Rates of Avoidable Hospitalization by Insurance Status in Massachusetts and Maryland

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Objective.—To determine whether uninsured and Medicaid patients have higher rates of avoidable hospitalizations than do insured patients.

Design.—We used 1987 computerized hospital discharge data to select a cross-sectional sample of hospitalized patients. Population estimates from the *Current Population Survey* were used to estimate rates of admission, standardized for age and sex.

Setting.—Nonfederal acute care hospitals in Massachusetts and Maryland.

Patients.—All patients under 65 years of age who were uninsured, privately insured, or insured by Medicaid. Hospitalizations for obstetric and psychiatric conditions were excluded.

Main Outcome Measures.—Relative risk of admission for 12 avoidable hospital conditions (AHCs) identified by a physician panel.

Results.—Uninsured and Medicaid patients were more likely than insured patients to be hospitalized for AHCs. Rates for uninsured patients were significantly greater than for privately insured patients in Massachusetts for 10 of 12 individual AHCs, and in Maryland for five of 12 AHCs. After adjustment for baseline utilization, the results were statistically significant for 10 of 12 AHCs in Massachusetts and seven of 12 AHCs in Maryland. For Medicaid patients, rates were significantly greater than for privately insured patients for all AHCs in each state before adjustment, and for nine of 12 and seven of 12 AHCs in each state, respectively, after adjustment for baseline utilization.

Conclusion.—Our findings suggest that patients who are uninsured or who have Medicaid coverage have higher rates of hospitalization for conditions that can often be treated out of hospital or avoided altogether. Our approach is potentially useful for routine monitoring of access and quality of care for selected groups of patients.

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NUMEROUS studies have documented access problems of persons who lack insurance coverage. The uninsured make fewer ambulatory visits and are less likely to have a regular source of care.[1,2] They are also less likely to receive certain preventive services,[2] are more likely to experience delays in their care,[3] and are treated differently in the hospital.[4-6] Recently, there has been increased attention to assessing whether the differences in utilization by insurance status lead to measurable differences in health outcomes. Previous studies have examined variations in health outcomes including in-hospital mortality,[6-8] adverse birth outcomes,[9,10] perceived health status,[11] and others.[12,13] It is important to expand this type of research not only in terms of other sorts of outcomes, but also in ways that may facilitate ongoing monitoring of care.

See also pp 2383 and 2426.

One method used by other authors in assessing possible problems with the quality of care for vulnerable populations is the sentinel health condition, often associated with the work of Rutstein and colleagues.[14,15] Epidemiological investigations applying this method have discovered variations in the rates of preventable deaths or hospitalizations due to sentinel causes in the United States,[16-19] Great Britain,[20,21] and other countries.[22] In this investigation, we extended this work by evaluating the association of insurance status with the rate of avoidable hospitalizations. We examined admissions for conditions such as ruptured appendix, cellulitis, diabetic coma, and asthma, that can often be avoided if ambulatory care is provided in a timely and effective manner. Our hypothesis was that patterns of admissions for avoidable hospital conditions (AHCs) would differ among insurance classes in ways that reflect the adequacy of outpatient care.

In addition to studying the hospital experience of uninsured and privately insured patients, we examined similar data for Medicaid patients. We did so because many uninsured patients are poor and because an often-mentioned strategy for health insurance reform is to expand the Medicaid program to cover more of the uninsured. However, Med-

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icaid reimbursement rates are generally lower than rates paid by private insurance companies,[23] and so access and quality of care may likewise be affected.

METHODS

Selection of Conditions

We used a literature review and clinical guidance from physicians to select the AHCs. Selection criteria were established to ensure that our list of conditions would be valid and reliable, that is, truly representative of avoidable hospitalizations as we defined them, and could be measured in a reasonably accurate fashion. The four criteria were as follows:

1. Consensus: Have previously published studies used similar indicators?

2. Importance: Do the conditions represent important health problems? Is hospitalization recommended for patients who contract these diseases?

3. Clinical face validity: Do the conditions make clinical sense in terms of identifying potential problems related to outpatient care? Is it more likely that hospitalizations for these conditions occurred as a result of problems with ambulatory care rather than other factors such as disease prevalence or provider practice styles?

