

Outcomes of surgery under Medicaid

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In this study, health outcomes during the 6-month period following surgery are examined for all Medicaid recipients in Michigan and Georgia who underwent selected surgical procedures between July 1, 1981, and June 30, 1982. Readmissions were somewhat more prevalent in both States for hysterectomy, cholecystectomy, appendectomy, and myringotomy. On

almost all measures in both States, levels of post-surgical utilization, expenditure, and complications were higher among females, older patients, Supplemental Security Income enrollees, and those with higher levels of presurgical utilization and longer and more costly surgical stays. The results further demonstrate the utility of claims data in monitoring outcomes of surgery.

Introduction

The growing interest in assessing and assuring the quality of health care has spurred the search for efficient methods of measuring the numerous dimensions of that complex concept. Of particular interest is the dimension that many observers consider the ultimate criterion for judging the quality of a health care intervention: its outcome, or whether it has the intended effect on the health status of the patient. The ideal method of measuring the outcomes of health care involves repeated assessment of the health status of large numbers of individuals with a given health condition, some of whom undergo the intervention and some of whom do not. Unfortunately, this method of the controlled clinical trial is extremely expensive when employed on a sufficient number of cases to provide statistically reliable results. It also raises serious ethical questions, e.g., withholding treatment from control patients when the treatment proves effective, or risking adverse effects to experimental patients when it does not. Attention has instead focused on methods of employing secondary sources of data—medical records, hospital discharge abstracts, insurance claims, and vital records (birth and death certificates)—to capture indirect indicators of health outcomes.

Most of the studies of health outcomes that have used health insurance claims (reviewed in the following section) have employed data from the Medicare program. Apparently none have used data from the Medicaid program, even though the latter is roughly comparable in magnitude to the former in terms of recipients, if not reimbursements (Ruther et al., 1987), and even though Medicaid targets the Nation's most vulnerable subpopulations: low-income elderly, disabled, and families with dependent children. This study uses Medicaid data from two States, Georgia and Michigan, to assess the outcomes of selected surgical procedures among Medicaid recipients who are not also eligible for Medicare. The purpose of the article is to demonstrate that claims data can be useful in identifying potential problems in the quality of care. It does not attempt to draw definitive inferences about differences in the quality of care among surgical procedures, patient groups, or States; factors influencing the quality of care; or Federal or State policy regarding the quality of care.

Previous studies

Mortality

Not surprisingly, the concept of health care "outcomes" is usually operationally defined as the occurrence of events that signal adverse consequences for the patient. Few would disagree that the most serious such outcome is death, which has thus been the usual focus of previous outcome-oriented studies. Most such studies (Luft, Bunker, and Enthoven, 1979; Luft, 1980; Shortell and LoGerfo, 1981; Flood, Scott, and Ewy, 1984a and 1984b; Maerki, Luft, and Hunt, 1986; Sloan, Perrin, and Valvona, 1986; Kelly and Hellinger, 1986; Blumberg, 1986; Rosenfeld et al., 1987) have confined that focus to deaths that occur during hospitalization. This limitation arises largely from reliance on hospital discharge abstract data, for few analysts would argue that only in-hospital mortality can be attributed to hospital care. Some early studies of hospital-related mortality (Brook et al., 1971; Stanford Center for Health Care Research, 1976; Flood et al., 1982) employed followup assessment and interviews to measure mortality up to 6 months after discharge. More recently, public health insurance claims and enrollment data have been used to link information on hospital care and subsequent death up to 1 year following surgery (Lubitz, Riley, and Newton, 1985; Riley and Lubitz, 1985; Wennberg et al., 1987).

Most of these studies have concentrated on the inverse relationship at the hospital level between mortality (number of deaths) and surgical volume (number of surgical procedures). All have demonstrated that, for most surgical procedures, mortality is lower for hospitals that perform more surgery, either of the specific type being studied or overall. The evidence of the relationship appears strong enough to prompt most analysts to advocate regionalization of surgery for certain procedures. The direction of causality underlying this relationship remains unclear, however. It could be that hospitals performing more surgery gain experience that reduces mortality or that hospitals known to have lower death rates (for reasons unrelated to surgical volume) attract more referrals for surgery. There appears to be no corresponding relationship between volume and mortality at the individual physician level (Kelly and Hellinger, 1986), and evidence on the independent effect of other hospital and physician characteristics on patient outcomes is quite mixed.

In addition, two recent studies urge caution on regionalization of surgery. Maerki, Luft, and Hunt (1986) point out the need for emergency treatment in

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small-volume hospitals, given their distance from designated regional specialty hospitals. They also question the capacity of some designated regional hospitals to handle a larger patient load. Sloan, Perrin, and Valvona (1986) found variation in mortality to be more procedure-related than volume-related and concluded that "an adequate statistical basis for setting minimum volume standards does not presently exist." These two studies appear to support Donabedian's (1984) call for further research on the nature of the association between outcome and organizational characteristics before regionalization of surgery is uncritically adopted.

A related area in the literature on hospital outcomes has focused on the survival rate of patients receiving intensive care, specifically the inverse relationship of the survival rate to the cost of such care (i.e., the positive association between mortality and cost). That is, patients consuming the most resources tend to have the lowest survival rate (i.e., the highest death rate). A more refined analysis that employed measures of extent of therapy and severity of illness (Scheffler et al., 1982) found that the relationship is actually U-shaped. That is, as the extent of therapy increases, the probability of death initially declines, then levels off, and finally increases rapidly. Again the dependent variable has usually been death in the hospital (Civetta, 1973; Turnbull et al., 1979; Scheffler et al., 1982), but a few studies have used followup assessment and interviews to capture post-hospital mortality as well (Cullen et al., 1976; Thibault et al., 1980; Chassin, 1982).

Another related area involves the nature of catastrophic illness and the characteristics of high-cost patients, including their mortality rates. These studies have further demonstrated the direct relationship between probability of death and amount of health care resources consumed, which stems from the fact that patients requiring more services tend to be older and more often near death. (They are also presumably "sicker," but no consensus has yet been achieved on how best to measure initial severity of case mix.) Again, the focus has usually been confined to death in the hospital (Schroeder, Showstack, and Roberts, 1979; Zook and Moore, 1980), but one study matched patient records to death records to obtain rates of post-hospital mortality (Schroeder, Showstack, and Schwartz, 1981). These studies have been conducted with an eye toward development of catastrophic insurance, especially for Medicare recipients. They also imply that improved methods of diagnosing terminal illness need to be developed so that appropriate forms of palliative care (especially hospice) can be encouraged and scarce acute care resources redirected to patients with better prognoses. Indeed, the extent of discrepancies between premortem and postmortem diagnoses has been proposed as an indicator of the quality of care (Anderson, 1984).

Nonmortality outcome measures

Although mortality may be the most serious adverse outcome of hospital care, it is by no means the sole indicator of the quality of that care (Kelly and Hellinger, 1986). Most importantly, patients who survive hospitalization vary in their degree of morbidity (extent of illness). A few of the studies of post-hospital mortality

(Brook et al., 1971; Stanford Center for Health Care Research, 1976; Flood et al., 1982) have also used followup interviews to assess the patient's health and functioning for up to 6 months after discharge. A similar approach has been employed in randomized trials designed to assess the efficacy of specific surgical procedures, such as tonsillectomy (Paradise et al., 1984), and was recently used to analyze outcomes among patients with chronic obstructive pulmonary disease (Strauss et al., 1986).

A less direct but still useful approach to measuring morbidity has been to quantify the patient's extent of utilization of health care following hospitalization. As with morbidity, this approach has been employed to supplement analyses of post-hospital mortality (Chassin, 1982) and to assess the efficacy of various surgical procedures (Roos and Roos, 1983), including tonsillectomy (Roos, Roos, and Henteleff, 1978) and prostatectomy (Wennberg et al., 1987). More recently, it has been used to compare outcomes among patients of family physicians and internists (Franks and Dickinson, 1986). A related area of the literature has focused on the "offset effect" of treatment for mental illness (Mumford et al., 1984; Borus et al., 1985) and alcoholism (Holder and Blose, 1986) in reducing health care utilization and expenditures.

