T3 MANUAL OF OPERATIONS

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CHAPTER 19

ECG CORE LABORATORY PROCEDURES

19.1 REST AND EXERCISE ELECTROCARDIOGRAPHIC REQUIREMENTS

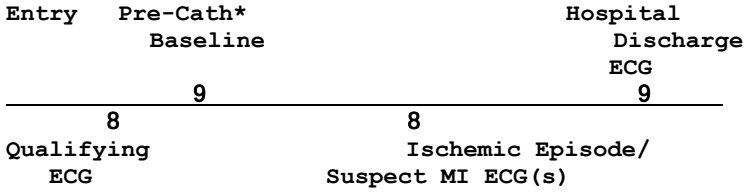
ECGs are used throughout the T3A and T3B Protocols to confirm the presence of coronary artery disease and ischemic pain. This chapter describes the ECG requirements and the procedures to be followed in the performance of ECGs in the T3 studies.

19.1.1 ECG Collection Times

The protocol ECG sampling points for T3A and T3B are shown below.

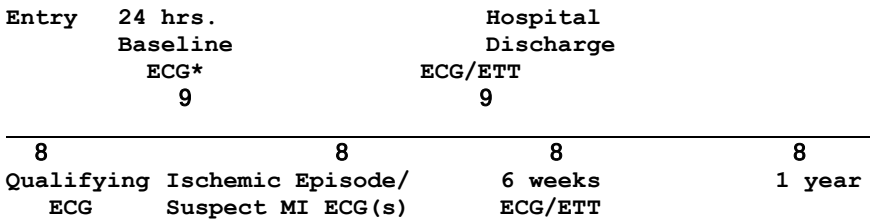
T3A Protocol:

Estimated number of ECGs/patient: 3



T3B Protocol:

Estimated number of rest ECGs/patient: 3
Estimated number of ETTs/patient: 2



*This ECG should be kept on file at the site and mailed to the Core ECG Laboratory only if there are significant new Q, ST, or T wave changes or if the patient experiences ischemic pain qualifying as failure of initial therapy.

19.1.1.1 Types of ECGs to be Collected

1. **Qualifying ECG. In addition to a qualifying episode of ischemic rest pain, each patient enrolled in the T3 trial must have evidence of coronary artery disease. Such evidence may be documented by prior MI, at catheterization (by > 70% luminal narrowing), or by new or presumably new ECG evidence of myocardial ischemia. A qualifying ECG should be submitted for each patient. For the individuals who qualify by prior MI or angiographic evidence of coronary artery disease, an ECG from the qualifying period should still be submitted. In some cases, more than one ECG may be submitted to the ECG Core Laboratory to document transient ECG changes.**

   ECG evidence of ischemia is defined as:

   a. **Transient or persistent ST-segment depression of at least 1.0 mm (80 msec. past J point) in two consecutive leads, or**
   b. **Transient or persistent T-wave inversion in two consecutive leads, or**
   c. **Transient (< 30 minutes in duration) ST-segment elevation of at least 1.0 mm in two consecutive leads. (See Section 3.3.1 and 4.3.1 of this Manual for further description of inclusion criteria).**

   Three copies of the qualifying ECG tracing should be obtained for use at the various Core Laboratories.

2. **T3A Pre-Cath (Baseline ECG). For T3A patients, submit a 12-lead ECG along with the ECG Acquisition Form (Form 09). This ECG should be obtained prior to the first protocol catheterization and after the cessation of ischemic pain. If the qualifying episode of ischemic pain has not ended before the first protocol catheterization, the ECG should be obtained as soon as possible after study treatment initiation.**

3. **T3B - Baseline ECG. Obtain a 12-lead ECG in the absence of ischemic pain within 24 to 48 hours of initiation of study drug treatment. This ECG should be retained in the T3 chart and mailed to the ECG Core Laboratory only if and when the patient develops an ischemic episode or suspected MI.**

4. Ischemic Episode/Suspect MI. For each episode of ischemic pain for which an ECG is obtained and qualifies as a treatment failure, submit a 12-lead ECG and Form 09. In the case of an ischemic episode or suspected MI, the following two ECGs should be sent to the ECG Core Laboratory:
   a. The ECG showing the maximum new Q- or QS-wave or maximum change of an old Q- or QS-wave.
   b. The ECG showing the maximum ST-segment elevation. If there is no ECG exhibiting ST-segment elevation, two ECGs may be chosen that show the maximum ST-segment depression and maximum negativity of the T-wave.

   The only situations when a single ECG will suffice for documentation of an MI are:
   a. when the maximum Q or QS findings and maximum ST-T changes co-exist on a single ECG,
   b. when only one or the other of these findings are noted,
   c. when there is no significant ECG change, or
   d. when only one ECG is recorded.
5. Pre-Hospital Discharge. A 12-lead ECG should be obtained within three days before hospital discharge. Submit this 12- lead ECG for both T3A and T3B patients. ECGs obtained during an exercise test using the modified Bruce Protocol (stopping at Stage II) should also be submitted at this time for T3B patients. The resting tracing from the exercise test may not be substituted for the 12-lead ECG.
6. Six-Week Follow-up. Submit a 12-lead ECG and ECGs obtained during an exercise test using the standard Bruce Protocol for T3B patients. These ECGs should be obtained within 42 to 70 days after randomization. The resting tracing from the exercise test may not be substituted for the 12-lead ECG.

ECGs and exercise test forms must be submitted to the ECG Core Laboratory for all protocol required ECGs and exercise tests. Only original tracings of ECGs should be mailed to the ECG Core Laboratory. A copy of the exercise test form must be mailed to the Core Laboratory along with the exercise test tracings. A copy of the rest ECG and exercise test tracings should be kept on

file at the Clinical Center. The required study forms for the above tests must be mailed to the ECG Core Laboratory at the same time as the ECG tracings. The original ECG Form 09 or the original ETT Form 8E, with a copy of the ECG(s) attached, should be sent to the Data Coordinating Center. If an ECG could not be obtained for a particular time period or event, Form 18 should be completed and submitted to the Data Coordinating Center.

ECGs associated with a Persantine/Thallium Imaging test should not be submitted to the ECG Core Laboratory or the Data Coordinating Center. These should be kept with the patient's medical record at the Clinical Center.

19.1.2 Rest ECG Requirements

Two original ECG tracings should be obtained for each protocol required ECG. One original of the ECG tracing should be kept in the patient's file at the Clinical Center. The ECG Form (Form 09) should be sent to the Data Coordinating Center with a copy of the ECG tracing. The second original ECG tracing should be labeled and mailed to the ECG Core Laboratory. In T3A, a copy of the Qualifying ECG, should be mailed to the Quantitative Core Laboratory along with the first protocol coronary angiogram. For T3B patients assigned to the Invasive Strategy, a copy of the Qualifying or ischemic pain ECG and a copy of the Baseline ECG should be mailed to the Qualitative Core Laboratory along with the coronary angiogram. For details on telephone transmission of ECGs, see Section 19.3.4, ECG Transmission, of this chapter.

19.1.3 Exercise Protocol and Electrocardiographic Requirements

19.1.3.1 Electrocardiographic Requirements

All patients will undergo exercise testing using the modified Bruce protocol prior to hospital discharge, and the exercise test will be limited to a submaximal workload or completion of Bruce Stage II. The six-week exercise test will be performed using the level of maximal exercise in the Bruce protocol.

All exercise ECGs submitted for review to the ECG Core Laboratory must be labeled with the following information:

Patient Identification Number and NAME CODE
Date of ECG
Time of Test: Hospital Discharge or Six-Week
Protocol ECG: Standing Rest
Peak Exercise

**Immediate Post-Exercise (IPE)
Recovery**

If the entire exercise test ECG is attached with Z-fold paper, then you need only label the segments containing the protocol required ECGs as well as the first page of the ECG tracings. If the entire exercise test is submitted on separate pages (i.e., without Z-folds), it is essential that all pages be labeled with:

Patient Identification Number and NAME CODE
Date of ECG
Time of Test
Protocol ECG

The Data Coordinating Center will provide pre-printed labels with this information for ECG tracings obtained during protocol exercise treadmill tests.

