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Financial Implications of a Hospital's Specialization in Rare Physiologically Complex Surgical Procedures

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Background: **The authors previously identified a hospital that has a unique role in its region for surgical care. In children aged 0–2 yr, the hospital performed 64% of all physiologically complex procedures statewide (≥ 8 American Society of Anesthesiologists Relative Value Guide basic units). For all age groups combined, 48% of the physiologically complex procedures performed at that hospital were rare, defined as < 1/workday statewide.**

Methods: **The authors tested the hypothesis that financially important differences can result from performing relatively large numbers of such specialized procedures. Methods were developed to compare contribution margin (revenue from facility and professional fees minus variable costs) per operating room hour (CM/OR hour) between patient groups and different types of surgical procedures.**

Results: **CM/OR hour was significantly larger by a financially important amount (> $250/OR hour) for pediatric *versus* geriatric patients ($P \leq 0.002$), primarily because of higher professional reimbursements, with no difference in hospital reimbursements. Unexpectedly, CM/OR hour was also significantly greater by at least $250 when a rare procedure was involved ($P < 0.001$ for all ages combined), primarily because of greater hospital reimbursements. For cases involving implant charges of $10,000 or greater, overall CM/OR hour was negative because increased revenues did not compensate for the high variable costs.**

Conclusions: **Other hospitals can use these methods to perform a similar analysis of the financial impact of those patient populations or surgical procedures that are unique to their own roles in their regional healthcare systems, and to identify the sources of financial losses and gains experienced by the hospital.**

ACADEMIC medical centers often claim that their patients are sicker or their surgical cases are more complex, although little data are available to support such claims. We previously identified an academic hospital that plays a unique role for surgical care in its region by performing a disproportionately large number of rare and physiologically complex surgical procedures.[1,2]

Previous analysis of discharge abstract data to examine surgery patterns within a U.S. state showed that one hospital performed a relatively large number of rare physiologically complex surgical procedures, especially in pediatric patients. Rare procedures were defined as those performed, on average, less than once per workday statewide. Physiologically complex procedures were defined as those having 8 or more American Society of Anesthesiologists' Relative Value Guide basic units. In children aged 0–2 yr, the hospital performed 64% of all physiologically complex surgery statewide, performed 63% of the rare physiologically complex surgery, and was the highest volume facility for 67% of all types of pediatric procedures.[1,2] The hospital did not exhibit a similar dominance for geriatric patients aged 80 yr and older, performing 6% of all physiologically complex surgery statewide and 15% of all rare physiologically complex procedures.[2] However, 40% of all the physiologically complex procedures performed in geriatric patients at that hospital were rare, a higher percentage than for any other hospital in the state.[2] For all age groups combined, rare physiologically complex procedures represented 21% of complex procedures statewide but 48% of complex procedures at that hospital.

This hospital thus serves a unique role for surgery in its region's healthcare system.[1,2] However, the financial implications of such dominance in pediatrics and such focus on performing many rare procedures have never been determined. Financial information is important for strategic planning, particularly in deciding which surgical specialties should be provided with additional support and what unique expertise and skills the hospital should emphasize in its communications to the public and referring physicians. The information can also be used to obtain governmental and private support for particular activities and to negotiate reimbursement rates paid by insurance companies or other third-party payers.

We therefore tested three hypotheses relevant to the finances of this particular academic hospital, chosen based on its specific areas of expertise.

First, we determined whether pediatric surgical cases were financially advantageous for the hospital and physicians compared with a control group of geriatric surgical cases, chosen because they represent an expanding market that could easily consume considerable hospital

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resources. If pediatric surgical cases were financially advantageous, the hospital should strive to play an even larger role in the provision of pediatric surgical services statewide, benefiting both the hospital and the community. More resources could be committed to educational efforts that would highlight the hospital as a center of excellence for pediatric surgery. Funds could be earmarked for capital expansion. Alternatively, pediatric surgical services might have a negative financial effect, possibly explaining why almost all physiologically complex pediatric surgery was performed at only three facilities in the state.[1] The hospital might then decide to pursue expansion in a different area and to refrain from marketing campaigns that would attract additional pediatric patients. Data on the financial consequences of the large role played by the hospital in pediatric health care would be of value in educating governmental agencies, philanthropists, and charitable organizations about the need for additional financial support.

