Recommendations for the Standardization and Interpretation of the Electrocardiogram: Part II: Electrocardiography Diagnostic Statement List A Scientific Statement From the American Heart Association Electrocardiography and Arrhythmias Committee, Council on Clinical Cardiology; the American College of Cardiology Foundation; and the Heart Rhythm Society Endorsed by the International Society for Computerized Electrocardiology

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Part II: Electrocardiography Diagnostic Statement List

A Scientific Statement From the American Heart Association Electrocardiography and Arrhythmias Committee, Council on Clinical Cardiology; the American College of Cardiology Foundation; and the Heart Rhythm Society

Endorsed by the International Society for Computerized Electrocardiology

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Abtract—This statement provides a concise list of diagnostic terms for ECG interpretation that can be shared by students, teachers, and readers of electrocardiography. This effort was motivated by the existence of multiple automated diagnostic code sets containing imprecise and overlapping terms. An intended outcome of this statement list is greater uniformity of ECG diagnosis and a resultant improvement in patient care. The lexicon includes primary diagnostic statements, secondary diagnostic statements, modifiers, and statements for the comparison of ECGs. This diagnostic lexicon should be reviewed and updated periodically. (J Am Coll Cardiol 2007;49:1128–35)

Key Words: AHA Scientific Statements ■ electrocardiography ■ computers ■ diagnosis

This is the second of 6 articles designed to upgrade the guidelines for the standardization and interpretation of the ECG. The project was initiated by the American Heart Association and has been endorsed by the American College of Cardiology, the Heart Rhythm Society, and the International Society for Computerized Electrocardiography. The rationale for this upgrade and a description of the process are contained in Part I by Kligfield et al (1).

The listing contained in the present statement seeks to present a limited set of ECG diagnostic statements that are clinically useful and that do not create unnecessary overlap or contain vague terminology. Some statements that are commonly used by electrocardiographers but that do not provide diagnostically or clinically useful information are not included. Some statements have been excluded to reduce the size of the statement set, so long as their meaning is well represented by included terms.

The Writing Group believes that the listing should be implemented as an available lexicon in report algorithms of the existing commercial electrocardiographs and that it should be used widely by ECG readers. The principal advantage of such use would be a worldwide improvement in uniformity of ECG interpretation. Such uniformity would promote better patient

Other members of the Standardization and Interpretation of the Electrocardiogram Writing Group include James J. Bailey, MD; Rory Childers, MD; Barbara J. Deal, MD, FACC; Mark Josephson, MD, FACC, FHRS; Paul Kligfield, MD, FAHA, FACC; Jan A. Kors, PhD; Peter Macfarlane, DSc; Olle Pahlm, MD, PhD; David M. Mirvis, MD, FAHA; Peter Okin, MD, FACC; Pentti Rautaharju, MD, PhD; Borys Surawicz, MD, FAHA, FACC; Gerard van Herpen, MD, PhD; Galen S. Wagner, MD; and Hein Wellens, MD, FAHA, FACC.

The American Heart Association, the American College of Cardiology Foundation, and the Heart Rhythm Society make every effort to avoid any actual or potential conflicts of interest that may arise as a result of an outside relationship or a personal, professional, or business interest of a member of the writing panel. Specifically, all members of the writing group are required to complete and submit a Disclosure Questionnaire showing all such relationships that might be perceived as real or potential conflicts of interest.

This statement was approved by the American Heart Association Science Advisory and Coordinating Committee on October 26, 2006, by the American College of Cardiology Board of Trustees on October 12, 2006, and by the Heart Rhythm Society on September 6, 2006.

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care. Additional advantages would be facilitation of the establishment of a uniform teaching curriculum in electrocardiography, availability of a uniform glossary of terms for research application, and promotion of research to better validate diagnostic criteria for the specific terms in the limited lexicon.

