Outcomes of surgery in the Medicare aged population: Rehospitalization after surgery

by Gerald Riley and James Lubitz

Using 1979 and 1980 data, rehospitalization rates following eight common surgical procedures are examined for aged Medicare beneficiaries. Rehospitalization rates within 30 days after discharge from the surgical stay varied considerably among procedures and were higher for older beneficiaries. Patients residing in the Northeast had the lowest rates of rehospitalization, although their rehospitalizations tended to be lengthier than those elsewhere. Rehospitalization rates were also tracked for 9 months following discharge from the surgical stay. For all procedures, rehospitalization rates decreased during the 9 months after discharge, but they remained above the prevailing hospitalization rate for the Medicare aged population for the entire 9 months. Principal diagnoses associated with rehospitalizations within 30 days were often related to the body system on which surgery was initially performed, suggesting that many rehospitalizations are for continuing problems related to the initial condition that necessitated surgery.

Rehospitalization rates presented in this article will serve as baseline data for monitoring trends under Medicare's prospective payment system for hospitals.

Introduction and background

Presented in this article are findings from the third study of outcomes for several common surgical procedures performed on aged Medicare beneficiaries. In the first study, post-surgical mortality rates in the hospital and up to 12 months following surgery were examined (Lubitz, Riley, and Newton, 1985). Age- and sex-specific mortality rates were presented, as well as mortality rates by census region. It was found that mortality rates for several procedures were significantly lower in the West; it was also found that nationally mortality for some procedures was above the prevailing rate for the Medicare aged population for up to a year after surgery. In the second study, the relationship between mortality and surgical volume in individual hospitals was examined (Riley and Lubitz, 1985). From that study, it was concluded that for some procedures lower mortality rates were associated with increased surgical volume. In this article, based on the third study, we look at rehospitalizations (also referred to as readmissions) following the same set of procedures studied previously.

Rehospitalization after surgery is an important aspect of the overall patterns of care provided to surgical patients. Readmission to the hospital can occur for treatment of a variety of conditions, including post-surgical complications, comorbid conditions, and the effects of nosocomial infections or other problems related to the initial hospital stay. Readmission may also be necessary to perform additional procedures that the patient was unable to undergo during the initial stay. Of course, the reason for readmission may also be unrelated to the original surgery. To the extent that readmissions are related to avoidable complications arising from the initial surgical stay, readmissions are a measure of post-surgical outcome.

Variations and trends in patterns of rehospitalization can also provide insights into underlying uncertainties in medical practice, as well as into responses to financial incentives facing physicians and hospitals. In particular, patterns of rehospitalization among aged Medicare surgical patients are of interest now because of the implementation of prospective payment to hospitals under Medicare. Prospective payment is expected to produce financial incentives that may radically change patterns of hospitalization, including readmissions. For example, hospitals have an incentive to discharge patients as early as possible because the hospital receives a fixed amount regardless of the length of stay of a particular case. This may result in some patients being discharged prematurely, with a subsequent need to return to the hospital. It has been anticipated that hospitals may "unbundle" services under prospective payment, i.e., admit a patient twice to perform two procedures that normally could be performed during one stay. To date, there has been no evidence of an increase in hospital admissions under prospective payment, however (Health Care Financing Administration, 1985).

Rehospitalizations are of general interest because patients experiencing multiple admissions account for a large portion of hospital expenditures (Anderson and Steinberg, 1984; Zook et al., 1980). Anderson and Steinberg (1984) estimated that, between 1974 and 1977, 24 percent of Medicare inpatient hospital expenditures were attributable to readmissions that occurred within 60 days after a discharge. They also found that readmission rates within 60 days after discharge did not vary with age among beneficiaries over 65 years of age, and that the probability of readmission was higher for males, beneficiaries living

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in rural areas, Medicaid-eligible beneficiaries, and beneficiaries undergoing surgery.

Guralnick and Resnic (1974) investigated multiple short-stay hospitalizations among Medicare beneficiaries in 1967. They found that one-fourth of all hospitalized persons were discharged from a short-stay hospital more than once in the year, and that 46 percent of discharges were attributable to those persons hospitalized more than once. They also found that the probability of multiple hospitalizations was higher for males than for females, and that the risk of multiple hospitalizations, given that one hospitalization had already occurred, rose with age, though the rise was slight.

Gornick (1977) described the rehospitalization experience of a sample of discharged patients in 1972-73, including both medical and surgical discharges. She found that a large number of readmissions occurred within 21 days after discharge (24.7 percent of readmissions during 1972-73 occurred within 21 days after a prior discharge), and that a significant number occurred on the same day as discharge (3.6 percent of readmissions). She also found considerable regional variation in hospitalization rates, and she noted that States with high hospitalization rates also had high rates of multiple hospitalizations. Regional rates of rehospitalization following selected procedures are provided in this article.

Characteristics (age and sex) of the beneficiaries who experience rehospitalization following specific kinds of surgery and the types of diganoses and procedures associated with their subsequent stays will be described here. Patterns of rehospitalization for aged Medicare beneficiaries who have undergone the following surgical procedures were examined in this study:

- Transurethral prostatectomy (TUR).
  - Those with a principal diagnosis of cancer.
  - Those with a principal diagnosis other than cancer.
- Cholecystectomy.
- Repair of inguinal hernia.
- Coronary artery bypass.
- Reduction of fracture of the femur.[1]
- Total hip replacement.
- Other arthroplasty of the hip.

These procedures were selected for the study because (with the exception of coronary artery bypass) they are among the most frequently performed on the aged. In 1980, hospital discharges for these operations comprised 14 percent of the 3.1 million total surgical discharges among the 26.5 million aged persons in the United States enrolled under Part A (Hospital Insurance) of Medicare.

Rehospitalization rates are contrasted for different age and sex groups and regions of the country. Rehospitalization data are also provided for various time periods following the surgical stay.