One specific form of utilization following an initial hospital stay has received special attention in the literature, namely hospital readmission. Hospital recidivism has been shown to vary greatly among the States (Gornick, 1977) and to be a major factor behind high-cost use (Anderson and Knickman, 1984). In particular, readmission for the same disease accounts for nearly 60 percent of all hospital charges (Zook, Savickis, and Moore, 1980). Similarly, the probability of undergoing reoperation (specifically, prostatectomy)—not necessarily related to deficiencies in care—can be as high as 33 percent (Wennberg et al., 1987). Analysis of Medicare data reveals that "... expenditures are highly concentrated on a small percentage of beneficiaries who are repeatedly admitted to the hospital ... [and] that a high percentage of Medicare hospitalizations are followed by readmissions within short periods of time" (Anderson and Steinberg, 1984).

Predictors of repeat hospitalization (Zook, Savickis, and Moore, 1980; Anderson and Steinberg, 1985; Fethke, Smith, and Johnson, 1986) include:

- Diagnosis (severe, chronic illnesses, especially those requiring life-maintenance therapy).
- Absence of surgery.
- Dependence (especially widowhood).
- Low levels of life satisfaction.
- Harmful personal habits (e.g., substance abuse).
- Eligibility for Medicaid.

For certain surgical procedures, rehospitalization rates among Medicare recipients are also higher for males and older patients (Riley and Lubitz, 1986). On the other hand, authors of a recent study of a sample of elderly patients in Wales assert that most rehospitalizations are the result not of social factors, but of relapse in the patient's original medical condition (Victor and Vetter, 1985). Similarly, rehospitalization following surgery is usually associated with the same body system involved in the original surgery (Riley and Lubitz, 1986).

Another nonmortality measure of hospital outcomes has been the rate of occurrence of surgical complications. Like mortality, the incidence of postoperative wound infection has been shown to be inversely related to surgical volume (Farber, Kaiser, and Wenzel, 1981). Nosocomial infections have also been shown to be more extensive than reported in hospital discharge abstracts (Massanari et al., 1987). Frequency of complications has also been used to characterize high-cost users (Zook and Moore, 1980). Along with post-hospital utilization, complications have also served as indicators of the efficacy of specific surgical procedures. Paradise et al. (1984) employed direct clinical assessment to measure the occurrence of complications following tonsillectomy, and Sussman et al. (1982) used medical records and notes and pathology reports to compare resident and attending surgeons in terms of in-hospital complication rates following appendectomy. Finally, Roos et al. (1985, 1986) have demonstrated that diagnosis codes in computerized claims records can be used to measure, for a variety of surgical procedures, the incidence of complications associated with readmission to the hospital.

In this study, we use a method similar to that employed by Roos et al. (1985) to measure post-surgical complications in outpatient as well as inpatient settings, plus standard measures of hospital readmission and other forms of post-hospital utilization and expenditure, to indicate outcomes of surgery among Medicaid recipients in Michigan and Georgia in 1981-82. These methods are discussed in the following section.

Methods

Population

In this article, we examine outcomes of selected inpatient surgical procedures among Medicaid recipients in Georgia and Michigan for 1981 and 1982 and identify patient characteristics associated with those outcomes. However, as pointed out in the introduction, no definitive inferences are intended concerning differences, factors, or policies regarding the quality of care. The analysis uses data from the Health Care Financing Administration's uniform State Medicaid data base known as "Tape-to-Tape," which contains claims, enrollment, and provider information for all Medicaid recipients in five States beginning in 1980. Special considerations of data availability led to the choice of Georgia and Michigan as the two States to be used in this study, and the exclusion of "crossover" enrollees (those eligible for Medicare as well as Medicaid) from the analysis. The latter decision means that the study population includes only the younger, healthier segment of the Medicaid population in the two States. The selected surgical procedures, listed in Table 1, were chosen on the basis of high frequency and cost in the study population.

Adverse outcomes

The analysis focuses on certain adverse surgical outcomes, namely rehospitalizations, complications, and unusually high levels of additional health care utilization and expenditure (Medicaid amount paid) following

Table 1
Selected surgical procedures and corresponding ICD-9-CM codes

Procedure	ICD-9-CM codes
1. Cesarean section (and ectopic pregnancy)	74.0-74.99
2. Hysterectomy	68.3-68.7
3. Oophorectomy and/or salpingectomy	65.3-65.62, 66.2-66.69
4. Herniorrhaphy (inguinal, femoral)	53.00-53.39
5. Appendectomy	47.0
6. Cholecystectomy	51.21-51.22
7. Tonsillectomy	28.2-28.3
8. Myringotomy	20.01-20.09

NOTES: ICD-9-CM is *International Classification of Diseases, 9th Revision, Clinical Modification*. A list of those complications deemed relevant to the surgical procedures in this table is presented in Table 2.

SOURCE: (Public Health Service and Health Care Financing Administration, 1980).

surgery. Aside from inpatient hospital services, the types of post-surgical care most likely to occur among noncrossover Medicaid recipients are physician (ambulatory) services and prescription drugs. Long-term care (nursing home and home health services) occurred much too infrequently in this population to yield reliable figures and is thus not included in the results. Moreover, at the time of initial data processing for this study, information on death was not available for Michigan, and in Georgia, the number of decedents was too small to permit detailed analysis of their attributes. This probably reflects the fact that the study population contains only noncrossovers, who tend to be younger and thus less likely to die than crossovers (McMillan and Gornick, 1984).

Of particular interest among the selected adverse outcomes is the frequency of diagnoses that can be interpreted as complications arising from the selected surgical procedures. These include diagnoses explicitly identified in the *International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM)* (Public Health Service and Health Care Financing Administration, 1980) as being either general complications of surgery or complications specific to one or more of those particular procedures. Although this method excludes many additional diagnoses that some specialists might interpret as procedure-specific complications, the lack of consensus on this topic (Roos et al., 1985) suggests a cautious approach.

The frequency count of surgical complications represents the number of times any one of those complication codes appeared as a principal or secondary diagnosis on an inpatient or outpatient claim (long-term care claims were not included). Two separate counts—one for inpatient claims and one for outpatient claims—are presented in the analysis. The operational basis for this distinction, plus the specification of time periods, selection of episodes, and construction of measures for this study, are briefly explained in the following sections, and in more detail in the "Technical note." The specific complications are listed in Table 2.

Time periods

The focus of this study is the 180-day period following admission to the patient's "key" inpatient stay, i.e., the

Table 2

Codes for selected surgical complications relevant to the procedures listed in Table 1

ICD-9-CM code	Complication	Relevant procedure numbers
518.4	Pulmonary edema (including postoperative)	All
518.5	Pulmonary insufficiency (including following surgery)	All
551.21	Incisional ventral hernia with gangrene	1-6
552.21	Incisional ventral hernia with obstruction	1-6
553.21	Incisional ventral hernia, no gangrene or obstruction	1-6
576.0	Postcholecystectomy syndrome	6
593.3	Stricture or kinking of ureter (including postoperative)	1-2
598.2	Postoperative urethral stricture	1-2
618.5	Prolapse of vaginal vault after hysterectomy	2
620.6	Broad ligament laceration syndrome	1-3
623.2	Stricture or atresia of vagina (including postoperative adhesions)	2
668	Complications of anesthesia in labor and delivery: ¹	
668.00-.02	Pulmonary	1
668.10-.12	Cardiac	1
668.20-.22	Central nervous system	1
668.80-.82	Other	1
668.90-.92	Unspecified	1
669	Other complications of labor and delivery, not otherwise specified: ¹	
669.10-.12	Obstetric shock (including following labor and delivery)	1
669.30-.32	Acute renal failure following labor and delivery	1
669.40-.42	Other complications of obstetrical procedures	1
669.80-.82	Other complications of labor and delivery	1
669.90-.92	Unspecified complications of labor and delivery	1
674	Other and unspecified complications of the puerperium, not otherwise specified ¹	1
674.10-.12	Disruption of cesarean wound, unspecified	1
674.30-.32	Other complications of obstetrical surgical wounds	1
995.2	Unspecified adverse effect of drug, etc.	All
995.4	Shock due to anesthesia	All
996.7	Other complications of internal prosthetic device, etc.	4
997	Complications affecting specified body systems, during or resulting from a procedure, not otherwise specified:	
997.0	Central nervous system	All
997.1	Cardiac	All
997.2	Peripheral vascular	All
997.3	Respiratory	All
997.4	Gastrointestinal	1-6
997.5	Urinary	1-3
997.9	Other	All
998	Other complications of procedures, not otherwise specified:	
998.0	Postoperative shock	All
998.1	Hemorrhage or hematoma complicating a procedure	All
998.2	Accidental puncture or laceration during a procedure	All
998.3	Disruption of operation wound	All
998.4	Foreign body accidentally left during a procedure	All
998.5	Postoperative infection	1-6
998.6	Persistent postoperative fistula	1-6
998.7	Acute reaction to foreign substance accidentally left during a procedure	All
998.8	Other specified complications of procedures, not otherwise specified	All
998.9	Unspecified complication of procedure, not otherwise specified	All

¹Meaning of 5th digit for complications mainly related to pregnancy: 0 = unspecified; 1 = delivered, with or without mention of antepartum condition; 2 = delivered, with mention of postpartum condition.

