Inpatient Hospital Admission and Death After Outpatient Surgery in Elderly Patients

Importance of Patient and System Characteristics and Location of Care

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Hypothesis: Surgery at different outpatient care locations in the higher-risk elderly (age ≥65 years) population is associated with similar rates of inpatient hospital admission and death.

Design: Claims analysis of patients undergoing 16 different surgical procedures in a nationally representative (5%) sample of Medicare beneficiaries for the years 1994 through 1999.

Setting: Hospital-based outpatient centers, freestanding ambulatory surgery centers (ASCs), and physicians’ office facilities.

Patients: Medicare beneficiaries older than 65 years.

Main Outcome Measures: Rate of death, emergency department risk, and admission to an inpatient hospital within 7 days of outpatient surgery.

Results: We studied 564,267 outpatient surgical procedures: 360,780 at an outpatient hospital, 175,288 at an ASC, and 28,199 at a physician’s office. There were no deaths in the day of surgery at a physician’s office, 4 deaths the day of surgery at an ASC (2.3 per 100,000 outpatient procedures), and 9 deaths the day of surgery at an outpatient hospital (2.5 per 100,000 outpatient procedures). The 7-day mortality rate was 35 per 100,000 outpatient procedures at a physician’s office, 25 per 100,000 outpatient procedures at an ASC, and 50 per 100,000 outpatient procedures at an outpatient hospital. The rate of admission to an inpatient hospital within 7 days of outpatient surgery was 9.08 per 1000 outpatient procedures at a physician’s office, 8.41 per 1000 outpatient procedures at an ASC, and 21 per 1000 outpatient procedures at an outpatient hospital. In multivariate models, more advanced age, prior inpatient hospital admission within 6 months, surgical performance at a physician’s office or outpatient hospital, and invasiveness of surgery identified those patients who were at increased risk of inpatient hospital admission or death within 7 days of surgery at an outpatient facility.

Conclusion: This study represents an initial effort to demonstrate the risk associated with outpatient surgery in a large, diverse population of elderly individuals.

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It has been estimated that approximately 60% to 70% of all surgical procedures are now being performed on an outpatient basis. As outpatient surgery continues to include a wider range of procedures and is offered to more patients at high risk, it is important to examine its safety in actual settings for high-risk populations.

Although complications in ambulatory surgery are relatively uncommon, little is known about the characteristics of patients or settings that have higher rates of poor outcomes such as death, unplanned hospitalizations, or emergency department (ED) visits following the procedure. Elderly individuals represent a high-risk group for clinical complications during surgery and during the period of recovery. We chose 7-day and 30-day periods of follow-up, whereas previous studies have used a 30-day period. A short period is less likely to introduce extraneous factors that may be unrelated to these less invasive procedures.

The ability to assess the absolute rates of inpatient hospital admission and death is limited by the large sample size required given the low rate of events. In the absence of a prospective study, administrative datasets such as Medicare claims allow one to determine current practice patterns and generate hypotheses for future investigation. We therefore used medical claims from a nationally representative sample of Medicare beneficiaries to determine if certain characteristics of patients or facilities were associated with higher adverse occurrences. We chose to evaluate...
16 surgical procedures based on their prevalence in the outpatient setting and their rapid diffusion from the inpatient to the outpatient setting during the last 10 years. To determine the influence of location of care of the initial procedure on outcome, we stratified these procedures into those performed in hospital-based outpatient centers, freestanding ambulatory surgery centers (ASCs), and physicians’ office-based practices and attempted to minimize the influence of selection bias by developing models that incorporated both a comorbidity scale and a measure of the propensity to use medical resources. This information could then be used to help identify patients most likely to require direct inpatient hospital admission from an outpatient surgery center and to provide information to patients and families about the potential need for prolonged observation for complications that may occur during the first week after surgery.

**METHODS**

The investigation involved a retrospective study of surgical procedures performed in Medicare beneficiaries from 1994 through 1999. For each year, individuals aged 65 and older, living in the United States, and enrolled in the Medicare program with both part A and part B fee-for-service coverage were included.

Data were obtained from 5% of the standard analytic files for the calendar years 1994 through 1999. These files are produced by the Center for Medicare and Medicaid Services, Baltimore, Md, and contain a nationally representative random sample of Medicare beneficiaries, which is commonly used for research purposes. Participants in Medicare managed care programs are not included in the dataset. In 1994, there were 1941453 beneficiaries in the database. By 1999, the number had increased to 2055561 beneficiaries. In all 6 years, 62% were women, and 84% were white.

