained by phone or from the examinee when he comes in for the examination. Errors in recording some measurements are reduced by having a second person act as a recorder. In addition, all data gathered in the examining center are reviewed by a designated exam staff member before the examinees leave. Records of unusual occurrences which may affect the validity of the data are also maintained.

Although emphasis is placed on doing examinations in a uniform and standard manner in the staff training (and retraining) periods, drift in technique is apt to occur in long surveys such as HHANES. Therefore, this manual should be used as a reference to help standardize procedures and reduce errors throughout the entire HHANES.

Recording

Just as uniformity and standardization are important in performing the procedures of the health examination, these same two characteristics are vital to recording the observations or measurements which are the result of the procedures. Accuracy and precision also are important; as is an additional characteristic, legibility. A scrawled entry that cannot be read is no entry at all; it is lost data. Completeness in recording is something that is often overlooked. We do not mean here, long, drawn-out, wordy entries. We do mean being sure not to omit entries. Of course the entries should be accurate, precise, and legible. We will have unavoidable losses of data, no x-rays on some, inability to obtain optimal performances of some procedures, and so forth. The examining staff are expected to use discretion regarding these unavoidable losses, to stop procedures occasionally when it is apparent that examinees cannot cooperate despite your best efforts. It is the avoidable loss of data that is the responsibility of each staff member to prevent. When no entry is possible, indicate this and the reason why. Most sections of the case record now make provision for this and should be used when necessary. Care should be taken not to write in any of the spaces set aside for coding.

To summarize:

A good record is the other half of a good observation; neither is adequate without the other.

Recording requires UNIFORMITY, ACCURACY, PRECISION, LEGIBILITY, and COMPLETENESS.

Each staff member should review the case record section as soon as he has finished making entries to be sure there are no avoidable omissions, other errors, or shortcomings.

Replicate Data

Despite precautions there are biases and variable measurement errors that cannot be or are not judged important enough to be eliminated. Another objective of the quality control program, therefore, is the determination of the extent of these errors. In HHANES one means for evaluating both types of error is replicate measurements. Replicate data are obtained basically in two ways, by reevaluating or rereading a hard document or by reproducing an actual measurement either by the usual procedure or by a standard procedure. Although hard documents such as weight and height measurements are reevaluated, the replicate program is primarily concerned with reproducing actual measurements.

During the operation of the survey, the primary use of replicate data is to indicate areas where retraining or reevaluation of procedures is needed. When the reports of findings of the survey are published, data from the replicates will be used to apprise the reader of the extent to which the data may be affected by measurement error.

Replicate data are gathered in many specific areas of the examination with varying degrees of frequency. For example, replicate measurements are made as frequently as on every examinee for measurements of hemoglobin and hematocrit. We replicate body measurements on one examinee every fourth examination session; thus we have these replicates on about three or four percent of the examinees. We also replicate a small proportion of the ultrasound and vision examinations.

Replicate blood pressure readings, dental examinations, and vision tests are done every three months by the "standard." These replicates are used immediately to correct drift in technique that may have crept into an examiner's work since he was last trained.

Additional blood is drawn from a systematic subsample of examinees. The blood sample is split and sample numbers assigned so that the paired samples cannot be identified as originating from single examinees by the

laboratory doing the determinations. In addition, each laboratory has its own quality control procedures which include the use of standards and repeated determinations. Although replicates are performed for various purposes the data are preserved and in previous NHANES have proved useful for indicating the extent of error in final evaluations.

Chapter 3

RESPONSIBILITIES OF EXAMINATION STAFF MEMBERS

Medical Policy Regarding the Examination

We are in the business of collecting data for statistical analysis. We are not set up to treat or manage a particular medical problem, nor are we meant to do any such treatment. Indeed, in most instances the examining physician will not be licensed within the State in which the examinations are being conducted. Because of these as well as other reasons certain policies must be followed.

An individual examinee should not be given any information on the findings of the examination except where medical advice of a very general, noncontroversial nature would be beneficial to the examinee. A single examination often does not allow an adequate interpretation of findings nor the best specific advice to give to an examinee. Only the examinee's personal physician or clinic physician who has the individual's long-term records available and who is primarily involved with the long-term care and followup of the examinee should interpret the findings for the individual and decide what to tell the person. For this reason we send reports of findings to the physician or clinic the examinee indicates. These reports include findings from the mobile examination center as well as laboratory reports. In addition, we send an electrocardiogram (ECG) tracing and a copy of the chest x-ray if the examinee received those procedures. We also send the examinee a letter notifying him that we have sent his physician or clinic the findings and urging him to contact his physician for the results.

Whenever a condition is found (such as abdominal mass or otitis media) which in the opinion of the examining physician requires early medical care, the examining physician will contact the personal physician or clinic named on the consent form the examinee has given, indicating the presence of the condition after consulting with other staff members to determine whether or not other findings should also be reported. The examining physician will send the examinee's physician a letter that describes the findings that need early medical care.

When the examinee has not indicated a physician to whom the findings can be sent, appropriate referral should be made depending upon the locality, using the advice of local medical authorities. This may vary from referral to a medical center clinic or emergency room to referral to a private physician nearby listed on the medical society roster for such matters. The medical advisors of the survey should be informed of all physician, nurse, or clinic contacts.

In other cases when it is advisable or necessary to transfer medical findings, laboratory data, x-rays, or electrocardiograms to the

examinee's physician before routine reporting of the results, the physician will check that a consent form has been signed and send an official HHANES letter with the phone number and address of the examination center.

As a matter of policy, when male physicians are examining female examinees, either the nurse or another adult female should be present in the examining room.

Responsibilities of All Staff Members

Membership on the staff of the Hispanic Health and Nutrition Examination Survey carries with it many responsibilities. Not the least of these is your responsibility to recognize that you are one member of a team of professional and paraprofessional persons upon whom certain demands have been placed in order to accomplish the overall task of the HHANES. You should be aware of and respect the job demands placed upon other staff members, should maintain an attitude of tolerance and consideration for fellow members of the team, and should willingly perform the extra tasks that may occasionally be assigned to support other staff members in the performance of their duties.

Each member has a responsibility to the Public Health Service for promoting good public relations. The Public Health Service will be judged by the actions of the staff both on and off duty. You must be discreet in speech and actions. You should refrain from any discussions about an examinee which might be overheard and from any discussions of the survey which might be overheard and unfavorably misinterpreted. You should exercise good judgment in any discussion of controversial subjects. You should be conscious of the customs of the area and should avoid any actions which might reflect unfavorably upon the Public Health Service or interfere with the work of the survey. Your personal appearance and behavior must be governed by these same considerations.

The examinee should be treated courteously as a person, not as a sample number. Exchanges of information between staff members for the better understanding of an examinee must be discreet.

Each individual staff member is the first and best guarantor of the quality of the data being collected. As such you have a responsibility for quality in every single step of the examination process. The most obvious methods of assuring quality are to perform procedures with accuracy, precision, and uniformity, according to instructions and to record completely, accurately, uniformly, and legibly. You are urged to suggest areas where quality control procedures need to be instituted and methods for their implementation.

All staff members may be required to drive a government, private rental, or privately owned automobile to transport examinees to and from

the examination center or to accompany the examinees by taxicab or public transportation. Staff members may be requested to perform tasks not directly related to their specific professional skills in order to implement the overall organization. Staff members are responsible for appropriate care and safeguarding of expensive portable equipment such as, but not limited to, cameras and tape recorders used during the examination, including storing and locking in instances where applicable.

Additional Responsibilities of Individual Staff Members

1. Coordinator

- a. Arrive for work 30 minutes before the first examinees are scheduled.
- b. Coordinate the flow of examinees through the examination center according to the procedure described in Chapter 5.
- c. Carry out the other coordinator duties described in Chapter 5 and Chapter 7.
- d. Try to make each examinee as comfortable as possible while he is in the examination center.
- e. Complete and review certain parts of the control record and reports of findings, and review certain completed records according to the instructions in this chapter.
- f. Check all rooms before leaving the trailers to see that all expensive portable equipment is stored and locked, and see that all doors are locked when you leave.
- g. See that certain data are transmitted from the field according to the instructions in Chapter III of the HHANES Field Staff Operations Manual.
- h. Complete beginning- and end-of-stand inventories and send them to headquarters along with the inventories collected from other exam staff members.

2. Health Technicians

- a. Responsibilities related to examinations
 - (1) Arrive for work 30 minutes before the first examinees are scheduled.

- (2) Do the necessary calibrations and maintenance before each session as specified in this manual.
 - (3) Carry out all parts of the examination completely and uniformly according to the procedures described in this manual.
 - (4) Do the following exams: x-ray, ECG, ultrasound, tympanometry, audiometry, and body measurements.
 - (5) Act as recorder for the dental examination when necessary.
 - (6) Make a note on the control record and unusual occurrence form or log book of any exam not done, done on a defective machine, or done in a nonstandard way.
 - (7) Inform the coordinator and chief technician of all equipment failures that prevent you from doing examinations. The coordinator needs to know so that she can make the necessary adjustments to the examinee flow system.
 - (8) Check all technician parts of the examination record for completeness, accuracy, and consistency.
 - (9) See that the x-rays are ready for the physician to review before the examinees leave the examination center.
 - (10) See that the ECG's are ready for the physician to review before the examinees leave the examination center.
 - (11) Check the x-rays, repeat them if necessary, and duplicate the PA and lateral chest films.
 - (12) Complete and review certain parts of the Report of Findings I according to the instructions in this chapter.
 - (13) Act as recorder for body measurements.
 - (14) See that certain data are transmitted from the field according to the instructions in Chapter III of the HHANES Field Staff Operations Manual.
- b. Responsibilities related to the maintenance of work stations

Each of the technicians will be responsible for the maintenance, supplies, and duties described later for one of the three work stations, audiometry/tympanometry, x-ray/ultrasound, and ECG/body measurements.

The rotation of the technicians at the stations will occur after a set period of time has elapsed, a minimum of one week. The length of time between rotations will be fixed by the chief technician and supervisory technician. The rotation system must be fair to all the technicians and also must not bias the data being gathered. The rotation pattern will continue in sequence from one stand to the next. For example, the technician in x-ray at the end of one stand should be in ECG at the beginning of the next stand. The technician responsible for a station during the first part of a stand should be responsible for opening that station on setup day. Likewise, the technician responsible for a station the last part of a stand is responsible for the closing of that station and for seeing that the data and transmittals from that station are complete and correct. The chief technician is ultimately responsible for seeing that all data and transmittals collected by technicians are correct and complete.

- c. Additional responsibilities for the technician at the ECG and body measurements station.
 - (1) Replenish the necessary supplies for the ECG and body measurements room.
 - (2) Do the ECG calibration at the beginning of the stand.
 - (3) Do the ECG weekly calibrations and daily checks.
 - (4) Keep the transmittals for the height photos and the two ECG tracings current.
 - (5) Maintain all the equipment in the ECG and body measurements rooms.
 - (6) Label and account for the digital ECG tapes.
 - (7) Clean the ECG electrodes and lead set wires at the end of the last session of each day.
 - (8) Turn off the equipment in the ECG and body measurements rooms at the end of each day.
 - (9) Tear and fold the two copies of each ECG and place one copy for the doctor to review and and initial. File both sets in numerical order each day.

- (10) File the height photos in numerical order at the end of each day.
 - (11) Check the ECG log book and body measurements unusual occurrence form to see that the entries are correct.
 - (12) Check the height and weight scales, skinfold calipers, and baby board daily.
 - (13) Do the body measurement calibrations at the beginning and end of each stand.
- d. Additional responsibilities for the technician at the x-ray and ultrasound station:
- (1) Replenish the necessary supplies for the X-omat, x-ray/ultrasound room, and darkroom.
 - (2) Warm up the x-ray tube before each session.
 - (3) Prepare the X-omat for the session.
 - (4) Do the x-ray calibration at the beginning of the stand.
 - (5) Turn on the ultrasound machine and allow it to warm up for at least twenty minutes before each session.
 - (6) Do the daily and beginning-of-stand ultrasound calibrations.
 - (7) Before morning exam sessions be sure that the room is ready for ultrasound exams, that film is in the cassettes, and that the table is set up for examinees.
 - (8) Change the date on the x-ray marker daily.
 - (9) Label and file in numerical order all x-rays in their envelopes. See that the envelope numbers agree with the film numbers.
 - (10) Make sure all chest films have been duplicated.
 - (11) Keep the chest x-ray and ultrasound transmittals current.
 - (12) Label and file in numerical order all sonograms in their envelopes. See that the envelope numbers agree with the film numbers.
 - (13) Store all VCR tapes in an appropriate place.

- (14) Maintain all the equipment in the x-ray and ultrasound room, dark room, and x-omat.
 - (15) Make sure the doctor initials the chest x-rays.
 - (16) Check the x-ray and ultrasound log books to see that the entries are correct.
 - (17) Close down the x-ray/ultrasound room, dark room, and X-omat at the end of each day.
- e. Additional responsibilities for the technician at the audiometry and tympanometry station.
- (1) Replenish the necessary supplies for the audiometry room.
 - (2) Do the beginning- and end-of-stand audiometric calibrations and the beginning-of-stand tympanometric calibration.
 - (3) Do the audiometric and tympanometric weekly calibrations and daily checks.
 - (4) Maintain all the equipment in the audiometry room.
 - (5) Clean the tympanic eartips at the end of each day.
 - (6) Turn off the equipment in the the audiometry room at the end of each day.
 - (7) File the tympanograms in numerical order. See that the envelope numbers agree with the tympanogram numbers.
 - (8) Check the audio and tymp log books to see that the entries are correct.
 - (9) Send copies of the audiometric calibrations to the biomedical engineer and Ken Stewart.
- f. Responsibilities related to examinee flow
- (1) Be familiar with the rules of the examinee flow system in Chapter 5.
 - (2) Follow the rules of the flow system under the direction of the coordinator. During the first part of the morning sessions it is important to do the ECG's and ultrasound exams as early as possible on those

examinees receiving the glucose tolerance test (GTT). Thus at this time one technician should do ECG's, another should do ultrasound exams, and the third should be available to do audiometry and tympanometry until all the ECG's and ultrasound exams on GTT examinees are done. The coordinator is in the end responsible for the smooth functioning of the flow system; thus her decision prevails if there is any difference of opinion over a flow system problem.

- (3) Try to see that under ordinary circumstances each technician does about the same number of examinations of each type as the other technicians do.

g. Additional responsibilities of the chief health technician

The chief technician may delegate some of his work station duties to other health technicians in order to complete the following responsibilities as chief health technician.

- (1) Provide supervision and guidance over all health technician procedures including all examination procedures; equipment calibrations; and completion of beginning and end of stand inventories and equipment checklists, data log books, unusual occurrence forms, quality control records, and reports of findings.
- (2) Evaluate the quality of all health technician data, provide any necessary feedback to the health technicians, and send completed evaluation forms to headquarters at the end of each stand.
- (3) Maintain records of all calibrations.
- (4) Perform minor repairs and periodic equipment maintenance.
- (5) Train new health technicians to do the examinations according to the instructions in this manual including applicable theory where appropriate. This also applies to training temporary help when required.
- (6) Report all problems relating to malfunctioning of equipment to the Field Operations Manager (FOM). The chief tech and FOM should decide upon the type of action required and their individual responsibilities in seeing that the problem is resolved. The FOM must be informed of all maintenance and repairs of equipment involving billing even though he may not have total responsibility for resolution of the problem.

- (7) Act as liaison between the health technicians and the headquarters supervisory technician and biomedical engineer on matters pertaining to all procedures done and equipment used by the health technicians.
 - (8) Assure that the data are collected according to the manual procedures, and correct any departures from the written instructions.
 - (9) Inform the examining physician if you have reason to believe any examination procedures should be eliminated for an examinee for physical or mental reasons.
 - (10) Provide supervision and guidance over other staff members who might, for various reasons, be required to perform health technician procedures.
 - (11) Be ultimately responsible for the quality and completeness of the data gathered by the health technicians.
- h. Technician responsibilities at the beginning of each stand
- (1) Inventory
Complete the inventory of all supplies, return the original to the coordinator, and note additional supplies needed.
 - (2) ECG
 - (a) Remove the straps from the machine.
 - (b) Connect the lead set to the machine being especially careful that the prongs match and are not damaged.
 - (c) Plug the machine into the wall socket.
 - (d) Turn the machine on and be sure that the LED readout is working.
 - (e) Generate an internal and an external calibration on an ECG test tape, and play back the external calibration to compare it with the original.
 - (f) Place the electrodes on the wires.
 - (g) Send the test tape and the hard copy printout immediately to the biomedical engineer at headquarters.

- (h) Place the baby board on top of the ECG counter.
 - (i) Make sure that the room is ready by insuring that the ECG solution, gauze, alcohol, and roster sheets are present, and that Tape I is inserted in the ECG machine.
- (3) Body measurements
- (a) Assemble the anthropometers, and check them and the calipers.
 - (b) Disengage the lock on the weight scale.
 - (c) Calibrate the standing height and weight scales, and send the calibrations to the Quality Control Section at headquarters.
 - (d) Check the baby board digital readout against the metric tape scale on the board.
 - (e) Record the skinfold caliper and baby board digital readout calibration values as the first entry of the daily calibration sheet.
- (4) Audiometry and tympanometry
- (a) Set up the audiometer and tympanometer.
 - (b) See that the tympanic eartips are clean and that the room is supplied with alcohol, gauze, and tympanogram envelopes.
 - (c) Calibrate the audiometer and tympanometer and send copies of the audiometer calibrations to the biomedical engineer and Ken Stewart.
- (5) X-omat
- (a) Match the X-omat transformer taps with the incoming line voltage.
 - (b) Pull all the roller racks. Examine them for chemical residue, and scrub the rollers clean. Replace the racks.
 - (c) Fill the X-omat and rinse it with water of 90° F. See that no leaks are present. Drain the water.
 - (d) Replace the developer filter.

(e) Mix the chemicals. Fill the insert tanks with chemicals starting with fixer, then developer. Add developer starter to the developer insert tank. Mix additional chemicals in the replenisher tanks.

(f) Check the water pressure.

(g) Check all the settings and chemical temperatures.

(6) X-ray room

(a) Remove all the restraining bolts on the upright cassette holder and tape them to the top of the stand. Be sure that the cassette holder moves freely, and that the x-ray tube head tracks properly.

(b) Have the transformer matched to the incoming line voltage.

(c) Unscrew the small bolt on the transformer and tape it to the top of the transformer.

(d) Expose a film with the sensitometer and check the value with the densitometer. Compare the values with those of the previous stand.

(e) Strap the step wedge to the cassette holder, take a film, check the wedges with the densitometer, and compare the values against those of the previous stand.

i. Technician responsibilities at the end of each stand

(1) Inventory

Complete the inventory of all supplies. Give it to the coordinator to send to headquarters.

(2) ECG

(a) Remove the last digital tape from the machine.

(b) Turn off and unplug the machine.

(c) Remove and clean the electrodes.

(d) Disconnect the lead set and store it in the drawer.

(e) Strap the machine to the wall.

- (f) Tape the foot of the baby board to the headboard, and place it on the floor.
 - (g) Close and lock all drawers.
 - (h) Secure the stool for transit.
- (3) Audiometry and tympanometry
- (a) Do the end-of-stand audiometric calibration.
 - (b) Disconnect the ear phone cables from the attenuator pads.
 - (c) Disconnect the ear phones from the headband.
 - (d) Disconnect the attenuator pads from the audiometer.
 - (e) Place the audiometer in the box.
 - (f) Wrap and store with the audiometer, the ear phones and cords, ear phone headband, examinee response switch, and attenuator pads.
 - (g) Store under the audiometry table, the B&K meter, half-inch microphone, 1000-Hz calibrator, cable, artificial ear coupler, and 500-gram weight.
 - (h) Turn off and unplug the tympanometer.
 - (i) Disconnect the probe from the tympanometer and pack it in the protective sack.
 - (j) Clean the tympanic eartips and pack them in the sack.
 - (k) Pack the sack and the tympanometer into the box, and put the box under the ECG table.
- (4) Body measurements
- (a) Check the skin fold calipers. Return the calipers to their cases and return the cases to the drawer.
 - (b) Secure the table with straps.
 - (c) Secure the weight scale platform so it won't move.
 - (d) Unplug the weight scale.

- (e) Move the scale weights to the far right side of the bar and tape them into position.
 - (f) Unplug the height scale light and tape the light against the camera bar extension.
 - (g) Push the height scale to the top of the bar, and tape it in place. Do not remove the camera, but tape it securely to the upright frame.
 - (h) Secure the stool.
- (5) X-omat
- (a) Turn off the main power breaker on the left side.
 - (b) Empty the replenisher tanks; rinse, and refill them with hot water.
 - (c) Open the drain valves in the dark room and drain the fixer, developer, and water. Close the drains and fill all three insert tanks with hot water. Remove and dispose of the developer filter. Return the trap lid.
 - (d) Remove the two crossover rollers, detector entrance roller assembly, and the squeegee or dryer roller assembly; and clean them using water and a Scotch Brite pad.
 - (e) Allow the detector entrance roller to push against the microswitch so that the machine will replenish itself.
 - (f) Drain the insert tanks by opening the drain valves. Remove the developer, fixer, and washer transport rollers. Scrub the insert tanks to remove all chemical deposits. Rinse and fill the insert tanks with hot water. Repeat step (e). Be sure there is sufficient water in the replenisher tanks that air is not drawn through the pumps.
 - (g) Drain all the tanks and wipe out the insert and replenisher tanks.
 - (h) Scrub the transport rollers and gears with a Scotch Brite pad until all deposits are removed; rinse and stand them up to dry.

- (i) Clean the area where the replenisher tanks sit and the shelf where the blower motor sits (accessible when rear panel is removed).
 - (j) Remove, rinse, and wipe down the dryer air tubes and transport rollers. Replace the dryer tubes.
 - (k) Inspect the transport rollers for deposits. If deposits are found, reclean the rollers with a Scotch Brite pad. When the rollers are clean, replace them in the correct insert tank.
 - (l) Replace the crossover and squeegee assemblies.
 - (m) Replace the detector entrance roller assembly in the machine.
 - (n) Replace the X-omat cover; and clean the outside of the X-omat, loading table, and dryer bin. Tape the panels and cover in place leaving a small space between the top cover and the back wall of the X-omat.
 - (o) Check that all water and mixing valves are off.
 - (p) Close the drains. Turn the power off both at the main breaker and at the unit breaker under the feed tray.
- (6) X-ray dark room
- (a) Lock the film bin and tape it around the edge.
 - (b) Check to see that the duplicator is firmly placed on the table.
 - (c) Place the small film separators on the floor and secure them in place.
 - (d) Remove everything from the shelf and place it all on the floor. Place the 14" x 17" cassettes between the wall and film bin and secure them with fiberglass tape.
 - (e) Close the door and make sure it is secure.
- (7) X-ray room
- (a) Line up the upright cassette holder so that the holes in the stand match up with the holes in the

counterweights. Put the bolts in place and tighten them.

- (b) Turn off the x-ray machine. Turn off the incoming voltage.
- (c) Screw the bolt in the transformer.
- (d) Strap and secure the ultrasound table to the wall between the cassette holder and the tubestand.
- (e) Tape gauze around the ultrasound transducer and secure it to the ATL frame.
- (f) Follow the ATL turndown procedure listed on the side of the machine.
- (g) Strap the ultrasound machine to the wall and secure it.

3. Laboratory technicians

- a. Arrive for work 15 minutes before the first examinees are scheduled.
- b. Perform the basic hematology, urinalysis, and sample preparation on all examinee specimens obtained.
- c. Check out all equipment before the receipt of the first whole blood and urine at the beginning of each examination session.
- d. Record all values on a daily worksheet and on the individual specimen worksheets.
- e. Record all abnormalities found in the hematology (after verification by repeating the tests) on the daily worksheet.
- f. After verifying the packing list as described in the laboratory manual, ship all specimens to CDC as required.
- g. Perform all required quality control procedures daily or weekly as prescribed by the laboratory manual and send the appropriate forms to CDC weekly. Keep the graphs of the hematology standards current and posted.
- h. Complete the inventory of all supplies at the beginning of each stand. Give a copy to the coordinator to send to headquarters. Keep the FOM apprised of the status of the dry ice supply.

- i. See that the laboratory equipment is properly maintained. If repairs or maintenance is necessary, inform the FOM so you both can decide upon the type of action required and each person's role in seeing that the problem is resolved. The FOM must be informed of all maintenance and repairs of equipment involving billing even though he may not have the total responsibility for resolution of the problem.
- j. Complete and review certain parts of the Report of Findings I according to the instructions in this chapter.
- k. Assist the nurse in drawing bloods, particularly during the morning sessions.
- l. See that certain data are transmitted from the field according to the instructions in Chapter III of the HHANES Field Staff Operations Manual.

