

Second National Health and Nutrition Examination Survey
(NHANES II), 1976-80

NHANES II ELECTROCARDIOGRAPHY DATA FILE DOCUMENTATION

Series 11, No. 2A

April 1998

Table of Contents

NHANES II Electrocardiography Data

General Information	
Data File Index	
Data File Item Descriptions, Codes, Counts, and Notes	
References	

ELECTROCARDIOGRAM EXAMINATION NATIONAL HEALTH AND NUTRITION
EXAMINATION SURVEYS (NHANES) I, II, & III

These data files are dedicated to the memory of Daniel D. Savage, M.D., Ph.D.

Daniel D. Savage (1944-1990) was born in Memphis, Tennessee. He attended the University of Wisconsin in Madison, and between 1965 and 1972 he received four degrees from that institution, including a Bachelor of Science degree in Chemistry, a Master of Science degree in Physiology, a Ph.D. in Physiology and an M.D. degree. During a life that was too short, Dr. Savage made major contributions to the field of cardiovascular medicine as an epidemiologist, researcher, and author. Perhaps his most important scientific contributions were the establishment and conduct of the Minority Framingham Study, and the establishment of left ventricular hypertrophy as an independent risk factor for sudden cardiac death. Dr. Savage has been described by his colleagues as a man of ideas, an innovator, scholar, and scientist who fervently served his community. His challenge to students was to "set your standards high, sacrifice to achieve your goals, and don't stop until you've done your best."

The data presented in this file consist of information about standard 12-lead resting electrocardiogram(ECG) recorded on men and women in the mobile examination center (MEC)during NHANES II. NHANES is a series of cross-sectional, national noninstitutionalized representative surveys conducted by the National Center for Health Statistics of the Centers for Disease Control and Prevention. Table 1 represents the following information: years the surveys were conducted; the eligibility age of the examinee receiving the exam; and equipment used.

Table 1. General information

Survey	Survey years	Age	Equipment used
I	1971-1975	25-74	Beckman Digicorder*
II	1976-1981	25-74	Marquette**
III	1988-1994	40 and over	Marquette** MAC 12

*Beckman Instruments, Inc. Fullerton California

**Marquette Medical Systems, Inc. Milwaukee, Wisconsin,

NHANES I ECG data quality and data processing procedures were substantially different from those used for NHANES II and NHANES III. NHANES I ECGs, recorded with Beckman Digicorders, were available as single channel data, 2.5 seconds per lead and sampled at 500 samples per second. In 1970-1975 when the survey was conducted, ECG acquisition technology was still in an early phase of development, and ECG data quality was in general poor. This made automated ECG processing difficult. The initial attempts to process NHANES I ECGs with an automated ECG program (ECAN-E, U.S. Public Health Service) from these single channel data did not produce stable ECG wave measurements, and a semiautomated procedure was later developed in an attempt to remedy the problem. This process involved the display of each ECG lead on a large screen of a Tektronix terminal, and an operator used cursors to identify the onsets and offsets of P, QRS and T waves of the complex selected for analysis. These ECG segments were then processed by the Dalhousie Novacode ECG program (Rautaharju et al, 1990).

The single channel ECG data of relatively poor quality imposes certain limitations on the validity of NHANES I ECG reports, particularly concerning ECG codes which rely on P wave detection and measurements. Arrhythmias were not coded. However, ECGs with no P waves identified by the program were checked visually for the presence of a trial fibrillation.

The QRS amplitude measurements in NHANES I were obtained with a reasonable degree of confidence although at times the gain control and calibration could not be ascertained with adequate reliability. ST-T measurements were more difficult because of drift problems, and although the program had algorithms with higher order terms for non-linear drift correction, these were difficult

to apply because of the short record length (2.5 records).

NHANES II 12-lead ECG data were recorded in 4 lead groups sequenced 3 leads at a time for 5 seconds (I, II, III, aVR, aVL, aVF, V1, V2, V3 and V4, V5, V6), and NHANES III ECGs with 8 independent components of the 12 standard leads simultaneously. For both surveys, the ECG data were sampled at 250 samples per second per channel. The availability of multiple simultaneous ECG leads for analysis greatly improved the precision and accuracy of ECG amplitude and interval measurements compared to the single channel procedure applied on NHANES I ECG data.

The key features of the Novacode ECG program are described elsewhere (Rautaharju et al, 1990). The program was designed to handle both the resting and exercise ECGs and it relies on the use of selective averaging to derive a representative P-QRS-T complex for analysis of wave durations and amplitudes.

The data are presented as three separate files, one for each survey. However, we named all the variables the same. The variable ECPSNUM is the variable showing the survey number. Eight fill values "Blank but applicable," were used to represent certain conditions or responses in which a respondent was eligible to receive the ECG but did not because of refusal, lack of time, lack of staff, loss of data, language barrier, unreliability, or the computer program not able to code the data.

Because we administered this test in the examination center, MEC examination weights (WTPFEX) must be used for data analysis. Besides the MEC weights, each file contains the following additional variables: respondent identification number (SEQN); race-ethnicity (DMARETHN); sex (HSSEX); age at interview (HSAGEIR); pseudo-PSU (SDPPSU); and pseudo-stratum (SDPSTRA). Tables 2a, 2b, and 3 presents additional information available from NHANES I and II. These data sets are available on tape and can be obtained from the National Technical Information Service (NTIS), Computer Products Office, 5285 Port Royal Road, Springfield, Virginia 22161 (703) 487-4807.

Table 2a. NHANES I PUBLIC USE DATA SETS

----- TAPE NAME/NUMBER -----	----- ORDER NUMBER -----
Anthropometry, goniometry, skeletal age, bone density, and cortical thickness, ages 1-74 years (4111) -----	PB-295908 -----
Arthritis, ages 25- 74 years (4121) -----	PB-296018 -----
Audiometric test (air, bone, speech reception), ages 25- 74 years (4241) -----	PB-297337 -----
Biochemistry, serology, hematology, peripheral blood slide, and urinary findings, ages 25-74 -----	PB-297344 -----

years (4800)	
Dental, ages 1-74 years (4235)	PB-296023
Dermatology, ages 1-74 years (4151)	PB80-130255
Dietary frequency and adequacy, ages 1-74 years (4701)	PB-295906
General well-being and the CES-D depression scale developed by the National Institute of Mental Health, ages 25-74 years (4171)	PB-296020

Table 2b. NHANES I PUBLIC USE DATA SETS

TAPE NAME/NUMBER	ORDER NUMBER
Health care needs, general medical history, sample person supplement, and respiratory and cardiovascular supplements, ages 25-74 years (4091)	PB-296029
Medical examination, ages 1-74 years (4233)	PB-296035
Medical history questionnaire, ages 12-74 years (4081)	PB-296073
Model gram and nutrient composition (4702-4703)	PB-296027
Near and distant vision, ages 25-74 years (4163)	PB-295910
Ophthalmology, ages 1-74 years (4161)	PB-296033
Pulmonary diffusion, TB, chest x ray planimetry, heart size, and lung and heart pathology,	PB87-126009

ages 25-74 years (4251)	
Spirometry-best trials only, ages 25-74 years (4250)	PB80-145931
24-hour recall consumption intake, ages 1-74 years (4704)	PB-297339

Table 3. NHANES II PUBLIC USE DATA SETS

TAPE NAME/NUMBER	ORDER NUMBER
Anthropometric data, ages 6 months 74 years (5301)	PB82-191917
Behavior questionnaire, ages 25-74 years (5317)	PB90-501578
Chest x ray examination ages 25- 74 years (5252)	PB89-136667
Health History supplement, ages 12- 74 years (5305)	PB83-256537
Hematology and biochemistry, ages 6 months-74 years (5411) Version 2	PB90-500943
Medical History, ages 12 -74 years (5020)	PB83-154815
Model gram and nutrient composition (5702-5703)	PB82-142613
Physician's examination, ages 6 months-74 years (5302)	PB86-242930
Total nutrient intake, food frequency, and other related dietary data, ages 6 months- 74 years (5701)	PB82-168261
Allergy Skin	PB86-121613

Testing, Ages 6-74,
(5309)

24-hour recall
specific food item,
ages 6 months-74
years (5704)

PB82-142639

Two aspects of NHANES surveys should be taken into account when conducting any analyses: the sample weights and the complex survey design. Therefore it is very important that the analyst refers to Landis et al. (1982) and NHANES III Analytic and Reporting Guidelines (U.S. DHHS, 1996b) before attempting to analyze the data.