We monitored 16 outpatient procedures: cataract, transurethral resection of the prostate, inguinal hernia, femoral hernia, umbilical hernia, laparoscopic cholecystectomy, dilation and curettage, simple mastectomy, modified mastectomy, carpal tunnel repair, knee arthroscopy, hysterectomy, rotator cuff repair, arteriovenous graft placement, hemorrhoidectomy, and vaginal hysterectomy. Each procedure was then mapped to a single code or group of Current Procedural Terminology-related codes. The location of care was determined by a place-of-service code on the surgeon’s claim. The term outpatient hospital refers to surgery performed in hospitals on an outpatient basis. Because of coding rules, office-based care includes procedures actually performed in a physician’s office and those performed at a nonaccredited ASC. The date of surgery was determined from the surgeon’s claim. Each operation was considered an independent event so that some patients may have had more than one procedure in the analysis.

Death, hospitalizations, and ED visits within 7 days of the outpatient procedure were the 3 outcome variables. Death was assessed from the Medicare enrollment files. Emergency department visits included any new physician claim with the ED as the place of service within 7 days of the outpatient procedure. Hospitalizations within 7 and 30 days of the outpatient procedure were assessed by the presence of a new Medicare part B physician claim with place of service coded as “inpatient.” To minimize potential errors resulting from inappropriate coding of service location for any subsequent inpatient hospital admission, we eliminated any encounters related to physicians who do not typically admit patients to the hospital (radiologists, pathologists, and anesthesiologists).

**STATISTICAL ANALYSIS**

The rates of admission to an inpatient hospital, ED visits, and death within 7 and 30 days of surgery per 1000 outpatient procedures by location of care were calculated. The rates for days 0 to 7 and days 8 to 30 were recalculated to determine the rate per day by dividing the total number of inpatient hospital admissions by the number of days in the interval of interest. Differences in the rates of inpatient hospital admission between locations of care were determined using the $\chi^2$ test. To adjust for severity of illness, several factors previously shown to affect inpatient hospital admission rates were included in the analysis. Specifically, age (by 5-year cohorts), sex, race, prior admissions to an inpatient hospital, and comorbidity were included in the model. The number of prior admissions to an inpatient hospital within the 2 quarters prior to the quarter in which the outpatient surgery was performed was included as a proxy for the propensity to use medical services.

The effect of coexisting medical conditions was assessed by modification of the Charlson index by Deyo et al using information from the previous 2 quarters prior to the quarter of the surgical procedure. The patient without any part A Medicare claims was considered to have a comorbidity index of 0.

Logistic regression equations were individually calculated for each of the outcomes of death, inpatient hospital admission, or ED visits (SAS software version 8.02; SAS Institute Inc, Cary, NC). The logistic regression equations were calculated only for procedures performed between 1995 and 1999 to determine inpatient hospital admission history using the 1994 claims. All of the risk adjustment factors mentioned previously were entered into these models, including either Charlson index or inpatient hospital admission history. The base-case scenario was assumed to be a white man aged 65 to 69 years undergoing cataract surgery at an ASC. An additional set of logistic regression equations was developed for the outcomes of death and inpatient hospital admissions for each surgical procedure. The C statistic (the area under the receiver operating characteristic curve) was calculated for the models. The C statistic ranges from 0.5 to 1, where $C=1$ for a perfect model and $C=0.5$ for a model no better than random classification.

**RESULTS**

We studied 564267 outpatient surgical procedures: 360780 (64%) at an outpatient hospital, 175288 (31%) at a free-standing ASC, and 28199 (5%) at a physician’s office. For the 16 procedures, there was a trend toward increasing frequency in the outpatient setting from 1994 through 1999, except for cataract surgery, which was already performed in the outpatient setting. For the 16 procedures, the proportion of surgery in the outpatient hospital increased from 80.6% in 1994 to 88.2% in 1999. This is higher than the rate for all surgical procedures because we selected 16 procedures that were more likely to be performed in the outpatient setting.

Table 1 presents the rates of death, ED visits, and inpatient hospital admissions at 7 and 30 days postsur-
surgery. The rate of deaths per day was lower during the first 7 days after surgery compared with the subsequent 23 days, and the rate of ED visits and inpatient hospital admissions per day was greatest during the first 7 days.