NOTE: ICD-9-CM is *International Classification of Diseases, 9th Revision, Clinical Modification*.

SOURCE: (Public Health Service and Health Care Financing Administration, 1980).

stay involving one of the selected surgical procedures (Table 1). However, except for the frequency count of complications (previous section), only the health care utilization occurring after discharge from the key stay is included in the post-surgical period. The characteristics of the key stay itself (number of days, amount of expenditures, etc.) are treated as predictors of post-discharge outcomes, along with the patient's demographic characteristics and levels of health care utilization during

the 180-day period preceding admission to the key stay. The study uses patients whose key stays occurred in the period from July 1981 through June 1982 to allow for the 180-day presurgical period as well as the 180-day post-surgical period within only 2 calendar years of data. Finally, the study uses only those patients who were continuously enrolled in Medicaid during an entire 12-month episode.

Measures

In addition to nonhospital services, the study uses measures of the patient's utilization and expenditure during any non-key inpatient stays (i.e., those not involving one of the selected surgical procedures) that occurred during either the presurgical or post-surgical period. Post-surgical inpatient stays (i.e., readmissions) were classified as being related or unrelated to the key stay on the basis of principal diagnosis. Utilization of physician services was classified as inpatient or outpatient (ambulatory) by matching the dates of service on the physician claims to admission and discharge dates on inpatient facility claims. The counts of surgical complications were similarly classified as inpatient or outpatient.

Findings

Adverse outcomes

In Table 3, we present the rate of post-surgical readmissions and complications per 1,000 patients for both Georgia and Michigan, stratified by surgical procedure. Both the overall readmission rate and the percent of readmissions judged to be related to the key surgical procedure are reported. The complication rates are further stratified by the setting in which they were diagnosed: inpatient or outpatient. Because of the small numbers of cases involved, the procedure-specific results for complications should be interpreted with caution, especially those based on less than 20 cases. Given its smaller enrollee population, Georgia will inevitably have more such instances of "low N." Standard errors are not reported, because the estimates are based on population data rather than sample data.

Readmissions

The overall readmission rate for all eight procedures is slightly higher in Georgia (174 per 1,000 patients) than in Michigan (160 per 1,000). Both figures are somewhat lower than the 220 per 1,000 patients (i.e., 22 percent) reported among Medicare beneficiaries (Anderson and Steinberg, 1984). Although a higher readmission rate might be expected among Medicare patients (who would tend to be older than our sample of noncrossover Medicaid enrollees), our data include readmissions up to 6 months after admission to the key hospital stay, whereas the Medicare figure covers only readmissions within 60 days of discharge.

The pattern of readmission rates among the various procedures is quite stable across the two States. In each State, the procedure with the highest readmission rate is cholecystectomy. Hysterectomy also ranks high on readmissions in both States (second in Michigan, third in Georgia), as do appendectomy (third in Michigan, fifth in Georgia) and myringotomy (fourth in both States). The two States produce identical rankings for oophorectomy and/or salpingectomy (sixth) and tonsillectomy (eighth, or lowest). The largest difference between the two States is for herniorrhaphy (second in Georgia, but seventh—next to lowest—in Michigan). Cesarean section is fifth in Michigan but seventh in Georgia.

Related readmissions

The percent of readmissions related to the key surgical procedure also displays a stable pattern of results across the two States, although some of the Georgia figures are based on less than 20 cases and must therefore be interpreted with caution. The overall percentage of related readmissions is more similar between the two States than was the overall readmission rate, but it is still slightly

Table 3
Number and percent of adverse outcomes in the 6 months after surgery among noncrossover Medicaid patients, by procedure: Georgia and Michigan, 1981-82

Measure	Procedure								
	All 8 procedures	Cesarean section	Hysterectomy	Oophorectomy and/or salpingectomy	Herniorrhaphy	Appendectomy	Cholecystectomy	Tonsillectomy	Myringotomy
Georgia									
Number of patients	3,325	609	354	715	321	142	397	678	109
Percent of total	100.0	18.3	10.6	21.5	9.7	4.3	11.9	20.4	3.3
Number of readmissions ¹	174	118	209	144	212	183	345	114	202
Percent related ²	27.4	25.0	35.9	19.6	16.7	3100.0	23.9	34.1	30.0
Number of complications: ³									
Inpatient	26	311	59	315	325	328	353	321	39
Outpatient	22	331	342	317	36	321	325	318	30
Michigan									
Number of patients	9,255	2,599	975	1,784	468	611	1,085	1,584	149
Percent of total	100.0	28.1	10.5	19.3	5.1	6.6	11.7	17.1	1.6
Number of readmissions ¹	160	167	194	154	137	190	228	81	188
Percent related ²	22.8	8.7	53.1	34.2	14.8	32.7	10.9	28.4	30.0
Number of complications: ³									
Inpatient	28	26	59	15	311	38	33	23	320
Outpatient	33	37	50	22	332	329	44	23	313

¹Mean per 1,000 patients.

²Readmissions with a principal diagnosis judged to be related to the key surgical procedure (includes only diagnoses appearing on more than 1 claim).

³Result based on less than 20 patients.

SOURCE: Health Care Financing Administration, Office of Research and Demonstrations: Data from the Medicaid Tape-to-Tape project.

Table 4

Change in health care utilization and expenditure among noncrossover Medicaid patients in the 6-month periods before and after surgery, by procedure: Georgia, 1981-82

Measure	Procedure											
	Hysterectomy			Oophorectomy and/or salpingectomy			Tonsillectomy			Myringotomy		
	Before	After	Percent change	Before	After	Percent change	Before	After	Percent change	Before	After	Percent change
Patient service	Probability											
Inpatient hospital	.427	.153	-64.2	.351	.108	-69.2	.119	.096	-19.3	.239	1.138	1-42.3
Inpatient surgery	.268	.045	-84.4	.211	.053	-74.9	.034	.029	-14.7	1.092	1.055	1-40.2
Physician	.912	.808	-11.4	.884	.792	-10.4	.957	.758	-20.8	.908	.844	-7.0
Outpatient surgery	.280	.150	-46.4	.143	.094	-34.3	.081	.058	-28.4	1.083	1.083	0.0
Prescription drug	.924	.949	2.7	.842	.786	-6.7	.885	.832	-6.0	.872	.807	-7.5
Utilization	Mean per 1,000 patients											
Inpatient stays	588	209	-64.5	453	144	-68.2	136	114	-16.2	257	1202	1-21.4
Inpatient days	2,862	1,234	-56.9	2,130	822	-61.4	671	423	-37.0	743	1734	1-1.2
Inpatient surgeries	1,141	249	-78.2	690	283	-59.0	140	214	52.9	1385	1587	152.5
Physician visits	7,576	5,698	-24.8	5,692	3,420	-39.9	5,475	3,128	-42.9	5,826	3,908	-32.9
Outpatient surgeries	675	325	-51.9	323	206	-36.2	155	127	-18.1	1183	1248	135.5
Prescriptions	11,935	11,712	-1.9	5,876	5,103	-13.2	5,650	4,481	-20.7	6,431	5,064	-21.3
Expenditure	Mean per patient											
Total ¹	\$1,230	\$712	-42.1	\$962	\$429	-55.4	\$382	\$276	-27.7	\$491	\$577	17.5
Inpatient hospital	628	315	-49.8	579	237	-59.1	139	108	-22.3	169	1287	169.8
Physician in hospital	152	50	-67.1	115	33	-71.3	30	23	-23.3	54	182	151.9
Ambulatory	329	196	-40.4	220	113	-48.6	165	104	-37.0	203	166	-18.2
Prescription drug	102	102	0.0	47	42	-10.6	41	34	-17.1	47	37	-21.3

¹Result based on less than 20 patients.