If the ECG is not a protocol ECG, please note on the ECG tracing the time or stage when the ECG is obtained. If entire exercise test tracings are submitted, please number the ECGs in the order they were obtained. Exercise equipment at your site may imprint each ECG obtained with identifying information. If this is the case at your hospital, then it is not necessary to identify the stage or exercise time on each ECG submitted to the ECG Core Laboratory. Exercise tests which are not labeled will be returned to the Clinical Center for completion. All ECGs required by protocol must be 12-lead electrocardiograms.

All ECGs submitted to the ECG Core Laboratory should be original copies. The ETT Form (Form 8G) will be used to collect physiologic and other pertinent exercise test data. An exercise test data packet for any individual patient mailed to the ECG Core Laboratory must include:

1. **Pre-exercise standing rest** ECG recorded with the limb electrodes placed in the modified exercise position (placed on the torso) recorded immediately prior to the onset of exercise.
2. **Peak exercise** 12-lead ECG obtained 30-60 seconds prior to the termination of the exercise protocol.
3. **Immediate post-exercise** 12-lead ECG recorded in the early recovery (or cool-down) period, within 30 seconds after the cessation of the

exercise protocol.

4. **Recovery** ECG tracing showing maximum abnormalities (with the time of recovery clearly identified on the tracing) or the three-minute recovery ECG tracing if the electrocardiogram has normalized at this point. This is the final ECG which should be obtained for all T3 exercise tests.

5. The ETT Form.

19.1.3.2 Exercise Test Protocol Requirements

The following two tables show the parameters associated with the exercise treadmill test at hospital discharge and at six-weeks.

Hospital Discharge ETT

The modified Bruce protocol consists of the following stages:

Stage	Speed	Grade	Time/Stage
0	1.7	0%	3:00*
1/2	1.7	5%	3:00
I	1.7	10%	3:00
II	2.5	12%	3:00

* Patients who are elderly, debilitated, or who are unable to ambulate at Bruce Stage 1/2 may start exercising at Bruce Stage 0.

Six-Week ETT

The Standard Bruce protocol consists of the following stages:

Stage	Speed	Grade	Time/Stage
1/2	1.7	5%	3:00*
I	1.7	10%	3:00
II	2.5	12%	3:00
III	3.4	14%	3:00
IV	4.2	16%	3:00
V	5.0	18%	3:00
VI	5.5	20%	3:00
-	-	-	-

*Patients who are elderly, debilitated, or who are unable to ambulate at Bruce Stage I may start exercising at Bruce Stage 1/2.

The patient should stop exercising after the completion of the entire test (completion of Stage II at hospital discharge) or when a study end point occurs. For this purpose the study end point is defined as follows:

1. Ischemic pain before completion of Stage II.

2. $\geq$ 2 mm of ischemic ST-segment deviation from baseline with or without

symptoms before completion of Stage II.

3. A hypotensive response (reduction in systolic pressure of more than 10 mm Hg from baseline or a prior recording during the ETT) before completion of Stage II.

19.2 EXERCISE TEST TECHNICIAN CERTIFICATION

Each technician wishing to be certified to obtain ECGs for the T3 Clinical Trial will need to submit the ECGs from five consecutive exercise tests in their entirety to the ECG Core Laboratory. The ECG tracings submitted may be photocopies of the original ECG tracings. A certification form should be completed for each exercise test technician submitting exercise tests to the ECG Core Laboratory.

An ETT technician will fail Core Laboratory certification by submitting more than one exercise test with excessive baseline wander or motion artifact. In the case where a technician has failed certification, written notification of the failure will be mailed to the research coordinator along with a letter of explanation and pertinent peak exercise ECG tracings. For certification of this exercise test technician, five consecutive exercise tests will need to be resubmitted in their entirety to the ECG Core Laboratory prior to submission of any T3 exercise tests.

Sites with exercise test technician(s) who initially failed certification will be mailed monthly tabulations of exercise test quality. Following six months of acceptable quality exercise tests, these sites will no longer receive monthly quality appraisals. If, however, any exercise technician continues to obtain suboptimal ECG tracings, they will not be permitted to submit exercise tests to the ECG Core Laboratory.

More detail concerning the certification process can be found in T3 Manual of Operations, Volume 2, Chapter 5, Core Laboratory Certification Procedures.

19.3 SUBMISSION OF DATA TO THE ECG CORE LABORATORY

19.3.1 Rest Electrocardiograms

19.3.1.1 Submission of Original ECG Tracings

Original ECG tracings must be submitted to the ECG Core laboratory whenever possible. In the rare event that you can only obtain a photocopy of the ECG or exercise ECG tracings:

1. Submit the best quality reproduction as possible.

2. Ensure that the ECG is photocopied "straight" on each page.

3. Photocopy the entire 12-lead ECG on a single page.

Upon request the ECG Core Laboratory will return all original tracings following analysis. These requests must be made in writing and mailed to the ECG Core Laboratory along with the ECGs or exercise test tracings.

19.3.1.2 In-hospital ECGs

To minimize deviations which may occur by varying electrode position, all electrode sites should be marked on the exact anatomic locations for the duration of the hospital stay.

19.3.1.3 Delete Diagnostic Information from ECGs

When submitting ECGs which have been labeled with diagnostic information, please be sure that all treatment strategies are deleted or covered over prior to mailing to the ECG Core Laboratory. For example, the diagnosis listed at the top of the ECG may list: post-PTCA or post-CABG. The ECG Core Laboratory should not receive such information.

19.3.1.4 Referring M.D. Letter for Follow-up ECGs

It will be helpful for coordinators, upon scheduling a patient for a follow-up ECG, to mail a letter of explanation concerning the need for original ECG tracings to each referring physician. A sample letter is enclosed in Exhibit 19-1.

19.3.2 Exercise Tests

19.3.2.1 Submission of Original ECG Tracings

Original ECG tracings must be submitted to the ECG Core Laboratory whenever possible. In the event that you can only obtain a photocopy of the exercise ECG tracings, please try to:

1. Submit the best quality reproduction as possible.
2. Ensure that the ECG is photocopied "straight" on each page.
3. Photocopy the entire 12-lead ECG on a single page.

Upon written request the ECG Core Laboratory will return original ECG tracings following analysis. A written request should indicate whether this policy should apply to all ECG tracings or to selected tracings. If this request applies to all tracings, once established, original ECG tracings will be returned to the Clinical Center after analysis. If a request is being made to return selected ECGs or exercise test tracings to the Clinical Center, the written request should accompany the ECGs in question.

19.3.2.2 Submission of 12-Lead ECGs or Rhythm Strips

Twelve-lead ECGs should be obtained for all protocol required ECGs. When transient ST or T wave changes can only be documented on a rhythm strip, be sure to identify the lead used and ensure the transient changes are not as a result of postural changes. Twelve-lead ECGs are required and preferable for all protocol ECGs obtained during hospital admissions, for scheduled follow-up, and during exercise testing.

19.3.2.3 Delete Diagnostic Information from Exercise ECGs

When submitting exercise tests, please be sure that all treatment strategies or referring diagnoses have been deleted or covered over prior to mailing to the ECG Core Laboratory. For example, the diagnosis listed at the top of the ECG may list: post-PTCA or post-CABG. The ECG Core Laboratory should not receive such information.

19.3.2.4 Filtered ECGs During Exercise Testing

Filtered ECGs may be used during exercise testing. It is suggested that ECGs be obtained without the use of any additional filtering techniques, however, the ECG Core Laboratory will accept ECG tracings which have been filtered if this is the common practice of the T3 Clinical Center. It should be emphasized that the use of filtered tracings should not replace adequate skin preparation techniques.

19.3.2.5 Referring M.D. Letter for Follow-up Exercise Tests

It will be helpful for coordinators, upon scheduling a patient for a follow-up exercise test, to mail a letter of explanation regarding Core Laboratory requirements to each referring physician. A sample letter is enclosed in Exhibit 19-2.