Multivariate logistic models for all 16 procedures were developed separately for death, ED visits, and inpatient hospital admission within 7 days of outpatient surgery. The statistically significant (P<.05) predictors of death within 7 days of outpatient surgery included being older than 85 years (odds ratio [OR], 2.30; 95% confidence interval [CI], 1.41-2.97), being female (OR, 0.69; 95% CI, 0.51-0.93), having surgery initially performed in an outpatient hospital (OR, 1.47; 95% CI, 1.00-2.16), and having prior hospital admission (OR per admission, 1.44; 95% CI, 1.29-1.61). During the 5 years used in the multivariate model, there were 156 deaths, none of which were patients who underwent simple mastectomy, femoral hernia, or rotator cuff repair.

The rate of admission to an inpatient hospital within 7 days of surgery increased with the number of inpatient hospital admissions during the previous 2 quarters of care. Similarly, the rates of 1-week outcomes increased with the number of comorbidities included in the modification of the Charlson index by Deyo et al.\(^*\) Approximately one third of physician Medicare claims associated with inpatient hospital admissions after outpatient surgery were related to the previously defined list of medical complications.

Table 2 presents ED visits, and Table 3 presents inpatient hospital admissions within 7 days of outpatient surgery. Replacing the continuous prior inpatient hospital admission variable with inpatient hospital admission within 7 days of outpatient surgery with a series of prior inpatient hospital admissions on an ordinal scale demonstrates ORs as follows: 1 prior admission (OR, 1.50; 95% CI, 1.42-1.59), 2 prior admissions (OR, 2.06; 95% CI, 1.89-2.26), 3 prior admissions (OR, 2.43; 95% CI, 2.10-2.82), and 4 or more prior admissions (OR, 3.39; 95% CI, 2.84-4.04). Rerunning the logistic regression equations with the modification of the Charlson index and replacing the variable for prior inpatient hospital admissions did not change the significant predictors of outcomes within 7 days of outpatient surgery or the magnitude of the significance.

When the regression equations for the individual procedures were performed, the importance of age and prior inpatient hospital admissions was similar to the overall findings. The influence of location of care varied by procedure, although the stability and predictive value of the individual models were a function of the total sample size and number of adverse events. For those models with sufficient sample size, the risk-
adjusted ORs for hospitalization and death within 7 days of outpatient surgery at an office-based care location are presented in Table 4.

**COMMENT**

Our sample of 16 surgical procedures frequently performed in an outpatient setting demonstrates a 7-day mortality rate of 41 people per 100,000 outpatient procedures, a rate of ED visits of 1,630 per 100,000 outpatient procedures, and an inpatient hospital admission rate of 2,660 people per 100,000 outpatient procedures. The rate varied among the procedures, with higher rates found either with greater invasiveness or based on an underlying indication for the surgery. The higher rate of inpatient hospital admissions and deaths for surgeries performed at an outpatient hospital supports the contention that physicians perform an adequate preoperative evaluation and appropriately perform surgery in patients at the highest risk in the location with the greatest available resources.

The rate of operative mortality associated with anesthesia and surgery in the outpatient setting (either in the operating room or postanesthesia care unit) has been estimated to be 0.25 to 0.50 per 100,000 outpatient procedures. These estimates were based on insurance claims of intraoperative mortality rates related to anesthesia in healthy individuals undergoing elective inpatient surgery. The ability to generalize from this select inpatient sample to the outpatient arena is questionable. We estimated the same-day mortality rate in a population older than 65 years to be 2.5 per 100,000 outpatient surgeries or 5 to 10 times greater than these insurance claim estimates. The cause of mortality in our dataset could not be assessed and therefore includes deaths associated with anesthesia, surgery, patient disease, a combination of factors, or nonsurgical factors (eg, automobile accident). Of note, the death rate for this population was actually lowest on the day of surgery.

Patient-specific factors were important predictors of adverse events. Advanced age (>85 years) and significant comorbidity were associated with increased risk of inpatient hospital admission, similar to previous studies.12 The strongest predictor of inpatient hospital admission was the inpatient hospitalization history. In our study, we observed more than a 2-fold increased risk associated with multiple prior inpatient hospital admissions and a nearly 2-fold increased risk associated with the oldest age cohort. African American and Hispanic individuals also had a markedly elevated risk of inpatient hospital admission, possibly related to issues of access to care.13 Additional analysis of the factors associated with poorer outcome in certain ethnic groups is clearly warranted.