Second, we tested the hypothesis that rare physiologically complex procedures were financially disadvantageous, formulated based on anecdotal evidence from administrators at teaching hospitals lamenting the costs of unusual procedures performed by academic physicians. Because few actuarial data on the financial costs of rare procedures are available, reimbursements may not be commensurate with true costs, especially if costs are higher for rare procedures. For example, operating room (OR) costs may be increased if necessary instruments are not anticipated in advance but have to be located and sterilized on demand. Rare procedures may present greater nursing challenges on the floor, and durations of stays may be longer than average for the Diagnosis Related Group (DRG) because of a lack of formal clinical pathways. Caregivers must rely on experience and case series rather than evidence-based practices. If rare procedures do create a financial disadvantage, the hospital may try to "carve out" such procedures by negotiating increased rates of reimbursement with third-party payers. Because rare procedures are by definition uncommon, the overall cost to third-party payers would be negligible. The impact on the financial success of those few hospitals concentrating on rare procedures would be large, however.

Third, we previously showed that implant costs constitute a substantial fraction of all variable costs.[3] Thus we tested the hypothesis that hospital revenue would not be sufficiently high to compensate for the cost of implants that were expensive. We predicted that financial performance would be poor when surgical procedures involved expensive implants.

To test our hypotheses, we developed methods for combining data from OR information systems, anesthesia billing systems, managerial accounting information systems, and state hospital discharge databases. Our goal was to identify financially important differences between groups of patients in contribution margin per OR hour (CM/OR hour), where contribution margin is reimbursement minus variable costs.

This particular hospital and the specific hypotheses chosen for testing may be considered a case study to determine the value of examining detailed financial information for use in strategic decision making. The usefulness of our results demonstrates that other hospitals should benefit from developing their own hypotheses and using these same methods to perform a similar analysis of the financial implications of whatever types of surgical procedures make that hospital unique in its own region.

Materials and Methods

Patients studied were those discharged in 2002 after elective surgery[3,4] at a U.S. academic hospital. Surgery was considered elective if (1) the patient was an outpatient or was admitted on the day of surgery, (2) the case was not performed on a weekend or university holiday, and (3) the case was not designated an emergency by the anesthesia provider. Elective surgeries compromised roughly 71% of total OR time.

Emergent cases were excluded for two main reasons. Most importantly, cost accounting is more straightforward for elective cases. If a patient admitted for an elective procedure has complications that require additional surgeries or an extended hospital stay, it is reasonable to attribute all the costs associated with the entire hospitalization to the procedure(s) for which the patient was originally admitted. For trauma patients with multiple injuries, subsequent costs cannot appropriately be attributed to the initial surgical procedure(s). In addition, a hospital has the ability to alter the number and types of elective cases it performs through strategic and tactical decisions, whereas changes in emergency room policies are more difficult to implement.

Financial data were used to determine the financial impact of surgical procedures performed on specific groups of patients. Financial gains (or losses) to the hospital and/or professional group(s) were calculated in terms of CM/OR hour. Profit is contribution margin minus fixed costs. When comparing groups of procedures, fixed costs can generally be ignored because they do not change. To maximize profit, a hospital should do more cases with a higher CM/OR hour.

The hospital and professional practice's accounting system (Eclipsys Corporation, Delray Beach, Florida) was used to estimate fixed and variable costs for each elective admission. At the many hospitals without such systems, variable costs can be estimated sufficiently accurately for decision making using the patients' OR times, hospital durations of stay, intensive care unit durations of stay, and implant costs.[3] Because we studied strategic

decision making, direct labor, such as nursing salaries, was treated as a variable cost for determining which differences in CM/OR hour were financially important. Costs and reimbursements were reported using year 2002 U.S. dollars.