Although we recognize that each vendor of ECGs possesses a proprietary set of diagnostic statements and underlying criteria, we hope that this list of statements will be made available by each of them so that the reader can select it as the primary dictionary for use in interpreting all or some ECGs. We are also hopeful that the vendors will collaborate among themselves to align diagnostic criteria for this specific lexicon. This would not interfere with continued development of entirely independent, proprietary diagnostic software by each manufacturer.

Organization and Use

Four lists are included within this document. The main listing (Table 1), "Primary Statements," displays 117 primary diagnostic statements under 14 categories. The majority of the primary statements are nondescriptive and convey clinical meaning without additional statements. The second listing (Table 2), "Secondary Statements," provides additional statements that can be used to expand the specificity and clinical relevance of both descriptive and other primary diagnostic statements. These secondary statements are divided into 2 groups. Those that are preceded by "suggests" invoke clinical diagnoses likely responsible for the ECG observation(s). Those that are preceded by "consider" are intended to propose at least 1, but sometimes >1, potentially associated clinical disorder. This set of primary and secondary diagnostic statements constitutes what we might call the "core statement lexicon."

The third list (Table 3) contains adjectives that can be used to modify the diagnostic statements. None of the modifiers change the meaning of the core statement but rather serve to refine the meaning. The list contains general modifiers, which can be used with many of the core statements, and specific modifiers assigned to a specific category of statements.

The fourth list (Table 4) is a short directory of comparison statements. It specifies 6 types of ECG changes that merit mention in the ECG interpretation and defines criteria to identify change within the 6 categories. Because so many statements could be made in comparing individual ECGs to ≥1 previous ECGs, the Writing Group recommends use of these 6 statements to convey clinically important information that could influence patient care by the attending physician while preserving brevity and uniformity. On the other hand, the Writing Group encourages readers to add uncoded text as needed to the report to more fully compare tracings.

Tables 5, 6, and 7 establish rules for use of the primary, secondary, and modifier statements, alone or in combination. Table 8 is a set of commonly used statements that can, for the most part, be precisely reproduced by use of the primary and secondary statements and their modifiers. These statements are commonly used concatenations provided for the convenience of the reader.

Criteria for Diagnoses

This listing does not specify diagnostic criteria for any of the statements. A single set of diagnostic criteria underlying the core statements would have great benefits for patient care and research. Although the Writing Group does not believe that a uniform criterion set can be achieved at this time, we encourage ECG vendors and electrocardiography researchers and experts to collaborate on the development of a universally acceptable criteria set and a means for perpetually refining it. Several of the chapters in this statement support specific criteria for some of the core statements.

Myocardial Infarction Terminology

Advanced imaging techniques, including echocardiography (2) and magnetic resonance (3,4), have demonstrated a need for change in existing terminology describing the cardiac location of myocardial infarction. New diagnostic statements for 6 common, distinct cardiac locations of myocardial infarction, documented by contrast-enhanced magnetic resonance, were recently recommended by a committee of the International Society for Holter and Noninvasive Electrocardiography (5). At the present time, the Writing Group considers the quantity of new data insufficient to recommend abandonment of existing terminology. Thus, traditional terms are listed in "Section M: Myocardial infarction" of the primary statement table (Table 1); however, we intend to revisit this issue when sufficient data have been developed.

Disclosures

Writing Group Disclosures

Writing Group Member	Employment	Research Grant	Other Research Support	Speakers' Bureau/Honoraria	Ownership Interest	Consultant/ Advisory Board	Other
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This table represents the relationships of writing group members that may be perceived as actual or reasonably perceived conflicts of interest as reported on the Disclosure Questionnaire, which all members of the writing group are required to complete and submit. A relationship is considered to be "significant" if (1) the person receives $10 000 or more during any 12-month period, or 5% or more of the person's gross income; or (2) the person owns 5% or more of the voting stock or share of the entity, or owns $10 000 or more of the fair market value of the entity. A relationship is considered to be "modest" if it is less than "significant" under the preceding definition.