There has been a great deal of interest in the safety of outpatient surgery.14,15 Recently, the US Department of Health and Human Services Office of Inspector General suggested that oversight of freestanding ASCs should be strengthened.13 However, our data suggest that ASCs have among the lowest adverse outcome rates of the 3 sites of care, even after controlling for factors associated with patients with higher risk. This most likely reflects strong physician and patient selection with regard to location of care and limitations in our risk adjustment.

During the late 1990s, physicians’ office-based surgical procedures became much more common, with an estimated 5% to 8% of procedures being performed in a physician’s office in 2000.16 Unlike the regulated environment of the outpatient hospital or freestanding ASC, most states have minimal regulations or standards regarding surgical care delivered in a physician’s office. Therefore, the ability to respond to emergencies may be

### Table 3. Risk Factors for Inpatient Hospitalization Within 7 Days of Outpatient Surgery for Medicare Beneficiaries Undergoing 16 Procedures From 1995 Through 1999*  

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Odds Ratio (95% Confidence Intervals)</th>
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<tbody>
<tr>
<td>African American</td>
<td>1.66 (1.55-1.78)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>3.03 (2.67-3.42)</td>
</tr>
<tr>
<td>Female</td>
<td>0.92 (0.88-0.96)</td>
</tr>
<tr>
<td>Age, y</td>
<td></td>
</tr>
<tr>
<td>70-74</td>
<td>1.12 (1.05-1.18)</td>
</tr>
<tr>
<td>75-79</td>
<td>1.30 (1.23-1.38)</td>
</tr>
<tr>
<td>80-84</td>
<td>1.51 (1.42-1.61)</td>
</tr>
<tr>
<td>≥85</td>
<td>1.89 (1.76-2.02)</td>
</tr>
<tr>
<td>Surgery at physician’s office</td>
<td>1.59 (1.40-1.81)</td>
</tr>
<tr>
<td>Surgery at outpatient hospital</td>
<td>2.66 (2.49-2.84)</td>
</tr>
<tr>
<td>Prior inpatient hospital admission</td>
<td>1.36 (1.32-1.39)</td>
</tr>
</tbody>
</table>

*Compared with a white man aged 65 to 69 years undergoing cataract surgery at an ambulatory surgery center. C statistic = 0.80.

### Table 4. Increased Risk Associated With Physician’s Office Care Compared With Ambulatory Surgery Center Care for a Given Procedure When Risk for Each Procedure Was Evaluated Individually*  

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Odds Ratio (95% Confidence Intervals)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hemorrhoidectomy</td>
<td>0.15 (0.08-0.28)</td>
</tr>
<tr>
<td>Cataract</td>
<td>1.56 (1.29-1.88)</td>
</tr>
<tr>
<td>Hysteroscopy</td>
<td>2.31 (1.09-4.89)</td>
</tr>
<tr>
<td>Inguinal hernia</td>
<td>3.82 (2.34-6.24)</td>
</tr>
<tr>
<td>Arteriovenous graft placement</td>
<td>4.05 (1.58-10.36)</td>
</tr>
<tr>
<td>Knee arthroscopy</td>
<td>4.72 (2.47-9.01)</td>
</tr>
<tr>
<td>Transurethral resection of prostate</td>
<td>7.49 (4.16-13.48)</td>
</tr>
<tr>
<td>Umbilical hernia repair</td>
<td>10.79 (3.73-31.22)</td>
</tr>
</tbody>
</table>

*Adjusted for age, sex, race, and inpatient hospital admission history.

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diminished because of fewer personnel and equipment. There are currently no federal regulations or Medicare mandates regarding standards for outpatient surgeries performed in physicians’ offices. For this reason, it is critical for physicians, patients, and insurers to understand the risks associated with different settings for patients with different risk profiles. We observed no deaths the day of surgery in a physician’s office, although the precise rate cannot be determined given the small sample size. We observed an increased risk-adjusted rate of inpatient hospital admission or death within 7 days of surgery for procedures initially performed in a physician’s office compared with an outpatient hospital, suggesting the need for continued surveillance. The rates were highly dependent on the surgical procedure, with hemorrhoidectomy associated with lower rates of adverse events in a physician’s office, whereas increased rates of inpatient hospital admissions were observed for cataract extraction, hysteroscopy, inguinal hernia repair, arteriovenous graft placement, knee arthroscopy, transurethral resection of the prostate, and umbilical hernia repair performed in a physician’s office.

