

Hospital Resources Used for Inpatient and Ambulatory Surgery

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New hospital and physician payment schemes encourage physicians to participate actively in efforts to minimize hospital resource use. As an example of the type of evaluations anesthesiologists may conduct, we examined hospital resources used for comparable groups of inpatients (INPTs) and day surgery unit (DSU) patients. Although INPTs and DSU patients undergoing surgical arthroscopy of the knee or diagnostic laparoscopy were similar with regard to age, physical status, and staff surgeon, more preoperative tests were performed for INPTs than for DSU patients ($P < .05$). Hospital costs for these tests were four times greater for INPTs than for DSU patients. Operating room time was from 20 to 45 min longer for INPTs than for DSU patients ($P < .05$). Recovery room time was from 25 to 52 min longer for DSU patients ($P < .05$). Per patient nursing labor costs paralleled operating and recovery room times. These kinds of analyses are important in identifying opportunities to improve resource use, in assessing institutional costs for surgical care, and in designing strategies that allow institutions and physicians to respond to cost containment pressures.

MAJOR THIRD PARTY payers, including Medicare and many Medicaid, HMO, and Blue Cross programs, have recently implemented fixed price payment schemes for hospital services. Under these programs, the number of hospital services (such as preoperative tests and operating room hours) provided no longer influence hospital payment: increases in net revenue are dependent on increased patient volume and/or reduced costs. As a corollary, when fewer hospital services (resources) are used per patient, more funds may be available for capital equipment purchases or for personnel.

Evaluations of resources used for surgical care have been conducted, but charges (*i.e.*, what the hospital bills) rather than costs have been used in these analyses.¹⁻³ Under fixed payment, hospital costs must be used to assess the economic impact of a particular service or mode of patient care.⁴ Evans and Robinson,⁵ using traditional accounting methods to determine the cost of surgical care at one Canadian hospital, found savings of 50-60% for ambulatory pediatric surgical care when compared to inpatient care. The savings accrued from lower rates of preoperative testing and elimination of overnight stays. No similar studies have been conducted for surgical care provided in the U. S.

The new financial environment does, however, encourage collaborative efforts between hospitals and physicians to minimize use of resources, to identify the cost of patient care, and to care for more patients. We describe below a retrospective study that is an example of the type of investigation anesthesiologists may undertake to respond to these incentives.

We compared the use of preoperative tests, and of operating and recovery room time for comparable groups of patients receiving inpatient (INPT) or ambulatory surgical care. We also computed hospital costs for the preoperative tests and for nursing labor costs, based on operating and recovery room times.

Materials and Methods

SURGICAL PROCEDURES

Patients who underwent surgical arthroscopy of the knee and diagnostic laparoscopy were studied. These procedures are among the most common ambulatory surgical procedures at our institution, as well as in other ambulatory surgical facilities. Diagnostic laparoscopies were divided into two groups, reflecting levels of surgical intervention: level I laparoscopy involves only visual examination of pelvic viscera; level II laparoscopy also includes fallopian tube lavage with methylene blue or radiopaque dye.

PATIENT SAMPLE

Inpatient and ambulatory surgery logs were used to identify patients who underwent INPT or ambulatory surgical arthroscopy during the period January 1984

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TABLE 1. Percent of DSU Patients and Inpatients with Each Preoperative Test Per Surgical Procedure

Preoperative Test	Surgical Arthroscopy		Level I Laparoscopy		Level II Laparoscopy	
	DSU (N = 62)	INPT (N = 61)	DSU (N = 49)	INPT (N = 24)	DSU (N = 46)	INPT (N = 42)
Chest radiogram	12%*	30%	24%*	58%	0%*	79%
Electrocardiogram	11%*	30%	12%*	50%	2%*	83%
Panel 6	3%*	92%	0%*	75%	2%*	86%

* $P < .05$.

through June 1984. Based on the large volume of diagnostic laparoscopies performed at our institution, we studied only patients who had this procedure in the 3-month period of March 1984 through May 1984.

We selected the dates for this retrospective study for several reasons. First, fixed price payment programs were not common. Second, no major third party payer required that these surgical procedures be performed on an ambulatory basis. Third, the same groups of surgeons performed each procedure in both the INPT and ambulatory surgical facilities. Fourth, surgical and anesthesia care protocols (*e.g.*, use of local, regional, or general anesthesia) for these procedures did not change during the 6-month period.

In addition, there was heavy demand for day surgery unit (DSU) operating room time during the study period, with delays varying from 3 days to several weeks between scheduling date and date of operation. This resulted in a large number of patients being scheduled for INPT care rather than waiting for an available DSU date. These factors provided us with the opportunity to examine resource use and particular costs for comparable groups of inpatients and ambulatory surgery patients.

