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Prediction models of Medicare 90-day postdischarge deaths, readmissions, and costs in bowel operations

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Abstract

BACKGROUND: The 90-day postdischarge morbidity and mortality rates following elective and emergent bowel surgery remain poorly defined.

METHODS: The 2009 to 2011 Medicare inpatient files for patients undergoing elective and emergent small and large bowel operations in 1,024 hospitals that passed present-on-admission coding accuracy standards had prediction models designed for inpatient mortality, prolonged postoperative length of hospital stay (prLOS), 90-day postdischarge mortality and readmissions, and total hospital costs.

RESULTS: Of 118,758 patients studied, there was a 4.7% inpatient mortality rate and 7.3% prLOS among live discharges. An additional 7,586 deaths and 26,969 readmissions occurred within 90 days of discharge. Prolonged preoperative and prolonged postoperative hospitalizations were significant ($P < .0001$) variables in predicting postdischarge deaths and readmissions. Total hospital costs were increased by over $18,000 per adverse outcome.

CONCLUSION: Postdischarge deaths and readmissions are more common than inpatient adverse events of death and prLOS in elective and emergent Medicare large and small bowel operations.

A comprehensive assessment of outcomes of surgical care must include postdischarge events. Reports on inpatient mortality rates and specific complications of care have been in abundance for most operations. However, postdischarge adverse events (eg, readmission to an acute care hospital) have been much more difficult to identify because patients are lost to follow-up or may seek care from another hospital or physician. Most hospitals and surgeons do not know the complete results of postdischarge care. As we have previously reported, 90-day postdischarge deaths in the Medicare population exceeded those occurring during the index hospitalization for elective procedures, and many more are readmitted to the hospital during this same 90-day time interval.[1] If outcome profiles exclude postdischarge events, then care redesign and improvement strategies will be suboptimal.

Major abdominal procedures of the small and large bowel have substantial risks of major morbidity. Many of these complications are not identified until the

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postdischarge period of time and, if they are sufficiently severe, will lead to readmissions and even deaths. Because of the evolving strategy of Medicare to impose hospital penalties for "excessive" readmissions in selected medical conditions, it is anticipated that these policies will soon be extended into surgical care.[2] However, prediction models to facilitate the identification of preventable events among postdischarge deaths and readmissions have proven very difficult because risk factors appear to be different than those identified for inpatient morbidity.[3] The conundrum for modeling the risk of readmissions is further compounded in emergency operations because those conditions that are present-on-admission (POA) versus those that are hospital acquired require accurate POA coding to delineate risk factors from complications of care.

Our group has developed a screening methodology to identify the accuracy of hospital POA coding.[4] This allows the identification of best hospitals for POA accuracy. Using the best coding hospitals permit the development of inpatient prediction models of adverse outcomes for both elective and emergency small and large bowel operations, but also when used with the Medicare Inpatient Limited Data Set permits the additional development of prediction models for postdischarge deaths and readmissions with the most accurate administrative data.

Methods

The Centers for Medicare and Medicaid Services Inpatient Limited Data Set for 2009 to 2011 was used to identify patients undergoing elective and emergent small and large bowel operations that were identified as part of Medicare Severity Diagnosis-Related Groups (MS-DRG) 329-331. The research database was refined to include only discharges 65 years of age or older with an International Classification of Diseases 9th Revision-Clinical Modification code for one of the following procedures: 17.31 to 17.39, 45.61, 45.62, 45.71 to 45.79, 45.81 to 45.83, 48.50 to 48.59, 48.62, 48.63, 48.69, 48.75, 48.76, and 68.8. Cases were excluded if they had a missing patient identifier, hospital identifier, principal diagnosis, or admission or discharge date. They were also excluded if the patient was transferred to another acute care facility, received from another acute care facility (including an ambulatory surgical center), or left against medical advice. Further refinements required that each hospital in the final research data set had 20 or more evaluable cases for the study period, and included only those that met an 80% or better rate for POA coding accuracy.[4]

In model development, only variables with P less than .001 were used. Schwarz criterion is employed to avoid over-fitting the models.[5] The performance of all final prediction models was evaluated by c-statistic computation. Cost models were evaluated by R^2 computations. All analyses used SAS software Version 9.4 (SAS Institute, Cary, NC).

Adverse outcomes are defined in this presentation to include the following: (1) inpatient or 90-day postdischarge deaths; (2) risk-adjusted prolonged postoperative length of stay (prLOS) following the operation; and (3) readmission to an acute care hospital with 90-days of discharge. Models for inpatient deaths following small and large bowel operations were designed by methods previously reported for elective colon surgery except that POA risk factors are included for emergency case evaluation.[6,7] Because an extended preoperative LOS is associated with increased postoperative morbidity,[8] these cases have not been excluded as we have done previously and a risk factor has been added for operations that occurred more than 2 days following admission. Hospital dummy variables are employed to account for hospital effects on final models.

Linear risk-adjusted LOS models are designed using live discharges from the index hospitalization and employed chronic disease risk factors that we have previously used, but also incorporated POA variables and the extended preoperative LOS variable as candidates. The prLOS cases are defined by using a moving average control chart by methods we have previously published.[9] Once prLOS outliers are identified, a logistic model is then created to predict prLOS as an adverse outcome.

The research database is then searched for the all-cause 90-day readmissions to acute care hospitals. Rehabilitation and skilled nursing admissions are excluded as readmission events. The 90-day interval is chosen because preliminary studies identified readmissions within this time frame to be reasonably linked to the index hospitalization. Rarely do patients following small and large bowel operations have elective admissions scheduled for unrelated indications during this 90-day interval. The patient's survival status is in the database for each year, and deaths within 90 days but without readmission are identified. All deaths that occur during or following readmission are included in the readmission cohort for prediction modeling.

The 90-day deaths without readmission and the 90-day readmission cases become the dependent variables in a forward stepwise regression model that use all index hospitalization risk factors, and also use prLOS from the index hospitalization as an additional variable. We then identified the MS-DRG for each readmission that occurred during the 90-day postdischarge interval to establish those readmissions that were not likely related to the index hospitalization.

Costs for each case were computed by adjusting charges for the index hospitalization using cost-to-charge ratios. The Medicare paid amount was used as the cost for readmissions. A lower limit for hospital costs was derived by computing each hospital's 10th percentile cost of each case and setting the lower limit equal to the 10th percentile of these costs at all hospitals. This lower limit is defined as the required costs of care and any case with lower costs were winsorized to this level. For routine cases (ie, those without any adverse event), the total hospital costs are subtracted by the required costs and this difference in