Patient, Provider, and Hospital Characteristics Associated with Inappropriate Hospitalization

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RAND

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PREFACE

This report was prepared for the National Center for Health Services Research. It represents further analysis of data collected in the RAND Health Insurance Experiment.

An earlier report published in 1986 in the *New England Journal of Medicine* (Vol. 315, pp. 1259–1266) dealt with the effects of cost sharing on inappropriate use of hospitals. That report also described the variations in inappropriate hospitalization among the six sites in the study. In this report, the authors summarize the results of research examining the relationship between inappropriate hospital use and patient, physician, and hospital characteristics.

SUMMARY

Studies conducted over the last 25 years have suggested that a substantial fraction of hospital use is inappropriate. As much as a quarter of acute hospital care is reported to be unnecessary, when medical records are reviewed. Further suggestive evidence of inappropriate hospitalization appears in studies that have found large geographic variation in surgery rates and in hospital admission rates by diagnostic category. Although these variations have been used to suggest that unnecessary or inappropriate medical services are being provided in high use areas, more recent studies have shown that inappropriate care is provided in both low use and high use areas.

This study examines the relationship between patient and provider (e.g., physician and hospital) characteristics and inappropriate hospital use, in terms of both admissions and days. The study examines adult nonpregnancy hospitalizations from a randomized trial of health insurance, the RAND Health Insurance Experiment (HIE). The data include evaluations of the appropriateness of inpatient treatment based on medical record review, patient characteristics (sociodemographic, economic, and health status), and provider characteristics (specialty and practice patterns for physicians, accreditations and facilities for hospitals).

Women and patients of older physicians are more likely to have been inappropriately admitted to the hospital. Twenty-seven percent of admissions attended by physicians licensed for more than 15 years were judged inappropriate, compared to a corresponding 20 percent for younger physicians ($P < 0.05$). Admissions were more likely to be inappropriate if the patient was female (27 percent compared with 18 percent) ($P < 0.001$). Controlling for patient and provider characteristics reduces but does not eliminate the differences in the appropriateness of inpatient care across the HIE sites. We conclude that patient and provider characteristics influence the likelihood that an admission is inappropriate; however, differences in provider and patient characteristics do not account for geographic differences in inappropriate hospitalization.

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I. INTRODUCTION

As a part of a wider concern for health care cost containment, recent attention has focused on the inappropriate use of hospital care. Recent studies done in different regions of the country, in different types of hospitals, looking at different types of hospital use, and using different methods have all documented substantial inappropriate use of the hospital. The problem exists to varying degrees in all parts of the country. It affects hospitalizations for adults, as well as children (Kemper, 1988). Some studies have focused on the appropriateness of acute hospital level of care (Siu et al., 1986; Kemper, 1988), whereas other studies have also examined the appropriateness of the clinical indications for a given procedure such as carotid endarterectomy, coronary angiography (Chassin et al., 1988), and pacemakers (Greenspan et al., 1988). This report will focus primarily on the factors associated with the inappropriate use of the acute hospital setting or level of care.

Many previous studies have examined the factors associated with inappropriate use. The rate of admissions considered inappropriate varies by region of the country (Siu et al., 1986; Restuccia, 1984; SysteMetrics, 1984), and also by hospitals within a given region (Restuccia, 1986; Borchardt, 1981). Smaller hospitals may have a greater percentage of inappropriate admissions (SysteMetrics, 1984), but the effect of hospital teaching status has been inconsistent in these studies (SysteMetrics, 1984; Restuccia, 1984, 1986).

Several aspects of the hospital stay may be associated with a greater likelihood of the admission being inappropriate, including the proportion of the stay devoted to diagnostic workup, the diagnostic category of the admission, and the urgency or critical nature of the admission (Payne, 1987; SysteMetrics, 1984). For specific hospital days during an admission (rather than the entire admission), the studies generally agree that the likelihood of a day being inappropriate is much greater for certain portions of the hospital stay, such as the last third of the stay (Restuccia, 1984). Apart from payor and patient age, the effect of various patient variables has not been extensively studied. Similarly, apart from physician specialty, the effect of physician characteristics on inappropriate use is unknown.

To develop interventions to reduce inappropriate hospitalization, a greater understanding is needed of the factors associated with such use. Economic mechanisms such as cost sharing have been shown to reduce hospital use, but they may not be an effective mechanism for

selectively reducing inappropriate hospital use while maintaining access to appropriate care (Siu et al., 1986). In the search for methods to deal with this problem, it would be important to define subgroups of patients, physicians, or hospitals that might be appropriate targets for interventions. For example, previous studies have shown that certain patients (Schroeder et al., 1979) and physicians (Roos et al., 1986) account for a disproportionate amount of hospital use (although not necessarily inappropriate use). In this study, we examined the effect of patient, physician, and hospital variables on inappropriate hospitalizations and days, using data from the RAND Health Insurance Experiment (HIE). The HIE data provide some of the most detailed and comprehensive information available on the health status of patients. The present study considers these patient characteristics, as well as the characteristics of the physicians and hospitals providing care in the HIE.

II. METHODS

HEALTH INSURANCE EXPERIMENT DESIGN

Between November 1974 and February 1977, the HIE enrolled families at six sites: Dayton, Ohio; Seattle, Washington; Fitchburg, Massachusetts; Franklin County, Massachusetts; Charleston, South Carolina; and Georgetown County, South Carolina. The sites were selected to represent the four census regions and a range of city sizes, and to include both urban and rural sites in the North and South.