Data and methods

The data sources for this study are the 1979, 1980, and 1981 Medicare provider analysis and review (MEDPAR) files, which are part of the Medicare Statistical System of the Health Care Financing Administration. The annual MEDPAR files contain information on discharges from short-stay hospitals for a 20-percent probability sample of Medicare beneficiaries selected on the basis of their Medicare identification numbers. The information includes demographic data (e.g., age and sex), hospital data (e.g., size and location), and information about the stay (e.g., principal surgical procedure, principal diagnosis, and whether the patient died in the hospital). In 1979-81, the principal surgical procedure and principal diagnosis were coded for each discharge using the International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM).

The hospital discharge is the unit of analysis for this study. Discharges of aged beneficiaries occurring in 1979 and 1980 with the appropriate ICD-9-CM procedure codes were selected and pooled across both years. Information on up to four subsequent hospitalizations within a year of surgery was obtained from the MEDPAR file and appended to the record for the index case. If an individual underwent more than one hospitalization for study procedures during 1979-80, each discharge was included as a separate observation. Cases with a principal diagnosis of cancer for the stay in which the study procedure was performed were excluded from the sample because there were very few patients with a principal diagnosis of cancer, and it was assumed that rehospitalization rates for cancer patients would be determined to a large extent by their disease and would be less influenced by their operations per se. Cancer patients were included among the transurethral prostatectomy patients, however, because of their larger numbers (17 percent of all TUR discharges); and they are reported separately in the tables. This group will be referred to as prostatectomy (TUR-CA) in the text.

All rehospitalizations were included in the analysis, regardless of the reason for them. In the case of total hip replacement, this means that some of the rehospitalizations included in the tables are for replacement of the second hip. Among total hip replacement patients, 5 percent of the rehospitalizations occurring within 30 days after discharge had another total hip replacement recorded as the principal surgical procedure on the MEDPAR bill.

An important potential limitation of the data concerns the reliability of diagnostic and procedure data in the Medicare Statistical System. The Institute of Medicine (IOM) (1979) compared diagnostic and surgical information on the Medicare record with that

[1] Although the surgical codes contained in the *International Classification of Diseases, 9th Revision, Clinical Modification* (ICD-9-CM) do not identify the specific part of the femur that is fractured, the majority of breaks for elderly patients occur at the neck of the femur. In this study, over 90 percent of patients with a principal diagnosis of a fractured femur had a fracture of the neck of the femur.

obtained by a trained field team that reabstracted hospital records for a sample of Medicare patients. Discrepancies were found for many diagnoses and procedures. There was a discrepancy between the IOM abstract and the Medicare record regarding the procedure in 21 percent of the cases reviewed. The 21-percent disagreement rate included disagreements about whether or not a procedure was performed and also about the nature of the principal procedure. In 43 percent of the cases in which Medicare records indicated a procedure was performed, there was a disagreement between the Medicare record and the IOM record on what the correct code was. Most of the discrepancies were caused by incomplete narrative information on the claim form from which codes were assigned.

Other errors included routine misuse of the coding system and the improper designation of one of several procedures as the principal one. Some types of errors might result in some undercounting of certain procedures but would not invalidate the information obtained for those cases identified for our study. Others are undoubtedly minor in nature and would not affect the study (e.g., most errors affecting only the fourth digit of the surgical code). The IOM study did not reveal any errors that would appear to systematically bias our study results.

Because the study data constitute a 20-percent sample of discharges for selected procedures, there is sampling error associated with the estimates presented in the tables. (Estimated standard errors for selected tables are available from the authors on request.)

Results

National estimates of the annual number of noncancer-related live discharges for the study procedures are given in Table 1, along with an estimate of cancer-related prostatectomies (TUR-CA). It should be noted that these estimates are probably somewhat low because prior to 1983 only the principal surgical procedure was coded for each inpatient bill. Of the study procedures, prostatectomy (TUR) accounted for the most discharges, with an overall average of 142,930 annually, followed by cholecystectomy (87,614) and inguinal hernia repair (84,090). Coronary artery bypass was the least common of this group of procedures (15,093 annually). The average annual numbers of discharges per 10,000 aged enrollees in 1979-80 for these procedures have been published (Lubitz, Riley, and Newton, 1985).

Because the focus of this article is rehospitalization following surgery, only surgical stays from which the patient was discharged alive were included in Table 1 and in subsequent tables. This is the population considered "at risk" for rehospitalization. The

Table 1

Average annual number of live discharges among aged Medicare enrollees for selected procedures, age, and sex: 1979-80

Procedure and sex	ICD-9-CM[1] code(s)	All ages	65-74 years	75-84 years	85 years or over
			Number of discharges		
Prostatectomy	60.2	142,930	78,267	52,300	12,363
Cancer diagnosis		24,698	11,385	10,488	2,825
Noncancer diagnosis		118,232	66,882	41,812	9,538
Cholecystectomy	51.2	87,614	55,745	26,326	5,543
Male		30,906	20,240	9,018	1,648
Female		56,708	35,505	17,308	3,895
Inguinal hernia repair	53.0, 53.1	84,090	51,840	26,825	5,425
Male		73,932	46,842	22,865	4,225
Female		10,158	4,998	3,960	1,200
Coronary artery bypass	36.1	15,093	13,582	1,483	28
Male		10,665	9,642	1,015	8
Female		4,428	3,940	468	20
Reduction, fracture of femur	79.05, 79.15, 79.25, 79.35	49,689	12,234	21,543	15,912
Male		10,347	3,422	4,345	2,580
Female		39,342	8,812	17,198	13,332
Total hip replacement	81.5	25,175	14,810	8,785	1,580
Male		8,617	5,632	2,655	330
Female		16,558	9,178	6,130	1,250
Other arthroplasty of hip	81.6	43,914	12,727	19,390	11,797
Male		9,134	3,422	3,690	2,022
Female		34,780	9,305	15,700	9,775

[1] *International Classification of Diseases, 9th Revision, Clinical Modification.*

SOURCE: Health Care Financing Administration, Bureau of Data Management and Strategy: Data from the Medicare Statistical System, 1979-81.