*Significant.

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This table represents the relationships of reviewers that may be perceived as actual or reasonably perceived conflicts of interest as reported on the Disclosure Questionnaire, which all reviewers are required to complete and submit.

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TABLE 1. Primary Statements

A. Overall interpretation	
1	Normal ECG
2	Otherwise normal ECG
3	Abnormal ECG
4	Uninterpretable ECG
B. Technical conditions	
10	Extremity electrode reversal
11	Misplaced precordial electrode(s)
12	Missing lead(s)
13	Right-sided precordial electrode(s)
14	Artifact
15	Poor-quality data
16	Posterior electrode(s)
C. Sinus node rhythms and arrhythmias	
20	Sinus rhythm
21	Sinus tachycardia
22	Sinus bradycardia
23	Sinus arrhythmia
24	Sinoatrial block, type I
25	Sinoatrial block, type II
26	Sinus pause or arrest
27	Uncertain supraventricular rhythm
D. Supraventricular arrhythmias	
30	Atrial premature complex(es)
31	Atrial premature complexes, nonconducted
32	Retrograde atrial activation
33	Wandering atrial pacemaker
34	Ectopic atrial rhythm
35	Ectopic atrial rhythm, multifocal
36	Junctional premature complex(es)
37	Junctional escape complex(es)
38	Junctional rhythm
39	Accelerated junctional rhythm
40	Supraventricular rhythm
41	Supraventricular complex(es)
42	Bradycardia, nonsinus
E. Supraventricular tachyarrhythmias	
50	Atrial fibrillation
51	Atrial flutter
52	Ectopic atrial tachycardia, unifocal
53	Ectopic atrial tachycardia, multifocal
54	Junctional tachycardia
55	Supraventricular tachycardia
56	Narrow-QRS tachycardia
F. Ventricular arrhythmias	
60	Ventricular premature complex(es)
61	Fusion complex(es)
62	Ventricular escape complex(es)
63	Idioventricular rhythm
64	Accelerated idioventricular rhythm
65	Fascicular rhythm
66	Parasystole
G. Ventricular tachyarrhythmias	
70	Ventricular tachycardia
71	Ventricular tachycardia, unsustained
72	Ventricular tachycardia, polymorphous
73	Ventricular tachycardia, torsades de pointes
74	Ventricular fibrillation
75	Fascicular tachycardia
76	Wide-QRS tachycardia
H. Atrioventricular conduction	
80	Short PR interval
81	AV conduction ratio N:D
82	Prolonged PR interval
83	Second-degree AV block, Mobitz type I (Wenckebach)
84	Second-degree AV block, Mobitz type II
85	2:1 AV block
86	AV block, varying conduction
87	AV block, advanced (high-grade)
88	AV block, complete (third-degree)
89	AV dissociation
I. Intraventricular and intra-atrial conduction	
100	Aberrant conduction of supraventricular beat(s)
101	Left anterior fascicular block
102	Left posterior fascicular block
104	Left bundle-branch block
105	Incomplete right bundle-branch block
106	Right bundle-branch block
107	Intraventricular conduction delay
108	Ventricular preexcitation
109	Right atrial conduction abnormality
110	Left atrial conduction abnormality
111	Epsilon wave
J. Axis and voltage	
120	Right-axis deviation
121	Left-axis deviation
122	Right superior axis
123	Indeterminate axis
124	Electrical alternans
125	Low voltage
128	Abnormal precordial R-wave progression
131	Abnormal P-wave axis
K. Chamber hypertrophy or enlargement	
140	Left atrial enlargement
141	Right atrial enlargement
142	Left ventricular hypertrophy
143	Right ventricular hypertrophy
144	Biventricular hypertrophy