Families participating in the experiment were assigned to one of 14 different fee-for-service health insurance plans. The plans had different levels of cost sharing, which varied both the coinsurance rate (the percentage paid out of pocket) and the stoploss (the upper limit on annual out-of-pocket expenses). Families were enrolled as a unit with only eligible members participating. The experiment excluded those 62 years of age and older at the time of enrollment, those with incomes in excess of $25,000 in 1973 dollars ($61,000 in 1985), those eligible for Medicare disability, those in the military and their dependents, veterans with service-connected disabilities, and individuals imprisoned or institutionalized. The sample of 3413 individuals used in this analysis includes all enrollees who were 18 years of age or older at the beginning of the study. Additional details on the design of the Health Insurance Experiment are available elsewhere (Newhouse et al., 1981, Brook et al., 1983).

Medical records were obtained from 90 percent of the adult hospitalizations in the study. We excluded admissions for labor and delivery, because almost all such admissions would be considered appropriate. We also excluded psychiatric and alcohol rehabilitation admissions (accounting for 7.5 percent of the remaining hospitalizations), because of inconsistent hospital policies regarding the release of these records. This resulted in a sample of medical records from 1132 admissions (Table 1).

As discussed in Siu et al. (1986) and in the appendix, the rate of missing records varied by site and was due primarily to the length of time that elapsed between the end of the experiment and solicitation of patient consent. We obtained patient and hospital descriptors on all 1132 patients for whom medical records were available.

Table 1

ADULT ENROLLMENT AND NONRESPONSE, BY SITE

	Seattle	Dayton	Fitchburg	Franklin	Charleston	Georgetown
No. of enrollees	781	685	415	524	442	556
No. of admissions	256	277	168	163	146	258
Response (% of admissions yielding records)	88.3	79.1	94.6	90.2	93.2	95.0
Months from exit to solicitation of consent[a]	5 or 25	24 or 48	4 or 31	4 or 31	0	0

[a]Two intervals are listed because enrollees exited from the study either three or five years after enrollment.

THE INAPPROPRIATENESS OF HOSPITALIZATION

Consent was obtained from all patients and copies of the hospital records were obtained for all patients who were hospitalized during the experiment.

To determine the appropriateness of hospital admissions or hospital days, we employed the Appropriateness Evaluation Protocol (AEP) (Gertman and Restuccia, 1981; Restuccia, 1984, 1986).[1] In this study, two board-certified physicians reviewed medical records using the AEP. They classified each admission into one of three categories: appropriate, inappropriate, or avoidable by ambulatory surgery. The AEP consists of 18 criteria divided into two types, one listing patient conditions that would require acute hospital care and the other listing specific services that require hospitalization. The appendix contains lists of the appropriate conditions for a hospitalization or a hospital day.

An admission was considered appropriate *if any* of these 18 criteria were met. However, if the reviewer disagreed with the judgment made on the basis of the explicit criteria, the AEP permitted the physician reviewer to overturn (or override) that decision. This override feature is intrinsic to the AEP, whose demonstrated validity takes into account use of the override option. Ten percent of admissions were classified on the basis of such overrides.

To assess whether ambulatory (or short-stay) surgery could have been substituted for the admissions involving at least one overnight

[1]We used what is known as the Adult Medical/(Unscheduled) Surgical version of the AEP.

stay, we used the list of ambulatory surgical procedures compiled by Restuccia (Restuccia et al., 1986). In this study, however, we considered admissions avoidable by ambulatory surgery as appropriate for two reasons. Ambulatory surgery centers were not available in all sites during the study period. Further, in Siu et al. (1986), the findings were not sensitive to how ambulatory surgery was classified.

The physicians also reviewed a single randomly selected hospital day using the AEP criteria for the appropriateness of the hospital day (Gertman, 1981). This part of the instrument consists of 27 criteria, listed in the appendix, describing patient conditions or specific medical or nursing services that require hospitalization. A day was classified as appropriate *if any* of the 27 criteria were met. Physician reviewer overrides were permitted as in the case of hospital admissions (Siu et al., 1986).

As we reported in Siu et al. (1986), the assessments of appropriateness using the AEP were reliable and valid. The two reviewers agreed on the appropriateness of admission 92 percent of the time (Kappa = 0.76) and of the day 88 percent of the time (Kappa = 0.73). For a sample of records (see the appendix), the study reviewers agreed with the decisions of a panel of experienced physicians 74–77 percent of the time (Kappa = 0.45–0.56). These results on agreement are all statistically different from zero at $P < 0.001$.

EXPLANATORY VARIABLES

We use four groups of explanatory variables to explain the variation in inappropriate inpatient care: insurance plan, health status, sociodemographic and economic measures, and provider characteristics.

Insurance Plan Variables

We group the insurance plans into three groups: (1) the free plan (no out-of-pocket cost to the family); (2) the family cost sharing or pay plan, where the coinsurance rate is 25, 50, or 95 percent for all services up to an upper limit on out-of-pocket expenses of $1000 or less,[2] and (3) the individual deductible plan with a 95 percent coinsurance rate for outpatient services (subject to a limit of $150 per person or $450 per family per year) and free inpatient care. These three groups are represented by dummy variables, with the free plan as the omitted group. We do not differentiate the plans by the size of the upper limit

[2]We group these plans into a single plan because earlier analysis showed no difference in inpatient use among these plans; see Newhouse et al. (1981); Manning et al. (1987).

on out-of-pocket expenses because the differences are too small for us to detect (Manning et al., 1987, Appendix B).

Measures of Health Status

We use three measures of health status: (1) general health perceptions; (2) physical or role limitations; and (3) chronic disease status. Each measure is based on the self-administered Medical History Questionnaire for individuals 14 years or older. All of the health status data to be used were collected at the beginning of the study; a summary description of each is presented below.

