



CIGNA MEDICAL COVERAGE POLICY

The following Coverage Policy applies to all plans administered by CIGNA Companies including plans administered by Great-West Healthcare, which is now a part of CIGNA.

**Subject Computerized
Electrocardiograph (ECG)
Analysis**

**Effective Date 9/15/2010
Next Review Date 9/15/2011
Coverage Policy Number 0210**

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Correlated Audioelectric Cardiography
 Implantable Cardioverter Defibrillator (ICD)
 Microvolt T-Wave Alternans
 Wearable Cardioverter Defibrillator and
 Automatic External Defibrillator

INSTRUCTIONS FOR USE

Coverage Policies are intended to provide guidance in interpreting certain **standard** CIGNA HealthCare benefit plans as well as benefit plans formerly administered by Great-West Healthcare. Please note, the terms of a participant's particular benefit plan document [Group Service Agreement (GSA), Evidence of Coverage, Certificate of Coverage, Summary Plan Description (SPD) or similar plan document] may differ significantly from the standard benefit plans upon which these Coverage Policies are based. For example, a participant's benefit plan document may contain a specific exclusion related to a topic addressed in a Coverage Policy. In the event of a conflict, a participant's benefit plan document **always supercedes** the information in the Coverage Policies. In the absence of a controlling federal or state coverage mandate, benefits are ultimately determined by the terms of the applicable benefit plan document. Coverage determinations in each specific instance require consideration of 1) the terms of the applicable group benefit plan document in effect on the date of service; 2) any applicable laws/regulations; 3) any relevant collateral source materials including Coverage Policies and; 4) the specific facts of the particular situation. Coverage Policies relate exclusively to the administration of health benefit plans. Coverage Policies are not recommendations for treatment and should never be used as treatment guidelines. Proprietary information of CIGNA. Copyright ©2010 CIGNA

Coverage Policy

CIGNA does not cover signal-averaged electrocardiography (SAECG) for any indication because it is considered experimental, investigational or unproven.

CIGNA does not cover remote algorithmic analysis of electrocardiographic-derived data (e.g., MultiFunction Cardiogram™ [MCG] [Premier Heart, Port Washington, NY]) for any indication because it is considered experimental, investigational or unproven.

General Background

There is a high incidence of sudden cardiac death (SCD) in patients with heart failure and diminished left ventricular ejection fraction and in patients who are recovering from acute myocardial infarction (MI). Significant effort has been directed to the identification of high-risk patients for interventions such as drugs or automatic implantable cardioverter defibrillators. Patients identified as high-risk actually account for a small proportion of preventable SCD, however Although the risk of SCD increases in proportion to the severity of cardiac disease in

an individual patient, most events occur in patients with no known cardiac history and with few or no risk factors. Various non-invasive methods may be used to assist in risk stratification, including left ventricular ejection fraction, standard electrocardiography, Holter monitoring, microvolt T-wave alternans, and exercise stress testing. Signal-averaged electrocardiography (SAECG) has also been proposed as a method of arrhythmia risk stratification.

SAECG is a noninvasive technique in which segments of a standard electrocardiogram (ECG) are computer-analyzed to detect small electrical impulses, called ventricular late potentials that follow the QRS segment. These impulses are imbedded in the ECG and are normally obscured by skeletal muscle activity and other extraneous causes of "noise" encountered in recording a typical ECG. With SAECG, signals are amplified, filtered, and then averaged using computer software. Ventricular late potentials are associated with elevated risk of ventricular tachyarrhythmias and sudden cardiac death, particularly in patients who have had recent myocardial infarction (MI) or who have cardiac abnormalities, such as coronary artery disease. An electrophysiologic (EP) study, an invasive procedure, is also commonly used to evaluate risk of sudden cardiac death. Although ventricular arrhythmias induced during EP studies are a strong predictor of risk, non-inducibility does not necessarily indicate a positive prognosis. There is no single test capable of accurately predicting SCD risk in various clinical settings and patient populations. The relative ability of each test to identify risk varies, and the optimal way to combine these tests is unclear. The sensitivity of an abnormal SAECG is reported to vary between 30–76%, and specificity between 63–96%. SAECG has a low positive predictive value for SCD (7–40%). The negative predictive value is high (>95%), but this is related to the low event rate of SCD ((Goldberger et al., 2009, Kusmirek and Gold, 2007; Zipes et al., 2006)