DATA COLLECTION AND ANALYSIS

Patient charts were reviewed to determine patient age, preoperative tests, American Society of Anesthesiologists (ASA) physical status (PS), staff surgeon, International Classification of Diseases—9th Clinical Modification (ICD9-CM) procedure code numbers, level of diagnostic laparoscopy, time in operating room, and time in recovery room. Chi-square and Z tests were used to determine the significance of differences in the distribution of patients or in mean values for patient groups. Significance was accepted at $P < .05$.

COST ANALYSIS

Our institution's cost system allows determination of hospital costs for individual laboratory and radiology services, and for nursing and aide labor costs. We calculated hospital costs for the most common (aside from

complete blood count and urinalysis) preoperative tests (EKG, Panel 6, chest radiogram) by multiplying the cost per test by the number ordered for INPTs and for DSU patients. Labor costs, which include salaries and employee benefits, were determined for operating and recovery room time in each surgical locus by multiplying per minute nursing labor costs by patient minutes in the operating and recovery rooms. Costs for other components of care, such as pharmaceuticals and overnight hospital stay, were not available for the period included in this study.

Results

For each procedure, there were no significant differences between DSU patients and INPTs in ASA physical status (all PS I or II) or in mean age (26–36 yr). There was no significant difference in the proportion of females undergoing arthroscopy in the DSU or INPT setting. In addition, for each procedure, the distribution of patients among individual staff surgeons was similar by locus of care. Anesthesia personnel were trained in the same institution and residents rotated through each area on a monthly basis.

PREOPERATIVE TEST USE AND COST

A preoperative testing algorithm was developed by the DSU anesthesia staff and is included on the patient processing form. A complete blood count (CBC) and urinalysis were the only preoperative tests required for ASA PS I and II patients less than 50 yr of age. Chest radiograms and electrocardiograms were required for patients over 50 yr of age. All other preoperative tests for DSU patients were ordered at the discretion of the scheduling surgeon. In contrast, no such minimum set of preoperative tests was specified for INPTs.

All DSU patients and INPTs had a preoperative CBC and urinalysis. There were major differences, however, in the use of chest radiograms, electrocardiograms, and Panel 6 tests (potassium, sodium, blood-urea-nitrogen, blood sugar, chloride, carbon dioxide), the most common tests ordered for INPTs. For each surgical procedure, a significantly higher percentage of INPTs than DSU patients had preoperative chest radiograms, electrocardiograms, and Panel 6 tests (table 1). Total hospital costs for these tests were \$1261 for DSU patients ($n = 157$) and \$5893 ($n = 127$) for INPTs.

OPERATING AND RECOVERY ROOM TIME AND LABOR COSTS

Mean total operating room time for each procedure ranged from 20 to 45 min longer for INPTs than for DSU patients ($P < .001$) (table 2). Conversely, recovery room time was longer ($P < .001$) for DSU patients un-

TABLE 2. Mean Operating and Recovery Room Time (Minutes) for DSU Patients and Inpatients per Surgical Procedure

Time Period	Surgical Arthroscopy		Level I Laparoscopy		Level II Laparoscopy	
	DSU	INPT	DSU	INPT	DSU	INPT
Operating room Time	83*	128	58*	83	65*	85
Labor costs	\$39.25*	\$66.38	\$28.28*	\$41.24	\$30.69*	\$43.30
Recovery room Time	101*	76	115*	63	125*	78
Labor costs	\$11.85*	\$8.99	\$13.48*	\$7.47	\$14.65*	\$9.31

* $P < .001$.

dergoing each procedure than for their INPT counterparts. Differences in per patient nurse and aide labor costs (while slightly different per minute in each area) essentially paralleled these differences in operating and recovery room time (table 2).

Discussion

Third party payment schemes and other cost-containment pressures necessitate that hospitals and physicians identify the economic consequences of patient care practices. This study examined the use of specific hospital resources and the true hospital costs for particular components of inpatient and ambulatory surgical care for three surgical procedures. While the DSU and INPT groups were similar with respect to age, ASA physical status, surgical staff, and anesthesia team, INPTs had more preoperative tests, longer stays in the operating room, shorter recovery room stays, and generated higher costs (for the components evaluated) than DSU patients.

PREOPERATIVE TESTS

The set of preoperative tests specified by the DSU anesthesia staff was rarely supplemented by the surgeons. In contrast, there was a much higher rate of preoperative testing for INPTs for whom no preoperative testing algorithm was available. For these INPTs, surgeons order the tests they think the anesthesiologists require to care for the patients. Overutilization of preoperative tests by surgical teams has also been reported by other investigators.⁶⁻⁸

Since the time of this study, we have revised the preoperative testing algorithm to reflect further experience in providing anesthesia care for DSU patients. The algorithm still only applies to ASA PS I and II patients. However, a CBC is now the only test required for all patients under 40 yr of age scheduled to receive anesthesia care. For patients over 40 yr of age, an electrocardiogram is obtained. For patients over 60 yr of age and those receiving diuretics or antihypertensive drugs (regardless of age), a CBC, electrocardiogram, chest ra-

diogram, and Panel 6 test are obtained. In addition, we have evaluated the newer DSU algorithm and found that it does not omit tests that might predict hospital admission following DSU care. Furthermore, it would have eliminated over 4000 preoperative tests without contributing to untoward events, had it been used for a group of orthopedic inpatients.⁹ Based on these findings, use of the algorithm is being expanded at our institution to include preoperative test ordering for surgical inpatients. We anticipate that its use will be associated with a large decrease in preoperative test utilization.

