

From the Society for Clinical Vascular Surgery

Vascular surgeon-hospitalist comanagement improves in-hospital mortality at the expense of increased in-hospital cost

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ABSTRACT

Objective: We have shown that vascular surgeon- hospitalist co management resulted in improved in-hospital mortality rates. We now aim to assess the impact of the hospitalist co management service (HCS) on healthcare cost.

Methods: A total of 1558 patients were divided into three cohorts and compared: 516 in 2012, 525 in 2013, and 517 in 2014. The HCS began in January 2013. Data were standardized for six vascular surgeons that were present 2012-2014. New attendings were excluded. Ten hospitalists participated. Case mix index (CMI), contribution margin, total hospital charges (THCs), length of stay (LOS), actual direct costs (ADCs), and actual variable indirect costs (AVICs) were compared. Analysis of variance with post-hoc tests, *t*-tests, and linear regressions were performed.

Results: THC rose by a mean difference of \$14,578.31 between 2012 and 2014 ($P < .001$) with a significant difference found between all groups during the study period ($P = .0004$). ADC increased more than AVIC; however, both significantly increased over time ($P = .0002$ and $P = .014$, respectively). A mean \$3326.63 increase in ADC was observed from 2012 to 2014 ($P < .0001$). AVIC only increased by an average \$392.86 during the study period ($P = .01$). This increased cost was observed in the context of a higher CMI and longer LOS. CMI increased from 2.25 in 2012 to 2.53 in 2014 ($P = .006$). LOS increased by a mean 1.02 days between 2012 and 2014 ($P = .016$), and significantly during the study period overall ($P = .018$). After adjusting for CMI, LOS increases by only 0.61 days between 2012 and 2014 ($P = .07$). In a final regression model, THC is independently predicted by comanagement, CMI, and LOS. After adjusting for CMI and LOS, the increase in THC because of comanagement (2012 vs 2014) accounts for only \$4073.08 of the total increase ($P < .001$). During this time, 30-day readmission rates decreased by ~7% ($P = .005$), while related 30-day readmission rates decreased by ~2% ($P = .32$). Physician contribution margin remained unchanged over the 3-year period ($P = .76$). The most prevalent diagnosis-related group was consistent across all years. Variation in the principal diagnosis code was observed with the prevalence of circulatory disorders because of type II diabetes replacing atherosclerosis with gangrene as the most prevalent diagnosis in 2013 and 2014 compared with 2012.

Conclusions: In-hospital cost is significantly higher since the start of the HCS. This surge may relate to increased CMI, LOS, and improved coding. This increase in cost may be justified as we have observed sustained reduction in in-hospital mortality and slightly improved readmission rates. (J Vasc Surg 2016;■:1-7.)

The implementation of hospitalist comanagement services in comanaging surgical inpatients is a relatively recent phenomenon. Nonetheless, statistics show that such cooperation between medical physicians and

surgeons in the joint care and oversight of surgical patients may be justified. According to the Centers for Disease Control and Prevention, 51.4 million surgical procedures were performed in 2010.¹ Further, the American College of Surgeons National Surgical Quality Improvement Program estimates that a single postoperative complication increases the total cost of care by 54%.² It additionally shows that a hospital's average profit margin is drastically reduced, from 23% to only 3.4%, for patients with complications.² As the number of surgeries performed each year increases, so does the prevalence of postoperative complications and subsequently, costs to the hospital. The introduction of hospitalists to a surgical comanagement service allows for coordination of medical care and more oversight of patients during their postoperative course of treatment. Comanagement may prove essential to the prevention of postoperative complications, the reduction of in-hospital mortality rates, and ultimately, the containment of hospital costs.

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Author conflict of interest: none.

Presented as an oral presentation at the Forty-fourth Annual Symposium of the Society for Clinical Vascular Surgery, Las Vegas, Nev, March 12-16, 2016.

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The editors and reviewers of this article have no relevant financial relationships to disclose per the JVS policy that requires reviewers to decline review of any manuscript for which they may have a conflict of interest.