A detailed description of the ECG procedure can be found in the plan and operation of the respective survey, NHANES I (U.S. DHEW, 1973), NHANES II (U.S. DHHS, 1980), and NHANES III (U.S. DHHS, 1996).

A bibliography of NHANES journal articles citing data from 1980 through 1996 and additional NHANES data can be obtained from the Data Dissemination Branch, NCHS at:

Data Dissemination Branch
National Center for Health Statistics
Room 1018
6525 Belcrest Road
Hyattsville, Maryland 20782

Phone: (301)436-8500

URL:<http://www.cdc.gov/nchswww>

NHANES II Electrocardiography Data File Index

Description	Variable Name	Positions

DEMOGRAPHIC DATA		
Sample person identification number	SEQN	1-5
NHANES II Survey (1976-80)	ECPSNUM	6
Sex	HSSEX	7
Race	DMARACER	8
Age at interview (Screener) in years	HSAGEIR	9-10
Pseudo-PSU	SDPPSU	11
Pseudo-stratum	SDPSTRA	12-13
MEC-examined sample final weight	WTPFEX	14-18
INTRODUCTORY INFORMATION		
Technician number (not reported)	ECPTECH1	19
Number of leads	ECPLEADS	20-21
Chest half-width (mm) (not reported)	ECPWIDTH	22
Chest half-depth (mm) (not reported)	ECPDEPTH	23

Major ECG abnormalities	ECPG1	24
Minor ECG abnormalities	ECPG2	25
Probable myocardial infarction (MI)	ECPG3	26
Possible MI	ECPG4	27
Probable left ventricular hypertrophy	ECPG5	28
Possible LVH by MC	ECPG6	29

MINNESOTA CODES

MC 1 Leadgroup L(I, aVL, V6)	ECPL1	30-31
MC 1 Leadgroup F(II, III, aVF)	ECPF1	32-33
MC 1 Leadgroup V(V1-V5)	ECPV1	34-35
MC 4 Leadgroup L	ECPL4	36-37
MC 4 Leadgroup F	ECPF4	38-39
MC 4 Leadgroup V	ECPV4	40-41
MC 5 Leadgroup L	ECPL5	42
MC 5 Leadgroup F	ECPF5	43
MC 5 Leadgroup V	ECPV5	44
MC 9.2 Leadgroup L	ECPL9	45
MC 9.2 Leadgroup F	ECPF9	46
MC 9.2 Leadgroup V	ECPV9	47

NHANES II Electrocardiography Data File Index

Description	Variable Name	Positions
MC 2 (QRS axis code)	ECPMC2	48-49
MC 3 (High-amplitude R waves)	ECPMC3	50-51
MC 6 (A-V conduction)	ECPMC6	52-53
MC 7 (Ventricular conduction)	ECPMC7	54
MC 9.1 (Low-amplitude QRS)	ECPMC91	55
MC 9.3 (High-amplitude P)	ECPMC93	56
MC 9.4 (QRS transition zone)	ECPMC94	57
MC 9.5 (High-amplitude T)	ECPMC95	58

CARDIAC/INFARCTION INJURY SCORE

Cardiac infarction score (12-lead by 10)	ECPCIIS	59-61
Probable infarction/injury	ECPCIIS2	62
Possible infarction/injury	ECPCIIS3	63
Consider infarction/injury	ECPCIIS4	64

LEFT VENTRICULAR MASS

ECG estimate of LV mass	ECPLVM	65-67
ECG estimate of LV mass index	ECPLVMI	68-70
Probable LVH	ECPLVM3	71

HEART RATE, BASIC ECG INTERVALS, AND MEAN AXIS DATA

Heart rate (beats per minute)	ECPRATE	72-74
PR interval (msec)	ECPPR	75-77
QRS interval (msec)	ECPQRS	78-80
QT interval (msec)	ECPQT	81-83
P axis, frontal plane (degrees)	ECPAXIS1	84-87
QRS axis, frontal plane (degrees)	ECPAXIS2	88-91

T axis, frontal plane (degrees) ECPAXIS3 92-95
 Rhythm code ECPBEAT 96

ECG WAVE MEASUREMENTS

P amplitude, positive phase, lead II(uV) ECPP1 97-99

NHANES II Electrocardiography Data File Index

Description	Variable Name	Positions
P duration, lead II (msec)	ECP2	100-102
P amplitude, positive phase, lead V1(uV)	ECP3	103-105
P amplitude, negative phase, lead V1(uV)	ECP4	106-109
Q or QS amplitude, lead I (uV)	ECPQA1	110-113
Q or QS amplitude, lead II (uV)	ECPQA2	114-117
Q or QS amplitude, lead III (uV)	ECPQA3	118-121
Q or QS amplitude, lead aVL (uV)	ECPQA4	122-125
Q or QS amplitude, lead aVF (uV)	ECPQA5	126-129
Q or QS amplitude, lead V1 (uV)	ECPQA6	130-133
Q or QS amplitude, lead V2 (uV)	ECPQA7	134-137
Q or QS amplitude, lead V3 (uV)	ECPQA8	138-141
Q or QS amplitude, lead V4 (uV)	ECPQA9	142-145
Q or QS amplitude, lead V5 (uV)	ECPQA10	146-149
Q or QS amplitude, lead V6 (uV)	ECPQA11	150-153
Q or QS duration, lead I (msec)	ECPQD1	154-156
Q or QS duration, lead II (msec)	ECPQD2	157-159
Q or QS duration, lead III (msec)	ECPQD3	160-162
Q or QS duration, lead aVL (msec)	ECPQD4	163-165
Q or QS duration, lead aVF (msec)	ECPQD5	166-168
Q or QS duration, lead V1 (msec)	ECPQD6	169-171
Q or QS duration, lead V2 (msec)	ECPQD7	172-174
Q or QS duration, lead V3 (msec)	ECPQD8	175-177
Q or QS duration, lead V4 (msec)	ECPQD9	178-180
Q or QS duration, lead V5 (msec)	ECPQD10	181-183
Q or QS duration, lead V6 (msec)	ECPQD11	184-186
R amplitude, lead I (uV)	ECPRA1	187-190
R amplitude, lead II (uV)	ECPRA2	191-194
R amplitude, lead III (uV)	ECPRA3	195-198
R amplitude, lead aVR (uV)	ECPRA4	199-202
R amplitude, lead aVL (uV)	ECPRA5	203-206
R amplitude, lead aVF (uV)	ECPRA6	207-210
R amplitude, lead V1 (uV)	ECPRA7	211-214
R amplitude, lead V2 (uV)	ECPRA8	215-218
R amplitude, lead V3 (uV)	ECPRA9	219-222
R amplitude, lead V4 (uV)	ECPRA10	223-226
R amplitude, lead V5 (uV)	ECPRA11	227-230
R amplitude, lead V6 (uV)	ECPRA12	231-234
R duration, lead I (msec)	ECPRD1	235-237
R duration, lead II (msec)	ECPRD2	238-240
R duration, lead III (msec)	ECPRD3	241-243

