Repeated Hospitalization for the Same Disease: A Multiplier of National Health Costs

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MEDICAL SUCCESS (SHORT OF CURE) AND FAILURE (short of death) favor patient recidivism, or repeated hospitalization for treatment of the same disease. This phenomenon has become a remarkably prominent factor in the national cost of illness, in the utilization of general hospitals, and in the future plans of many patients and families. It is a reflection of both bioscience advance and public expectation.

For example, the birth of a child with major congenital defects brings a social mandate for prolonged, repetitive, and expensive therapy once the child has survived the first few hours after birth. In end-stage chronic renal failure, kidney dialysis requires lifelong, repetitive therapy, and even kidney transplantation will sometimes lead to repeated hospitalization. By the same token, total hip replacement, if successful, leads the patient directly to repair of the other hip as soon as it becomes symptomatic; if unsuccessful, complications of total hip replacement can be among the most expensive episodes in orthopedic surgery. Other such repetitive, and therefore predictable, illnesses include cirrhosis of the liver in chronic alcoholism, poorly

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controlled diabetes, cancer, degenerative vascular disease, intractable anemia, chronic obstructive lung disease, and mental disease. In all, a superior science has made possible the first step, yet the sequelae continue to demand medical resources. These are the substrates on which American medicine spends so many billions of dollars. These—not the episodic cancer or chest trauma on a respirator—are the high-cost users.

A previous study (Zook and Moore, 1980) found that a comparatively small fraction of hospital patients, about 13 percent, utilized over half of hospital resources in a year. This finding held true across widely differing hospital populations. Yet, high-cost patients were not predominantly those in intensive care after major trauma, or "brain death" patients in terminal condition. Rather, the typical high-cost patient experienced multiple hospitalizations for the same disease, often a disease from which death is not even likely in the short term. Analysis beyond a single year revealed an even more significant cost of repeated hospitalization for the same disease (RHSD).

Gruenberg (1977) emphasized the importance of long-term illness in the national medical budget and suggested that its frequency was increased by improvements in medical procedures. Reduction of mortality from severe or chronic illness lengthens the average duration of the illness and increases its frequency in the total population. Over time, these RHSDs can be extremely demanding of medical resources. The maintained treatment posture (with neither cure nor death) is a remarkable cost-multiplier that can be ascribed to a small group of patients.

In this paper we examine the fiscal and clinical nature of repeated hospitalization for the same disease, in several different types of short-stay hospitals. The data were developed from a random sample of 2,238 medical records in six contrasting hospital populations. Because previous research has often underestimated the full long-term cost of an illness by failing to link repeated admissions of the same patient over time, each record was linked across earlier hospitalizations for the current illness to provide a longitudinal profile of repeated admissions.

Hospital recidivism has three principal implications for public health policy. First, if there are predictable, high-cost groups of "repeater" patients with particular illnesses (e.g., renal failure) or traits (e.g., alcoholism or extreme obesity), public health policies targeted at

such groups might well achieve major economies. One such program of vigorous follow-up and increased medical compliance for diabetics reduced the incidence of hospital readmission in that group by 56 percent (Miller and Goldstein, 1972).

Second, medical recidivism has implications for the design of major-risk health insurance. If many high-cost patients suffer illnesses with predictably high utilization rates spread over years, a one-year eligibility definition will be inequitable, and will fail to provide financial incentives for more effective modes of long-term, preventive, or follow-up care. In addition, greater attention needs to be paid to the use of premium design and coinsurance to channel recidivist patients down the most cost-effective, long-term track of care.

Third, unusually high rates of readmission by certain hospitals, doctors, or communities might signal possible provider accountability or overuse of medical resources. Financial incentives in health insurance should be structured to discourage costly hospital readmissions when preventive programs and low-cost alternatives are available.

Method

Data and Definitions

Medical records for 2,238 patients were selected on the basis of a random sample of hospital discharges in 1976 from six diverse hospital populations in Massachusetts. Hospital A was a large teaching and referral hospital for adults. Hospitals B1 and B2 were, respectively, the medical-surgical service and the spinal-cord injury center of a Veterans Administration (VA) hospital. Hospital C was a suburban community hospital. Hospital D was a large teaching and referral hospital for children. Hospital E was a tax-supported municipal hospital.