19.3.2.6 Test Summary or Averaged Summary Exercise Test Data

Copies of the physician's test interpretation or summary graphs printed from exercise testing equipment following test termination are not satisfactory for submission as exercise test data. A copy of data which would not be acceptable to submit for exercise test information is shown in Exhibit 19-3.

19.3.3 Submission of Inaccurate/Incomplete Data

When submitting ECGs to the ECG Core Laboratory which do not sufficiently meet acceptable quality, a letter of explanation must accompany each mailing. A sample letter has been enclosed in Exhibit 19-4 for your use. In the case that a Clinical Center does not submit a letter of explanation, the Clinical Center coordinator will be contacted for submission of an additional electrocardiogram or for an explanation concerning the inaccurate or incomplete data. For exercise tests and in certain cases protocol ECGs, the ECG Core Laboratory will return the ECG tracings to you for submission of missing data. Enclosed with the ECGs you would find a letter detailing missing or incomplete information (Exhibit 19-5). It would benefit each coordinator to submit all required information initially to the ECG Core Laboratory. Otherwise research

coordinators will be required to review and resubmit ECG data after the ECG Core Laboratory has received and reviewed the data. This may be up to three to four weeks after the original ECG was obtained.

We expect that a small minority ($\leq$ 5%) of ECGs will be of unacceptable quality. Individual Clinical Centers should not exceed 5% for in-hospital ECGs. For ECGs obtained from outlying hospitals, please prearrange receipt of original tracings from those referring physicians when follow-up data, such as at six-weeks, are required. It has been helpful for coordinators, upon scheduling a patient to mail a letter of explanation regarding Core Laboratory requirements to each referring physician. Sample letters are shown in Exhibits 19-1 and 19-2.

19.3.4 Procedures for Mailing/Transmitting ECGs

All sites have the option to mail or transmit ECGs through dedicated telephone lines to the ECG Core Laboratory.

19.3.4.1 ECG Transmission

For your convenience, the ECG Core Laboratory is equipped with a Marquette Mac-12 cart and a dedicated (1-800-621-7260) telephone line. However, your site must possess Marquette Electronics equipment for you to be able to use that line. Difficulties have arisen with specific Marquette MUSE systems. If you desire to transmit your ECGs electronically to the ECG Core Laboratory, please have your ECG lab supervisor contact Leslee Shaw with information on your site's MUSE system. A copy of all ECGs which have been transmitted to St. Louis will be kept for future use by the Data Coordinating Center. Upon transmission of the ECGs, you will receive a facsimile copy of all ECGs. You must, however, mail the ECG Form 09 and a copy of the ECG to the Data Coordinating Center.

For those sites who will be mailing ECGs, you should send original ECG tracings to the ECG Core Laboratory. At the same time, you should send copies of the ECGs with the ECG Acquisition Form (Form 09) to the Data Coordinating Center.

It is essential that you enter the exact date and time the ECG was obtained on the ECG Form. Do not round or approximate times on the ECG Form. Discrepancies of greater than nine minutes will be returned to the Clinical Center for clarification.

When mailing the exercise ECG tracings, please be sure that a copy of the Exercise Testing Form is sent to the Data Coordinating Center. If your site

possesses Marquette Electronics equipment in the Exercise Laboratory as well as a computerized storage facility, then you may be able to transmit exercise ECG tracings electronically to the ECG Core Laboratory. You will need to contact your MUSE staff and Exercise Laboratory personnel for further details. Certain Clinical Centers may not routinely obtain 12-lead ECGs during exercise testing. It is required that you do so for all protocol ETTs at hospital discharge and six-weeks. You will, therefore, need to make arrangements with your exercise testing staff or those at an outlying hospital to obtain only 12-lead ECGs at:

1. Standing rest (torso),
2. Peak exercise,
3. Immediate post-exercise, and
4. Three minute recovery (or maximum ECG change).

Often the peak exercise ECG may contain significant muscle artifact and it may be more beneficial for analysis to use an ECG which has been obtained within the minute preceding exercise termination. This can often be difficult for the research coordinator to identify and it may be easier for the entire exercise test to be mailed to the ECG Core Laboratory. We will gladly accept the entire test for our review. If the coordinator does not plan to mail all the exercise test ECGs to St. Louis, then he or she should carefully select peak exercise ECG tracings with the least baseline artifact and with a heart rate within ten beats per minute of the peak heart rate.

In the case where excessive artifact is noted at peak exercise, it is essential that the immediate post-exercise ECG tracing be as "clean" as possible. This tracing must be obtained within 30 seconds of exercise termination. Upon review of the certification tests quite frequently the first ECG recorded in the recovery period was not obtained until one minute following exercise termination. At one minute into recovery, the heart rate has often significantly decreased from its peak value. It is essential that you emphasize with the exercise testing staff that this immediate post-exercise ECG be obtained within 30 seconds of exercise termination.

In the event that a portion of the exercise test cannot be obtained, please mail the information collected along with a letter of explanation to the ECG Core Laboratory. If a letter of explanation is not submitted along with inaccurate or incomplete data, you will be contacted by the ECG Core Laboratory for further clarification of this exercise test.

Any missing ECGs or discrepancies noticed on your facsimile receipts sent from St. Louis should be immediately directed to our data entry coordinator, Laura Schaefer. If we cannot locate a missing ECG, another ECG will need to be sent. It is, therefore, beneficial for you to keep an additional original ECG tracing within each patient's file. If your site has the capability of computerized ECG storage, this may not be necessary. Occasionally, ECGs are obtained which do not for some reason reach the centralized storage facility and it is to your benefit to keep a copy within each patient's file.

Please be sure that all ECGs submitted for review to the Core Laboratory are labeled with the following information:

Patient Identification Number and NAME CODE
Date and time of ECG
ECG category

Labeling requirements for exercise ECGs are described in Section 19.1.3.1 of this chapter.

If you need to contact the ECG Core Laboratory, the following staff members can be responsive to your questions:

1. Regarding exercise testing: Mark Muehl, M.A.
   Leslee Shaw, M.A.
2. Regarding rest ECGs: Karen Stocke, B.S.
   Leslee Shaw, M.A.
3. Regarding fax receipts of ECGs/ETTs: Laura Schaefer

19.4 CORE LABORATORY DAILY OPERATIONS

The following procedures are utilized daily for evaluation and storage of Minnesota Code and QRS measurement data points in the T3 Core ECG Laboratory.

19.4.1 Entry Log and Quality Control Evaluation

All ECGs received at the laboratory are logged into our MicroVax II inventory program. All ECGs, at this time, undergo evaluation of the following quality control criteria:

1. Invalid calibration marks

   Calibration marks which exceed ± 1.0 mm greater than the standard 10 mm pulse.

2. Missing leads

   With the exception of rhythm strips, ECGs received missing one or more leads will be documented in our data base.

3. Excessive baseline wander

Baseline wander is considered excessive when greater than 3 mm difference exists between the P-Q baseline of three consecutive ECG complexes in more than one lead.

4. Motion artifact

Excessive motion artifact has been defined as motion artifact where the width of the movement spikes are $ 3.0 mm in two or more ECG complexes within any lead.

Upon receipt of ECGs at the ECG Core Laboratory, a full quality control analysis will be made. If an ECG from your Clinical Center does not meet any of the above listed quality control criteria, the Clinical Center coordinator will be contacted for submission of an additional electrocardiogram or for an explanation with regard to the inaccurate or incomplete data. For exercise tests and in certain cases protocol ECGs, the ECG Core Laboratory will return the ECG tracings to you for submission of missing data. Enclosed with the ECGs you will find a letter detailing missing or incomplete information.

All quality control markers are entered into a table (Exhibit 19-6). A summary of all quality control parameters for each Clinical Center will be provided to the research nurse/coordinators and Principal Investigators at each Steering Committee meeting.

19.4.2 ECG Interpretation

19.4.2.1 Initial Coding

The following QRS interval measurements are determined: PR interval, QRS duration, QT interval, Q duration, Q depth, R height, heart rate, and QRS axis. All measurements made by coders are reviewed by two lab supervisors with final approval by one of the lab physicians.

