Reliability of Predicting Early Hospital Readmission After Discharge for an Acute Coronary Syndrome Using Claims-Based Data

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Early rehospitalization after discharge for an acute coronary syndrome, including acute myocardial infarction (AMI), is generally considered undesirable. The Centers for Medicare and Medicaid Services (CMS) base hospital financial incentives on risk-adjusted readmission rates after AMI, using claims data in its adjustment models. Little is known about the contribution to readmission risk of factors not captured by claims. For 804 consecutive patients >65 years discharged in 2011 to 2013 from 6 hospitals in Massachusetts and Georgia after an acute coronary syndrome, we compared a CMS-like readmission prediction model with an enhanced model incorporating additional clinical, psychosocial, and sociodemographic characteristics, after principal components analysis. Mean age was 73 years, 38% were women, 25% college educated, and 32% had a previous AMI; all-cause rehospitalization occurred within 30 days for 13%. In the enhanced model, previous coronary intervention (odds ratio [OR] = 2.05, 95% confidence interval [CI] 1.34 to 3.16; chronic kidney disease OR 1.89, 95% CI 1.15 to 3.10; low health literacy OR 1.75, 95% CI 1.14 to 2.69), lower serum sodium levels, and current nonsmoker status were positively associated with readmission. The discriminative ability of the enhanced versus the claims-based model was higher without evidence of overfitting. For example, for patients in the highest deciles of readmission likelihood, observed readmissions occurred in 24% for the claims-based model and 33% for the enhanced model. In conclusion, readmission may be influenced by measurable factors not in CMS′ claims-based models and not controllable by hospitals. Incorporating additional factors into risk-adjusted readmission models may improve their accuracy and validity for use as indicators of hospital quality. **(Am J Cardiol 2016;117:501−507)**

Early readmissions are often considered preventable and reflective of poor inhospital management or discharge practices.[1] Eight years ago, the Medicare Payment Advisory Commission called for the development of new measures to aid in predicting readmission after myocardial infarction, which, along with 6 other conditions, was thought to contribute to nearly 1/3 of potentially preventable early readmissions. In 2011, a claims-based method developed by Krumholz et al was approved by the National Quality Forum and implemented by the Centers for Medicare and Medicaid Services (CMS) for estimating hospitals' risk-standardized readmission rates for patients discharged after an acute myocardial infarction (AMI).[2] Subsequently, the Affordable Care Act established the Hospital Readmission Reduction Program and payment reforms that penalize hospitals with higher than predicted readmission rates. These penalties heighten interest in identifying and improving transitional care for patients with acute coronary syndrome (ACS) at high risk for readmission.[3,4] Despite the high economic and clinical stakes, little is known about the impact of clinical, psychosocial, and sociodemographic factors on rehospitalization in patients admitted with an ACS.[1,5,6] The claims-based model of Krumholz et al is only modestly discriminating. We hypothesized that adding patient clinical, psychosocial, and sociodemographic information could improve the performance of this readmission prediction model. Therefore, using data from a cohort of Medicare-age patients discharged after an ACS, we compared the performance of a CMS-like model to each of 3 models that incorporated a number of variables representing clinical, psychosocial, and sociodemographic characteristics, respectively.

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Methods

Details of the design, participant recruitment, interview processes, and medical record abstraction procedures used in Transitions, Risks and Action in Coronary Events (TRACE-CORE) have been previously described.[7,8] In brief, TRACE-CORE used a 6-site prospective cohort design to follow 2,187 adults discharged alive after an ACS hospitalization. Participants with an ACS were identified using active surveillance methods by trained study staff from April 2011 to May 2013. Adult patients admitted to any of the 6 participating medical centers with electrocardiographic or cardiac biomarker criteria consistent with an ACS, those who underwent urgent coronary revascularization, and symptomatic participants with >70% stenosis in a coronary artery on coronary angiography were considered eligible. Pregnant patients, patients with dementia or receiving palliative care, those with an ACS secondary to demand ischemia, perioperative ACS cases, and those under custody of a prison system were ineligible. The 6 participating hospitals were selected for their diverse patient population; also, the catchment areas of these 6 hospitals are such that, if early readmission occurred, it was very likely to be at one of the study hospitals. Sites included 2 academic teaching hospitals and a large community hospital that cover essentially all ACS admissions in Central Massachusetts. The other sites included 2 hospitals affiliated with a managed care organization in Atlanta, GA, and a tertiary care academic medical center covering most ACS admissions in Central Georgia. The institutional review boards at each participating recruitment site approved this study. All participants provided written informed consent.