In each hospital we selected records of patients discharged on particular days in 1976. These days were chosen by a randomized scheme that ensured an adequate representation of holidays, seasons of the year, and days of the week, since patient-discharge mix varies greatly over time. The sample as a percent of all discharges in the year was chosen to vary across hospitals, because of the wide range of institutional sizes. These sampling characteristics are summarized in Table 1.

TABLE 1
Sample of Patient Discharges from Six Hospitals in 1976

Hospital	Type	Number of Beds	Hospital Discharges Recorded by Hospital	Number of Records Sampled	Sample Fraction of All 1976 Discharges
A	Adult teaching-referral hospital	330	10,450	576	5.5%
B1	Veterans hospital (medical-surgical)	160	2,820	305	10.8
B2	Veterans hospital (spinal cord injury)	100	540	86	15.9
C	Community suburban hospital	275	9,110	455	5.0
D	Children's teaching-referral hospital	340	13,170	410	3.1
E	Tax-supported municipal hospital	190	6,790	406	5.9
		1,395	42,880	2,238	5.2%

The retrospective nature of these data means that the illness experiences are truncated, and understate the amount of lifetime readmission for any one patient and illness because the future is still unknown. Our data do not include readmissions throughout the entire illness, only the experience to date. However, sampling on the basis of discharges does provide aggregate evidence on the long-term importance of RHSD. The significance of RHSD can be assessed by comparing the number of readmissions with the number of first admissions for each disease category.

Billing data were obtained from a random sample of 30 percent of the indexed hospitalizations in each hospital, except for the VA hospital where bills are not computed. (The administrative cost of obtaining these old bills restricted the study to a sample that was sufficiently large to permit precise statistical estimation of the others.) To estimate missing billings for the indexed hospitalizations, a day-rating scale was developed. This represented five different degrees of complexity of care in a hospital day. The five groups ranged from a "1-day," a low-intensity day of dwelling or only the most minor testing, to a "5-day," a high-intensity day of emergency intensive care or full life-support services.

Observations were reweighted individually to account for proportional oversampling of repeating patients.[1] For instance, in estimating frequencies, data from patients seen twice in a hospital in 1976 were weighted by one-half, as compared with patients seen only once. In the absence of this reweighting, patients who experienced multiple admissions would be overrepresented in any frequency estimates for the patient population. For further details of the record review and data retrieval, see Zook and Moore (1980).

Each of the 2,238 records had every day of its indexed hospitalization fully characterized by this scale. Thus, a five-day stay might have the pattern: 2, 3, 2, 1, 1. For each hospital, the average billing for each day category was estimated from billing data for 30 percent of patients. This was done by regressing the total bill for each patient on the number of days in each category. The regression weights can be

[1] Several studies have found, in fact, that the most variable components of utilization across regions of the country (Gornick, 1977), across types of insurance plans (Luft, 1978), and across cost strata (Zook and Moore, 1980) are hospital admission and readmission rates, as opposed to length of stay or cost per day.

interpreted as the average charge for each category of day. Multiplying these five weights by the number of days in each category and summing yields an estimate for billings that has a .94–.98 correlation with the actual bills available. For days in categories 1 through 5 at Hospital A, these weights were, respectively, $216, $271, $426, $914, and $1,447. Combining this with the day rating profile 1, 1, 3, 2, 1, for instance, would yield an average bill of $1,345 (216 × 3 + 271 + 426). The scale and more detail on estimation are available upon request from the authors. Charges at the VA hospital, where no bills are computed, were estimated by combining day ratings, the average cost per occupied patient day (about $200), and the relative day weights for Hospital A. The average charge per day at the VA hospital was constrained to equal its $200 average.

Repeated hospitalization for the same disease was defined by a diagnostic classification system containing nineteen principal categories (listed in Table 3). All repeated hospitalizations in the years before the sampled hospitalizations were coded, whether at that or at another hospital. Multiple (different) illnesses were not studied; data collection was limited to treatment of the illness causing the current (index) admission.

Repeated hospitalizations were determined through page-by-page reading of the complete medical record, including all previous admissions at that hospital, all physician notes, patient histories, referral letters, and copies of discharge summaries from other facilities.