Coronary artery disease (CAD) causes approximately one in six deaths in the United States each year, and is the leading cause of death in American men and women. Non-invasive methods used to determine the presence or evaluate the risk of CAD include ECG, stress testing, with or without nuclear imaging, pharmacologic stress testing, and echocardiography, in combination with evaluation of medical and family history. Advanced imaging techniques, including computed tomography angiography (CTA) and cardiovascular magnetic resonance (CMR) are also being explored for the evaluation of CAD. No single non-invasive test has been demonstrated to identify patients with CAD with high sensitivity and specificity. Coronary angiography, an invasive procedure, remains the gold standard in the diagnosis of CAD (American Heart Association, 2010; Topol, 2007).

The MultiFunction Cardiogram™ (MCG) (Premier Heart, Port Washington, NY), a computerized ECG device, has been proposed as a non-invasive alternative for the evaluation of known or suspected coronary artery disease. The MCG records a simultaneous two-lead resting ECG from leads II and V5, using proprietary hardware and software. The analog MCG ECG signal is amplified, digitized, and transmitted to Premier Heart's datacenter via an encrypted internet connection. The data is analyzed, signal-averaging is performed, and the data is subjected to six mathematical transformations to identify functional indices. Patterns of abnormal indices are compared to abnormal index patterns in the reference database to reach a final diagnostic output. The diagnostic output consists of a numeric score of 0–20 and the presence of local or global ischemia, indicating the level of coronary obstruction/myocardial ischemia. A report of the testing is available on the MCG unit or can be viewed through a web browser. An earlier version of the device, 3DMP EKG Multiphase Information Analysis System, received FDA approval through the 510(k) process on March 21, 2000 (Premier Heart, LLC website, Strobeck et al., 2009).

Literature Review

Signal-averaged Electrocardiography (SAECG): The Cardiac Arrhythmias and Risk Stratification after Acute Myocardial Infarction (CARISMA) study (Huikuri et al., 2009) was conducted to evaluate the power of various invasive and non-invasive risk markers to predict arrhythmias with the potential to be treated with an ICD. Of 5869 consecutive patients screened two to seven days following acute myocardial infarction (AMI) in ten European centers, 312 patients with a mean left ventricular ejection fraction (LVEF) of $31 \pm 6\%$ were included. Reasons for exclusion included patient or physician refusal, other serious illness, planned coronary bypass graft surgery, or death. All patients received an implantable ECG loop-recorder 5–21 days following AMI to document fatal or near-fatal ventricular tachyarrhythmias, the primary endpoints of the study. Heart rate variability/turbulence, ambient arrhythmias, SAECG, T-wave alternans, and programmed electrical stimulation were performed six weeks after AMI. During the two year follow-up, 25 patients (8%) experienced fatal or near fatal tachyarrhythmias. The strongest predictor of these events was heart rate variability ($p < 0.001$), as measured by Holter monitor. Induction of sustained monomorphic ventricular tachycardia during programmed electrical

stimulation was also predictive of the final endpoint ($p=0.003$). QRS duration measured from the SAECG was a predictor of the primary endpoint, but when adjusted for clinical variables, the predictive power of SAECG was only of borderline significance ($p=0.04$). The authors stated that, while these results are promising, larger randomized interventional studies are needed before recommendations can be made regarding post-AMI Holter monitor screening.

