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Are readmission rates on a neurosurgical service indicators of quality of care?

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Abstract

Object—The goal of this study was to examine the reasons for early readmissions within 30 days of discharge to a major academic neurosurgical service.

Methods—A database of readmissions within 30 days of discharge between April 2009 and September 2010 was retrospectively reviewed. Clinical and administrative variables associated with readmission were examined, including age, sex, race, days between discharge and readmission, and insurance type. The readmissions were then assigned independently by 2 neurosurgeons into 1 of 3 categories: scheduled, adverse event, and unrelated. The adverse event readmissions were further subcategorized into patients readmitted although best practices were followed, those readmitted due to progression of their underlying disease, and those readmitted for preventable causes. These variables were compared descriptively.

Results—A total of 348 patients with 407 readmissions were identified, comprising 11.5% of the total 3552 admissions. The median age of readmitted patients was 55 years (range 16–96 years) and patients older than 65 years totaled 31%. There were 216 readmissions (53% of 407) for management of an adverse event that was classified as either preventable (149 patients; 37%) or unpreventable (67 patients; 16%). There were 113 patients (28%) who met readmission criteria but who were having an electively scheduled neurosurgical procedure. Progression of disease (48 patients; 12%) and treatment unrelated to primary admission (30 patients; 7%) were additional causes for readmission. There was no significant difference in the proportion of early readmissions by payer privately insured patients and those with public or no insurance ($p = 0.09$).

Conclusions—The majority of early readmissions within 30 days of discharge to the neurosurgical service were not preventable. Many of these readmissions were for adverse events

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Disclosure

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that occurred even though best practices were followed, or for progression of the natural history of the neurosurgical disease requiring expected but unpredictably timed subsequent treatment. Judicious care often requires readmission to prevent further morbidity or death in neurosurgical patients, and penalties for readmission will not change these patient care obligations.

Keywords

early readmission; neurosurgery; quality improvement; Centers for Medicare and Medicaid Services

Readmission within 30 days after discharge has been described as a surrogate measure of quality of care in the cardiac, pulmonary, and general medicine disease literature^{4,5,21} (see also the review by Vest et al.⁴⁷). Although there is evidence that such early readmissions may not be entirely avoidable,⁶ in some studies in the patient populations with heart failure and obstructive lung disease, readmission is equated with failed care delivery.^{3,15,30} Also, there is a need for cost-saving measures because the estimated yearly cost of Medicare readmissions is \$17.4 billion.²⁷ According to the CMS, these early readmissions are considered suboptimal care^{12,13} and will result in reimbursement penalties starting in 2013 from the CMS, under the Patient Protection and Affordable Care Act, in an effort to hold hospitals accountable for their quality of care.^{5,7} However, this approach may actually penalize hospitals that attain a lower incidence of death by prudently using such readmissions for more optimal management in these patients, because patients who die can obviously no longer be readmitted.^{25,28,38}

Readmission can prevent the development of more serious morbidity from progression of disease, and can avoid the consequences of mismanagement due to discontinuous care between physicians who are unfamiliar with managing specialized problems. This is especially true in neurosurgery, in which patient access can be limited to major academic centers at great distances. The nature of neurosurgical disorders does not easily lead to predictable outcomes because patients can deteriorate rapidly with only vague warning signs, and continuity of care is vital. Neurological symptoms can be subjective and subtle, making the physical examination difficult to interpret and requiring imaging as a crucial part of diagnosis. When patient deterioration occurs, it is usually rapid and life threatening.

The low threshold for admission and observation of neurosurgical patients primarily reflects this lack of predictable outcomes and the grave consequences of possible error. Although not always planned or preventable, early readmissions allow for early, function-saving intervention and prevention of further adverse events in neurosurgical patients. Although some readmissions will result from preventable adverse events, some will be a result of a planned, safe management strategy. In addition, no study to date has discussed the particular stepwise deterioration often associated with the natural history of certain neurosurgically treated diseases like chronic SDHs and skull base tumors as a separate category from unpreventable readmissions. To further study the nature of this judicious management strategy, we examined the clinical variables associated with early readmissions to the high-volume academic adult neurosurgical service at Barnes-Jewish Hospital and Washington University in St. Louis, in which approximately 2200 operations are performed and 2500 patients are admitted annually.