4. Nurse

- a. Responsibilities related to examinations
 - (1) Arrive for work 15 minutes before the first examinees scheduled.
 - (2) Draw blood from all examinees according to the instructions in this and the CDC laboratory manual.
 - (3) When time allows, assist the physician in his examination of females over ten years of age.
 - (4) Administer the GTT questionnaire and procedure.
 - (5) Administer the hair collection questionnaire and procedure.
 - (6) Help with arriving examinees if the coordinator asks.
 - (7) Try to provide to each examinee a feeling of continuity throughout the examination, in this way perhaps making the examinee less anxious and more comfortable during his stay in the exam center.
 - (8) Review the physician's examination form and certain parts of the Report of Findings I for completeness according to the instructions in this chapter.
 - (9) See that certain data are transmitted from the field according to the instructions in Chapter III of the HHANES Field Staff Operations Manual.

- b. Additional responsibilities
 - (1) See that letters to examinee's physicians concerning medical findings requiring immediate attention get mailed promptly.
 - (2) See that the appearance of the examination areas, the equipment, and the inventories of supplies for the venipuncture room are maintained.
 - (3) Keep Glucola stocked in the refrigerator.
- c. Responsibilities at the beginning of each stand
 - (1) Check the new supplies with the new inventory list and put them away.
 - (2) Complete the beginning of stand inventories and give them to the coordinator.
 - (3) Set up the venipuncture room making sure all equipment works and supplies are adequate. Notify the FOM immediately if any supplies are needed for the examination.
 - (4) Check the emergency medical kit.
- d. Responsibilities at the end of each stand
 - (1) Do the venipuncture room inventory.
 - (2) Give the unusual occurrence form from the venipuncture room to the coordinator.
 - (3) Pack the venipuncture room for travel.
- 5. Dietary coordinator
 - a. Oversee the data gathering activities of the dietary interviewers, especially regarding completeness of records, consistency of interviewing techniques, and application of food codes.
 - b. Keep the interviewers' supervisor (the contractor) informed of the quality of work.
 - c. Organize and work as a chairperson for the community nutrition meeting at the beginning of each stand in order to acquire necessary background information as described in Chapter 6.

- d. Substitute as a dietary interviewer for two sessions a week (one session for each interviewer) when the schedule is at least eighty percent full.
- e. Review any unusual occurrence sheets that may accompany a dietary questionnaire and resolve any problems in the best way possible.
- f. Listen to and evaluate at least one English tape recorded interview per stand for each dietary interviewer.
- g. Perform market checks on regional foods that are not covered in the food codebook in order to assign appropriate food codes and nutrient values.
- h. Oversee the data gathering activities of the MEC interviewer, with special regard to completeness of records, sufficient probing, and properly followed skip patterns.
- i. Inform the MEC interviewer and his/her supervisor (the contractor) of the quality of work.
- j. Account for all dietary and MEC interview records. Pack all questionnaires properly and transmit them from the field according to the instructions in Chapter III of the HHANES Field Staff Operations Manual.
- k. Prepare an end-of-stand report that includes a chronology of the major events of the stand, an evaluation of the interviewers' work and quality of data, and ways you are trying to improve the data quality.

Responsibilities for Completing the Control Record

The coordinator is responsible for entering the required information to complete the top section of the control record except that the nurse will fill in the GTT priority number. The coordinator also records the times the examinee enters and leaves the examination center.

Each examiner is responsible for filling in the section of the control record pertaining to the procedure he is doing. This involves entering the time the procedure started, the time it ended, and the examiner number. If a procedure or a part of a procedure is not done, record the reason under "Procedure or part of overall procedure not done."

Responsibilities for Completing the Reports of Findings

Report of Findings I will be mailed from headquarters. Each examinee will have a report sent which will include a copy of the chest x-ray and an ECG tracing if these procedures were done. Results of almost all of the lab work done outside the exam center will be mailed to the physician when they are available as part of Report of Findings II. Each Report of Dental Findings will be mailed by the dentist from the field after the examination.

1. Coordinator

Enter on Report I and the Report of Dental Findings the name and address of the physician, clinic, or dentist to whom results are to be sent. This information can be obtained from the authorization form. Stay within the box outlines since the form has been designed for a window envelope. Enter the name and address of the examinee from the list provided by the FMA. See that the date of examination is entered from the control record. The coordinator is responsible for seeing that all staff members have made the required entries and that each form is complete.

2. Physician

The physician will fill in the blood pressure section and the section on other clinical findings of Report I. If there are no other clinical findings, the physician will write "None." If the blood pressure was not taken, the "Not done" box should be checked. If these sections are not completed properly, the coordinator should return the form to the physician to complete.

3. Health Technicians

The technician recording the body measurements is responsible for entering the date of examination, age, sex, height, and weight on Report I. The technician doing tympanometry and audiometry is responsible for those entries. The x-ray and ECG boxes will be checked at headquarters when the report is mailed.

4. Laboratory Technicians

The laboratory technicians are to enter each day on Report I the values for all of the blood and urine tests done in the examination center. These can be entered from the results recorded on the laboratory worksheet.

5. Dentist

The dentist will enter his findings on the Report of Dental Findings and mail each of them from the field. The dentist will also fill in the vision section of Report I.

Responsibilities for Checking HHANES Documents in the Field

1. Records to be checked

<u>Record</u>	<u>Person Responsible</u>
Control Record	Coordinator
Report of Findings I	Coordinator
Physician's Examination	Physician
Body Measurements	Chief Technician
Tympanic Impedance Test	Chief Technician
Audiometry	Chief Technician
Ultrasound Examination	Chief Technician
Vision Test	Dentist
Report of Dental Findings	Dentist
Glucose Challenge Questionnaire	Nurse
Hair Collection Questionnaire	Nurse
Dietary Questionnaire	Dietary Interviewer
Adult Sample Person Supplement	MEC Interviewer

2. Types of errors to look for

a. Blanks

A whole section or only a part of a section may be left blank. There may be a positive or "yes" answer to one part which necessitates something being written in the second part. But the second part has unfortunately been left blank.

b. Contradictory entries

An example would be a statement that the examinee had never seen a doctor followed by extensive descriptions of medical care in a following section. Another example might be a "no" answer to a question about trouble seeing, but a "yes" answer on trouble with vision even when wearing glasses.

c. Miscellaneous errors

One type would be writing something in an "other" category that should have been specified in an included code; for example, on the audiometry form, "equipment defect" written in under "other" (code 123 or 142) when a code (119 or 138) for equipment defect is available.

3. When to check the records

All records should be checked over so that corrections can be made or missing data obtained while the examinee is still in the exam center. The nurse, coordinator, and chief technician should check their forms during the examination session and request the appropriate staff members to make the corrections indicated. After checking a record, the person doing the checking should place his or her initials in the lower left corner of the document.

4. Importance of review

The objective of the review is to see that we obtain the best data possible. Missing data are no data; and while imputation procedures can be applied in some instances, there is no substitute for complete and accurate data. The information obtained on these documents will be given directly to persons in data preparation who will code and punch only what they see in front of them, without giving thought to correcting apparent errors. Errors will provide misleading information that becomes greatly magnified in the process of inflating the data from our sample to national estimates. If caught in time through computer editing procedures, some corrections can be made; but the cost of these corrections in terms of time and money is very high. We hope that you will provide every assistance possible in doing your assignments to the best of your abilities.

Chapter 4

EMERGENCY MEDICAL PROCEDURES

Introduction

The best method of coping with a medical emergency is prevention. The examining physician can at his discretion with good medical judgment cancel certain procedures such as the glucose tolerance test if the testing will lead to any endangering of the examinee's health.

Before examinations begin the FOM will obtain information on the types and availability of emergency medical services in the area in which the mobile examination center is located. This should include emergency medical services available from police or fire rescue squads, other county or local rescue squads, and hospital ambulance services, as well as the nearest medical facility. The FOM will select the best services available from the standpoint of convenience to the mobile examination center and availability of service and equipment. In some cases it may be desirable to select two. He will then post the names and phone numbers of the services selected in a conspicuous place near the phones in the exam center and the offices. The numbers of the nearest police and fire stations will also be posted.

Equipment

A Banyan emergency kit is kept in the physician's room. The nurse and the physician should check all the equipment at the start of each stand. The Banyan kit contains an emergency reference guide and the following equipment and drugs:

Instruments

- Alcohol sponge
- Endotracheal tubes
- Hemostats
- Laryngoscope
- Light source for laryngoscope
- Needle holder
- Oropharyngeal airways
- Scalpel
- Scissors
- Sphygmomanometer, velcro cuff
- Stethoscope, light weight Bowles
- Stylet
- Thumb forceps
- Tourniquet
- Intravenous cannula
- Travenol IV set

Prefilled syringes

- Sodium bicarbonate
- Epinephrine
- Atropine sulfate
- Calcium chloride
- Dextrose
- Lidocaine

Drugs

- Aminophylline
- Amyl nitrite aspirol
- Aromatic spirits of ammonia aspirol
- Benadryl
- Compazine
- Calcium gluconate
- Nitroglycerin
- Aramine
- Inderal
- Isuprel
- Lasix
- Narcan
- Syrup ipecac
- Solu-Cortef

Needles

Sutures

Syringes

Resuscitation Equipment

- Adult and child masks
- Right angle adapter
- Extension tube
- Oxygen reservoir assembly

Oxygen Equipment

- Oxygen mask with strap and rebreathing bag
- Tubing
- Spare cylinder
- Regulator/gauge assembly
- Hand wheel

Procedures

The emergency equipment is for emergency situations only.

The primary concern of all the field staff should be to get the victim to the nearest medical facility. The emergency equipment is not to be used as a substitute.

Only the physician should administer emergency procedures and use the contents of the emergency kit. The physician should only administer first aid procedures until the examinee can be gotten to a hospital or other care arrives at the exam center.

If the ambulance personnel are adequately trained in emergency medical care, seriously ill examinees who receive emergency medical care at the exam center need not be accompanied to the hospital by the physician. If it is necessary for the physician to accompany the examinee to the hospital, the exam center must be closed. The nurse will contact the examinee's designated physician/clinic as soon as possible to inform them of the incident and the medical facility to which the examinee was taken.

Anytime the physician uses emergency equipment and/or drugs for an examinee or sends the examinee for immediate medical care, the physician should complete an emergency report. The physician and the nurse should sign the form. The nurse should send the report to headquarters as soon as possible.

Chapter 5

COORDINATOR

Introduction

Efficient coordination of the flow of examinees through the examination center is the most important function of the coordinator. In addition to this, the coordinator has other responsibilities which are described in this chapter.

Beginning of the Stand

1. Complete the inventory of all supplies. Send the original along with the original inventories collected from the nurse, health techs, and lab techs to headquarters, and note additional supplies needed. Also, let the field operations manager (FOM) know what supplies are needed.
2. Be sure that each examining room has an "unusual occurrence" form posted in it.

Beginning of the Examination Session

1. Sometime before each session see that the charts for that session are ready for use. You should advise the field management assistant (FMA) of any discrepancies in sample numbers, but don't change a sample number without first confirming the change with the FMA. Review the medical histories, then give them to the examining physician to review. Check the daily schedule for any notes from the administrative office about unusual requests or instructions. If there are any they should be noted on the examinee's control record.
2. Arrive for work 30 minutes before the first scheduled examinee.
3. As each examinee arrives, clock her in and ask what his date of birth is. Be sure that the examinee has been given a sample number in the correct series according to her age on the date of first interview. He should receive an examination designed for the age group she was in on the date he was first interviewed, not the age group she is in on the date of examination. For example, a person who was nineteen years old on the day he was interviewed but who has turned twenty before the day she is examined should have a sample number in the 400-599 series and should receive the examination designed for those 12-19 years old. If you have any doubt about the

examinee's age on the date of first interview (the date the screener was completed) and the examinee is on the borderline of one of the age groups, check with the FMA to determine the exact date of first interview. Got it?

4. Take the oral temperature of each examinee by the time she has changed clothes. Report any temperature over 101⁰ F to the physician.

Rules of the Examinee Flow System

1. Basic rule for pairing examinee with examiner
 - a. If several examinees are waiting, the examinee who has been waiting the longest since he was last seen should be served first.
 - b. If several examiners are available to an examinee, the following priorities determine who serves the examinee:

Six Months to Five Years of Age

Change
Physician's Examination
Dental Examination
Dietary Interview
Tympanometry
Body Measurements
Change
Venipuncture (VP)

Six to Eleven Years of Age

VP
Change/Urine
Physician's Examination
Dental Examination/Vision Test
Dietary Interview
Audiometry/Tympanometry
Body Measurements
Change

Twelve to Nineteen Years of Age

VP
Change/Urine
Physician's Examination
Dental Examination/Vision Test
Dietary Interview
Sample Person Supplement
Hair Collection (afternoon and evening sessions only)
Audiometry/Tympanometry
Body Measurements
Change

Twenty to Seventy-Four years of Age, Non-Fasting

VP
Change/Urine
Physician's Examination
Dental Examination/Vision Test
Dietary Interview
Sample Person Supplement
Electrocardiography (ECG)
Audiometry/Tympanometry
X-Ray
Body Measurements
Change

Twenty to Seventy-Four Years of Age, Fasting

Change/Urine
Ultrasound Examination
ECG
VP
Physician's Examination
Hair Collection
Dental Examination
Sample Person Supplement
Dietary Interview
Tympanometry
X-Ray
Body Measurements
Change

2. Other rules

- a. During morning sessions, each fasting examinee should receive the ultrasound and ECG exams before he receives

Glucola. But the order of assignment to these examinations depends on the hour each examinee last ate or drank anything. As each fasting examinee arrives, send her to the nurse who will administer part of the glucose challenge questionnaire to determine whether or when the examinee can be given Glucola. Then the nurse will write a "GTT priority" number at the top of the control record. If the examinee last ate before 4:45 PM the previous day, the Glucose Tolerance Test (GTT) can not be done that day. If he last ate between 6:15 PM and 10:45 PM the day before (Priority 2), she can be given Glucola anytime between 8:45 AM and 10:15 AM. Thus you don't need to worry too much about when "Priority 2" examinees receive Glucola as long as it's between 8:45 AM and 10:15 AM. However, if the examinee has a priority of either "1" or "3", you must pay special attention to the time she last ate and be sure he is sent to the nurse for VP and Glucola within the allowable time limits shown on the "Time Chart for Glucose Challenge Test."

- b. Once you have determined the GTT priority number of a fasting examinee you should keep it in mind when assigning the examinee to ECG, ultrasound, and VP. ECG must be done before Glucola is administered. If for some reason it is not, then it can be done at the very end of the examination at least two hours after the Glucola was given. Ultrasound should be done before Glucola is administered unless the upper limit for the GTT fasting time is rapidly approaching. Then it is permissible to do the Ultrasound exam right after the Glucola is given. It is also permissible to give Glucola before ultrasound if it appears that unless you do, the Glucola won't be administered before 10:15 AM. All GTT's must be started before 10:15 AM so that the examination session won't be unduly lengthened.
- c. As soon as one examinee is sent to ultrasound another one who is ready should be held for ultrasound and not be assigned to anything else first.
- d. The nurse is responsible for doing the second and third VP's on the examinees who get the GTT. The nurse may interrupt any examination to insure that she will get the GTT blood specimens at 1 hour plus or minus 5 minutes and 2 hours plus or minus 5 minutes after the Glucola is given. Laboratory techs may be asked to draw blood if the nurse is too busy to draw it on time.
- e. Before body measurements can be assigned, two techs must be available, one to measure the other to record. However, if necessary, the dentist can be used to record for body

measurements if two techs are not available. Only under the most unusual circumstances should you ever record body measurements for the techs.

- f. The SP supplement can be interrupted between its sections if the ultrasound room is available and no other examinee but the one doing the supplement is free to send to ultrasound.
- g. No one should be sent to x-ray until all ultrasound exams are finished.
- h. The physician's examination of females must be chaperoned if the physician is male.
- i. A technician must be available to record for the dental examination before it can be assigned. The vision test does not need a recorder.

Duties Not Directly Related to Examinee Flow

1. Be responsible for urine collection as described in Chapter 7.
2. Quickly review for completeness and consistency each chart as it is returned by the examiner. Have all errors corrected before the examinee leaves the examination center.
3. See that transportation from the examination center is available for each examinee when he is ready to go.
4. See that any necessary remuneration is given to each examinee before he leaves and that the necessary receipts are signed.
5. Stay until the last examinee leaves the center. All examiners except the physician can leave when finished with all their exams after first checking with the coordinator. The physician must be in the examination center during the whole examination session unless there are only questionnaires left to be administered.
6. Count the money at the end of each day making sure that receipts balance with cash on hand.
7. Once a week compare your examinee count with the FMA's count so that the transmittal sheets can be kept accurate and up to date.

Body Measurement Replicates

An intertechnician body measurement replicate is to be done every fourth session on the examinee who arrives first at the exam center. The sessions on which replicates are to be done are shown on the schedule sheet. For the sessions during which a replicate is done, you should write the examinee's sample number in the appropriate space on the schedule sheet and assign the original body measurements on that examinee to a technician according to the usual flow system rules. You should assign the replicate measurements in a random way to one of the other technicians and write that technician's number in the appropriate space on the schedule sheet.

Full Scale Replicates

At each stand we will try to do replicate examinations on about twelve examinees taken from a pool of those over eleven years old examined before the last eight exam days of the stand. As each of these examinees leaves the exam center, ask her if she would be willing to return for another examination, complete except for x-rays, between one and three weeks later. Say that he would receive remuneration and mileage payments, as before, for coming again. If he is willing, list her name, sample number, and date of examination. Give each day's list to the FMA who will try to schedule each of these people for a replicate exam. When the examinee returns, treat him just like the rest of the examinees. She should receive the same examination he did the first time except for x-rays and should be remunerated fully.

He also should have a body measurement replicate done during the second examination. The tech who did body measurements on the examinee during the first examination should do either the original or replicate body measurements during the second examination. Either of the other two techs can do the other set of measurements.

End of the Stand

1. Transmit data from the field according to the instructions on records transmittal in the HHANES Field Staff Operations Manual.
2. Send the schedule sheet and unusual occurrence forms to headquarters.
3. Complete the inventory of all supplies. Give a copy of it along with the copies of the inventories collected from the nurse, health techs, and laboratory techs to the FOM to mail to headquarters in a separate envelope. Leave a copy of the end of stand inventory in your desk drawer to be used at that caravan's next stand.

Communication Between FOM and Examination Staff

The coordinator is the channel of communication between the FOM and the examination staff as far as operational matters within the examination center are concerned. She should report to the FOM any problems that occur during the examination which require contact with the family, physician, school, etc. She should inform the exam staff of any schedule changes and reasons for them as she receives them from the administrative office. She should also inform the FOM as soon as possible of any equipment repairs required in the exam center.

Under no circumstances should the coordinator contact sample persons at home or at work. Any contacts with sample persons should be made by the FOM, FMA, or HER.

Chapter 6

DIETARY COORDINATOR

Introduction

The main function of the dietary coordinator in the Hispanic HANES is to monitor the work of the contractor's dietary and MEC interviewers and help them maintain a high degree of accuracy and consistency in data collection. This and other responsibilities will be further explained in this chapter.

Beginning of the Stand

At each new stand, it is the responsibility of the dietary coordinator to make sure the dietary and MEC interviewers have set up their rooms properly in the mobile examination center (MEC) and are ready for operation when examinations begin.

Dietary Meeting

Another responsibility of the dietary coordinator is to organize and conduct dietary meetings with key nutrition-related personnel who are knowledgeable about the foods and food habits of the community. Such individuals may be public health and/or agriculture extension nutritionists, school food service personnel, hospital or clinic dietitians, and personnel of various nutrition programs. The purpose of the meetings, one of which is held before examinations begin at each stand, is to provide facts about the survey and to obtain background information concerning local food customs, food terminology, specialty items that may be reported in the area being surveyed, and sources of nutrition referrals. Knowledge of the local practices makes it possible for the dietary interviewers to understand the respondents better and to probe more effectively during the dietary interview. The cooperation and support of local professionals is important because many times these are people whom the sample person has learned to trust and may consult before participating in the survey.

1. Setting up the meetings

Call the local contact person whom one of the community outreach coordinators (who has previously been to the area doing public relations work for the survey) has initially identified to coordinate the meeting. Since the outreach coordinator already has informed the contact person about the dietary meeting to be held, you will be making the second contact by telephone to arrange the date, time, and place of

the meeting, and to find out who will be attending. This confirmation is usually done at least two weeks before the stand begins.

2. Conducting the meeting

- a. Have the dietary interviewers attend the meeting and participate in asking appropriate questions to gather local dietary background information.
- b. Begin the meeting by passing out public relations packets, and then present the slide show that explains the objectives and gives an overview of the Hispanic HANES. Give the participants time to ask questions after the presentation.
- c. From the participants, try to find out the following types of information:
 - (1) Dietary and cooking practices and patterns.
 - (2) Traditional foods of the area.
 - (3) Local names and colloquialisms for common foods and preparation methods.
 - (4) Common shopping practices and patterns related to food storage, for example canning or freezing.
 - (5) Area grocery stores and restaurants most commonly used by the Hispanic population.
 - (6) School lunch and breakfast menus for the period of the stand including summer school and day care feeding programs.
 - (7) Vending machines in the schools and the kinds of foods available in them.
 - (8) Characteristics of the population including family size and composition.
 - (9) The referral process for local health and nutrition resources.
 - (10) Names and phone numbers for further contact.

Overseeing the Data Gathering Activities of the Dietary Interviewers

One of the main responsibilities of the dietary coordinator is to monitor the work of the dietary interviewers. This is to be done in the following ways:

1. Check all questionnaires for completeness and legibility. Obviously, if a form cannot be read, the data are lost. Return any questionnaires that are illegible or incomplete to the interviewer to clarify and revise if possible.
2. Edit a ten-percent sample of questionnaires done by each dietary interviewer with regard to completeness, conformity to established coding procedures, and proper use of interviewing techniques. Always edit a questionnaire in orange pen or pencil. If the dietary questionnaire is not complete, an acceptable explanation must be provided by the interviewer. Common errors that can be caught in editing are incorrect or omitted codes, failure to check the food frequency against the 24-hour recall, and inadequately probed responses.
3. Provide feedback from these reviews to the interviewers in a timely fashion; otherwise, repetitive errors may occur.
4. Keep a record of the errors found for each interviewer in an edit book. Also, keep a record of those forms that were completely correct. At the end of each stand, mail these edit sheets to headquarters. You may want to make copies for your personal records.
5. Monitor tape recordings of dietary interviews
 - a. In a random manner select certain dietary interviews to be tape recorded so that each interviewer will record one English and one Spanish interview at every stand location. However, keep in mind that since a recording is required for each language, you must review the appointment schedule in advance before selecting the interviews to be recorded. For example, it will do no good to have an interviewer record a Spanish interview if there are no Spanish speaking sample persons scheduled for that session.
 - b. Listen to and evaluate the English tapes with regard to the interviewers' ability to maintain consistent interviewing practices and follow established procedures.
 - c. Then meet with each interviewer and discuss areas of strength and areas that need improvement. It is a good idea to provide each interviewer with a written critique as a reference. If time allows, the interviewers also should listen to and comment on the taped interviews.

- d. Send the Spanish tapes to the Hispanic dietary consultant to be evaluated.

Unusual Occurrence Sheets

An unusual occurrence sheet (UOS) may be inserted into one of the dietary questionnaires. A UOS is a standard form filled out by an interviewer when she is unable to complete a questionnaire. For example, she may not be able to code certain foods either because these foods are not listed in the codebook or because she is uncertain that the codes are correct. In other instances, there may be a question about the manner in which the food was reported or the way that the food is categorized in the codebook.

1. Review all the unusual occurrence sheets and resolve the problems encountered in the best way possible.
2. If a food code is needed, refer to the USDA food coding manual to see if the food item is listed.
 - a. If a suitable code is found, insert it in the appropriate space on the questionnaire. Any new codes should be given to the interviewers and added to the Hispanic HANES food codebook as well. The added codes should also be indicated on the UOS so that they can be incorporated into the codebook at headquarters.
 - b. If a code cannot be found in the USDA manual, either because the product is new on the market or because the food is a cultural or colloquial variation, determine whether or not there is a need for a market check that may eventually produce a new food code.
3. Forward all UOS's to headquarters at the end of each stand along with a report on how the problems were resolved.

Market Checks

The purpose of doing market checks is to determine the nutrient content of previously unreported food products not covered in the food codebook. Market checks are primarily your responsibility. However, it is very important for the dietary interviewers to be alert while conducting the 24-hour recall and obtain enough information to enable you to do a market check. If a food is unfamiliar, the dietary interviewer should probe for the brand name, the place where the food was purchased, and the container size. If the examinee cannot actually tell the size in ounces, he should estimate the size by using food models. If appropriate, the interviewer should obtain other identifying

information about the food such as flavor, texture, color, or method of packaging. This information should be written on an unusual occurrence sheet.