The General Health Index (GHINDX) measures perceptions of overall health at the present, in the past, and in the future, as well as resistance to illness and health worry (Ware, 1976; Davies and Ware, 1981).

The physical or role limitations measure is scored dichotomously (PHYSLM: 1 = limited, 0 otherwise) to indicate the presence of one or more limitations resulting from poor health in any of the following categories: self-care (eating, bathing, dressing), mobility (confined, or able to use public or private transportation), physical activity (walking, bending, lifting, stooping, climbing stairs, running), and usual role activities (work, home, school); (Stewart et al., 1977, 1978, 1981a, 1981b).

The disease measure is a simple count of the number of diseases or health problems (out of a possible 26), for individuals aged 14 or older (Manning et al., 1982).

Other Patient Characteristics

The model used in our analysis also includes covariates for study site, age, sex, race, education, family income, and family size. With the exception of family income, the data were collected before or at enrollment in the study (1974–77). Family income data are from 1975 in Dayton, 1978 for the three-year group in South Carolina, and 1976 for all other participants.

Hospital Characteristics

Variables describing the hospitals were obtained from the American Hospital Association (AHA) files. This included information regarding Joint Commission on Accreditation of Hospitals (JCAH) accreditation, the presence of a residency program, medical school affiliation, ownership, number of beds, number of admissions, the occupancy rate, and available facilities.

Physician Characteristics

During the review of the medical record, information was collected regarding the identity of the attending physician. Information on the training and practice characteristics of the attending physicians was obtained from the American Medical Association Directory of Physicians' Master File. For osteopaths, we obtained information from the Directory of the American Osteopathic Association. From these two sources, variables were derived on physician sex, years from licensing, type of practice, practice arrangement, self-designated specialties, and board certification in any recognized specialty.

Although we obtained patient and hospital descriptors on all 1132 patients for whom medical records were available, information is missing for a number of physicians either because the physician failed to provide that information or because the physician did not appear on the appropriate provider tape. We believe the latter case arose primarily because of patients' physicians moving or entering medical practice after the date of tape preparation. To supplement the information available on tape, we located 95 of these physicians by way of the computerized National Yellow Pages. For this latter sample of physicians, information on their characteristics was obtained from their practices by phone interview. Despite these efforts, we continued to have missing information on a number of physicians (the number varying depending upon the variable). Early analyses showed that this information was not randomly missing. Missing data were replaced by the mean value for that variable in our logistic regression models, and dummy variables were included to indicate those cases that had data missing for a given variable.

Table 2 describes the variables and shows the range of values obtained for the independent variables used in this analysis.

STATISTICAL METHODS

We used a logistic regression to estimate the probability that a particular admission or hospital day was medically inappropriate. The dependent variable in these regressions is whether the admission or day is inappropriate. For these analyses, we consider admissions potentially avoidable by ambulatory surgery as appropriate. This is done because free-standing, ambulatory surgical facilities or units were generally not available at the six sites during the years of the study.

Table 2

VARIABLE DEFINITIONS, SAMPLE MEANS, AND STANDARD DEVIATIONS

Variable	Mean	Standard Deviation	Definition
Site			
DAY	0.19346290	0.39518726	= 1 if Dayton, OH[a]
FIT	0.14045936	0.34761657	= 1 if Fitchburg, MA[a]
FRA	0.12985866	0.33629644	= 1 if Franklin Co., MA[a]
CHA	0.12014134	0.32527045	= 1 if Charleston, SC[a]
GEO	0.21643110	0.41199347	= 1 if Georgetown Co., SC[a]
Patient Characteristics			
AGE	42.20133361	12.22455517	= age
LNAGE	3.69535033	0.31752143	= log (age)
FEMALE	0.59893993	0.49032976	= 1 if female
BLACK	0.14808110	0.35364982	= 1 if black
AFDC	0.05412975	0.22094336	= 1 if any family member receives Aid to Families with Dependent Children
GHINDX	62.87351359	16.71969871	= general health index
MHI	72.79053408	14.57835893	= mental health index
PHYSLM	0.36010679	0.47821496	= 1 if role or physical limitation
PAY	0.39399293	0.48884927	= 1 if coinsurance rate 25, 50, 95% for all services[b]
IDP	0.21731449	0.41260064	= 1 if Individual Deductible Plan[b]
LFAM	1.05338594	0.55332144	= log of family size at enrollment
LOGINC	8.77089174	0.70105846	= log of family income
EDLTHS	0.34805654	0.47656460	= 1 if education < 12 years[c]
SOMCOL	0.15282686	0.35997956	= 1 if 12 < education < 16 years[c]
COLL	0.10689046	0.30911049	= 1 if education > 16 years[c]
Physician Characteristics			
SOLO	0.45424837	0.44857415	= 1 if solo practitioner
BOARD	0.66472868	0.45095059	= 1 if board-certified
INTMED	0.20542636	0.38592570	= 1 if specialty is internal medicine
SURGEON	0.43120155	0.47307272	= 1 if specialty is surgery
OBGYN	0.12596899	0.31695952	= 1 if specialty is obstetrics or gynecology[d]
GENERAL	0.18023256	0.36717280	= 1 if specialty is general or family practice
OLDMD	0.51059536	0.46792688	= 1 if licensed for 15 or more years
MISSPCT	0.08833922	0.28391304	= 1 if missing specialty
MISSOLO	0.18904594	0.39171816	= 1 if missing solo/group status
MISOLDMD	0.12455830	0.33036335	= 1 if missing OLDMD
Hospital Characteristics			
JCAH	0.89292035	0.30907775	= 1 if JCAH approved
TEACH	0.25929204	0.43805235	= 1 if the hospital belonged to the Council of Teaching Hospitals (COTH) or had an AMA approved residency
PUBLIC	0.09203540	0.28894809	= 1 if public hospital
LNBEDS	5.40648420	0.63292588	= log (bedsize)

[a]Seattle, Washington, is the omitted site.
[b]The free plan is the omitted group.
[c]A high school education is the omitted group.
[d]This variable refers to the physicians' specialty. Note that pregnancy-related admissions are excluded from this analysis.