Methods

After appropriate institutional review board approval, a retrospectively collected quality improvement database for early readmissions to the adult neurosurgical service at Barnes-Jewish Hospital between April 30, 2009, and September 26, 2010, was reviewed. This

database was designed similarly to that of the CMS reporting scheme for early readmission identification for patients with heart failure admitted within 30 days after discharge.¹² All patients were cared for by 1 of 14 attending neurosurgeons at Washington University in St. Louis. These charts were reviewed by 2 neurosurgeons (M.N.S. and I.T.S.) for clinical variables including performed procedures, associated complications, and reasons for readmission within 30 days of discharge from inpatient status. The readmissions were sorted into 1 of 3 categories: scheduled, adverse event, and unrelated. The adverse event readmissions were further subcategorized into patients readmitted even though best practices were followed, those readmitted due to progression of their underlying disease, and those readmitted for preventable causes with supervision from the senior neurosurgeon (R.G.D.). The best practices refer to those agreed upon by the faculty of the neurosurgery department, such as appropriate study orders and appropriate antibiotic administration, accounting for intersurgeon variance.

Adverse events resulting in preventable readmissions include nosocomial infections, falls, SSIs, VTEs such as deep venous thromboses and pulmonary emboli, post-procedure complications, and CSF leaks after cranial base surgery requiring repair. Adverse events resulting in readmission although best practices were followed include shunt malfunctions, new neurological symptoms like headache and altered mental status, and unrelated strokes. Adverse events due to the progression of the underlying disease is a category specific to certain neurosurgical disorders such as chronic SDHs and seizures due to underlying brain neoplasms in which the appropriate treatment is administered but future treatments are expected in an unpredictable and unpreventable fashion. These readmissions have therefore been categorized differently from those adverse events that occurred even though best practices were followed. Scheduled readmissions for elective surgery involve patients discharged with planned procedures within 30 days. Illnesses unrelated to primary admission involve unrelated exacerbations of preexisting chronic conditions or new conditions resulting from trauma, or unrelated community infections. Descriptive statistics were generated using Microsoft Excel (Microsoft, Inc.), and chi-square and Fisher exact testing was performed using GraphPad Prism (GraphPad Software). The overall agreement among multiple raters was measured according to the Fleiss kappa statistic by using SAS version 9.3 (SAS Institute, Inc.; <http://support.sas.com/kb/25/006.html>).

Results

A total of 348 consecutive patients were linked to 407 total early readmissions. This is from a total 3552 admissions from that time period, or 11.5%. The patient demographic data are listed in Table 1. There were 186 male (53.4%) and 162 female (46.6%) patients in the cohort. They had an overall mean age of 54.8 years, ranging from 16 to 96 years, with a median age of 56.5. There were 109 patients who were 65 years or older (31.3%) and this proportion was not significantly different than expected numerically ($p = 0.19$). The mean number of days between discharge and readmission was 10.5, ranging from 1 to 30 days, with a median number of 8 days. Of the self-reported race of the patients, there were 277 white patients (79.6%), 61 black patients (17.5%), and 10 patients reporting another race (2.9%).

The reasons for readmission are described in Table 2. A large number of readmissions (113 [27.8%] of 407) were a result of scheduled elective surgery for a pathological entity identified and worked up in the initial admission. The majority of readmissions (264 [64.9%] of 407) stemmed from adverse events that were further sub-categorized into preventable readmissions (149 [36.6%] of 407), readmissions even though best practices were followed (67 [16.5%] of 407), and readmissions from natural progression of disease

(48 [11.8%] of 407). The remainder of readmissions stemmed from illnesses unrelated to the primary readmission (30 [7.37%]).