Results

The Frequency of RHSDs

Patients with repeated hospitalizations for the same disease were found frequently in each hospital population. (Reference to patients, as opposed to single hospitalizations, implies that data frequencies were corrected by a simple adjustment factor for oversampling of repeatedly hospitalized individuals.) Of our total sample of 2,238 hospital discharges in 1976, 1,170 (52 percent) were RHSDs. Between 40 percent at Hospital C and 70 percent at Hospital B1 of single hospitalizations were RHSDs, and in the spinal-cord injury center the proportion rose as high as 97 percent (Table 2).

TABLE 2
Fraction of All Single Hospitalizations That Are RHSDs, over Retrospective Time Intervals

Hospital	Retrospective Time Intervals				
	One Year	Two Years	Five Years	Ten Years	All Years
A	39.5%	45.6%	53.0%	55.3%	55.6%
B1	44.3	60.4	68.0	69.3	70.2
B2	69.9	90.7	94.2	96.5	96.5
C	25.3	32.1	37.6	38.9	39.6
D	37.6	43.4	47.8	49.7	50.5
E	26.6	34.7	38.9	40.6	40.7

Long-term illness was surprisingly frequent in these "short-stay" hospital populations. At least five previous hospitalizations for the same disease were experienced by 27 percent of patients seen in 1976 in the VA hospital (B1), 14 percent in the children's referral hospital (D), 8 percent in the small, suburban community hospital (C). The spinal-cord injury center had a rate of 69 percent. If readmissions were of very short duration, as compared with first admissions, they might be of secondary cost-importance; on the contrary, however, readmissions were above average both in duration and in unit cost.

Patients with repeated hospitalizations had their first hospitalization an average of six years before the indexed discharge. This range is shown (Table 2) as the percentage of repeated hospitalizations within various retrospective time periods (one, two, five, ten, and all years). The proportions for one year ranged from 25 percent in Hospital C, to 44 percent at Hospital B1, to 70 percent at Hospital B2.

Costs of RHSDs

RHSD accounted for approximately 60 percent of all hospital charges. Repeated hospitalizations were generally more expensive than the first hospitalization. Across hospitals, repeated hospitalizations were from 24 percent (Hospital E) to 55 percent (Hospital B1) more expensive than first admission. Even in the suburban community hospital, Hospital C, repeated hospitalizations accounted for 48 percent of total billings and were 42 percent more expensive per incident

than nonrepeated hospitalizations. Consequently, repeated hospitalizations accounted for a disproportionate share of total hospital charges, ranging from 46 percent at Hospital E to 79 percent at Hospital B1.

The frequency distribution of billings for repeated and nonrepeated hospitalizations showed that, on average, the cost of repeated admissions had a higher overall mean ($3,111 versus $2,040, in 1976 dollars) and greater density in the upper tail of the unit-cost curve. The proportion of single hospitalizations with billings over $2,000 ranged from 17 percent (Hospital C) to 46 percent (Hospital A), as compared with the proportion of repeated hospitalizations, which ranged from 28 percent (Hospital E) to 64 percent (Hospital A). RHSDs accounted for a majority of hospitalizations and of hospital resources.

To determine whether this might be due to some intervening variable, such as diagnosis, an additional calculation was made. For each major diagnostic group a regression equation was fitted, with billing as the dependent variable, and patient sex, hospital, age, personal habits indicated in the record, race, secondary diagnosis, and employment status, as independent variables. An indicator as to whether or not that hospitalization was a repeat was also included. The coefficient on this variable can be interpreted as the billing premium associated with repeated hospitalization.

By this regression method, repeated hospitalizations were found to cost substantially more than first hospitalization for gastrointestinal disease (by 45 percent), orthopedic disorders (by 16 percent), infectious disease (by 24 percent), peripheral vascular disease (by 56 percent), and for all other illnesses together (by 30 percent). Repeated hospitalizations were found to be *less* costly than the first admission for vascular disease of the heart and for spinal cord injury. There was no statistical difference with first admissions for cancer, lung disease, and endocrine-metabolic disease.