The anesthesia group's billing information system contained Current Procedural Terminology (CPT) codes for each surgical case, which were used to determine physiologic complexity. We considered a case physiologically complex if any of its component procedures had 8 or more American Society of Anesthesiologists (ASA) Relative Value Guide basic units[1,2,5–7] according to the ASA Crosswalk (A Guide for Surgery/Anesthesia CPT Codes). Use of this classification scheme for this purpose has previously been validated in several studies.[1,6,7] If the patient underwent more than one surgical case during his or her hospital stay, the determination of physiologic complexity was based on the first case, because the decision to provide care for that patient was predicated on factors associated with that first case. Examples of procedures that are not physiologically complex include repair of inguinal hernia (4 units) and laparoscopic cholecystectomy (7 units). Procedures that are physiologically complex include myelomeningocele repair (8 units) and lung lobectomy (13 units). Surgical cases involving physiologically complex procedures comprised 28% of all elective surgical time and 42% of total net revenue for elective cases.

The OR information system was used to calculate OR times.

The State of Iowa inpatient and outpatient discharge abstract databases for 2001 were used to identify rare procedures. The discharge abstract databases include cases performed in every nonfederal hospital and hospital-affiliated outpatient surgery center statewide. Procedures and diagnoses were coded by each facility using *International Classification of Diseases*, 9th revision, Clinical Modification (ICD-9-CM) codes. The number of times a procedure was performed statewide in all hospitals combined was determined for each procedure.

A procedure was considered rare if it was performed less than 250 times in the entire state in 2001, equivalent to once per workday statewide. Of the 2,108 different types of procedures performed statewide, 88% were of types considered rare, representing 8% of all procedures performed. At some hospitals, certain rare procedures would not be considered particularly uncommon if those hospitals were regionalized centers for such types of procedures and performed a disproportionate number of all procedures statewide. For example, 87 of 110 statewide kidney transplantations were performed at the study hospital in 2001, almost two a week. Still, most rare types of procedures represent truly uncommon ICD-9-CM codes. Each rare procedure was performed a median of only 11 times statewide in 2001. Examples of rare procedures performed at the study hospital include trabeculae carneae cordis operations (ICD-9-CM 35.35, n = 2), lysis of cortical adhesions (ICD-9-CM 2.91, n = 5), and partial excision of pituitary gland transfrontal approach (ICD-9-CM 7.61, n = 5).

The hospital accounting system included a principal ICD-9-CM procedure code and up to 10 additional ICD-9-CM procedure codes for each inpatient admission. For outpatients, ICD-9-CM procedure codes were determined from CPT codes in the anesthesia billing database using methods similar to the reverse of those described previously for converting ICD-9-CM codes to CPT codes.[1,2,5–7]

The mean length of stay (LOS) for each DRG nationwide was obtained from the Agency for Healthcare Research & Quality's Healthcare Cost and Utilization Project.§

Statistical Analyses and Reporting of Results

For each group, CM/OR hour was calculated as the ratio of total contribution margin to total OR time. To assess the statistical significance of differences in CM/OR hour between groups, one- or two-sided *P* values were calculated using the normal approximation bootstrap method.[8] We also tested whether the groups differed by a financially important amount, considered to be $250 or greater per OR hour. The value of $250 per OR hour was chosen because it represents a typical value for the variable direct costs needed to staff an OR (average combined salaries of an OR nurse, OR technician, academic surgeon, resident or certified registered nurse anesthetist, and half an anesthesiologist). Results would not be affected if $150 or $500 had been used instead of $250. *P* values were corrected for multiple comparisons using the procedure of Holm.[9] SEs and 95% confidence intervals for CM/OR hour were determined using the method of Fieller.[10,11]

When comparing groups, actual values for CM/OR hour were not reported for each group. Results indicate only whether differences in CM/OR hour equal or exceed $250. Exact values were not provided for three reasons. First, publication of specific numbers would disclose confidential information to organizations with whom the study hospital is negotiating. Second, inclusion of these values would be of no benefit because readers should not attempt to draw conclusions by comparing values among institutions. Specific values are applicable only to this particular institution, with its unique combination of procedure types and payer mix. Third, only differences in CM/OR between groups are important, not specific values. Contributions margins are highly sensitive to the categorization of certain costs as fixed or variable, whereas differences are not. For exam-