A meta-analysis conducted by Bailey et al. (2001) evaluated current risk stratification tests for predicting major arrhythmic events after MI. The analysis included a total of 44 studies for which major adverse events incidence and predictive accuracy could be inferred. Tests reviewed included SAECG, heart rate variability, severe ventricular arrhythmia on ECG, left ventricular ejection fraction and EPS. The authors concluded that combinations of the four noninvasive tests in stages may allow 90% of patients to be stratified as high-risk or low-risk, with EPS reserved for patients for whom noninvasive tests are inconclusive, but that no single test was satisfactory alone for predicting risk. The authors further concluded that a large prospective study to develop a robust prediction model is feasible and desirable.

Several case series and cohort studies have evaluated noninvasive methods of identifying patients at risk for major arrhythmias and sudden cardiac death. The effectiveness of SAECG, T-Wave Alternans (TWA), electrophysiologic studies (EPS), heart rate variability, and baroreflex sensitivity have been evaluated in various combinations (Gold, et al., 2000; Iketa, et al., 2000; Gomes, et al., 2001; Huikuri, et al., 2001). These studies did not demonstrate that SAECG alone or in combination with other noninvasive tests is effective in defining risk and determining the appropriateness of specific pharmacological therapy or ICD implantation.

MultiFunction Cardiogram (MCG): Strobeck et al. (2009) conducted a meta-analysis to compare MCG to coronary angiography in detecting the presence and recurrence of hemodynamically relevant coronary artery disease. Three published prospective trials were included in the analysis, although the included trials were not specifically named ($n=1076$). The study participants consisted of a convenience sample of patients already scheduled for the reference procedure, coronary angiography, for any indication. The intent of the included studies was not to study MCG as a screening device, but to focus on the potential of the device as a diagnostic assay for coronary artery stenosis. Patients may or may not have had prior angiography and/or coronary intervention. Results were classified by two angiographers for hemodynamically relevant stenosis ($>70\%$). A coronary ischemia severity score of 0–20 was calculated for each patient. The severity score was significantly higher for patients with relevant coronary stenosis (5.4 ± 1.8 vs. 1.7 ± 2.1). The device correctly classified 941 of the 1076 patients (sensitivity 91.2%; specificity 84.6%; negative predictive value [NPV] 0.942, positive predictive value [PPV] 0.777). Adjusted PPV and NPV were 81.9% and 92.6%, respectively.

Evidence evaluating the use of MCG is limited; studies published to date, including Weiss et al., 2002; Hosokawa, et al., 2008; Grube, et al., 2007, Grube et al., 2008, have compared the device to coronary angiography. It is difficult to draw conclusions from the available evidence because of limitations in study design. It is not possible to determine how MCG compares to coronary angiography in determining the risk of presence of coronary artery disease. In addition, there are no published studies that evaluate the efficacy of MCG compared to other available non-invasive diagnostic methods (e.g., standard 12-lead ECG, stress testing, echocardiography and other imaging techniques). There is insufficient evidence in the published medical literature to determine how the use of this test would impact patient outcomes. The clinical utility of MCG in the evaluation or treatment of individuals with known or suspected coronary artery disease has not been established.

Professional Societies/Organizations

An American Heart Association (AHA) American College of Cardiology (ACC) Foundation/Heart Rhythm Society scientific statement on noninvasive risk stratification techniques for identifying patients at risk for sudden cardiac death states that an abnormal SAECG is likely a risk factor for sudden cardiac death, based predominantly on prospective analysis. The clinical utility to guide selection of therapy has been tested, but not yet demonstrated. The statement concluded that, given the high negative predictive value of the test, it may be useful for the identification of patients at low risk. Routine use of SAECG to identify patients at high risk for sudden cardiac death is not supported (Goldberger et al., 2008).