Diagnostic Categories Where RHSD Was Frequent

The long-term, repetitive nature of an illness is reflected in the frequency of RHSD, shown in Table 3. (Some might question whether more categories, refined from the nineteen here, would also show

TABLE 3
Ratio of Repeated to First Hospitalization by Diagnostic-Related Group for All Hospitals Together*

Diagnostic Category	Proportion (P) of Hospitalizations That Were Repeated†	Ratio of Repeated to Nonrepeated Hospitalizations‡ (P/1-P)	Average Number of Stays per Illness Episode (1/1-P)	Number in Sample
Spinal cord injury	95.3% (2.3)	20.50 (13.3, 40.7)	21.50	86
Renal failure	94.7 (3.6)	18.00 (10.2, 57.8)	19.00	38
Alcohol-related gastrointestinal disease	80.0 (10.3)	4.00 (2.3, 9.3)	5.00	15
Disease of the blood	78.1 (7.3)	3.57 (2.4, 5.8)	4.57	32
Cancer	73.8 (3.5)	2.82 (2.4, 3.5)	3.82	157
Benign lung disease	70.9 (5.8)	2.44 (1.9, 3.3)	3.44	61
Chronic or degenerative vascular disease	70.8 (2.3)	2.43 (2.2, 2.7)	3.43	399
Congenital defects	68.8 (4.0)	2.21 (1.8, 2.7)	3.21	135
Endocrine/metabolic disorders	62.2 (6.7)	1.65 (1.3, 2.2)	2.65	53

Neuromuscular disease	62.1 (8.0)	1.64 (1.2, 2.3)	2.64	37
Mental disease	61.5 (5.5)	1.60 (1.3, 2.0)	2.60	78
Benign bowel disease	50.2 (4.1)	1.01 (.9, 1.2)	2.01	145
Orthopedic conditions	41.1 (4.0)	.70 (.6, .8)	1.70	148
Gynecological disorders	37.9 (6.8)	.61 (.5, .8)	1.61	58
Disease of the eye	35.5 (6.0)	.55 (.4, .7)	1.55	62
Trauma	33.8 (3.2)	.51 (.4, .6)	1.51	220
Genitourinary disease	24.8 (8.8)	.33 (.2, .5)	1.33	24
Infectious disease	24.8 (8.8)	.33 (.2, .5)	1.33	24
Other illnesses	19.4 (2.4)	.24 (.2, .3)	1.24	228

* The sample size by disease did not permit precise estimates for each hospital.
† Standard deviation in parentheses.
‡ Range shown is for recidivist proportion ± 1 standard deviation.

high RHSD rates or whether, in some sense, this is an artifact of the method. To examine this, we refined the system to fifty-five groups and found similar results.) If, for example, the number of first and repeated admissions in our sample were equal, then the average case of that illness would have two expected admissions over its duration. Each first hospitalization would be matched by a repeated hospitalization; an illness with a ratio of 3:1 would therefore have four admissions during its average course.

Table 3 gives the ratio of repeated to nonrepeated hospitalizations by diagnosis for all hospitals pooled together. Our sample was not large enough to give precise disease-by-disease estimates separately for each hospital, though the most repetitive illnesses tended to be the same ones across hospitals. The actual level of hospitalizations per illness was slightly greater in the teaching and the VA hospitals. For instance, repeated hospitalizations in vascular disease varied from 56 percent in the municipal hospital, to 64 percent in the adult teaching hospital, to 80 percent in the VA hospital. For trauma, these percentages were, respectively, 29, 33, and 37 percent. For cancer, they were 53, 75, and 73 percent.

Illnesses that accounted for the most repetitive hospitalizations were spinal cord injury, renal failure, cancer, congenital defects, diseases of the blood, benign lung disease, and chronic degenerative vascular disease. In the tertiary referral hospitals, illnesses requiring repeated and regular life-maintenance therapy (e.g., dialysis for renal failure or transfusion therapy for sickle cell anemia) were frequent among RHSD. Life maintenance accounted for 8 percent of repeated hospitalizations for the same disease in Hospital A and for 18 percent in Hospital D.

In all the hospitals except B2 (the spinal-cord injury center), the seven diagnostic categories listed above accounted for 56 percent of RHSDs, but for only 21 percent of nonrepeated admissions. At the other extreme, patients in eight diagnostic groups accounted for 66 percent of all nonrepeated admissions, but for only 27 percent of RHSD. Illnesses with few repeat episodes included genitourinary disease (male), gynecological disease (female), diseases of the eye, infectious disease, minor orthopedic disorders, pregnancy and related disorders, trauma, and a miscellaneous category of disorders and symptoms.