Correlation in the Responses

Although we have observations for over a thousand hospitalizations, we do not have that number of *independent* observations. The error terms in our equations exhibit substantial positive correlations among family members and over time for individuals. Failure to account for these correlations in the analysis would yield statistically biased and inefficient estimates of the standard errors. As a result, the inference statistics (t and χ^2 statistics) calculated in the usual way (without adjusting for these correlations) would be too large. We correct the inference statistics for this positive correlation. This correction is similar to that for the random effects least-squares model or, equivalently, the intracluster correlation model. The correction method is fully described by Brook et al. (1983), based on prior work by Huber (1967).

Standardized and Unstandardized Comparisons

These regressions are used to predict the probability that either an admission or day is inappropriate. For different groups (e.g., site, sex, specialty), we make both unstandardized and standardized comparisons. For the unstandardized comparisons, we predict the mean probability (and calculate its standard error) without correcting for the other differences between the contrast groups. For example, in comparing Seattle with one of the rural sites such as Franklin County, we do not adjust for the differences in the mix of physicians or hospital types.

In addition to these "unstandardized" predictions, we also estimate standardized predictions that remove the effects of other factors that are confounded with the contrast of interest. For example, we want to purge the Seattle–Franklin County comparison of differences in patient and provider mix. To do this, we predict the probability that each admission or day is inappropriate if that case were in Seattle, then as if it were in Dayton, etc. In each case, we initialized all the site indicators to zero, then reset the indicator for Seattle to equal one, and make the prediction as if that case were in Seattle. We repeat the process for each other site, first initializing all site indicators to zero, resetting the flag for that site to one, and predicting the result.

This procedure is like the usual direct adjustment, except that it is based on the estimated model that controls for several factors simultaneously.

Table 2 shows the mean and standard deviates for the dependent and major independent variables used in this analysis.

III. RESULTS

As previously reported, we found that 23 percent of the adult hospital admissions were inappropriate and 35 percent of the days were inappropriate. These percentages varied by the six sites with a high of approximately a third of the hospital admissions being inappropriate in our Dayton and South Carolina sites, and a low of 9 percent inappropriate in our Seattle site. Similar, though less pronounced, differences were obtained by site for inappropriate hospital days.

The following results (Table 3, left side) were obtained in the logistic regression with hospital admission inappropriateness as the dependent variable. As we have shown before, cost-sharing had no effect on the proportion of admissions that were inappropriate ($\chi^2(2) = 0.89$, n.s.); however, there were significant differences by site ($\chi^2(5) = 26.81$, $p < 0.0001$). Gender ($p < 0.001$) and education ($\chi^2(3) = 8.97$, $p < 0.05$) were significant correlates of inappropriate admission; however, race, income, family size, AFDC status, and age were not statistically significant independent variables. Among the hospital variables, JCAH accreditation and bed size were statistically significant at the 5 percent level, whereas hospital type had no apparent effect. Among the physician variables, specialty ($\chi^2(3) = 38.52$, $p < 0.0001$) and length of time since licensing ($p < 0.05$) were significant independent variables.

Unstandardized and standardized estimates based on these regressions are shown in Table 4. For unstandardized estimates, a greater likelihood of an inappropriate hospital admission was associated with certain largely nonprocedure specialties, an attending physician who was not board-certified, a physician licensed more than 15 years ago, non-JCAH accredited hospitals, nonpublic hospitals, female patients, and patients having had some college education. The unstandardized comparisons give the gross unadjusted differences between groups (e.g., boarded compared with not boarded). These differences could be due to the intrinsic differences among the groups compared or could be due to other factors that differ between the groups. The standardized comparisons control for these other differences. The standardized predictions demonstrate that the proportion of admissions considered inappropriate are increased significantly only if the physician was licensed more than 15 years ago, if the patient was female, and if the attending physician was either an internist or a general/family practitioner.

Regression coefficients (Table 3, right side) showed that cost sharing had no significant effect on the appropriateness of a hospital day ($\chi^2(2)$