NHANES II Electrocardiography Data File Index

Description	Variable Name	Positions
R duration, lead aVR (msec)	ECPRD4	244-246
R duration, lead aVL (msec)	ECPRD5	247-249
R duration, lead aVF (msec)	ECPRD6	250-252
R duration, lead V1 (msec)	ECPRD7	253-255
R duration, lead V2 (msec)	ECPRD8	256-258
R duration, lead V3 (msec)	ECPRD9	259-261
R duration, lead V4 (msec)	ECPRD10	262-264
R duration, lead V5 (msec)	ECPRD11	265-267
R duration, lead V6 (msec)	ECPRD12	268-270
S amplitude, lead I (uV)	ECPSA1	271-274
S amplitude, lead II (uV)	ECPSA2	275-278
S amplitude, lead III (uV)	ECPSA3	279-282
S amplitude, lead aVR (uV)	ECPSA4	283-286
S amplitude, lead aVL (uV)	ECPSA5	287-290
S amplitude, lead aVF (uV)	ECPSA6	291-294
S amplitude, lead V1 (uV)	ECPSA7	295-298
S amplitude, lead V2 (uV)	ECPSA8	299-302
S amplitude, lead V3 (uV)	ECPSA9	303-306
S amplitude, lead V4 (uV)	ECPSA10	307-310
S amplitude, lead V5 (uV)	ECPSA11	311-314
S amplitude, lead V6 (uV)	ECPSA12	315-318
S duration, lead I (msec)	ECPSD1	319-321
S duration, lead II (msec)	ECPSD2	322-324
S duration, lead III (msec)	ECPSD3	325-327
S duration, lead aVR (msec)	ECPSD4	328-330
S duration, lead aVL (msec)	ECPSD5	331-333
S duration, lead aVF (msec)	ECPSD6	334-336
S duration, lead V1 (msec)	ECPSD7	337-339
S duration, lead V2 (msec)	ECPSD8	340-342
S duration, lead V3 (msec)	ECPSD9	343-345
S duration, lead V4 (msec)	ECPSD10	346-348
S duration, lead V5 (msec)	ECPSD11	349-351
S duration, lead V6 (msec)	ECPSD12	352-354
R' amplitude, lead I (uV)	ECPRPA1	355-358
R' amplitude, lead II (uV)	ECPRPA2	359-362
R' amplitude, lead III (uV)	ECPRPA3	363-366
R' amplitude, lead aVR (uV)	ECPRPA4	367-370
R' amplitude, lead aVL (uV)	ECPRPA5	371-374
R' amplitude, lead aVF (uV)	ECPRPA6	375-378
R' amplitude, lead V1 (uV)	ECPRPA7	379-382

NHANES II Electrocardiography Data File Index

Description	Variable Name	Positions
R' amplitude, lead V2 (uV)	ECPRPA8	383-386
R' amplitude, lead V3 (uV)	ECPRPA9	387-390
R' amplitude, lead V4 (uV)	ECPRPA10	391-394
R' amplitude, lead V5 (uV)	ECPRPA11	395-398
R' amplitude, lead V6 (uV)	ECPRPA12	399-402
J amplitude, lead I (uV)	ECPJ1	403-406

J amplitude, lead II (uV)	ECPJ2	407-410
J amplitude, lead III (uV)	ECPJ3	411-414
J amplitude, lead aVR (uV)	ECPJ4	415-418
J amplitude, lead aVL (uV)	ECPJ5	419-422
J amplitude, lead aVF (uV)	ECPJ6	423-426
J amplitude, lead V1 (uV)	ECPJ7	427-430
J amplitude, lead V2 (uV)	ECPJ8	431-434
J amplitude, lead V3 (uV)	ECPJ9	435-438
J amplitude, lead V4 (uV)	ECPJ10	439-442
J amplitude, lead V5 (uV)	ECPJ11	443-446
J amplitude, lead V6 (uV)	ECPJ12	447-450
Negative T amplitude, lead I (uV)	ECPNTA1	451-455
Negative T amplitude, lead II (uV)	ECPNTA2	456-459
Negative T amplitude, lead III (uV)	ECPNTA3	460-463
Negative T amplitude, lead aVR (uV)	ECPNTA4	464-467
Negative T amplitude, lead aVL (uV)	ECPNTA5	468-471
Negative T amplitude, lead aVF (uV)	ECPNTA6	472-475
Negative T amplitude, lead V1 (uV)	ECPNTA7	476-479
Negative T amplitude, lead V2 (uV)	ECPNTA8	480-484
Negative T amplitude, lead V3 (uV)	ECPNTA9	485-489
Negative T amplitude, lead V4 (uV)	ECPNTA10	490-494
Negative T amplitude, lead V5 (uV)	ECPNTA11	495-499
Negative T amplitude, lead V6 (uV)	ECPNTA12	500-504
Positive T amplitude, lead I (uV)	ECPPTA1	505-508
Positive T amplitude, lead II (uV)	ECPPTA2	509-512
Positive T amplitude, lead III (uV)	ECPPTA3	513-516
Positive T amplitude, lead aVR (uV)	ECPPTA4	517-520
Positive T amplitude, lead aVL (uV)	ECPPTA5	521-524
Positive T amplitude, lead aVF (uV)	ECPPTA6	525-528
Positive T amplitude, lead V1 (uV)	ECPPTA7	529-532
Positive T amplitude, lead V2 (uV)	ECPPTA8	533-536
Positive T amplitude, lead V3 (uV)	ECPPTA9	537-540
Positive T amplitude, lead V4 (uV)	ECPPTA10	541-544
Positive T amplitude, lead V5 (uV)	ECPPTA11	545-548

NHANES II Electrocardiography Data File Index

Description	Variable Name	Positions
Positive T amplitude, lead V6 (uV)	ECPPTA12	549-552

NHANES II Electrocardiography Data File

FILENAME=NH2ECG VERSION 1.0 N=9,219

DEMOGRAPHIC DATA

Positions	Item description	Notes
SAS name	Counts	and code
1-5 SEQN	9219	Sample person identification number 00187-27796

6		NHANES II Survey (1976-80)	
ECPSNUM	9219	2	NHANES II
7		Sex	
HSSEX	4361	1	Male
	4858	2	Female
8		Race	
DMARACER	8039	1	White
	1010	2	Black
	170	3	Other
9-10		Age at interview (Screener) in years	
HSAGEIR	9219	25-74	
11		Pseudo-PSU	
SDPPSU	9219	1-2	
12-13		Pseudo-stratum	
SDPSTRA	9219	01-32	
14-18		MEC-examined sample final weight	
WTPFEX	9219	02000-79634	

NHANES II Electrocardiography Data File

INTRODUCTORY INFORMATION

Positions		Item description	
SAS name	Counts	and code	Notes

19		Technician number	
ECPTECH1		(not reported in NHANES II)	
	9219	Blank	
20-21		Number of leads	
ECPLEADS	3	05	
	21	06	
	68	09	
	7	10	
	54	11	
	8750	12	
	316	88 Blank but applicable	
22		Chest half-width (mm)	
ECPWIDTH		(not reported in NHANES II)	
	9219	Blank	
23		Chest half-depth (mm)	
ECPDEPTH		(not reported in NHANES II)	
	9219	Blank	
24		Major ECG abnormalities	
ECPG1	7786	0	Absent
	1431	1	Present
			See note

		2	8	Blank but applicable	
	25			Minor ECG abnormalities	See note
ECPG2		7103	0	Absent	
		2114	1	Present	
		2	8	Blank but applicable	
	26			Probable myocardial infarction (MI)	See note
ECPG3		9167	0	Absent	
		50	1	Present	
		2	8	Blank but applicable	

NHANES II Electrocardiography Data File

INTRODUCTORY INFORMATION

Positions		Counts		Item description and code	Notes
SAS name					
	27			Possible MI	See note
ECPG4		8980	0	Absent	
		237	1	Present	
		2	8	Blank but applicable	
	28			Probable left ventricular hypertrophy (LVH) by Minnesota Code (MC)	See note
ECPG5		9061	0	Absent	
		156	1	Present	
		2	8	Blank but applicable	
	29			Possible LVH by MC	See note
ECPG6		8402	0	Absent	
		815	1	Present	
		2	8	Blank but applicable	