4. Data clarity: Are the conditions clearly coded in an available data source covering large populations?

Three published studies developed lists of hospital discharge diagnoses that were thought to reflect potential problems with the quality of ambulatory care in health maintenance organizations or other settings.[17,24,25] Altogether, 23 different conditions were identified from the literature and reviewed. For clinical input, we convened a panel of five general internists, including one of us (A.M.E.), who practices at one of the major teaching hospitals in Boston. The choices were further critiqued by several expert clinical consultants and anonymous reviewers.

Fourteen conditions identified from the literature were eliminated, including the following: pulmonary embolism, septicemia, shock, endometrial cancer, stroke, and tuberculosis (conditions 1 through 6), because the link between effective outpatient care and avoidance of hospitalization was thought to be tenuous; radical mastectomy/breast cancer (condition 7), because the standards of care in 1987 lacked consensus and rates of admission might have been related more to patient and physician discretion than to stage at diagnosis; metastatic carcinoma (condition 8), because hospitalization rates were thought to be more highly related to the prevalence of a heterogeneous group of diseases and to practice patterns than to outpatient care; ruptured ectopic pregnancy and "complications of office procedures" (conditions 9 and 10), because these could not be reliably identified from the *International Classification of Diseases, Ninth Revision, Clinical Modification*[26] codes; drug toxicity (condition 11), because the populations at risk—the uninsured (and Medicaid)—comprise disproportionately persons with chronic mental illness and therefore are more likely to have experienced the toxic effects of drugs; bleeding secondary to anticoagulant therapy (condition 12), because no admissions with this as the principal diagnosis occurred in our sample; and premature birth and toxemia of pregnancy (conditions 13 and 14), because pregnancy is in many cases a predictable event and it is likely that a substantial number of uninsured persons obtain insurance to cover perinatal costs.

Table 1.—Avoidable Hospital Conditions, *ICD-9-CM** Codes, and Admission Rates for Patients Under 65 Years of Age, 1987

Conditions	*ICD-9-CM* Codes	Admission Rates†	
		Massachusetts	Maryland
Ruptured appendix	540.0, 540.1	2.79	2.14
Asthma	493	20.78	17.69
Cellulitis	681, 682	11.25	8.68
Congestive heart failure	428, 402.01, 402.11, 402.91	5.58	6.14
Diabetes	250.1, 250.2, 250.3, 251.0	3.02	3.99
Gangrene	785.4	0.26	0.23
Hypokalemia	276.8	0.27	0.31
Immunizable conditions	032, 033, 037, 072, 045, 055	0.07	0.04
Malignant hypertension	401.0, 402.0, 403.0, 404.0, 405.0, 437.2	0.84	1.64
Pneumonia	481, 482, 483, 485, 486	14.72	14.92
Pyelonephritis	590.0, 590.1, 590.8	3.78	4.11
Perforated or bleeding ulcer	531.0, 531.2, 531.4, 531.6, 532.0, 532.2, 532.4, 532.6, 533.0, 533.1, 533.2, 533.4, 533.5, 533.6	2.49	2.47

*ICD-9-CM indicates *International Classification of Diseases, Ninth Revision, Clinical Modification.*
†Per 10 000 study population under the age of 65 years with private insurance, Medicaid, or no insurance.

Finally, the panel added three other conditions (congestive heart failure, pneumonia, and pyelonephritis) that met our criteria. The 12 conditions selected by the panel for our investigation are found in Table 1. Once the conditions were chosen, one of us (A.M.E.), who is a physician, identified the appropriate *International Classification of Diseases* codes.

In thinking about AHCs, two conceptual distinctions seem important. First, some hospital admissions, such as those for immunizable conditions, are almost always avoidable. Even a single case may be cause for concern. However, for most AHCs, being avoidable is a matter of degree. Because treatment of patients with chronic conditions such as asthma or congestive heart failure is complex, monitoring AHCs may be most useful when their rates deviate substantially from some prescribed norm. A second distinction is between admissions that are avoidable and those that are discretionary. These are very different concepts that can be easily confused. For example, both appendicitis and ruptured appendix are nondiscretionary admissions, yet only ruptured appendix is potentially avoidable.