Table 3

LOGISTIC REGRESSION ESTIMATES FOR INAPPROPRIATE INPATIENT USE

	Inappropriate Admission		Inappropriate Day	
Variable	Coefficient	t	Coefficient	t
INTERCEPT	−4.9169E+00	−0.85	6.8627E+00	1.37
PAY	−4.2873E-02	−0.21	−1.3667E-01	−0.61
IDP	−2.1575E-01	−0.92	1.7416E-01	0.67
DAY	7.6878E-01	1.99	1.2145E+00	3.14
FIT	5.5363E-01	1.43	6.4065E-01	1.67
FRA	1.0353E+00	2.74	9.1331E-01	2.62
CHA	1.4253E+00	3.49	6.8117E-01	1.68
GEO	1.6184E+00	4.59	6.6136E-01	1.96
BLACK	−2.2922E-01	−0.80	6.9452E-02	0.22
LOGINC	5.6578E-02	0.37	2.2796E-01	1.27
LFAM	3.8128E-01	1.93	9.6473E-02	0.46
AFDC	4.8330E-03	0.01	2.3926E-01	0.51
GHINDX	−6.3604E-03	−1.02	−7.5967E-03	−1.06
FEMALE	6.1928E-01	3.39	9.4133E-01	4.54
AGE	−3.7197E-03	−0.07	7.7767E-02	1.57
LNAGE	2.9841E-01	0.14	−3.1395E+00	−1.66
DISEA	5.8920E-04	0.06	−2.3757E-03	−0.21
PHYSLM	3.2822E-01	1.72	1.3195E-01	0.54
EDLTHS	−4.4477E-01	−2.24	−1.9964E-03	−0.01
SOMCOL	−6.2136E-01	−2.17	−1.2856E-01	−0.42
COLL	−2.0719E-01	−0.63	−2.5104E-01	−0.71
SOLO	8.2483E-04	0.00	1.0380E-01	0.47
MISSOLO	2.4256E-01	0.92	6.1672E-01	2.01
BOARD	−3.9360E-01	−1.72	−3.7622E-01	−1.76
INTMED	9.1267E-03	0.03	−1.4743E-01	−0.51
SURGEON	−1.0171E+00	−3.59	−4.7701E-01	−1.82
OBGYN	−1.9509E+00	−5.17	−3.0849E-01	−0.92
MISSPCT	1.0532E-01	0.19	1.3619E-01	0.27
OLDMD	4.1200E-01	1.98	4.5346E-01	2.24
MISOLDMD	−6.4058E-01	−1.50	−5.4585E-01	−1.85
JCAH	−6.5055E-01	−2.03	−3.6428E-01	−1.07
TEACH	7.6938E-02	0.22	1.3246E-01	0.38
PUBLIC	−1.7153E-01	−0.40	−2.3315E-01	−0.56
LNBEDS	4.2178E-01	1.96	−2.9785E-01	−1.31

Table 4

ESTIMATED PERCENTAGE OF INAPPROPRIATE ADMISSIONS, BY PHYSICIAN, HOSPITAL, AND PATIENT CHARACTERISTICS
(Standard errors)

Characteristics	Unstandardized	Standardized
Specialty		
General/family	39.4 (9.6)	33.8 (3.8)
Internal medicine	31.6 (10.6)	33.9 (3.5)
Surgery	15.1 (8.2)[a]	17.3 (2.3)[a]
Obstetrics/gynecology	10.0 (4.0)[a]	8.1 (2.1)[a]
Solo practice		
Yes	24.5 (2.2)	23.2 (2.2)
No	22.2 (1.9)	23.2 (2.1)
Board-certified		
Yes	18.8 (1.5)	21.4 (1.8)
No	33.5 (2.9)[a]	27.5 (2.9)
Years from licensing		
>15	28.1 (2.1)	26.8 (2.0)
<15	19.6 (2.0)[b]	20.0 (2.2)[c]
JCAH accredited		
Yes	21.7 (1.4)	21.9 (1.4)
No	35.5 (4.9)[b]	32.4 (5.2)
Teaching status		
Yes	22.2 (2.7)	24.0 (4.2)
No	23.5 (1.5)	22.9 (1.9)
Public hospital		
Yes	14.4 (3.7)	20.9 (5.7)
No	24.1 (1.4)[c]	23.3 (1.4)
Sex		
Male	18.1 (1.8)	17.8 (1.9)
Female	26.6 (1.7)[a]	26.8 (1.8)[a]
Education		
High school	26.6 (2.0)	36.7 (2.9)
<High school	23.4 (2.4)	36.5 (3.0)
Some college	15.0 (2.6)[a]	29.4 (4.5)
College	21.5 (4.3)	27.7 (5.3)

[a] $p < 0.001$ vs. first category.
[b] $p < 0.01$ vs. first category.
[c] $p < 0.05$ vs. first category.

= 1.41, n.s.). However, site differences persisted ($\chi^2(5) = 12.19$, $p < 0.05$) although they were smaller. Among the patient variables, only sex remained statistically significant ($p < 0.001$). None of the hospital variables remained significant and only years from licensing remained significant among the set of physician variables.

Predictions based on these estimated logistic regression coefficients are shown in Table 5. For unstandardized estimates, the likelihood of a hospital day being inappropriate is increased if the physician is not boarded, if the physician was licensed more than 15 years ago, if the hospital is nonpublic, and if the patient is female. The standardized

Table 5

ESTIMATED PERCENTAGE OF INAPPROPRIATE DAYS, BY PHYSICIAN, HOSPITAL, AND PATIENT CHARACTERISTICS
(Standard errors)

Characteristics	Unstandardized	Standardized
Specialty		
General/family	46.5 (3.9)	39.7 (4.2)
Internal medicine	34.4 (4.0)[a]	36.6 (4.6)
Surgery	26.7 (2.8)[b]	30.0 (3.0)
Obstetrics/gynecology	37.8 (5.0)	33.3 (5.0)
Solo practice		
Yes	36.5 (3.1)	34.4 (3.2)
No	30.7 (2.4)	32.4 (2.5)
Board-certified		
Yes	29.6 (2.3)	31.6 (2.5)
No	43.6 (2.9)[b]	39.2 (3.3)
Years from licensing		
>15	39.8 (2.8)	39.0 (2.8)
<15	29.1 (2.5)[c]	29.9 (2.6)[a]
JCAH accredited		
Yes	30.3 (3.4)	33.6 (1.9)
No	36.0 (2.0)	41.2 (6.6)
Teaching status		
Yes	36.5 (2.4)	36.5 (5.6)
No	30.7 (3.1)	33.9 (2.3)
Public hospital		
Yes	22.3 (5.6)	30.3 (7.4)
No	35.8 (1.8)[a]	34.9 (1.9)
Sex		
Male	23.8 (2.5)	23.4 (2.6)
Female	41.7 (2.5)[b]	42.0 (2.6)[b]

[a] $p < 0.05$ vs. first category.
[b] $p < 0.001$ vs. first category.
[c] $p < 0.01$ vs. first category.

estimates, however, show that only years from licensing and patient gender are associated with increased inappropriate hospital days.