²Includes long-term care, not shown.

SOURCE: Health Care Financing Administration, Office of Research and Demonstrations: Data from the Medicaid Tape-to-Tape project.

higher in Georgia (27.4 percent) than in Michigan (22.8 percent). Directly comparable figures are not available in the existing literature, but Zook and Moore (1980) report that 19 percent of low-cost users had related readmissions ("repeated hospitalization for the same disease") within 1 year, compared with 73.6 percent of high-cost users. Their results were based on medical records, rather than claims, for a sample of 2,238 patients in 6 Massachusetts hospitals.

Georgia's rankings of the various procedures on percent-related readmissions are within two ranks of Michigan's for all procedures except cesarean section (fourth in Georgia, but seventh in Michigan). The pattern of rankings is somewhat different from that for the overall readmission rate, however. This implies that many of the readmissions observed for some procedures may not really be related to the key surgical procedure. Most notably, cholecystectomy—which ranked first on the overall readmission rate in both States—ranks rather low on related readmissions (fifth in Georgia, sixth in Michigan).

Complications

The overall rate of complications found in inpatient settings (which are probably more serious than those found in outpatient settings) is slightly higher in Michigan (28 per 1,000 patients) than in Georgia (26 per 1,000 patients). The rate of complications found in outpatient settings, on the other hand, is substantially higher in Michigan (33 per 1,000 patients) than in Georgia (22 per 1,000 patients). Michigan's slightly higher rate of

surgical complications diagnosed in inpatient settings, despite its lower rate of inpatient readmissions, suggests that its rate of inpatient complications per readmission would be even higher. The divergence in the results for readmissions and complications may indicate that they are influenced by different sets of factors. Only one previous study (Zook and Moore, 1980) reported overall complication rates for several procedures. Keeping in mind several major methodological differences (e.g., that study used medical records rather than claims), our rates appear to be much lower than those reported for even the low-cost patients (5 percent, or 50 per 1,000 patients) in that study.

As with readmissions, the two States display quite similar patterns across procedures, although most of the figures for Georgia are based on less than 20 patients and must therefore be interpreted with caution. In both States and in both inpatient and outpatient settings, the rate of complications is highest for hysterectomy. The complication rate also tends to be higher than average in both States for cholecystectomy, appendectomy, and cesarean section. Rates noticeably lower than average appear for oophorectomy and/or salpingectomy and tonsillectomy. The figures for herniorrhaphy and myringotomy are also generally much lower than average but are based on less than 20 cases in Michigan as well as in Georgia.

Our complication rates for Michigan (giving a larger number of cases) for three of our selected procedures can be roughly compared with those reported in previous studies. For tonsillectomy, Paradise et al. (1984) reported that 137 per 1,000 patients (13 of 95 children) had surgery-related complications, based on direct followup

Table 5

Change in health care utilization and expenditure among noncrossover Medicaid patients in the 6-month periods before and after surgery, by procedure: Michigan, 1981-82

Measure	Procedure											
	Hysterectomy			Oophorectomy and/or salpingectomy			Tonsillectomy			Myringotomy		
	Before	After	Percent change	Before	After	Percent change	Before	After	Percent change	Before	After	Percent change
Patient service	Probability											
Inpatient hospital	.381	.144	-62.2	.285	.119	-58.2	.104	.064	-38.5	.148	.134	-9.5
Inpatient surgery	.265	.056	-78.9	.161	.038	-76.4	.032	.016	-50.0	1.047	1.054	14.9
Physician	.988	.886	-10.3	.809	.789	-2.5	.985	.830	-15.7	.973	.933	-4.1
Outpatient surgery	.739	.435	-41.1	.625	.454	-27.4	.200	.178	-11.0	.255	.235	-7.8
Prescription drug	.926	.933	0.8	.892	.854	-4.3	.916	.778	-15.1	.906	.792	-12.6
Utilization	Mean per 1,000 patients											
Inpatient stays	510	194	-62.0	398	154	-61.3	128	81	-36.7	302	188	-37.7
Inpatient days	2,643	1,587	-40.0	1,628	995	-36.9	543	295	-45.7	2,846	1,000	-64.9
Inpatient surgeries	331	82	-75.2	224	54	-75.9	45	28	-37.8	1,114	181	-28.9
Physician visits	8,001	5,405	-32.4	4,412	3,798	-13.9	6,321	3,165	-49.9	7,899	5,094	-35.5
Outpatient surgeries	1,805	997	-44.8	1,879	907	-51.7	324	282	-13.0	362	289	-20.2
Prescriptions	12,162	12,039	-1.0	7,447	6,107	-18.0	5,588	3,556	-36.4	6,799	5,154	-24.2
Expenditure	Mean per patient											
Total ²	\$1,541	\$871	-43.5	\$934	\$554	-40.7	\$420	\$246	-41.4	\$1,195	\$521	-56.4
Inpatient hospital	772	438	-43.3	488	294	-39.8	135	83	-38.5	835	254	-69.6
Physician in hospital	127	56	-55.9	67	33	-50.7	22	11	-50.0	62	26	-58.1
Ambulatory	530	248	-53.2	324	173	-46.6	218	119	-45.4	254	202	-20.5
Prescription drug	96	94	-2.1	54	47	-13.0	36	24	-33.3	43	37	-14.0

¹Result based on less than 20 patients.

²Includes long-term care, not shown.

SOURCE: Health Care Financing Administration, Office of Research and Demonstrations: Data from the Medicaid Tape-to-Tape project.

assessment. This is almost six times greater than our claims-based rate of 23 per 1,000. On the other hand, Roos et al. (1985, 1986) used methods more similar to ours to assess the extent of inpatient complications (i.e., those that caused readmission to the hospital) for two of our selected procedures (hysterectomy and cholecystectomy) plus prostatectomy. Aside from the population used (their claims were drawn from the public health insurance system of Manitoba), the chief difference in methodology lies in the list of ICD-9-CM diagnosis codes used to indicate complications (Roos et al., 1985). Theirs was developed by a panel of physicians and included codes that were not explicitly labeled as complications of surgery. On the other hand, their list did not include all of the codes that are so labeled.

For hysterectomy, their computer-coded rate was actually lower than ours—about 40 per 1,000 patients (depending on the year), compared with our rate of 59 per 1,000. For cholecystectomy, their rate was very similar to ours: about 35 per 1,000, compared with our rate of 33 per 1,000 (Roos et al., 1985). This general similarity of results—not only across States, but also across data bases, years, and countries—lends some degree of confidence to the claims-based approach to measuring complications of surgery. That is, even though they tend to be underreported, those complication rates can be used as conservative but stable measures of “sentinel health events” that indicate possible problems of quality of care. The major task would appear to be achieving consensus on an efficient method of identifying specific complication codes to monitor.

Summary

Post-surgical readmissions among Medicaid patients appear to be somewhat more prevalent in Georgia than in Michigan and for the following procedures in both States: cholecystectomy, hysterectomy, appendectomy, and myringotomy. A lower readmission rate is evident for oophorectomy and/or salpingectomy and tonsillectomy. The two States also show quite similar patterns of surgery-related readmissions, although the patterns for individual procedures differ somewhat from those for the overall readmission rate. Finally, Michigan shows higher overall rates of surgical complications than does Georgia, although the difference is smaller for inpatient than outpatient settings. Michigan's slightly higher rate of inpatient complications, despite its lower rate of inpatient readmissions, suggests that its rate of inpatient complications per readmission would be even higher. Nevertheless, the generally stable patterns of complications across States and procedures, and their similarity to those of previous studies, suggest their potential usefulness in future research.