§ 2001 National Inpatient Sample file was downloaded from the "Quick Statistics" section available at: http://hcup.ahrq.gov/HCUPnet.asp. Accessed February 18, 2005.

ple, physician costs were included as variable costs in this analysis, but they could have been considered fixed costs or even omitted entirely. Values of CM/OR would then be vastly different, but differences between patient groups or types of surgical procedures would be only minimally affected.

Results

Results are summarized in table 1. At the hospital studied, CM/OR hour averaged $1,773 for all patients (n = 14,315), which is between two values previously found for other hospitals, after adjustment for medical inflation.[12,13]

Hypothesis 1: Pediatrics versus Geriatrics

Contribution margin per OR hour was significantly larger for pediatric *versus* geriatric patients undergoing inpatient surgery that was physiologically complex, inpatient surgery that was not physiologically complex, and outpatient surgery (all $P < 0.001$). Differences were financially important, defined as $250 or more per OR hour. Differences remained significant (all $P < 0.001$) when profit was calculated by including fixed costs. Differences remained significant (all $P \leq 0.003$) after excluding patients undergoing pediatric otolaryngology, the most common pediatric specialty,[1] or patients with implant charges of at least $10,000.[3]

Each patient's hospital LOS was compared to the 2001 national average LOS for discharges with the same federal DRG. Differences in postoperative costs, as measured by LOS, did not account for the larger CM/OR hour for pediatric patients. Children had DRG-adjusted hospital LOS values that were 0.9 ± 0.5 (mean ± SE) days less than average, whereas the elderly had DRG-adjusted hospital LOS values that were 0.9 ± 0.2 days less than average ($P = 0.96$, Student two-sided t test).

Variable costs, professional reimbursement, and hospital reimbursement were studied separately for inpatient surgery that was physiologically complex, inpatient surgery that was not physiologically complex, and outpatient surgery. Variable costs per OR hour and hospital reimbursement per OR hour did not differ between age groups by a financially important amount (all $P > 0.1$). Professional reimbursement per OR hour was larger for children by a financially important amount. Therefore, differences in professional reimbursement accounted for much of the difference between age groups in CM/OR hour.

Hypothesis 2: Rare Physiologically Complex Procedures

Another facet of care in which this hospital predominated was rare physiologically complex surgical procedures. When at least one of the physiologically complex procedures was of a type considered rare (median frequency statewide 53 occurrences in 2001), variable costs were higher by more than $250 compared with physiologically complex procedures that were not rare ($P < 0.01$). However, revenues compensated for the increase in costs, and CM/OR hour was significantly greater by at least $250 when a rare procedure was involved. Our hypothesis that discharges involving rare

Table 1. Summary of Results

	CM/OR Hour
CM/OR hour for all patients (n = 14,315 discharges)	$1,773 ± 23
Pediatric patients (aged 0–12 yr, n = 2,193) compared to geriatric patients (aged 65 yr or older, n = 2,981)	
Inpatient surgery that was physiologically complex (≥ 8 ASA RVG basic units)	↑ $P < 0.002$
Inpatient surgery that was not physiologically complex	↑ $P < 0.002$
Outpatient surgery	↑ $P < 0.002$
Professional reimbursements	↑ $P < 0.001$
Hospital reimbursements	NS
DRG-adjusted hospital LOS	NS
Physiologically complex procedures (n = 2,107)	$2,191 ± 100, NS
Rare physiologically complex procedures (n = 1,147) compared to nonrare physiologically complex procedures (n = 960)	↑ $P < 0.001$
Professional reimbursements	NS
Hospital reimbursements	↑ $P < 10^{-7}$
DRG-adjusted hospital LOS	↓ $P < 10^{-11}$
Geriatric patients (n = 283 rare, n = 294 nonrare)	↑ $P < 0.001$
Physiologically complex thoracic procedures on the lung and esophagus* (n = 115)	↑ $P < 0.02$
Back surgery* (often requiring implants costing several thousands of dollars, n = 605)	↓ $P < 10^{-4}$
Implant charges of at least $10,000	
Backs (n = 116)	−$15 ± 245
All types of procedures (n = 292)	−$327 ± 223
Rare procedures (n = 169)	−$524 ± 323