19.4.2.2 Lab Supervisors

Full ECG interpretation, including evaluation of all interval measurements and Minnesota code interpretation, are provided by the following individuals:

1. Kathy Galan, R.N.
2. Mark Muehl, M.A.
3. Karen Stocke, B.S.
4. Leslee Shaw, M.A.

Each ECG is evaluated by two of the above listed individuals prior to being given to a physician for evaluation. A copy of the T3 Minnesota coding sheet is shown in (Exhibit 19-7).

19.4.2.3 Physician Evaluation

Final interpretation of each ECG is made by one of the following lab physicians:

1. Preben Bjerregaard, M.D.
2. Liwa Younis, M.D., Ph.D.
3. Bernard Chaitman, M.D.
4. Robert Wiens, M.D.

19.4.2.4 Serial Change Comparison

Two or more ECGs are compared for changes in Q-wave, ST-segment, and/or T-wave codes. All ECGs are compared to the previously obtained ECG for (1) progression to a higher Minnesota code, (2) regression to a lower Minnesota code, and/or (3) no change in the codes between the two ECGs. A sample printout of the serial change report is included (Exhibit 19-8).

19.5 DATA ENTRY AND FINAL REVIEW

Upon final review, ECG data points are entered into our MicroVax II for storage. Each ECG must be entered twice for entry approval. Approved data can only be accessed by the lab supervisor, Leslee Shaw, and computer programmer, Li-Yung Lui.

19.6 EXERCISE TEST MEASUREMENT AND COMPUTERIZED INTERPRETATION

19.6.1 Entry Log and Quality Control Information

Each exercise test received at the laboratory is initially reviewed for any inaccurate or missing ECG data. All exercise tests are reviewed by one of the lab supervisors for:

1. Invalid or missing calibration marks.
2. Missing leads.
3. Averaged ECGs (filtered ECGs will be noted).
4. Excessive baseline artifact.
5. Excessive motion artifact.
6. Missing any of the following ECG tracings: standing rest, peak exercise, immediate post exercise, or recovery.
7. Original ECG tracings should be mailed to the ECG Core Laboratory for all exercise test ECGs including: standing rest, peak exercise, immediate post exercise, and recovery. All photocopied ECGs will be documented in this quality control program. It is our goal to have

Clinical Centers submit approximately 80% of the hospital discharge and six-week follow-up exercise tests as original tracings.

A copy of the exercise test quality control report has been included as Exhibit 19-9. A summary of all quality control parameters for each site will be provided to the research coordinators and Principal Investigators at each Steering Committee meeting.

Clinical Centers who have an exercise test technician(s) who initially failed certification will be mailed monthly tabulations of exercise test quality. Following six months of acceptable quality exercise test tracings, these Clinical Centers will no longer receive monthly quality appraisals. If, however, any exercise test technician continues to obtain suboptimal ECG tracings, they will not be permitted to submit exercise tests to the ECG Core Laboratory.

19.6.2 Initial ST Segment and Arrhythmia Evaluation

All leads with greater than ± 0.5 mm of ST segment changes observed at peak exercise or recovery will be measured on an X-Y digitizing board. Any arrhythmias visualized on the ECGs submitted to the laboratory will be entered into the patient's file.

19.6.3 ST Segment Measurement and Interpretation

The following data points will be measured in the exercise test program: R wave height, J point, and ST-segment depression or elevation (at 60 and 80 msec). All measurement points are evaluated by several criteria corresponding to upsloping, horizontal, or downsloping ST- segment depression and ST-segment elevation with and without Q-waves.

19.6.4 Physician Approval

All data points and corresponding criteria are reviewed by lab physicians. Specific data points may be remeasured until the exercise test information is acceptable to the reviewing physician. Upon final approval, the patient's exercise test file is transferred to a file which can only be accessed by one of our computer programmers.

19.6.5 Final Data Storage and Transfer of Data to the Data Coordinating Center

All data entry is reviewed by one of the lab supervisors prior to filing. Transfer of data to the Data Coordinating Center will be made by diskette mailing of the following files: entry log and quality control information, ECG

interpretation and serial change comparisons, and exercise test evaluation.

EXHIBIT 19.1

SAMPLE LETTER OF EXPLANATION TO REFERRING PHYSICIAN
CONCERNING ECG CORE LABORATORY REQUIREMENTS FOR ECGS

TO: _____

FROM:
T3 Research Coordinator

The following patient, _____, is scheduled on _____ at _____ for an electrocardiogram. It is very helpful for analysis of this ECG at the ECG Core Laboratory if we could obtain an original copy of this tracing. Could you please record two tracings, one for your records or for hospital records and one for us to be mailed to the T3 Research Coordinator at the following address:

_____

_____

_____

_____

Thanks for your continued support with the T3 research study.

Sincerely,

EXHIBIT 19.2

SAMPLE LETTER OF EXPLANATION TO REFERRING PHYSICIAN
CONCERNING ECG CORE LABORATORY REQUIREMENTS FOR ETTS

TO: _____

FROM:
T3 Research Coordinator

The following patient, _____, is scheduled on _____ at _____ for an exercise test. It is very helpful for analysis of the exercise test at the ECG Core Laboratory if we could obtain an original copy of the ECG tracings.

Standing Rest

Peak Exercise

Immediate Post-Exercise

Three Minute Recovery (or maximum ST segment change)

If, when each of the above listed ECGs are obtained during the exercise test, we would appreciate it if your testing staff could obtain two ECGs: one for your records or for hospital records and one for us to be mailed to the T3 Research Coordinator at the following address:

_____

_____

_____

_____

Thanks for your continued support with the T3 research study.

Sincerely,

EXHIBIT 19-3

SAMPLE OF UNACCEPTABLE EXERCISE TEST INFORMATION

MUSE Loc: 0

Date: 23-AUG-89
Time: 13:25:48
Referred by:
Medications:
Test Indication:
Test Type:
Technician:

Phase	Stage	Time in Phase	Duration of Stage	Speed (mph)	Grade (%)	W.L. (METS)	H.R. (bpm)	B.P.	R.P.P. (x100)	P.E.	V.E. (/min)	ST (CM5)	Comments
PRE-TEST		00:00	00:00	0.0	0.0	0	60				2	1.1	
COUCHE		03:51	03:51	0.0	0.0	0	67	120/70	80		0	1.1	
ASSIS		00:00	00:00	0.0	0.0	0	67				0	1.1	
DEBOUT		01:07	01:07	1.0	0.0	0	63	120/80	76		0	1.2	
EXERCISE	1	03:00	03:00	1.7	10.0	4	85	150/80	128		0	0.5	
	2	06:00	03:00	2.5	12.0	7	102	165/80	168		0	-0.8	
	3	06:36	00:36	3.4	14.0	7	110				3	-1.3	
PEAK EX		00:00	00:00	3.4	14.0	7	110				3	-1.3	
RECOVERY		07:13	07:13	0.0	0.0	0	66	120/75	79		3	0.4	

Results:
Procedure: BRUCE
Exercise Time: 06:36
Maximum Heart Rate Attained: 110bpm 65% Max Predicted 169bpm
Maximum BP: 170/70
Maximum Workload Attained: 7METS
Reason for Termination:
DYSPNEA

Impressions:

CASE12 0048 Confirmed By: Date: CAS

[redacted]
1
23-AUG-89
13:25:48
25mm/s
10mm/mV
100Hz
Procedure:
BRUCE
Sample Cardiac Cycles
Measured At
80ms post J
(10mm/mV)
Auto Points