Changes in utilization

In Tables 4 and 5, we present, for selected procedures in Georgia and Michigan, respectively, the changes in levels of health care utilization and expenditure from the 6-month presurgical period to the 6-month post-surgical period. Again, the post-surgical period excludes the utilization and expenditure involved in the surgical

Table 6

Health care utilization and expenditure among noncrossover Medicaid patients in the 6 months after surgery, by patient characteristic: Georgia, 1981-82

Measure	Patient characteristics								
	All patients	Sex		Age		Race ¹		Eligibility ²	
		Male	Female	Low	High	White	Black	AFDC ³	SSI ⁴
Number of patients	3,325	652	2,673	1,644	1,681	1,027	2,239	2,559	744
Percent of total	100.0	19.6	80.4	49.4	50.6	30.9	67.3	77.0	22.4
Patient service					Probability				
Inpatient hospital	.133	.121	.136	.114	.152	.192	.101	.096	.261
Inpatient surgery	.051	.040	.053	.044	.057	.076	.038	.040	.085
Physician	.785	.736	.796	.815	.755	.796	.782	.796	.749
Outpatient surgery	.090	.069	.095	.089	.090	.096	.085	.082	.116
Prescription drug	.829	.758	.847	.791	.867	.896	.795	.801	.925
Utilization				Mean per 1,000 patients					
Inpatient stays	174	161	177	144	203	265	125	114	378
Inpatient days	980	834	1,015	742	1,212	1,528	669	537	2,497
Inpatient surgeries	294	238	308	293	296	446	220	221	544
Physician visits	3,807	3,354	3,918	3,808	3,807	4,927	3,256	3,230	5,839
Outpatient surgeries	192	144	203	162	221	227	172	168	274
Prescriptions	6,761	4,899	7,215	5,083	8,402	9,609	5,283	4,596	14,310
Expenditure				Mean per patient					
Total ⁵	\$528	\$483	\$540	\$426	\$627	\$722	\$413	\$324	\$1,232
Inpatient hospital	260	234	266	221	297	367	195	157	609
Physician in hospital	42	44	42	38	47	67	30	26	100
Ambulatory	135	111	141	123	147	159	122	104	245
Prescription drug	58	43	62	42	73	85	44	37	131
Complications				Mean per 1,000 patients					
Inpatient	26	*25	27	21	31	34	21	21	43
Outpatient	22	*17	23	25	19	28	20	21	*24

¹59 patients (1.8 percent of the total sample) whose race was "other" or "unknown" were excluded.

²22 patients (0.7 percent of the total sample) whose eligibility was "other" were excluded.

³Aid to Families with Dependent Children.

⁴Supplemental Security Income.

⁵Includes long-term care, not shown.

⁶Result based on less than 20 patients.

SOURCE: Health Care Financing Administration, Office of Research and Demonstrations: Data from the Medicaid Tape-to-Tape project.

hospital stay itself. The four procedures selected for this analysis (hysterectomy, oophorectomy and/or salpingectomy, tonsillectomy, and myringotomy) are those in which surgery is less often done on an urgent or emergency basis. Rather, they are usually intended to reduce the patient's need for ongoing health care. The four procedures excluded from this analysis (cesarean section, herniorrhaphy, appendectomy, and cholecystectomy) are usually performed to resolve an acute episode, rather than to reduce the patient's ongoing level of health care utilization.

The most general basis for comparing the specific surgical procedures in Tables 4 and 5 is to examine the change in total expenditure from the presurgical period to the post-surgical period. By that standard, the largest reduction occurs for myringotomy (-56 percent) in Michigan and for oophorectomy and/or salpingectomy (-55 percent) in Georgia. In Michigan, all three of the other procedures show remarkably similar reductions of slightly more than 40 percent: hysterectomy (-44 percent), tonsillectomy (-41 percent), and oophorectomy and/or salpingectomy (-41 percent). The results for Georgia are far more varied. Although that State's figure for hysterectomy (-42 percent) is almost identical to Michigan's, the figure for tonsillectomy

(-28 percent) is much lower, and myringotomy actually produces an overall increase in total expenditure in Georgia (+18 percent). To ascertain the sources of these variations, let us examine the pattern of differences among procedures for each type of service.

In both States, hysterectomy and oophorectomy and/or salpingectomy tend to rank first or second among the four procedures in terms of percentage reduction in most of the measures of health care utilization and expenditure, with particularly large reductions in the inpatient categories. The only exception is prescription drugs, where hysterectomy actually shows an increase, probably reflecting the use of post-surgical hormone therapy. Tonsillectomy usually ranks third or fourth in percentage reduction in most categories, with physician (outpatient) services being the major exception in both States, plus prescription drugs in Michigan. Myringotomy shows the most divergent patterns in the two States. In Georgia, it usually ranks lowest (including actual increases rather than reductions in inpatient expenditures and most of the surgery measures), except on prescription drugs, where it produces the largest reduction on all three measures (probability, utilization, and expenditure). In Michigan, although myringotomy ranks first or second on most utilization and expenditure measures, it shows the lowest

Table 7

Health care utilization and expenditure among noncrossover Medicaid patients in the 6 months after surgery, by patient characteristic: Michigan, 1981-82

Measure	Patient characteristics									
	All patients	Sex		Age		Race ¹		Eligibility ²		
		Male	Female	Low	High	White	Black	AFDC ³	SSI ⁴	
Number of patients	9,255	1,450	7,805	4,551	4,704	5,888	2,993	8,501	589	
Percent of total	100.0	15.7	84.3	49.2	50.8	63.6	32.3	91.9	6.4	
Patient service										
				Probability						
Inpatient hospital	.121	.090	.127	.112	.130	.114	.138	.111	.268	
Inpatient surgery	.043	.032	.045	.041	.045	.041	.048	.039	.100	
Physician	.835	.815	.839	.831	.839	.827	.853	.833	.900	
Outpatient surgery	.422	.183	.467	.412	.432	.403	.463	.430	.334	
Prescription drug	.860	.738	.883	.849	.871	.862	.861	.857	.920	
Utilization				Mean per 1,000 patients						
Inpatient stays	160	132	165	147	173	154	178	139	467	
Inpatient days	1,104	783	1,164	978	1,226	952	1,370	862	4,492	
Inpatient surgeries	65	47	68	59	70	58	78	56	189	
Physician visits	4,096	3,389	4,227	3,950	4,238	3,852	4,613	3,898	7,080	
Outpatient surgeries	809	295	904	776	840	741	954	821	685	
Prescriptions	6,799	3,783	7,359	6,059	7,515	6,302	7,874	6,113	16,888	
Expenditure				Mean per patient						
Total ⁵	\$601	\$439	\$621	\$545	\$654	\$519	\$739	\$497	\$2,078	
Inpatient hospital	310	224	326	283	336	255	393	238	1,344	
Physician in hospital	36	25	38	33	38	34	39	29	129	
Ambulatory	188	128	199	177	198	167	230	179	322	
Prescription drug	53	29	57	46	59	49	61	46	144	
Complications				Mean per 1,000 patients						
Inpatient	28	27	28	25	30	30	23	25	63	
Outpatient	33	26	34	30	36	36	28	31	42	

¹374 patients (4.0 percent of the total sample) whose race was "other" or "unknown" were excluded.

²165 patients (1.8 percent of the total sample) whose eligibility was "other" were excluded.

³Aid to Families with Dependent Children.

⁴Supplemental Security Income.

⁵Includes long-term care, not shown.

SOURCE: Health Care Financing Administration, Office of Research and Demonstrations: Data from the Medicaid Tape-to-Tape project.

reductions in probability of use for all services but prescription drugs.

In summary, the results demonstrate substantial reductions in most measures of health care utilization and expenditure following all four of the selected surgical procedures in both States, with the single exception of myringotomy in Georgia. It is conceivable that myringotomy is more susceptible to geographic variations in outcomes as well as incidence. This could arise from greater uncertainty among physicians not only about appropriate use of that procedure (Wennberg, Barnes, and Zubkoff, 1982) but also about its proper execution and followup care. Nevertheless, the overall pattern of decline in utilization suggests that these four surgical procedures are generally effective in reducing health care use and cost among Medicaid recipients in these two States.