Data Sources

Hospital discharge abstracts for Massachusetts were obtained from the Massachusetts Health Data Consortium. Maryland data were obtained from Managed Health Care Services in Baltimore. Massachusetts and Maryland were chosen because they have easily accessible statewide data record systems on inpatient hospitalization. Calendar year 1987 was the most recent year during which complete data were available for both states at the time the investigation began. The initial sample for both states was processed by the Massachusetts Health Data Consortium. The variables included age, sex, race, expected payer, patient's ZIP code of residence, the principal diagnosis, and up to nine secondary diagnoses. Only patients under the age of 65 years were sampled.

We included 100% of admissions for patients with the expected payer of Medicaid, self-pay, or free care—the latter two categories comprising the uninsured.[4] Private payers were sampled at 25% and were weighted by a factor of 4 to arrive at frequencies for the state. Multiple admissions were not excluded, since readmissions may also occur because of poor access to postdischarge ambulatory care.

In Massachusetts we obtained information on hospitalizations for residents who were treated in neighboring states. We were unable to obtain out-of-state admissions for Maryland residents. All admissions by out-of-state residents to hospitals in Massachusetts or Maryland were excluded, as were admissions to Veterans Administration hospitals. Avoidable hospital conditions were identified by matching codes for the principal diagnosis only. Although secondary diagnoses often contribute to the reason for a particular hospitalization, we could not know reliably whether they were strongly related to the principal reason for admission.

We also examined rates of hospitalization for non-AHCs. We excluded hospitalizations for psychiatric and obstetric conditions because abnormally high adverse selection into public or private insurance for these conditions could bias the results.

The number of residents by insurance status in each state were estimated using the 1988 Bureau of the Census *Current Population Survey* March supplement.[27] We used the 1988 supplement because it asks about respondents' insurance status in 1987 and is commonly used to estimate the uninsured population.[28]

Data Analysis

Population-Based Relative Rates.—The principal analysis was designed to assess population-based relative rates of admission for AHCs and non-AHCs. Simple rates for each AHC and all AHCs together were constructed for uninsured, Medicaid, and private patients. Rates of hospital admission for each insurance class were directly standardized for age and sex based on the combined study sample. We used the following age strata: under 18 years of age, 18 to 24 years of age, and 25 to 64 years of age. These categories reflect populations of particular interest to policymakers; that is, children under the age of 18 years, who make up a large segment of persons covered by Medicaid, and young adults aged 18 to 24 years, who are at elevated risk of being uninsured. We then calculated relative admission rates (uninsured vs privately insured and Medicaid vs privately insured) for each AHC and all AHCs together.

Adjusted Relative Rates.—Our initial analysis revealed considerable differences in the overall rates of hospital admission by payer. Underlying unmeasured factors other than access or quality of care such as patient demand, treatment preferences, or physician supply might influence variations in utilization. It therefore seemed important to examine admission rates for AHCs in the context of admission rates for other hospital conditions, more generally. We made adjustments by dividing each AHC relative rate by the relative rate of admission for all non-AHCs, ie, all other nonexcluded conditions. The relative rates for non-AHCs thus serve as an index of baseline utilization among the insurance classes. Mathematically, the relative rate adjusted for baseline utilization is simply a ratio of two relative rates:

$$\frac{(SR_u^a/SR_p^a)}{(SR_u^{na}/SR_p^{na})}$$

where SR refers to age-sex standardized rates, u to the uninsured, p to persons with private insurance, a to AHCs, and na to non-AHCs. As before, we calculated this ratio for each AHC and for all AHCs together. Similar computations were performed using Medicaid recipients in place of the uninsured. Details on calculation of SEs and significance testing are available from the authors.

The adjusted relative rate (ratio) can be interpreted as a comparison of AHC with non-AHC utilization. If the AHC rate of admission for insured and uninsured patients were the same, the numerator would be equal to 1; but if the uninsured had much lower hospitalization rates for other conditions, then the denominator would be less than 1 and the relative rate would be adjusted upward and would be greater than 1. Alternatively, if the uninsured had higher non-AHC hospitalization rates, the AHC relative rate would be adjusted downward.

Our primary method of adjustment was to use all non-AHCs as a comparison, as described above. However, non-AHCs include low-discretion conditions for which rates of hospitalization might be less associated with insurance status, as well as high-discretion conditions, for which rates might be strongly associated with insurance status. To explore the impact of alternative adjustments, we calculated relative rates of AHCs using subsets of non-AHCs defined by level of discretion. We selected high- and low-discretion conditions using a list provided by Roos and colleagues,[29] in which higher interarea variation in rates of admission was assumed to indicate greater discretion. The high-variation conditions include chest pain, peptic ulcer, pediatric gastroenteritis, and others. The low-variation conditions include acute myocardial infarction, hip repair, and others. High- and low-variation conditions comprised about 20% and 6% of all non-AHC discharges, respectively.