PRE-TEST	COUCHE	ASSIS	DEBOUT	EXERCISE 1	EXERCISE 1	EXERCISE 1	EXERCISE 2
(1) 00:00	(1) 03:51	(1) 03:54	(1) 05:01	(1) 01:00	(1) 02:00	(1) 03:00	(1) 04:00
(2) 00:00	(2) 03:51	(2) 00:02	(2) 01:07	(2) 01:00	(2) 02:00	(2) 03:00	(2) 01:00
0.0mph 0.0%	0.0mph 0.0%	0.0mph 0.0%	1.0mph 0.0%	1.7mph 10.0%	1.7mph 10.0%	1.7mph 10.0%	2.5mph 12.0%
HR: 60bpm	HR: 67bpm BP: 120/70	HR: 67bpm	HR: 63bpm BP: 120/80	HR: 80bpm	HR: 82bpm BP: 148/80	HR: 85bpm BP: 150/80	HR: 96bpm
CC5 0.8	CC5 0.6	CC5 0.7	CC5 0.7	CC5 0.4	CC5 0.2	CC5 0.3	CC5 -0.2
CM5 1.1	CM5 1.1	CM5 1.1	CM5 1.2	CM5 0.8	CM5 0.6	CM5 0.5	CM5 -0.1
ML 0.7	ML 0.9	ML 0.9	ML 1.2	ML 0.7	ML 0.5	ML 0.3	ML -0.1
V6 0.6	V6 0.6	V6 0.5	V6 0.6	V6 0.4	V6 0.3	V6 0.3	V6 0.0
V5 0.8	V5 0.8	V5 0.8	V5 0.8	V5 0.5	V5 0.4	V5 0.3	V5 0.0
aVF 0.5	aVF 0.7	aVF 0.7	aVF 0.9	aVF 0.5	aVF 0.3	aVF 0.2	aVF -0.2

CASE12 0048

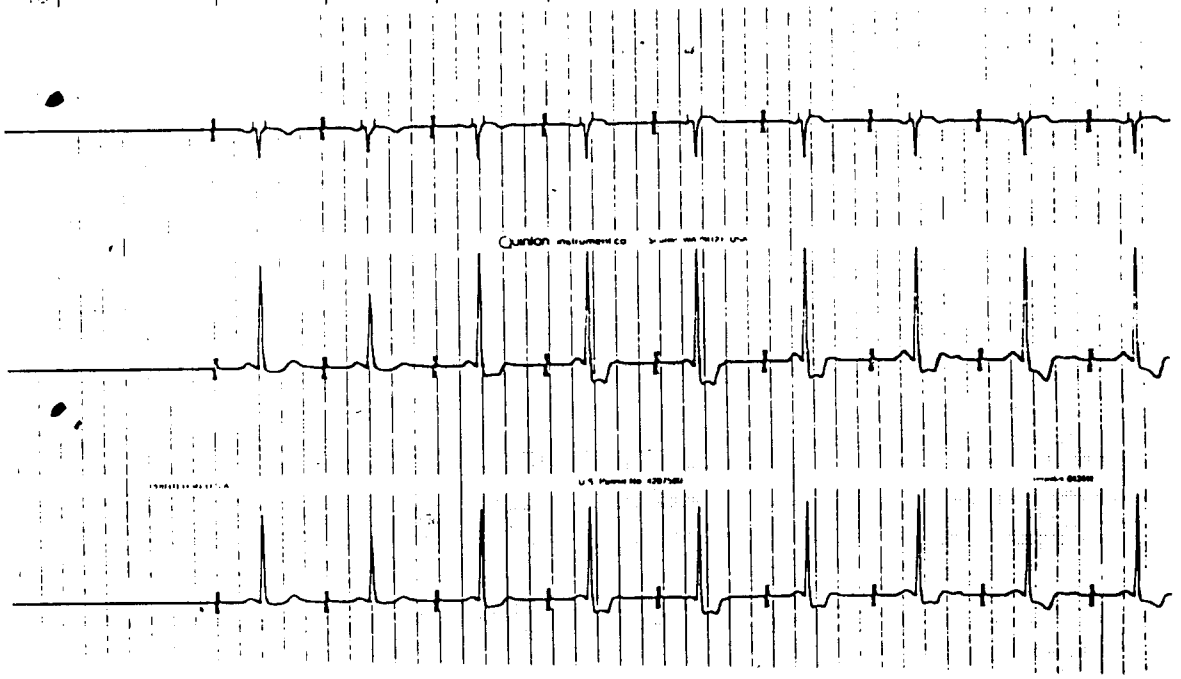
EXHIBIT 19-3 (Continued)

SAMPLE OF UNACCEPTABLE EXERCISE TEST INFORMATION

[redacted] 138-163 SEP 9 88 FINAL RE[redacted]

AVERAGED BEATS

	STAGE	RESTING	PRE EXER	STG 1	STG 2	STOP EX	RECOVRY	RECOVRY	RECOVRY	
	STAGE TIME			2:50	2:50	0:00	1:00	2:00	4:00	
	GAIN	X1	X1	X1	X1	X1	X1	X1	X1	X1
	HR/ER	76/36	96/0	129/0	156/0	156/0	131/0	104/0	92/0	99/0
V1	V5 L/S	-0.5/0	-0.5/0	-1.3/+4	-2.2/0	-3.5/0	-2.2/+4	-1.5/+4	-1.8/-8	-1.5/-
AVF	BP	130/90	130/90	140/92	192/104	192/104	188/108	178/100	162/94	144/9
V5										



[redacted] 138-163 SEP 9 88 FINAL REPO[redacted]

ENVIRONMENT WEIN-SHUG-RUBIN PROTOCOL: BRUCE METS ACHIE[redacted]

EXERCISE STOPPED AT STAGE 3 0:00 TOTAL EXERCISE TIME 6:00 TOTAL RECOVERY TIM[redacted]

AVERAGED BEATS

		RESTING	PRE EXER	STOP EX	ST CHG
	GAIN	X1	X1	X1	X1
V1	HR/ER	76/36	96/0	156/0	156/0
AVF	V5 L/S	-0.5/0	-0.5/0	-3.5/0	-3.5/0
V5	BP	130/90	130/90	192/104	192/104

HEARTRATE GRAPH
0 TO 250 BPM
MAX HR = 156
ECTOPIC RATE GRAPH
0 TO 50 BPM
MAX ER = 0

BLOOD PRESSURE GRAP
50 TO 300 MMHG
MAX BP = 192/104
HR X BP PRODUCT GRA
0 TO 50K MMHG-BPM
MAX/REST=30K/10K =

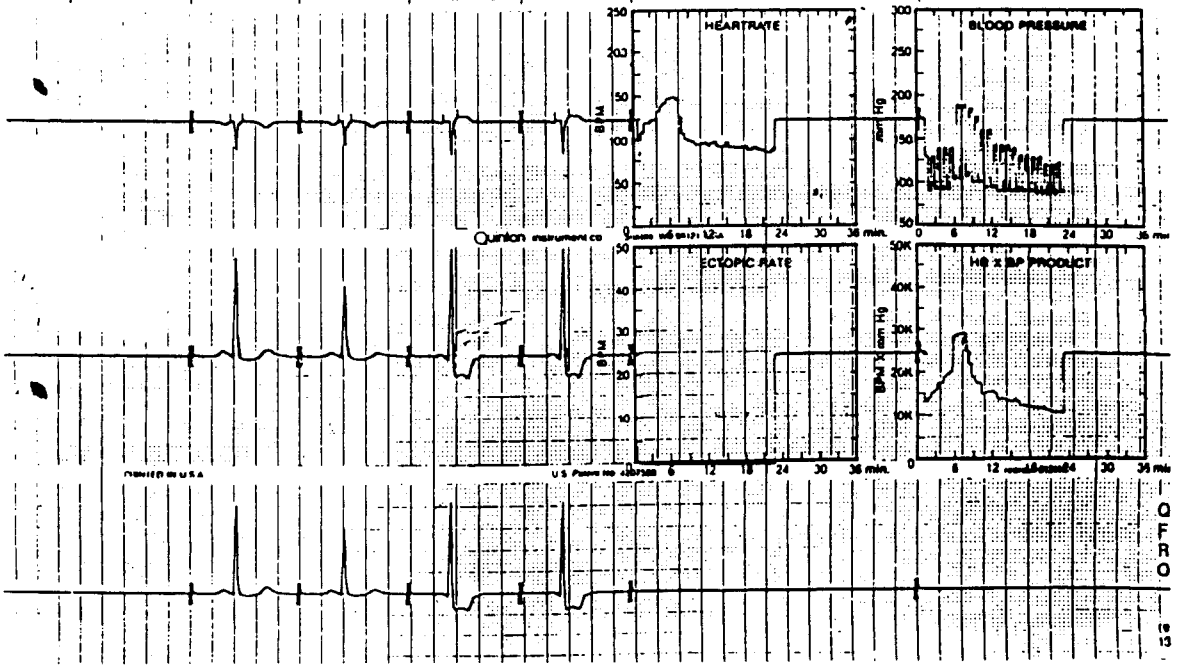


EXHIBIT 19-3 (Continued)