1. Determining the need for a market check
 - a. Determine from the UOS's which foods need to be market checked. Foods that are nationally available are to be looked at further and/or market checked at headquarters. Staff at headquarters can, in some cases, contact a specific company and receive the needed nutrition information thus obviating the need for you to go to the market.
 - b. Fill out the identifying information section of the market check sheet for each of the food items that you will check locally. Record the brand name, if known, and any other descriptive information that you have available from the UOS.
2. Completing the market check
 - a. Once you have found the item in the store, fill in the market information section of the market check sheet. Do not correct or change any of the identifying information you previously entered.
 - (1) Record the brand name of the item from which you are taking the information and the place (store) where you found the item.
 - (2) Fill in the name and address of the manufacturer or distributor. This is important information since headquarters may be able to obtain the exact nutrient content from the manufacturer.
 - (3) Record the size of the container and price of the item.
 - b. Next, look at the labeling information to determine if the contents are broken down by serving size. If so, fill in the label information section of the market check sheet.
 - (1) Write the number of grams or ounces in one serving size and circle the correct unit, either GM or OZ.
 - (2) Record the other items listed by serving size (usually calories, protein, carbohydrates, fat, sodium, and potassium) in GM/MG per serving in Column I on the market check sheet. If the nutrient information is not available by serving size on the label, record N/A in Column I.

- (3) Complete Column II of the label information section, percent of U.S. RDA per serving. This information, if available, is also listed on the product label. Record the information exactly as it is on the market check sheet. If no nutrient information by percent U.S. RDA is available, write N/A in Column II.
 - (4) Do not record anything in the area labeled "Nutrients per 100 GM." That column is for office use only.
 - (5) Record the ingredients as listed on the product label in the space provided near the bottom of the market check sheet.
 - (6) In the comments section at the bottom of the page, write any information that you think might be useful in identifying the nutrient composition of the food item.
- c. Send the completed market check sheets to headquarters at the end of the stand for nutrient calculation and assignment of food codes. If possible, make and keep copies for your own reference.
3. Purchasing the food item
 - a. If the weight, nutrient information, or description is not available on the label, or if the food item does not have a label, then purchase the food item. For example, you may need to buy a food item from a bakery or a delicatessen.
 - b. When purchasing food for the market check, have the sales clerk initial the receipt. Give your receipts to the field management assistant who will submit them for reimbursement.
 - c. Take the food item to the mobile examination center; and using the scales there, determine a gram weight per serving size or edible portion.
 - d. Complete a market check sheet for each of these items and write in any descriptive information available about the product.

4. Unusual situations

The examinee may not always be able to provide enough information to the dietary interviewer to make it easy for you to identify the food item when you do the market check. For example, sometimes the examinee will be able to describe the packaging of a product but be unable to recall the brand name.

Or, the person may think that he or she has given all the information. But, when you get to the store, you find that the description was not really complete; and more than one product could fit the description. In any case, the standard market check procedure is to record all the information available so that a decision can be made about how to code the food. For example:

- a. If you do not have the brand name of the item and find two products that fit the description given by the examinee, record the information from both labels.
- b. If the description given by the examinee is incomplete and more than one product fits the description, record all the possibilities.
- c. If the identifying information is not complete but you are fairly certain that you have located the correct product, record the information and be certain to note the discrepancies in the comments section on the market check sheet.

Substituting as a Dietary Interviewer

When the examination schedule is at least eighty percent full, the dietary coordinator is to substitute two sessions a week as a dietary interviewer, one session for each interviewer. This enables the interviewers to have more time to code the foods on the 24-hour recall, as well as edit their work and verify a portion of each other's work. The dietary interviewer manual thoroughly explains the procedure to follow as a dietary interviewer. When filling in as a dietary interviewer, you should report to work fifteen minutes before examinees are scheduled to arrive.

Visitors to the Mobile Examination Center

From time to time dietitians, nutritionists, and other professionals may contact the dietary staff about visiting the examination center. Explain to such persons that to protect the confidentiality of examinees and to avoid congestion, visits are limited to those times when the center is not operating, for example, the afternoon of a day scheduled as a split shift. Arrangements for visitors to tour the center should be made in collaboration with the field operations manager. You and possibly one or both of the dietary interviewers should be available to show these visitors the center and to explain the different parts of the examination.

Overseeing the Data Gathering Activities of the MEC Interviewer

Another main responsibility of the dietary coordinator is to monitor the work of the MEC interviewer. This is to be done in the following ways:

1. Edit one hundred percent of the adult sample person questionnaires done during the first two days of the stand because many times there will be a different MEC interviewer at each stand. After the first two days, reduce the amount of editing to a twenty-percent sample of questionnaires for the remainder of the stand.
2. Check the questionnaires for completeness, legibility, sufficient probing, and properly followed skip patterns.
3. Provide timely feedback to the interviewer concerning the quality of work; otherwise repetitive errors may occur.
4. Keep a record of the errors in an edit book. Also keep a record of those forms that were completely correct. At the end of each stand, mail the edit sheets to headquarters. You may want to make copies for your personal records.

Informing the Contractor of the Quality of Work

Since the dietary and MEC interviewers work for the contractor, not for the government, it is important that you inform the contractor of the results of your quality control work. Thus, you should talk with the contractor about once every stand, or more often if there are specific problems. As the supervisor of the interviewers, the contractor will take any action necessary as a result of your findings.

End of Stand Reports

At the end of each stand it is your responsibility to write a report that includes a chronology of the major events of the stand, an evaluation of the quality of data with reference to the interviewers' work, recommendations for improving data quality when possible, and suggestions for improving the overall stand operation.

PART II. PROCEDURES

Chapter 7

URINE COLLECTION AND TESTING

Equipment

Graduated 200-cc cups

Introduction

The manner of collection of urine specimens and the tests done on them vary by age, sex, and test group of the examinee. The coordinator is responsible for seeing that the urine is collected according to the instructions in this chapter.

Urine is to be collected on all examinees six years of age and over.

The coordinator or other staff member is to give the examinee a properly labeled urine cup and have him void at the time he is changing clothes. If a urine specimen is not obtained at that time, the coordinator is responsible for getting it sometime during the examination. However, a urine specimen obtained from a GTT examinee who has drunk any fluids is not to be used for examination of the sediments.

If the laboratory needs additional urine the coordinator is responsible for obtaining a second specimen from the examinee before he leaves the examination center.

Collection Procedure

1. Group 1: Males and females, 6-11 years old (GREEN LABEL)

Give the examinee a urine cup labeled with his sample number and UR-1. Ask the examinee for a urine sample; no special instructions are needed for this group. When the examinee returns to the reception area, record the time on the Control Record. Take the urine specimen to the laboratory as soon as possible.

2. Group 2: Males and females, 12-19 years old (YELLOW LABEL), and males and females, 20-74 years old (BLUE LABEL)

(Note that the blue label group does not get the GTT.) Mark a line on a urine cup indicating the level where the cup would

hold 35 cc if it were filled to that level. Give the examinee the cup labeled with his sample number and UR-2, and ask him for enough urine to fill the cup up to the 35-cc line. Ask the examinee to empty his bladder into the toilet after filling the cup to the 35-cc line, take the cup to the lab, and return to the reception area. Record the time on the Control Record. If the examinee has not given a urine sample by the end of the exam, ask him to furnish the specimen then with the time recorded as above. If the lab tech reports that the specimen is inadequate, obtain another specimen from the examinee before he finishes his exam, with the same instructions as above. This time a white sample number label should be attached to the urine cup.

3. Group 3: GTT Males and Females, 20-74 years old (ORANGE LABEL)

Give the examinee a urine cup with his sample number label and UR-3. Ask the examinee for a urine sample and say that "it is very important to urinate a little bit into the toilet before starting to fill the container." Ask the examinee to take the cup to the lab and return to the reception area. Record the time on the Control Record.

Testing Procedures

The processing of urine in HHANES can be divided into four procedures: Dip N-Multistix, pesticide sample preparation, microscopic examination of sediments, and specific gravity determination. The laboratory technicians are responsible for doing the following procedures.

1. Dip N-Multistix

Do a dip stick test on the urine of all examinees who provide specimens. Repeat all clinically abnormal results immediately. Once it has been ascertained that a particular result is abnormal, report the result directly to the examining physician. Record the results on the worksheet for Deck 516.

a. Introduction

CLINI-TEK is a semi-automated instrument designed for reading reagent strips for pH, protein, glucose, ketone, bilirubin, occult blood, nitrite, and urobilinogen and displaying the results in clinically meaningful units. Determinations are precise and rapid. One simply inserts a reagent strip which has been dipped in a urine specimen into the instrument, views the readout display and records test results. For convenience, it is recommended that the

instrument be turned on at the beginning of the stand and left on until the end of the stand.

b. Testing Procedure:

- (1) Completely immerse all reagent areas of a reagent strip in fresh, well-mixed, uncentrifuged urine. Remove the reagent strip immediately and press the start button at the same time the strip is removed. The ANALYZE light should come on.
- (2) Tap the edge of the reagent strip against the side of the urine container. Remove excess urine by holding the strip horizontally, with reagent areas up, to prevent the mixing of chemicals from adjacent reagent areas, and draw the edge of the strip across a paper towel. Avoid contact between the reagent areas and the paper towel.
- (3) Place the reagent strip with reagent areas up in position on the reagent strip feed table within ten seconds after depressing the start button.
- (4) When the CLINI-TEK cycle is complete, view the readout display and record the test results. If the reagent strip is rejected by the instrument, the REJECT light will come on and the readout display will blank. Should this occur, check the reagent strip for proper positioning on the feed table, the feed table insert for proper positioning on the feed table, and the reagent strip for a missing test area. If the instrument is defective, see Section 6 of the Operator's Manual, Trouble Shooting.
- (5) Remove and discard the used reagent strip.

NOTE: To keep the feed table insert and its strip holding channel clean, wipe the channel with a damp, absorbent tissue after testing 50 urine specimens or after each batch is completed. See Section 5 of the Operator's Manual, Care of Instrument, for complete information on cleaning the feed table and feed table insert.

c. Shutdown Procedure

- (1) When testing is complete, clean the feed table and feed table insert and inspect the white reference block as described in Section 5 of the Operator's Manual, Periodic Cleaning.

- (2) To place the feed table in the storage position, press and hold the START button until the feed table starts to move inward. When the table begins to move release the START button. The table will move into the storage position and remain there. No reagent strip should be on the feed table when the instrument is not in use.
- (3) Turn CLINI-TEK electrical power off only if the instrument is not going to be used for an extended period of time.

2. Pesticides

This procedure is to be done on all urine specimens with blue labels marked UR-2 and all even-numbered specimens with yellow labels marked UR-2. This group represents a half-sample of examinees 12-74 years of age.

Pour a urine sample of 20 cc into a special vial provided by EPA. If less than 15 cc of urine is available from the first catch ask the coordinator to obtain an additional specimen. The initial inadequate urine sample should be stored in the special EPA vial in the refrigerator until the additional specimen is available. Mix the two catches of urine in the catch vial and repour them into the EPA vial for transmittal. Complete the transmittal form for Deck 510.

3. Microscopic examination of sediments

This procedure is to be done on urine specimens with orange labels marked UR-3. This group of males and females 20-74 years of age receive the GTT. The test results should be recorded on the Deck 516 worksheet.

a. Preliminary Procedure

Centrifuge a 12-cc urine sample for 5 minutes at 2500 rpm. Pour off the clear supernate and tap the bottom of the tube to resuspend the sediments. Using a coverslip, examine a drop of sediment with the microscope.

b. Cell counts

- (1) Count up to ten high power fields (HPF) for red blood cells and white blood cells.
- (2) Count up to 509 red cells. If there are 000-509 red cells, enter the number in the spaces provided (the decimal point automatically provides the average

number of cells per HPF). For example, if there are 107 red cells in 10 HPF's, enter 107. If 54, enter 054. If more than 509 red cells have been counted but the field is not packed with red cells, check the "51 3/4" box. If packed, check the "Full" box.

- (3) Count white blood cells using exactly the same procedure.
- (4) If either red or white cells are obviously packed, check "Full." It is not necessary to count to 509.

c. Cast counts

- (1) Count the following kinds of casts: hyaline, waxy, granular, erythrocyte, leukocyte, and epithelial.
- (2) Count up to ten low power fields (LPF) for casts. Note the number of each kind of cast. For example, if there are 18 granular casts, write 018 under "Granular Casts." If there are also 46 hyaline casts, write 046 under "Hyaline Casts." If there are more than 50 of any particular kind of cast, check the box for more than 50 and stop counting that kind of cast. For example, if there are 50 hyaline casts and 46 granular casts in less than 10 LPF's you should keep on counting for granular casts, but you may check the "more than 50" box for hyaline casts. Such high cast counts can be expected to be very rare among our examinees.

d. Time recording

Record the time when the cell and casts have all been read for each examinee. This time entry is essential because it is the only indication that the test was done if all results were negative, i.e., no cells, casts, or other findings were present.

e. Other findings

Use this column to enter any other urinary findings. The entry is to be a qualitative observation, i.e., many bacteria or few crystals.

4. Specific gravity determination

This measurement is to be done on urine specimens with orange labels marked UR-3. This is the group of examinees 20-74 years of age who receive the GTT. The recording of results is to be done on the worksheet for Deck 516.

a. Introduction

The TS Meter and Concentrimeter have been designed for simple rapid microanalysis. Although these instruments actually measure refractive index, different models are calibrated for special or general use. For the Model 10400 TS Meter the scales are calibrated in terms of protein concentration of plasma or serum (grams/100 ml) and specific gravity of urine. Determinations are precise, rapid, and require only a drop of fluid sample. One simply reads the value on the appropriate scale as seen through the eyepiece where the sharp boundary between dark and light fields crosses the scale. The instruments are temperature compensated for temperatures between 60° and 100° F so that the reading need not be adjusted for either the temperature of the sample or the temperature of the room in which used.

c. Operating instructions:

- (1) Hold the instrument horizontally. The recommended loading procedure, in order to reduce evaporation to a minimum, is to lower the cover plate onto the dry, clean prism and then place the sample liquid on the exposed prism on the top or bottom of the measuring prism so that the liquid will be drawn into the space between the prisms by capillary action. Take care to avoid lifting the cover plate before the reading is made. A dropping pipette may be used to transfer the sample to the measuring prism.
- (2) To hold the instrument for reading, place a middle finger on the name plate and press the plastic cover gently but firmly. This spreads the minimal volume of sample in a thin even layer over the prism. Expose it to the illuminating source of the AO refractometer illuminated stand. To obtain the optimum contrast between light and dark boundary, the instrument may have to be properly tilted with respect to the window or lamp. Increased contrast and sharpness of the boundary may be obtained by use of the vertical bold color fluorescent lamp.
- (3) Bring the scale seen in the eyepiece into best focus by rotating the eyepiece. This setting need not be changed as long as the same individual continues to use the instrument.
- (4) Make the reading on the correct scale at the point where the dividing line between bright and dark fields

crosses the scale. For HHANES the lower specific gravity scale is the one to be read. Enter the reading under refractive index, for example, 1.017.

- (5) Use a soft cloth or soft tissue moistened with water for wiping the prism. Dry the prism with a soft cloth or tissue. If the prism surface or cover plate is not well cleaned before the next sample is loaded, an erroneous or fuzzy reading may result. Do not immerse the eyepiece or the black focusing ring in water and do not use very hot water. Never use gritty cleaning compounds to clean the prism. Never expose the instrument to temperatures above 150° F.

d. Zero setting

The zero setting of the TS Meter should need adjustment infrequently, if ever. To check the adjustment, make sure the temperature of the instrument is between 70° and 85° F and take a reading on distilled water. If the reading departs from zero by more than one half of a division, push a jeweler's screw driver through the cement seal and turn it clockwise to increase the reading or counterclockwise to decrease the reading. Make sure that the final motion is clockwise. Seal the hole with caulking compound after the correct reading has been obtained. NOTE: Caulking compound is supplied with the instrument.

e. Air bubble

Temperature compensation is produced by optical action of a filled cavity arranged in the optical path. This cavity is hermetically sealed and cannot leak. Thermal expansion of the liquid is accommodated by an air bubble which is kept out of the optical path by a bubble trap placed at the end of the cavity. In transit or under severe vibration the bubble may escape the trap and appear in the visible portion of the refractometer prism. If this occurs the instrument should be held vertically, eyepiece down, and shaken lightly. This will allow the bubble to pass into the trap where it will be kept during all normal operations.

Chapter 8

LABORATORY PROCEDURES

Equipment

For a list and setup of equipment see the laboratory manual.

Hematology

The basic procedures and reporting methods are explained in the laboratory manual. It is the responsibility of the laboratory technicians to follow these procedures carefully to insure work of the highest quality and uniformity.

The following tests are to be done for each examinee if sufficient specimen is available:

- Hemoglobin (cyanmethemoglobin)
- Hematocrit (spun hematocrit)
- Red cell count (Coulter)
- White cell count (Coulter)
- Blood film (sent to CDC)

These tests constitute a basic hematology package that is done entirely in the field facility. The laboratory technicians perform all tests in duplicate and record all results on a daily work sheet. All clinically borderline results should be repeated immediately. To facilitate the reporting of any abnormal result the hematocrit should be done before the other laboratory work is completed. This allows the cell indices to be calculated immediately.

Once it has been ascertained that a particular result is abnormal, according to predetermined guidelines prepared by CDC, a laboratory technician should report the result directly to the examining physician. The technician should also see that an abnormal findings report is initiated when the abnormal result has been verified.

Glucose Tolerance Test

The gray top tube should be centrifuged and the plasma removed within 5 minutes after the venipuncture. If the tube is clotted or grossly hemolyzed, inform the nurse and write the reason the GTT was cancelled on the laboratory worksheet for Deck 511.

Keep a separate record in the laboratory of the sample number, date, and name of any GTT examinee who did not receive the GTT on the same day as the rest of the examination.

If the examinee returns for a rescheduled GTT, enter from the separate record his sample number and other information on the Deck 511 hematology worksheet used that day; and indicate in the "Comments" section that it was a rescheduled GTT and the date when the examinee had the rest of the examination.

Other Blood Assessments

The blood assessments listed in the following table by age group and material on which the test is performed, require an elaborate separation and handling procedure in the field laboratory which is described in detail in the laboratory manual.

OVERALL ANALYTICAL PROTOCOL FOR HISPANIC HANES SPECIMENS

Group A 4-5 Years Old Red Label	Group B 6-11 Years Old Green Label	Group C 12-19 Years Old Yellow Label	Group D 20-74 Years Old Blue Label	Group E 20-74 Years Old Orange Label
WHOLE BLOOD				
CBC Lead Protoporphyrin RBC Folate ¹	CBC Lead Carboxy-hemoglobin ² Protoporphyrin RBC Folate ¹	CBC Lead Carboxy-hemoglobin ² Protoporphyrin RBC Folate ¹	CBC Lead Carboxy-hemoglobin ² Protoporphyrin RBC Folate ¹	CBC Lead Carboxy-hemoglobin ² Protoporphyrin RBC Folate ¹
SERUM				
Iron TIBC Folate ¹ Vitamin A/E Tetanus	Ferritin ¹ Iron TIBC Folate ¹ Vitamin A/E Thiocyanate ² Tetanus	Ferritin ¹ Pesticides ³ Syphilis Iron TIBC Folate ¹ Vitamin A/E Thiocyanate ² ICAP	Ferritin ¹ Cholesterol Triglycerides Pesticides Profile Syphilis Iron TIBC Folate ¹ Vitamin A/E Thiocyanate ²	Ferritin ¹ Cholesterol Triglycerides Profile Syphilis Iron TIBC Folate ¹ Vitamin A/E Thiocyanate ² ICAP
PLASMA				
-	-	-	-	GTT ⁴

¹Anemia group only. See Table 3 for an explanation of the subgroup criteria.

²Collected only on persons with odd sample numbers.

³Collected only on persons with even sample numbers.

⁴A fasting blood specimen is collected; then the examinee is given "Glucola" (2604, Ames Diagnostics, Elkhart, Indiana), a 75-gram carbohydrate-load cola solution. Additional blood specimens are collected one and two hours after cola ingestion.

Shipping Instructions

1. Beginning of stand and general instructions

- a. Working with the FOM, determine from the local post office the times airmailed packages are picked up in order to connect with the best flights to Atlanta, Baltimore, Pittsburgh, Alamogordo, and Washington, D.C. Shipments will be scheduled once a week on Tuesday mornings.

IMPORTANT: Since the materials packed in accordance with the instructions below will remain frozen or cool about 2½ days, shipments to Washington and Pittsburgh should not be sent to arrive there on weekends or on Federal holidays.

- b. For all shipments of whole blood, serum, or urine, pack the shippers with specimens and dry ice (or coolant) just before transport to the postal drop.
- c. Maintain a supply of dry ice for shipping specimens. A 60-pound block 10" x 10" x 12" should be sawed at the plant into 1" slabs, giving ten 6-pound slabs 1" x 10" x 12". Then each of these should be sawed lengthwise giving twenty 1" x 10" x 6" cakes (3 pounds each). Cakes of ice should be stored for later use in an extra shipper under the trailer. When storing the ice, minimize the exposed surface area by reassembling as much of the block as possible in the storage container. Since some shipments require a coolant to keep the materials cool but not frozen during the shipment, keep two coolant packs in the freezer at all times. Replace each used one to maintain the inventory for weekend shipments or other unexpected demands for these items.
- d. When packing the shippers, use asbestos gloves to handle the dry ice to avoid burning the hands. Glasses or an eye shield should also be worn if the dry ice cakes are to be broken into small pieces. Wrap the cakes in a single sheet of paper and tape them shut before placing them in the shipper. Then, remove the bagged specimens from the freezer and pack them in the bottom of the shipper as tightly as possible to prevent them from rattling about; use crumpled newspaper to fill holes and to even the top to 4 1/4" from the top of the shipper. Place a dry ice cake on top so that it sinks 1/4" below the rim. Pack the sides with crumpled paper. Place the polyfoam lid on top of the shipper; do not pack so that it has to be forced down.
- e. Place a plastic envelope containing the correct transmittal sheets on top of the polyfoam lid. Secure the outer carton

lid on the shipper with filament tape if no straps are available.

- f. If a coolant is required instead of dry ice, use the special small shippers. Either label or stamp "REFRIGERATE-DO NOT FREEZE" on each shipper using coolant. Pack the shipper and coolant so the contents do not rattle about. Secure the polyfoam lid. Do not forget to replace the used coolant in the freezer.
- g. Cover or remove used address labels on all shippers. Express Mail Service (EMS) best accomplishes the required timely delivery of specimen shippers. This service is available from specified postal facilities in or near most cities to be sampled in HHANES. The correct procedure for use of Express Mail Service follows:

On arrival at the stand the FOM should contact the postal service to determine the nearest branch offering EMS and if service is available to the required delivery points. The local postmaster should be sent a letter outlining our schedule of shipments and destinations along with the address and telephone number of Health Examination Field Operations Branch (HEFOB) and Tom Makepeace's name in case any questions arise regarding charges after the close of the stand.

There are two types of EMS, regular and programmed. If regular service is not available to the destinations required, it may be possible to establish programmed service. This, however, requires some special effort and may depend on the cooperation of the EMS manager at the originating postal facility. The postal service generally eschews establishing such service for the short term project.

The local post office will provide appropriate labels for our use. Billing will be handled directly by OASH, and no accounting information is required. If EMS is not available (and it will not be for all stands), the shippers should be sent and stamped "Priority Mail." It is the responsibility of the laboratory technicians to verify with the FOM the type of service available.

- h. Attach a "HUMAN BLOOD-DRY ICE" label to the top of the shipping carton. The human blood label should also contain afterhours delivery instructions.
- i. Send one copy of the transmittal records in the shippers, the other copy to the same address in a separate envelope.

This is to ensure against loss and considerable time lags in detecting missing shippers.

2. Weekly Shipments

a. Shipments to the Centers for Disease Control (Vials 1, 2, 3, 5a, 5b, 5c, 6, 7, 9, 12, 14, 16, 17, 18, 19)

- (1) Accumulate the frozen vials collected during the week. Put them standing upright in a whirl bag labeled with an additional HHANES label. The serum and whole blood should be solidly frozen when placed in the shipper.
- (2) Complete the transmittal form for Deck 511 daily as the vials are processed.
- (3) Pack all specimens in Vials 1, 2, 3, 5a, 5b, 5c, 6, 7, 9, 12, 14, 16, 17, 18, and 19 in a large shipper with 12 pounds of cake ice. If the 3-pound cakes mentioned above have evaporated to about three-fourths of an inch wide, use five cakes instead of four. Secure an express mail label bearing the CDC address to the outside of the shipper. General instructions on packing with dry ice are applicable. To prevent loss place a franked address label on this shipper also.
- (4) Enclose with the shipper one copy of the transmittal for Deck 511 in a whirl bag.
- (5) Send the shipments to:

Elaine Gunter
Building 32, Room 30 - Chamblee
Centers for Disease Control
Atlanta, Georgia 30333

b. Carboxyhemoglobin (Vial 4) and Thiocyanate (Vial 8)

- (1) Accumulate Nos. 4 and 8 vials in the refrigerator until the weekly shipment is to be made; do not freeze them. Specimens should be cooled before being shipped.
- (2) Complete the transmittal for Deck 515 daily as the vials are processed.
- (3) Pack the vials in the small special shippers provided according to the general instructions for shipping using a coolant to refrigerate the specimens in transit.
- (4) Enclose with the shipper one copy of the transmittal for Deck 515 in a whirl bag.