NHANES II Electrocardiography Data File

MINNESOTA CODES

Positions		Counts		Item description and code	Notes
SAS name					
	30-31			MC 1 Leadgroup L(I, aVL, V6)	
ECPL1		8738	00	1.0.0	
		28	11	1.1.1	
		3	13	1.1.3	
		11	21	1.2.1	
		5	22	1.2.2	
		13	31	1.3.1	
		12	33	1.3.3	
		409	88	Blank but applicable	

32-33		MC 1 Leadgroup F(II, III, aVF)
ECPF1	8495	00 1.0.0
	6	11 1.1.1
	13	14 1.1.4
	1	15 1.1.5
	31	21 1.2.1
	5	22 1.2.2
	21	23 1.2.3
	23	24 1.2.4
	3	25 1.2.5
	75	26 1.2.6
	19	31 1.3.1
	77	34 1.3.4
	3	35 1.3.5
	28	36 1.3.6
	419	88 Blank but applicable

NHANES II Electrocardiography Data File

MINNESOTA CODES

Positions		Item description	
SAS name	Counts	and code	Notes

34-35		MC 1 Leadgroup V(V1-V5)
ECPV1	8611	00 1.0.0
	21	11 1.1.1
	14	12 1.1.2
	33	16 1.1.6
	11	17 1.1.7
	6	21 1.2.1
	2	22 1.2.2
	23	27 1.2.7
	68	28 1.2.8
	3	31 1.3.1
	75	32 1.3.2
	352	88 Blank but applicable

36-37		MC 4 Leadgroup L
ECPL4	8445	00 4.0.0
	3	11 4.1.1
	40	12 4.1.2
	164	20 4.2.0
	148	30 4.3.0
	19	40 4.4.0
	400	88 Blank but applicable

38-39		MC 4 Leadgroup F
ECPF4	8630	00 4.0.0
	1	11 4.1.1
	13	12 4.1.2
	108	20 4.2.0
	45	30 4.3.0
	9	40 4.4.0
	413	88 Blank but applicable

NHANES II Electrocardiography Data File

MINNESOTA CODES

Positions SAS name	Counts	Item description and code		Notes
40-41 ECPV4	8559	MC 4	Leadgroup V	
	5	00	4.0.0	
	43	11	4.1.1	
	164	12	4.1.2	
	67	20	4.2.0	
	28	30	4.3.0	
	353	40	4.4.0	
		88	Blank but applicable	
42 ECPL5	7831	MC 5	Leadgroup L	
	7	0	5.0	
	246	1	5.1	
	576	2	5.2	
	174	3	5.3	
	385	4	5.4	
		8	Blank but applicable	
43 ECPF5	8373	MC 5	Leadgroup F	
	1	0	5.0	
	137	1	5.1	
	272	2	5.2	
	28	3	5.3	
	408	4	5.4	
		8	Blank but applicable	
44 ECPV5	8107	MC 5	Leadgroup V	
	15	0	5.0	
	303	1	5.1	
	294	2	5.2	
	151	3	5.3	
	349	4	5.4	
		8	Blank but applicable	

NHANES II Electrocardiography Data File

MINNESOTA CODES

Positions SAS name	Counts	Item description and code		Notes
45 ECPL9	8778	MC 9.2	Leadgroup L	
	32	0	9.2.0	
		2	9.2.2	

	409	8	Blank but applicable	
46			MC 9.2 Leadgroup F	
ECPF9	8782	0	9.2.0	
	17	2	9.2.2	
	420	8	Blank but applicable	
47			MC 9.2 Leadgroup V	
ECPV9	8691	0	9.2.0	
	174	2	9.2.2	
	354	8	Blank but applicable	
48-49			MC 2 (QRS axis code)	See note
ECPMC2	6709	00	2.0.0	
	776	11	2.1.1	
	388	12	2.1.2	
	747	21	2.2.1	
	110	22	2.2.2	
	41	30	2.3.0	
	11	40	2.4.0	
	437	88	Blank but applicable	
50-51			MC 3 (High-amplitude R waves)	
ECPMC3	7784	00	3.0.0	
	395	12	3.1.2	
	47	13	3.1.3	
	151	14	3.1.4	
	15	20	3.2.0	
	68	31	3.3.1	
	310	32	3.3.2	
	449	88	Blank but applicable	

NHANES II Electrocardiography Data File

MINNESOTA CODES

Positions			Item description	
SAS name	Counts		and code	Notes
52-53			MC 6 (A-V conduction)	
ECPMC6	8489	00	6.0	
	131	30	6.3	
	4	40	6.4	
	140	50	6.5	
	455	88	Blank but applicable	
54			MC 7 (Ventricular conduction)	
ECPMC7	7651	0	7.0	
	29	1	7.1	
	159	2	7.2	
	310	3	7.3	
	250	4	7.4	
	385	5	7.5	
	22	6	7.6	
	413	8	Blank but applicable	

55			MC 9.1 (Low-amplitude QRS)
ECPMC91	8732	0	9.1.0
	83	1	9.1.1
	404	8	Blank but applicable
56			MC 9.3 (High-amplitude P)
ECPMC93	8786	0	9.3.0
	80	3	9.3.3
	353	8	Blank but applicable
57			MC 9.4 (QRS transition zone)
ECPMC94	3751	0	9.4.0
	4131	1	9.4.1
	1335	2	9.4.2
	2	8	Blank but applicable

NHANES II Electrocardiography Data File

MINNESOTA CODES

Positions			Item description	
SAS name	Counts		and code	Notes
58			MC 9.5 (High-amplitude T)	
ECPMC95	8618	0	9.5.0	
	137	5	9.5.5	
	464	8	Blank but applicable	

NHANES II Electrocardiography Data File

CARDIAC/INFARCTION INJURY SCORE

Positions			Item description	
SAS name	Counts		and code	Notes
59-61			Cardiac infarction/injury score for	See note
ECPCIIS			12-lead ECG multiplied by 10	
	8747		000-488	
	472	888	Blank but applicable	
62			Probable infarction/injury	See note
ECPCIIS2	8318	0	Absent	
	440	1	Present	
	461	8	Blank but applicable	
63			Possible infarction/injury	See note
ECPCIIS3	8394	0	Absent	
	364	1	Present	
	461	8	Blank but applicable	
64			Consider infarction/injury	See note

ECPCIIS4	8067	0	Absent
	691	1	Present
	461	8	Blank but applicable

NHANES II Electrocardiography Data File

LEFT VENTRICULAR MASS

Positions SAS name	Counts	Item description and code	Notes
65-67 ECPLVM	8844 375	ECG estimate of LV mass 059-336 888 Blank but applicable	See note
68-70 ECPLVMI	8767 452	ECG estimate of LV mass index 040-283 888 Blank but applicable	See note
71 ECPLVM3	8073 694 452	Probable LVH 0 Absent 1 Present 8 Blank but applicable	See note

NHANES II Electrocardiography Data File

HEART RATE, BASIC ECG INTERVALS, AND MEAN AXIS DATA

Positions SAS name	Counts	Item description and code	Notes
72-74 ECPRATE	8949 270	Heart rate (beats per minute) 037-164 888 Blank but applicable	
75-77 ECPPR	8902 317	PR interval (msec) 095-348 888 Blank but applicable	
78-80 ECPQRS	8949 270	QRS interval (msec) 059-183 888 Blank but applicable	
81-83 ECPQT	8845 374	QT interval (msec) 254-545 888 Blank but applicable	
84-87 ECPAXIS1	8837 382	P axis, frontal plane (degrees) -178-0158 8888 Blank but applicable	