Despite these alternative adjustments, we were also concerned that certain patient characteristics, such as alcoholism, could unduly affect the rates for the uninsured. We therefore repeated the principal analyses after excluding patients with a secondary diagnosis of alcoholism.

Unavoidable Hospitalizations.—We also examined rates of admission for health problems that were specifically not avoidable. We chose appendicitis, presenting either with or without rupture, as an example of such a condition. Although Roos et al[29] have shown that hospitalization rates for appendicitis vary somewhat, prevailing clinical wisdom is that hospitalization for appendicitis is almost certain and that the incidence of appendicitis is generally unrelated to the health and socioeconomic status of the population. The hypothesis in this case was that hospitalization rates for appendicitis would be similar across insurance classes.

Patient-Level Analyses.—To investigate whether group differences in race or income affected our results, we used logistic regression to examine the association of insurance status with the odds of an AHC, given that the patient was hospitalized. Within a given age-sex stratum, it can be shown that the ratio of adjusted relative rates—as defined by the above ratio (using hospital and population data)—is algebraically equivalent to an odds ratio of AHC vs non-AHC admissions (using only hospital data, which are available from the authors). In the regressions, the patient admission was the unit of analysis. The dependent variable was coded 1 if an AHC occurred and 0 otherwise. Because of low frequencies of AHCs in some of the age-sex strata, the dependent variable was collapsed to represent all AHCs combined. The independent variables included median household income of the patient's ZIP code, a dummy variable for race (nonwhite was the reference group), and dummy variables for uninsured and Medicaid patients (privately insured patients was the reference group). Separate models were estimated for each age-sex cohort in each state.

Severity of Illness.—We tested whether the severity of AHCs differed across insurance class. We did this because it is possible that for these conditions some practitioners might have had lower admission thresholds for disadvantaged patients; that is, they may have been more inclined to admit someone for an AHC under the presumption that the patient faced access barriers. To measure severity within diagnostic groupings, we used DRGSCALE, a modification of disease staging.[30,31] DRGSCALE uses data on principal con-

ditions and comorbidities from discharge abstracts to calculate standardized severity scores, where 100 is the predicted national average severity for patients within each diagnosis related group.

RESULTS

Relative Rates of Admission

After psychiatric and obstetric admissions were excluded, the overall unadjusted rates of admission for the uninsured in 1987 were quite similar to the rates for privately insured patients in Massachusetts and somewhat lower in Maryland (Table 2). Rates of admission for Medicaid patients were substantially higher. Avoidable hospital conditions accounted for 7.4% of admissions in Massachusetts and 7.8% of admissions in Maryland (not shown in Table 2).

Table 3 lists age- and sex-standardized relative rates of admission that compare utilization for uninsured and privately insured patients in each state for each AHC, all AHCs taken together, all non-AHCs, and high- and low-discretion non-AHCs. In most cases, uninsured patients were more likely than privately insured patients to be admitted for AHCs, as indicated by a relative rate that was greater than 1. The relative admission rates were greater than 1 for all of the AHCs in Massachusetts and 11 of the 12 individual AHCs in Maryland. The findings were statistically significant for 10 of the 12 individual AHCs in Massachusetts, and for five of 12 AHCs in Maryland. Because the relative rates of admission for the non-AHCs were close to 1 (relative rate=1.02 in Massachusetts, 0.85 in Maryland; $P>.05$ for both states), the relative rates before and after adjustment for baseline utilization were similar. For example, in Massachusetts, the relative rate for asthma was 1.45 and the adjusted relative rate was 1.42 (95% confidence interval [CI], 1.20 to 1.63). In Maryland, the relative rate was 1.01 and the adjusted relative rate was 1.19 (95% CI, 0.92 to 1.45).

For all 12 AHCs combined, the age- and sex-standardized relative rates for the uninsured were 1.75 in Massachusetts and 1.28 in Maryland ($P<.05$ for both states). After adjustment for baseline utilization, the overall AHC relative rates were 1.71 in Massachusetts and 1.49 in Maryland ($P<.05$ for both states).