Factors in surgical outcomes

In the remaining tables, we compare various dichotomized characteristics of the entire sample of surgical cases in each State in terms of their utilization, expenditure, and complications during the post-surgical period. Unfortunately, the small size of the sample, particularly in Georgia, precluded similar breakdowns by these characteristics within each selected surgical procedure. The results for Georgia are presented in

Tables 4, 6, 8, and 10 and for Michigan in Tables 5, 7, 9, and 11. In all of the tables, cases classified in lesser categories (i.e., missing data or "other") on a given characteristic are excluded. The same measures of utilization and expenditure employed in Tables 4 and 5 are also used in these tables. Let us again emphasize that the purpose of this analysis is to explore some factors associated with surgical outcomes, not to draw definitive inferences about such factors or to explain variations in those outcomes.

Patient characteristics

Tables 6 and 7 (Georgia and Michigan, respectively) stratify the measures of post-surgical utilization, expenditure, and complications by various categories of patient characteristics: sex, age, race, and Medicaid eligibility. (Recall that age is dichotomized on a procedure-specific basis.) As might be expected, on virtually all measures in both States, utilization and expenditures are higher among females, older patients, and enrollees eligible through Supplemental Security Income (SSI) rather than Aid to Families with Dependent Children (AFDC). There are some notable exceptions to this pattern, however. In Georgia, younger patients have a higher probability of using physician services (as do AFDC recipients) and suffer more outpatient-based

Table 8

Health care utilization and expenditure among noncrossover Medicaid patients in the 6 months after surgery, by level of prior utilization: Georgia, 1981-82

Measure	All patients	Level of prior utilization							
		Number of inpatient days		Number of surgeries		Number of ambulatory visits		Number of prescriptions	
		None	1 or more	None	1 or more	Less than 6	6 or more	Less than 6	6 or more
Number of patients	3,325	2,469	856	2,918	407	2,299	1,026	2,146	1,179
Percent of total	100.0	74.3	25.7	87.8	12.2	69.1	30.9	64.5	35.5
Patient service					Probability				
Inpatient hospital	.133	.107	.209	.124	.199	.114	.176	.096	.201
Inpatient surgery	.051	.043	.074	.045	.091	.046	.060	.038	.074
Physician	.785	.768	.833	.776	.845	.723	.923	.746	.856
Outpatient surgery	.090	.077	.125	.083	.140	.080	.112	.072	.121
Prescription drug	.829	.810	.886	.824	.870	.800	.904	.755	.965
Utilization					Mean per 1,000 patients				
Inpatient stays	174	126	312	158	287	138	254	114	284
Inpatient days	980	632	1,982	863	1,821	775	1,440	562	1,740
Inpatient surgeries	294	251	418	258	555	252	389	200	466
Physician visits	3,807	3,360	5,098	3,620	5,150	2,368	7,032	2,635	5,941
Outpatient surgeries	192	169	256	180	273	170	241	155	258
Prescriptions	6,761	5,588	10,144	6,389	9,430	5,227	10,197	3,125	13,378
Expenditure					Mean per patient				
Total ¹	\$528	\$401	\$897	\$480	\$874	\$414	\$784	\$316	\$916
Inpatient hospital	260	178	497	227	494	205	383	164	435
Physician in hospital	42	30	77	37	84	32	66	26	72
Ambulatory	135	117	189	128	186	95	225	96	207
Prescription drug	58	47	89	54	84	44	88	25	117
Complications					Mean per 1,000 patients				
Inpatient	26	23	35	24	244	21	37	20	37
Outpatient	22	21	25	21	229	19	28	20	25

¹Includes long-term care, not shown.

²Result based on less than 20 patients.

SOURCE: Health Care Financing Administration, Office of Research and Demonstrations: Data from the Medicaid Tape-to-Tape project.

complications, and they score about the same as older patients on several outpatient measures. In Michigan, AFDC recipients score higher on both measures of outpatient surgery.

Perhaps the most noteworthy finding emerging from Tables 6 and 7 is the opposite racial pattern in the two States. In Georgia, white patients consistently show higher levels of utilization and expenditure than do black patients, whereas in Michigan, the pattern is exactly opposite. Similar contrasting patterns of racial differences in overall utilization and expenditure between the South and North Central Regions have been observed in Medicare data (Ruther and Dobson, 1981) and National Health Interview Survey data (Link, Long, and Settle, 1982). These patterns have usually been attributed to greater problems of access to health care for black patients and to less generous Medicaid programs in the South. On the other hand, the rate of surgical complications is higher among white patients in both States, and it is higher overall in Michigan than in Georgia.

Prior utilization

Tables 8 and 9 compare post-surgical outcomes by dichotomized levels of presurgical utilization: inpatient days of care (none versus 1 or more), inpatient surgeries

(none versus 1 or more), ambulatory visits (less than 6 versus 6 or more), and drug prescriptions (less than 6 versus 6 or more). Even more consistently than the results by patient characteristics, recipients with high levels of pre-period utilization show higher levels of post-period utilization, expenditure, and complications. Indeed, neither State produces a single exception to this pattern on any measure. Moreover, the differences between high users and low users are often quite large. This finding fits the pattern of overall stability in individual health care utilization reported in most previous research (Anderson and Steinberg, 1984), demonstrating that patients who were sicker prior to surgery are likely to remain sicker after surgery.

Key-stay characteristics

Tables 10 and 11 stratify the measures of surgical outcomes by dichotomized characteristics of the key (surgical) hospital stay: length of stay, hospital payment, and physician payment. Again, quite consistently in both States, patients whose key stay was above average on these three measures tend to show much higher levels of post-surgical utilization, expenditure, and complications. Indeed, only one exception to this pattern emerges: In Georgia, the rate of post-period inpatient surgery is about the same in both categories of physician payment. As

Table 9

Health care utilization and expenditure among noncrossover Medicaid patients in the 6 months after surgery, by level of prior utilization: Michigan, 1981-82

Measure	All patients	Level of prior utilization							
		Number of inpatient days		Number of surgeries		Number of ambulatory visits		Number of prescriptions	
		None	1 or more	None	1 or more	Less than 6	6 or more	Less than 6	6 or more
Number of patients	9,255	6,991	2,264	8,208	1,047	6,805	2,450	5,863	3,392
Percent of total	100.0	75.5	24.5	88.7	11.3	73.5	26.5	63.3	36.7
Patient service					Probability				
Inpatient hospital	.121	.101	.185	.112	.190	.106	.163	.094	.169
Inpatient surgery	.043	.034	.069	.038	.082	.037	.060	.032	.062
Physician	.835	.821	.881	.830	.877	.795	.949	.789	.915
Outpatient surgery	.422	.398	.498	.410	.518	.416	.439	.380	.495
Prescription drug	.860	.841	.918	.853	.919	.836	.926	.803	.959
Utilization					Mean per 1,000 patients				
Inpatient stays	160	118	289	145	279	135	228	115	238
Inpatient days	1,104	741	2,226	955	2,272	930	1,586	719	1,769
Inpatient surgeries	65	48	118	55	142	56	91	44	101
Physician visits	4,096	3,646	5,486	3,896	5,663	3,072	6,938	2,980	6,024
Outpatient surgeries	809	732	1,048	757	1,218	720	1,056	646	1,091
Prescriptions	6,799	5,804	9,869	6,333	10,451	5,094	11,533	3,736	12,093
Expenditure					Mean per patient				
Total ¹	\$601	\$454	\$1,050	\$485	\$818	\$454	\$945	\$404	\$937
Inpatient hospital	310	206	630	261	696	269	423	205	491
Physician in hospital	36	25	69	30	80	29	56	23	57
Ambulatory	188	164	259	176	275	144	309	138	273
Prescription drug	53	45	77	49	82	39	89	28	95
Complications					Mean per 1,000 patients				
Inpatient	28	25	35	26	37	27	28	24	35
Outpatient	33	29	45	31	50	29	44	28	41

¹Includes long-term care, not shown.