88-91		QRS axis, frontal plane (degrees)
ECPAXIS2	8856	-179-0180
	363	8888 Blank but applicable
92-95		T axis, frontal plane (degrees)
ECPAXIS3	8837	-179-0180
	382	8888 Blank but applicable

NHANES II Electrocardiography Data File

HEART RATE, BASIC ECG INTERVALS, AND MEAN AXIS DATA

Positions		Item description	
SAS name	Counts	and code	Notes
96		Rhythm code	See note
ECPBEAT	8658	1 Sinus rhythm	
	22	2 Atrial fibrillation/flutter	
	2	3 Pacemaker	
	363	4 Ventricular ectopic complexes	
	12	5 Wandering atrial pacemaker	
	1	6 Supraventricular tachycardia	
	137	7 Supraventricular ectopic complexes	
	24	9 Other rhythm abnormality	

NHANES II Electrocardiography Data File

ECG WAVE MEASUREMENTS

Positions		Item description	
SAS name	Counts	and code	Notes
97-99		P amplitude, positive phase, lead II (microvolt (uV))	
ECPP1	8862	000-491	
	357	888 Blank but applicable	
100-102		P duration, lead II (msec)	
ECPP2	8862	000-176	
	357	888 Blank but applicable	
103-105		P amplitude, positive phase, lead V1 (uV)	
ECPP3	8885	000-252	
	334	888 Blank but applicable	
106-109		P amplitude, negative phase, lead V1 (uV)	
ECPP4	8886	-343-0000	
	333	8888 Blank but applicable	

110-113		Q or QS amplitude, lead I (uV)
ECPQA1	8855	0000-1019
	364	8888 Blank but applicable
114-117		Q or QS amplitude, lead II (uV)
ECPQA2	8862	0000-1366
	357	8888 Blank but applicable
118-121		Q or QS amplitude, lead III (uV)
ECPQA3	8833	0000-1891
	386	8888 Blank but applicable
122-125		Q or QS amplitude, lead aVL (uV)
ECPQA4	8866	0000-1303
	353	8888 Blank but applicable

NHANES II Electrocardiography Data File

 ECG WAVE MEASUREMENTS

Positions		Item description	
SAS name	Counts	and code	Notes

126-129		Q or QS amplitude, lead AVF (uV)	
ECPQA5	8873	0000-1605	
	346	8888 Blank but applicable	
130-133		Q or QS amplitude, lead V1 (uV)	
ECPQA6	8886	0000-2900	
	333	8888 Blank but applicable	
134-137		Q or QS amplitude, lead V2 (uV)	
ECPQA7	8891	0000-3293	
	328	8888 Blank but applicable	
138-141		Q or QS amplitude, lead V3 (uV)	
ECPQA8	8893	0000-3353	
	326	8888 Blank but applicable	
142-145		Q or QS amplitude, lead V4 (uV)	
ECPQA9	8893	0000-3238	
	326	8888 Blank but applicable	
146-149		Q or QS amplitude, lead V5 (uV)	
ECPQA10	8892	0000-2400	
	327	8888 Blank but applicable	
150-153		Q or QS amplitude, lead V6 (uV)	
ECPQA11	8897	0000-0667	
	322	8888 Blank but applicable	
154-156		Q or QS duration, lead I (msec)	
ECPQD1	8855	000-128	
	364	888 Blank but applicable	
157-159		Q or QS duration, lead II (msec)	

ECPQD2 8862 000-154
 357 888 Blank but applicable

NHANES II Electrocardiography Data File

 ECG WAVE MEASUREMENTS

Positions SAS name	Counts	Item description and code	Notes
160-162 ECPQD3	8833 386	Q or QS duration, lead III (msec) 000-186 888 Blank but applicable	
163-165 ECPQD4	8866 353	Q or QS duration, lead aVL (msec) 000-154 888 Blank but applicable	
166-168 ECPQD5	8873 346	Q or QS duration, lead aVF (msec) 000-150 888 Blank but applicable	
169-171 ECPQD6	8886 333	Q or QS duration, lead V1 (msec) 000-148 888 Blank but applicable	
172-174 ECPQD7	8891 328	Q or QS duration, lead V2 (msec) 000-194 888 Blank but applicable	
175-177 ECPQD8	8893 326	Q or QS duration, lead V3 (msec) 000-180 888 Blank but applicable	
178-180 ECPQD9	8893 326	Q or QS duration, lead V4 (msec) 000-110 888 Blank but applicable	
181-183 ECPQD10	8892 327	Q or QS duration, lead V5 (msec) 000-116 888 Blank but applicable	
184-186 ECPQD11	8897 322	Q or QS duration, lead V6 (msec) 000-122 888 Blank but applicable	

NHANES II Electrocardiography Data File

 ECG WAVE MEASUREMENTS

Positions SAS name	Counts	Item description and code	Notes
-----------------------	--------	------------------------------	-------

```

-----
187-190      R amplitude, lead I (uV)
ECPRA1      8855      0000-2519
              364      8888 Blank but applicable

191-194      R amplitude, lead II (uV)
ECPRA2      8862      0000-2622
              357      8888 Blank but applicable

195-198      R amplitude, lead III (uV)
ECPRA3      8833      0000-2503
              386      8888 Blank but applicable

199-202      R amplitude, lead aVR (uV)
ECPRA4      8872      0000-2238
              347      8888 Blank but applicable

203-206      R amplitude, lead aVL (uV)
ECPRA5      8866      0000-2432
              353      8888 Blank but applicable

207-210      R amplitude, lead aVF (uV)
ECPRA6      8873      0000-2388
              346      8888 Blank but applicable

211-214      R amplitude, lead V1 (uV)
ECPRA7      8886      0000-2599
              333      8888 Blank but applicable

215-218      R amplitude, lead V2 (uV)
ECPRA8      8891      0000-3023
              328      8888 Blank but applicable

219-222      R amplitude, lead V3 (uV)
ECPRA9      8893      0000-3293
              326      8888 Blank but applicable

```

NHANES II Electrocardiography Data File

```

-----
ECG WAVE MEASUREMENTS
-----

```

Positions SAS name	Counts	Item description and code	Notes
223-226 ECPRA10	8893 326	R amplitude, lead V4 (uV) 0000-3922 8888 Blank but applicable	
227-230 ECPRA11	8892 327	R amplitude, lead V5 (uV) 0000-3684 8888 Blank but applicable	
231-234 ECPRA12	8897 322	R amplitude, lead V6 (uV) 0000-3518 8888 Blank but applicable	

235-237		R duration, lead I (msec)
ECPRD1	8855	000-178
	364	888 Blank but applicable
238-240		R duration, lead II (msec)
ECPRD2	8862	000-178
	357	888 Blank but applicable
241-243		R duration, lead III (msec)
ECPRD3	8833	000-170
	386	888 Blank but applicable
244-246		R duration, lead aVR (msec)
ECPRD4	8872	000-152
	347	888 Blank but applicable
247-249		R duration, lead aVL (msec)
ECPRD5	8866	000-184
	353	888 Blank but applicable
250-252		R duration, lead aVF (msec)
ECPRD6	8873	000-168
	346	888 Blank but applicable

NHANES II Electrocardiography Data File

 ECG WAVE MEASUREMENTS

Positions		Item description	
SAS name	Counts	and code	Notes
253-255		R duration, lead V1 (msec)	
ECPRD7	8886	000-170	
	333	888 Blank but applicable	
256-258		R duration, lead V2 (msec)	
ECPRD8	8891	000-196	
	328	888 Blank but applicable	
259-261		R duration, lead V3 (msec)	
ECPRD9	8893	000-174	
	326	888 Blank but applicable	
262-264		R duration, lead V4 (msec)	
ECPRD10	8893	000-160	
	326	888 Blank but applicable	
265-267		R duration, lead V5 (msec)	
ECPRD11	8892	000-182	
	327	888 Blank but applicable	
268-270		R duration, lead V6 (msec)	
ECPRD12	8897	000-168	
	322	888 Blank but applicable	