For comparability with the data set used to generate and test the original CMS model, we excluded TRACE-CORE participants <65 years (n = 1,321), those with planned readmissions (n = 30), and patients who died within 30 days of discharge (n = 7). We also excluded patients with missing data during the index hospitalization (n = 13) and those participants who were same-day discharges (n = 12, Supplementary Appendix A), resulting in an analytic sample of 804 elderly adults discharged after ACS (Supplementary Appendix A).

Trained study staff abstracted participants' baseline demographic, clinical, laboratory, and electrocardiographic data and inhospital clinical complications from available hospital medical records. Co-morbidities present at the time of hospital admission were identified from each participant's admission history and physical examination. Development of complications during hospitalization was defined according to validated criteria.[9] We re-abstracted 5% of randomly selected charts to confirm high inter-rater reliability at all sites.[8] Clinical data were used to derive the lobal Registry of Acute Coronary Events (GRACE) risk score.[10] Each participant's discharge summary was reviewed to confirm an ACS diagnosis and to characterize it as unstable angina, non−ST-segment elevation myocardial infarction (STEMI), or STEMI based on established criteria.[10−13] Questionable cases were adjudicated by 2 study physicians blinded to clinical diagnosis.

Trained interviewers conducted a computer-assisted face-to-face interview during each participant's index hospitalization for ACS or by phone within 72 hours of discharge. We assessed cognitive impairment using the Telephone Interview for Cognitive Status.[14] To assess severity of depressive symptoms, participants completed the Patient Health Questionnaire.[15] Study patients also completed the Generalized Anxiety Disorder questionnaire,[16] a validated scale. Participants completed the 4-item version of the Perceived Stress Scale, a validated measure of the degree to which situations in one's life are seen as stressful.[17] To assess participants' engagement in their health care, we included the Patient Activation Measure 6.[18] Participants also completed brief screens for low health literacy and numeracy.[19,20] We also included 6 questions about social support from the Medical Outcomes Study Social Support Survey[21] and alcohol use from the Alcohol Use Disorders Identification Test (AUDIT-C) questionnaire and assessed smoking status and use of smokeless tobacco products using items from the Translational Research Investigating Underlying Disparities in Acute Myocardial Infarction Patients' Health Status study.[22]

On subsequent structured follow-up interviews,[14] participants reported emergency visits and hospital readmissions during follow-up telephone interviews. Post-discharge records were reviewed to confirm the patient's readmission status and provide data on the timing and reason for rehospitalization. For the present study, a hospital readmission was considered present only if confirmed using medical record data. All-cause mortality was ascertained from proxy reports and review of medical records augmented by review of local and national vital statistics records.

All study participants were discharged alive after an ACS hospitalization. Our primary study outcome was whether the patient had an unscheduled readmission at any of our 6 participating hospitals for any reason during the following 30 days. In this report, we use the term "readmission" to indicate any unplanned rehospitalization within 30 days of discharge from the index ACS admission. We examined the relation between readmission and several pre-existing factors included in the CMS model,[2] additional inhospital clinical factors, psychosocial and sociodemographic factors, and inhospital complications. We used analysis of variance and the chi-square statistics to test differences in individual sociodemographic, psychosocial, clinical, and treatment factors between those with and without readmission.

Because there were only 106 readmissions among our 804 participants, we needed to limit the number of variables used for prediction. Thus, within each block of variables representing a distinct domain, we first conducted a principal components analysis and then chose the number of high-information summary variables that had the lowest Akaike information criterion (AIC) when used to predict readmission. Block 1 included abstracted information from 18 variables in CMS′ model that are available in TRACE-CORE. We did not have the data to include the following additional predictors that the CMS model extracts from claims data: asthma, urinary tract infection, pneumonia, metastatic cancer, hemiplegia, chronic skin ulcer, malnutrition, any infection, and electrolyte or fluid disorder. In model 2, based on a priori assumptions and known relations between these factors and survival,[1] we studied the additional explanatory power associated with clinical factors not currently considered by CMS (block 2 added to block 1).