SOURCE: Health Care Financing Administration, Office of Research and Demonstrations: Data from the Medicaid Tape-to-Tape project.

with prior utilization, patients requiring more extensive and/or intensive care during the key hospital stay generally require more post-surgical care as well. It should be pointed out, however, that the characteristics of the key stay may, to some extent, reflect the influence of complications arising from the surgery. Nevertheless, throughout Tables 6 through 11, the rate of surgical complications shows quite stable and consistent patterns in both States, with higher figures appearing in patient categories that also show higher levels of post-surgical utilization and expenditure. As noted, the major exception is for race in Michigan.

Summary

Some rather strong and consistent patterns characterize the factors underlying surgical outcomes. On almost all measures in both States, post-surgical levels of utilization, expenditure, and complications are higher among females, older patients, and enrollees eligible through SSI rather than AFDC. Without exception, moreover, those levels are higher among patients with higher levels of presurgical utilization and among patients whose key (surgical) hospital stay was above average in length of stay, hospital payment, and physician payment. On the other hand, the two States do show opposite racial patterns of post-surgical levels of utilization and expenditure, with white patients consistently higher than

black patients in Georgia, but the reverse in Michigan. The rate of surgical complications, however, is higher among white patients in both States.

Conclusion

In this study, we examined outcomes of surgery among all Medicaid recipients in Michigan and Georgia who underwent selected surgical procedures between July 1, 1981, and June 30, 1982. Outcomes were measured during the 6-month period following surgery using the following indicators: rate of inpatient hospital readmission, percentage of such readmissions related to the key surgical procedure, rate of surgical complications, and extent of post-surgical utilization of and expenditure for various kinds of health services. Readmissions appeared to be somewhat more prevalent in Georgia than in Michigan and for hysterectomy, cholecystectomy, appendectomy, and myringotomy in both States. On the other hand, Michigan showed higher overall rates of surgical complications than did Georgia, although the difference was smaller for inpatient than outpatient settings. Michigan's slightly higher rate of inpatient complications, despite its lower rate of inpatient readmissions, suggests that its rate of inpatient complications per readmission would be even higher. The divergence in the results for readmissions and

Table 10

Health care utilization and expenditure among noncrossover Medicaid patients in the 6 months after surgery, by characteristics of the key hospital stay: Georgia, 1981-82

Measure	Characteristics of the key hospital stay						
	All patients	Length of stay		Hospital payment ¹		Physician payment ²	
		Less than average	Average or more	Less than average	Average or more	Less than average	Average or more
Number of patients	3,325	1,791	1,534	1,944	1,355	1,348	1,677
Percent of total	100.0	53.9	46.1	58.5	40.8	40.5	50.4
Patient service				Probability			
Inpatient hospital	.133	.095	.177	.098	.185	.119	.144
Inpatient surgery	.051	.038	.065	.035	.073	.052	.055
Physician	.785	.765	.807	.761	.819	.769	.835
Outpatient surgery	.090	.070	.113	.081	.102	.068	.115
Prescription drug	.829	.779	.889	.799	.873	.813	.857
Utilization				Mean per 1,000 patients			
Inpatient stays	174	117	241	123	249	151	194
Inpatient days	980	487	1,555	549	1,608	772	1,122
Inpatient surgeries	294	246	350	228	386	320	318
Physician visits	3,807	3,266	4,439	3,471	4,299	3,702	4,248
Outpatient surgeries	192	158	231	178	213	121	261
Prescriptions	6,761	4,658	9,216	5,368	8,745	5,255	7,821
Expenditure				Mean per patient			
Total ³	\$528	\$337	\$751	\$360	\$777	\$426	\$611
Inpatient hospital	260	139	400	141	435	209	306
Physician in hospital	42	27	60	27	64	37	51
Ambulatory	135	112	163	117	163	126	154
Prescription drug	58	38	81	44	78	43	69
Complications				Mean per 1,000 patients			
Inpatient	26	12	43	14	44	18	36
Outpatient	22	17	27	15	32	16	27

¹26 patients (0.8 percent of the total sample) whose hospital payment was unknown were excluded.

²300 patients (9.0 percent of the total sample) whose physician payment was unknown were excluded.

³Includes long-term care, not shown.

SOURCE: Health Care Financing Administration, Office of Research and Demonstrations: Data from the Medicaid Tape-to-Tape project.

complications may indicate that they are influenced by different sets of factors.

Changes in health care utilization and expenditure from the 6-month period preceding surgery to the 6-month period following surgery were analyzed using four procedures (hysterectomy, oophorectomy and/or salpingectomy, tonsillectomy, and myringotomy). These procedures are not usually performed on an urgent or emergency basis, but rather are intended to reduce the patient's need for ongoing health care. The results showed substantial reductions in most utilization and expenditure measures following all four of the selected procedures in both States, with the single exception of myringotomy in Georgia. This pattern suggests that these four surgical procedures were generally effective in reducing health care use and cost among Medicaid recipients in these two States.

On almost all measures in both States, levels of post-surgical utilization, expenditure, and complications were higher among females, older patients, enrollees eligible through SSI rather than AFDC, patients with higher levels of presurgical utilization and expenditure, and patients whose key (surgical) hospital stay was above average in length of stay, hospital payment, or physician payment. The two States produced opposite racial patterns, however, with white patients showing consistently higher levels than black patients in Georgia,

but the reverse in Michigan. The rate of surgical complications, on the other hand, was higher among white patients in both States.

In terms of methodology, the results further demonstrate the utility of claims data in monitoring outcomes of surgery and inpatient hospital care more generally. In particular, analyzing changes in utilization following surgical procedures designed to reduce utilization (e.g., tonsillectomy) appears to be a promising approach. Also, the stability and consistency of our measure of surgical complications across States and procedures, and its adherence to expected patterns across patient categories, make it worthy of further exploration. Even though it captures only those diagnoses explicitly identified as complications of surgery in the ICD-9-CM coding system, it may ultimately prove useful in quality-monitoring activities as a preliminary screen in selecting cases for more intensive investigation.

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Table 11

Health care utilization and expenditure among noncrossover Medicaid patients in the 6 months after surgery, by characteristics of the key hospital stay: Michigan, 1981-82

Measure	Characteristics of the key hospital stay						
	All patients	Length of stay ¹		Hospital payment ²		Physician payment ³	
		Less than average	Average or more	Less than average	Average or more	Less than average	Average or more
Number of patients	9,255	4,985	4,251	4,590	4,620	4,621	4,343
Percent of total	100.0	53.9	45.9	49.6	50.0	49.9	46.9
Patient service				Probability			
Inpatient hospital	.121	.090	.158	.084	.159	.099	.145
Inpatient surgery	.043	.030	.058	.028	.058	.033	.054
Physician	.835	.811	.864	.815	.858	.815	.862
Outpatient surgery	.422	.354	.501	.317	.529	.339	.508
Prescription drug	.860	.812	.916	.817	.905	.817	.906
Utilization				Mean per 1,000 patients			
Inpatient stays	160	116	211	106	214	125	194
Inpatient days	1,104	591	1,701	571	1,631	769	1,429
Inpatient surgeries	65	42	92	36	94	49	82
Physician visits	4,096	3,427	4,878	3,481	4,728	3,616	4,644
Outpatient surgeries	809	618	1,032	561	1,061	617	1,009
Prescriptions	6,799	4,726	9,220	4,896	8,710	5,160	8,468
Expenditure				Mean per patient			
Total ⁴	\$601	\$377	\$859	\$364	\$838	\$464	\$870
Inpatient hospital	310	170	473	161	460	220	396
Physician in hospital	36	21	53	21	51	25	47
Ambulatory	188	146	236	141	235	159	219
Prescription drug	53	35	73	36	69	39	67
Complications				Mean per 1,000 patients			
Inpatient	28	18	39	19	36	19	36
Outpatient	33	25	41	29	37	26	41

¹19 patients (0.2 percent of the total sample) whose length of stay was unknown were excluded.
²45 patients (0.5 percent of the total sample) whose hospital payment was unknown were excluded.
³291 patients (3.1 percent of the total sample) whose physician payment was unknown were excluded.
⁴Includes long-term care, not shown.