Financial implications of specializing in pediatric surgical procedures, performing relatively large numbers of rare physiologically complex surgical procedures, and performing procedures requiring expensive implants. Contribution margin per operating room hour (CM/OR hour) is shown for discharges involving the specified types of surgical procedures, either as mean ± SE or in comparison to relevant control groups. Actual values are not shown for each group to avoid disclosing confidential information. Values would not be useful for comparing institutions because they would differ according to payer mix, actual reimbursement levels, and fixed costs. Comparisons between groups of cases within a single hospital provide the most useful information. *P* values are all two sided, and dollar amounts have been compared to $250.

* Defined in appendix.

↑ = CM/OR hour is greater by a financially important amount, defined as $250 or more; ↓ = CM/OR hour is smaller by a financially important amount; ASA RVG = American Society of Anesthesiologists Relative Value Guide; DRG-adjusted hospital LOS = difference between the average hospital length of stay and the national average for that Diagnosis Related Group; NS = CM/OR hour is not significantly different by at least $250 ($P > 0.1$).

procedures were financially disadvantageous was incorrect, because CM/OR was not smaller (one-sided $P > 0.99$), even among patients aged 65 yr and older (one-sided $P > 0.99$).

Contribution margin per OR hour was higher for pediatric surgery due to greater professional reimbursements, whereas the increased CM/OR hour for physiologically complex rare procedures was due to higher hospital reimbursements. Discharges involving rare procedures were also associated with higher professional reimbursements (two-sided $P < 10^{-6}$), but the amount was not financially important (two-sided $P > 0.6$ when difference was compared to \$250). When profit was calculated by including fixed costs such as building maintenance, the difference between discharges that involved a rare procedure and those that did not remained significant (two-sided $P < 10^{-6}$).

Because a larger proportion of discharges at this hospital involve rare procedures when compared with other hospitals in the state, this hospital may be relatively more efficient at caring postoperatively for patients undergoing rare procedures. If so, the greater hospital reimbursement and higher CM/OR hour and profit associated with rare procedures may be related to early discharges. Average LOS was greater for rare procedures, consistent with their higher variable costs. However, the DRG-adjusted hospital LOS for physiologically complex rare procedures was 1.7 ± 0.2 days less than the national average, compared with 0.3 ± 0.1 days for procedures that were not rare. Mean differences are economically relevant, being proportional to the total number of hospital days that were reimbursed by a DRG-based system but that the hospital did not provide.[14] Because the national averages were 7.7 ± 0.1 days for rare procedures and 4.8 ± 0.1 days for procedures that were not rare,[15] rare procedures afforded greater opportunities for reducing costs with no change in revenues. Therefore, revenues exceeded variable costs by a greater amount for rare procedures.

Hypothesis 3: Implants

We examined several surgical specialties to determine whether the financial advantage associated with rare physiologically complex procedures was a consistent finding or was sensitive to the selection of specialties (*e.g.*, limited to those with low implant utilization). The hospital might want to encourage greater OR allocations for those specialties with the highest CM/OR hour[16] or limit OR allocations for specialties with low CM/OR hour.

For example, the hospital performed almost 25% of all physiologically complex thoracic procedures done statewide, and 82% of these procedures were of types considered rare. Elective physiologically complex general thoracic surgery procedures on the lung and esophagus (see appendix for list of specific procedure codes) resulted in a CM/OR hour that was significantly higher than that for nonthoracic procedures by a financially important amount (two-sided $P < 0.02$). Thoracic surgery is therefore financially beneficial to the hospital.