0741-5214

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A vascular surgery hospitalist comanagement service was first implemented at the Mount Sinai Medical Center and the Icahn School of Medicine at Mount Sinai in early 2013.³ Since then, the program has proven effective at managing complex medical comorbidities and improving in-hospital mortality rates among vascular surgery patients.⁴ In addition, comanagement was found to have a positive impact on vascular surgery pain outcomes as well as patient satisfaction.⁵ Because vascular surgery patients often face multiple medical comorbidities, their expected morbidity and mortality after surgery is much higher than the average patient.⁶ Therefore, this high-risk cohort of patients may uniquely benefit from a hospitalist comanagement service. Although the effect of a comanagement service on in-hospital mortality rates and postoperative pain outcomes has been assessed, the program's impact on total hospital costs has yet to be studied.

The main purpose of this study was to determine the impact of a collaborative, hospitalist-led approach in the vascular surgery service on the cost of care.

METHODS

Patient population and data collection. This study was performed at the Mount Sinai Medical Center and Icahn School of Medicine at Mount Sinai, an urban tertiary care hospital and medical school located in New York City.⁴ A retrospective review of deidentified hospital administrative data was conducted on 1558 patients treated at Mount Sinai between 2012 and 2014. The Office for Excellence in Patient Care Reporting System through the Icahn School of Medicine at Mount Sinai, as well as institutional Department of Surgery finance records, provided the data used for this study. Institutional Review Board approval of the study was waived because patient specific information was not studied. Informed consent was also waived because the data collected were retrospective and deidentified.⁴

The vascular surgeon-hospitalist comanagement service was implemented in January 2013. Patients were divided into three cohorts: 516 treated in 2012 prior to comanagement, 525 treated in 2013 during the first year of comanagement, and 517 treated in 2014 during the second year of comanagement. Because of discrepancies between the total number of billing encounters obtained from The Department of Surgery financial data and the number of hospital discharges from the Office for Excellence in Patient Care Reporting System, select cases missing financial data were excluded from this study. For this reason, the numbers are slightly off from our previous study assessing the same comanagement program.⁴ Data were standardized for six vascular surgeon attendings who were present 2012-2014 and saw patients in all three cohorts. Two new attendings that joined the Mount Sinai faculty in July 2013 were

excluded. Ten hospitalists also participated to make up the remainder of the comanagement service.

The primary endpoints captured from the data collected were case mix index (CMI), contribution margin (CM), total hospital charges (THCs), actual direct costs (ADCs), actual variable indirect costs (AVICs), length of stay (LOS), and readmission rates (RARs). CMI is defined as the average relative weight of diagnosis-related groups (DRGs), for a given hospital or division; in our case, the calculation of CMI values was division- and physician-specific. Because DRGs classify inpatient stays into groups based on a patient's age, sex, condition, procedure, and overall case complexity or comorbidity, our CMI reflects the clinical complexity of cases and provides an idea of how resources were allocated to treat patients in a given group. CM is the percent contribution, or dollar difference between total net charges to patients and relative variable costs; it can be used to measure the percentage that a given case is contributing to overall hospital profitability.⁷ THCs include all charges associated with a given patient's admission that are billed to a third party payer. ADCs, or controllable costs, are those that can be easily identified within the department and are usually assigned to products and services.⁷ These included labor by physicians and other procedure-specific staff as well as fixed costs for supplies and equipment. AVICs typically include overhead, such as administration, information technology, and human resources, in addition to any variable costs that were required to care for and treat patients on a case-by-case basis. LOS describes the duration (in days) of a patient's hospitalization, calculated by subtracting the day of admission from the day of discharge. Readmission rates will include general readmissions, including any admission to Mount Sinai Hospital within 30 days of discharge from the patient's original hospital stay, and related readmissions, including any readmissions to Mount Sinai Hospital within 30 days of discharge for an event directly related to a patient's primary admission.

All Department of Surgery financial data were automatically adjusted for inflation prior to use in our analysis.

Statistical analysis. All data were analyzed using SPSS software (IBM Corp, Armonk, NY). Normalized comparisons were made. Analysis of variance with post-hoc tests and *t*-tests were performed for each variable collected. Multiple linear regression models were used to assess the impact of confounding by CMI and LOS on the relationship between comanagement and THC. By creating a final regression model with CMI, LOS and comanagement as independent predictors of THC, we are able to estimate the association of each variable with THC when all other variables are held constant. An analysis of covariance was also used to assess CMI as a possible covariate in the relationship between comanagement and LOS. For regression analyses only, the data

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