Adverse events resulting in readmissions from preventable causes were primarily from complications with wounds (49 [12%] of 407) such as dehiscence or SSI. These were followed by readmissions for nosocomial infections (22 [5.41%] of 407) such as urinary tract infections or pneumonia. Readmissions due to postprocedure complications (15 [3.69%] of 407) and CSF leak following cranial base surgery (14 [3.44%] of 407) were considered potentially preventable. Additionally, readmissions for refractory postoperative pain comprised 10 patients (2.46%), as did those for VTEs. All of the preventable thrombotic events occurred in patients on a rational, systematized, mechanical and chemoprophylactic regimen. The remainder of adverse events resulting in readmission from preventable causes occurred in patients who fell at subacute care facilities (8 [1.97%] of 407) and in those suffering from other medical conditions (21 [5.16%] of 407) such as complications from medications either started or withheld during the primary admission.

In contrast, many adverse events resulting in readmission were a result of complications occurring in spite of best practices being followed (67 [16.5%] of 407) and complications of the progression of the natural history of certain chronic neurosurgical diseases (48 [11.8%] of 407). The majority of adverse events occurring in spite of best practices being followed were related to hydrocephalus, including shunt malfunctions (35 [8.60%] of 407). The development of new neurological symptoms requiring readmission for further workup numbered 11 (2.7%), and readmission for unrelated stroke numbered 3 patients (0.74%). Other reasons for readmissions even though best practices were followed involved 18 patients (4.42%); these included poor functional recovery and chest pain. Finally, notably, the patient's insurance type in the readmission cohort private/commercial (41.3%) versus Medicare/Medicaid/uninsured (58.7%) was not significantly different from the proportion in the overall 3552 admissions in the same time period ($p = 0.09$). The interrater agreement was measured using the Fleiss kappa statistic, with a kappa of 0.79 ($p < 0.0001$), which is substantial.

Discussion

This is the first published systematic evaluation of early readmissions to a large neurosurgical service at a major American teaching hospital within 30 days from discharge; such early readmissions account for 11.5% of our total admissions. We conclude that these readmissions reflect careful patterns of care and are not indicators for inappropriate care. There are many reasons for frequent readmissions that involve the pathophysiological characteristics of the disease processes as well as the lack of access to neurosurgical care in the community. Most neurosurgical procedures require inpatient observation or prolonged acute care postoperatively, which makes readmission for management of complications penalized under the "early readmission" criterion unlike an outpatient procedure with a same-day discharge. In addition, neurosurgical procedural complications require management by the primary surgeon due to the specificity of problems and complexity of techniques. A significant proportion of the early readmissions (27.8%) were prescheduled readmissions in patients with staged procedures such as deep brain stimulation surgery. These procedures are purposefully staged because patients with medically refractory Parkinson disease are often too ill to endure very long operations without their medications. This strategy has allowed for a highly successful program at our institution with a very low rate of morbidity and mortality.⁴²

In addition, surgical culture demands conscientious accountability and, for this reason, surgeons are often compelled to readmit patients to their primary service and institution to

facilitate appropriate, timely management of their patient's nonsurgical illness and appropriate modification in the setting of a neurosurgical illness. This observation explains the 30 unrelated complications (7.37%) requiring readmission as well as all the nonneurosurgical adverse events requiring readmission. Although outpatient interventions may normally be sufficient to adjust postdischarge heart failure^{29,32} and chronic obstructive pulmonary disease^{1,35} care paradigms and medications, these principles do not always apply to neurosurgical patients. Most of these patients have advanced imaging and laboratory-predicated management paradigms that often must be obtained on an emergency basis. Neurological symptoms like headache, weakness, and sensory deficiencies often correlate poorly with both the pathophysiological characteristics of the disease process and its severity.

