Changing Patterns of Hospital Use for Patients with Musculoskeletal Diseases in Michigan, 1980 to 1987

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Over the past 10 years there have been dramatic changes in health care financing in the United States, such as Medicare's Prospective Payment System for hospitalized Medicare beneficiaries, and in health services delivery, such as the growth in health maintenance organizations and other forms of managed care. These changes have occurred largely in response to payors' concerns about the rising cost of health care. A study of such changes in financing and delivery, and how specific groups of patients are affected is necessary so that the effects of these changes on patients' health can be determined.

We examined the hospitalization rates for patients with musculoskeletal diseases in Michigan from 1980 through 1987. During this period, the overall age-adjusted hospitalization rates decreased 7.0% per year ($p = 0.001$). The decrease occurred less for surgical discharges (6.0% per year) than for medical discharges (8.6% per year) ($p < 0.001$). While these overall trends are of interest, they obscure disease-specific trends that vary significantly from both the overall, and the medical and surgical trends. For example, while surgical discharges, in general declined, procedures related to major joint and limb reattachment (DRG #209) increased at a rate of 6.3% per year. And while medical discharges in general decreased over this period, discharges for osteomyelitis increased 5.4% per year. The patterns of disease-specific trends offers insight into the possible causes for these changes. Finally, it is important to understand the epidemiology of hospital use to evaluate the effects of new medical care delivery and payment systems on the care of subsets of patients.

Over the period from 1975 to 1987 health care costs in the United States rose from $133 billion or 8.3% of the gross national product to $500 billion or 11.1% of the gross national product [1]. The treatment of patients with musculoskeletal diseases accounts for a significant proportion of the nation's health care costs [2]. As noted in the National Medical Care Expenditure Survey (NMCUES), approximately 20% of the noninstitutionalized population has musculoskeletal disease. Total charges for the treatment of these conditions accounted for more than $12 billion or 8% of the United States' total health care costs of the civilian noninstitutionalized population in 1980. While approximately 40% of all health care expenditures are related to hospital care, according to NMCUES, 59% of the charges for musculoskeletal conditions in 1980 occurred in an in-hospital setting, demonstrating the importance of hospital-based care for patients with musculoskeletal disease [2].

The decade of the 1980s witnessed dramatic changes in the delivery and financing of medical care. Perhaps the single most important change in the 1980s

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was the introduction of Medicare's Prospective Payment System (PPS) for hospitalized Medicare beneficiaries [3]. Under the Medicare Prospective Payment System, hospitals are paid based upon a patient's diagnosis related group (DRG). The DRG is determined by the patient's principal diagnosis, age, presence or absence of comorbidity and/or complication, type of surgical procedure, and the like [3]. The Medicare PPS system was introduced in October 1983; hospitals were placed on the system at the beginning of their fiscal year, and, therefore, they were placed on the system during the 1983 to 1985 calendar period.

Coupled with this change in payment, there was new emphasis in managed care systems such as health maintenance organizations and preferred provider organizations. These changes in financing and delivery of care led to fundamental changes in the use of the hospital as a site of care. Over the period of 1980 to 1984, there was a statistically significant decline in total Medicare hospital discharges, and in length of stay [4]. While overall trends are of general interest, they often obscure important differences in utilization between diseases and procedure. To understand how hospital utilization for musculoskeletal diseases changed, we examined hospital utilization for patients with musculoskeletal diseases in Michigan from 1980 to 1987, both in the aggregate and at the DRG-specific level.

METHODS

Patient Population

Hospital discharges identified for this study were obtained from the Michigan Inpatient Database (MIDB). The MIDB is a computerized file of all Michigan residents who were hospitalized in Michigan hospitals and from Michigan border communities to hospitals in the states of Ohio and Indiana. In 1980, there were over 1.5 million hospitalizations in the over 200 Michigan and border community hospitals. All admissions from the Major Diagnostic Category (MDC) #8, Disease and Disorders of the Musculoskeletal System and Connective Tissue (DRG 209-256), were included, a total of 147,637 hospital discharges in 1980. (Note: A new DRG, #471, Bilateral Multiple Major Joint of the Lower Extremity, was subsequently added to the DRG system; this DRG is also included.)*

*Certain DRGs that were segregated and the basis of patients' comorbidity/complication or age were collapsed and given the label of the fist DRG for the purposes of the analysis. 209 = 209 + 471; 210 = 210 + 211 + 212; 214 = 214 + 215; 218 = 218 + 219 + 220; 221 = 221 + 222; 223 = 223 + 224; 226 = 226 + 227; 228 = 228 + 229; 233 = 233 + 234; 240 = 240 + 241; 244 = 244 + 245; 250 = 250 + 251 + 252; 253 = 253 + 254 + 255.