Unstandardized estimates of the proportion of admissions or days that were inappropriate are shown in Table 6. In the case of both hospital admissions and days, the lowest proportion of inappropriate use is found in the Seattle site. The highest proportions of inappropriate use are found in the Dayton and Georgetown sites, with the other sites having intermediate values. Taking into consideration and standardizing for patient, physician, and hospital variables reduces but does not eliminate the variation in proportion of inappropriate use. Addition of these explanatory variables reduces the variation resulting from site differences from 5.1 percent to 2.6 percent for hospital admissions and from 2.4 percent to 1.6 percent for inappropriate days.[1] This is most striking in the comparison of Georgetown and Seattle for hospital days, where the twofold difference (42 compared with 21) in percentage inappropriate was reduced by half (34 compared with 22). Thus, although addition of patient, physician, and hospital variables decreased the extent of variation, significant geographic differences in the proportion of inappropriate hospital use remain even after controlling for these sources of variation.

Table 6

ESTIMATED PERCENTAGE OF INAPPROPRIATE HOSPITAL USE, BY SITE

	Admissions		Days	
Site	Unstandardized	Standardized	Unstandardized	Standardized
Seattle	9.7 (2.1)	11.4 (2.6)	21.0 (3.5)	22.0 (4.0)
Dayton	29.7 (3.4)[a]	20.3 (3.4)[b]	42.4 (4.1)[a]	45.7 (5.9)[c]
Fitchburg	15.1 (2.7)	17.4 (3.4)	32.6 (5.5)	33.6 (5.9)
Franklin	18.4 (3.1)[c]	24.2 (4.0)[a]	34.0 (4.4)[b]	39.2 (5.3)[c]
Charleston	27.9 (4.0)[a]	30.8 (4.7)[a]	33.8 (5.4)[b]	34.4 (6.0)
Georgetown	35.1 (3.6)[a]	34.4 (4.1)[a]	42.1 (3.6)[a]	34.0 (4.2)[b]

[a] $p < 0.001$ vs. first category.
[b] $p < 0.05$ vs. first category.
[c] $p < 0.01$ vs. first category.

[1]These are based on the percentage of variance explained in models with site variables, with and without other variables included.

IV. DISCUSSION

As in other studies, inappropriate use of the acute hospital setting varied by geographic region in the Health Insurance Experiment. There was much greater variation in inappropriate hospital admissions than in inappropriate days. For both inappropriate admissions and days, we found that older physicians and female patients were more likely to be associated with inappropriate use. For inappropriate admissions, certain physician specialties (surgery and obstetrics/-gynecology) were less likely to result in an inappropriate admission. A number of other physician, patient, and hospital variables were significantly associated with inappropriate hospital admission; however, their effect was not independent of other patient and provider characteristics.

Although differences in diagnostic mix may also be a factor, the specialty differences in inappropriate use were most likely related to the performance of procedures. The two procedure-related specialties, surgery and obstetrics/gynecology, had lower rates of inappropriate admission. Many of the patients admitted by specialists in these fields undergo a procedure within the first day of admission, leading the hospitalization to have been more likely designated appropriate by the AEP. This argument is supported by the observation that physician specialty has a smaller (and insignificant) effect on the percentage of inappropriate hospital days, because inappropriate hospital days during the admission are less likely to have been affected by a procedure performed on the day of admission. Additionally, the specialty effect is removed when a variable denoting whether a major procedure done is included in the model.

Controlling for other patient and physician characteristics, years from licensing remained an important predictor of both inappropriate admission and days. We cannot determine whether the observed effect is related either to declining clinical skills or to a cohort effect of older physicians having been trained in an era when hospitals were used to provide more nonacute services. Similarly, we are unable to explain the gender differences in inappropriate hospitalization. Gender effects have been observed in most studies attempting to explain overall (appropriate and inappropriate) patterns of medical care utilization (Muller, 1986). The differences observed in our study could not have been due to child bearing, because pregnancy and related admissions were excluded from this analysis. Furthermore, the differences

remained after controlling for differences in health perceptions, functioning, education, income, and a variety of other patient and provider factors. This leaves a number of possible explanations, including differences in (a) how physicians perceive women's health needs, (b) the level of support available to women at home, and (c) the types of nonobstetric medical problems encountered by women.

It is notable that the site differences in the proportion of inappropriate admissions or days remain even after we control for most measurable aspects of patient, provider, and hospital characteristics. In some cases, inclusion of these variables reduced the magnitude of the predicted differences in inappropriate use. For example, the percentage of inappropriate days in the Georgetown site (42 percent) was about twice that in the Seattle site (21 percent) before standardization for other variables. After standardization for other variables, this disparity, although significant, was much smaller (34 percent in Georgetown and 22 percent in Seattle). For the most part, however, site differences remained after controlling for these variables. This confirms Wennberg's observation that practice patterns differ by geographic region and cannot be fully explained by underlying patient, provider, or system characteristics of the quality or detail that are readily available (Wennberg, 1982).