The fulminant onset of neurological symptoms and disastrous, irreparable morbidities as well as deaths associated with neurosurgical conditions also favor a risk-averse admission paradigm. Hydrocephalus, both new onset and chronic, remains one of the most challenging diseases to treat definitively due to its myriad causes and the high failure rate of the primary treatment, CSF shunting.^{20,34,39,43} In our series, noninfectious shunt malfunctions constituted 35 readmissions (8.6%), with the primary reason being that shunt malfunction can be difficult to diagnose by radiological or clinical criteria, and often requires neurosurgical consultation.²⁶ This is especially true in a population that is developmentally delayed, brain injured, or demented. Chronically shunted hydrocephalus is particularly difficult to manage because, in addition to requiring multiple static and dynamic imaging modalities to ascertain appropriate implant function, the ultimate goal is symptomatic relief that may require invasive testing³¹ or even operative exploration of an existing shunt system.²⁶ In addition, the need to compare new imaging to previously obtained studies, along with examination by the primary neurosurgeon, often necessitates transfer to the original center of care.

The strategy of watchful waiting reduces surgical shunt explorations and overtreatment and, hence, is in line with a recent editorial on reducing waste in the US health care system.⁹ Because it is very difficult to evaluate neurosurgical problems on an outpatient basis, the default care model is to admit the patient if there is any uncertainty in shunt function to avoid morbidity and death. In contrast to the rapid resolution of acute hydrocephalus symptoms, sometimes subacute processes require stabilizing the patient rehabilitation center, with the knowledge that the patient will probably return to the hospital for further intervention. This management strategy allows a patient to recover in a setting specifically designed to aid recovery. Included in this study are 48 patients (11.8%) who were readmitted for natural history of disease progression. Examples include delayed CSF leaks after resection of skull base meningiomas and delayed hydrocephalus after subarachnoid hemorrhage,^{18,46} as well as SDHs in which there is delayed reaccumulation of subdural fluid requiring further intervention.¹¹ Between interventions, the patient continues to recover neurologically and physically outside of the acute care setting, which reflects the prudent usage of readmission to achieve a long-term goal of overall improvement.

Similar to expecting readmission for unpreventable complications, some otherwise preventable complications are more frequently readmitted after neurosurgical admission. In this study, there were 149 potentially preventable readmissions (36.6%), which is well within the range of recent reviews of early readmission rates for general medical conditions.^{19,45} Uncomplicated posthospitalization VTEs such as deep vein thrombi and pulmonary emboli that otherwise can be managed in the outpatient setting routinely require inpatient readmission due to the inability to attain therapeutic anticoagulation in a patient within 30 days of an intracranial surgery and the need for inferior vena cava filter placement. These events occur with high frequency on the neurosurgical service due to

tumor biology,⁴⁰ length of operating time,³⁶ and inability to initiate prophylactic anticoagulation in patients during intracranial surgery to avoid devastating intracranial hemorrhage.¹⁷ Large studies involving neurosurgical patients uniformly show a nonzero rate of postoperative VTE, suggesting that deep venous thrombotic complications are not completely preventable in this population.^{14,22,24} In this study, there were only 10 readmissions (2.46%) for such thromboembolic events. In addition, according to our protocol all of these patients were on a chemoprophylactic and mechanical prophylactic regimen postoperatively, suggesting that currently these complications may not be truly preventable.

There were 22 readmissions (5.41%) for nosocomial infections such as urinary tract infections and pneumonia that were associated with bacteremia or sepsis, and presented as altered mental status and required inpatient treatment. We have since initiated protocols for the prompt removal of nonessential urinary catheters and indwelling central venous catheters in an attempt to reduce the frequency such nosocomial infections.^{33,48} The SSIs represent the majority of the preventable readmissions in this series; 49 cases (12% of total readmissions), representing 1.6% (49 of 3149) of all operations in that time period, which is similar to a study of the 2005 Nationwide Inpatient Sample reporting a 1% SSI rate.¹⁶ Due to the risk of infection to the CNS, even superficial infections in shunts and cranial wounds merit readmission for the administration of intravenous antibiotic therapy. In other specialties, such infections can be treated in an outpatient setting.