Statistical Methods

The observed variation in hospital discharge rates consists of two elements, random variation and actual differences in discharge rates over time. It is important to distinguish between random variability and that caused by the temporal trend. A Poisson regression model with an extra systematic component of variance enables us to distinguish between the random variation and that caused by the temporal trend [5]. The expected number of discharges was calculated using indirect age adjustment based on the average 8-year (1980 to 1987) statewide discharge rate as the "standard" population [6].

The data analyzed were at the state level over the 8-year period. In order to test for a steady increase or decrease in hospital discharges, a time trend variable for year (0,1, . . . , 7) was included in the Poisson regression models. The statistical significance of the time trend variable was determined by comparing the appropriate likelihood ratio statistics with the chi-square distribution with one degree of freedom. Using the coding (0,1, . . . , 7) assumes a linear time trend that may not be appropriate for all DRGs. Formal tests of linearity were computed as the difference in the scaled deviance from the linear trend model to a model that used indicator variables to represent the years. None of the tests provided evidence against the assumption of a linear trend. In order to test whether a specific DRG time trend differed significantly from all the other DRGs within the medical or surgical DRGs, an indicator variable for the DRG and the two-way interaction with time were added to the models. Likelihood ratio tests were used to determine whether differences were statistically significant [7]. All statistical tests were adjusted utilizing the Bonferroni correction [8].

RESULTS

Comparison with Overall Trends

The overall trend in hospital discharges for patients in Michigan with diseases other than musculoskeletal was a decrease of 3.8% per year ($p < 0.001$). We compared the hospital discharge rates for patients with musculoskeletal disease to those for all other patients in Michigan from 1980 to 1986. Patients with

musculoskeletal disease experienced an overall decrease in hospital discharges that was 3.3% per year more (in the same negative direction) than the overall trend ($p < 0.05$).

Musculoskeletal Hospital Discharge Trends, 1980 to 1987

The time trend in musculoskeletal hospital discharges in Michigan from 1980 to 1987 was a 7.1% decrease per year ($p < 0.001$). The decrease in surgical discharges (DRG 209-234,471) was 6.0% per year ($p < 0.001$), while the trend for medical musculoskeletal diseases (DRG 235-256) was a decrease of 8.6% per year ($p < 0.001$).

Individual DRG Time Trends

While the overall surgical and medical hospital discharges for patients with musculoskeletal diseases decreases at a similar pace, individual DRGs experienced markedly different time trends (see Table 1).

While surgical DRGs had an overall 6.0% per year decrease in discharges, the rates for some DRGs decreased by much more, e.g., DRG 232, Arthroscopy, experienced a 36.9% per year decrease in admissions, while others such as DRG 217, Wound Debridement and Skin Graft Except Hand, experienced a 9.7% per year increase (see Table 1).

The same spectrum of variation in admissions can be seen in the medical DRGs, which had an overall 8.6% decrease in discharges. Individual DRGs experienced different degrees of change in hospital discharges, ranging from DRG 238, Osteomyelitis, which experienced a 5.4% per year increase, while DRG 246, Non-specific Arthropathies, experienced a 19.4% per year decrease (see Table 1).

Comparison to Overall Medical and Surgical Trends

While the overall trends in Medical and Surgical Musculoskeletal DRGs are of interest, of greater interest are the intraspecialty trends. If we can identify statistically significant differences in discharge rates of individual DRGs when compared to the corresponding medical and surgical time trends, we can highlight areas in which shifts in the site of care or the scope of care have occurred. In better identifying these dramatic shifts in care, specialists and health care researchers can focus on important subsets of patients to insure that this care has not been compromised by the change in health care delivery.