Our rates of inpatient hospital admission after outpatient surgery were consistent with other studies. Twersky et al16 studied 6243 patients who underwent ambulatory surgery across 12 consecutive months and described 187 patients (2.9%) who returned to the same hospital, 1.3% of whom returned for complications from outpatient surgery. Mezei and Chung6 reported a 1.1% rate of inpatient hospital admission within 30 days of outpatient surgery.

From a clinical perspective, this suggests that the intersection of a patient with advanced age, with a history of inpatient hospital admission within the previous 2 quarters of the year, and who is undergoing a planned outpatient procedure with a higher risk for inpatient hospital admission warrants the institution of plans both to directly transfer that patient to a hospital if a complication arises in a freestanding or office-based facility or to monitor the patient at home after facility discharge for potential complications that warrant return to a hospital setting. The absolute rate of inpatient hospital admission, ED visits, and death within 7 days of outpatient surgery in this group at baseline was approximately 0.1%, but that may increase if performed in patients with multiple prior inpatient hospital admissions, advanced age, and procedures with greater risk (eg, transurethral resection of the prostate). The ability to identify specific subgroups of patients at greatest risk will allow a cost-effective approach for targeting care for a vulnerable population.

Our study had several limitations related to the use of an administrative database. We did not have patient-specific data such as type of anesthesia, operating room time, or monitoring. We could not determine the cause of the inpatient hospital admission or death. The accuracy of our analysis was limited to the accuracy and completeness of the coding in the standard analytic files. There may have been discrepancies in clinical codes as well as place of service coded as “office,” which included both physicians’ offices and unaccredited ASCs. Our assessment of dates was based on Medicare part B data including a physician claim with an inpatient hospital as the location of care. Because some of these claims may reflect incorrectly coded outpatient visits, our data may reflect the upper limits of the number of inpatient hospital admissions. Some outpatient hospital–based facilities may perform surgery on patients for whom inpatient hospital admission is planned as part of their protocol. Our data also may be biased by underreporting, because claims may not be submitted for patients who die in the outpatient setting.

The strength of our conclusions with regard to location of care may represent an additional limitation because there is a clear selection bias with respect to which patients are appropriate for the different care locations. Physicians may recommend certain settings based on information not available in the claims data. We attempted to adjust for severity of illness using both prior inpatient hospital admission and the Charlson comorbidity index. Despite the multivariate models, there were higher rates of risk-adjusted outcomes in hospital-based outpatient surgery, suggesting that there may be additional selection criteria that were not measured by either of our established methods. Alternatively, the higher rates may be related to surgical complexity not reflected in Current Procedural Terminology codes. Selection may be the result of a wide array of ad hoc systems and protocols by which physicians make these judgments. This indicates a need for both standardization of data and an appropriate instrument for determining risk that can be used by the busy physician. Finally, our study is limited to the Medicare population and cannot be generalized to a younger population or procedures not covered by Medicare (eg, cosmetic procedures).

This study represents an initial effort to demonstrate in a large, diverse population the risks associated with outpatient surgery. It also demonstrates that patient outcomes are a function of patient characteristics independent of the surgical procedure, confirming the current perception of risk as a multivariate phenomenon. The accelerated pace at which more complex procedures are being performed in locations increasingly removed from sophisticated support facilities requires that this effort be structured to permit appropriate assessment of these trends. The lack of such analyses could encourage the inappropriate movement of patients and procedures to lower-intensity settings or, conversely, inhibit the appropriate movement of some of these procedures to lower-cost facilities that may be more accessible to patients. The ability to identify high-risk subsets would suggest that systems to ensure timely access to the health care system for complications that occur at home should be considered and allow for more appropriate preoperative evaluation and patient selection. As the trend toward increasingly complex procedures continues in the outpatient arena, the approach used here could be used to monitor the safety of the procedures performed in one setting when follow-up care may occur in a separate setting.

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REFERENCES


Surgical Anatomy

The cutaneous nerves of the front of the thigh are derived from segments L. 1, 2, 3, 4. The lateral, intermediate, and medial cutaneous nerves of the thigh and the (long) saphenous nerve are derived from the femoral nerve. They pierce the deep fascia along an oblique line that roughly marks the Sartorius.