271-274		S amplitude, lead I (uV)
ECPSA1	8855	0000-2388
	364	8888 Blank but applicable
275-278		S amplitude, lead II (uV)
ECPSA2	8862	0000-2181
	357	8888 Blank but applicable
279-282		S amplitude, lead III (uV)
ECPSA3	8833	0000-2707
	386	8888 Blank but applicable

NHANES II Electrocardiography Data File

 ECG WAVE MEASUREMENTS

Positions		Item description	
SAS name	Counts	and code	Notes

283-286		S amplitude, lead aVR (uV)	
ECPSA4	8872	0000-2108	
	347	8888 Blank but applicable	
287-290		S amplitude, lead aVL (uV)	
ECPSA5	8866	0000-2360	
	353	8888 Blank but applicable	
291-294		S amplitude, lead aVF (uV)	
ECPSA6	8873	0000-2581	
	346	8888 Blank but applicable	
295-298		S amplitude, lead V1 (uV)	
ECPSA7	8886	0000-2816	
	333	8888 Blank but applicable	
299-302		S amplitude, lead V2 (uV)	
ECPSA8	8891	0000-2990	
	328	8888 Blank but applicable	
303-306		S amplitude, lead V3 (uV)	
ECPSA9	8893	0000-2992	
	326	8888 Blank but applicable	
307-310		S amplitude, lead V4 (uV)	
ECPSA10	8893	0000-2998	
	326	8888 Blank but applicable	
311-314		S amplitude, lead V5 (uV)	
ECPSA11	8892	0000-2920	
	327	8888 Blank but applicable	
315-318		S amplitude, lead V6 (uV)	
ECPSA12	8897	0000-2262	
	322	8888 Blank but applicable	

NHANES II Electrocardiography Data File

 ECG WAVE MEASUREMENTS

Positions SAS name	Counts	Item description and code	Notes
319-321 ECPSD1	8855 364	S duration, lead I (msec) 000-126 888 Blank but applicable	
322-324 ECPSD2	8862 357	S duration, lead II (msec) 000-144 888 Blank but applicable	
325-327 ECPSD3	8833 386	S duration, lead III (msec) 000-156 888 Blank but applicable	
328-330 ECPSD4	8872 347	S duration, lead aVR (msec) 000-128 888 Blank but applicable	
331-333 ECPSD5	8866 353	S duration, lead aVL (msec) 000-134 888 Blank but applicable	
334-336 ECPSD6	8873 346	S duration, lead aVF (msec) 000-170 888 Blank but applicable	
337-339 ECPSD7	8886 333	S duration, lead V1 (msec) 000-138 888 Blank but applicable	
340-342 ECPSD8	8891 328	S duration, lead V2 (msec) 000-144 888 Blank but applicable	
343-345 ECPSD9	8893 326	S duration, lead V3 (msec) 000-144 888 Blank but applicable	

NHANES II Electrocardiography Data File

 ECG WAVE MEASUREMENTS

Positions SAS name	Counts	Item description and code	Notes
346-348 ECPSD10	8893	S duration, lead V4 (msec) 000-168	

	326	888	Blank but applicable
349-351			S duration, lead V5 (msec)
ECPSD11	8892	000-138	
	327	888	Blank but applicable
352-354			S duration, lead V6 (msec)
ECPSD12	8897	000-130	
	322	888	Blank but applicable
355-358			R' amplitude, lead I (uV)
ECRPA1	8855	0000-2110	
	364	8888	Blank but applicable
359-362			R' amplitude, lead II (uV)
ECRPA2	8862	0000-1919	
	357	8888	Blank but applicable
363-366			R' amplitude, lead III (uV)
ECRPA3	8833	0000-2434	
	386	8888	Blank but applicable
367-370			R' amplitude, lead aVR (uV)
ECRPA4	8872	0000-2049	
	347	8888	Blank but applicable
371-374			R' amplitude, lead aVL (uV)
ECRPA5	8866	0000-1773	
	353	8888	Blank but applicable
375-378			R' amplitude, lead aVF (uV)
ECRPA6	8873	0000-1713	
	346	8888	Blank but applicable

NHANES II Electrocardiography Data File

 ECG WAVE MEASUREMENTS

Positions		Item description	
SAS name	Counts	and code	Notes
379-382		R' amplitude, lead V1 (uV)	
ECRPA7	8886	0000-2135	
	333	8888	Blank but applicable
383-386		R' amplitude, lead V2 (uV)	
ECRPA8	8891	0000-1641	
	328	8888	Blank but applicable
387-390		R' amplitude, lead V3 (uV)	
ECRPA9	8893	0000-1606	
	326	8888	Blank but applicable
391-394		R' amplitude, lead V4 (uV)	
ECRPA10	8893	0000-3313	
	326	8888	Blank but applicable

395-398		R' amplitude, lead V5 (uV)
ECPRPA11	8892	0000-3337
	327	8888 Blank but applicable
399-402		R' amplitude, lead V6 (uV)
ECPRPA12	8897	0000-3201
	322	8888 Blank but applicable
403-406		J amplitude, lead I (uV)
ECPJ1	8855	-597-0133
	364	8888 Blank but applicable
407-410		J amplitude, lead II (uV)
ECPJ2	8862	-350-0212
	357	8888 Blank but applicable
411-414		J amplitude, lead III (uV)
ECPJ3	8833	-321-0390
	386	8888 Blank but applicable

NHANES II Electrocardiography Data File

 ECG WAVE MEASUREMENTS

Positions		Item description	
SAS name	Counts	and code	Notes
415-418		J amplitude, lead aVR (uV)	
ECPJ4	8872	-779-0295	
	347	8888 Blank but applicable	
419-422		J amplitude, lead aVL (uV)	
ECPJ5	8866	-281-0218	
	353	8888 Blank but applicable	
423-426		J amplitude, lead aVF (uV)	
ECPJ6	8873	-188-0440	
	346	8888 Blank but applicable	
427-430		J amplitude, lead V1 (uV)	
ECPJ7	8886	-109-0279	
	333	8888 Blank but applicable	
431-434		J amplitude, lead V2 (uV)	
ECPJ8	8891	-297-0500	
	328	8888 Blank but applicable	
435-438		J amplitude, lead V3 (uV)	
ECPJ9	8893	-347-1558	
	326	8888 Blank but applicable	
439-442		J amplitude, lead V4 (uV)	
ECPJ10	8893	-502-0291	
	326	8888 Blank but applicable	

443-446		J amplitude, lead V5 (uV)
ECPJ11	8892	-280-0326
	327	8888 Blank but applicable
447-450		J amplitude, lead V6 (uV)
ECPJ12	8897	-271-0276
	322	8888 Blank but applicable

NHANES II Electrocardiography Data File

 ECG WAVE MEASUREMENTS

Positions SAS name	Counts	Item description and code	Notes
451-455 ECPNTA1	8855 364	Negative T amplitude, lead I (uV) -2326-00000 88888 Blank but applicable	
456-459 ECPNTA2	8862 357	Negative T amplitude, lead II (uV) -523-0000 8888 Blank but applicable	
460-463 ECPNTA3	8833 386	Negative T amplitude, lead III (uV) -626-0000 8888 Blank but applicable	
464-467 ECPNTA4	8872 347	Negative T amplitude, lead aVR (uV) -629-0000 8888 Blank but applicable	
468-471 ECPNTA5	8866 353	Negative T amplitude, lead aVL (uV) -430-0000 8888 Blank but applicable	
472-475 ECPNTA6	8873 346	Negative T amplitude, lead aVF (uV) -425-0000 8888 Blank but applicable	
476-479 ECPNTA7	8886 333	Negative T amplitude, lead V1 (uV) -684-0000 8888 Blank but applicable	
480-484 ECPNTA8	8891 328	Negative T amplitude, lead V2 (uV) -2331-00000 88888 Blank but applicable	
485-489 ECPNTA9	8893 326	Negative T amplitude, lead V3 (uV) -1782-00000 88888 Blank but applicable	