Thus, we compared each surgical DRG to the overall surgical time trend and each medical DRG to the overall medical time trend. Table 1 identifies those DRGs whose time trend differs significantly from the specialty time trend. Fully $\frac{11}{16}$ of the surgical DRGs had time trends that differed significantly from the overall *surgical* time trend. Despite the fact that surgical DRGs, in aggregate, experienced a 6.0% per year decrease in hospital discharges, $\frac{5}{12}$ surgical DRGs actually experienced an increasing number of discharges. DRGs such as 209, Major Joint and Limb Reattachment (6.3% per year increase), and 214, Black and Neck Procedures with comorbidity-complications (3.2% per year increase) experienced an increase in hospital discharges, while DRGs such as 232, Arthroscopy (36.9% per year decrease) and 225 Foot Procedures (20.3% per year decrease) experienced marked decreases in hospital discharges. The same type of variability from the overall trend also occurred in the medical DRGs in which $\frac{5}{16}$ medical DRGs had time trends that differed from the overall *medical* trend (see Table 1). Unlike the surgical cases, a smaller number of medical DRGs experienced an increase in hospital discharges ($\frac{3}{12}$).

DISCUSSION

The reasons for the observed changes in hospital discharges in Michigan are multifactorial and likely vary from disease to disease. While the reason(s) for the change in hospitalizations can vary, there are three principal etiologies: shift from inpatient to outpatient setting, changes in coding practice, and changes in availability of technology.

The shift from the inpatient to the outpatient setting is a major force behind many of the changes seen in the time trend analysis. Conditions such as tendonitis, fractures of the arm, and procedures such as arthroscopy, and selected foot, hand, and knee procedures, are now more likely to be performed in outpatient settings. The motivation to shift the site of care from an inpatient to an outpatient setting is largely monetary. Many third-party payors have instituted preadmission review programs that exclude certain diagnoses or procedures from in-hospital reimbursement if the patient is otherwise healthy. A further indication of the shift has been the dramatic growth in ambulatory surgery centers.

All diagnostic information is coded in the International Classification of Diseases—9th edition, Clinical Modification (ICD-9-CM). The interest in coding accuracy was obviously heightened with the advent of Medicare's DRG-based Prospective Payment System (PPS). Under PPS, hospitals are paid based upon the diagnostic characteristics of their patients modified by the patient's age, procedures typically performed in the operating room, significant comorbidities and complications, and, for a small subset of

TABLE 1

Hospital Discharge Rate Time Trends in Michigan for Patients with Musculoskeletal Diseases 1980–1987, DRG Level Analysis[a]

Surgical			Yearly change %
DRG	N, 1980		
209[b]	5509	Major joint and limb reattachment	6.3[c]
210[b]	6218	Hip and femur except major joint, age >17 with CC	0.1
213	173	Amputation	2.8
214[b]	8593	Back and neck procedures with CC	3.2
216	408	Biopsy	-0.9
217[b]	681	Wound debridement and skin graft except hand	9.7
218[b]	5514	Lower extremity and humerus except hip, foot and femur, age >17 with CC	2.3[c]
221[b]	11755	Knee with CC	-23.6[c]
223[b]	3633	Major shoulder/elbow procedure, or other upper extremity procedure w CC	1.0
225[b]	13727	Foot	-20.3[c]
226	4902	Soft tissue with CC	-9.4[c]
228[b]	7873	Major thumb or joint procedure, or other hand or wrist procedure with CC	-17.9[c]
230	1147	Local excision and removal of internal fixation devices of hip and femur	-9.4[c]
231	3863	Local excision and removal of internal fixation devices except hip and femur	-14.4[c]
232[b]	1633	Arthroscopy	-36.9[c]
233[b]	3835	Other musculoskeletal system and connective tissue or procedures with CC	-10.0[c]

Medical			Yearly change %
DRG	N, 1980		
235[d]	1125	Fracture of femur	-2.4
236[d]	2298	Fracture of hip and pelvis	0.4
237	299	Sprain, strain and dislocation of hip, pelvis and thigh	5.7[c]
238[d]	513	Osteomyelitis	5.4[c]
239[c]	2504	Pathological fracture and malignancy	1.0
240	3625	Connective tissue with CC	-9.0[c]
242[c]	355	Septic arthritis	3.5
243	31988	Medical back	-8.7[c]
244	3866	Bone disease and specific arthropathies with CC	-18.7[c]
246	695	Nonspecific arthropathies	-19.4[c]
247	5047	Signs and symptoms	-17.9[c]
248	2089	Tendonitis, myositis, and bursitis	-12.7[c]
249	824	Aftercare	-13.4[c]
250	2901	Fracture, sprain, strain and dislocation of forearm, hand and foot, age >17 with CC	-11.0[c]
253	7553	Fracture, sprain, strain and dislocation of upper arm and lower leg, age >17 w CC	-8.0[c]
256	2491	Other musculoskeletal system and connective tissue diagnoses	-8.4[c]

CC, patient had a diagnosis on the DRG comorbidity or complication list; OR, operating room.