An ACC/AHA guideline on management of patients with acute MI (Alpert, et al., 2004) evaluated noninvasive assessment of ventricular arrhythmias by methods such as SAECG, 24-hour ambulatory monitoring, heart rate variability, micro T-wave Alternans and T-wave variability in patients recovering from ST-elevated MI. The

ACC/AHA guideline classifies these tests as Class IIb. A designation of Class II indicates there is conflicting evidence and/or a divergence of opinion about the usefulness/efficacy of a procedure or treatment. For procedures in Class IIa, the weight of evidence/opinion is in favor of usefulness/efficacy. For Class IIb procedures, the usefulness/efficacy is less well established by evidence/opinion. The guideline states that insufficient data are available to determine whether general therapies (e.g., beta-adrenoceptor blockade, ACE inhibition, and revascularization procedures) or specific interventions (e.g., treatment with amiodarone or an ICD) targeted toward high-risk patients identified by a combination of noninvasive tests after MI can more favorably impact mortality. The guideline concludes that it is difficult to justify the costs of the routine use of these procedures in the absence of demonstrated clinical benefit.

An ACC/AHA/European Society of Cardiology (ESC) guideline for management of patients with ventricular arrhythmias and prevention of sudden cardiac death (Zipes, et al., 2006) discusses the use of SAECG to improve the diagnosis and risk stratification of patients with ventricular arrhythmias or who are at risk of developing life-threatening ventricular arrhythmias. Similar to the ACC/AHA guideline on acute MI, this guideline also classifies SAECG as a Class IIb indication, in which the usefulness/efficacy are not well established.

The use of the MultiFunction Cardiogram (MCG) is not addressed in relevant ACC/AHA guidelines.

Summary

Signal-averaged electrocardiography (SAECG) has been proposed as a noninvasive method for arrhythmia risk stratification. There is insufficient evidence in the published medical literature, however, to demonstrate the clinical utility of SAECG used alone or in combination with other testing in establishing the risk of ventricular arrhythmias and sudden death, in the diagnosis of arrhythmogenic right ventricular dysplasia/cardiomyopathy, or when used as a patient selection criterion for pharmacological therapy, ICD implantation or other treatment.

The MultiFunction Cardiogram (MCG) has been proposed as a noninvasive method for the evaluation of known or suspected coronary artery disease. There is insufficient evidence in the published medical literature to demonstrate the clinical utility of MCG or to determine how this procedure compares to other available diagnostic methods.

Coding/Billing Information

Note: This list of codes may not be all-inclusive.

Experimental/Investigational/Unproven/Not Covered:

CPT®*	Description
93278	Signal-averaged electrocardiography (SAECG) with or without ECG
0206T	Algorithmic analysis, remote, of electrocardiographic-derived data with computer probability assessment, including report

ICD-9-CM Diagnosis Codes	Description
410.00-410.92	Acute myocardial infarction
411.0-411.89	Other acute and subacute forms of ischemic heart disease
412	Old myocardial infarction
414.00-414.9	Coronary atherosclerosis
425.0-425.9	Cardiomyopathy
	All other codes

*Current Procedural Terminology (CPT®) © 2010 American Medical Association: Chicago, IL.