TABLE 1. Primary Statements, Cont'd

L. ST segment, T wave, and U wave	
145	ST deviation
146	ST deviation with T-wave change
147	T-wave abnormality
148	Prolonged QT interval
149	Short QT interval
150	Prominent U waves
151	Inverted U waves
152	TU fusion
153	ST-T change due to ventricular hypertrophy
154	Osborn wave
155	Early repolarization
M. Myocardial infarction	
160	Anterior MI
161	Inferior MI
162	Posterior MI
163	Lateral MI
165	Anteroseptal MI
166	Extensive anterior MI
173	MI in presence of left bundle-branch block
174	Right ventricular MI
N. Pacemaker	
180	Atrial-paced complex(es) or rhythm
181	Ventricular-paced complex(es) or rhythm
182	Ventricular pacing of non–right ventricular apical origin
183	Atrial-sensed ventricular-paced complex(es) or rhythm
184	AV dual-paced complex(es) or rhythm
185	Failure to capture, atrial
186	Failure to capture, ventricular
187	Failure to inhibit, atrial
188	Failure to inhibit, ventricular
189	Failure to pace, atrial
190	Failure to pace, ventricular

AV indicates atrioventricular; MI, myocardial infarction.

TABLE 2. Secondary Statements

Suggests...	
200	Acute pericarditis
201	Acute pulmonary embolism
202	Brugada abnormality
203	Chronic pulmonary disease
204	CNS disease
205	Digitalis effect
206	Digitalis toxicity
207	Hypercalcemia
208	Hyperkalemia
209	Hypertrophic cardiomyopathy
210	Hypocalcemia
211	Hypokalemia or drug effect
212	Hypothermia
213	Ostium primum ASD
214	Pericardial effusion
215	Sinoatrial disorder
Consider...	
220	Acute ischemia
221	AV nodal reentry
222	AV reentry
223	Genetic repolarization abnormality
224	High precordial lead placement
225	Hypothyroidism
226	Ischemia
227	Left ventricular aneurysm
228	Normal variant
229	Pulmonary disease
230	Dextrocardia
231	Dextroposition

CNS indicates central nervous system; ASD, atrial septal defect; and AV, atrioventricular.

TABLE 3. Modifiers

General	
301	Borderline
303	Increased
304	Intermittent
305	Marked
306	Moderate
307	Multiple
308	Occasional
309	One
310	Frequent
312	Possible
313	Postoperative
314	Predominant
315	Probable
316	Prominent
317	(Specified) Lead(s)
318	(Specified) Electrode(s)
321	Nonspecific
General: conjunctions	
302	Consider
310	Or
320	And
319	With
322	Versus
Myocardial infarction	
330	Acute
331	Recent
Myocardial infarction, cont'd	
332	Old
333	Of indeterminate age
334	Evolving
Arrhythmias and tachyarrhythmias	
340	Couplets
341	In a bigeminal pattern
342	In a trigeminal pattern
343	Monomorphic
344	Multifocal
345	Unifocal
346	With a rapid ventricular response
347	With a slow ventricular response
348	With capture beat(s)
349	With aberrancy
350	Polymorphic
Repolarization abnormalities	
360	≥0.1 mV
361	≥0.2 mV
362	Depression
363	Elevation
364	Maximally toward lead ___
365	Maximally away from lead ___
366	Low amplitude
367	Inversion
369	Postpacing (anamnestic)

TABLE 4. Comparison Statements

Code	Statement	Criteria
400	No significant change	Intervals (PR, QRS, QTc) remain normal or within 10% of a previously abnormal value
		No new or deleted diagnoses with the exception of normal variant diagnoses
401	Significant change in rhythm	New or deleted rhythm diagnosis
		HR change >20 bpm and <50 or >100 bpm
		New or deleted pacemaker diagnosis
402	New or worsened ischemia or infarction	Added infarction, ST-ischemia, or T-wave-ischemia diagnosis, or worsened ST deviation or T-wave abnormality
403	New conduction abnormality	Added AV or IV conduction diagnosis
404	Significant repolarization change	New or deleted QT diagnosis
		New or deleted U-wave diagnosis
		New or deleted nonischemic ST or T-wave diagnosis
		Change in QTc >60 ms
405	Change in clinical status	New or deleted diagnosis from Axis and Voltage, Chamber Hypertrophy, or Enlargement primary statement categories or "Suggests. . ." secondary statement category
406	Change in interpretation without significant change in waveform	Used when a primary or secondary statement is added or removed despite no real change in the tracing; ie, an interpretive disagreement exists between the readers of the first and second ECGs