SAMPLE OF UNACCEPTABLE EXERCISE TEST INFORMATION

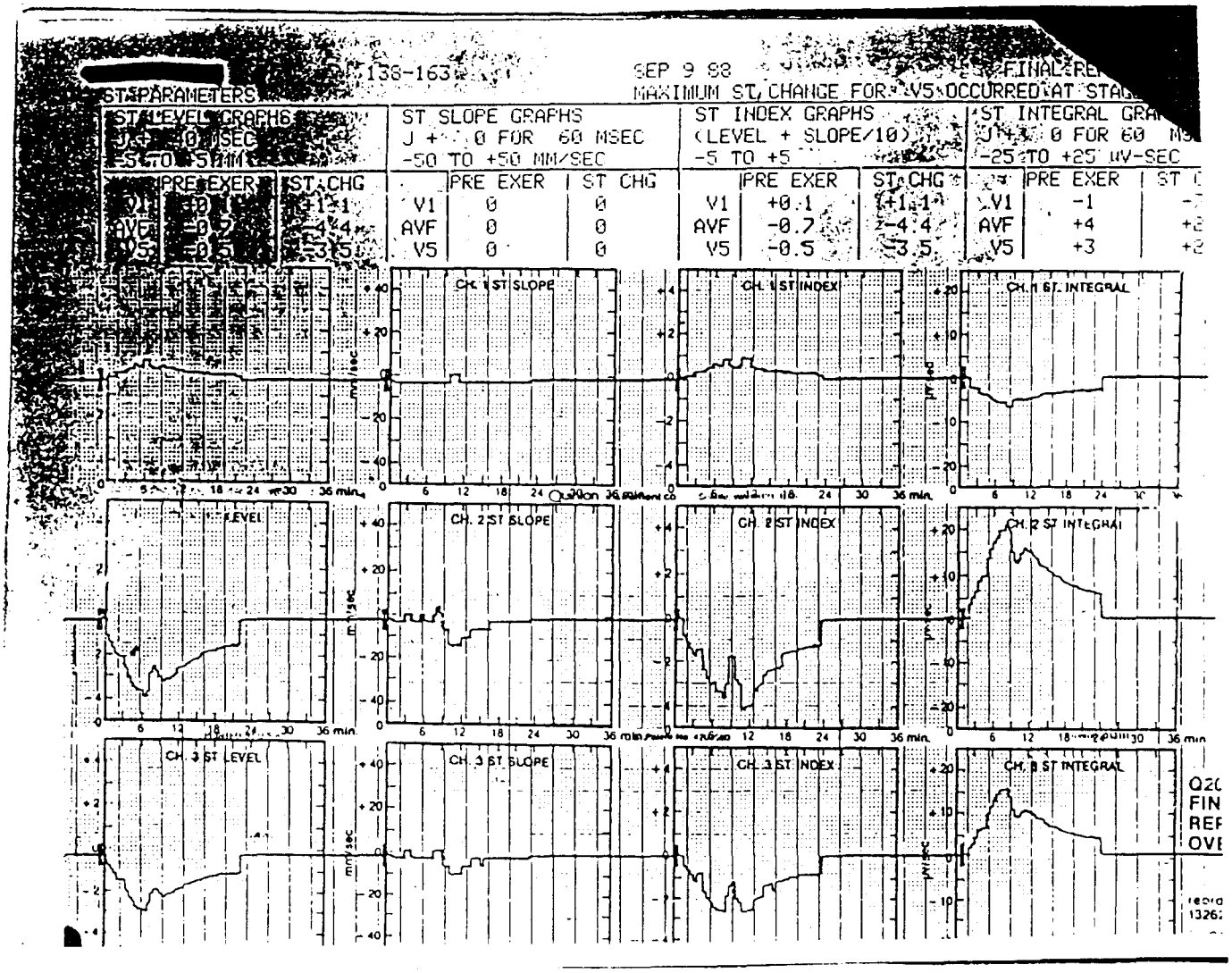


EXHIBIT 19-4

SAMPLE LETTER OF EXPLANATION TO ECG CORE LABORATORY
CONCERNING INCOMPLETE ECG DATA

Date: _____

TO: Leslee J. Shaw, M.A.

FROM: _____
T3 Coordinator

RE: T3 Patient ID: _____
ECG Date & Time: _____
Exercise Test Date: _____

Please note that in your records, I am enclosing an ECG/ETT which contains inaccurate or incomplete data. The following information could not be obtained as per protocol requirements:

ECG:

___ Missing Leads
___ Excessive Baseline Wander
___ Excessive Muscle Artifact
___ Missing Calibration Mark
___ Invalid Calibration Mark
___ Lead Reversal
___ Missing ECG

EXERCISE TEST:

___ Missing Leads
___ Excessive Baseline Wander
___ Excessive Muscle Artifact
___ Lead Reversal
___ Sitting or Supine Rest ECG only
___ Missing Protocol ECG(s):
  ___ Standing Rest
  ___ Peak Exercise
  ___ Immediate Post-Exercise
  ___ Recovery

This information is incomplete or missing for the following reasons:

_____

_____

_____

*Please note that you must use one form per incomplete or inaccurate data submission. Thanks for your help with this matter, Leslee

EXHIBIT 19-5

SAMPLE LETTERS TO CLINICAL CENTERS CONCERNING
INCOMPLETE OR UNACCEPTABLE ECG DATA

TO:

RE: ECGS of Unacceptable Quality
Patient ID. No.: _____
_____
_____
_____
_____

You have submitted ECGs for the _____ ECG(s) on a T3 patient(s) which are of unacceptable quality. The ECGs listed above exhibit one or more of the following problems which will interfere with interpretation of the ECG:

1. Excessive Motion Artifact
2. Excessive Baseline Wander
3. Lead Wires Switched
4. Missing Leads
5. Invalid Calibration Mark
6. Torso Limb Leads

We are trying to increase the quality of the data which we analyze at the ECG Core Lab and your help with this matter would be greatly appreciated. In the future, please try to submit an ECG which does not contain the above listed problems. In the rare case that you are unable to obtain any other ECG beside the one which you have submitted, please send a letter of explanation to the ECG Core Lab.

Thank you for your help,

Leslee Shaw, M.A.
T3 ECG Core Lab

EXHIBIT 19-5 (Continued)

SAMPLE LETTERS TO CLINICAL CENTERS CONCERNING
INCOMPLETE OR UNACCEPTABLE ECG DATA

TO:

RE: Use of Photocopy ECGS
Patient ID. No.: _____
_____
_____
_____
_____

You have submitted photocopy ECGs for the _____ ECG(s) on a T3 patient(s). Please note that photocopies are suboptimal to submit to the ECG Core Lab. This form of reproduction alters our ability to interpret the ECG.

We are trying to increase the quality of the data which we analyze at the ECG Core Lab and your help with this matter would be greatly appreciated. In the future, please try to submit only original copies to the ECG Core Lab. In the rare case that you are unable to obtain original copies from an outlying hospital or doctor's office, please send a letter of explanation to the ECG Core Lab.