Table 2

Percent of patients discharged alive for selected procedures, 1979-80

Procedure	Percent discharged alive
Prostatectomy (cancer diagnosis)	98.6
Prostatectomy (noncancer diagnosis)	99.1
Cholecystectomy	97.5
Inguinal hernia repair	99.5
Coronary artery bypass	95.3
Reduction, fracture of femur	95.0
Total hip replacement	98.8
Other arthroplasty of hip	95.8

SOURCE: Health Care Financing Administration, Bureau of Data Management and Strategy: Data from the Medicare Statistical System, 1979-81.

percent of all patients undergoing the study procedures in 1979-80 who were discharged alive are shown in Table 2.

Patients undergoing reduction of fracture of the femur, coronary artery bypass, and other arthroplasty of the hip had inhospital mortality rates of 4 to 5 percent, whereas patients in the other study categories had death rates of 0.5 to 2.5 percent.

During the period 1979–80, the number of patients undergoing one or more rehospitalizations within 30 days after discharge, per 10,000 live discharges, was highest for coronary artery bypass, at 1,633 per 10,000 (Table 3). This finding is consistent with the fact that, among these eight procedure groups, coronary artery bypass patients exhibited many of the highest age- and sex-specific mortality rates within 1.5 months following surgery (Lubitz, Riley, and Newton, 1985). Rehospitalization rates were also high for patients undergoing prostatectomy (TUR-CA) (1,379 readmitted per 10,000 discharges), other arthroplasty of the hip (1,187 readmitted per 10,000 discharges), and reduction of fracture of the femur (1,178 per 10,000). Patients undergoing the latter two procedures also exhibited high rates of mortality following surgery (750 deaths per 10,000 procedures and 878 deaths per 10,000, respectively, in the 1.5 months following surgery). The lowest rates of rehospitalization were experienced by patients undergoing repair of inguinal hernia (508 per 10,000), who also had low mortality rates. It is interesting to note that prostatectomy (TUR) patients had higher rates of rehospitalization (1,071 per 10,000) than did cholecystectomy patients (806 per 10,000), although the number of deaths per 10,000 for cholecystectomy patients substantially exceeded those for prostatectomy (TUR) patients (372 and 214 within 1.5 months following surgery, respectively).

The data in columns 2 and 3 of Table 3 can be used to show that of all patients reentering a hospital within 30 days after discharge, between 34 and 47 percent (depending on the initial procedure) were readmitted within a week following surgical discharge. This indicates that a significant portion of readmissions occur within a very short time after discharge. The relative frequencies of readmission

Table 3

Number of Medicare surgical patients rehospitalized per 10,000 live discharges on the day of discharge, within 7 days, and within 30 days for selected procedures: 1979-80

Procedure	Same day as discharge	Within 7 days	Within 30 days
	Number rehospitalized per 10,000 live discharges		
Prostatectomy (Cancer diagnosis)	63	466	1,379
Prostatectomy (Noncancer diagnosis)	52	409	1,071
Cholecystectomy	59	328	806
Inguinal hernia repair	25	177	508
Coronary artery bypass	204	727	1,633
Reduction, fracture of femur	300	535	1,178
Total hip replacement	126	367	838
Other arthroplasty of hip	269	556	1,187

SOURCE: Health Care Financing Administration, Bureau of Data Management and Strategy: Data from the Medicare Statistical System, 1979-81.

within 7 days after discharge were similar to those for readmissions within 30 days after discharge; the difference is that prostatectomy (TUR-CA) exhibited the fourth highest readmission rate within 7 days after discharge and the second highest rate within 30 days after discharge. Some surgical patients were rehospitalized on the same day as discharge from the surgical stay. These figures include patients who were transferred from one short-stay hospital to another. Transfers to long-term hospitals are not included in the table because the MEDPAR file includes discharges from short-stay hospitals only.

The same-day readmission rate varied somewhat more among procedures than did the rehospitalization rates within 7 and 30 days. Patients undergoing reduction of fracture of the femur and other arthroplasty of the hip had the highest same-day readmission rates of 300 and 269 per 10,000, respectively. Patients undergoing inguinal hernia repair, prostatectomy (TUR), and cholecystectomy had same-day readmission rates of only 25, 52, and 59 per 10,000, respectively. The high rates of same-day rehospitalization for reduction of fracture of the femur and other arthroplasty of the hip patients may reflect transfers to rehabilitation hospitals for recovery following repair of a fractured hip. Data in columns 1 and 3 of Table 3 indicate that patients undergoing immediate readmission as a percent of all patients undergoing readmission within 30 days after discharge varied from 5 percent (prostatectomy, both CA and other, and inguinal hernia repair) to 25 percent (reduction of fracture of the femur).

Several patterns are evident in the rehospitalization data with respect to age and sex (Table 4). For reduction, fracture of femur, and other arthroplasty of hip rehospitalization rates differed little by age. For prostatectomy (TUR-CA) rates were lowest for patients 75–84 years of age. For all other procedures, rehospitalization rates increased with age (e.g., for

Table 4

Number of Medicare surgical patients rehospitalized per 10,000 live discharges, within 30 days of discharge, for selected procedures, by age and sex: 1979-80

Procedure and sex	All ages	65-74 years	75-84 years	85 years or over
	Number rehospitalized per 10,000 live discharges			
Prostatectomy (Cancer diagnosis)	1,379	1,456	1,240	1,584
Prostatectomy (Noncancer diagnosis)	1,071	951	1,156	1,536
Cholecystectomy	806	681	969	1,286
Male	930	804	1,114	1,472
Female	738	611	893	1,207
Inguinal hernia repair	508	408	627	876
Male	510	409	639	923
Female	495	390	562	708
Coronary artery bypass	1,633	1,557	2,310	(1)
Male	1,481	1,400	2,217	(1)
Female	1,999	1,942	2,513	(1)
Reduction, fracture of femur	1,178	1,093	1,198	1,218
Male	1,418	1,286	1,387	1,647
Female	1,115	1,018	1,150	1,134
Total hip replacement	838	726	939	1,329
Male	830	697	998	1,742
Female	843	744	914	1,220
Other arthroplasty of hip	1,187	1,090	1,209	1,255
Male	1,505	1,205	1,680	1,693
Female	1,103	1,048	1,099	1,164

[1] Data on coronary artery bypass for enrollees 85 years of age or over are excluded because of the small number of procedures.