References

1. Antman EM, Anbe DT, Armstrong PW, Bates ER, Green LA, Hand M, et al. ACC/AHA guidelines for the management of patients with ST-elevation myocardial infarction; A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee to Revise the 1999 Guidelines for the Management of patients with acute myocardial infarction). *J Am Coll Cardiol*. 2004 Aug 4;44(3):E1-E211.
2. Bailey JJ, Berson AS, Handelsman H, Hodges M. Utility of current risk stratification tests for predicting major arrhythmic events after myocardial infarction. *J Am Coll Cardiol*. 2001 Dec;38(7):1902-11.
3. Bigger JT. Prophylactic use of implanted cardiac defibrillators in patients at high risk for ventricular arrhythmias after coronary artery bypass graft surgery. *Coronary Artery Bypass Graft (CABG) Patch Trial Investigators. N Engl J Med*. 1997;337:1569-75.
4. Cain ME, Anderson JL, Arnsdorf MF, Mason JW, Scheinman MM, Waldo AL. Signal-averaged electrocardiography. ACC Expert Consensus Document. *JACC*. 1996 Jan;27(1):238-249.
5. ECRI Institute. Hotline Response [database online]. Plymouth Meeting (PA): ECRI Institute; 2009 Oct 2. Signal-Averaged Electrocardiographs for Patients after Myocardial Infarction. Accessed Aug 2, 2010. Available at URL address: <http://www.ecri.org>
6. Gold MR, Bloomfield DM, Anderson KP, El-Shefir NE, Wilber DJ, Groh WJ, et al. A comparison of T-wave alternans, signal averaged electrocardiography and programmed ventricular stimulation for arrhythmia risk stratification. *J Am Coll Cardiol*. 2000 Dec;36(7):2247-53.
7. Goldberger JJ, Cain ME, Hohnloser SH, et al. American Heart Association Council on Clinical Cardiology, American Heart Association Council on Epidemiology and Prevention; American College on Cardiology Foundation; Heart Rhythm Society. AHA/ACC Foundation/Heart Rhythm society scientific statement on noninvasive risk stratification techniques for identifying patients at risk for sudden cardiac death: a scientific statement from the AHA Council on Clinical Cardiology Committee on Electrocardiography and Arrhythmias and Council on Epidemiology and Prevention. *Heart Rhythm*. 2008; 5(10):e1-21.
8. Goldberger JJ, Challapalli S, Waligora M, Kadish AH, Johnson DA, Ahmed MW, Inbar S. Uncertainty principle of signal-averaged electrocardiography. *Circulation*. 2000 Jun 27;101(25):2909-15.
9. Gomes JA, Cain ME, Buxton, AE, Josephson ME, Lee KL, Hafley GE, et al. Prediction of long-term outcomes by signal-averaged electrocardiography in patients with unsustained ventricular tachycardia, coronary artery disease, and left ventricular dysfunction. *Circulation*. 2001 Jul 24;104(4):436-41.
10. Gregoratos G, Abrams J, Epstein AE, Freedman RA, Hayes DL, Hlatky, MA, et al. American College of Cardiology/American Heart Association Task Force on Practice Guidelines. American College of Cardiology/American Heart Association/North American Society for Pacing and Electrophysiology Committee. ACC/AHA/NASPE 2002 guideline update for implantation of cardiac pacemakers and antiarrhythmia devices: summary article. A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (ACC/AHA/NASPE Committee to Update the 1998 Pacemaker Guidelines). *J Cardiovasc Electrophysiol*. 2002 Nov;13(11):1183-99.
11. Grimm W, Christ M, Bach J, Muller HH, Maisch B. Noninvasive arrhythmia risk stratification in idiopathic dilated cardiomyopathy: results of the Marburg Cardiomyopathy Study. *Circulation*. 2003 Dec 9;108(23):2883-91. Epub 2003 Nov 17.
12. Grube E, Bootsveld A, Buellesfeld L, Yuecel S, Shen JT, Imhoff M. Computerized two-lead resting ECG analysis for the detection of coronary artery stenosis after coronary revascularization. *Int J Med Sci*. 2008 Mar 2;5(2):50-61.

