The feasibility and accuracy of evaluating lipid management performance metrics using an electronic health record

Christopher P. Danford, MD, Ann Marie Navar-Boggan, MD, PhD, Judy Stafford, MS, Catherine McCarver, MBA, MHA, Eric D. Peterson, MD, MPH, and Tracy Y. Wang, MD, MHS, MSc ***Durham, NC***

Background Over the past decade, electronic health records (EHRs) have emerged as a potential tool to assess quality of care; however, the feasibility and accuracy of EHRs to assess adherence to lipid management performance measures have not been evaluated.

Methods We created a retrospective cohort of 3779 patients with coronary artery disease who were followed up in a cardiology clinic at an academic medical center using an EHR database. Of these 3779 patients, 300 randomly-selected charts were reviewed to identify reasons for failure to adhere to lipid management performance measures.

Results Based on the EHR, a low-density lipoprotein cholesterol measurement was obtained in 73% of patients within the past 3 years; of which, 34% had low-density lipoprotein cholesterol levels ≥100 mg/dL and statin therapy had been prescribed in 88%. Manual chart review revealed that many of these apparent failures were actually false positives, due to inaccurate capture of indications and contraindications to lipid measurement and statin prescription, patient/provider treatment preferences, and external data sources.

Conclusions While it is possible to monitor adherence to lipid management performance measures using an EHR, the accuracy of this assessment is currently limited and may underestimate provider quality of care. (Am Heart J 2013;166:701-8.)

Existing clinical trial and observational data have consistently shown that levels of low-density lipoprotein cholesterol (LDL-C) are correlated with cardiovascular risk and that lipid-lowering with 3-hydroxy-3-methylglutaryl–coenzyme A reductase inhibitors (ie, statins) reduces the incidence of cardiovascular mortality in high-risk patients. Current standards of practice for lipid management in patients with coronary artery disease (CAD) are encapsulated by the Adult Treatment Panel III (ATP III) guidelines, as well as other key clinical practice guidelines for the secondary prevention of cardiovascular events in patients with CAD.[1-7] Furthermore, leading professional societies, payors, and regulators have developed practice-level performance measures evaluating health care quality, and many of them have established quality improvement programs to facilitate their measurement and reporting.[8-10]

In this context, electronic health records (EHRs) serve an essential function for collecting aggregate data and enabling performance measurement for both internal quality improvement and external reporting. With the passage of the American Recovery and Reinvestment Act of 2008, providers and health systems have also been moving toward "meaningful use" of EHRs in line with national strategies to promote patient safety, increase efficiency of health care delivery, and improve health care quality.[11]

While strategies are being implemented to use EHRs to collect and report provider performance, there has been little validation of whether such approaches are feasible or accurate for health care quality surveillance. As a result, there are several concerns. First, the use of administrative data to define disease states, such as diagnoses encapsulated by *International Classification of Diseases, Ninth Revision* (*ICD-9*) codes, may not be adequately sensitive or specific to the conditions of interest.[12-14] Second, EHRs may not capture information on tests or treatment modifications done in other health care settings. Finally, many EHR-based performance

From the Duke Clinical Research Institute, Durham, NC.
James A. de Lemos, MD, served as guest editor for this article.
Funding Sources: This project was supported by grant number U19HS021092 from the Agency for Healthcare Research and Quality. The content is solely the responsibility of the authors and does not necessarily represent the official views of the Agency for Healthcare Research and Quality.
Submitted April 5, 2013; accepted July 30, 2013.
Reprint requests: Christopher P. Danford, MD, Duke University School of Medicine, 450 Research Drive, Durham, NC 27710.
E-mail: christopher.danford@duke.edu
0002-8703/$ - see front matter

http://dx.doi.org/10.1016/j.ahj.2013.07.024

Table I. CAD diagnosis by *ICD-9* classification

	Sensitivity	Specificity
ICD-9 code 410–412, 414 (any suffix), V45.81, or V45.82 coded at any encounter prior to 12/1/2009	0.99	0.34
ICD-9 code 410–412, 414 (any suffix), V45.81, or V45.82 coded at any *outpatient* encounter prior to 12/1/2009	0.94	0.70
ICD-9 code 410–412, 414 (any suffix), V45.81, or V45.82 coded at *more than 2 outpatient encounters* prior to 12/1/2009	0.90	0.80
ICD-9 code 410–412, 414 (any suffix), V45.81, or V45.82 coded at any *outpatient encounter with cardiologist* prior to 12/1/2009	0.93	0.76

CAD indicates Coronary artery disease; *ICD-9*, International Classification of Disease, Ninth Revision.

metrics may not account for legitimate contraindications to therapy or patient preferences that may only be evaluated using resource-intensive chart reviews.[15-17]

Our study utilized data from an institutional EHR repository to: (1) examine the feasibility of measuring adherence to lipid management guidelines and patterns of statin use among patients with established CAD; and (2) evaluate the accuracy of data derived from an EHR to carry out quality assessments in the context of lipid management for secondary prevention of coronary events.