SOURCE: Health Care Financing Administration, Bureau of Data Management and Strategy: Data from the Medicare Statistical System, 1979-81.

cholecystectomy, the rates were 89 percent higher for those 85 years of age or over than for those 65–74 years of age). This differs from the findings of Anderson and Steinberg (1984), who found no difference in readmission rates within 60 days following discharge by age. Their analyses included both medical and surgical stays, however. Substantial differences by sex are also evident in Table 4. Females tended to be rehospitalized less frequently than males in the 30 days following discharge, with the exception of all coronary artery bypass patients and total hip replacement patients 65–74 years of age, where rates for females were higher. For example, among cholecystectomy patients, males were readmitted 26 percent more often than females.

Regional comparisons

The rehospitalization experience of the beneficiaries undergoing the study procedures often varied significantly by region (Table 5). The table provides information on the number of persons rehospitalized per 10,000 live discharges and on the number of hospital days associated with readmissions occurring within 30 days after discharge, per 10,000 live discharges. The latter measure is included in the table to take recognition of the fact that, although certain regions (notably the Northeast) tended to have low readmission rates, their average lengths of stay tended to be long, and therefore the number of hospital days associated with readmission tends to be high. The regional rates presented in the table are age and sex standardized to the U.S. sample population by the direct method. This means that the standardized regional rates represent what the overall regional rates would have been if each region had the Nation's age and sex distribution of patients, given the age- and sex-specific rates observed in each region. Statistically significant differences in regional rates were identified by making six pairwise comparisons among the regions for each procedure (testing for differences in proportions for the rehospitalization rates and using t-tests for number of days) and applying an $\alpha = .0083$ (or $.05 \div 6$) level of significance.

For five of the eight procedures, significant regional differences were observed in the number of patients rehospitalized per 10,000 live discharges. Significant regional differences were also identified for four procedures with respect to the number of days associated with readmissions occurring within 30 days after discharge, per 10,000 live discharges. In particular, patients in the Northeast had the lowest rehospitalization rate among the four regions for seven of the eight procedures. The difference between the rehospitalization rate for the Northeast and that for one or more of the other regions was statistically significant for five procedures. The Northeast had the highest number of days associated with readmissions within 30 days for five of the eight procedures, however, because of its longer average length of stay. Conversely, the West had the lowest number of days associated with rehospitalization for seven of the eight procedures because of its short length of stay (the difference between the West and at least one other region was significant for four procedures). The South and North Central Regions tended to have the highest rehospitalization rates, accounting for the two highest readmission rates out of the four regions for six of the procedures. The South had particularly high rates of rehospitalization for cholecystectomy, reduction of fracture of the femur, and other arthroplasty of the hip, with rehospitalization rates that were significantly higher than those for each of the other three regions. Unadjusted State-specific rehospitalization rates are available from the authors upon request.

The regional patterns in rehospitalization rates described above agree closely with regional patterns of hospitalization found by Gornick (1977). She found that in 1972 the Northeast had the lowest discharge rate per 1,000 enrollees (261.0) and the South the highest (328.6). We examined the relationship between hospitalization rates and rehospitalization rates on an

Table 5

Number of Medicare surgical patients rehospitalized per 10,000 live discharges, within 30 days of discharge, and the average number of hospital days associated with all readmissions occurring within 30 days, for selected procedures, by region: 1979-80

Procedure	United States	Region				Significant regional differences[1]
		North East	North Central	South	West	
Prostatectomy (Cancer diagnosis)						
Number rehospitalized	1,379	1,338	1,420	1,437	1,263	No
Number of days	15,440	17,340	16,720	14,880	11,790	Yes
Prostatectomy (Noncancer diagnosis)						
Number rehospitalized	1,071	1,012	1,118	1,100	1,017	Yes
Number of days	11,380	12,740	11,830	11,190	9,500	Yes
Cholecystectomy						
Number rehospitalized	806	701	775	914	772	Yes
Number of days	9,860	9,910	9,780	10,920	7,720	Yes
Inguinal hernia repair						
Number rehospitalized	508	495	522	513	495	No
Number of days	5,660	6,550	6,370	5,230	4,100	Yes
Coronary artery bypass						
Number rehospitalized	1,633	1,391	1,727	1,721	1,563	No
Number of days	19,340	19,660	20,610	19,320	17,350	No
Reduction, fracture of femur						
Number rehospitalized	1,178	1,057	1,108	1,371	1,077	Yes
Number of days	21,620	24,000	20,910	22,390	18,490	No
Total hip replacement						
Number rehospitalized	838	721	765	939	955	Yes
Number of days	13,560	16,320	11,150	16,080	12,060	No
Other arthroplasty of hip						
Number rehospitalized	1,187	876	1,120	1,397	1,179	Yes
Number of days	20,670	20,530	19,100	22,800	18,830	No

[1] 1 or more pairwise differences significant at the .05 ÷ 6 = .0083 level.

NOTE: Age and sex adjusted to the U.S. sample by the direct method.