(5) Stamp an "AIRMAIL SPECIAL DELIVERY" label or "EXPRESS MAIL" label with the address below and securely attach it to the shipper.

(6) Send the shipments to:

University of Pittsburgh
Department of Epidemiology
Graduate School of Public Health
Pittsburgh, Pennsylvania 15261
Attention: Dr. Radford or Ms. Larocco

(7) If questions arise or if it is necessary to send a shipper Wednesday through Friday during any week, call:

Brenda Lewis 301-436-8267
Trena Ezzati 301-436-7081
Eileen Larocco 412-624-2256

c. Pesticides (Vial 13)

(1) Use the special glass containers provided by the Environmental Protection Agency (EPA) identified as Vial 13 (5cc. of serum).

(2) Wrap each bottle individually with a gauze swab and secure it to the bottle with a rubber band.

(3) Freeze the vials in an upright position. Be sure they are solidly frozen before shipping.

(4) Accumulate the vials with the corresponding urine containers labeled with the sample number only in the freezer until the weekly shipment is to be made.

(5) Complete the transmittal for Deck 510 daily as the vials are processed.

(6) Pack about 20-25 containers in the special metal shippers provided by EPA. General packing instructions for dry ice shipping apply. The shipper should be packed with 12 pounds (three cakes) of dry ice.

(7) Enclose with the shipper one copy of the transmittal for Deck 510 in a whirl bag.

(8) Attach to the shipper "PERISHABLE-PACKED IN DRY ICE" labels visible on all sides and send it by Express Mail to the address below. Reverse the address label transmitting the shipper to the site; the franked label

should now have the address below. Secure the edge of the label with a piece of tape.

Toxicant Analysis Center
USEPA
Building 1105, NASA-NSTL
Bay St.Louis, Missouri 39529

- (9) Send a copy of the transmittal to EPA at the address below.

U.S. Environmental Protection Agency
Exposure Evaluation Division
Field Studies Branch (TS-798)
401 M Street, S.W.
Washington, D.C. 20460
Attention: Tom Dickson

- (10) If any questions arise or if a shipment must be sent that may arrive on Saturday, Sunday, or a Federal holiday, call:

Brenda Lewis 301-436-8267
Trena Ezzati 301-436-7081
Tom Dickson 202-382-3581

3. Every other week shipments

a. Cholesterol/Triglyceride (Vial 10)

- (1) Accumulate the No. 10 vials in the freezer until the biweekly shipment is to be made.
- (2) Complete the transmittals for Deck 513 daily as the vials are processed.
- (3) Pack about 40-45 No. 10 vials in the shippers provided by the Lipid Research Clinic (LRC), Johns Hopkins Hospital. General packing instructions for dry ice apply. Three cakes (9 pounds) of dry ice should fit into the shipper in the slots provided on the bottom of the shipper and on top of the vials.
- (4) Enclose with the shipper one copy of the transmittal for Deck 513 in the shipper in a whirl bag.
- (5) Securely attach to the shipper a franked "AIRMAIL SPECIAL DELIVERY" label or an Express Mail label stamped with the address below, or, when available, a label provided by the LRC. Old labels should be discarded.

- (6) Send the shipper to the address below.

Johns Hopkins Hospital
600 North Wolf Street
CNSC8-115
Baltimore, Maryland 21205
Attention: Bob Walker

- (7) Send the yellow copy of the transmittal to the address below.

Lipid Research Program Clinic
Second Floor, CNB Plaza
Chapel Hill, North Carolina 27514
Attention: Jim Hosking

- (8) If any questions arise or if a shipper has to be sent Wednesday through Friday, call:

Brenda Lewis 301-436-8267
Trena Ezzati 301-436-7081
Dr. Paul Bachorik 301-955-3197

d. Sequential Multiple Analyzers (Vial 11)

- (1) Accumulate No. 11 vials in the freezer until the biweekly shipment is to be made.
- (2) Complete the transmittals for Deck 512 daily as the vials are processed.
- (3) Pack approximately 40-45 No. 12 vials in the plastic shippers provided by the contractor; general packing instructions with dry ice apply. Three cakes (9 pounds) of dry ice should fit on the bottom of the shipper and on top of the vials.
- (4) Enclose with the shipper one copy of the transmittal for Deck 512 in a whirl bag.
- (5) Securely attach to the shipper a franked "AIRMAIL SPECIAL DELIVERY" label or an Express Mail label stamped with the address below, or, when available, a label provided by the contractor. Old labels should be discarded.

(6) Send the shipper to the address below.

PRI Clinical Services Laboratories
P.O. Box 1027
Holloman Air Force Base,
New Mexico 88330
Attention: Brenda Billhymer

(7) If any questions arise or if a shipper has to be sent
Wednesday through Friday, call:

Brenda Lewis 301-436-8267
Trena Ezzati 301-436-7081
Brenda Billhymer 505-479-6511 extension 52214

4. Once a stand shipment

This shipment is a special one for quality control purposes. It consists of one set of the split duplicate carboxyhemoglobin (Vial 4) samples taken on dry run day. The shipment can be sent on any Tuesday morning during the stand.

- a. Place 1 ml of whole blood in each Vial 4 provided. Replace the caps and tighten them well. Put parafilm around the top of each vial to prevent leakage.
- b. Store the vials in the refrigerator until the shipment is to be made; do not freeze them. Specimens should be cooled before being shipped.
- c. Complete the transmittal for Deck 515.
- d. Pack the vials in the small special shipper provided according to the general instructions for shipping using a coolant to refrigerate the specimens in transit.
- e. Enclose with the shipper one copy of the transmittal for Deck 515 in a ziploc bag.
- f. Enclose with the shipper a label preaddressed to Brenda Lewis so that the shipper can be returned.
- g. Send the shipper by Federal Express or Emery Air Freight to arrive within 24 hours of shipment. The FOM will provide labels for the shipper. These specimens are not to be mailed through the postal service.

h. Send the shipment to:

Robert Robertson
Building 17
National Naval Medical Research Institute
Naval Medical Center
Bethesda, Maryland 20814

i. If questions arise or if it is necessary to send a shipper
Wednesday through Friday, call:

Brenda Lewis 301-436-8267
Dale Hitchcock 301-436-7081
Robert Robertson 301-295-1076

Chapter 9

HAIR COLLECTION

Equipment

- Stainless steel surgical scissors
- Aluminum clips
- Nylon combs
- Isopropyl alcohol
- Distilled water bottle
- Ziploc plastic bags
- Plastic gloves
- Squeeze bottle

Introduction

The purpose of the hair collection procedure is to relate the concentration of trace metals in the hair to the health and nutritional status of the individual. The concentration of trace metals in the most recent growth of hair represents the current nutritional status of a person.

Hair is collected on all sample persons in the glucose tolerance test (GTT) subsample who are examined in the morning and on sample persons from ages twelve through nineteen who are examined in the afternoon or evening. Hair should also be collected whenever possible on those examinees who take insulin.

The nurse is responsible for collecting the hair in the venipuncture room.

Preparation

1. Disinfect the stainless steel surgical scissors, aluminum clips, and nylon combs by dipping them into isopropyl alcohol after each use. Rinse them with distilled water and again with isopropyl alcohol applied from the squeeze bottle. Dry the instruments in a Ziploc bag.
2. Store the scissors, clips, and combs in the Ziploc plastic bags when the instruments are not in use.
3. Use disposable powder-free gloves to handle the hair specimens.

Procedure

1. Enter on the control record the time the procedure begins and your examiner number. Enter the examinee's name, age and sex, and your examiner number at the top of the hair collection questionnaire. If the examinee refuses the procedure or you can't complete the collection for some reason, make a note to that effect on the control record and on the nurse's log.
2. Administer the hair collection questionnaire in either English or Spanish whichever the examinee prefers.
3. With a nylon comb, horizontally partition the hair between the ears on the back of the head. Pull the top section of partitioned hair (above the ears) up out of the way, and fasten it to the hair above the ears with aluminum clips.
4. At each of 8 to 10 different sites on the nape area of the back of the head below the partition line, gather 15 to 20 strands of hair.
5. Cut each group of hair strands as close to the scalp as possible. Then from each group, cut off the two inch length of hair closest to the scalp, and store it in a Ziploc bag along with the two-inch lengths from the other cuttings. A minimum of 200 mg is needed for the hair analysis. Discard the remaining hair.
6. Seal the Ziploc bag with the 8 or 10 hair samples in it, and fasten a sample number sticker to it.
7. Enter on the control record the time the procedure is completed.
8. Take the hair samples to the lab at the end of each examining day. The laboratory technicians will note in the comments section of the hematology worksheet the examinees from whom the nurse has collected hair.

Shipping the Hair Samples

1. Place the hair samples in the a large yellow franked envelope with the 511 hematology worksheets.
2. Ship the hair samples to the Centers for Disease Control with the other specimens that go there.

Chapter 10

TUBERCULOSIS SKIN TEST

Equipment

PPD-S tuberculin antigen
Sterile disposable 1cc TB syringes packed with needles
Alcohol sponges
Dry 2x2 gauze pads

Purpose

The nurse administers PPD-S to each examinee so that we may assess the prevalence of TB positive skin tests in the Hispanic population.

Injection Procedure

1. Explain to the examinee the purpose of, importance of, and procedure for of the test. Have the examinee sign a consent form in the language of his choice. If the examinee is under eighteen years old, have the parent or guardian sign the consent form. Remember that a previous markedly positive test is not in itself a contraindication to the TB test.
2. Check the upper arm for evidence of a BCG vaccination. Ask the examinee if he has had such a vaccination. Record on the TB form the presence or absence of a BCG scar.
3. Draw up in one TB syringe 0.10cc of the 5TU PPD-S.
4. Have the examinee sit on the examining table with the volar forearm exposed.
5. Thoroughly cleanse the upper one-third of the volar forearm with an acetone sponge.
6. Holding the forearm skin taut, inject the PPD-S intradermally approximately two inches below the anticubital fossa on the volar forearm surface of the left arm. The site of injection should be over a muscle belly. Hairy areas and areas without adequate subcutaneous tissue, such as concavities over a tendon or bone, should be avoided. Make sure the injection sites are ones that will be obvious when the results are read. A satisfactory test should leave a wheal approximately 6-10 mm in diameter. If the test is not satisfactorily given and must be repeated, due to the examinee's jerking, loss of antigen fluid,

too deep an injection, or any other problem, choose a second site below that of the first and make a note to that effect in the nurse's TB Skin Test Record Book. The small amount of bleeding which may occur at the injection sites a few minutes later may be cleaned with a dry gauze sponge.

7. Arrange for the examinee to have the test read 48-72 hours later either in the exam center, the field office, or in the examinee's home.

Reading Procedure

1. Read the skin test 48-72 hours after injection. The extent of induration is the sole criterion for determining reactivity to the antigen; erythema is to be ignored. It is important that the indurated area be measured precisely in millimeters at the widest transverse diameter after thorough palpation and close examination under adequate light. Reactivity to the test may be suppressed in people who have received concurrent or recent immunization with any live virus vaccine or who are receiving corticosteroids or immuno-suppressing agents.
2. Record the examinee's name and sample number, the time and date the test was given, the date read, the place of reading, and the millimeters induration of PPD-S in the TB Skin Test Record Book and on the Physician's Report of Findings. If the test is not administered to or read for a particular examinee, note that in the record book and state the reason why using the codes provided.

Confounding of Skin Test Interpretation by Possible BCG Inoculation

By introducing 5 tuberculin units of purified protein derivative (PPD) intradermally, the body is challenged with tuberculosis protein extract. Humans with activated immune response, due to previous infection or BCG inoculation, will react to PPD.

The reaction to PPD is positive if related to infection by TB. The reaction to PPD is positive if related to recent BCG inoculation. However, reaction to PPD decreases the longer the period since BCG inoculation. Also the BCG inoculation may have been ineffective in the first place. Thus, any TB skin test greater than 10 mm wide is now considered positive, regardless of BCG inoculation.

Chapter 11
VENIPUNCTURE

Equipment

For a list and the setup of equipment see the laboratory manual.

Introduction

The nurse draws blood from all examinees in the hematology room. The primary area from which the blood is drawn is the antecubital fossa; the dorsal part of the hand is a secondary site. Detailed discussion of the procedures and use of the equipment is provided in the laboratory manual.

Procedure

1. Venipuncture
 - a. Cleanse the area with alcohol and apply a tourniquet of the correct size proximal to the site.
 - b. Insert the needle into the vein.
 - c. Once the needle is inserted into the vein, release the tourniquet to permit free circulation and flow of blood.
 - d. Collect the required tubes according to the instructions in the laboratory manual.
 - e. At the end of the procedure, withdraw the needle and apply pressure and a Band-Aid to the venipuncture site.
 - f. Label each tube of blood collected with the examinee's number and take the tubes to the laboratory for processing.
2. Fingerstick
 - a. If a finger stick is necessary, select one of the middle fingers.
 - b. Cleanse the finger with alcohol and dry it with gauze.
 - c. Puncture it with a lancet along the lateral side of the finger where there are fewer nerve endings. Facilitate the blood flow by a gentle pressure on the finger. Avoid undue

"milking" as this will induce excess tissue fluid and dilution of the blood which will invalidate the hematology samples.

- d. Collect the required tubes according to the instructions in the laboratory manual.
- e. At the end of the procedure, apply pressure and a Band-Aid to the venipuncture site.
- f. Label each tube of blood collected with the examinee's number and take the tubes to the laboratory for processing.

Glucose Tolerance Test (GTT)

There are no time limitations that restrict the GTT except that the examinee must have fasted for ten to sixteen hours before the test. Although it is, of course, best to obtain all three blood samples, it is better than nothing to get two or even one of them. For example, an examinee could have eaten as late as 1:00 A.M. and still give the fasting blood sample and possibly the one-hour sample depending on the time burdens of the examination session.

1. Administer the GTT questionnaire in either Spanish or English whichever the examinee prefers.
2. After verifying that the examinee has fasted properly, draw one gray top tube of blood before administering the Glucola*.
3. Administer a 75-gram challenge of Glucola immediately after drawing the fasting blood specimen. Since the bottle contains a 100-gram challenge, use only three-fourths of the bottle. There is a line on the bottle to indicate the correct amount to use for a 75-gram challenge.
4. Draw one gray top tube one hour plus or minus five minutes after the Glucola is administered.
5. Draw one gray top tube two hours plus or minus five minutes after the Glucola is administered.
6. Since the GTT is done on plasma, be sure that the blood is mixed well with the anticoagulant. Invert the tube gently to dissolve the anticoagulant. Hemolysis can also be prevented if there is a free flow of blood during the initial stick.
7. At the end of the procedure, label each tube with the examinee's number and take the tubes to the laboratory for processing.

8. If the GTT is cancelled, write "GTT cancelled" and the reason why on the questionnaire, the control record, and the nurse's log. Encourage the examinee to return for this test at a later date.

*Glucola is a product of Ames Division, Miles Laboratories, Inc., Elkhart, Indiana 46515. One bottle (NDC 0193-2607-10 2604) contains carbonated water, carbohydrate equivalent 100 grams glucose (10.7 grams per fluid ounce), kola extract, artificial coloring, and sodium benzoate as preservative. The product contains no caffeine. Each bottle has net contents of 9.3 fluid ounces (275 milliliters).

Chapter 12

SONOGRAPHY

Equipment and Supplies

- ATL real-time sector scanner
- 3 MHz rotary scanning head transducer
- TV monitor, 310 A/B
- Digital scan controller, 851B
- Pulse echo, 600B
- Keyboard echo analyzer, 5(1)A
- Multi-image camera
- Scanning (sonographic) couplant
- Gauze pads
- Alcohol
- 8" x 10" ultrasound film
- Film cassettes (2)
- VCR T-120 tapes
- Calibration phantom

Introduction

The ATL real-time sector scanner consists of a rotary scanning head with three transducers of 3.0 MHz frequency each and a five part electronic modular system. From the top down, the system has a TV monitor, a real-time digital scan controller, a pulse echo, a keyboard echo analyzer, and a multi-image camera. In addition, a video cassette recorder (VCR) has been attached to the system. All units are plugged into the equipment cart's power distribution area at the rear so that by simply turning the power switch on the lower right side of the equipment cart, one can electrically activate all units.

Equipment Setup Procedure

1. Preliminary procedure
 - a. Check with the chief technologist to make sure that the incoming voltage is appropriate for the operation of the ATL unit. Remove the tie-down webbing from the ATL unit and the ultrasound table. Check the connection plugs of the 3.0 MHz transducer. One plug should connect to the 851B module and the other to the 600B module. Remove the packing material and tape from around the transducer. Check the transducer casing for any cracks and the transducer cable for any bends or breaks.

- b. Plug the main power cable into the wall outlet on the left side of the x-ray room. Clip the cable through the U-clip near the wall outlet.
- c. Turn on the battery switch in back of the unit. Turn on the electrical power switch on the lower right hand side of the equipment cart.
- d. Be sure power is being supplied to all five modules, from the top down, the TV, the real-time digital scan controller, the pulse echo, the echo analyzer, and the multi-image camera. All five units have power lights that should be lighted. If a light does not come on, check the back panel of that component to be sure that its power toggle switch is on and that the power cord is plugged in.
- e. If "error" appears on the TV screen, stop and consult the self-test instructions in the echo analyzer operating manual.

2. Transducer head

Check the transducer head for air bubbles. Air bubbles in the head will cause a "blind spot" on the TV image where returning sound waves are blocked from reaching the screen; the effect will be a loss of information. If you see air bubbles, angle the transducer so the access channel is at the uppermost part of the head. Gently tap the sides of the transducer head to consolidate the air directly under the access channel. Slide the metal stopper of the access channel downward. Using a syringe set filled with mineral oil, insert the needle into the access channel until it reaches the air pocket. Displace the air by gently forcing the mineral oil down the access channel. When all of the air has been evacuated, withdraw the needle and close the metal stopper.

3. Scan controller (851B)

Set the scan controller knobs on the 851B module as shown on the next page. The control settings are the correct positions for conducting an exam. It is not necessary to change the controls or to reset them when the unit is turned off and on. The four knobs on the 851B module labeled "variable" are used for gallbladder imaging.

a. Top row, left to right

<u>Control</u>	<u>Setting</u>
ANGLE	90° narrow aperture
FREQUENCY	3.0
MODE	Variable, real-time (when unit is operating); off (at all other times)
IMAGE	Usually A mode
GRAY SCALE	2
LIVE	Variable, press for real-time scan function
TAPE	Nonfunctional
RECORD	Nonfunctional

b. Bottom row, left to right

<u>Control</u>	<u>Setting</u>
DEPTH	Variable
ECG TRIGGER	Nonfunctional
FREEZE FRAME	Variable, press to freeze image
PRINT IMAGE	Nonfunctional
ECG	Nonfunctional

c. On the far right-hand side of the 851B, see that the MARKER and TEST PATTERN buttons are in, the negative image button is out, and the three rotor element buttons are depressed. These settings on the 851B should not be changed at any time.

4. Pulse echo (600B)

Set the 600B pulse echo knobs as below. Those controls marked with an asterisk (*) are nonfunctional for normal scanning. The control settings are the correct positions for conducting an exam. It is not necessary to change the controls or to reset them when the unit is turned off and on. The four knobs on the 600B module labeled "variable" are used for gallbladder imaging.

a. Top row, left to right:

<u>Control</u>	<u>Setting</u>
REJECT	Entirely counter-clockwise for exam
NEAR	Variable
DAMPING	Variable
SLOPE POSI	Variable
SLOPE RATE	Variable

- b. Bottom row, left to right:

<u>Control</u>	<u>Setting</u>
ECHO/TRANS*	Out
EXPAND*	Clockwise
POSITION*	Clockwise
VIDEO/RF*	Out
ENHANCE*	Out
ECG GAIN*	Entirely counter-clockwise
ECG POSITION*	Entirely counter-clockwise
PHONO GAIN*	Entirely counter-clockwise
PHONO POSITION*	Entirely counter-clockwise
PULSE/PHONO*	Out
MIDLINE*	Out
DISPLAY 1/DISPLAY 2*	Out
TIME MAKER*	Entirely counter-clockwise
SWEEP RATE*	Entirely counter-clockwise
M-MODE BUTTONS (8)	Out
ON/OFF POWER	On

*Nonfunctional for normal scanning

5. TV controls

Adjust the TV brightness and contrast controls for a pleasing and diagnostically accurate image. This image should be fairly flat, with neither overt brightness nor glaring contrast.

6. Multi-image camera

- a. Be sure the reverse image button is up at all times. Open the fold-down door and note the reverse brightness and contrast settings written on the piece of masking tape. Keep this note underneath the controls for future reference. It is not necessary to adjust the normal brightness or contrast settings. Settings will vary from van to van; however, approximate settings are 525 for reverse brightness and 800 for contrast.
- b. If you notice at any time during a stand that film brightness and contrast do not accurately reflect the TV monitor image, the reverse contrast and brightness settings will need to be adjusted. To adjust these settings, follow the sequence listed below:
 - (1) Visualize and freeze-frame a good gallbladder and liver image on the TV screen of the monitor. You can see this image on the camera screen by sliding the upper door on the camera module to the right. The camera image will be inverted in gray tones.

- (2) Adjust the brightness control until lower blocks of the gray scale separate into individual blocks. Close the sliding door.
- (3) Insert a cassette and withdraw the lowest slide on the cassette.
- (4) Begin taking images on film, escalating the brightness setting in increments of ten numbers until an appropriate brightness setting reflects an acceptable gray scale on film. Lock the knob and note this setting.
- (5) Open the sliding door.
- (6) Adjust the contrast control knob downward in numbers until the central blocks (next to the center background block) separate into individual blocks without being blacked out. Close the door.
- (7) Begin taking images on film escalating the contrast setting in increments of thirty numbers until an acceptable contrast is found. Take another series of images in increments of five around the acceptable image until an image is displayed that matches the monitor image.
- (8) Remove the masking tape identifying any previous settings and replace it with a tape noting the new, correct settings.