Potentially Harmful Habits of the Repeaters

Certain groups of patients, especially those with potentially harmful personal habits, were much more likely to be repetitive in their use of the hospital for that illness than were other groups. Table 4 shows the ratio of repeated hospitalizations to first hospitalizations for several contrasting groups of patients.

Substantial diversity existed across hospital populations. Patients treated at the VA hospital had the highest rate of repeated hospitalization, followed by the tertiary referral hospitals, and finally by the community hospitals. Patients over 70 years of age had more repeated admissions than others at Hospital C and Hospital D, but fewer at Hospital A and Hospital B1. Males also had a slightly higher rate of repeated hospitalization than females, except at Hospital D.

TABLE 4
Ratio of Total Repeated to Nonrepeated Hospitalizations in 1976 by Category of Hospital and Patient

Patient Group	Hospital				
	A	B1	C	D	E
All hospitalizations	1.25	2.35	.65	1.02	.68
Age:					
Over 70	1.50	2.09	1.08	—*	1.35
Under 70	1.19	2.38	.56	1.02	.60
Sex:					
Males	1.31	2.38	.78	.88	.82
Females	1.19	—*	.52	1.27	.61
Potentially harmful personal habit noted in the record:†					
Habit-illness link	1.19	4.00	2.00	—*	2.00
Other	1.11	1.54	.45	1.01	.53
History of chronic alcoholism:					
Alcoholic problem	1.93	3.00	3.60	—*	2.82
Other	1.21	2.22	.60	1.02	.58

* Insufficient number in group.
† Possible association of illness with alcohol abuse, heavy smoking, obesity, or drug abuse as noted by physician comments or patient's history in the medical record.

Unhealthy personal habits such as alcohol abuse, drug abuse, extreme obesity, or heavy smoking were especially associated with a high ratio of repeated hospitalization. Patients with a history of chronic alcoholism had a ratio of repeated to first hospitalizations that ranged from 1.9 at Hospital A to 3.6 at Hospital C. The ratio for persons with no alcoholism noted in their history ranged from only .6 in Hospital E to 2.2 in Hospital B1. Patients who were judged on the basis of the medical record to have a potential link between illness and habit had ratios of repeated to first hospitalization that ranged from 1.2 in Hospital A to 4.0 in Hospital B1. Patients whose record showed no such possible link had an average rate that ranged from .5 in Hospital C to 1.5 in Hospital B1.

Regression analysis was used to check whether unhealthy personal habits indicated in the patient's medical record were associated with repeated admission for the same disease even within a diagnostic-demographic category.[2] To examine this we regressed the number of past readmissions on indicators of employment status, marital status, race, age, hospital attended, secondary diagnosis (present or not), sex, and a possible unhealthy habit indicated in the record (yes or no).

Using such an analysis of all diseases together, as well as for single illness groups, we still found readmission much more frequently among patients with an unhealthy habit. On average, the heavy smoker with a benign pulmonary disease had 65 percent more readmissions than other patients who suffered from the same illness. Patients with endocrine metabolic disease, who also were severely obese or alcoholic, had an average of 47 percent more readmissions than those without obesity or alcoholism. For benign gastrointestinal disease the excess share was 59 percent. In virtually every set of calculations—by hospital, by illness, and for all patients together—those with recorded adverse lifestyle factors had more readmissions for their present disease than other patients.

[2] These regressions were estimated by a Tobit maximum-likelihood procedure. Tobit analysis is appropriate when the dependent variable (hospitalizations) is truncated at a point of significant density (no patients have zero, but many have only one hospitalization). Without explicitly modeling this truncation, ordinary least-squares methods would lead to biased estimates. By explicitly modeling the limited data range, bias can be corrected. Tobit analysis was first introduced by Tobin (1956) to estimate regressions for unemployment rates, also a truncated variable.