SOURCE: Health Care Financing Administration, Bureau of Data Management and Strategy: Data from the Medicare Statistical System, 1979-81.

operation-specific basis for our set of study procedures. This was done by computing a Spearman's rank correlation coefficient for regional hospitalization and readmission rates, adjusted for age and sex differences among regions. Hospitalization rates were computed as numbers of specific procedures per 10,000 aged Medicare enrollees. In order to make hospitalization and readmission rates comparable across procedures, each procedure-specific regional rate was first divided by the U.S. rate for that procedure. This was done for both hospitalization and readmission rates. The regional rates, divided by the U.S. rates, were then pooled across the eight procedures, yielding 32 pairs of hospitalization and readmission data. The correlation coefficient for these data was .40, which was significant at the .05 level. Therefore, in regions where beneficiaries tended to undergo relatively large numbers of certain procedures, they also tended to be rehospitalized more often following these procedures.

Length of surgical stay

Readmission rates may be expected to vary with differences in the length of stay of the hospitalizations in which the surgeries were performed. Patients with longer than average length of stay often have complications or comorbid conditions that require additional treatment and may also lead to subsequent readmission. Patterns in rehospitalization rates by length of preceding stay are of particular interest at this time because, under prospective payment, there may be a financial incentive to discharge patients that exceed average lengths of stay if such patients are perceived as being a source of unreimbursed expenses. It is also possible that patients with very short lengths of stay may frequently need to return to the hospital.

Age- and sex-adjusted rehospitalization rates by quartile of the length of the surgical stay are given in Table 6. The adjusted rates represent what the rehospitalization rate would have been in each quartile if all quartiles had the same age and sex distribution as the average of all patients undergoing the particular procedure. For each procedure, the rates of readmission varied directly with the length of the original surgical stay. For patients undergoing cholecystectomy and inguinal hernia repair, the range in readmission rates was largest. Readmission rates for inguinal hernia repair patients in the lowest

Table 6

Number of persons rehospitalized per 10,000 live discharges, within 30 days of discharge (excluding transfers) for selected procedures, by length of original surgical stay: 1979-80

Procedure	Total	Length of stay			
		1st quartile	2nd quartile	3rd quartile	4th quartile
	Number rehospitalized per 10,000 live discharges				
Prostatectomy (Cancer diagnosis)	1,324	1,104	1,178	1,383	1,678
Prostatectomy (Noncancer diagnosis)	1,024	788	814	1,081	1,421
Cholecystectomy	752	419	579	836	1,171
Inguinal hernia repair	484	284	331	492	910
Coronary artery bypass	1,459	1,187	1,225	1,636	1,815
Reduction, fracture of femur	906	827	825	946	1,072
Total hip replacement	721	506	709	687	1,008
Other arthroplasty of hip	943	801	865	930	1,229

NOTE: Rehospitalization rates are age and sex adjusted to the total sample using the direct method.

SOURCE: Health Care Financing Administration, Bureau of Data Management and Strategy: Data from the Medicare Statistical System, 1979-81.

Table 7

Number of patients rehospitalized per 10,000 live discharges, within 30 days of discharge for selected procedures, by hospital location: 1979-80

Procedure[1]	Total	SMSA	Non-SMSA
	Number rehospitalized per 10,000 live discharges		
Prostatectomy (Cancer diagnosis)	1,379	1,319	1,596
Prostatectomy (Noncancer diagnosis)	1,071	1,039	1,188
Cholecystectomy	806	761	930
Inguinal hernia repair	508	483	574
Reduction, fracture of femur	1,178	1,125	1,359
Total hip replacement	838	831	871
Other arthroplasty of hip	1,187	1,141	1,353

[1]Coronary artery bypass is not included in the table because there are too few observations in non-SMSA areas.

NOTE: SMSA is standard metropolitan statistical area. Rehospitalization rates for SMSA and non-SMSA areas are age and sex adjusted to the total sample using the direct method.

SOURCE: Health Care Financing Administration, Bureau of Data Management and Strategy: Data from the Medicare Statistical System, 1979-81.

quartile with respect to length of surgical stay were only 31 percent of the readmission rates for patients in the highest quartile; readmission rates for cholecystectomy patients in the lowest quartile were 36 percent of those for patients in the highest quartile. Readmission rates did not vary as strongly with length of stay for patients undergoing reduction of fracture of the femur. Readmission rates were nearly identical for the two lowest quartiles of length of stay, and patients in the lowest quartile had readmission rates 77 percent of those for patients in the highest quartile.

Comparison of hospitals by location

Patients undergoing surgery in hospitals located in standard metropolitan statistical areas (SMSA's) were readmitted to a hospital within 30 days after discharge less often (after adjusting for age and sex differences) than those undergoing surgery in non-SMSA hospitals (Table 7). For all procedures except total hip replacement, patients undergoing operations in SMSA hospitals were rehospitalized between 82 and 87 percent as often as patients undergoing operations in non-SMSA hospitals. For total hip replacement patients, readmission rates were similar for those undergoing operations in SMSA and non-SMSA hospitals. Anderson and Steinberg (1984) found higher readmission rates within 60 days after discharge for beneficiaries residing in rural areas. These differences may be the result of several factors. Small rural hospitals may frequently transfer more complicated cases to urban tertiary care hospitals. Some sophisticated equipment and facilities maintained in physicians' offices and clinics in urban areas may be available only in hospitals in rural areas, necessitating some readmissions for followup care. Case mix may also differ among geographic areas.

The differences in rehospitalization rates between SMSA and non-SMSA areas may be related to the regional differences noted earlier. The Northeast, which exhibited the lowest readmission rates, had the lowest percent of patients residing in non-SMSA areas for most procedures, with the West exhibiting a similar concentration of patients in SMSA areas (data not shown)[2]. The North Central and South, which had the highest rates of rehospitalization, also had the highest percents of patients residing in non-SMSA areas.

Patterns through time

Patients who undergo the study procedures tend to have higher than average hospitalization rates for several months following discharge (Table 8). Data in Table 8 provide the ratio of all observed hospitalizations to those expected if the sample patients experienced the prevailing hospitalization

[2]We are considering the percent of patients residing in non-SMSA areas to be a proxy for the number undergoing operations in non-SMSA hospitals for the purpose of comparing regions.

patterns of the Medicare aged population in total. (This ratio will be referred to as the hospitalization ratio.) The expected hospitalization experience is estimated by dividing total Medicare discharges for 1980 by the 1980 mid-year enrollment, then prorating by 30 or 90 days. The expected numbers of hospitalizations per 10,000 aged enrollees for a 30-day period by age and sex are available from the authors.