7. Keyboard

The keyboard echo analyzer is used to establish headings in the semi-fixed format, to set the time/date function in the fixed format, and to measure gallbladder size during a study. The analyzer contains its own battery that charges whenever the unit receives line power and, after fully charged, will operate without recharging for at least sixty days. The battery functions to keep the date/time clock running so that it is not necessary to reset the date and time daily. Do not turn off the battery switch on the back of the unit.

a. Fixed format

The time and date in fixed format appear automatically in the upper right corner of the TV monitor screen shortly after the cart is turned on. It is necessary to set the date and time at the beginning of the stand and at any time power is lost. To set the fixed format:

- (1) Press and hold CTRL while pressing SET. Release both.
- (2) Code in the month, day, and year. To code month, use the numeric form (January=01, . . . , December=12).
- (3) Code in the exact time based on the 24-hour clock (12:00 noon=12:00:00, . . . , 12:00 midnight=24:00:00).
- (4) Press and hold CTRL while pressing CLOCK. Release both.
- (5) Check the seconds/minutes function to be sure the clock begins timing.

b. Semi-fixed format

The study information is contained in a semi-fixed format located in the upper left corner of the TV monitor screen. It is necessary to set the format at the beginning of each stand and at any time that power is lost from the trailers. To set the semi-fixed format:

- (1) Press and hold CTRL while pressing FORM twice. Release both.
- (2) Using the four arrow keys to position the cursor, type in:

```

U.S.H.H.A.N.E.S.
SP#
AGE          S/R
TECH#

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- (3) Press and hold CTRL while pressing GUARD twice. Release both. The format is now fully protected. You can use the unprotected data storage to type in additional information that may be helpful in understanding and interpreting the image, such as examinee position and transducer plane.

c. Measurement

The echo analyzer calculates and displays the distances between any two points on a displayed anatomical sector. The measurement is shown in millimeters after the distance heading. The control lever on the right side of the keyboard, called a joystick, is used to make point-to-point measurements anywhere on the anatomical image under examination.

- (1) Press MEAS ON/OFF to activate the cursors for measurement. Two cross-shaped graphic calipers (cursors) will appear on the TV screen.
- (2) Using the joystick, position the left caliper cursor at the desired point.
- (3) Press CURSR/SELCT key.
- (4) Using the joystick, position the other caliper cursor at the desired point. Once the cursors are positioned, the distance in mm between them can be read from the TV screen after the DISTANCE heading. The linear distance between the two caliper cursors is continually updated as they are moved. The accuracy of these calipers depends upon the full and correct performance of the daily calibration.

c. Calibration

The echo analyzer automatically monitors its battery condition, supply voltages, and computer memory. When an "out-of-limit" condition is sensed, an "error" caption indicating the fault condition or conditions will appear on the screen. If the error caption appears, turn the little unit off immediately. Inform the chief tech and the biomedical engineer of the condition in "error". After an error condition is rectified, it is necessary to do a complete daily calibration.

8. Video cassette recorder (VCR)

A VCR has been added to the ultrasound system to provide for recording the real-time studies. Each recording should consist of the examination from beginning to end and include appropriate verbal references by the technologist.

- a. Turn the VCR machine power on by depressing the ON/OFF switch on the far right side of the unit.
- b. Press EJECT. The cassette holder on the top of the unit will elevate.
- c. Place in the holder a clean cassette labeled with the stand and tape numbers. Press down on the top of the holder to close it.
- d. Press RESET to reset the counter digits to 0000.
- e. Advance the VCR tape approximately five digits by pressing FF/SEARCH.

- f. Press STOP to stop the movement of the tape.

NOTE: All other function switches are preset by the biomedical engineer and should not be changed.

Calibration

1. Daily calibration

The full daily calibration ensures that the calibration cursor is aligned with the six set points for all combinations of sector depth and angle. This calibration, which is internal and checks only internal system function, must be performed before each examining session and after an "error" condition has been rectified.

- a. Turn the machine on for at least 20 minutes before beginning the calibration.
- b. Select the 5-cm depth, 90⁰-sector-aperture angle with the system in the real-time mode.
- c. Press the CAL ON/OFF key on the keyboard. The calibration pattern should appear on the TV screen with a calibration cursor (one cross-shaped symbol). This pattern will appear clearer with the near gain control lowered.
- d. Using the joystick located on the keyboard, position the calibration cursor over the line intersection of the calibration pattern.
- e. Press the SET CAL key on the keyboard. This key locks the cursor location into the memory, then automatically calls up the next calibration pattern location.
- f. Repeat step e for all six separate calibration intersections for that depth.
- g. Repeat steps c through f to align all intersections of each sector depth (7 through 21 cm).
- h. Press the CAL ON/OFF key to terminate the full daily calibration process. The echo analyzer is now calibrated for measurement at all given sector angles and depths.
- i. With the depth set on 11 cm, press the MARKER pushbutton (upper right on the scan controller) to call up a vertical grid.

- j. Press MEAS ON/OFF to activate the caliper cursors.
 - k. Position one cursor directly over a major marker on the grid by using the joystick.
 - l. Press the CURSR/SELCT key and position the other cursor on the major marker directly below the first cursor. The distance read-out should be 10 mm plus or minus 1 mm.
 - m. Measure a larger distance by performing step k, and then positioning the other cursor on a major marker 5 markers away. The distance read-out should be 50 mm plus or minus 1 mm. The caliper cursors and the marker pattern may be left on in anticipation of the exam session's studies.
 - n. Turn off the scan controller mode function.
2. VCR calibration

The calibration procedure for the VCR consists of recording the ultrasound daily calibration at the beginning of each week.

- a. Record WEEKLY CALIB on the roster under SP column.
- b. Press FF/SEARCH to advance the film approximately five counter digits. Record this beginning number on the roster.
- c. Turn the microphone, amplifier, and pre-amplifier on.
- d. Press PLAY and REC simultaneously. Identify verbally the process of weekly calibration, stand number, and tech number.
- e. Perform the daily calibration as already described.
- f. Press STOP. Turn off the microphone, amplifier, and pre-amplifier.
- g. Record the counter number on the roster.
- h. Press REW/SEARCH until the counter number returns to the same as recorded as beginning of weekly calibration.
- i. Press PLAY.
- j. Review the images recorded on VCR tape. If the images differ from the calibration performed, notify the chief tech and the biomedical engineer.

- k. When the recorded weekly calibration is ended and the counter numbers are the same as recorded as End of Calibration on the roster, press STOP.

3. System calibration

At the beginning of each stand and again after any servicing of the ATL unit, a system calibration should be performed to substantiate the degree of axial and lateral resolution and the accuracy of the cursor digital distance display. This calibration verifies the accuracy of the machine against external standards.

- a. Turn the machine on for at least 20 minutes before beginning the calibration.
- b. Perform a full daily calibration.
- c. Remove the phantom from its carrying case and place it on the ultrasound table with the membrane window face-up.
- d. Apply a sufficient amount of scanning couplant to the membrane window to assure good transducer contact.
- e. Insert a loaded cassette, then remove the lowermost slide. In the camera position window, a number will appear indicating the number of exposures remaining on the film. The lower film in the cassette is now ready to record images in a six-image-per-film format. Exposures are made either by pushing the EXPOSE button or by pushing the foot switch EXPOSE control.
- f. Take films of the following images:
 - (1) IMAGE 1. With the depth set at 13 cm, scan the pins in the phantom placed vertically 2 cm apart. Freeze-frame the best image obtainable. Place the cursors on the first and second pins. The digital distance reading on the TV screen should be 20 mm.
 - (2) IMAGE 2. Using the same image as Image 1, place one cursor on the first pin and the other cursor on the deepest pin visible. The digital distance reading should be 20 mm for each pin visualized.
 - (3) IMAGE 3. Using the same image as Image 1, place the cursors in a horizontal plane at the edges of the narrowest pin visible to obtain a reading of lateral resolution.

- (4) IMAGE 4. With the depth set at 16 cm, scan the phantom to show all three modules of staggered pins. Freeze-frame the best image obtainable for all three modules. Put one cursor on the first pin of the center module and the other cursor on the second pin of the center module. The second cursor must be directly beneath the first cursor in a vertical plane. The digital distance reading on the TV screen should be 3 mm.
 - (5) IMAGE 5. Turn on the gain on the scan controller; turn the DAMP/REJECT knob fully clockwise. With the depth set on 16 cm, scan for the lowest pin visible of the vertical row of pins in the phantom. Freeze-frame the best image obtainable. Put one cursor on the lowest pin visualized and the other cursor at the skinline (2 mm above the top of the chevron image). The image should show the 14-cm pin 140 mm deep.
 - (6) IMAGE 6. With the depth set on 9 cm, scan the staggered pin module. Freeze-frame the best image possible. This image should reveal separation between each of the five pins to confirm axial resolution of 0.5 mm. The 3-cm and 12-cm depth modules will reveal separation only up to the 1-mm pin; the 7-cm module will show the 0.5-mm separation.
- g. Compare film quality with the previous calibration films of that ATL system. If any unusual conditions are noted, bring them to the attention of the chief tech, the supervisory tech, and the biomedical engineer.

General Instructions and Precautions

1. Supply the room with sonographic couplant, gauze pads, alcohol, table paper, gloves, and all other materials necessary for examining.
2. Wipe the transducer head with alcohol after each exam.
3. Place the transducer back in its holding bracket after each exam. Do not drop the transducer on the floor or lay it across the ATL unit.
4. Turn the mode from "real-time" to "off" whenever the live screen function is not in freeze-frame. If the live function is on freeze-frame, the rotor will continue to rotate even after the mode has been turned off. This unnecessary rotation will cause excessive wear on the rotor assembly.

5. Do not remove an exposed film before replacing the black dark slide.
6. Do not leave loaded film cassettes in the room with the ATL unit unless an exam is being performed. X-rays will expose sonographic film.
7. Note on the ultrasound roster any unusual circumstances regarding an exam, for example, "SP claims to have had a cholecystectomy," "probable stones," or "camera down."
8. Do not spill any liquid on the keyboard. However, if you do, shut off the unit immediately. Notify the chief tech, supervisory tech, and biomedical engineer. The only liquids permissible in the ultrasound room are alcohol and sonographic couplant. Keep coffee and all other liquids out of the examining room.

End of Stand Procedures

1. Check that all film cassettes have been removed from the ATL unit.
2. Turn off the main power switch on the side of the machine.
3. Move the unit away from the wall; then unplug the ATL cord from the wall power outlet and wrap it around the main frame in back of the unit.
4. Wrap and tape the transducer head securely in packing material. Pillow Paw slippers provide excellent protection.
5. Tape the protected transducer head securely against the right side rail of the ATL unit to eliminate the possibility of damage during transit.
6. Move the unit to the far left corner of the x-ray room. The wheels should be facing forward and locked into position.
7. Strap the ATL unit to the floor brackets using the tie-down webbing provided.
8. Strap the ultrasound table to the right wall of the x-ray room using the webbing provided.

Examination Procedure

1. Preparation

- a. Record the beginning time on the control record.
- b. Have the examinee remove the gown belt and fold the gown top up to expose the upper right quadrant of the abdomen. Male examinees may prefer to remove the gown top.
- c. Request that the examinee lie down on the examination table in a supine position.
- d. Code pertinent examinee information into the semi-fixed format of the TV monitor screen. This information includes the correct examinee identification number, age, sex/race code, and tech number. Identify the examinee's anatomical position and transducer plane (reidentify during exam as necessary).

2. Examination

- a. Insert a film cassette into the film holder. Check that the LED number "6" appears on the camera position window. Remove the dark slide.
- b. Turn on the microphone and the pre-amplifier.
- c. Advance the VCR tape approximately five counter digits. Stop the VCR and write the counter number on the roster in the Beginning column along with the SP number, tech number, date, and any pertinent comments. Start the VCR tape to record the examination.
- d. Apply scanning couplant to the examinee's upper right quadrant.
- e. Turn the ATL system on. Check that all functions of the system are in their proper positions as detailed in the equipment section. Adjust the REJECT, SLOPE RATE, and SLOPE POSITION to obtain an image of the best possible quality.
- f. Place the transducer on the examinee's abdomen at midline just below the xiphoid process.
- g. Move the transducer laterally following the slope of the rib cage until the liver margin appears on the TV monitor screen.

- h. Have the examinee take a deep breath and hold it.
- i. Using the liver as a window, angle the transducer up under the costal (rib) margin to obtain a view of the gallbladder. If the liver is unusually small or high, move the transducer to a more lateral position and scan intercostally.
- j. Scan the gallbladder for its maximum length and freeze the image. Allow the examinee to breath normally.
- k. Place the cursors on the inside wall at the neck and fundus of the gallbladder at its maximal length.
- l. Take a picture of this image while identifying the image number (1-12) verbally on VCR tape.
- m. Using the same image, move the cursors to the area of maximal anterior-posterior diameter. Place the cursors on the inside wall at this point so that the A-P plane is perpendicular to the longitudinal plane of the gallbladder.
- n. Repeat step l.
- o. Repeat steps j through n once; then go on to step p.
- p. Return the machine to real-time function.
- q. Place the transducer in a transverse position.
- r. Scan the gallbladder until an acceptable image showing good wall definition is obtained in a transverse plane.
- s. Freeze-frame this image.
- t. Place A-P cursors across the maximum wall thickness of the anterior wall.
- u. Take a picture of this image while identifying the image number on VCR tape.
- v. Repeat steps r through u once.
- w. Replace the dark slide and remove the film cassette. Return the cassette to the holder with the unexposed film camera-side down. Remove the dark side.
- x. Have the examinee turn left-side down on the table (left lateral decubitus position).

- y. Place the transducer on the examinee's abdomen at midline just below the xiphoid process.
 - z. Follow steps g through v once.
3. Post examination procedure
- a. Turn the VCR, pre-amplifier, and microphone off. Note the counter frame number on the ultrasound roster.
 - b. Replace the dark slide and remove the film cassette.
 - c. Have the examinee return to a supine position. Use gauze pads to remove the excess scanning couplant from the examinee's abdomen. Redrape if necessary.
 - d. Ask the examinee to relax for a few moments while the films are processed.
 - e. Process the two 8" x 10" films.
 - f. With a magic marker number the pictures in sequence from 1 to 12.
 - g. Complete the ultrasound section of the examinee's chart including the questionnaire.
 - h. Place the films in an envelope labeled with the examinee number sticker, tech number, and date.
 - i. Assist the examinee in getting off the table.
 - j. Record the VCR counter number on the roster in the Ending column.
 - k. Record the ending time on the control record.

Chapter 13

X-RAY

Introduction

A posterior-anterior (PA) chest x-ray is taken on each examinee between the ages of 20 and 74 years. A lateral chest x-ray is taken on each examinee between 45 and 74 years old.

Restrictions and Precautions

1. Do not take x-rays on any examinee known to be pregnant. If the examinee is pregnant, check the box on the control record.
2. Do not take any more than two repeat x-rays in each position on any one examinee. The taking of extra films should occur very rarely. Place all repeat films for an examinee in the x-ray jacket. If more than one film per position is taken for an examinee, select the best one and place a sample number sticker on it. The chief technician will evaluate this film using the quality control standards described later in this chapter.

Radiation Badges

Every precaution recommended by the American College of Radiology and the Radiological Health Division of the U.S. Public Health Service is incorporated in our x-ray setup. Radiation detection badges are worn by the x-ray technicians during all operating sessions of the mobile examination center. New badges are provided every three months. When the new ones are received, return the used badges to headquarters for reading.

X-Ray Exposures

1. Automatic control

Automatic exposure control (AEC) is the normal mode in which x-rays are taken in the mobile examination center. With the AEC feature, sensors terminate the exposure when an x-ray of optimum quality has been obtained. Therefore the radiation exposure to the examinee is kept to a minimum.

- a. Depress the AEC button on the x-ray control panel to activate the AEC.

- b. Set the correct exposure for the examinee's chest thickness by turning the exposure dial to one of the five density selections. The same setting will generally be used for PA and lateral views.

<u>Thickness (cm)</u>	<u>AEC Selection</u>
17-18	-2 (50% less than normal)
19-20	-1 (25% less than normal)
21-24	N (normal)
25-28	+1 (25% greater than normal)
29-30	+2 (50% greater than normal)

- c. When taking a PA film, depress the left sensor (topmost of the three sensor selection buttons). When taking a lateral film, depress the center sensor (the center of the three sensor selection buttons).

2. Manual control

- a. PA chest, 72-inch distance, 110 KVP, 300 MA

<u>Chest Thickness (cm)</u>	<u>MAS</u>	<u>Time (sec)</u>
17-18	2.5	1/120
19-20	5.0	1/60
21-22	7.5	1/40
23-24	10.0	1/30
25-26	15.0	1/20
27-28	20.0	1/15
29-30	30.0	1/10

- b. Lateral chest, 72-inch distance, 110 KVP

The rule of thumb for determining the setting is to leave the KVP and MA the same as for the PA chest x-ray but increase the exposure time by a factor of three. For example, for an examinee with a chest thickness of 24 cm, the PA setting according to the above table would be 110 KVP, 10.0 MAS, 300 MA, and 1/30 second. Then for the lateral chest x-ray on the same examinee, the settings would be 110 KVP, 30 MAS, 300 MA, and 1/10 second.

Procedures

1. Before and after taking the x-rays
 - a. Record on the control record the time the examinee enters the x-ray room.

- b. Stick an examinee sample number label on the x-ray roster and record the date and tech number on the roster. Note on the x-ray roster any chest x-ray that was not taken because of machine defects or pregnancy.
 - c. If for any reason an examinee refuses to have x-rays taken, notify the chief technician. The chief technician will be sure that the examinee understands what the procedure includes. If the refusal is firm, note the reason in the comments section of the x-ray roster.
 - d. Note the sample number that has been previously stamped on each record. Put this number in the lead number holder along with the date and an L (which designates left).
 - e. Using the calipers, measure the depth of the examinee's chest at the level of the sixth thoracic vertebra in both the PA and lateral positions. Use these measurements to set proper exposure factors.
 - f. After taking the x-rays (or after an examinee refuses), enter on the control record the time the examinee leaves the x-ray area.
2. PA chest x-ray
- a. Place a 14" x 17" cassette vertically in the image receptor stand. If a horizontal film position is needed to obtain the entire chest field at the level of the costophrenic angles, raise the lower cassette guide rail by lifting the lower rail up then lowering it to the left.
 - b. Align the cone so that the markings on the side of the cone coincide with the vertical dimension of the cassette (17 for a vertically placed film, 14 for a horizontally placed film).
 - c. Secure the lead identification number to the upper left corner of the front surface of the image receptor panel.
 - d. Position the examinee with his anterior chest pressed against the image receptor stand panel. Have him place the back of his hands on the top of his hips and roll his shoulders forward.
 - e. Adjust the cassette holder vertically so that the top edge of the cassette is approximately $1\frac{1}{2}$ inches above the examinee's shoulders. The central ray should center automatically to the midpoint of the film.

- f. With the Automatic Exposure Control (AEC) on, set the correct exposure from the five density selections. If the examinee needs more or less exposure than is obtainable with the AEC, turn the AEC off and set the exposure factors manually.
- g. Depress the left sensor button on the x-ray control panel.
- h. Ask the examinee to take a deep breath and hold it for the length of the exposure.
- i. Close the x-ray room door.
- j. Make the exposure while standing in the darkroom. Watch the examinee for movement and the generator indicators to see that the x-ray exposure was made.

3. Lateral chest x-ray

- a. Place a 14" x 17" cassette vertically in the image receptor stand.
- b. Align the cone for 17 inches to coincide with the vertical dimension of the cassette placement.
- c. Secure the lead identification number vertically to the upper right corner of the front surface of the image receptor panel.
- d. Have the examinee raise both arms above his head then place his hands on opposite elbows.
- e. Position the examinee so his left side is pressed against the image receptor panel. Center the examinee's axillary plane perpendicular to the center of the film. Check that the examinee is in the true lateral position.
- f. Adjust the cassette holder vertically so that the top edge of the cassette is approximately $1\frac{1}{2}$ inches above the examinee's shoulders. The central ray should center automatically to the midpoint of the film.
- g. With the AEC on, set the correct exposure from the five density selections. If the examinee needs more or less exposure than is obtainable with the AEC, turn the AEC off and set the exposure factors manually.
- h. Depress the center sensor button on the x-ray control panel.

- i. Ask the examinee to take a deep breath and hold it for the length of the exposure.
- j. Close the x-ray room door.
- k. Make the exposure while standing in the darkroom. Watch the examinee for movement and the generator indicators to see that the x-ray exposure was made.

Calibrations and Checks

1. Exposure calibration

On setup day and any other day when the x-ray machine may not be operating properly, a calibration check on exposure factor should be made as follows:

- a. Place a 14" x 17" cassette vertically in the holder.
- b. Attach the step wedge to the image receptor panel, thin side up, so that the top of the second step is parallel with the top of the delineated center AEC sensor area.
- c. Make a manual exposure at the following factor: 70 KVP, 200 MA, 3/20 second, 30 MAS.
- d. Place another 14" x 17" cassette vertically in the holder.
- e. Make an exposure with the AEC set at the "normal" station and the center sensor activated.
- f. Label the calibration films with the stand number, stand location, date, technician number, and exposure technique (manual or AEC).
- g. Take densitometer readings at steps 2, 5, and 8 on each film.
- h. Compare the density readings with standard film taken at the time of installation. The variation between the shades of gray on a given step should be within one density step. If not, recalibrate. If the problem persists, inform the biomedical engineer in headquarters.

2. Processor calibration

- a. Plug the sensitometer into a power outlet in the dark room, and close the dark room door as though you were going to process film.

- b. Place an unexposed 14" by 17" radiographic film lengthwise under the metal holding tongue of the sensitometer.
 - c. Depress the exposure button on the sensitometer momentarily, then release it. Do not hold the exposure button down; doing so will make multiple exposures.
 - d. Remove the film and place it lengthwise in the X-omat processor.
 - e. Take densitometer readings at steps 3 and 7.
 - f. Compare density readings with sensitometer calibration strips obtained at previous stands. If there is a large variation or a trend in values, repeat the calibration. If the problem persists, inform the chief tech and the biomedical engineer.
3. Collimator check
- a. Place a loaded cassette in the cassette holder.
 - b. Make an exposure and process the film. The exposed area on the developed film should be centered on the film so the unexposed border is even on opposite edges of the film. If not, inform the biomedical engineer at headquarters.
4. Tube warm-up procedure
- At the beginning of each exam session or any time the x-ray unit has been turned off for two hours or longer, it is necessary to warm up the machine before making full exposures.
- a. Place an unloaded 14" by 17" cassette in the cassette holder. Align the cone size to coincide with cassette placement.
 - b. Turn the AEC on the control panel off, and set the following exposure factors: 60 KVP, 200 MA, $\frac{1}{2}$ sec.
 - c. Activate the rotor, and make one exposure; pause five or ten seconds, and then make another exposure.
 - d. Remove the cassette from the holder, and store it beside the control panel.
5. End of session procedure
- a. Turn off both the x-ray machine and the incoming voltage.

- b. Turn off the power both at the main breaker and at the unit circuit breaker.
- c. Turn off the water valve.
- d. Open the wash drain valve located behind the panel under the X-omat feed tray in the darkroom.
- e. Vent the cover of the X-omat approximately two inches from the back wall of the X-omat.

Beginning of Stand Procedures

1. X-omat

- a. Match the X-omat transformer taps with the incoming line voltage. Normally the biomedical engineer will do it at the beginning of each stand.
- b. Pull all the roller racks. Examine them for chemical residue, and scrub the rollers clean using a Scotch Brite pad. Be careful not to use the Scotch Brite pad on any metal part of the racks. Replace the racks.
- c. Close the drain valves for the developer, fixer, and wash insert tanks located under the feed tray under the darkroom.
- d. Turn on the main power breaker located on the wall in front of the X-omat and the circuit breaker located beneath the feed tray in the darkroom.
- e. Fill the X-omat insert and replenish the tanks with water at 90° F. Allow the unit to replenish itself for several minutes. See that no leaks are present. Drain the water.
- f. Replace the developer filter.
- g. Mix the developer and fixer chemicals according to the manufacturer's directions. Fill the insert tanks with chemicals starting with fixer, then developer. Add eight ounces of developer starter to the developer insert tank. Mix more developer and fixer chemicals in the designated replenisher tanks.
- h. Check the water pressure at the sink valve. The gauge should read approximately 60 psi. If it doesn't, have the FOM check the water filter.

- i. Check that the dryer temperature gauge reads 350° C. (950° F.).
 - j. Check that the dryer temperature gauge on the front of the X-omat is set at approximately 1250° F.
2. X-ray darkroom
 - a. Remove the tape from around the film bin.
 - b. Plug the darkroom safelight into the wall outlet.
 - c. Open all the film cassettes and check for loose felt edging or loose intensifying screens.
 - d. Clean the screens with screen cleaner and gauze.
 - e. Check that the duplicator is firmly placed on the table.
 - f. While processing a film, check that the safelight and accompanying bell signal are functioning properly.
 - g. After processing the step wedge calibration, make a duplicate of the film to see that the duplicator is working properly. Adjust the duplicate brightness control on the front of the duplicator as necessary.
 3. X-ray room
 - a. Before turning the power on, remove all the restraining bolts on the upright cassette holder and tape them to the top of the stand.
 - b. Turn the power on and check that the cassette holder moves freely and the x-ray tube head tracks properly.
 - c. Match the X-ray transformer taps, located in the darkroom, with the incoming line voltage. Normally the biomedical engineer will do it at the beginning of each stand.
 - d. Unscrew the small bolt on the transformer and tape it to the top of the transformer.
 - e. Do the exposure calibration, processor calibration, and collimator check as described in the calibration section of this chapter.

End of Stand Procedures

1. X-omat

- a. Empty the replenisher tanks; rinse, and refill them with hot water.
- b. Open the drain valves in the dark room and drain the fixer, developer, and water. Close the drains and fill all three insert tanks with hot water. Add a dilute solution of developer and fixer systems cleaner to the appropriate insert tank. Remove and dispose of the developer filter. Return the trap lid.
- c. Remove the two crossover rollers, detector entrance roller assembly, and the squeegee or dryer roller assembly; and clean them using water and a Scotch Brite pad. Be careful not to use the Scotch Brite pad on any metal part of the racks.
- d. Replenish the X-omat water until it appears clear in the insert tanks.
- e. Drain the insert tanks by opening the drain valves. Remove the developer, fixer, and washer transport rollers. Scrub the insert tanks to remove all chemical deposits. Rinse and fill the insert tanks with hot water. Repeat the previous step. Be sure there is sufficient water in the replenisher tanks that air is not drawn through the pumps.
- f. Drain all the tanks and wipe out the insert and replenisher tanks.
- g. Scrub the transport rollers and gears with a Scotch Brite pad until all deposits are removed; rinse them and stand them up to dry.
- h. Clean the area where the replenisher tanks sit and the shelf where the blower motor sits (accessible when the rear panel is removed).
- i. Remove, rinse, and wipe down the dryer air tubes and dryer transport rollers. Replace them in the X-omat.
- j. Replace the transport rollers in the correct insert tanks. Replace the crossover and squeegee assemblies.
- k. Replace the detector entrance roller assembly in the machine.
- l. Replace the X-omat cover; and clean the outside of the X-omat, loading table, and dryer bin. Tape the panels and cover in place leaving a small space between the top cover and the back wall of the X-omat.

- m. Check that the water valve is off.
 - n. Close the drains. Turn the power off both at the main breaker and at the unit breaker under the feed tray.
2. X-ray dark room
- a. Lock the film bin and tape it around the edge.
 - b. Check to see that the duplicator is firmly placed on the table.
 - c. Put the small film separators on the floor and secure them in place.
 - d. Remove everything from the shelf and put it all on the floor. Place the 14" x 17" cassettes between the wall and film bin and secure them with fiberglass tape.
 - e. Close the door and make sure it is secure.
3. X-ray equipment
- a. Line up the upright cassette holder so that the holes in the stand match up with the holes in the counterweights. Put the bolts in place and tighten them.
 - b. Turn off the x-ray machine. Turn off the incoming voltage.
 - c. Screw the bolt in the transformer.

Standards of Quality for PA and Lateral Chest X-Rays

1. PA chest x-ray

The PA chest x-ray is used to diagnose pulmonary pathology and to measure heart size. The following standards should be met by each PA film and will be used to evaluate the quality of the diagnostic films:

- a. The apices must appear on the film. They must not be cut off, nor must the identification marker obscure any part of the apices.
- b. The costophrenic angles must appear on the film.
- c. The examinee must be in the correct position, not rotated to one side or the other. The sterno-clavicular articulations must be clearly visible and symmetrical. The

vertebral spinous processes at the medial ends of the clavicles must be visible.

- d. The exposure must be taken on full inspiration. Count the ribs. The average, normal examinee's diaphragm will be depressed on full inspiration and lie between the tenth and eleventh ribs.
- e. The film must not be underexposed. The rib margins must be clearly defined and the vertebral bodies and pulmonary markings visible through the heart shadow.
- f. The film must not be overexposed. The translucent disc spaces must not be clearly visible through the heart shadow; the fine lung markings must be visible.
- g. There must be no movement or breathing on exposure. Check the structural details and the lung markings to make sure they are not blurred or poorly defined.
- h. There must be no artifacts on the film. In particular, there must be no roller (processing) marks, static marks, or black crescent marks that would interfere with reading the film.
- i. The identification marker must be shown on the film. The film must be correctly identified. Check the number to make sure it is the correct one.

2. Lateral chest x-ray

The lateral chest x-ray is used as an additional aid to the PA chest x-ray to diagnose pathology. The same standards used to evaluate the quality of the PA chest films are used to evaluate the lateral chest films. The following additional standard must also be met by the lateral chest films:

Anterior and posterior chest walls must be shown. The area of the chest wall directly above both the anterior and the posterior costophrenic angles must not be cut off the film.

Chapter 14

BODY MEASUREMENTS

Equipment

Anthropometer parts: 2 sets of four sections each, 4 sliding arms,
1 metal base
Body measurement table
Footstool
Bitrochanteric calipers
Skinfold calipers
Steel tape
Insertion tape
Special height scale
Polaroid Land camera with close-up photographic lens
Special light attachment for camera
Self-zeroing weight scale
Toledo 8805 ticket printer
Toledo keyboard
Set of weights for calibration of weight scale (one 25-lb weight
and five 50-lb weights)
Infant measuring board

Introduction

Most of the body measurements are taken on all examinees. Some of the measurements are only taken on various subsets of examinees. Two anthropometers are provided; one is to be calibrated and reserved as a spare. Each anthropometer consists of four sections of rod and two caliper arms. The rod section used for bitrochanteric breadth measurements has one arm fixed to the top end of the instrument and the other arm free to slide. Two other rod sections are used for sitting heights and will be mounted in the metal base. The remaining section can be used as a spare when required.

Measuring and Recording

The anthropometric measurements consist of various heights, breadths, girths, and skinfolds. Certain measurements are routinely taken on the right side. If, because of casts, amputations, or other reasons, any of these particular measurements are taken on the left side, note the reason on the body measurement page and the unusual occurrence form.

All measurements, except skinfolds, should be taken to the nearest tenth of a centimeter. Skinfold measurements are taken to the nearest

half of a millimeter. If the digit to the right of the last digit to be recorded appears to be exactly "five", raise the last digit to be recorded one unit if that digit is an odd number or leave it unchanged if it is an even number. This is sometimes known as the "odd up-even down rule."

When the examinee's sample number ends in a "3" or a "6", all skin fold measurements and the elbow breadth, upper arm girth, and medial calf circumference are to be done on the left side as well as on the right side of the body. If any measurement cannot be taken on the left side, write the reason not done on the body measurement and unusual occurrence forms.

If a skinfold is too tight to be measured, "tight skin" should be written in the recording space for that skinfold.

If a skinfold is above the measurable limits of the calipers, "60+" should be written in the recording space for that skinfold.

The original examiner and recorder should complete an examination once it is started.

The examiner takes each measurement and says it to the recorder. The recorder repeats the number, records it in the proper space, and says the name of the next measurement. The examiner should keep the measuring instrument set until the recorder repeats the number. If the anthropometer becomes unset in any way before the measurement is read back, the measurement should be made again. On standing measurements the recorder should see that the examinee stands erect. For the standing height measurement the recorder should check the height photo to be sure of the accuracy of the technician's reading.

The recorder is important because he helps insure the accurate recording of the measurement while also helping the examiner position the examinee correctly. The recorder also assists the examiner by seeing that the steel tape is horizontal with proper tension when girths are measured. The recorder, having had the same training as the examiner, should recognize an error in measurement or in reading from the wrong scale. (The anthropometer has two scales, ascending and descending.) When he does see an error he should call it to the examiner's attention and have the mistake corrected.

Procedure for Measuring Examinees Eight Years Old and Over

1. Before and after measuring
 - a. Before starting the measurements, record on the control record the examiner number and the time the procedure begins. Record on the body measurement form the examiner and recorder numbers, and the age and sex of the examinee.

- b. After finishing the measurements, record the time on the control record; and complete the date, age, sex, height, and weight sections on the Report of Findings to Physician page of the chart.

2. Height

- a. Have the examinee stand erect with his back and heels against the upright bar of the height scale ("Stand up tall" or "Stand up straight") with feet together and head in the Frankfort horizontal plane ("Look straight ahead"). Grasp the examinee under the mastoid processes and stretch him gently upward.
- b. While maintaining the examinee's head position with one hand, bring the horizontal bar down snugly to the examinee's head. Lock the bar in place.
- c. Place one of the sample number labels next to the tape on the upright bar so the label can be read on the height measurement photograph.
- d. Photograph the height measurement being sure that the examinee's hair does not obscure the scale when you take the photograph. Ask the examinee to step aside.
- e. Process the film and stick the sample number label from the height scale on the photo. Do not cover up the scale or the photographed sample number.
- f. Read the standing height measurement from the photograph and record it on the body measurement form in four digits to the nearest millimeter (0.1 of cm) from the metric scale. If there are less than four digits, fill in the blank spaces with zeroes as appropriate. For example, 99.0 should be 099.0. When the measurement is exactly at the half-way point between two millimeter marks, round up if the preceding whole number is odd; and round down if even.

3. Weight

- a. Make sure that the electronic digital scale is in the kilogram mode. If it is not, press the LB/KG key on the keyboard face.
- b. Make sure that the digital LED readout shows 000.00. If it does not, press the ZERO key on the keyboard scale to zero the scale.
- c. Have the examinee stand on the center of the weight scale platform.

- d. Insert the body measurement page in the slot of the scale's printer.
 - e. Press the PRINT key on the front of the printer to record on the body measurement page the time of day, the date, and the examinee's weight to the nearest twentieth of a kilogram.
 - f. Check to be sure that the printed weight is legible and is the same as the weight displayed on the LED.
 - g. Record the weight in kilograms on the body measurement form in the space provided. Always record the weight in five digits, filling in the blank spaces with zeroes as needed. For example, 44.5 should be entered as 044.50. The last digit should always be a zero or a five.
4. Biacromial breadth