SOURCE: Health Care Financing Administration, Office of Research and Demonstrations: Data from the Medicaid Tape-to-Tape project.

Jerry Riley of the Health Care Financing Administration; and the editor and two anonymous reviewers for this journal.

Technical note

Time periods

Post-surgical period

The time periods employed in this study center around the "key" (or "index") inpatient stay for each patient, i.e., the stay that involved one of the selected surgical procedures (Table 1). Patients who had more than one of the selected surgical procedures were excluded from the analysis in order to avoid analytical complications that would arise from duplicating their characteristics in the analysis file. More is said about the selection of episodes in a later section. The post-surgical period used in this study extends from the date of discharge from the key stay through the 180th day following admission to that stay. Each patient is thus monitored over a uniform period of 6 months following the date of surgical admission—not the date of actual surgery (principal procedure date), for reasons given in this section.

Except for the frequency count of surgical complications, all health care utilization and expenditures

occurring during the key stay itself are excluded from the measures representing the post-surgical period. These key-stay characteristics (number of days, amount of expenditure, etc.) are instead treated as predictors of post-discharge outcomes, because they more truly reflect what went into the surgery than what came out of it. To be sure, that utilization is part of the total package of health care consumed by the patient as part of the entire episode of illness involving the surgical procedure and its subsequent effects. The focus of this study, however, is on those later outcomes, which are influenced in part by the nature of the health care rendered during the key stay. Of course, the characteristics of the key stay may, to some extent, reflect the influence of complications arising from the surgery.

Moreover, the admission date, rather than the date of surgery, is used to anchor the 6-month ending date of the post-surgical period so that all of the key-stay utilization and expenditure can be kept intact, rather than having to allocate it somewhat arbitrarily into the presurgical and post-surgical periods. This means that some presurgical services rendered during the key stay, but which may not have been directly related to the surgery itself, are included in the attributes of that stay. Such services are usually not very extensive, however. Surgery tends to occur soon after admission, and most diagnostic and

ancillary services rendered between admission and surgery are actually preparatory to surgery. Moreover, because it is not required for Medicaid reimbursement, the date of surgery tends to be less reliable than the admission date in the Tape-to-Tape data. Finally, using date of admission to commence measuring outcomes tends to correct for variations in discharge practices.

Presurgical period

The patient's levels of health care utilization during the 6-month period preceding the admission date of the key hospital stay are also included in the analysis. For surgical procedures that are more elective in nature, the percentage change in levels of utilization from the presurgical period to the post-surgical period is a potentially useful outcome measure. For example, tonsillectomy is intended to reduce the frequency and severity of throat infections. One method of assessing the extent to which it does so is to compare levels of health care utilization before and after surgery. On the other hand, such procedures as appendectomy are usually performed to alleviate an acute episode, so that the patient's post-surgical levels of utilization would be expected to return to presurgical levels. Most previous research suggests that the general stability of individual patterns of health care consumption makes prior levels of utilization reliable predictors of subsequent levels. Thus, when comparing levels of post-surgical utilization among different types of patients, presurgical utilization levels should be controlled in the analysis.

Selection of episodes

This study uses only those patients whose key hospital stay occurred in the period from July 1981 through June 1982. This permits a full 6-month post-surgical period ending as late as December 1982 (for patients admitted to the hospital in June 1982) and a full 6-month presurgical period beginning as early as January 1981 (for patients admitted to the hospital in July 1981). It therefore requires the use of only the 1981 and 1982 Tape-to-Tape files and keeps the study period short enough to minimize the effects of the rapid changes in State Medicaid programs taking place in the early 1980s.

Furthermore, the analysis uses only those patients continuously enrolled in Medicaid during an entire 12-month episode. Recipients who were not continuously enrolled may well have consumed health care services not captured in the Tape-to-Tape data base during their periods of nonenrollment. This could seriously bias the results of the analysis by underrepresenting the overall levels of health care utilization and expenditure. Unfortunately, excluding such patients means that medically needy recipients who enrolled in Medicaid shortly before, or even during, a surgical hospital stay are not represented in the study population.

Measures

In addition to nonhospital services, the utilization and expenditure measures used in this study include summary characteristics of any non-key hospital stays that occurred in either the presurgical period or the post-surgical period. Non-key stays are those not involving one of the

selected surgical procedures, even though they could well be clinically related to that patient's key procedure. The characteristics of those non-key stays include the number of stays, the number of days of care, the number of inpatient surgeries, the amount of expenditure (Medicaid amount paid), and (for post-surgical stays only) the frequency of surgical complications (Table 1) involved in those stays.

To ascertain which of a patient's post-surgical inpatient stays were related to the key surgical procedure, a senior medical records specialist classified as "related" or "unrelated" (to the key procedure) all principal diagnoses recorded during at least two post-surgical inpatient stays (thereby eliminating diagnoses appearing in only one isolated instance). Again, the key (surgical) stay itself was excluded from these tabulations. The percentage of such stays with a principal diagnosis judged to be related to the key surgical procedure thus serves as an additional measure of surgical outcome. Put differently, it represents the percentage of inpatient hospital readmissions that can be considered related to the key surgical procedure.

In addition to utilization and expenditure measures, each Tape-to-Tape claim record also contains certain basic information about the patient involved in that claim. These indicators, including the patient's sex, age, race, and eligibility group (Supplemental Security Income versus Aid to Families with Dependent Children), are used here as potential predictors of surgical outcomes. Month-by-month enrollment status (to check for continuity of enrollment throughout a 12-month episode) and any patient background data not available in the claim records were drawn from the Tape-to-Tape enrollment file. For purposes of crosstabulation analysis, the quantitative independent variables (length of stay, etc.) were dichotomized at the median. Patient age groups were tailored to each surgical procedure by dichotomizing at the age suggested by a senior medical records specialist as being about average for patients undergoing that procedure.

The dependent variables are standard measures of health care utilization and expenditure in the post-surgical period: the probability of use of (i.e., the proportion of patients using) various types of health services (e.g., inpatient hospital); the level of utilization of those services (e.g., mean number of inpatient days per 1,000 patients); and the level of expenditure for those services (e.g., mean amount paid per patient for inpatient hospital care). When measured for the presurgical period, these same variables serve as predictors of their counterparts in the post-surgical period. Of particular interest among these standard dependent variables is the mean number of post-surgical hospital stays (i.e., readmissions).

Also serving as a dependent variable (i.e., for the post-surgical period only) is the rate of surgical complications (mean number per 1,000 patients), as listed in Table 2. A final dependent variable is the percentage of post-surgical inpatient hospital stays (i.e., readmissions) with a principal diagnosis judged to be related to the key surgical procedure. (Only diagnoses appearing on more than one such claim are included.)

The nature of the measures of outpatient (ambulatory) care requires further elaboration. The Tape-to-Tape "outpatient" claims file contains not only claims for outpatient hospital, clinic, laboratory, X-ray, and other ambulatory services. It also contains claims for physician

and other nondental practitioner services (hereafter referred to simply as physician services) rendered in any setting, including an inpatient hospital. Such services can involve surgery or other procedures, no matter how minor. In this study, outpatient (ambulatory) utilization is measured by the number of physician visits in settings other than an inpatient hospital: physician's office, hospital outpatient department or emergency room, freestanding clinic, nursing home, or patient's home.

Physician claims for inpatient services (including surgery) were identified by matching the outpatient claims file to the inpatient claims file by dates of service and were placed in a separate file. Simultaneously, expenditures (Medicaid payments) for physician services rendered in a hospital were also separated from all other expenditures for ambulatory care. Similarly, surgical procedures (excluding claims from anesthesiologists and physician assistants) were separated into inpatient and outpatient surgeries. However, even more so than in the inpatient category, outpatient "surgery" includes many kinds of intrusive diagnostic and palliative procedures, as well as actual therapeutic operations, no matter how minor. The frequency count of surgical complications is also broken down into inpatient and outpatient settings. Finally, the measures of "prescription drug" utilization and expenditure used in this study cover only medicines obtained by prescription or over the counter. They do not include drugs "bundled in" with hospital or nursing home bills. Fortunately, bundling was not extensively practiced in either State during 1981-82.

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