Another example is back surgery (see appendix), which differs from thoracic surgery in that back surgery often requires implants costing several thousands of dollars. Elective physiologically complex back surgery had an average CM/OR hour that was significantly less than the hospital average for all other types of physiologically complex surgery by a financially important amount. For back surgeries with implants charges of at least \$10,000, CM/OR hour was actually negative (table 1).

For all types of procedures combined that had implant charges of at least \$10,000, CM/OR hour was $-\$327 \pm 223$. Although hospital reimbursements were almost \$800 greater for discharges involving expensive implants, they were not high enough to compensate for the \$3,600 increase in variable costs per OR hour. CM/OR hour was even more negative for rare physiologically complex procedures with expensive implants.

Discussion

In this case study, we examine the financial implications of surgical specialization by comparing pediatric and geriatric patients, examining surgical procedures that are rare, and analyzing surgical procedures that involve expensive implants. We believe this to be the first report showing that combining data from an OR information system (for OR times), an anesthesia billing system (for physiologic complexity), a managerial accounting information system (for financial information), and state hospital discharge databases (for procedure frequency) can identify significant and financially important differences between patient groups in CM/OR hour.

This case study shows that linking these data can provide new and important insights into the financial implications of a hospital's unique role in its regional health system. For example, the data confirmed subjective impressions that professional reimbursement was greater for pediatric than geriatric patients and that procedures involving expensive implants resulted in a lower CM/OR hour because increased revenues did not compensate for the high variable costs. Results yielded the surprising discoveries that hospital reimbursement did not differ by a financially important amount between pediatric and geriatric patients, that rare procedures were associated with higher hospital reimbursements, and that expensive implants can have a profoundly negative impact on profitability.

The hospital used information obtained from this analysis to help administrators understand the financial implications or different types of surgeries. Although medical directors might favor expanding their pediatric

practice, and hospital executives might conclude that increasing the number of rare procedures would be most beneficial, such apparent conflicts can more easily be reconciled if administrators understand the various factors that determine overall CM/OR hour. Our findings emphasize the need to consider both professional and facility reimbursements and costs when examining the financial implications of surgical practice patterns.

By generating concrete data demonstrating unequivocally that procedures involving expensive implants have a detrimental effect on overall CM/OR hour, we were able to use measures to minimize implant costs. Other than reducing the number of procedures, however, approaches to this problem are limited. Because inventory control is unlikely to result in cost savings for expensive implants because they are not high volume items, hospitals should place great importance on negotiating the lowest price possible for such implants.[17] Unfortunately, doing so by standardization of practices and implants will be difficult to accomplish because 58% of discharges associated with implant charges of at least $10,000 involved physiologically complex procedures that were rare. Surgeons will often be unable to rely on evidence-based studies for selecting one implant over another. Clinical trials demonstrating the superiority of one implant over another or the equivalence of different implants are not feasible to perform because of insufficient numbers of patients.

Results clearly show that certain specialties were much more lucrative than others. This information was used to guide strategic decision making. Previous studies have found that CM/OR hour can vary more than 10-fold among surgeons, where surgeon is considered a surrogate for subspecialty.[3,4,11–13] Therefore, the hospital can choose to focus growth of OR resources selectively on those subspecialties that will produce the greatest financial gain.[16]

Over a long period of time, the hospital may adjust staffing levels and bed availability to match changes in surgical practices, thereby altering nursing costs. For this reason, labor was considered a variable cost when determining whether differences in CM/OR hour were financially important. However, other institutions may decide to consider labor a fixed cost, depending on the strategic options under consideration.

The specific results reported here cannot be generalized to other institutions. Although the same methods can certainly be used elsewhere, our conclusions about the relative financial impact of surgery in different age groups or for different types of procedures do not apply to other hospitals. Fixed costs differ markedly among hospitals and professional practices and can be relatively large or small compared with CM/OR hour, depending on the hospital and how it defines and allocates fixed costs. In addition, revenues are highly sensitive to payer mix and reimbursement rates. For example, Medicaid payments vary widely between states. In 1999, Iowa paid an average of $390 in physician claims for each user of Medicaid services, whereas Illinois paid $371.‖ For each inpatient hospitalization, however, Iowa paid an average of $5,225, and Illinois paid $9,631. Therefore, when compared with Iowa, rates in Illinois were relatively more favorable for the hospital than the professional component. Even payment rates from a single provider, such as Medicare, may vary widely depending on hospital wage index, geographic practice cost index, case mix index, and subsidies for graduate medical education. To avoid comparisons with other hospitals, precise values for CM/OR hour for each patient group in the study hospital were not reported here.