- a. Have the examinee stand facing away from you in the standard erect position with his feet together and his arms hanging freely at his sides.
 - b. Place an anthropometer arm on each of the acromial processes.
 - c. Compress the soft tissue over the acromial processes as much as possible by applying pressure on the anthropometer arms near where they touch the body (not where they are attached to the anthropometer).
 - d. Measure the maximum breadth of the body between the acromial processes to the nearest 0.1 cm. Be sure that the anthropometer arms do not slip off the acromial processes. This is a bone-to-bone measurement taken over the examinee's gown.
5. Iliac crest breadth
- a. Have the examinee stand facing away from you in the standard erect position with his feet together.
 - b. Locate the maximum lateral width of the body between the crests of the ilia. This maximum width is in the anterior superior aspect of the body.
 - c. Place an anthropometer arm on each iliac crest. You may need to hold the ends of the anthropometer arms in a slightly declining position.

- d. Compress the soft tissue over the ilia as much as possible by applying pressure on the anthropometer arms near where they touch the body (not where they are attached to the anthropometer).
 - e. Measure the maximum breadth of the body between the iliac crests to the nearest 0.1 cm. Be sure that the anthropometer arms do not slip off the bony landmarks. This is a bone-to-bone measurement taken over the examinee's gown.
6. Bitrochanteric breadth
- a. Have the examinee stand with his feet together in the standard erect position.
 - b. Place the caliper arms on the protuberances of the greater femoral trochanters.
 - c. Compress the soft tissue over the trochanters as much as possible by applying pressure on the caliper arms near where they touch the body (not where the arms are attached to the anthropometer).
 - d. With the top section of the anthropometer measure to the nearest 0.1 cm the maximum breadth of the body at the level of the greater femoral trochanters. This is a bone-to-bone measurement taken over the examinee's gown.
7. Elbow breadth
- a. Have the examinee stand with his feet together in the standard erect position and extend his right arm forward until it is perpendicular to his body.
 - b. Have him bend his arm so the angle at the elbow forms 90° with his fingers pointing up and the dorsal part of his wrist toward you.
 - c. With the sliding calipers in the same plane as the axis of the upper arm, measure to the nearest 0.1 cm the greatest breadth across the elbow joint. This is a bone-to-bone measurement across the epicondyles of the humerus and is usually taken at an oblique angle because the inner condyle is lower than the outer condyle. Be careful that the calipers do not slide off the epicondyles.
8. Upper arm girth
- a. Have the examinee stand with his feet together in the standard erect position and with his right arm flexed 90°

at the elbow.

- b. Mark the lateral edge of the acromial process. Place the insertion tape along the posterior upper arm so that the same number appears on the tape at the acromial process of the scapula as at the olecranon process of the ulna. Mark the midpoint of the upper arm which is indicated by the zero point (black triangle) on the tape.
- c. Have the recorder mark the examinee's arm at the level of the zero point on the tape. It is of paramount importance to take this measurement accurately since the midpoint of the arm is the level at which both the arm girth and triceps skinfold measurements are taken.
- d. Have the examinee relax his elbow so his arm hangs freely at his side.
- e. Place the steel tape so it encircles the arm at the marked point and measure the circumference to the nearest 0.1 cm. The tape should rest firmly on the skin surface but should not compress the skin.

9. Triceps skinfold

- a. Have the examinee stand with his feet together in the standard erect position, relax his shoulder, and let his arm hang freely at his side.
- b. Mark a point on the right midtriceps in the same plane as the midhumeral point used for the upper arm girth and perpendicular to the olecranon process of the ulna.
- c. Grasp a fold of skin and subcutaneous tissue firmly with thumb and forefinger approximately 1 cm above this level, and draw it directly back from the body making sure that no muscle tissue is included in the fold. The crest of the fold should be parallel to the long axis of the arm.
- d. Apply the calipers at the level of the point marked earlier and indented directly below the thumb and forefinger, and measure the fold to the nearest 0.5 mm without releasing the fingers.
- e. Take a second measurement; if the two disagree, continue taking measurements until you get two that agree to within 0.5 mm.

10. Subscapular skinfold

- a. Have the examinee stand with his feet together in the standard erect position and relax his shoulders and arms.
 - b. Palpate the inferior angle of the scapula. Grasp a fold of skin and subcutaneous tissue directly above the angle firmly with the thumb and forefinger, and draw it straight back from the body making sure that no muscle tissue is included in the fold. The fold should parallel natural cleavage lines of the skin which are often lines about 45° from the horizontal extending medially upward.
 - c. Apply the calipers about 1 cm directly below the thumb and forefinger and measure the fold to the nearest 0.5 mm without releasing the fingers.
 - d. Take a second measurement; if the two disagree, continue taking measurements until two agree to within 0.5 mm.
11. Iliac crest skinfold
- a. Have the examinee stand with his feet together in the standard erect position.
 - b. Palpate the right suprailiac crest and pull a fold of skin and subcutaneous tissue directly above the crest. The fold should follow natural cleavage lines of the skin which are usually at 45° from the horizontal extending medially downward.
 - c. Apply the calipers about 1 cm directly below the thumb and forefinger, and measure to the nearest 0.5 mm the thickness of the fold taken over the right crest at the midaxillary line but perpendicular to it.
 - d. Take a second measurement; if the two disagree, continue taking measurements until two agree to within 0.5 mm.
12. Medial calf circumference
- a. Have the examinee sit on the measuring table facing the doorway with his leg hanging loosely.
 - b. Place the steel tape on a line between the proximal and distal processes of the tibia, and have the recorder make a vertical line along the edge of the tape at about the middle of the leg.
 - c. Encircle the calf of the leg with the steel tape at what appears to be its maximum circumference. Move the tape up and down the leg slightly to confirm that you have the

maximum circumference. Have the recorder mark along the top edge of the tape a horizontal line that intersects the vertical line drawn previously.

- d. Keeping the tape taut without compressing the skin, measure the circumference to the nearest 0.1 cm.

13. Medial calf skinfold

- a. Have the examinee sit on the measuring table with his leg hanging loosely.
- b. Grasp a fold of skin and subcutaneous tissue about 1 cm above the intersection of the markings on the leg.
- c. Place the skinfold calipers at the level of the horizontal line and indented directly below the thumb and forefinger, and measure to the nearest 0.5 mm the thickness of the skinfold.
- d. Take a second measurement; if the two disagree, continue taking measurements until two agree to within 0.5 mm.

14. Handedness

Ask the examinee whether he is right-handed or left-handed and record his answer by checking the correct box.

15. Sitting height

- a. Have the examinee sit as far back on the measuring table as he can so that the backs of his knee joints (popliteal fossae) are at the front edge of the table. Have him sit erectly with his eyes straight ahead and the infraorbital meatal line parallel to the table top (that is, eyes in the horizontal plane looking straight ahead). Check with the recorder on the examinee's position before making the measurement.
- b. Grasp the examinee laterally under the mastoid processes and under the mandible. Lift the examinee gently to a maximal sitting height.
- c. While maintaining the examinee's head position with one hand, bring the caliper arm down firmly against the midline of the examinee's head. You might have to compress some hairstyles.
- d. Take the measurement to the nearest 0.1 cm with your eyes at the same level as the caliper arm. Do not make the

reading at an angle. Short technicians should stand on the stool available in the measuring room.

Procedure for Measuring Children Under Eight Years Old

1. Before and after measuring
 - a. Before starting the measurements, record on the control record the examiner number and the time the procedure begins. Record on the body measurement form the examiner and recorder numbers and the age and sex of the examinee.
 - b. After finishing the measurements, record the time on the control record; and complete the date, age, sex, height, and weight sections on the Report of Findings to Physician page of the chart.
2. Standing height (two through seven years old)

Use the same procedure as that for older examinees.
3. Weight

Use the same procedure as that for older examinees.
4. Biacromial breadth
 - a. Stand the child on the foot stool (placed in the center of the room) so that you can take the measurements with your eyes at about the same level as the caliper arms.
 - b. Otherwise, use the same procedure as that for older examinees.
5. Biiliac crest breadth
 - a. Stand the child on the foot stool (placed in the center of the room) so that you can take the measurements with your eyes at about the same level as the caliper arms.
 - b. Otherwise, use the same procedure as that for older examinees.
6. Bitrochanteric breadth
 - a. Stand the child on the foot stool (placed in the center of the room) so that you can take the measurements with your eyes at about the same level as the caliper arms.

- b. Otherwise, use the same procedure as that for older examinees.
- 7. Elbow breadth

Use the same procedure as that for older examinees except that the child may be either standing on the footstool or sitting.
- 8. Upper arm girth
 - a. Stand the child on the foot stool (placed in the center of the room) so that you can take the measurements with your eyes at about the same level as the caliper arms.
 - b. Otherwise, use the same procedure as that for older examinees.
- 9. Triceps skinfold
 - a. Stand the child on the foot stool (placed in the center of the room) so that you can take the measurements with your eyes at about the same level as the caliper arms.
 - b. Otherwise, use the same procedure as that for older examinees.
- 10. Subscapular skinfold
 - a. Stand the child on the foot stool (placed in the center of the room) so that you can take the measurements with your eyes at about the same level as the caliper arms.
 - b. Otherwise, use the same procedure as that for older examinees.
- 11. Iliac crest skinfold
 - a. Stand the child on the foot stool (placed in the center of the room) so that you can take the measurements with your eyes at about the same level as the caliper arms.
 - b. Otherwise, use the same procedure as that for older examinees.
- 12. Medial calf circumference

Use the same procedure as that for older examinees.
- 13. Medial calf skinfold

Use the same procedure as that for older examinees.

14. Handedness

If the child is old enough, ask him whether he is right-handed or left-handed; and record his answer by the checking the correct box. Otherwise, question the child's parent or guardian to obtain the information.

15. Sitting height (two through seven years old)

- a. Have the child sit erectly on the measuring table with his eyes directed straight ahead (the eyes should be in a horizontal plane looking straight ahead). The child should sit as far back on the table as he can so that the backs of his knee joints (popliteal fossae) are in contact with the front edge of the table. Check with the recorder on the child's position before making the measurement. Younger children need to be encouraged to sit up straight, and you might have to give support to a younger child. First, straighten out his back by placing your right hand over the upper part of the chest and your left hand over the lumbar area and pushing gently. Then, grasp the child laterally under the mastoid processes and under the mandible. Lift the child to a maximal sitting height. Be sure that the child's hands are placed in his lap to avoid his rendering you any assistance in elevating himself by using them.
- b. After checking the child's position with the recorder and while maintaining head position with one hand, bring the caliper arm firmly against the midline of the examinee's head. You might have to compress some hairstyles.
- c. Take the measurement to the nearest 0.1 cm with your eyes at the same level as the caliper arm.

16. Chest circumference

- a. Two through seven years old, standing
 - (1) Have the child stand on the footstool in the standard erect position with his feet together.
 - (2) Pass the steel tape around the chest at the level of the nipple line so that it is at a right angle to the longitudinal axis of the body.
 - (3) Have the recorder see that the tape is against the child's body just below the angles of the scapula.

(4) Measure to the nearest 0.1 cm the chest circumference at mid-respiration, with the examinee breathing normally and with his arms relaxed at his sides.

b. Three years old and under, supine

(1) Have the child lie supine on the infant measuring board.

(2) Put the tape around the chest at nipple level at a right angle to the longitudinal axis of the body.

(3) Take the measurement to the nearest 0.1 cm at normal midrespiration.

17. Head circumference

a. Have the child either sit on the footstool or stand for this measurement.

b. Steady the child's head and place the steel tape firmly around the frontal bones (forehead) just above but not including the supra-orbital ridges, passing the tape around the head just above the ears on each side, and laying it over the maximum occipital prominence at the back of the head.

c. Have the recorder hold the tape on the maximal occipital prominence once the tape has been positioned correctly.

d. Pull the tape firmly to compress the hair and underlying soft tissues.

e. Measure the head circumference to the nearest 0.1 cm.

18. Recumbent length (three years old and under)

a. Have the child lie on his back on the infant measuring board.

b. Find another technician to help take this measurement. One technician holds the child's head in the Frankfort plane (that is, eyes straight ahead, in this case straight upward so that the plane they form is parallel to the movable footboard) and applies gentle traction to bring the head into contact with the fixed headboard. The second technician holds the child's legs by placing one hand firmly over the knees. The child's toes should point directly upward. Then, while applying downward pressure to the legs (to prevent the knees from flexing), the second

technician brings the movable footboard to rest firmly against the child's heels. You may need a third person to help with restless infants so you can take measurements as quickly as possible and maintain accuracy.

- c. Read the measurement to the nearest 0.1 cm from the digital counter on the measuring footboard.
19. Crown-rump length (three years old and under)
 - a. Have the child lie on his back on the infant measuring board with his hips bent at a right angle.
 - b. Find another technician to help take this measurement. One technician holds the child's head in the Frankfort plane and applies gentle traction to bring the head into contact with the fixed headboard. The second technician supports the child's legs under the flexed knees and brings the movable footboard to rest against the child's buttocks with firm pressure.
 - c. Read the measurement to the nearest 0.1 cm from the digital counter on the measuring footboard.

Unusual Occurrence Form

The unusual occurrence form is used to describe the reasons why parts of the examination were not obtained or why they may have been done in a nonstandard way. For instance, it should identify infants on whom data could not be obtained because of uncontrollable behavior, examinees on whom right-side measurements could not be taken, and all refusals. This form should include the sample numbers of all infants (under two years old) on whom height photos were not taken. Conditions affecting the exam should also be listed here, for example: "SP pregnant" or "right side atrophy due to paralysis."

Field Checks and Calibrations

1. Calipers
 - a. Bitrochanteric calipers

Calibrate the bitrochanteric calipers at the beginning of the stand and once a week during the stand as follows:

- (1) Separate the arms of the calipers to a randomly chosen whole number measurement. Place the steel measuring tape between the inner edges of the caliper arms to

measure the distance between them. This measurement should be the same as the numerical measurement indicated on the anthropometer. If it is not, make sure that the two sections of anthropometer rod fit tightly together at the joint. Also, make sure that the fixed caliper arm fits snugly against the top end of the anthropometer. An adjustment can be made by unscrewing the Allen screw in the top of the fixed caliper arm holder and pressing the holder and rod firmly together.

- (2) Check the linearity of the anthropometer's arms by placing the skinfold step wedge tightly between the inner edges at the base of the arms. Holding the arms immobile, move the step wedge toward the arm tips. If the arms are bent a widening or narrowing of the space will be noticed as the step wedge is moved. The separation of the caliper arms should not exceed 1.0 mm. If it does, replace the bent caliper arms with a spare set.

b. Skinfold calipers

Calibrate the skinfold calipers before each examining session as follows:

- (1) Make sure the reading on the scale is 0.0 when the caliper arms are in a closed position.
- (2) Place the step wedge standard between the caliper arms at each of the five steps, and check that the reading on the scale corresponds to the standard measurement.
- (3) If the calipers are not accurate, adjust them by pressing firmly on the arms while the caliper arms are in place on the step level that is out of calibration.
- (4) Record the measurement taken at each step on the body measurement calibration log sheet under the appropriate heading. An identical calibration should be done on the spare set of skinfold calipers and the corresponding measurements also recorded on the calibration log sheet. Be careful to record the calipers' values on the correct device identification line. (The spare is not always the B instrument.)
- (5) If the calipers are 1 mm or more out of calibration at any level, use the other set of calipers and return the faulty set to headquarters.

- (6) If the calipers become too loose, use the spare set of calipers and return the faulty set to headquarters.

c. Elbow breadth calipers

- (1) Calibrate the elbow breadth calipers at the beginning of the stand and once a week during the stand using the same procedure used for bitrochanteric anthropometer calibration. Be sure to calibrate the "flat" end portion of the calipers (as opposed to the "sharp end" portion).
- (2) If any abnormality is noticed, use the spare set of elbow breadth calipers and notify the chief technician about the condition.

2. Sitting height anthropometer

a. Beginning of stand and weekly during the stand

- (1) Check that the sliding arm is perpendicular to the upright bar and is not bent. If the arm is bent, use the spare caliper arm and notify the chief tech.
- (2) Adjust the caliper arm to a randomly selected whole number measurement. Place the edge of the metal base even with the edge of the sitting height table.
- (3) Using the metal tape, measure from the lower edge of the caliper arm to the top edge of the sitting height table. This measurement should correspond to the anthropometer reading.
- (4) Move the metal base backward on the sitting height table so that the tip end of the caliper arm is at the edge of the table. Again use the metal tape to measure from the lower edge of the caliper arm to the top edge of the sitting height table. This measurement should correspond to the anthropometer reading.
- (5) If either of the tape measurements differs from the anthropometer reading, check that the correct side of the caliper arm holder is being used. If so, exchange the caliper arm for the spare arm; inform the chief tech; and repeat the entire calibration process with the spare caliper arm in place.

b. Daily

- (1) See that the bottom of the anthropometer is perfectly flush with the undersurface of the metal stand. (Do

not handle the anthropometer by the rod sections alone; they are apt to be wrenched from the base or become separated at the joint between the two rods.)

- (2) See that the instrument, when properly mounted in the base, stands vertically without support. If it doesn't, check that the metal base screw responsible for holding the metal rod sections upright is screwed tightly against the rod. Check that the rod is sitting flush against the supporting side of the metal base. If these conditions are both met and the anthropometer still does not stand vertically, use the spare anthropometer set and notify the chief tech about this condition.
- (3) See that the anthropometer numbers read in the correct sequence and the movable arms slide freely without slipping.

3. Infant measuring board

- a. Check the infant measuring board at the beginning of each stand by placing a steel tape beside the steel tape mounted on the board to check that the steel tape on the board has not been stretched or bent during transit. If it has, inform the chief tech and the biomedical engineer. The tape will need to be repositioned.
- b. At the beginning of the stand and before each examining session, move the footboard of the baby board to some point along its length chosen at random. This point should alternate between high and low numbers from session to session to assure total calibration. Check the digital counter reading against the steel tape reading to make sure they agree. Record the counter reading on the daily calibration log sheet under the appropriate heading. If the two readings do not agree, inform the chief tech who will be responsible for the following correction process.
 - (1) Place the footboard at some randomly chosen whole number.
 - (2) Unscrew and remove the digital counter cover plate from the side of the infant measuring board. Remove the digital counter from its position on the footboard.
 - (3) Using the small gear located on the right side of the counter, rotate the digits until they agree with the location of the footboard.

- (4) Without allowing the digits on the counter or the footboard to move, gently position the counter back into place on the footboard making sure to mesh the small gear on the counter with the larger gear located on the footboard.
 - (5) Replace the digital counter cover plate.
 - (6) Move the footboard from one end of the infant measuring board to the other, to make sure that the digital counter and the tape measurements agree for the entire length of the board.
- c. Record beginning of stand and all postrepair calibrations in the log book under the correct headings.

4. Height scale

a. Beginning of stand checks

- (1) Check that the upright bar and attached tape measure have not been damaged.
- (2) Check that the horizontal bar is firmly attached to the upright sliding section and that the section operates smoothly. If it doesn't, clean the upright bar with white vinegar.
- (3) Check the Polaroid camera and light to see that they produce optimum photos.

b. Calibration

Calibrate the height scale at the beginning of each stand before examinations begin and at the end of each stand after all examinations are done as follows:

- (1) Place the sitting height anthropometer at the middle of the height scale base.
- (2) Place the horizontal bar of the height scale firmly against the anthropometer top.
- (3) Take a Polaroid photograph of the height scale tape. The measurement recorded should be 104 cm. If it's not, adjust the sighting window on the height scale until the measurement does agree and rephotograph the scale.

- (4) Record on the back of the photo the stand number, location, technician number, date, and the level set on the sitting height anthropometer for the calibration.
- (5) Give the photo to the chief tech for shipment to the Quality Control Section at headquarters.

5. Weight scale

a. Digital weight scale

Calibrate the weight scale at the beginning of each stand before examinations begin and at the end of each stand after all examinations are done as follows:

- (1) Place the electronic digital system in the pound mode by pressing the LB/KG button on the keyboard until the readout is in tenths. If the digital readout does not register "000.0," press the zero key to automatically balance the scale at zero.
- (2) After zeroing the scale properly, print the zero weight on a sheet of 8½" x 11" paper.
- (3) Place calibration weights on the scale in increments of 25 pounds, starting with 25 and continuing to 250.
- (4) Print the weight in pounds at each increment on the calibration paper by pressing the PRINT key on the time/date unit. At 100 pounds, print the weight in pounds and in kilograms to attest to the accuracy of the pound/kilogram conversion.
- (5) If the scale is out of calibration by at least one half-pound at more than three levels, inform the chief tech. Professional servicing will be necessary.
- (6) When a satisfactory calibration is obtained, record the stand number, stand location, date, and tech number on the sheet and give it to the chief tech to send to headquarters.

b. Printer

The printer comprises a bank of numbers and letters that indicate, from left to right, time (AM or PM), date, and weight. To set the time/date function displayed in the LED on the front panel, do the following:

- (1) Plug the power cord into the power outlet.

- (2) Find the two pushbuttons on the rear panel of the printer above the attached power cable. The top one is the "set" button; the bottom one is the "advance" button.
- (3) Press the "set" button to cause the rightmost LED digit to begin blinking. Press the "advance" button to advance the numerals until the correct year designation appears. Press "set" once again to fix that numeral in the LED and cause the second digit from the right to begin blinking.
- (4) Follow the above process through the six-digit field that represents the date and the four-digit field that represents the time. Although the time must be set according to a 24-hour clock, time will appear on the LED and the printout according to a twelve-hour clock, AM and PM.
- (5) When all the digits have been correctly set, press the "set" button twice to start the timing operation.

c. Spare scale

If it is necessary to use the spare scale because the electronic digital scale is out of order, calibrate it before using according to the following instructions:

- (1) Turn the scale lock at the back of the unit to a horizontal position to unlock the spring mechanism.
- (2) Zero the scale if the trailer is not level. Turn the knob on the left side of the scale gently until the scale reads "0.00." A reading of "E.EE" indicates you have adjusted the scale to below zero.
- (3) After zeroing the scale properly, print the zero weight on a sheet of 8½" x 11" paper.
- (4) Place calibration weights on the scale in increments of 25 pounds, starting with 25 and continuing to 250.
- (5) Print the weight in pounds at each increment on the calibration paper.
- (6) If the scale is out of calibration by a constant amount at all increments, correct the error with the adjustment knob on the left side of the scale.
- (7) If the scale is out of calibration by at least a half-pound at more than three weight increments but not out

consistently at all stations, call the company for servicing.

- (8) When a satisfactory calibration is obtained, record the stand number, stand location, date, and tech number on the sheet; and give it to the chief tech to send to headquarters.
- (9) When the electronic digital scale has been repaired and the spare scale is no longer needed for data collection, turn the scale lock at the back of the unit to a vertical position.

d. Daily check

- (1) Have the tech responsible for the body measurement station weigh himself daily to roughly check the accuracy of the weight scales.
- (2) If there is any reason to believe the scales are not accurate, do a complete recalibration. The recording of the calibration should be sent to the Quality Control Section at headquarters.

6. Cleaning of equipment

- a. At the beginning of each stand and during the stand as necessary, wipe the anthropometer, calipers, and tape measures with white vinegar to allow their sliding parts to move more freely.
- b. Clean the equipment with alcohol at the end of each examining day.
- c. Clean the camera roller bars periodically according to the following instructions to assure uniform spreading of the photo developing agent.
 - (1) Open the back of the camera by releasing the lever on the bottom panel of the camera.
 - (2) Grasp the roller springs on the top and bottom of the roller assembly and pull them straight outward, thus allowing the roller bars to swing free of the inside camera body.
 - (3) Clean the roller bars thoroughly using alcohol on gauze to remove the chemical residue.

- (4) Put the roller assembly against the back panel of the camera body, and press firmly at the center of the roller bars to reseat the rollers.
- (5) Place the back of the camera against the main body of the camera, and press on it firmly to close the camera.

End of Stand Procedures

1. Pack-up calibration
 - a. Calibrate completely the weight and standing height scales as described earlier in this chapter under Field Checks and Calibrations.
 - b. Give the calibration sheet to the chief tech to send to headquarters. Also send the skinfold daily calibration sheet to headquarters at the end of the stand.
2. Pack-up procedures
 - a. Calipers
 - (1) Dismantle the bitrochanteric and sitting height anthropometer calipers and place each of these and the elbow breadth calipers in the traveling case. Store the case and the sitting height anthropometer base in the body measurement table.
 - (2) Place the skinfold calipers in their protective case, and store it in the body measurement table drawer.
 - b. Weight scale
 - (1) Unplug the power cord, and check that the weight scale is in a vertical position.
 - (2) Move the weight blocks on the front of the scale to the far right side, and tape them in position.
 - (3) Immobilize the scale platform by inserting table paper snugly between the platform and the scale base.
 - c. Printer
 - (1) Unplug the power cord from the wall outlet.
 - (2) Disconnect the input cable to the scale, and tape the cable onto the printer shelf.

- (3) Put the printer on the floor.
- d. Height scale
- (1) Unplug the light from the power outlet.
 - (2) Place the light against the camera-holding bar and tape it into position.
 - (3) Raise the horizontal bar to the top of the upright bar and tape it into position.
 - (4) Be sure that the camera is securely fastened down for transit.
- e. Body measurement table
- (1) Close and lock the drawers and cabinet doors.
 - (2) Place the webbing strap around the table and secure the ends to the wall brackets. Be sure the strap is pulled tightly around the table for transit.

Replicates

An intertechnician body measurement replicate is to be done every fourth session on the examinee who arrives first at the exam center. The sessions on which replicates are to be done are shown on the schedule sheet.

For the sessions during which a replicate is to be done, the coordinator will write the examinee's sample number in the appropriate space on the schedule sheet and will assign the original body measurements on that examinee to a technician according to the usual flow system rules without allowing the technician to know that the examinee's body measurements will be replicated. After the original body measurements have been completed she will assign the replicate measurements in a random way to one of the other technicians and write that technician's number in the appropriate space on the schedule sheet.

Chapter 15

TYMPANOMETRY

Equipment

Tympanometer
Probe
Assembly
Eartips, Rock and conventional
Chart paper

Introduction

Tympanometry is a test of the status of the middle ear measured at the plane of the tympanic membrane (eardrum). It is a test of the middle ear function only and does not assess hearing ability. All examinees receive this test.

Set-up

1. Plug the probe, air hose, and light jack into the back of the tympanometer.
2. Check the mode selection rocker switch on the back of the tympanometer; it should be in the center "Normal" position.
3. Check the pressure selection rocker switch; it should be in the "Normal" position.
4. Switch the little unit on; the red light will flash. If the paper advances without stopping, shut the machine off and recheck that the rocker switch is in the "Normal" position.
5. If the probe is not clean, unscrew the silver probe cone with your fingers and clean it with a pipe cleaner by pulling the pipe cleaner all the way through the probe. Do not use pliers on the probe.
6. Put your fingers over the tip of the probe; the red light will stop flashing and the pen will drop to the dots at the bottom of the chart paper. If it doesn't, recheck that the mode selection switch is in the "Normal" position.
7. Clean the eartips and place them in the tray, ready for use.
8. Supply the tympanometry area with alcohol, gauze pads, scissors, and tympanogram envelopes.

Daily Check

1. To check the integrity of the system, a technician should perform an impedance test on himself at the beginning of each examining day. Attach the chart tracing to the left margin of the daily form. Check the appropriate space on the form to indicate acceptable or unacceptable results. Record any abnormal or unacceptable results at the right margin of the form.
2. If you notice odd responses from the instrument such as that the green light is on but no paper advances, the red light continues flashing despite a good seal, or that the paper advances continuously, check the mode selector switch to see that it is in the "Normal" position. If that does not correct the problem, switch the instrument off, then on; this should stabilize the unit.

Test Procedure

1. Have the examinee sit in a comfortable, relaxed position (infants and children could be held by a parent). Explain to the examinee what the test involves and why it is being done.
2. Examine the ear to determine the size and direction of the ear canal. Select an eartip of the proper size to seal the ear canal. In general, Rock eartips should be used with children and adults; conventional eartips should be used with infants.
3. Attach the eartip to the end of the probe. Lightly pull up and back on the ear to straighten the ear canal. Seal the canal by placing the probe against the ear canal opening. Maneuver the probe slowly until the green light appears on the probe. Hold the probe still until the green light goes out.
4. Look at the lights on the probe. Do not watch the tympanometer. If you watch the tympanometer, the probe tip may move against the canal wall and void the test. If the red light comes on, the probe is blocked. A blinking red light indicates there is no seal; reposition the probe, and apply more pressure. Both lights may appear during the test. This means that either the seal, is lost the probe is blocked, or the examinee vocalized. This may negate the test; however, careful inspection of the tympanogram may reveal general shape; and, if so, the test can be used.
5. Check the tympanogram curve and reflex measurement recorded on the strip chart. Record on the strip chart the physical volume value displayed in the LED of the tympanometer, and mark on the tracing which ear was being tested.

6. If a satisfactory test is recorded for each ear, complete the appropriate sections of the examinee's chart. If a satisfactory test is not obtained, retest the problem ear.
7. Stick sample number labels on the tympanogram and a tympanogram envelope, and put the tympanogram in the envelope. Write the date and tech number on the envelope.
8. Stick a sample number label on the audio/tymp roster, and enter the date, technician number, examinee age, and a check mark in the impedance test column if any tracing (acceptable or unacceptable) was obtained. Comments regarding the test should be noted in the section of the roster provided for them.

Recording Procedure

1. Complete the top part of the tympanic impedance section of the examinee's chart with the age and sex of the examinee, the tympanometer number, and the technician number.
2. For each ear, check the box that indicates the style of eartip used for the test.
3. For each ear, check the box that indicates whether the tympanogram was obtained or not obtained.
4. For each ear, record the physical volume in the three-digit field. If there are fewer than three digits, use leading zeroes. For example, 1.5 cc should be recorded as 01.5 cc.
5. For each ear, record the acoustic reflex as present or absent. To determine which it is, look at the pen deflection at the far left side of the tracing. If the pen is deflected to the top of or above the darkened square, the reflex is present. If the pen deflection falls within the darkened square, the normal reflex is absent.
6. For each ear, record the curve shape according to the following criteria:
 - a. A normal curve has a sharp peak either on or off the scale at 1.0 mm H₂O with the ascending and descending lines of the curve separated by one box or less on the graph.
 - b. A rounded curve has no sharp peak.
 - c. A truncated curve has no peak, and the tracing is off the scale at 1.0 mm H₂O with the ascending and descending lines separated by more than one box on the graph.

- d. A curve with no peak is without a peak. This category includes flat tracings and those whose ascending lines ascend to 400 mm H₂O.
7. Record the pressure at maximum compliance by noting the mm H₂O value listed across the top of the graph directly above the peak. On rounded peaks, take the reading from the peak's midpoint at maximum compliance. Each small box horizontally represents 25 mm H₂O. Take the reading from the line closest to the peak or midpoint. If the peak or midpoint is exactly in the center of the box, take the reading toward the zero compliance point. Normal values for pressure at maximum compliance should range from -100 mm H₂O to +100 mm H₂O. If the value is outside this range, check the positive box on the Physician's Report of Findings page, and write down the pressure value.
8. Record the maximum compliance by noting the cc value on the compliance scale along the left side of the graph at the same level as or the closest line to the peak or midpoint. If the peak or midpoint is exactly halfway between two lines, take the higher compliance value for that tympanogram. Normal compliance values range from 0.3 cc to 1.0 cc. If the compliance value is outside this range, check the positive box on the Physician's Report of Findings page, and write down the compliance value.

Instructions to Examinee

1. Example of verbal instructions for examinees seven years old and older

This is a test to check the flexibility of your eardrum. In a moment, I'll insert a small rubber tip into your ear. You'll feel a slightly raised pressure in your ear for a moment followed by four beeps which end the exam. If you would like, you may watch the chart paper recording the mobility of your eardrum while the test is being done. Please don't move, speak, or swallow from the time I place the tip in your ear until I remove it.

2. Example of verbal instructions for examinees four to six years old

(Have the child look at the strip chart paper picturing a car. Point out the car to the child and also the red and green lights on the tympanometer.) Your ear is a magic ear! It can make this car move!! I'm going to put a magic wand in your ear. When you see the green light go on, the car will move forward. If you don't talk or move, you'll see another car appear and