Discussion

Importance of Long-Term Illness in Short-Stay Hospitals

Repeated hospitalizations for the same disease accounted for more than half of hospitalizations and for nearly 60 percent of total hospital charges. We estimate that a 20 percent reduction in rates of readmission for treatment of the same disease might save well over $11 billion in hospital costs. This special segment of high-cost users deserves special attention by scientists, clinicians, epidemiologists, and economists. Here is the "big expense" area of the budget where small fractional gains have large overall impact.

The few studies that focus upon this phenomenon confirm our findings. Roemer and Myers (1956) found that although 12 percent of middle-aged males under the Canadian National Health System used the hospital in any one year, only 33 percent used it over a period of five years, suggesting a large amount of recidivism. Gornick (1977) found that over a two-year period the share of Medicare patients who had multiple hospitalizations ranged from a low of 29 percent in Maryland to 45 percent in North Dakota. Patients who experienced multiple admissions accounted for 61 percent of all discharges during those two years. Other research in California by Schroeder et al. (1979), and in England under the Oxford Record Linkage Project (Acheson and Barr, 1965) has also found repeated hospitalizations and linked episodes of illness to be of substantial importance in their study populations.

RHSD is a highly nonrandom phenomenon that clusters in certain long-term diagnostic and patient groups. The frequency of medical recidivism has been obscured in previous research on "catastrophic illness," which has focused on annual or short-term, episodic, or partial single-insuror data rather than upon linked record data (Birnbaum, 1978; Trapnell, 1977; Meyer, 1976).

Implications of RHSD for Design of Health Insurance Plans

"Catastrophic health insurance," or insurance to pay for large medical expenses, has been proposed as a low-cost, politically acceptable al-

ternative to complete national health insurance. The typical "high-cost illness" for which these plans are designed (with benefits based on one-year expenditure levels) is the sudden trauma or heart attack requiring intensive care and, often, accompanied by a high short-term mortality rate. Attention has not focused on the repeaters, who may survive for many years and may consume even more medical resources. Our results suggest that, in fact, patients with RHSD may be a more dominant high-cost group than has been heretofore recognized.

Many of the patients with high readmission rates also had notes in their medical records that indicated a potentially harmful habit. When insurance covers the expenses of illness whose incidence and treatment costs are beyond human control or influence, the "moral hazard" of excessive utilization is low. When insurance covers an event that can be influenced by the patient, in part, the "moral hazard" distortion is a more present danger. Components of both types appear among the high-cost patients and should be identified and dealt with separately.

Financial incentives need to be applied to change future behavior, not to punish for the past. Coinsurance to reduce moral hazard could take such forms as premium reductions for nonsmokers and persons at optimal body weight. It should also be possible to introduce premium increases for persons with early signs of an illness related to a current habit. Stoppage of the habit or participation in an educational program could be rewarded by premium reduction. In fact, it is true that stopping smoking even after a long period as a smoker can substantially reverse or retard the course of pulmonary disease (Ebert, 1979).

Companies that fund group plans might be offered financial reward for providing educational and incentive plans in the workplace. Although we do not at present know the exact location of the most promising leverage points, we do know that great opportunity exists. Even relatively mild educational campaigns such as the Stanford Heart Disease Project have induced significant changes in eating and smoking habits.

As we have shown, prevalence rates and the costs of long-term illness are high and are increasing over time. The percentage of persons in the population unable to carry on any major activity increased by 40 percent in the eight years from 1967 to 1974 (2.3 percent to 3.3 percent) and the percentages of persons with some major

chronic limitation of daily living increased by 23 percent (11.5 percent to 14.1 percent) (Department of Health, Education, and Welfare, 1977). Failure to build appropriate long-term incentives into insurance reimbursement, to study specific tracks of long-term illness, and to highlight recidivism as a major cost factor will miss major opportunities for economies and improvements in the health care of the American people.

Our analysis focused primarily upon variations in readmission rates by disease and patient characteristics. However, as we noted earlier, large geographic variations in readmission rates also exist. To understand reasons for regional variations, one would need to look beyond illness mix and patient characteristics to different insurance structures, distances to the hospital, and income levels, to name a few factors. Our analysis is directed to "within-region" variation as opposed to "among-regions" variation. The large cost impact of even small changes in readmission probabilities in a region suggests that efforts be directed towards better understanding of these causes of medical recidivism.