The relative rates for high- and low-discretion non-AHC conditions were about the same or slightly lower than the relative rates for all non-AHCs (Table 3). As a result, the magnitudes of the adjusted relative rates were similar or slightly larger when we used these alternative figures for baseline comparisons (not shown in Table 3).

We repeated all of our analyses after eliminating patients with secondary diagnoses of alcoholism. The only sizable change in the magnitude of the relative rates in Massachusetts was for bleeding ulcer, which dropped from 1.62 to 1.29 ($P<.05$ for both states) (not shown). The figure for hypokalemia also decreased somewhat and was no longer significant. The changes to the other AHCs were negligible. A similar pattern occurred in Maryland.

The relative rates comparing Medicaid and privately insured patients are presented in Table 4. Before adjustment, all of the relative rates for the individual AHCs and the combined AHCs were considerably greater than 1 ($P<.05$ for all comparisons). The adjusted relative rates were much lower. Nevertheless, even after adjustment, 11 of the 12 relative rates for the individual AHCs in Massachusetts were still greater than 1 ($P<.05$ for nine conditions). Comparable results occurred in Maryland. The adjusted relative rate for Medicaid patients for all AHCs taken together was 1.84 in Massachusetts and 1.65 in Maryland ($P<.05$ for both states).

As with the uninsured, we also tested our hypotheses using alternative adjust-

Table 2.—Hospital Admission Rates* by Insurance Status for Persons Under the Age of 65 Years, 1987

	Uninsured	Medicaid	Private
Massachusetts			
Admission rate (per 10 000)	858.70	1549.69	826.87
Resident population (%)	495 400 (11.1)	355 090 (8.0)	3 602 286 (80.9)
Maryland			
Admission rate (per 10 000)	608.07	1934.00	730.44
Resident population (%)	508 083 (14.5)	255 517 (7.3)	2 748 659 (78.3)

*The rates exclude admissions to Veterans Administration hospitals, and admissions for obstetric or psychiatric disorders. Rates for Massachusetts include admissions for residents in hospitals located in neighboring states.

Table 3.—Age- and Sex-Standardized Relative Admission Rates of Avoidable and Other Hospital Conditions for Uninsured vs Privately Insured Patients, 1987

	Massachusetts			Maryland		
Conditions	Relative Rates	Adjusted* Relative Rates	95% Confidence Interval†	Relative Rates	Adjusted* Relative Rates	95% Confidence Interval†
Ruptured appendix	1.17	1.14	0.93-1.34	1.03	1.20	0.80-1.60
Asthma	1.45‡	1.42‡	1.20-1.63	1.01	1.19	0.92-1.45
Cellulitis	2.68‡	2.62‡	2.07-3.17	1.69‡	1.97‡	1.47-2.47
Congestive heart failure	1.20	1.17	0.90-1.43	1.55‡	1.81‡	1.33-2.28
Diabetes (diabetic ketoacidosis; coma)	2.83‡	2.77‡	2.21-3.32	1.86‡	2.18‡	1.59-2.76
Gangrene	2.33‡	2.27‡	1.57-2.98	2.74‡	3.21‡	1.91-4.51
Hypokalemia	1.66‡	1.62‡	1.21-2.04	1.25	1.46	1.00-1.92
Immunizable conditions	2.08‡	2.03‡	1.09-2.96	0.71	0.83	0.25-1.41
Malignant hypertension	2.44‡	2.38‡	1.83-2.93	1.65‡	1.93‡	1.41-2.44
Pneumonia	1.64‡	1.60‡	1.32-1.89	1.17	1.37‡	1.05-1.69
Pyelonephritis	1.59‡	1.55‡	1.29-1.81	1.08	1.26	0.93-1.60
Bleeding ulcer	1.62‡	1.58‡	1.20-1.97	1.35	1.58‡	1.09-2.06
All AHCs§	1.75‡	1.71‡	1.41-2.01	1.28‡	1.49‡	1.15-1.84
All non-AHCs	1.02	1.00	. . .	0.85	1.00	. . .
High-discretion non-AHC	1.14	. . .	. . .	0.84	. . .	. . .
Low-discretion non-AHC	0.77‡	. . .	. . .	0.73‡	. . .	. . .