NHANES II Electrocardiography Data File

 ECG WAVE MEASUREMENTS

Positions SAS name	Counts	Item description and code	Notes
490-494 ECPNTA10	8893 326	Negative T amplitude, lead V4 (uV) -1616-00000 88888 Blank but applicable	
495-499 ECPNTA11	8892 327	Negative T amplitude, lead V5 (uV) -1280-00000 88888 Blank but applicable	
500-504 ECPNTA12	8897 322	Negative T amplitude, lead V6 (uV) -1793-00000 88888 Blank but applicable	
505-508 ECPPTA1	8855 364	Positive T amplitude, lead I (uV) 0000-0715 8888 Blank but applicable	
509-512 ECPPTA2	8862 357	Positive T amplitude, lead II (uV) 0000-0824 8888 Blank but applicable	
513-516 ECPPTA3	8833 386	Positive T amplitude, lead III (uV) 0000-0652 8888 Blank but applicable	
517-520 ECPPTA4	8872 347	Positive T amplitude, lead aVR (uV) 0000-0605 8888 Blank but applicable	
521-524 ECPPTA5	8866 353	Positive T amplitude, lead aVL (uV) 0000-1367 8888 Blank but applicable	
525-528 ECPPTA6	8873 346	Positive T amplitude, lead aVF (uV) 0000-0884 8888 Blank but applicable	

NHANES II Electrocardiography Data File

 ECG WAVE MEASUREMENTS

Positions SAS name	Counts	Item description and code	Notes
529-532 ECPPTA7	8886 333	Positive T amplitude, lead V1 (uV) 0000-1128 8888 Blank but applicable	
533-536 ECPPTA8	8891	Positive T amplitude, lead V2 (uV) 0000-1786	

	328	8888	Blank but applicable
537-540			Positive T amplitude, lead V3 (uV)
ECPPTA9	8893	0000-2119	
	326	8888	Blank but applicable
541-544			Positive T amplitude, lead V4 (uV)
ECPPTA10	8893	0000-1903	
	326	8888	Blank but applicable
545-548			Positive T amplitude, lead V5 (uV)
ECPPTA11	8892	0000-1606	
	327	8888	Blank but applicable
549-552			Positive T amplitude, lead V6 (uV)
ECPPTA12	8897	0000-1408	
	322	8888	Blank but applicable

Notes

ECPWIDTH: Chest half-width(mm)

Two anthropometric measurements related to the chest dimensions and chest electrode locations were obtained in NHANES III using an electrode locator (Heartsquare) used to position the V4 electrode at a 45 degree angle between the midsternal line and the left midaxillary line (location of V6) (Rautaharju et al, 1976). The half-width of the chest is the distance (cm) from the midsternal line to the left lateral chest wall at the level of V6. The half-depth of the chest is the distance from the frontal plane at lower sternum to the frontal plane which transects the thorax at the level of the midaxillary levels. Both of these measurements were obtained to the nearest 0.5 cm and reported as three digit numbers without a decimal (mm) for NHANES III only.

ECPDEPTH: Chest half-depth (mm)

See note for ECPWIDTH.

ECPG1: Major ECG abnormalities

Minnesota Code Comments

Major Q, QS waves	1.1 or 1.2 except 1.2.8	Highest code in any leadgroup
ST depression	4.1 or 4.2	
Negative T waves	5.1 or 5.2	
Complete AV block	6.1	Coded visually, not coded in NHANES I
WPW pattern	6.4	
Artificial pacemaker	6.8	Coded visually, not coded in NHANES I
Ventricular conduction defect	7.1 or 7.2 or 7.4	
Atrial fibrillation /flutter	8.3	Coded visually
ST elevation	9.2	

ECPG2: Minor ECG abnormalities

Minnesota Code Comments

Minor Q waves	1.2.8 or 1.3	
High R waves	3.1 or 3.3	Any 3.1 or 3.3 code
Minor ST codes	4.3 or 4.4	
Minor T wave codes	5.3 or 5.4	
Prolonged PR interval	6.3	
RR' in V1 or V2	7.3 or 7.5	
Left anterior fascicular block	7.7	

ECPG3: Probable myocardial infarction by the Minnesota Code

Major Q/QS waves (Code 1.1.1 through 1.1.7), or Moderate Q/QS waves with ST depression or T wave inversion (Code 1.2.1 through 1.2.7 and code 4.1, 4.2, 5.1 or 5.2)

ECPG4: Possible myocardial infarction by the Minnesota Code

Moderate Q/QS waves without ST depression or T wave inversion (Code 1.2.1 through 1.2.7 without Code 4.1, 4.2, 5.1 and 5.2), or minor Q/QS waves with ST depression or T wave inversion (Code 1.2.8 or 1.3.1 through 1.3.6 and Code 4.1, 4.2, 5.1 or 5.2)

ECPG5: Probable LVH by the Minnesota Code

Code 3.1 with code 5.1 or 5.2 or 5.3

ECPG6: Possible LVH by the Minnesota Code

Code 3.1 without code 5.1 and 5.2 and 5.3, OR Any code 3.3

ECPMC2 MC 2 (QRS axis code)

The algorithm used for QRS axis determination provides a more accurate estimation of the mean frontal plane axis than the approximation used in Minnesota Code 2 according to the conventional visual measurement.

The algorithm used for the QRS axis determination is also used for P and T axis calculation.

Values of QRS integrals (net QRS 'areas', A) determined from the six limb leads are used for the mean frontal plane QRS axis calculation.

Three separate axis angle (ANG) values are calculated from three pairs of limb leads. The lead vectors of these three pairs of leads are assumed to be orthogonal according to the Einthoven's equilateral triangle approximation, and the relative strength of the lead vectors of leads aVR, aVL and aVF are assumed to be 3/2 times the lead vector strengths of leads I, II and III. Consequently, the augmented unipolar limb leads are scaled by factor 1.16 in these pairwise calculations of the three angles ANG(1), ANG(2) and ANG(3).

$$\begin{aligned} \text{ANG}(1) &= \text{ARCTG} (1.16 \times A(\text{aVF}), A(\text{I})), \\ \text{ANG}(2) &= \text{ARCTG} (A(\text{II}), 1.16 \times A(\text{aVF})), \\ \text{ANG}(3) &= \text{ARCTG} (1.16 \times A(\text{aVR}), A(\text{III})) + 120 \end{aligned}$$

In case the three values are reasonably consistent, the final mean frontal plane axis is taken as the mean value of these three separate angle

determinations. Several inconsistency checks are performed, and if abnormally large discrepancies are found, the angle is termed 'undetermined'.

QRS axis values are used to identify abnormal axis deviations, with the following categories for the QRS axis code (code 2):

2.0.0	from 0 to 90 degrees	Normal QRS axis
2.1.1	from -29 to -1 degrees (LAD)	Borderline left axis deviation
2.1.2	from -89 to -30 degrees	LAD
2.2.1	from 91 to 119 degrees (RAD)	Borderline right axis deviation
2.2.2	from 120 to 150 degrees	RAD
3.3	from 149 to 90 degrees	Extreme axis deviation
2.4		Indeterminate QRS axis

ECPCIIS, ECPCIIS2, ECPCIIS3, ECPCIIS4: Cardiac Infarction/Injury Score for 12 lead ECG multiplied by 10

This ECG coding scheme was developed as a measure of the likelihood of myocardial infarction on a continuous scale. The following thresholds for the score define the likelihood of infarction in a decreasing order:

Probable infarction CIIS ≥ 20
Possible infarction $15 \leq \text{CIIS} < 20$
Consider infarction $10 \leq \text{CIIS} < 15$

These thresholds correspond to the estimated specificity levels of 98%, 95% and 90% (Rautaharju et al., 1981.).