The age groups or types of procedures examined here are most likely not even relevant to other hospitals. Each hospital needs to develop its own hypotheses and study those patient populations or surgical procedures that are characteristic of its own surgical practice and that make the hospital unique in its own region.

We have clearly demonstrated the feasibility (*i.e.*, proof of concept) of combining data from multiple sources to identify significant differences in CM/OR hour and shown how such information can be extremely useful in guiding strategic decision making. Every hospital could benefit from a similar analysis of its own financial situation, taking into consideration whatever makes the hospital unique in its own region and the relative numbers of different types of procedures it performs. Findings can generate valuable information to provide justification and support for current services, tell a hospital where to focus its surgical caseload, identify threats to overall profitability, and create opportunities to improve the bottom line. This article illustrates the value of aligning data from multiple sources to provide concrete financial information that is crucial for perioperative strategic decision making and long-term planning.

‖ Medicaid validation reports available at: http://www.cms.hhs.gov/researchers/max/current/default.asp. Accessed February 18, 2005.

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Appendix: Specific ICD-9-CM and DRG Codes for Procedures Considered Together as Single Groups

Category	ICD-9-CM Procedure Code
General thoracic surgery procedures on the lung	Wide sleeve resection of bronchus (32.1)
	Plication of emphysematous bleb (32.21)
	Lung volume reduction surgery (32.22)
	Wedge resection (32.29)
	Segmental resection of lung (32.3)
	Lobectomy (32.4)
	Complete pneumonectomy (32.5)
	Radical dissection of thoracic structures (32.6)
	Other excision of lung (32.9)
	Suture of bronchial laceration (33.41)
	Closure of bronchial fistula (33.42)
	Closure of lung laceration (33.43)
	Bronchial repair NEC (33.48)
	Lung repair NEC (33.49)
	Incision of mediastinum (34.1)
	Destruction of mediastinal lesion (34.3)
	Destruction of chest wall lesion (34.4)
	Decortication of lung (34.51)
	Other pleural excision (34.59)
	Scarification of pleura (34.6)
	Repair of pleura (34.93)
	Thoracic operation NEC (34.99)
General thoracic surgery procedures on the esophagus	Esophagectomy NOS (42.40)
	Partial esophagectomy (42.41)
	Total esophagectomy (42.42)
	Intrathoracic esophagoesophagostomy (42.51)
	Intrathoracic esophagogastrostomy (42.52)
	Intrathoracic esophageal anastomosis with interposition of small bowel (42.53)
	Anastomosis of esophagus to intestinal segment NOS (42.54)
	Intrathoracic esophageal anastomosis with interposition of colon (42.55)
	Esophagocolostomy NOS (42.56)
	Retrosternal formation of reversed gastric tube (42.58)
	Other intrathoracic anastomosis of esophagus (42.59)
	Esophagomyotomy (42.7)

Category	DRG Diagnosis Code
Procedures on the back and spine	004—Spinal procedures
	009—Spinal disorders and injuries
	496—Combined anterior–posterior spinal fusion
	497—Spinal fusion except cervical with cc
	498—Spinal fusion except cervical without cc
	499—Back and neck procs except spinal fusion with cc
	500—Back and neck procs except spinal fusion without cc
	519—Cervical spinal fusion with cc
	520—Cervical spinal fusion without cc

cc= complications; DRG = Diagnosis Related Group; ICD-9-CM = *International Classification of Diseases*, 9th revision, Clinical Modification; NEC = not elsewhere classified; NOS = not otherwise specified.