*Ratios of the relative rates for each avoidable hospital condition divided by the relative rate for all non–avoidable hospital conditions.
†Confidence intervals apply only to adjusted relative rates.
‡ $P<.05$.
§AHC indicates avoidable hospital condition.

Table 4.—Age- and Sex-Standardized Relative Admission Rates of Avoidable and Other Hospital Conditions for Medicaid vs Privately Insured Patients, 1987

	Massachusetts			Maryland		
Conditions	Relative Rates	Adjusted* Relative Rates	95% Confidence Interval†	Relative Rates	Adjusted* Relative Rates	95% Confidence Interval†
Ruptured appendix	1.27‡	0.58‡	0.51-0.65	1.38‡	0.45‡	0.36-0.54
Asthma	4.03‡	1.84‡	1.63-2.05	4.93‡	1.61‡	1.33-1.90
Cellulitis	4.41‡	2.02‡	1.76-2.27	6.18‡	2.02‡	1.63-2.41
Congestive heart failure	5.28‡	2.41‡	2.08-2.75	7.73‡	2.53‡	2.00-3.06
Diabetes (diabetic ketoacidosis; coma)	5.06‡	2.32‡	2.00-2.63	8.61‡	2.82‡	2.26-3.38
Gangrene	3.35‡	1.53‡	1.18-1.89	14.43‡	4.73‡	3.10-6.35
Hypokalemia	3.31‡	1.51‡	1.17-1.86	3.28‡	1.07	0.77-1.38
Immunizable conditions	3.69‡	1.69	0.92-2.46	3.43‡	1.12	0.37-1.88
Malignant hypertension	3.40‡	1.56‡	1.29-1.82	5.32‡	1.74‡	1.36-2.13
Pneumonia	4.32‡	1.98‡	1.73-2.22	4.29‡	1.41‡	1.15-1.66
Pyelonephritis	3.07‡	1.40‡	1.20-1.61	2.90‡	0.95	0.74-1.16
Bleeding ulcer	2.21‡	1.01	0.86-1.16	3.30‡	1.08	0.84-1.33
All AHCs§	4.02‡	1.84‡	1.62-2.05	5.04‡	1.65‡	1.35-1.95
All non-AHCs	2.19‡	1.00	. . .	3.05‡	1.00	. . .
High-discretion non-AHC	2.88‡	. . .	. . .	3.35‡	. . .	. . .
Low-discretion non-AHC	1.54‡	. . .	. . .	2.17‡	. . .	. . .

*Ratios of the relative rates for each avoidable hospital condition divided by the relative rate for all non–avoidable hospital conditions.
†Confidence intervals apply only to adjusted relative rates.
‡$P<.05$.
§AHC indicates avoidable hospital condition.

ers, as well as excluding patients with alcoholism. The relative rates for low-discretion non-AHCs were lower than for all non-AHCs and therefore this adjustment resulted in somewhat higher adjusted relative rates. The relative rates for high-discretion non-AHCs were higher than for all non-AHCs, particularly in Massachusetts, and as a result the adjusted relative rates were lower. For example, the adjusted relative rate for asthma in Massachusetts was 1.84 (95% CI, 1.63 to 2.05) using all AHCs as an adjuster and 1.40 (95% CI, 1.23 to 1.56) using high-discretion non-AHCs, while the figure for bleeding ulcer dropped below 1 ($P>.05$) using the high-discretion adjuster. Overall, after adjustment with high-discretion non-AHCs, 10 of the 12 relative rates for the individual AHCs in Massachusetts were still greater than 1 ($P<.05$ for six conditions), and eight of the 12 relative rates in Maryland were still greater than 1 ($P<.05$ for seven conditions). Finally, similar to the pattern of findings for the uninsured, the exclusion of alcoholic patients reduced the estimates and the significance levels for hypokalemia and bleeding ulcer, but did not substantially affect rates for other AHCs.

Admissions for Appendicitis

Using the population-based approach described previously, we found that the relative rates of admission for appendicitis (uninsured vs private and Medicaid vs private) in each of our study states varied only slightly, between 0.71 and 1.09, depending on insurance status and state, and none of the estimates differed significantly from 1.0.