OPERATING ROOM TIME

Examining the differences in operating room time is also intriguing, particularly since patients underwent the same procedures and were cared for by similar groups of anesthesiologists and surgeons in each surgical setting. The DSU and INPT operating room scheduling schemes may account for some of the difference. Every DSU case has a specific starting time, making delays easy to detect. Inpatient cases, however (except for the first case of the day in each operating room), are scheduled "to follow" without specific starting times. Therefore, the time-oriented DSU environment may encourage efficiency, particularly due to the ease with which delays may be monitored and the opportunity for surgeons to identify expected start-times for each case. In fact, efficient use of inpatient operating room time may be achieved by revising the scheduling scheme to include a specific starting time and anticipated duration of procedure for each inpatient case. Such changes might be particularly effective if operating room time for individual surgeons was allocated within a block of time designated for the surgical specialty and if chairmen of surgical departments received periodic reports about individuals' operating room utilization.

Operating room efficiency is an important issue for hospitals to consider under reimbursement programs that encourage maximizing patient volume. Prolonged operating times result in lost opportunities to care for

patients. For example, an elementary analysis (not accounting for room turn-around time, etc.) using the data above regarding operating room time for surgical arthroscopies indicates that 5.1 DSU patients and 3.3 INPTs could be cared for per 7-h operating room shift (420 min/83 min-DSU, 420 min/128 min-INPT). This represents a loss of (and revenues from) 1.8 surgical arthroscopies per day in the INPT facility, with similar losses of professional anesthesia and surgical revenues.

RECOVERY ROOM TIME

The longer recovery room times for ambulatory patients undergoing arthroscopy or diagnostic laparoscopy reflect differences in criteria used for discharge from the DSU and INPT recovery rooms. DSU patients must have stable vital signs, be able to tolerate oral liquids, have minimal nausea and vomiting, and be able to walk. Surgical arthroscopy patients frequently have a heavy leg bandage and must be able to use crutches to leave the ambulatory facility. Physical demands on INPTs who are transported on a litter from the recovery room to an INPT room are far less rigorous. They need to be responsive and in no acute distress, yet they may also be heavily medicated and unable to walk.

DSU recovery room nurse and aide costs for arthroscopy and laparoscopy patients are higher than for INPTs. However, we did not assess labor costs for the post-recovery room phase of INPT care that includes transfer to a hospital room by transport personnel, and stabilization, monitoring, evaluation, and ambulation the patients by floor nursing personnel. We also did not include the cost for the overnight hospital stay. Nevertheless, when costs for operating and recovery room time were combined, we found savings of 15–30% in nurse and labor costs alone for DSU care.

STUDY LIMITATIONS

Three methodologic issues and biases in this study should also be noted. First, this was a retrospective study of patients who were not randomly assigned to receive INPT or DSU care. While the INPT and DSU groups were comparable in ASA physical status, age, surgeon, and anesthesia teams, we were not able to assess other factors (*e.g.*, previous surgical experience) that may affect the use of particular hospital resources. Unfortunately, current third party payer regulations prohibit a prospective randomized study of DSU and INPT care for the same surgical procedure.

Second, different nursing personnel staff the DSU, the INPT operating rooms, and the INPT recovery room. All groups of nurses, however, participate in similar required orientation and training programs, and are likely to have the same standards for practice. Nev-

ertheless, nurses who enjoy a faster-paced environment may be attracted to the DSU, suggesting that efficiency in all surgical settings may be somewhat dependent on nursing "personnel personalities." From another perspective, it may be important for institutions to develop programs that motivate nurses to develop in a fast-paced environment that enhances efficiency.

Third, this study was conducted at a major urban teaching hospital with separate, though contiguous, DSU and INPT surgical facilities. Ambulatory surgery programs at other institutions may be incorporated in the INPT operating and recovery rooms, and some institutions provide acute and step-down recovery areas for ambulatory surgery patients. Use of particular resources and hospital labor costs may be different in these types of facilities and recovery room labor costs may be lower where less intensive, step-down recovery areas are available.

In summary, fixed price payment programs encourage hospitals and physicians to identify and implement the most resource-efficient modes of patient care. We have presented a retrospective study that exemplifies the type of analysis anesthesiologists may undertake to determine the number and cost of resources consumed in providing care. The findings may be used to modify clinical and administrative practices in surgical care settings, thus contributing to efforts directed at minimizing the use of resources and maximizing patient volume.

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