beep four times. Then the red stop light will go on and the magic trick will be finished. Now, be really quiet and let's watch.

Chapter 16

AUDIOMETRY

Equipment and Supplies

Soundproof room
Two Beltone audiometers, Model 200-C
B&K sound level meter, Model 2203
B&K artificial ear coupler, Model 4151
B&K condenser microphone, Model 4144 (1")
B&K octave band filter, Model 1613
B&K acoustic calibrator, Model 4230
500-gram weight
Daily check list
Field calibration forms
Environmental noise survey form

Introduction

Puretone audiometric testing is done on all examinees from six to nineteen years old. The testing is also done on a half-sample of examinees between 20 and 74 years old, those with sample numbers in the 500-799 series.

Daily Field Checks

1. Preliminary procedure
 - a. Turn the power on and switch to the manual mode.
 - b. Turn the tone switch to the "on" position to turn on the tone indicator light.
 - c. Place all switches and controls in their "off" positions.
 - d. Turn the "talk back" and "talk over" controls fully counterclockwise.
2. Tone quality
 - a. Set the hearing level dial at 70 dB, pads in.
 - b. Turn the Channel I output control alternatively to the left and right phones.
 - c. Turn the frequency dial successively from 500 Hz through

4000 Hz while listening through each earphone in turn for purity of tones.

- d. Check the appropriate spaces on the form and note any abnormalities.

3. Masking tone quality

- a. Turn the Channel I tone switch to "off" and the Channel II tone switch to "on."
- b. Be sure the Channel II input dial is set at "NB Noise" and the accompanying masking level attenuator dial is set at 60 dB.
- c. Set the Channel I frequency control at 500 Hz.
- d. While listening through each earphone, turn the Channel II output control alternately from the left to the right earphones.
- e. Change the Channel I frequency dial successively from 500 Hz to 4000 Hz.
- f. Check the appropriate spaces on the form and note any abnormalities found.

4. Hearing level control

- a. Set the frequency dial on 2000 Hz.
- b. Turn the hearing level dial slowly from 20 dB to 60 dB and back to zero while listening for scratches, abrupt changes in loudness of tone, or other extraneous signals.
- c. Check the appropriate spaces on the form as each phone is checked and note any abnormal conditions in the "Remarks" section.

5. Wires leading to the earphones

- a. While wearing the earphones with the 1000 Hz tone on at 40 dB, shake the wire to each earphone gently; and listen for scratches, interruption of the tone, or any other abnormality.
- b. If the tone is interrupted or changes loudness, tighten the set screws holding the earphone cord in the earphone. Also, tighten and clean the connector jack at the back of the audiometer with a rubber eraser. If these actions do not correct the fault, replace the audiometer.

- c. If it is necessary to replace an earphone cord, as it is from time to time, loosen the set screws in the earphone, unplug the old earphone cord, plug in the new cord, and finally tighten up the set screws.

5. Attenuator and frequency dials

If the attenuator and frequency dials slip on the shaft, report it under "Remarks" and replace the audiometer.

6. Consequences of field check failure

Send any defective unit to EAR-CO for service. If neither audiometer works properly, contact the engineer at headquarters, then Mr. Kenneth Stewart for instruction.

Field Calibration

1. General

- a. Do a field calibration of both audiometers at the beginning and the end of each stand. Also calibrate the audiometer in use weekly. The field calibration report forms give the expected reading at each frequency and the tolerance limits allowed around that reading. The expected readings were determined for each set of field calibration equipment at EAR-CO's laboratory. If a microphone requires replacement, send the calibration equipment back to EAR-CO for a determination of new expected readings for the new microphone.
- b. Make reports on these field calibrations in duplicate. Mail one copy that day to the biomedical engineer at headquarters and the other to EAR-CO, 523 Washington Avenue, Bridgeville, Pennsylvania 15017. Save the originals until the end of the stand and then send them to the engineer at headquarters.
- d. If the calibration shows a unit to exceed the specified limits, have another technician make an independent calibration. If both technicians agree that the audiometer is in calibration, consider the unit satisfactory for use. If the difficulty cannot be resolved, send the little unit to EAR-CO for service.

2. Pure Tone Calibration

- a. Preparation of the sound level meter

- (1) Turn the function selector to "Batt" and pull up on it to turn on the meter. The sound level needle should be deflected into the range marked "Battery" on the meter to indicate that the B&K has proper power to make accurate calibration readings. If the needle does not indicate an appropriate meter reading, replace the batteries. To do so, unscrew the four screws at the bottom of the B&K filter unit. Remove the straight bar on the top side of the unit by pulling it up. By removing this bar you can separate the filter and meter sections. The three 1.5-volt batteries are located at the bottom of the meter section.
- (2) Screw the artificial ear coupler onto the meter case with the cable provided.
- (3) Unscrew the top half of the coupler.
- (4) Screw the microphone cartridge (one inch in diameter) with the protective grid onto the bottom half of the coupler.
- (5) Turn the black knob above the meter to position the number "90" opposite the marker on the meter case. Turn the clear knob to place the red circle over 90.
- (6) Set the function selector to "A-Slow" and pull it up to turn on the meter.
- (7) Remove the half-inch adaptor from the acoustic calibrator and set the calibrator firmly over the microphone.
- (8) Press the tone actuator (on the side of the calibrator) once and release it. The sound level meter should read 94 dB on the A scale. If not, use a screw driver (supplied with the meter) to turn the adjustment (Adj.) screw to produce the desired reading. (If the tone has disappeared, reactivate the calibrator.) The sound level meter is now in calibration.

b. Mounting of the earphone

- (1) Screw the top of the coupler back on.
- (2) Set the earphone to be tested over the cavity of the coupler, making sure that the earphone rests squarely on the coupler.
- (3) Place the 500-gram weight on top of the earphone.

c. Calibration procedure

(1) Pads out

- (a) Turn the black knob on the sound level meter until the number 80 on the dial is opposite the marker on the meter case, and keep the red circle over 80.
- (b) Select the earphone to be tested.
- (c) Set the audiometer at a frequency of 500 Hz and a hearing level of 70 dB. The Channel I output control should indicate the earphone being tested.
- (d) Turn the tone switch to "on".
- (e) Record the sound level meter reading (external filter) on the report form. Be sure that the weighting switch on the external filter is in the "off" position. Determine the meter reading as in the following example:

Red circle over	80
Meter needle at	<u>4.5</u>
Meter reading is	84.5

Since the expected reading at this frequency is 83.0 dB with a tolerance of plus or minus 3 dB, the audiometer is within calibration at this frequency.

- (f) Continue testing at the other three frequencies indicated on the report form. In each case the report form provides the appropriate settings for the sound level meter and external filter knob.
- (g) To test the other earphone, remove the weight and lift the earphone already tested off the coupler. Place the other phone on the coupler and put the weight back on. Repeat steps (c) through (f).

(2) Pads In

- (a) Turn the black knob and red circle on the sound level meter attenuator to "100."
- (b) Set the sound level meter function knob to "external filter" and the filter knob to "500 Hz."
- (c) Set the audiometer frequency to "500 Hz" and select the earphone to be tested.

- (d) Turn the tone switch to the "on" position.
- (e) Adjust the hearing level dial to bring the sound level meter needle to the number "4" at the center of the B&K meter. The reading is now 104, pad out.
- (f) Unplug the earphone from the audiometer, plug it into the pad, and plug the pad into the audiometer.
- (g) Rotate the sound level meter's black attenuator knob to "70." Leave the red circle over 70.
- (h) Observe and record the sound level meter reading. The reading obtained (about 74) is the pad in reading.
- (i) Repeat steps (a) through (h) exactly in the order given above for each frequency. Any deviation in the sequence will result in an invalid calibration.
- (j) Write the difference between readings (pad out minus pad in) for each frequency on the forms provided.
- (k) To test the other earphone and pad, remove the weight and lift the earphone already tested off the coupler. Place the other phone and weight back on. Repeat steps (a) through (j) using the other pad. The absolute value (the number without the plus or minus sign) of the difference should be within the range indicated on the pad in form for the pad being used. For example, the range for the right ear using pad R102 is 0.5 dB plus or minus 3 dB. If the difference does not fall within the range for any one of the four frequencies with a given earphone (right/left), notify the chief technician, then the supervisory technician or engineer at headquarters, and finally EAR-CO.

3. Masking noise calibration

- a. Set up the field calibration equipment as before.
- b. Set the function selector on the B&K meter to "C-Slow."
- c. Turn the audiometer Channel II tone switch "on" to bring the tone indicator light on. Turn the Channel I tone switch "off".
- d. Turn the frequency and input dials to "NB Noise" and the Channel I frequency selector to "500 Hz."

- e. Set the masking level knob at "60 dB" as indicated on the form.
- f. Select the earphone to be tested. The Channel II output control should indicate the earphone being tested.
- g. Set the black knob and red circle on the sound level meter at "80" and obtain the reading. Determine the actual masking signal level at the selected range of frequencies as in the following example:

Red circle over	80
Meter needle at	<u>2.4</u>
Masking signal level is	82.4 dB

Since the expected reading is 81.7 dB with a tolerance of plus or minus 3 dB, the level of the masking noise is within the specifications for this frequency range.

- h. Repeat the procedure with the Channel I frequency selector at the other frequencies and other attenuator settings indicated on the form.

Environmental Noise Survey

1. General

A noise survey is to be done during the setup day before the start of each stand. Send one copy of the completed form immediately to the biomedical engineer at headquarters and one to EAR-CO. Steps 2g through 2n below should first be done with the trailer's air conditioning/heating unit off then done again right away with the air conditioning/heating unit on.

2. Procedure

- a. Screw the one-inch microphone (with the protective grid in place) directly onto the connector on the B&K sound level meter.
- b. Check the battery condition and calibration according to the previous instructions.
- c. Set the selector knob to the "external filter slow" position.
- d. Set the weighting switch on the octave filter at "off".
- e. Close both doors to the audiometry room.

- f. Turn off all hearing test equipment.
- g. Set the black knob to "70."
- h. Rotate the frequency knob to "31.5."
- i. Adjust the red circle knob to obtain a meter reading which is somewhat above 0 dB on the meter scale. Read the red circle number and add to it the meter reading as in the following example:

Red circle on	60 dB
Meter reading	4 dB
Environmental noise level	<u>64 dB</u> at 31.5 Hz

- j. Record the reading on the correct form. The meter reading will fluctuate a bit. Try to estimate an average reading after having observed the meter for a moment.
- k. Turn the frequency knob to "63."
- l. Turn the red circle knob to obtain a meter reading as you did while following instruction 2i above.
- m. Proceed through each octave band from 125 Hz through 8000 Hz.
- n. Under "Comments" explain the circumstances, if possible, where the environmental noise levels exceed ANSI allowable levels.

Audiometric Testing Procedures

1. Preliminary procedure

At the beginning of each examination session turn on the audiometer at least ten minutes before doing the daily field check. Both doors to the audiometry room should be closed while testing.

2. Recording

- a. Enter the beginning time and technician number on the control record.
- b. Use the left side of the audiometry form first when the sample number is even and the right side first when the sample number is odd.

- c. Enter the age and sex of the examinee, the audiometer number, and the technician number on the audio form.
- d. Indicate which ear will be tested first by circling "right ear" or "left ear" on the form. This will compensate for any bias that would result if we always tested the same ear first.

3. General instructions

- a. Perform pure tone audiometric tests with attenuator pads in for both ears in the sequence indicated on the recording form.
- b. If any part of the test cannot be completed, enter "X" in the appropriate space and indicate the reason under "Condition Affecting Test Results." If other than physical conditions of the examinee have affected any of the audiometric results, explain in the space provided at the right of this section. If any thresholds of 30 dB or greater (without attenuation) are obtained, be sure to question the examinee about physical conditions which might contribute to the results and check the appropriate box or boxes under "Condition Affecting Test Results." If you find a 15- to 19-year-old with a 40-dB or greater threshold (without attenuation) at 4000 Hz in one or both ears, ask him if he has listened to a large amount of amplified music. Please note under "Other". If the examinee does not respond to 100 dB at any test frequency, record "100+" in the appropriate space.

4. Testing with the attenuator pads out

- a. If you find an examinee with a hearing level of 100 dB or above at any frequency when tested with the attenuator pads in, finish testing that ear, then retest that ear at all frequencies with pads out.
- b. Circle any entries already made on the audio form for results of testing with pads in, and write in the new results of testing with pads out.
- c. Check the "Pads out" box under "Condition Affecting Test Results" at the bottom of the form.

5. Instructions to the examinee

- a. Points that should be stressed in detail to the examinee
 - (1) Tell the examinee that once the earphones are placed by the technician, the examinee must not touch them. The

technician should ask if they are comfortable and readjust them if necessary.

- (2) Tell the examinee that he will hear tones that are high and low and that will become softer and softer until he will have difficulty hearing them. When he hears a tone, he should depress the response button and release it when the tone is no longer heard. Remind him to concentrate very hard when the tones are soft.
- (3) Have the examinee remove eyeglasses, earrings, chewing gum, wigs, and hair ornaments if they interfere with proper placement of the headset.

- b. Example of verbal instructions for examinees from 7 to 74 years old

We are going to see how well you hear some tones from these earphones. You will hear short tones that are both high and low. They will become softer and softer. Each time you hear a tone, please press this button (technician demonstrates with response button) and when you no longer hear the tone let the button up. Listen carefully when the tone starts to get softer but even if you think you hear it, press the button and I will be able to tell if you hear it. First you will hear the tones in your right/left ear (point) and then in your other ear. If the tone seems to be in this ear (point to nontest ear), please tell me. Remember to press the button when you hear a tone and let it up when you no longer hear it. Do you have any questions? (If so, clarify as necessary.)

- c. Example of verbal instructions for 6 year olds and immature older children

(Bring the child into position to face the audiometer. With a 50 dB, 1000 Hz tone in one phone, hold it to the child's ear.) We are going to see how well you can hear some tones from these earphones. Listen to this one. Every time I play a tone, the red light goes on. Do you see it? (Demonstrate) If you listen carefully and hear the tone, you can turn it off by pressing this button and making the white light go on. (Indicate by depressing response button.) (Hand the response button to the examinee and present the tone, encouraging the child to press the response button. When he does, release the stimulus tone. Repeat the sequence at least once or until you feel that the child understands his task. Reinforce the child's performance with a positive

comment.) Good. Now we will play this game while you sit in that chair. (Indicate the chair and hand the child the response button.) (Place the headset on the child.) First you will hear the tones in this ear (indicate right or left) and then you will hear them in your other ear. Are you ready?

- d. Examples of verbal instructions when masking of the better ear is required (when the difference between the hearing levels of the two ears is 40 dB or greater at any frequency)

Now you will hear the tone in your right/left ear (point). At the same time you will hear a noise, like wind, in your other ear (point). The noise is to keep you from hearing the tone in that ear so don't pay any attention to it. I want you to listen for the tones in your right/left ear (point) and press the button whenever you hear them. Do you understand? (If not, clarify as necessary.)

6. Specific procedure for hearing test

- a. Take the examinee into the test room and seat him opposite you but facing away so that he cannot see you or the equipment being operated.
- b. Close the test room doors.
- c. Ask the examinee if he has any problems which might affect his hearing such as colds or earaches, or anything like that. Record these under "Condition Affecting Test Results."
- d. Repeat the instructions briefly.
- e. Before placing the earphones, make sure the ears are not obstructed with cotton.
- f. Place the earphones on the examinee and make sure that each earphone is over the ear canal and that it has a good seal against the examinee's ear. The red earphone is placed on the right ear; blue on the left. Hair should be pushed away from the ears before the headset is placed.

- g. Make sure that the audiometer is ready for the test by checking that it is set as follows:

Channel I

<u>Machine Dial</u>	<u>Correct Setting</u>
Channel I Monitor	Off (unless using)
Channel I Output	Right/Left
On/Off Toggle Switch	Off
Auto/Manual Toggle Switch	Manual
Frequency	1000 Hz
Decibels	70 dB ¹

Channel II

<u>Machine Dial</u>	<u>Correct Setting</u>
Channel II Monitor	Off unless using
Channel II Output	Off ²
On/Off Toggle Switch	Off ²
Auto/Manual Toggle Switch	Manual
Frequency and Input	NB Noise
Decibels	90 dB ¹

¹When pads are out, the decibels should be set at "40" for Channel I and "60" for Channel II.

²When masking is required, the Channel II Output should be set at Right/Left and the On/Off Toggle Switch should be set at "On".

NOTE: DIALS SISI and Speech-Input have nothing to do with either Air Conduction or Masking testing.

- h. Introduce the 1000-Hz tone to the first ear to be tested at a level of 70 dB for about one second. This should be well within the range of audibility for most examinees and will serve as listening practice. If the tone is not heard at 70 dB, increase the level in 10-dB steps until he responds to it.
- i. When the examinee responds, set the intensity dial 10 dB below the previous stimulus intensity (60 dB) and present the tone for one or two seconds.

- j. Decrease the level of the tone in 10-dB steps with at least one presentation per level until no response is obtained.
- k. Then increase the intensity dial by 5 dB and present a stimulus.
- l. If a response is obtained at this level, reduce the intensity by 10 dB. If no response is obtained, increase the intensity by 5 dB. Always descend by 10-dB increments and count the number of responses at the lowest level while ascending in intensity in 5-dB steps.
- m. Record as the threshold the lowest dial reading at which more than half of the responses are obtained to ascending presentations, that is, two out of three or three out of five trials. Below this level, less than 50 percent response is obtained and above this level, 100 percent response is approached.
- n. Enter the correct two-digit entry on the test form.
- o. Repeat the procedure presenting each successive frequency in the order listed on the examination form to the test ear, and then shift to the other ear as indicated on the test form until the pure tone test has been completed for all frequencies in both ears.

7. Masking procedure to be used when the difference in thresholds between the two ears is 40 dB or greater at the same frequency.

At any frequency, when the threshold of one ear is poorer than the other ear by 40 dB or more, retest the poorer ear while using a masking noise in the better ear.

- a. When this difference of at least 40 dB is found while testing with pads in, use a masking level of 90 dB, pads in, regardless of the difference in thresholds between the two ears. Record these results in the appropriate spaces on the audiometry form.
 - b. When this difference of at least 40 dB is found while testing with pads out, use a masking level of 60 dB, pads out, regardless of the difference in thresholds between the two ears. Record these results in the appropriate spaces on the audiometry form.
8. Procedure necessary for threshold accuracy
- a. Avoid rhythmic presentation of signals to the examinee. The examinee may respond to the rhythm rather than to the sound. This is especially true of younger persons.

- b. Avoid the long, drawn-out search for a threshold that tends to lessen the interest and cooperation of the person being tested and to produce fatigue. If necessary, test at another frequency, then return to the problem frequency later. Note at the bottom of the form any change in the order of the test.
- c. Avoid giving visual or auditory cues when the tone is presented, for example, looking at the person each time a tone is presented or making a click with the interrupter switch.
- d. Double check the dial readings.
- e. Check whether or not the interrupter switch was in the "off" position.
- f. Avoid activity which will distract the examinee.
- g. Check the response of the examinee occasionally by leaving the tone off for several seconds and then presenting the tone to see if he is responding consistently.
- h. Avoid presentation of the test tone for longer than three seconds. This may lead to a false response.
- i. Count only the ascending responses in determining the threshold.
- j. Avoid being influenced by the threshold obtained for the first 1000 Hz tone when obtaining the threshold for the second presentation of this tone.
- k. Make sure all forms are complete. Record the time the test is finished on the control record. If the test is not done or incomplete, record the reason why on the audio form, the control record, and the audio roster.

ELECTROCARDIOGRAPHY

Equipment

- Marquette Microcomputer Augmented Cardiograph Unit
- Marquette cassette tapes
- 14-wire patient cable
- Metal electrodes (4)
- Suction electrodes (11)
- Extremity electrode straps (4)
- Extra patient cable wires
- External calibrator unit
- ECG Sol
- Alcohol
- Gauze pads
- Fine sandpaper
- Table paper
- Pillow

Introduction

All adult examinees (ages 20-74) are administered a resting electrocardiogram (ECG) as a routine part of the physical examination. A Marquette Microcomputer Augmented Cardiograph (MAC) unit is used to obtain the electrocardiograms. The MAC unit has five modes of operation: resting (manual), transmitting, tape recording, tape playback, and selftest. The resting (manual) mode and the tape recording mode are used to obtain the two ECG tracings during the exam. The specific functions of all five modes are discussed later in this chapter.

Description of the Equipment

The function of the MAC unit is to obtain a three-channel electrocardiogram for hard copy charting and recording on tape. Because the MAC unit has a wide range of capabilities dependent upon feature selection, it is important to set the feature switches in the format described in this section. Features are listed below in sequence, top to bottom, left to right as they appear to the technician facing the little unit.

1. Calibrator panel

The panel consists of a bank of fourteen outlets into which the technician plugs the fourteen associated lead wires required to perform an internal machine calibration.

2. Patient data digi-switches

The twenty digi-switches provide for pertinent examinee information to be recorded on tape. Before recording an ECG, the switches should be set to reflect the appropriate information.

<u>Digits</u>	<u>Information</u>	<u>Possible Settings</u>
1-2	Cassette slot number	01-16
3-5	Technician number	100-149
6-8	Examinee height in cm	001-998
	Height unknown	999
9-11	Examinee weight in kg	001-998
	Weight unknown	999
12-13	Sample person age in years	20-74
14	Sex/race code	1-4
	Hispanic male	1
	Hispanic female	2
	Other male	3
	Other female	4
15-16	Stand number	01-55
17-19	Sample number	600-999
20	Check digit	0-9

3. Mode thumbwheel switch

This switch is used to select one of three machine modes of operation, resting (manual) or tape recording ECG, tape playback, or selftest.

4. Sensitivity (mm/mV) thumbwheel switch

This switch should be in the third position to provide ten millimeters per millivolt on the chart paper.

5. Indicator lights

Six indicator lights on the unit light up as specific segments of the electrocardiogram are being recorded on paper. These indicator lights represent the following lead groups:

Std (Standard complex),
I II III,
R L F,
V₁ V₂ V₃,
V₄ V₅ V₆,
Rhythm (Frank lead sets).

6. Call/Send indicator

This indicator is used for the transmitting mode only. The indicator lights up when the Call pushbutton is depressed and blinks throughout all data transmission. Upon acknowledgement of the ECG data transmission, the indicator light goes out.

7. Paper supply indicator

The indicator light flashes when the unit is running out of chart paper or when the paper carrier assembly is not seated properly.

8. LED display

This is a three-character display used in the resting, transmitting, and selftest modes. The normal display for a resting ECG is the examinee's heartrate. The remaining displays indicate problems associated with the ECG or with the transmittal of data. These display codes are listed in the Marquette service manual.

9. 35-Hertz filter pushbutton

The 35-Hz filter reduces noise on the ECG tracing. This switch should be depressed for data collection but inoperative during the selftest.

10. Chart paper speed pushbutton

Four chart paper speeds are provided for use with the Marquette system. All data collection and calibrations should be run at 25 millimeters per second. The 25 mm/sec pushbutton should be depressed during all operating phases.

11. Auto pushbutton

Depressing this switch activates a hard copy tracing of either the twelve-lead or the Frank-lead ECGs.

12. Select pushbutton

Depressing this switch cycles the machine through the six ECG segments that can be recorded. The Select switch can be used to designate the recording of a specific segment and must be used to cycle the machine to the Rhythm function to obtain a Frank-lead tracing.

13. Run pushbutton

Depressing this switch starts the chart paper drive.

14. Stop pushbutton

Depressing this switch stops the chart paper drive.

15. Call I

This switch is not functional.

16. Call II

Depressing this switch transmits data to tape.

Test Procedure

The ECG includes a standard twelve-lead set as well as Frank (orthogonal) leads. Fourteen leads must be placed at precise anatomical locations on the examinee to obtain optimal quality data.

1. Preparation

- a. Record the beginning time on the control record.
- b. Have the examinee sit on the ECG table with his feet toward the bottom of the table in preparation for lying down on his back. Have him remove the examination gown top. If the examinee is female, have her remove only the left arm from the gown to reduce the amount of exposure and to facilitate redraping.

2. Lead placement

- a. Before placing any lead, apply a small amount of electrode paste to the examinee's skin at the appropriate site and rub the skin surface with the electrode using an up and down motion to ensure good contact. Excessive amounts of electrode paste should not be used, especially at the precordial sites, as this increases the possibility of contact between the electrode pastes on two adjacent chest electrode sites. If the examinee's skin is extremely oily, scaly, or sweaty, clean the electrode area with alcohol before applying the paste.
- b. Palpate the fifth intercostal space at the sternal junction. Place the M orthogonal electrode plate at this level at the midline on the examinee's back. Tape the plate in position if necessary.

- c. Have the examinee lie down flat on his back with his arms relaxed at his sides.
- d. Apply the four limb-lead electrodes to the extremities using either suction electrodes or straps. Apply the right leg (RL) electrode first to allow adequate stabilization time; then apply the left leg (LL), left arm (LA), and right arm (RA) electrodes. Position the arm electrodes on the upper arm just distal to the shoulder joint and the leg electrodes just proximal to the ankle joint on the medial calf. Extremity electrodes positioned anywhere on the extremity should yield the same electrical potential from that extremity.
- e. Palpate the examinee's chest and place the precordial leads appropriately. Locations for the chest electrodes are:
 - V₁ - fourth intercostal space at the right border of the sternum,
 - V₂ - fourth intercostal space at the left border of the sternum,
 - V₃ - midway between positions V₂ and V₄,
 - V₄ - midclavicular line and the interspace at which the apex is located or at the fifth intercostal space if the apex is not palpable,
 - V₅ - anterior axillary line on a horizontal level with V₄,
 - V₆ - midaxillary line on the same horizontal level as V₄ and V₅.
- f. Place the three remaining orthogonal leads at their correct positions, the fourth orthogonal lead (M) having already been positioned on the examinee's back:
 - E - over the midsternum at the level of the fifth intercostal space (the same level as V₄, V₅, and V₆),
 - I - at the right midaxillary line (opposite and on the same level as V₆),
 - H - on either side of the neck or anywhere above the shoulders except for bony areas,

3. Recording procedure

a. Chart paper recording

- (1) Set the data digi-switches to indicate the pertinent examinee information. The odd-up, even-down rule should be followed when setting height and weight.
- (2) Check that all other switches on the Marquette unit are set properly. The ECG segment indicator light should be on I II III. If it is not, depress the Select switch until this light goes on.
- (3) Depress the Auto switch. A standard twelve-lead ECG using 5.6-second lead sets will be recorded on chart paper and a standard complex generated at the end of the tracing.
- (4) Observe the LED display for error codes.
- (5) Depress the Select switch until the Rhythm indicator light goes on.
- (6) Depress the Auto switch. An orthogonal Frank lead ECG using 5.6-second lead sets will be recorded on chart paper and a standard complex generated at the end of the tracing.
- (7) Using the Select switch, cycle through the segments until the Std light is on.
- (8) Press Run. Allow the chart paper to advance until the ECG including a standard complex can be removed from the machine.
- (9) Place a sample number sticker on the tracing. Record the tech number and date on the tracing; then file it in the ECG room.

b. Cassette tape recording

- (1) Follow (1) and (2) of the chart paper recording instructions above.
- (2) Check that space is available on the cassette tape. If not, insert a new cassette tape labeled with the stand and tape numbers. Write the tape number and date on the log sheet.
- (3) Depress the Call II switch. The following actions should occur in sequence:

- (a) All lead segment indicator lights except Std and Rhythm should light up simultaneously.
 - (b) The Call/Send indicator should blink during data gathering.
 - (c) A standard twelve-lead ECG using nine-second lead sets should be recorded on chart paper and a standard complex generated at the end of the tracing.
 - (d) The LED should display "dp" as data are recorded on cassette tape. Upon completion of data recording, the LED should display "P" and a number corresponding to the tape position used.
- (4) Depress the Select switch until the Rhythm indicator light is on.
 - (5) Depress Call II. An orthogonal Frank-lead ECG using nine-second lead sets will be recorded on chart paper and cassette tape.
 - (6) Depress the Select switch to cycle to the Std segment.
 - (7) Depress Run. Allow the chart paper to advance until the ECG including a standard complex can be removed from the machine.
 - (8) Place a sample number sticker on the ECG roster and enter the date, technician number, and tape positions used for recording the ECG. Comments regarding the test should be noted in the section of the roster provided for them. It should be emphasized that the ECG roster must show the chronological sequence of data recorded. If a person was examined and then later reexamined, the roster must include an entry for each time the person was examined.
 - (9) Place a sample number sticker on the tracing. Record the tech number and date on the tracing; then place it in the physician's passbox to be reviewed.
 - (10) Record the ending time on the control record.

Field Calibration

1. Introduction

At the beginning of the stand and once a week during the stand, perform a field calibration. The full calibration of the Marquette ECG system consists of three procedures: a self-calibration to assess the internal integrity of the system, an external source calibration to assure that data are being gathered properly from outside signals, and a playback calibration to assess the reliability of external source data stored on cassette tape.

2. Beginning-of-stand calibration procedure

a. Self-calibration

- (1) Insert the patient cable wires into the appropriate outlets of the self-calibrator panel on the machine.
- (2) Set the machine function switches as follows:

<u>Switch</u>	<u>Setting</u>
Mode	7
Sensitivity	10
35-Hz filter	Out, not depressed
Paper speed	25 mm/sec

- (3) Press Auto. A calibration tracing which includes tests for gain, linearity, step response, frequency response, and offset will be generated on hard copy.
- (4) Remove the chart tracing from the machine and compare the test patterns with the standard configurations (Service Manual for MAC, section 6, pages 6-8/6-9). If any difference is noted, inform the chief tech and the biomedical engineer.

b. External source calibration

- (1) Label a cassette tape with the date, stand number, tech number, and the word "test"; and insert it into the machine.
- (2) Insert the patient lead wires into the appropriate outlets of the external source calibrator.
- (3) Check the batteries of the calibrator by pushing the On/Off toggle switch to the right. A red test light on the right side of the calibrator should light up. If it doesn't, replace the batteries.
- (4) Turn the external calibrator on.

(5) Set the patient data digi-switches as follows:

<u>Digit</u>	<u>Information</u>	<u>Setting</u>
1-2	Cassette slot number	01-16
3-5	Technician number	100-149
6-11	Identical numbers	999999
12-20	Sequential numbers	1-9

(6) Set the machine function switches as follows:

<u>Switch</u>	<u>Setting</u>
Mode	0
Sensitivity	10
Indicator lights I II III	Lighted
35-Hz filter	Depressed
Paper speed	25 mm/sec

(7) Press Call II. A calibration tracing of the output signals from the external calibrator will be generated on hard copy and on cassette tape.

(8) Using the Select pushbutton cycle through the segment indicator lights until Rhythm is lighted.

(9) Repeat step (7).

(10) Reset the patient data digi-switches as follows:

<u>Digit</u>	<u>Information</u>	<u>Setting</u>
1-2	Cassette slot number	01-16
3-5	Technician number	100-149
6-11	Descending sequential numbers	9-4
12-20	Descending sequential numbers	9-1

(11) Repeat steps (7) through (9).

(12) Reset the patient data digi-switches as follows:

<u>Digit</u>	<u>Information</u>	<u>Setting</u>
1-2	Cassette slot number	01-16
3-5	Technician number	100-149
6-11	Descending sequential numbers	9-4
12-20	Identical numbers	99999999

(13) Repeat steps (7) through (9).

- (14) Remove the chart tracing from the machine and compare the test pattern with the standard configurations shown on the face of the calibrator unit. If any difference is noted, inform the chief tech and the biomedical engineer at headquarters.
- (15) Turn the external calibrator off and store it in the ECG cabinet.

c. Playback calibration

- (1) Remove the patient lead wires from any calibrator source.
- (2) Set the machine Mode switch to 6.
- (3) Set the first two digits of the patient data digi-switches to reflect the tape position number that is being recalled.
- (4) Press Call II. The information stored on the selected tape position will be recalled and generated on hard copy.
- (5) Remove the chart tracing from the machine and compare it to the original tracing. If any difference is noted, inform the chief tech and the biomedical engineer in headquarters.

d. Transmittal

Label all tracings with the stand number, stand location, tech number, date, and type of calibration recorded. Send all hard copy tracings and the cassette test tape immediately to the biomedical engineer at headquarters.

3. Weekly calibration procedure

Do the weekly calibration procedure on the first examining day of the week. It consists of the same three procedures as the beginning-of-stand calibration and is performed in the same way with one exception. For the weekly calibration, generate only the first two records of the external source calibration.

Beginning of Stand Procedures

1. Plug the power cord into the wall power outlet. Turn the machine on by pressing the power toggle switch located on the lower front panel of the unit.

2. Attach the fourteen-wire patient cable to the main body of the machine. Be careful that the connector on the cable is properly mated to the socket to avoid damaging any of the connector's prongs.
3. Rub the banana plug at the end of each lead wire with fine sandpaper to remove any tarnish. Use the sandpaper to clean any tarnish from the M electrode plate and the limb lead electrode plates (if in use).
4. Clean all suction electrodes in a dilute solution of mild detergent. Allow these electrodes to dry thoroughly.
5. Supply the room with scissors, exam table paper, gauze pads, alcohol, and ECG Sol in preparation for exams. Make sure that there is an adequate supply of ECG cassette tapes. If there is not, inform the biomedical engineer in headquarters.
6. Hang the clipboard with the roster pages on the wall cuphook supplied.
7. Make sure that the legs of the exam table are seated firmly in floor holders. Place a pillow at the head of the table and cover it with examination table paper.
8. Perform all beginning-of-stand calibrations as outlined in the field calibration section of this chapter.

End of Stand Procedures

1. Turn off the incoming power to the machine by pressing the power toggle switch located on the lower front panel of the unit.
2. Disconnect the power cord from the wall power outlet. Coil the cord and place it in the accessory basket attached to the front of the machine.
3. Disconnect the electrodes from the patient cable. Clean each one; then store them in the cabinet in the ECG room.
4. Disconnect the patient lead wire cable. Place it in a protective covering and store it in the cabinet in the ECG room.
5. Place all room supplies in the cabinet.
6. Make sure that the webbing strap that secures the Marquette machine for transit is properly affixed to the wall holders and tightened around the unit.

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