

# Use of Echocardiography in Olmsted County Outpatients With Chest Pain and Normal Resting Electrocardiograms Seen at Mayo Clinic Rochester

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## Abstract

**Objective:** To determine how often unnecessary resting echocardiograms that are “not recommended” by clinical practice guidelines are performed in patients with stable chest pain and normal resting electrocardiograms (ECGs).

**Patients and Methods:** We performed a retrospective search of electronic medical records of all outpatients seen at Mayo Clinic Rochester from January 1, 2010, through December 31, 2013, to identify residents of Olmsted County, Minnesota, with stable chest pain and known or suspected coronary artery disease who underwent resting echocardiography and had normal resting ECGs and no other indication for echocardiography.

**Results:** Of the 8280 outpatients from Olmsted County who were evaluated at Mayo Clinic Rochester with chest pain, 590 (7.1%) had resting echocardiograms. Ninety-two of these 590 patients (15.6%) had normal resting ECGs. Thirty-three of these 92 patients (35.9%) had other indications for echocardiography. The remaining 59 patients (10.0% of all echocardiograms and 0.7% of all patients) had normal resting ECGs and no other indication for echocardiography. Fifty-seven of these 59 patients (96.6%) had normal echocardiograms. Thirteen of these 59 echocardiograms (22.0%) were “preordered” before the provider (physicians, nurses, physician assistants) visit.

**Conclusion:** The overall rate of echocardiography in Olmsted County outpatients with chest pain seen at Mayo Clinic Rochester is low. Only 1 in 10 of these echocardiograms was performed in violation of the class III recommendation in the American College of Cardiology Foundation/American Heart Association guidelines for the management of stable angina. These unnecessary echocardiograms were almost always normal. The rate of unnecessary echocardiograms could be decreased by eliminating preordering.

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Health care resources devoted to imaging services, and in particular cardiac imaging services, have been of increasing concern to third-party payers. One of the goals of clinical practice guidelines is to identify procedures and treatments that are ineffective or harmful. The American College of Cardiology Foundation (ACCF) and the American Heart Association (AHA) have collaborated on clinical practice guidelines for almost 30 years. Class III recommendations in these guidelines are assigned to procedures and treatments that are not recommended in

specific situations. The ACCF/AHA guidelines for the management of stable angina, first published in 1999,<sup>1,p2835</sup> had a class III recommendation on the use of echocardiography in patients with stable symptoms and known or suspected coronary artery disease: “Echocardiography is not recommended in patients with a normal ECG, no history of MI, and no signs or symptoms suggestive of heart failure, valvular heart disease, or hypertrophic cardiomyopathy”. The most recent revision of these guidelines in 2012<sup>2</sup> maintained this class III recommendation.

A single-center study in 2000<sup>3</sup> suggested that as many as 39% of echocardiograms ordered to check left ventricular systolic function were in patients with normal resting ECGs. However, this study required referral to echocardiography for entry and was not designed to determine how often echocardiography was performed in patients with chest pain and known or suspected coronary artery disease. The study relied on physician contact, rather than the medical record, for the primary indication and did not identify other indications. To our knowledge, no published data exist to indicate how often this class III recommendation is not followed in community practice. The purpose of this study was therefore to assess the rate of echocardiography performed in patients of Olmsted County, Minnesota, with known or suspected coronary artery disease seen at Mayo Clinic Rochester, to determine how often these patients had normal resting ECGs and no other indication for echocardiography, and to assess the clinical impact of the echocardiograms performed in violation of this class III recommendation. Our hypothesis was that echocardiography was often performed in patients with chest pain and known or suspected coronary artery disease who had normal ECGs and no other recognized indication for echocardiography and that these tests would be of limited clinical value.

## PATIENTS AND METHODS

### Study Group

We searched the electronic medical records of all outpatients seen at Mayo Clinic Rochester from January 1, 2010, through December 31, 2013, to identify residents of Olmsted County with stable chest pain that was possibly due to coronary artery disease. We specifically excluded the following:

1. patients seen in the emergency department;
2. patients seen in the hospital;
3. patients admitted within 24 hours of an outpatient visit;
4. patients who had exertional dyspnea without chest pain (we did include patients who had both exertional dyspnea and chest pain); and
5. patients who did not provide research authorization in accordance with Minnesota law.

We adapted a natural language processing algorithm used previously to identify heart failure<sup>4</sup> to identify outpatient encounters with chest pain. The natural language processing algorithm was implemented in a pattern-based concept extraction engine, in which a rule-based context annotator is included to assign each concept a status modifier, that is, confirmed, negative, or probable.<sup>5</sup> We performed several pilot studies to test our algorithm. The first study considered patients seen during January 2010 (without restriction to Olmsted County residents). We excluded individuals for whom chest pain was *not* a confirmed symptom (eg, "There is no evidence of chest pain" or "Chest pain negative"). We also ignored clinical notes in which chest pain was listed in the review of systems but not in the subsequent diagnoses or clinical impression. After these refinements, we performed a second pilot study of patients seen from January 1, 2010, through March 31, 2010 (without restriction to Olmsted County), and further refined the algorithm to more completely exclude patients seen in the emergency department and in the hospital.

### Echocardiograms

We used the echocardiographic laboratory database from Mayo Clinic Rochester to identify all patients from the study population who underwent a resting echocardiogram within 3 days before or 7 days after the clinical note reporting chest pain. We restricted our search to resting transthoracic echocardiograms performed at Mayo Clinic Rochester. We excluded echocardiograms performed at remote sites on one of our mobile vans, stress echocardiograms, and transeophageal echocardiograms.

### Electrocardiograms

We used the database of the Mayo ECG laboratory to identify patients with echocardiograms who had normal resting ECGs. We considered sinus bradycardia and varying P-wave morphology to be normal; any other abnormal ECG finding was grounds for exclusion. We performed a pilot search to identify all normal ECGs in patients from Olmsted County in 2011. We identified 6628 such patients and manually reviewed every 50th patient for a sample of 131. This manual review identified 3 patients from a sample of 131 who had an abnormal ECG: 1 patient

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