Similarly, many potentially preventable neurosurgical postprocedure complications like new-onset seizure and stroke (15 [3.69%] of 407) and CSF leaks (14 [3.44%] of 407) merit readmission for supportive care and prevention of further morbidity. There were 2 cases of patients requiring readmission for management of their antihypertensive medications, either due to syncope or hypertensive crisis that, although preventable and able to be addressed as an outpatient medicine issue, could have resulted in further neurological injury and resulted in readmission. Finally, 8 of the preventable readmissions (1.97%) were related to falls that happened subsequently at the transfer facility. Although preventable on the part of the rehabilitation or nursing facility with more appropriate supervision, due to cognitive impairment in stroke and brain-injured patients, it is difficult to balance restraint and activity to prevent falls, and such patients have a high risk of falling.⁴⁴ Moreover, this kind of readmission should not warrant penalization of the original hospital because neurological recovery often occurs on the order of weeks to months, not hours to days, and the resultant activity assessment elsewhere changes dramatically after discharge.

Overall, the total number of potentially preventable readmissions (36.6%) to the neurosurgical service due to adverse events was a minor cause of early readmission, underscoring our conclusion that most neurosurgical readmissions are warranted and reflect appropriate rather than substandard care. There are many advantages to reducing readmissions, not the least of these being more efficient utilization of limited resources and higher patient satisfaction. We are actively working to establish methods to reach this goal. Among these efforts are better discharge planning and discharge instructions as well as nursing follow-up both at home and via telephone.¹⁵ We have implemented such protocols for disease pathologies that are well studied and uniform and able to be managed in an outpatient setting, such as endocrine abnormalities after pituitary adenoma surgery,⁴⁹ and will continue to reduce readmissions for such causes.

However, we maintain that a significant number of readmissions represent appropriate care and therefore should not be classified as avoidable or interpreted to represent a failure of care. Our study demonstrates the power of a 2-step review of “harm” within an organization. Our first step involved the use of a simple trigger to identify the prevalence of a specific

type of harm. Although it is useful to follow the impact of intervention and to provide a basis for comparison, the actual prevalence of harm does not provide any useful information regarding how to actually reduce it. The second step of our study involved the systematic review of all events identified. Although it is our assertion that many of the readmission events were not preventable, urinary catheter–associated infections and readmissions for diabetes insipidus are conditions that may be suitable for intervention. Additionally, although the nature of neurosurgical disease may prevent the reduction of VTE in our population with current treatment modalities, better screening tools and treatments may be available in the future. A better understanding of the prevalence of this disorder within our population would probably help to implement these treatments in the future.

Surgeon bias is a potential limitation of a retrospective review, and we attempted to minimize this bias by having multiple surgeons independently review all the patient charts, with great interrater agreement, as noted in *Results*. Even with multiple surgeon review there are disagreements. With some debate over the preventability of VTEs in the setting of a protocol for prophylaxis and readmissions for CSF leaks, a range for readmissions categorized as adverse events even though best practices were followed would be 16.5%–22.4%. Sometimes the true categorization of a complication cannot happen until the complication has run its course. For this reason, periodic reviews of morbidities and mortalities are ingrained in surgical culture. Such reviews offer excellent educational opportunities for complication management and avoidance as well as inculcating a culture of honesty among surgical trainees.¹⁰ In an ideal environment, young surgeons use these reviews to learn complication avoidance from their peers through directed, free-of-blame discussion of clinical experience and relevant literature from more senior colleagues.

Along the lines of such intradepartmental reviews, there has been a recent movement to open the Medicare database of physician practices to the public to expose poor care.⁴¹ On the national level, to better address quality improvement in general surgical patients, the American College of Surgeons' National Surgical Quality Improvement Program (ACS NSQIP) prospectively collects and compares data on postoperative complications at different institutions. In addition, the National Neurosurgery Quality and Outcomes Database (N²QOD) aims to prospectively collect similar outcomes data in neurosurgical patients.² However, there remains some skepticism among surgeons about the validity of reporting individual outcomes publicly and using such data to structure pay-for-performance programs.³⁷

Although we understand the desire of consumers and patient advocates to improve outcomes, we think that the punitive approach to minimize readmissions is not justified,⁷ especially when many of our readmissions are not preventable. Many patients who need to be readmitted to the hospital have complex illnesses, and the decision making process to readmit these patients is equally difficult and requires flexible, patient-centered care systems as described by Berwick.⁸ The justification of a readmission takes a significant understanding of the disease process developed over years of clinical experience. Further supporting this argument of justified readmissions, Gawande²³ has concluded that great institutions do not simply minimize complications but “rescue” patients from their complications before they become “catastrophes.”