Directions for Future Research

The "hidden" component of repeated hospital utilization demands greater attention. Debate over catastrophic health insurance will require fuller understanding of these recidivist patient groups who consume such large quantities of the national medical resources. In any single year, they may not fall into a "catastrophic" category, but over time they can be among the most expensive of all patients. Moreover, as medicine achieves mortality reduction in persons with these long-term, repetitive illnesses, there will be an increase in their prevalence and total medical costs.

For instance, before 1930 the mortality for spinal cord injury was near 100 percent; now the life table for paraplegics and quadriplegics is converging toward that of the overall population (although with much greater use of the health services). As a result, the number of persons in the population with a spinal cord injury has risen from near zero at the beginning of this century to over 600,000 today. This striking success in medicine is also the cause of higher cost (Smart and Sanders, 1976).

Children with extrophy of the bladder demonstrated a 25 percent

ten-year mortality rate in the 1950s; now the mortality rate is only 2 percent (MacFarlane et al., 1979). Similar advances have occurred in cystic fibrosis, Down's syndrome, pneumonia in old age, childhood leukemia, and other long-term illnesses. More elaborate models of these illnesses are needed to chart their demographic trends and to predict future high-cost utilization for patients in identifiable clinical categories.

Failure to understand these relations was responsible, in part, for original underestimates in 1971 of the cost of the kidney disease amendments of the Social Security Act. In 1972 the Department of Health, Education, and Welfare projected that the cost of the program in 1976 would be $395 million; the actual total was $573 million, rising later to over $1 billion. This 45 percent underestimate (in the comparatively short time of four years) can be traced to underestimation of the effect of an increased number of surviving renal patients on the total number of those patients over time, a failure to appreciate the cost importance of repeated hospitalization for the same disease.

References

Acheson, F.D., and Barr, A. 1965. Multiple Spells of In-patient Treatment in a Calendar Year. *British Journal of Preventive and Social Medicine* 19:182–191.

Birnbaum, H. 1978. *The Cost of Catastrophic Illness.* Lexington, Mass.: D.C. Heath.

Department of Health, Education, and Welfare. 1977. *Limitation of Activity Due to Chronic Conditions.* Public Health Service Publication, Series 10, No. 111.

Ebert, R. 1979. Cessation of Cigarette Smoking and Pulmonary Disease. *Journal of the American Medical Association* 240:2159.

Gornick, M. 1977. Medicare Patients: Geographic Differences in Hospital Discharge Rates and Multiple Stays. *Social Security Bulletin,* June:22–41.

Gruenberg, E.M. 1977. The Failures of Success. *Milbank Memorial Fund Quarterly/Health and Society* 55 (Winter):3–24.

Luft, H.S. 1978. How Do the Health Maintenance Organizations Achieve Their Savings? *New England Journal of Medicine* 296:1336–1343.

MacFarlane, M., Lattimer, J., and Hensle, T. 1979. Improved Life Expectancy of Children with Extrophy of the Bladder. *Journal of the American Medical Association* 242:442–444.

Miller, L., and Goldstein, J. 1972. More Efficient Care of Diabetes in a County Hospital Setting. *New England Journal of Medicine* 286:1388–1391.

Meyer, M.F. 1976. *Catastrophic Illnesses and Catastrophic Health Insurance.* Washington, D.C.: The Heritage Foundation.

Roemer, M., and Myers, G. 1956. Multiple Admission to Hospital. *Canadian Journal of Public Health* 47:469–481.

Schroeder, S.A., Showstack, J.A., and Roberts, H.E. 1979. Frequency and Clinical Description of High Cost Patients in 17 Acute Care Hospitals. *New England Journal of Medicine* 300:1306–1309.

Smart, C., and Sanders, C. 1976. *The Costs of Motor Vehicle-Related Spinal Cord Injuries.* New York: Insurance Institute for Highway Safety.

Tobin, J. 1958. Estimation of Relationships for Limited Dependent Variables. *Econometrics* 26:12–24.

Trapnell, G. 1977. *The Rising Cost of Catastrophic Illness.* Falls Church, Va.: Actuarial Research Corporation.

Zook, C.J., and Moore, F.D. 1980. The High Cost Users of Medical Care. *New England Journal of Medicine* 302:996–1002.

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