ECPCIIS2: Infarction/Injury probable

See note for ECPCIIS.

ECPCIIS3: Infarction/Injury possible

See note for ECPCIIS.

ECPCIIS4: Consider Infarction/Injury probable

See note for ECPCIIS.

ECPLVM, ECPLVMI, ECPLVM3: Estimate LV Mass and LV Mass Index

Coefficients for the regression equation used for ECG estimation of left ventricular mass (LVM) and left ventricular mass index (LVMI) (Rautaharju et al, 1990).

White and Black Men

Variables	LVM	LVMI
R amplitude in V5 (αV)	0.0217	0.0100
Q or S amplitude in V1 (αV)*	0.0338	0.0203
Q or S amplitude in III (αV)*	0.0600	0.0287
Negative T amplitude in V6 (αV)	0.3158	0.1819
Positive T amplitude in aVR (αV)	-0.2958	-0.1482
QRS duration (msec.)	1.8204	1.0485
Intercept	-58.5098	-36.4290

White Women

Variables	LVM	LVMI
R amplitude on aVL (æV)	0.0320	--
R amplitude in V5 (æV)	0.0233	0.0178
Q or S amplitude in V5 (æV)*	0.0693	0.0528
Q or S amplitude in I (æV)*	-0.1545	-0.1128
Positive T amplitude in V1 (æV)	0.1122	0.1075
Negative T amplitude in aVF (æV)	--	0.1701
Positive T amplitude in V6 (æV)	-0.1236	-0.0939
Intercept	134.7722	88.4357

Black Women

Variables	LVM	LVMI
R amplitude in aVL (æV)	--	0.0216
R amplitude in I (æV)	0.0498	--
(R amplitude in V6 + S amplitude in V2) (æV)	0.0235	0.0184
R amplitude in V1	-0.0507	--
R amplitude in V2 (æV)	--	-0.0143
Q or S amplitude in V6 (æV)*	-0.0980	-0.0693
Negative T amplitude in aVL (æV)	--	0.199
Negative T amplitude in I (æV)	0.5225	--
QRS duration (msec.)	1.8478	0.7460
Intercept	-90.7136	-22.3064

* whichever is larger

The following limits for LVMI are taken to indicate the presence of probable left ventricular hypertrophy to correspond upper normal limits for echocardiographic LVMI by the conventions of the American Society for Echocardiography (Levy et al. 1987). These LVH criteria have been evaluated recently in an independent study population (Rautaharju et al, 1996).

Males > 150 g/m²
Females > 120 g/m²

ECPLVMI: ECG estimate LV Mass Index

See note for ECPLVM.

ECPLVM3: Probable LVH

See note for ECPLVM.

ECPAXIS2: QRS axis, frontal plane (degrees)

See note for ECPMC2

ECPBEAT: Rhythm Code

Arrhythmias were not coded in NHANES I except that ECGs with no P waves detected or with P wave detection uncertain were coded visually for the presence of atrial fibrillation. Arrhythmic codes were determined visually by a senior electrocardiographer (PMR) for NHANES II and III. Note that the history of atrial fibrillation was an exclusion criterion for ECG recording in NHANES III. Pacemaker enhancement circuits were not used in ECG recorders of any of these surveys which makes coding uncertain.

References

- Blackburn H, Keys A, Simonson E, Rautaharju PM and Punsar S. The electrocardiogram in population studies: A classification system. *Circulation* 1960;21:1160-1175.
- Levy D, Savage DD, Garrison RJ, Anderson KM, Kannel WB, Castelli WP. Echocardiographic criteria for left ventricular hypertrophy: The Framingham Heart Study. *Am J Cardiol* 1987;59:956-60.
- National Center for Health Statistics. Ingram DD, Makuc DM. Statistical issues in analyzing the NHANES I epidemiologic followup study. *Vital and Health Statistics, Series 2, Number 92*. DHHS Pub. No. (PHS) 94-1395. Public Health Service. Washington. U.S. Government Printing Office. May., 1994.
- National Center for Health Statistics. Landis JR, Lepkowski JM, Eklund SA, Stehouwer SA. A statistical Methodology for Analyzing Data from a Complex Survey: The First National Health and Nutrition Examination Survey. *Vital and Health Statistics. Series 2, No. 92*. DHHS Pub. No. (PHS) 82-1366. Public Health Service. Washington. U.S. Government Printing Office. Sept., 1982.
- National Center for Health Statistics. Miller HW: Plan and Operation of the Health and Nutrition Examination Survey, United States 1971-73. *Vital and Health Statistics. Series 1, Nos 10a and 10b*. DHEW Pub. No. (Stat.) 73-1310. Health Services and Mental Health Administration, Washington. DC. U.S. Government Printing Office. Feb 1973.
- National Center for Health Statistics. Engel A, Murphy RS, Maurer K, Collins E. Plan and Operation of the HANES I Augmentation Survey of Adults 25-74 Years, United States, 1974-75. *Vital and Health Statistics. Series 1, No 14*. DHEW Pub. No. (PHS) 78-1314. Public Health Service. Washington. U.S., Government Printing Office, June 1978.
- Plan and Operation of the Second National Health and Nutrition Examination Survey. 1976-1980. *Vital and Health Statistics. Series 1, No. 15*. DHEW Pub. No. (PHS) 81-1317. Public Health Services, Washington. DC. U.S. Government Printing Office.
- Prineas RJ, Crow RS and Blackburn H. The Minnesota Code Manual of Electrocardiographic findings. Standards and Procedures for Measurement and Classification. John Wright. PSG Inc. Boston, Bristol, London, 1982
- Rautaharju PM, Wolf HK, Eifler WL, Blackburn H. A simple procedure for positioning precordial ECG and VCG electrodes using an electrode locator. *Journal of Electrocardiology* 1976;9:35-40.
- Rautaharju PM, Warren J, Jain U, Wolf HK and Nielsen CL. Cardiac infarction injury score: An electrocardiographic coding scheme for ischemic heart disease. *Circulation* 1981;64:249-256.
- Rautaharju PM, LaCroix AZ, Savage DD, Haynes S, Madans JH, Wolf HK, Hadden W, Keller J, Cornoni-Huntly J. Electrocardiographic estimate of left ventricular mass vs. radiographic cardiac size and the risk of cardiovascular disease mortality in the epidemiologic follow-up study of the First National Health and Nutrition Examination Survey. *Am J Cardiol* 1988;62:59-68.

Rautaharju PM, MacInnis PJ, Warren JW, Wolf HK, Rykers PM, Calhoun HP. Methodology of ECG Interpretation in the Dalhousie Program: NOVACODE ECG classification procedures for clinical trials and population health surveys. *Methods of Information in Medicine* 1990;29:362-74.

Rautaharju PM, Manolio TA, Siscovick D, Zhou SH, Gardin LM, Furberg CD, Borhani NO, Newman A. Classification accuracy of electrocardiographic criteria for left ventricular hypertrophy in normal weight and overweight older adults: The Cardiovascular Health Study. *Annals Noninvasive Electrocardiology* 1996;1:121-32.

Rowland M, Parsons V, Makuc D. Simplified design structures for NHANES I variance estimation. *Proceeding American Statistical Association*, 1988:773-76.

U.S. Department of Health and Human Services (DHHS). National Center for Health Statistics. Third National Health and Nutrition Examination Survey, 1988-94, Plan and Operations Procedures Manuals (CD-ROM). Hyattsville, Md.: Centers for Disease Control and Prevention, 1996. Available from National Technical Information Service (NTIS), Springfield, Va. Acrobat .PDF format; includes access software: Adobe Systems Inc. Acrobat Reader 2.0).