[a]See footnote on page two.

[b]Surgical DRGs whose change in hospital discharges differs significantly from the overall surgical trend ($p<0.001$).

[c]$p<0.001$.

[d]Medical DRGs whose change in hospital discharges differs significantly from the overall medical trend ($p<0.001$).

patients, their disposition. One of the first changes noted in coding was the shift from nonspecific (and less costly) codes to more precise codes [9]. Thus, it is not surprising to find that DRGs such as 256, Other Musculoskeletal System and Connective Tissue Diagnoses, or DRG 247, Signs and Symptoms, experienced a decline in admissions. Although a component of the fall in discharges from these DRGs is likely due to the shift to the outpatient site, another reason is the improved description of patients' diagnostic information and, therefore, a shift to more specific DRGs [9].

A final category to explain some of the observed increases in hospital admission rates has to do with improved technology, and the wider availability of the technology. In the surgical DRGs, the increased number of discharges in DRG 209, Major Joint and Limb Reattachment, identifies an emerging technology whose use has increased over this period. The increased number of discharges in DRG 238, Osteomyelitis, is likely due to improved technology that has facilitated our ability to make this diagnosis. In addition, a component is likely due to improved diagnostic coding.

We have shown that there has been a dramatic decline in age-adjusted hospital discharges for patients with musculoskeletal diseases. The overall decline, however, obscures significant differences at the level of the DRG. The trends that we have seen over the decade of the 1980s will probably slow in the 1990s. The reasons for the slowing are threefold:

1. Many of the financial and administrative changes contemplated have already taken place (e.g., PPS, preadmission review, etc.).
2. Many of the improvements in coding have already occurred.
3. It is likely that we have gone as far as possible in reducing hospital admissions and, in fact, in some cases too far, and we will see a stabilization or even a reversal of these trends.

It is important to highlight change in clinical practice and to pinpoint where it has been most dramatic, so the health effects on patients can be studied. It is hopeful that the new Agency for Health Care Policy and Research in the United States, with the mandate to study outcome and effectiveness of care, will focus on conditions undergoing the most flux in clinical practice for in-depth study, to insure that patients with diseases undergoing most rapid change in health care delivery are not adversely affected.

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REFERENCES

1. Letsch SW, Levit KR, Waldo DR. National health expenditures. Health Care Financing Review 1988:101–109
2. Murt HA, Parsons PE, Harlow WR, et al. Disability, Utilization, and Costs Associated with Musculoskeletal Conditions, United States 1980. National Medical Care Utilization and Expenditure Survey, Series C, Analytical Report No. 5. DHHS Pub. No. 86-20405. National Center for Health Statistics. Public Health Service, Washington. U.S. Government Printing Office, September 1986
3. Vladich BC. Medicare hospital payment by diagnosis-related groups. Ann Int Med 1984: 100:576–591.
4. Desharnais S, Kobrinski E, Chesney J, Long M, Ament R, Fleming S. The early effects of the prospective payment system or inpatient utilization and the quality of care. Inquiry 1987:2417
5. Breslow NE. Extra Poisson variation in log-linear models. Appl Stat 1984:33–38.
6. Fleiss JL. The Standardization of Rates. Statistical Methods for Rates and Proportions, 2nd ed. New York, Wiley, 1981
7. McCullagh P, Nelder JA. Generalized Linear Models. Appendix A, 2nd ed. New York, Chapman and Hall, 1989.
8. Elston RC, Johnson WD. Essentials of Biostatistics. Guide to a Critical Evaluation of Published Reports. Philadelphia, FA Davis, 1987
9. Carter GM, Newhouse JP, Relles DA. How Much Change in the Case Mix Index is DRG Creep? Santa Monica, CA, RAND Corporation, 1990