For future research on geographic variations in hospital use, our study indicates that the extent and pattern of variations differ, not only by the consideration of patient and provider characteristics but also by whether admissions or hospital days are the focus of analysis. The lesser variation observed in inappropriate hospital days may reflect the fact that many inappropriate hospital admissions are short. Thus, the variation in inappropriate admissions is attenuated when one examines inappropriate days.

These results suggest that targeting utilization review on interventions to specific physicians or hospitals chosen on the basis of various characteristics would not be very useful. For the most part, various easily obtainable physician and hospital characteristics are not predictors of inappropriate use. Although years from licensing and patient gender are important predictors, neither variable is particularly discriminating. Considerable inappropriate use is found in both sexes and in both categories of physician licensing.

Our study focused on a broad segment of the hospital population. We did not address issues related to the appropriateness of hospital use by specific diagnoses, partly because of limited sample size for most diagnoses and partly out of an attempt to focus on a wide segment of the hospital population. We also did not address issues related to the elderly, because the HIE contains only data on medical and surgical

hospitalizations of the nonaged. Nevertheless, our findings apply to the remaining adult, nonobstetric medical-surgical hospitalizations or about half the hospital admissions in this country.

Although our data are primarily from the late 1970s, we believe this is not a serious limitation. Although hospital admission rates have declined from their peaks in the late 1970s, the decreased rates appear to be largely related to more frequent use of ambulatory surgery and to increased cost sharing (Siu et al., 1986). Because our data include indicators for ambulatory surgery and degree of patient cost sharing, we can control for these effects.

Given these results, how can inappropriate hospitalization be selectively reduced? From previous work, we know that cost sharing reduces inappropriate hospital use; however, it is not a discriminating instrument in that it reduces appropriate hospital use as well. The effects of prepayment or capitation on inappropriate use are also uncertain at this time (Siu et al., 1988). Whatever the case may be for prepayment, it would have little effect on the vast majority of physicians who currently practice in the fee-for-service sector. Second-opinion programs have been advocated in the case of surgery, but relatively few cases may be denied in these programs (Gertman et al., 1980). Similarly, preadmission screening of elective admissions may not be very effective. Review of Medicare admission requests in Connecticut resulted in only 0.37 percent of cases being disapproved, and half of these disapproved cases were admitted anyway, either immediately or a few days later (Imperiale, 1988). Preferred provider programs are not likely to have a significant impact on inappropriate use. These providers are generally selected on the basis of willingness to accept discounts, not on the basis of quality of care or lower rates of inappropriate use. At any rate, the data presented in this report suggest that it would be difficult to identify doctors with lower rates of inappropriate use on the basis of easily determined characteristics.

Given that most existing cost containment mechanisms are not likely to reduce inappropriate hospital use in the fee-for-service sector, other approaches are necessary. Retrospective review with feedback of results to physicians (Borchardt, 1981) may be one such approach. Conducting retrospective audits and making these results available to major buyers (e.g., major employers) is a second approach to this problem. It would be more efficient to target utilization review on those hospitalizations that are most likely to be inappropriate. However, our results indicate that targeting on the basis of patient or provider characteristics would be very difficult.

Appendix

APPROPRIATENESS

CRITERIA FOR APPROPRIATENESS OF HOSPITAL DAY

The physician reviewers used the following criteria from the AEP to determine the appropriateness of the hospital day. They are divided into three sections: medical services, nursing and life support services, and patient condition. A hospital day was considered appropriate if any of the 27 criteria was fulfilled. As with the appropriateness of hospital admission, the physician reviewer was allowed to override any appropriateness decision made solely on the basis of the criteria.

Medical Services

1. Procedure in operating room that day.
2. Scheduled for procedure in operating room the next day, requiring preoperative consultation or evaluation.
3. Cardiac catheterization that day.
4. Angiography that day.
5. Biopsy of internal organ that day.
6. Thorancentesis or paracentesis that day.
7. Invasive CNS diagnostic procedure that day.
8. Any test requiring strict dietary control, for the duration of the diet.
9. New or experimental treatment requiring frequent dose adjustments under direct medical supervision.
10. Close medical monitoring by a doctor at least three times daily.
11. Postoperative day for any procedure covered in numbers 1 or 3–7, above.

Nursing and Life Support Services

1. Respiratory care: intermittent or continuous respirator use or inhalation therapy (with chest PT, IPPB) at least three times daily.

2. Parenteral therapy: intermittent or continuous IV fluid with any supplementation (electrolytes, protein, medications).
3. Continuous vital sign monitoring, at least every 30 minutes, for at least four hours.
4. IM or SC injections at least twice daily.
5. Intake and output measurement.
6. Major surgical wound and drainage care (chest tubes, T-tubes, hemovacs, Penrose drains).
7. Close medical monitoring by nurse at least three times daily, under doctor's orders.

Patient Condition

Within 24 hours before day of review:

1. Inability to void or move bowels (past 24 hours) not attributable to neurologic disorder.

Within 48 hours before day of review:

2. Transfusion resulting from blood loss.
3. Ventribular fibrillation or ECG evidence of acute ischemia.
4. Fever at least 101 rectally (at least 100 orally), if patient was admitted for reason other than fever.
5. Coma: unresponsiveness for at least one hour.
6. Acute confusional state, not due to alcohol withdrawal.
7. Acute hematologic disorders, significant neutropenia, anemia, thrombocytopenia, leukocytosis, erythrocytosis, or thrombocytosis, yielding signs or symptoms.
8. Progressive acute neurologic difficulties.