Although observed hospitalization rates for the sample patients are being compared with the prevailing hospitalization rate in the Medicare aged population, it should not be inferred that post-surgical patients are truly "expected" to experience prevailing hospitalization patterns shortly after surgery. Surgical patients sometimes have poor underlying health (particulary nonelective cases), and any surgery-related complications may lead to additional hospitalizations. Consequently, data in Table 8 are not intended to measure excessive or unnecessary hospitalizations, but they are presented as a descriptive measure that puts post-surgical hospitalization patterns into clearer perspective.

Coronary artery bypass patients had the highest hospitalization ratio in the first month following discharge (6.67), although prostatectomy (TUR-CA) patients had the highest hospitalization ratios in the following months (e.g., 2.47 in months 7–9). Hospitalization ratios were relatively high for all groups of patients in the first month following discharge, decreased substantially in the second month, and continued to decrease slowly after that. These ratios remained significantly above 1 for the entire 9-month period following discharge for all eight study procedures, even though the mortality experience for some categories of patients returned to normal well before then (Lubitz, Riley, and Newton, 1985).

The percent of patients with multiple rehospitalizations within 6 months after discharge is given in Table 9. Prostatectomy (TUR-CA) patients tended to undergo multiple rehospitalizations more often than other patients (15.3 percent underwent two or more rehospitalizations within 6 months after discharge). Coronary artery bypass patients tended to undergo multiple hospitalizations with the second highest frequency (10.2 percent underwent two or more rehospitalizations). Inguinal hernia repair patients exhibited the lowest multiple rehospitalization rate (only 4.6 percent underwent two or more rehospitalizations).

Table 8

Ratio of actual-to-expected number of readmissions for various time periods after surgical discharge for selected procedures: 1979-80

Procedure	Months after discharge				
	1	2	3	4-6	7-9
	Ratio				
Prostatectomy (Cancer diagnosis)	4.42	3.20	3.16	2.92	2.47
Prostatectomy (Noncancer diagnosis)	3.58	2.01	1.86	1.63	1.53
Cholecystectomy	3.01	1.99	1.69	1.54	1.45
Inguinal hernia repair	1.72	1.34	1.21	1.17	1.14
Coronary artery bypass	6.67	3.05	2.42	1.89	1.67
Reduction, fracture of femur	3.75	2.15	1.86	1.53	1.42
Total hip replacement	3.07	1.73	1.79	1.45	1.38
Other arthroplasty of hip	3.87	1.96	1.71	1.47	1.41

NOTES: Expected number of readmissions is based on the age- and sex-specific rates of the entire Medicare aged population applied to the populations of patients undergoing the individual procedures. All ratios are significantly above 1.00 at the .05 level.

SOURCE: Health Care Financing Administration, Bureau of Data Management and Strategy: Data from the Medicare Statistical System, 1979-81.

Rehospitalization: Conditions and procedures

The most common conditions for which study patients were rehospitalized within 30 days after discharge are listed in Table 10. Not surprisingly, the most common reasons for rehospitalization usually involved the same body systems that were involved in the original surgery. For example, over one-half of the rehospitalizations attributable to coronary artery bypass patients involved diseases of the circulatory system, as measured by the principal diagnosis listed on the Medicare record. This represented 973 rehospitalizations per 10,000 live discharges for coronary artery bypass patients. Similarly, 29 percent

Table 9

Percent distribution of Medicare patients for selected procedures, by number of readmissions within 6 months of discharge: 1979-80

Procedure	Total discharges	No readmissions	1 readmission	2 readmissions	3 readmissions	4 or more readmissions
	Percent distribution					
Prostatectomy (Cancer diagnosis)	100.0	57.3	27.5	10.1	3.3	1.9
Prostatectomy (Noncancer diagnosis)	100.0	71.6	20.1	5.8	1.8	0.7
Cholecystectomy	100.0	77.3	16.2	4.4	1.5	0.6
Inguinal hernia repair	100.0	81.7	13.7	3.4	0.9	0.3
Coronary artery bypass	100.0	66.8	22.9	7.0	2.1	1.1
Reduction, fracture of femur	100.0	70.6	22.2	5.5	1.2	0.6
Total hip replacement	100.0	76.2	18.1	4.3	1.0	0.5
Other arthroplasty of hip	100.0	72.0	21.1	5.3	1.2	0.5

SOURCE: Health Care Financing Administration, Bureau of Data Management and Strategy: Data from the Medicare Statistical System, 1979-81.

Table 10

Five most common groups of principal diagnoses associated with rehospitalizations occurring within 30 days of surgical discharge for selected procedures: 1979-80