It may be counterproductive for experienced clinicians to be “looking over their shoulder” due to financial penalties associated with readmission when it is ultimately the best avenue of care for that patient. Thus, an unintended consequence of this policy may be to prevent optimal care involving readmissions for neurosurgical patients needing inpatient care. The results of this study demonstrate that the majority of neurosurgical readmissions are unpreventable; in fact they may reflect exceptional care in avoidance of further

complications and in managing complicated diseases. It should be noted, however, that we would not have been able to make this assertion without a thorough review of our readmissions and that we did identify areas for improvement. There is concern, however, that the misuse of such data may lead to worse rather than better patient care, as described above.

Conclusions

Hospital readmissions in neurosurgical patients represent a complex spectrum of diagnoses and decisions that correctly call for inpatient care. In the patients of this study, many readmissions were related to the need for management of unpreventable adverse events. Inpatient care under these circumstances ensures patient safety by avoiding the consequences of delayed diagnosis and the benefit of resolution of an adverse event. Continued efforts to reduce adverse events in neurosurgical patients will remain an essential component of appropriate specialty surgical care, and readmission penalties will not change that obligation we have to our patients.

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Abbreviations used in this paper

CMS	Centers for Medicare and Medicaid Services
SDH	subdural hematoma
SSI	surgical site infection
VTE	venous thromboembolism

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TABLE 1

Demographic data in 348 patients with early readmission after discharge from the neurosurgical service*

Variable	Value (%)
total patients	348
male	186 (53.4)
female	162 (46.6)
mean age (yrs)	54.8
range	16–96
age ≥ 65 yrs	109 (31.3)
mean no. of days [†]	10.5
range	1–30
race	
white	277 (79.6)
black	61 (17.5)
other	10 (2.9)

* Early readmissions are defined as those occurring ≤ 30 days after discharge. Note that sex is distributed approximately equally for readmitted patients. The proportion of patients ≥ 65 years of age was not significantly different than expected for the numerical age range ($p = 0.19$).

[†] The mean number of days between discharge and readmission.

TABLE 2

Distribution of type of early readmission versus insurance type in 407 cases *

Early Readmission [†]	No. (%)	Mean No. of Days [‡]	Insurance Type, No. (%)	
			Private	Public/Uninsured
scheduled	113 (27.8)	19.8	51 (45.1)	62 (54.9)
potentially preventable AE	149 (36.6)	9.86	66 (44.3)	83 (55.7)
wound complication	49 (12.0)			
nosocomial infection	22 (5.41)			
postop complication	15 (3.69)			
CSF leak	14 (3.44)			
VTE	10 (2.46)			
postop pain	10 (2.46)			
fall	8 (1.97)			
other	21 (5.16)			
AE despite best practice	67 (16.5)	12.0	20 (29.9)	47 (70.1)
hydrocephalus/shunt	35 (8.60)			
new neuro Sxs	11 (2.70)			
unrelated stroke	3 (0.74)			
other	18 (4.42)			
AE due to progression of NHD	48 (11.8)	9.33	18 (37.5)	30 (62.5)
unrelated	30 (7.37)	17.7	13 (43.3)	17 (56.7)
total	407 (100)	10.5	168 (41.3)	239 (58.7)

* AE = adverse event; neuro = neurological; NHD = natural history of disease; Sx = symptom.

[†] After excluding patients admitted for electively scheduled procedures, the majority were readmitted for reasons that were not preventable, such as progression of natural history of disease, unpreventable complications like new neurological deficits, or disease processes unrelated to the original admission. The majority of readmissions were in patients who were publicly insured or uninsured (58.7%), but the reasons for readmission between privately and publicly insured patients were not significantly different ($p = 0.09$).

[‡] The mean number of days between discharge and readmission.