Methods

Study population

Our study cohort was drawn from the Duke University Health System enterprise-wide data warehouse, which contains electronically available data from multiple institutional information systems contributing to the EHR, including demographic information, claims-based diagnosis and procedure information, laboratory values, and medication lists for all inpatient, outpatient, and emergency department encounters at Duke University Medical Center.[18]

We first performed a preliminary analysis to determine how to best identify patients with CAD from EHR-based data elements. Using the Duke Databank for Cardiovascular Disease, which captures detailed angiographic information for all patients undergoing cardiac catheterization at Duke University, we examined consecutive patients who underwent cardiac catheterization between June 1, 2005, and June 1, 2010 and who had at least 2 visits with a Duke cardiologist during that time period. Data collection and follow-up for the Duke Databank for Cardiovascular Disease have been described previously.[19,20] This group was stratified based on whether they had angiographic evidence of at least 50% stenosis in at least one major epicardial coronary vessel on catheterization, evidence of prior stenting, or prior coronary artery bypass surgery. Using this population as a reference "gold standard," the sensitivities and specificities of four claims-based definitions of CAD were evaluated: (1) *ICD-9* code of CAD at any inpatient or outpatient encounter; (2) *ICD-9* code of CAD at any outpatient encounter; (3) *ICD-9* code of CAD at two or more outpatient encounters; and (4) *ICD-9* code of CAD at any outpatient encounter with a cardiologist. The *ICD-9* codes used to define CAD include 410.x-412.x, 414.x, V45.81, or V45.82. The results of our analysis demonstrated lower specificity for definition one and similar sensitivity and specificity among the latter three definitions (Table I).

We then used Definition 4 (*ICD-9* code of CAD at any outpatient encounter with a cardiologist) to create a retrospective study cohort consisting of all patients 18 years of age or older with CAD who had at least two visits with a Duke Cardiology provider from June 1, 2009, to June 31, 2010. Eligible cardiology outpatient encounters for establishing a diagnosis of CAD included any cardiology visit prior to or within the first six months of the study period. Individuals were excluded if they had no medication data available electronically (n = 184). This yielded a final study population of 3779 patients.

Study procedures

The primary outcomes of interest included three measures endorsed by the American College of Cardiology/American Heart Association Task Force on Performance Measures: (1) whether LDL-C measurements were obtained in patients with CAD; (2) whether LDL-C levels met the treatment goal of <100 mg/dL; and (3) whether statin therapy was prescribed.[8-10] These data were extracted from the EHR data repository by searching laboratory data for the last LDL-C measurement obtained by any provider during the study period, and statin prescriptions were identified in the outpatient medication list from the last cardiology encounter during the study period.

Manual chart reviews were performed for a randomly-selected subset of CAD patients from three groups: (1) 100 patients without an LDL-C measurement; (2) 100 patients with CAD, but based on electronic medication data, were not prescribed a statin; and (3) 100 patients with CAD who were prescribed a statin. As our electronic definition was not 100% specific for CAD, patients selected for chart review were initially screened for documentation of CAD in the provider note. Patients without a documentation of CAD in the provider note were excluded. A total of 114 randomly selected charts were screened to identify 100 patients with CAD and without LDL-C measurement, 104 charts were screened to identify 100 CAD patients prescribed a statin, and 150 charts were screened to identify 100 patients with documented CAD not prescribed a statin. Subsequent detailed reviews of the clinic note were performed to evaluate the accuracy of electronic medication or laboratory data, reasons for lack of statin use and/or lack of LDL-C measurement, and provider responses to elevated LDL-C.

Statistical methods

Descriptive statistics were used to evaluate the rate of statin use, average LDL-C by type of statin, and data from chart reviews. Wilcoxon rank-sum and Kruskal-Wallis tests were used to compare median LDL-C by group, and the Chi-square test was used for comparison of proportions. We calculated 95%