Procedure	Principal diagnoses of rehospitalization and ICD-9-CM codes[1]	Number rehospitalized per 10,000 live discharges	Percent of rehospitalizations occurring within 30 days
Prostatectomy (Cancer diagnosis)	Neoplasms (140-239)	685	44.8
	Diseases of the circulatory system (390-459)	217	14.2
	Diseases of the genitourinary system (580-629)	176	11.5
	Symptoms, signs, and ill-defined conditions (780-799)	113	7.4
	Complications of surgical and medical care, not elsewhere classified (996-999)	94	6.2
Prostatectomy (Noncancer diagnosis)	Diseases of the genitourinary system (580-629)	300	25.3
	Diseases of the circulatory system (390-459)	227	19.2
	Complications of surgical and medical care, not elsewhere classified (996-999)	134	11.3
	Symptoms, signs, and ill-defined conditions (780-799)	128	10.8
	Neoplasms (140-239)	88	7.4
Cholecystectomy	Diseases of the digestive system (520-579)	251	28.9
	Diseases of the circulatory system (390-459)	176	20.3
	Symptoms, signs, and ill-defined conditions (780-799)	100	11.5
	Diseases of the genitourinary system (580-629)	61	7.0
	Diseases of the respiratory system (460-519)	55	6.3
Inguinal hernia repair	Diseases of the circulatory system (390-459)	121	22.1
	Diseases of the genitourinary system (580-629)	94	17.3
	Diseases of the digestive system (520-579)	98	18.0
	Symptoms, signs, and ill-defined conditions (780-799)	51	9.4
	Neoplasms (140-239)	46	8.3
Coronary artery bypass	Diseases of the circulatory system (390-459)	973	53.4
	Symptoms, signs, and ill-defined conditions (780-799)	207	11.4
	Diseases of the digestive system (520-579)	121	6.7
	Complications of surgical and medical care, not elsewhere classified (996-999)	95	5.2
	Diseases of the respiratory system (460-519)	87	4.7
Reduction, fracture of femur	Fractures (800-829)	287	22.7
	Diseases of the circulatory system (390-459)	246	19.5
	Symptoms, signs, and ill-defined conditions (780-799)	118	9.4
	Diseases of the respiratory system (460-519)	104	8.2
	Diseases of the digestive system (520-579)	83	6.5
Total hip replacement	Diseases of the circulatory system (390-459)	184	20.5
	Diseases of the musculoskeletal system and connective tissue (701-739)	127	14.2
	Symptoms, signs, and ill-defined conditions (780-799)	80	9.0
	Complications of surgical and medical care, not elsewhere classified (996-999)	74	8.2
	Diseases of the digestive system (520-579)	66	7.3
Other arthroplasty of the hip	Diseases of the circulatory system (390-459)	233	18.3
	Fractures (800-829)	205	16.1
	Symptoms, signs, and ill-defined conditions (780-799)	135	10.6
	Diseases of the respiratory system (460-519)	100	7.8
	Diseases of the digestive system (520-579)	79	6.2

[1] *International Classification of Diseases, 9th Revision, Clinical Modification.*

SOURCE: Health Care Financing Administration, Bureau of Data Management and Strategy: Data from the Medicare Statistical System, 1979-81.

of rehospitalizations following cholecystectomy involved diseases of the digestive system, and 25 percent of those following prostatectomy (TUR) involved diseases of the genitourinary system. Fractures were common reasons for rehospitalizations following reduction of fracture of the femur (23 percent) and other arthroplasty of the hip (16 percent). In addition, 45 percent of rehospitalizations following prostatectomy (TUR-CA) were for treatment of neoplasms. This indicates that for many patients the condition that necessitated the original surgery, or a related problem, was associated with followup hospitalization. For patients undergoing prostatectomy (TUR-CA), prostatectomy (TUR), total hip replacement, and coronary artery bypass, complications of surgical and medical care were fairly common reasons for readmission, accounting for 6, 11, 8, and 5 percent of rehospitalizations, respectively. Symptoms, signs, and ill-defined conditions were also

Table 11

Three most common groups of principal procedures associated with rehospitalizations occurring within 30 days after surgical discharge, for selected procedure: 1979-80

Procedure	Principal diagnoses of rehospitalization and ICD-9-CM codes[1]	Number of rehospitalizations per 10,000 live discharges	Percent of all rehospitalizations occurring within 30 days
Prostatectomy (Cancer diagnosis)	Operations on male genital organs (60-64)	[2]163	10.7
	Operations on the urinary system (55-59)	[2]129	8.4
	Operations on the digestive system (42-54)	[2]49	3.2
Prostatectomy (Noncancer diagnosis)	Operations on the urinary system (55-59)	[2]83	7.0
	Operations on male genital organs (60-64)	[2]58	4.9
	Operations on the digestive system (42-54)	[2]57	4.8
Cholecystectomy	Operations on the digestive system (42-54)	81	9.4
	Operations on male genital organs (60-64)	[2]50	2.0
	Operations on the urinary system (55-59)	16	1.8
Inguinal hernia repair	Operations on the digestive system (42-54)	69	12.3
	Operations on male genital organs (60-64)	[2]63	10.1
	Operations on the urinary system (55-59)	21	3.8
Coronary artery bypass	Operations on cardiovascular system (35-39)	88	4.8
	Operations on the digestive system (42-54)	40	2.2
	Operations on the musculoskeletal system (76-84)	24	1.3
Reduction, fracture of femur	Operations on the musculoskeletal system (76-84)	116	9.2
	Operations on the digestive system (42-54)	34	2.7
	Unspecified procedures (HCFA code 00.60)	24	1.9
Total hip replacement	Operations on the musculoskeletal system (76-84)	169	18.8
	Operations on the digestive system (42-54)	29	3.2
	Unspecified procedures (HCFA code 00.60)	25	2.8
Other arthroplasty of the hip	Operations on the musculoskeletal system (76-84)	140	11.0
	Operations on the digestive system (42-54)	34	2.6
	Unspecified procedures (HCFA code 00.60)	28	2.2

[1] International Classification of Diseases, 9th Revision, Clinical Modification.
[2] Rate given per 10,000 live male discharges.

SOURCE: Health Care Financing Administration, Bureau of Data Management and Strategy: Data from the Medicare Statistical System, 1979-81.

a common reason for rehospitalization following all procedures.

The most common surgical procedures performed during rehospitalizations within 30 days after discharge are summarized in Table 11. For each of the eight procedures studied, the most common followup procedures performed during rehospitalization involved the same body system as the original operation did. For example, total hip replacement patients underwent 169 operations on the musculoskeletal system per 10,000 live discharges, accounting for 19 percent of all readmissions within 30 days. Prostatectomy (TUR) patients underwent 141 operations on the urinary system or on the genital organs per 10,000 live discharges, accounting for 12 percent of all readmissions. This suggests that patients undergoing the types of surgery included in this study often receive followup surgical treatment for the underlying condition that necessitated the original surgery or for a related problem.