Thank you for your help,

Leslee Shaw, M.A.
T3 ECG Core Lab

cc: Clinical Center Principal Investigator

EXHIBIT 19-5 (Continued)

SAMPLE LETTERS TO CLINICAL CENTERS CONCERNING
INCOMPLETE OR UNACCEPTABLE ECG DATA

TO:

RE: Exercise Tests of Unacceptable Quality

Patient ID. No.: _____

_____

_____

_____

_____

You have submitted ECGs for the _____ exercise test(s) on a T3 patient(s) which are of unacceptable quality. The ECGs obtained during the exercise test contain one or more of the following problems which interfere with the interpretation of the exercise test:

1. Excessive Motion Artifact
2. Excessive Baseline Wander
3. Lead Wires Switched
4. Missing Leads
5. Invalid Calibration Mark
6. Sitting or Supine Pre-exercise ECG
7. Missing one or more of the Protocol ECGs: Rest, Peak Exercise, Immediate Post Exercise, or the Recovery ECG.

We are trying to increase the quality of the data which we analyze at the ECG Core Lab and your help with this matter would be greatly appreciated. In the future, please try to submit ECGs which are of acceptable quality. In the rare case that you are unable to obtain any other ECGs for the exercise test (such as ETTS performed at an outlying hospital or doctor's office), please send a letter of explanation to the ECG Core Lab.

Please note that this does pertain to scheduled follow-up ETTs, you need to make special arrangements with the personnel performing the test outside of your institution so that all of the protocol ECGs may be 1) of adequate quality and that 2) <u>all</u> of the protocol ECGs may be submitted to the ECG Core Lab including: pre-exercise, peak exercise, immediate post exercise and recovery.

Thank you for your help,

Leslee Shaw, M.A.
T3 ECG Core Lab

cc: Clinical Center Principal Investigator

EXHIBIT 19-5 (Continued)

SAMPLE LETTERS TO CLINICAL CENTERS CONCERNING
INCOMPLETE OR UNACCEPTABLE ECG DATA

TO:

RE: Use of Photocopy ECG for Exercise Tests
Patient ID. No.: _____
_____
_____
_____
_____

You have submitted photocopy ECGs for the _____ exercise test(s) on a T3 patient(s). Please note that photocopies are suboptimal to submit to the ECG Core Lab. This form of reproduction alters our ability to interpret the ECG.

We are trying to increase the quality of the data which we analyze at the ECG Core Lab and your help with this matter would be greatly appreciated. In the future, please try to submit only original copies to the ECG Core Lab. In the rare case that you are unable to obtain original copies from an outlying hospital or doctor's office, please send a letter of explanation to the ECG Core Lab.

Thank you for your help,

Leslee Shaw, M.A.
T3 ECG Core Lab

cc: Clinical Center Principal Investigator

St. Louis University TIMI III Core ECG Lab

REST QUALITY CONTROL REPORT

ECG Sequence | Quality Control

SIT	TOTAL	QF	BL	C2	MI	HD	TRANS	ORIG	PHOTO	UNID	CALM	CALI	POOR
011	248	63	70	17	33	38	122	115	11	0	2	10	-
015	369	104	102	46	26	79	158	202	9	0	2	6	1
021	295	72	91	17	25	78	165	99	31	0	0	1	-
041	591	160	194	27	56	122	569	17	5	29	0	2	
051	564	135	164	45	52	109	412	150	2	0	0	9	

ECG Sequence | Quality Control

SIT	TOTAL	QF	BL	C2	MI	HD	TRANS	ORIG	PHOTO	UNID	CALM	CALI	POOR
011	248	25.4	28.2	6.9	13.3	15.3	49.2	46.4	4.4	0.0	0.8	4.0	1.6
015	369	28.2	27.6	12.5	7.0	21.4	42.8	54.7	2.4	0.0	0.5	1.6	3.0
021	295	24.4	30.8	5.8	8.5	26.4	55.9	33.6	10.5	0.0	0.0	0.3	1.-
041	591	27.1	32.8	4.6	9.5	20.6	96.3	2.9	0.8	4.9	0.0	0.3	0.2
051	564	23.9	29.1	8.0	9.2	19.3	73.0	26.6	0.4	0.0	0.0	1.6	0.2

St. Louis University TIMI III Core ECG Lab

KEY TO REST QUALITY CONTROL REPORT

KEY TO TABLE

SIT - TIMI III site code
TOTAL - Total Number/% of ECGs in database for site
QF - Number/% of Qualifying ECGs
BL - Number/% of Baseline ECGs
C2 - Number/% of Second Cath ECGs
MI - Number/% of Suspected MI ECGs
HD - Number/% of Hospital Discharge ECGs
TRANS - Number/% of Transmitted ECGs
ORIG - Number/% of Original ECGs received by mail
PHOTO - Number/% of Photocopied ECGs
UNID - Number/% of ECGs received without TIMI III IDs
CALM - Number/% of ECGs missing calibration pulse
CALI - Number/% of ECGs with invalid calibration pulse
POOR - Number/% of ECGs with technically poor quality or missing leads

SITE NOS.

011 - MONTE
015 - WIN
021 - BAY
041 - RIH
051 - CPMC

EXHIBIT 19-7

TIMI VISUAL COMPUTER MINNESOTA CODE ECG GRADING FORM

CEL Coder: _____ _____

Date: _____ Time: _____

Tech. No. _____ _____

Category:
Baseline_____
Cath 1 ECG_____
Cath 2 ECG_____
Unscheduled ECG_____
Hospital Discharge_____
6 Weeks_____ 1 Year_____

Patient's I. D. Number
(Recorded on calibration strip)

Numeric Code

Name Code

Arrhythmias (8X)

AV Cond. Defect (6XX)

Vent.Cond. Defect (7XX)

Q and QS Patterns (1XX)

I	aVL	2	3	V_1
V_6		aVF		V_5

ST Segment Depression (4XX)

I	aVL	2	3	V_1
V_6		aVF		V_5

T Wave Items (5X)

I	L	2	3	V_2
V_6		F		V_5

Misc. (9X)

R (3X)

ST Segment Elev (92X)

I	AVL	2	3	V_1
V_6		aVF		V_5

QRS

+/-	AXIS

Heart Rate

per minute

	R Ht (mm)	S Dp (mm)	R/S ≥.5	T Wave flat/pos	R Width ≥40ms
V_1					
V_2					

Tech. Prob.

96

98

	I	aVL	V_6	II	III	aVF	V_1	V_2	V_3	V_4	V_5
Q Wave Dur. (≥ 20ms)											
Q Wave Depth (≥1mm)											
R Wave Height (mm)											

(+/-) Lead Reject

QRS ms

PR ms

QT ms

Biphasic P-wave V_1 ≥ - 1 mm; notches ≥ .04 sec apart

Q & QS (1-4-)

I	aVL	2	3	V_1
V_6		aVF		V_5

Q & QS (1-5-)

I	aVL	2	3	V_1
V_6		aVF		V_5

Dig.

EXHIBIT 19-8

ST. LOUIS UNIVERSITY -- TIMI III CORE ECG LAB — SERIAL CHANGE REPORT

			No Change/New MI			Regression			Progression			
			Lateral	Inferior	Anterior	Lateral	Inferior	Anterior	Lateral	Inferior	Anterior	
0110001	EZEED	07/20/1988 07:11				08/05/1988 13:41						
)			1	0						23/11		Q Wave
)			0	0								ST Dep
)			0	0								ST El
)			2	0						3/2		T Wave
0110002	BUCRI	08/02/1988 11:06				08/09/1988 14:37						
)			0	0								Q Wave
2.0			0	2.0			2.0 /0000			0000/2.0		0000/2.0 ST Dep
)			0	0								ST El
)			0	0						3/2		T Wave
0110002	BUCRI	08/09/1988 14:37				09/12/1988 11:00						
)			0	0								Q Wave
.0 /2.0			0	0				2.0 /0000				ST Dep
			0	0								ST El
			0	0		2/0						T Wave
0110003	DIXJO	08/15/1988 08:34				08/27/1988 13:30						
			0	0								Q Wave
			0	0								ST Dep
			0	0								ST El
/3			3	3						0/3	0/3	T Wave
o Change/New MI						Regression			Progression			
ateral	Inferior	Anterior				Lateral	Inferior	Anterior	Lateral	Inferior	Anterior	
110003	DIXJO	08/27/1988 13:30				09/30/1988 13:00						
			0	0								Q Wave
			0	0								ST Dep
			0	0								ST El
			0	0		3/0	3/0	3/0				T Wave
110004	MCDJA	08/11/1988 15:50				08/24/1988 09:45						
			0	0			21/00					Q Wave
			0	0		12.0/0000		3.0/0000				ST Dep
			0	0								ST El
			3/3	3					0/3		0/3	T Wave
110005	STOLE	08/17/1988 21:02				08/22/1988 11:28						
			0	0								Q Wave
			0	0			2.0/ 3.0					ST Dep
			0	0								ST El
			0	0								T Wave
110005	STOLE	08/22/1988 11:28				11/04/1988 13:05						
			0	0								Q Wave
			2.0	0						3.0/ 2.0		ST Dep
			0	0								ST El
			0	0								T Wave