13. Grube E, Bootsvelde A, Yucel S, Shen JT, Imhoff M. Computerized two-lead resting ECG analysis for the detection of coronary artery stenosis. *Int J Med Sci*. 2007 Oct 16;4(5):249-63.
14. Huikuri HV, Makikallio TH, Raatikainen MJ, Perkiomaki J, Castellanos A, Myerburg RJ. Prediction of sudden cardiac death: appraisal of the studies and methods assessing the risk of sudden arrhythmic death. *Circulation*. 2003 Jul 8;108(1):110-5.
15. Huikuri HV, Raatikainen MJ, Moerch-Joergensen R, Hartikainen J, Virtanen V, Boland J, Anttonen O, Hoest N, Boersma LV, Platou ES, Messier MD, Bloch-Thomsen PE; Cardiac Arrhythmias and Risk Stratification after Acute Myocardial Infarction study group. Prediction of fatal or near-fatal cardiac arrhythmia events in patients with depressed left ventricular function after an acute myocardial infarction. *Eur Heart J*. 2009 Mar;30(6):689-98. Epub 2009 Jan 20.
16. Hosokawa J, Shen JT, Imhoff M. Computerized 2-lead resting ECG analysis for the detection of relevant coronary artery stenosis in comparison with angiographic findings. *Congest Heart Fail*. 2008 Sep-Oct;14(5):251-60
17. Huikuri HV, Tapanainen JM, Lindgren K, Raatikainen P, Makikallio TH, Aoralsomem EK, et al. Prediction of long-term outcomes by signal-averaged electrocardiography in patients with unsustained ventricular tachycardia, coronary artery disease, and left ventricular dysfunction. *Circulation*. 2001 Jul 24;104(4):436-41.
18. Ikeda T, Sakata T, Takami M, Kondo N, Tezuka N, Nakae T. Combined assessment of T-wave alternans and late potentials used to predict arrhythmic events after myocardial infarction. A prospective study. *J Am Coll Cardiol*. 2000 Mar 1;35(3):722-30.
19. Josephson M, Wellens HJ. Implantable defibrillators and sudden cardiac death. *Circulation*. 2004 Jun 8;109(22):2685-91.
20. Libby: Braunwald's heart disease, a textbook of cardiovascular medicine, 8th ed. Saunders, an imprint of Elsevier; 2007.
21. McKenna WJ, Thine G, Vava A, Fontaliran F, Blomstrom-Lyndqvist C, et al. Diagnosis of arrhythmogenic right ventricular dysplasia/cardiomyopathy. Task Force of the Working Group Myocardial and Pericardial Disease of the European Society of Cardiology and of the Scientific Council on Cardiomyopathies of the International Society and Federation of Cardiology. *Br Heart J*. 1994 Mar;71(3):215-8.
22. Premier Heart. MCG System. Accessed Aug 3, 2010. Available at URL address: <http://www.premierheart.com/webapp/contents/about.php>
23. Ryan TJ, Antman EM, Brooks NH, Califf RM, Hillis LD, Hiratzka LF, et al. 1999 update: ACC/AHA guidelines for the management of patients with acute myocardial infarction. A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee on Management of Acute Myocardial Infarction). *J Am Coll Cardiol*. 1999 Sep;34(3):890-911.
24. Strobeck JE, Shen JT, Singh B, Obunai K, Miceli C, Sacher H, et al. Comparison of a two-lead, computerized, resting ECG signal analysis device, the MultiFunction-CardioGram or MCG (a.k.a. 3DMP), to quantitative coronary angiography for the detection of relevant coronary artery stenosis (>70%) - a meta-analysis of all published trials performed and analyzed in the US. *Int J Med Sci*. 2009;6(4):143-55. Epub 2009 Apr 7.
25. Topol EJ. Textbook of cardiovascular medicine, 3rd ed. Lippincott Williams & Wilkins; 2007.
26. Weiss MB. Computer-enhanced frequency-domain and 12-lead electrocardiography accurately detect abnormalities consistent with obstructive and nonobstructive coronary artery disease. *Heart Dis*. 2002 Jan-Feb;4(1):2-12.

27. Zipes DP, Camm AJ, Borggrefe M, Buxton AE, Chaitman B, Fromer M, et al. ACCAHA/ESC 2006 guidelines for the management of patients with ventricular arrhythmia and the prevention of sudden cardiac death: a report of the American College of Cardiology/American Heart Association Task Force and the European Society of Cardiology Committee for Practice Guidelines (Writing Committee to Develop Guidelines for Management of Patients With Ventricular Arrhythmias and the Prevention of Sudden Cardiac Death). J AM Coll Cardiol 2006;48:e247-e346.

Policy History

<u>Pre-Merger Organizations</u>	<u>Last Review Date</u>	<u>Policy Number</u>	<u>Title</u>
CIGNA HealthCare	09/15/2008	0210	Signal-Averaged Electrocardiography (SAECG)

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