Discussion and conclusions

Rehospitalization following surgery is an important measure of patient outcomes. It is often an indication of complications related to the surgery or of continued care for the condition that necessitated the surgery. Although rehospitalization rates are not as easily interpretable as mortality or direct measures of morbidity, they can provide significant insights into outcomes and patterns of treatment.

The number of surgical patients rehospitalized within 30 days after discharge per 10,000 discharges was high for some procedures. Among coronary artery bypass patients, 16 percent were rehospitalized within a month; 12 percent of other arthroplasty of hip and reduction of fracture of the femur patients were also rehospitalized within a month. These procedures also ranked high on post-surgical mortality rates (Lubitz, Riley, and Newton, 1985).

The most frequent principal diagnoses associated with readmission suggest that many patients are rehospitalized for the same problem (or a related problem) as that which prompted them to undergo surgery in the first place. For example, prostatectomy (TUR) patients were most frequently rehospitalized for diseases of the genitourinary system, cholecystectomy patients for diseases of the digestive system, prostatectomy (TUR-CA) patients for neoplasms, and reduction of fracture of the femur

patients for fractures. Complications of surgical and medical care was also a fairly common reason for readmission for patients undergoing prostatectomy (TUR), coronary artery bypass, total hip replacement, and prostatectomy (TUR-CA).

Strong regional differences exist in the incidence of readmissions that tend to mirror regional patterns in the hospitalization rates for these procedures. In particular, the Northeast Region usually had the lowest rates of readmission with the South and North Central Regions often exhibiting the highest. The fact that similar regional patterns in hospitalization rates were found in this study, as well as in earlier ones, suggests that the same factors that produce regional variation in overall hospitalization also apply to readmission following surgery. Such variation may be related to differences in physician training, practice styles, case mix, or other factors. The regional differences in rehospitalization rates may be related to the fact that readmissions were found to be less frequent when the operation was performed in a hospital located in an SMSA. The Northeast and West had the lowest proportion of patients residing in non-SMSA's, and the North Central and South had substantially higher proportions of such patients. We also noted that, because of differences in average length of stay, the average number of hospital days associated with readmission occurring within 30 days after discharge per 10,000 live discharges was lowest in the West and very high in the Northeast.

It is interesting to note that hospitalization rates after surgery remained higher than the rates for the Medicare population in general for at least 9 months following discharge for all eight procedures, although the first article in this series showed that mortality rates for some categories of patients returned to normal levels shortly after surgery. It is a well-known fact that, for Medicare beneficiaries, past use of health care services, including hospital services, is positively correlated with subsequent use of services (Beebe, Lubitz, and Eggers, 1984; Eggers, 1982; Anderson, Resnic, English et al., 1982; McCall and Wai, 1983). Regarding the high level of hospital use of our study patients following surgery, we do not know whether their underlying health was worse than that of the Medicare population at large, whether they continued to suffer complications related to their surgery, or whether they were more inclined to use hospital services for other reasons. For example, they may have regular physicians who tend to prescribe higher than average amounts of hospital care.

The readmission patterns reported here will serve as baseline information for evaluation of the impact of prospective payment on Medicare beneficiaries and program costs. For example, changes in readmission rates could have strong cost implications. Readmissions data can also provide indirect information on the effects of changes in quality of care. Conclusions about quality of care cannot be made solely on the basis of readmission data, however, and must take account of the limitations in readmissions as a patient outcome measure.

Rehospitalization rates often tended to be considerably higher for patients with a lengthy surgical stay. This is a potentially important group of patients to monitor for changes in readmission rates because of possible institutional pressures to discharge these patients prematurely. Too early discharge for patients suffering complications could lead to subsequent hospitalization for the same condition. Preliminary data indicate that reductions in average length of stay between 1981 and 1984 have occurred throughout the distribution of stays, however, and do not appear to have been concentrated on the longer stays (Helbing, 1985). Incentives under the prospective payment system could conceivably change the nature of the relationship between rehospitalization rates and the length of surgical stay. For example, if many patients in the lower quartile were discharged prematurely, then one may begin to see an inverse relationship between rehospitalization and length of surgical stay.

Peer Review Organizations (PRO's) will have an important role in assessing the appropriateness of readmissions under prospective payment. Under their contracts, PRO's will review all readmissions (to either the same or other hospitals) occurring within 7 days after discharge. As part of its review, the PRO will make a determination as to whether the patient was discharged prematurely, and it will submit a report to the appropriate HCFA regional office on each premature discharge. The fact that high rates of readmission persist for months after surgical discharge suggests that consideration should be given to extending PRO review time beyond 7 days after discharge. PRO's will also review the medical appropriateness of all transfers to other hospitals and to skilled nursing facilities (SNF's), including distinct-part SNF's associated with the transferring hospital.

Roos, Cageorge, Austen et al. (1985) have demonstrated that diagnostic information taken from claims data can be used to identify surgical complications that result in readmissions. Using Health Services Commission data from Manitoba, they developed computerized algorithms for identifying complications following prostatectomy, cholecystectomy, and hysterectomy that exhibited high rates of sensitivity and specificity. Roos et al. pointed out that such algorithms can be used to inexpensively monitor surgical outcomes and assess quality of care. They mentioned that such algorithms may be particularly useful to PRO's. Bunker and Fowles (1985) have pointed out that using a computer-based audit to judge quality of care by individual physicians and hospitals may be problematic because of deficiencies in the data available. For example, Medicare claims data prior to 1984 contain only the principal diagnosis associated with the hospitalization and have been shown to contain a substantial number of errors (Institute of Medicine, 1979).

A model for predicting the probability of readmission within 60 days after hospital discharge has been developed for the aged Medicare population by Anderson and Steinberg (1985). They found that

the probability of readmission was related to several clinical and demographic characteristics of the patient as well as to the size and location (urban vs. rural) of the discharging hospital. They suggest that this model can be applied by PRO's to identify hospitals with high readmission rates not attributable to case mix.

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