Within 14 days before day of review:

9. Occurrence of a documented, new acute myocardial infarction or cerebrovascular accident (stroke).

NONRESPONSE

Nonresponse in obtaining consents for medical record review did not vary significantly by health insurance plan, but it did so by site, largely because of the varying time lag between the end of the experiment and our solicitation of the participants' consent (see Table 1). Dayton participants exited first, followed by Seattle, Massachusetts, and South Carolina participants, in that order.

Table A.1

INDEPENDENT VARIABLES

Indicator variables (0, 1)	
PAY	= 1 if coinsurance rate = 25, 50, 95 percent for all services[a]
IDP	= 1 if Individual Deductible Plan[a]
DAY	= 1 if Dayton, OH[b]
FIT	= 1 if Fitchburg, MA[b]
FRA	= 1 if Franklin Co, MA[b]
CHA	= 1 if Charleston, SC[b]
GEO	= 1 if Georgetown Co., SC[b]
BLACK	= 1 if black
AFDC	= 1 if any family member a recipient of Aid to Families with Dependent Children
FEMALE	= 1 if female
PHYSLM	= 1 if physically or role limited
EDLTHS	= 1 if education < 12 years[c]
SOMCOL	= 1 if 12 < education < 16 years[c]
COLL	= 1 if education > 16 years[c]
Continuous variables	
LOGINC	= log of family income
LFAM	= log of family size at enrollment
LNAGE	= log (age)
GHINDX	= general health index
DISEA	= count of chronic diseases and health problems

[a]The free plan is the omitted group.
[b]Seattle, Washington, is the omitted site.
[c]A high school education is the omitted group.

Responders and nonresponders differed on selected characteristics (see Tables A.1 and A.2 for the results of a logistic regression of nonresponse). The nonresponders were more likely to be poor, less educated, young, and healthy. We believe that these individuals were more likely to have changed their residence between the end of the study and the followup contact. Hence, they were less likely to be located for consents to release medical records. Nonresponders and responders did not differ significantly with respect to race, family size, or sex.

Table A.2

LOGISTIC REGRESSION FOR NONRESPONSE

Variable	Coefficient	Std. Dev. Coefficient	t
INTERCEPT	9.2951E+00	2.131E+00	4.36
PAY	−5.9412E-02	3.428E-01	−0.17
IDP	5.7985E-01	3.684E-01	1.57
DAY	9.3646E-01	4.079E-01	2.30
FIT	−1.1784E+00	5.900E-01	−2.00
FRA	−4.1937E-01	4.895E-01	−0.86
CHA	−1.0988E+00	5.083E-01	−2.16
GEO	−1.3954E+00	5.841E-01	−2.39
BLACK	4.8667E-02	5.138E-01	0.09
LOGINC	−5.1911E-01	2.039E-01	−2.55
LFAM	2.9917E-01	2.732E-01	1.09
AFDC	−4.5375E-01	5.150E-01	−0.88
GHINDX	1.6429E-02	1.011E-02	1.63
FEMALE	−1.5101E-01	2.760E-01	−0.55
LNAGE	−2.3520E+00	3.901E-01	−6.03
DISEA	−1.8148E-02	1.453E-02	−1.25
PHYSLM	6.3384E-01	3.488E-01	1.82
EDLTHS	8.3047E-01	3.500E-01	2.37
SOMCOL	1.6069E-02	4.466E-01	0.04
COLL	2.1874E-02	6.063E-01	0.04

NOTE: See Table A.1 for acronyms.

EXCLUSIONS

In addition to the exclusion of patients younger than 18, we excluded from our evaluation of the appropriateness of inpatient treatment admissions for pregnancy-related causes, psychiatry, and alcohol rehabilitation. We excluded pregnancy-related admissions (85 percent of which were for labor and delivery), because the instrument used in this study was not designed to evaluate the appropriateness of such admissions. Furthermore, we reasoned that virtually all admissions for labor and delivery would be considered appropriate. Psychiatry and alcohol rehabilitation cases accounted for 7.5 percent of the remaining hospitalizations and were excluded because of inconsistent hospital administrative policies regarding release of these medical records.

RELIABILITY AND VALIDITY OF MEASURES

To assess interobserver reliability, 10 percent of the records were reviewed by both physicians. The reviewers agreed 84 percent of the time on whether the admission was appropriate, inappropriate, or avoidable by use of ambulatory surgery (kappa = 0.72).

When ambulatory surgical admissions were classified as appropriate, the reviewers agreed on appropriateness 92 percent of the time (kappa = 0.76). They agreed on whether the hospital day was appropriate, inappropriate, or avoidable by use of ambulatory surgery 81 percent of the time (kappa = 0.68). When ambulatory surgery days were considered appropriate, overall agreement increased to 88 percent (kappa = 0.73). Overall agreement on the stage of disease presentation was 58 percent (kappa = 0.32).

Because there is no acknowledged "gold standard" for appropriateness, we judged the validity of the AEP by how well it replicated the assessment of experienced clinicians. We selected two sets of physicians (each set containing seven physicians) to review medical records within their own specialty. Medical records were randomly selected from a related study and 194 dictated abstracts were prepared and reviewed by a pair of clinicians. We compared the clinicians' subjective assessments of appropriateness (i.e., appropriate, inappropriate, or avoidable by ambulatory surgery) with the assessments made by a physician using the AEP. The AEP assessments agreed with those of one set of physicians 74 percent of the time (kappa = 0.45) and with those of the second set of physicians 77 percent of the time (kappa = 0.56).

All the above kappa levels are statistically significantly different from what would occur by chance ($p < 0.001$). The kappa statistics observed are within the range of (and many are better than) those for physician agreement on physical signs and interpretation of diagnostic procedures (Koran, 1975).

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