Table 5.—Odds of Avoidable Hospital Conditions by Insurance Status, 1987*

	No.	Uninsured Odds Ratio (95% Confidence Interval)	Medicaid Odds Ratio (95% Confidence Interval)
		Massachusetts	
Age group, y			
Male			
<18	32 631	1.26 (1.11-1.43)	1.73 (1.56-1.93)
18-24	6403	1.33 (1.05-1.68)	1.06 (0.78-1.45)
25-64	42 944	1.47 (1.35-1.59)	1.26 (1.15-1.39)
Female			
<18	27 967	1.34 (1.16-1.55)	1.67 (1.48-1.88)
18-24	6968	1.33 (1.08-1.65)	1.38 (1.12-1.69)
25-64	44 157	1.35 (1.24-1.48)	1.59 (1.47-1.71)
		Maryland	
Male			
<18	22 800	0.86 (0.75-0.99)	1.34 (1.19-1.51)
18-24	4214	1.29 (0.95-1.75)	0.81 (0.57-1.16)
25-64	32 522	1.34 (1.21-1.48)	1.13 (1.02-1.25)
Female			
<18	20 560	0.88 (0.75-1.02)	1.08 (0.94-1.24)
18-24	4354	1.72 (1.31-2.27)	1.64 (1.25-2.16)
25-64	33 217	1.76 (1.58-1.95)	1.69 (1.54-1.85)

*Multiple logistic regression models were estimated, with controls for race and income. The patient hospitalization was the unit of analysis. Estimated odds ratios (Ψ) were calculated by exponentiating the parameter estimates of the dichotomous insurance variables for uninsured and Medicaid (privately insured patients comprised the reference group), where $\Psi=e^{\beta}$. Sample numbers are not weighted by the sampling factor and refer to the number of patients in each age-sex stratum.

Patient-Based Analyses

In Table 5 we present the results of the logistic regressions. Odds ratios greater than 1 indicate that the probability of being admitted for an AHC, adjusted for baseline utilization, race, and income, was greater for the uninsured (or Medicaid) patients than for privately insured patients. For most age-sex strata, our prior results indicating higher incidence of hospitalization for AHCs for uninsured and Medicaid patients persist after control for race and income. The odds of hospitalization for an AHC are 26% to 76% higher for uninsured patients, except for children under the age of 18 years in Maryland, for whom the odds are about 12% to 14% lower. The odds of hospitalization for an AHC for Medicaid patients are 6% to 73% higher than the privately insured across the strata, except for males aged 18 to 24 years in Maryland.

Patient Severity

Using DRGSCALE we examined the within–diagnosis related group severity of patients admitted for AHCs and found small differences by payer. The DRGSCALE scores (±SE) in Massachusetts for uninsured, Medicaid, and privately insured patients were 90 (±0.4), 96 (±0.4), and 94 (±0.4), respectively ($P<.01$ for each comparison with the privately insured patients). The figures in Maryland were 92 (±0.5), 96 (±0.4), and 94 (±0.5), respectively ($P<.05$ for comparisons with the privately insured patients). In addition, we examined DRGSCALE scores by individual AHC and found that the differences among payers varied by condition. The uninsured DRGSCALE scores were lower than the private scores for only five of 12 AHCs in Massachusetts ($P<.05$ for two conditions) and seven of 12 in Maryland ($P<.05$ for four conditions). In contrast, the Medicaid DRGSCALE scores were higher than the privately insured scores for 9 AHCs in Massachusetts ($P<.05$ for four conditions) and eight AHCs in Maryland ($P<.05$ for three conditions).

COMMENT

Our study documents that persons who are uninsured or insured by Medicaid have higher rates of admission for conditions for which hospitalization can potentially be avoided than do those who are insured privately. The results suggest a sizable epidemiological finding of excess morbidity among the uninsured and Medicaid populations in Massachusetts and Maryland. We found higher rates for nearly all of the 12 individual conditions that we selected. More than 2000 uninsured admissions and nearly 8000 Medicaid admissions in the two states would have been avoided if these groups had been hospitalized for these conditions at the same rate as were the privately insured. For most of the conditions that we selected, these differences persisted after adjusting for baseline hospitalization experience.

As with any adverse outcome, avoidable hospitalizations may have multiple causes. Where possible, we attempted to minimize this concern via careful selection of conditions and via secondary analyses or statistical adjustments. Nevertheless, alternative hypotheses other than poor ambulatory care may exist to explain higher rates of AHCs among vulnerable populations.