QTc indicates corrected QT interval; HR, heart rate; bpm, beats per minute; AV, atrioventricular; and IV, intraventricular.

TABLE 5. General Use Rules

1	Secondary statements must be accompanied by a primary statement
2	Modifiers must be accompanied by a primary statement
3	A primary statement may be accompanied by nothing, by ≥1 modifiers, by ≥1 secondary statements, or by both.
4	Each secondary statement can accompany only certain primary statements (see Table 6)
5	Each general modifier can accompany only certain primary statements (see Table 7)
6	Each specific modifier can accompany only primary statements within its category

TABLE 6. Secondary–Primary Statement Pairing Rules

Secondary Code	May Accompany These Primary Codes
200	145–147
201	21, 105, 109, 120, 131, 141, 145–147
202	105, 106, 145–146
203	109, 120, 125, 128, 131, 141, 143
204	147
205	145–147
206	145–147
207	149
208	147
209	142
210	148
211	147–148, 150
212	14, 154
213	82, 105–106, 121
214	124
215	42, 131, 145–147
220	145–147, 151
221	55, 56
222	55, 56
223	148, 149
224	128
225	22, 24–26, 37, 38
226	145–147
227	145–147
228	80, 105, 128, 155
229	109, 120, 122–123, 125, 128, 131, 141, 143
230	128, 131
231	128

TABLE 7. General Modifier–Primary Statement Pairing Rules*

General Modifier Code	May (May Not) Accompany These Primary Codes or May Be Between Codes in These Categories or Groups of Categories	May/ May Not	Location
301	1–20, 24–76, 81, 83–106, 108, 122–124	May not	b
302	1–3, 12–16, 80–82, 111–130, 145–152	May not	b, i
303	30, 31, 36, 37, 41, 60, 62, 63, 82, 107, 109, 110	May	a, b
304	21–26, 30–76, 80, 82–108, 124, 180–190	May	b
305	1–20, 27–76, 81, 85–106, 111, 122, 123, 148–150, 160–190	May not	b
306	1–20, 27–76, 81, 85–106, 111, 122, 123, 148–150, 160–190	May not	b
307	26, 30, 31, 36, 37, 41, 60–62, 185–190	May	b
308	26, 30, 31, 36, 37, 41, 60–62, 185–190	May	b
309	26, 30, 31, 36, 37, 41, 60–62, 185–190	May	b
310	C, D, E, F, G, N, H, I, J, K, L, M	May	i
312	1–3, 15, 80–82, 120–122, 128	May not	b
313	145–147	May	b
314	20–23, 33–35, 38–56, 63–76, 83–89, 180–184	May	b
315	1–3, 15, 80–82, 120–122, 128	May not	b
316	1–20, 27–76, 81, 85–106, 111, 122, 123, 148–150, 160–190	May not	b
317	C, D, E, F, G, N, H, I, J, K, L, M	May	i
318	C, D, E, F, G, N, H, I, J, K, L, M	May	i
319	C, D, E, F, G, N, 100, J, K, L, M	May	i
321	40, 55, 56, 145–147	May	b

b indicates before; a, after; and i, between.
*Not inclusive.

TABLE 8. Convenience Statements*

Code	Statement
500	Nonspecific ST-T abnormality
501	ST elevation
502	ST depression
503	LVH with ST-T changes
	Others to be added

LVH indicates left ventricular hypertrophy.
*This table will be developed independently by each ECG laboratory.

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