EXHIBIT 19-8 (Continued)

Serial Change Comparison for Q, ST, & T Wave Changes

Line 1: The patient identification number and the two compared ECG dates & times are contained within the first line.

```
ST. LOUIS UNIVERSITY -- TIMI III CORE ECG LAB                    SERIAL CHANGE REPORT

 No Change/New MI                    Regression                          Progression
 Lateral   Inferior  Anterior        Lateral   Inferior  Anterior        Lateral   Inferior  Anterior
 PATIENTID           DATE #1         DATE #2
:0110001:EZEED :07/20/1988 :07:11 :08/05/1988 :13:41 :
```

Columns correspond to the following lead groups:

Lateral:	leads I, AVL, V6	Columns: 1, 4, 7
Inferior:	leads II, III, AVF	Columns: 2, 5, 8
Anterior:	leads V1-V5	Columns: 3, 6, 9

```
==========================================================================================
No Change/New MI                    Regression                          Progression
Lateral   Inferior  Anterior        Lateral   Inferior  Anterior        Lateral   Inferior  Anterior
```

No Change/New MI: correspond to new or no changes in Q, ST, and T wave codes in any of the above lead groups:

- 0 = no code
- 1, 2, 3 = new Minnesota Q codes
- 11.0, 12.0, 2.0, etc. = new ST segment codes
- 1, 2, 3, etc. = new T wave codes

The presence of the same level code on both ECGs is documented by the same code separated by a slash. e.g. 2.0/2.0

Columns 4-6: correspond to regression to lower Minnesota codes.
Columns 7-9: correspond to progression to higher Minnesota codes.

For both the regression and progression sections, the two codes documented on the serial ECGs are entered into the corresponding lead group separated by a slash. e.g. 2.0/0000

EXHIBIT 19-8 (Continued)

Minnesota code hierarchy in:

Q codes consist of the following levels: 1, 2, 3
With "1" defined as definite MI,
"2" probable MI, and
"3" possible MI.

ST depression codes: 14.0, 13.0, 11.0, 2.0, 3.0

14.0: ST depression $\geq$ 4.0 mm
13.0: ST depression $\geq$ 3.0 mm
11.0: ST depression $\geq$ 2.0 mm
12.0: ST depression > 1.0 mm < 2.0 mm
2.0: ST depression $\geq$ 0.5 mm < 1.0 mm
3.0: Downsloping ST depression < 0.5 mm

T wave codes:

6: Inverted T waves > 5.0 mm in at least 3 leads
5: Inverted T waves > 1.0 mm in at least 3 leads
1: Inverted T waves $\geq$ 5.0 mm in any lead (excluding V1 and III)
2: Inverted T waves > 1.0 mm < 5.0 mm in any lead excluding V1)
3: Flat T waves in any lead (excluding III or AVF)
4: T/R amplitude ratio < 1/20

A more detailed description of data variables will be provided to the Coordinating Center prior to any file transfer.

EXHIBIT 19-8 (Continued)

Serial Change Comparison for Q, ST, & T Wave Changes

Line 1: The patient identification number and the two compared ECG dates & times are contained within the first line.

Columns correspond to the following lead groups:

Lateral:	leads I, AVL, V6	Columns: 1, 4, 7
Inferior:	leads II, III, AVF	Columns: 2, 5, 8
Anterior:	leads V1-V5	Columns: 3, 6, 9

No Change/New MI: correspond to new or no changes in Q, ST, and T wave codes in any of the above lead groups:

0 = no code
1, 2, 3 = new Minnesota Q codes
11.0, 12.0, 2.0, etc. = new ST segment codes
1, 2, 3, etc. = new T wave codes

The presence of the same level code on both ECGs is documented by the same code separated by a slash. e.g. 2.0/2.0

Columns 4-6: correspond to regression to lower Minnesota codes.
Columns 7-9: correspond to progression to higher Minnesota codes.

For both the regression and progression sections, the two codes documented on the serial ECGs are entered into the corresponding lead group separated by a slash. e.g. 2.0/0000

EXHIBIT 19-8 (Continued)

Minnesota code hierarchy in:

Q codes consist of the following levels: 1, 2, 3
With "1" defined as definite MI,
"2" probable MI, and
"3" possible MI.

ST depression codes: 14.0, 13.0, 11.0, 2.0, 3.0

14.0: ST depression $\geq$ 4.0 mm
13.0: ST depression $\geq$ 3.0 mm
11.0: ST depression $\geq$ 2.0 mm
12.0: ST depression > 1.0 mm < 2.0 mm
2.0: ST depression $\geq$ 0.5 mm < 1.0 mm
3.0: Downsloping ST depression < 0.5 mm

T wave codes:

6: Inverted T waves > 5.0 mm in at least 3 leads
5: Inverted T waves > 1.0 mm in at least 3 leads
1: Inverted T waves $\geq$ 5.0 mm in any lead (excluding V1 and III)
2: Inverted T waves > 1.0 mm < 5.0 mm in any lead excluding V1)
3: Flat T waves in any lead (excluding III or AVF)
4: T/R amplitude ratio < 1/20

A more detailed description of data variables will be provided to the Coordinating Center prior to any file transfer.

St. Louis University TIMI III ECG Core Lab

EXERCISE QUALITY CONTROL REPORT

ECG Sequence — Quality Control

SITE	TOTAL	HD	UFU	PHOTO	ACC	DRIFT	MUSCL	CAL	LEAD	TRACE	AVG
011	33	4	1	17	28	2	2	33	2	2	26
015	69	27	13	20	53	19	10	68	4	2	10
021	35	10	3	24	27	3	2	30	4	3	6
041	83	14	16	25	78	0	7	79	0	3	5
051	61	15	3	26	58	1	2	59	11	0	2

ECG Sequence — Quality Control

SITE	TOTAL	HD	UFU	PHOTO	ACC	DRIFT	MUSCL	CAL P	LEAD	TRACE	AVG
011	33	12.1	3.0	51.5	84.8	6.1	6.1	100.0	6.1	6.1	78.8
015	69	39.1	18.8	29.0	76.8	27.5	14.5	98.6	5.8	2.9	14.5
021	35	28.6	8.6	68.6	77.1	8.6	5.7	85.7	11.4	8.6	17.1
041	83	16.9	19.3	30.1	94.0	0.0	8.4	95.2	0.0	3.6	6.0
051	61	24.6	4.9	42.6	95.1	1.6	3.3	96.7	18.0	0.0	3.3

St. Louis University TIMI III ECG Core Lab

KEY TO EXERCISE QUALITY CONTROL REPORT

SITE - TIMI III site code
TOTAL - Total Number/% of ECGs in database for site
HD - Number/% of Hospital Discharge ECGs
UFU - Number/% of Unscheduled Followup ECGs
PHOTO - Number/% of Photocopied ECGs
ACC - Number/% of Acceptable ECGs
DRIFT - Number/% of Baseline Drift ECGs
MUSCL - Number/% of Muscle Artifact ECGs
CAL - Number/% of Improper or Missing Calibration Pulse ECGs
LEAD - Number/% of Missing Lead ECGs
TRACE - Number/% of Missing Trace ECGs
AVG - Number/% of Averaged/Filtered ECGs