For example, higher rates of admission may result from increased incidence or prevalence of disease among uninsured and Medicaid populations, perhaps owing to poor environmental or social factors. Because data were not available, we were unable to adjust precisely for differences in disease prevalence in the denominator population. However, recent data suggest that the uninsured are not significantly different from the privately insured in terms of reporting problems with 10 common chronic conditions including diabetes, asthma, and heart problems.[32] Also, our adjustments for baseline hospital use, race, and income should have corrected for some of the dissimilarities in need and/or demand for hospital services. Nevertheless, removing alcoholics from the analyses had a noticeable effect on the relative rates for hypokalemia and bleeding ulcers. Although it is still possible that disease prevalence may explain some of our other findings, it is unlikely to be the predominant explanation for the consistent patterns we found across disparate conditions.

The frequency of avoidable hospitalizations may also be affected by patients' compliance, by their patterns of seeking care, or by providers' perceptions of barriers to ambulatory care. For example, physicians may have lower thresholds for admitting disadvantaged patients for AHCs if they think that outpatient follow-up might be unreliable. We gathered evidence on severity to address this possibility. Considering AHCs as a group, uninsured patients were slightly less severely ill and Medicaid patients were slightly more severely ill compared with privately insured patients. This suggests a lower threshold for admitting uninsured patients but a higher threshold for admitting Medicaid patients. However, the differences in DRGSCALE were small and varied substantially by individual AHC. Thus, we believe that differences in admission threshold are not likely to be an important explanation for the patterns that we found.

Finally, rates of AHCs may be influenced by underlying practice patterns. Therefore, we compared AHC and non-AHC relative rates as a method of adjustment. It is important to note that just as our list of AHCs includes conditions that reflect a spectrum of avoidability, the list of non-AHCs may contain selected conditions that many practitioners would consider to be at least partially avoidable. To the extent that this is true, dividing AHC relative rates by non-AHC relative rates may be an overadjustment. As alternatives to using all non-AHCs to adjust our AHC relative rates, we used subsets of non-AHCs defined by level of discretion, but our findings did not change qualitatively.

Earlier investigations support the conclusion that certain types of hospitalizations noted among disadvantaged and uninsured populations may be at least partially avoidable or preventable.[33] In work at a health maintenance organization, Solberg et al[25] identified 15 diagnoses indicating potential links with inadequate prehospital care. Of hospital cases with those diagnoses, 45% failed explicit quality criteria and 10% were judged implicitly by physicians to have received poor-quality care. Their research supports the validity of the concept of avoidable hospitalizations, at least from the perspective of a potential link with quality. Other researchers are currently pursuing related activities including assessments of ambulatory care for groups that differ by income and other socioeconomic characteristics (oral communications, John Billings, JD, and Jack Hadley, PhD, May 1992; and Andrew Bindman, MD, June 1992). Our methods may serve as a prototype for those interested in monitoring health care problems for large populations that differ by payer status or other social, economic, or geographic characteristics. Data on sentinel health outcomes such as those used in this study can be easily collected using hospital discharge data and population estimates.

As with any research based on administrative databases, our results may be biased by unreliable data[34] and other related limitations. We identified AHCs on the basis of principal diagnosis only. Therefore, certain admissions may have been missed as a result of similar clinical conditions being coded in a different order. This could present a bias if one insurance class was systematically coded differently than another; however, the usual incentive for systematic bias in coding order—to maximize diagnosis related group reimbursement—was not applicable to the populations under study. For the logistic regressions, we used the median household income of the patients' ZIP codes as an estimate of individual patients' incomes. Although this technique has been used in other published work,[5] this ecological approach may lead to biased estimates of the effect of income on utilization.

The frequencies for three of our individual conditions (gangrene, hypokalemia, and immunizable conditions) were very low, and the estimated CIs for these conditions may be unreliable. Our SEs for certain conditions may also be underestimated owing to the presence of readmissions.[35] Out-of-state admissions for Maryland were not available. In Massachusetts, admissions to out-of-state hospitals represented 1.0% of all admissions, a very small amount. Maryland is a smaller state and more emigration may

have occurred.

Our population estimates by insurance status are derived from the *Current Population Survey* in each study state, and the small samples in the survey could lead to imprecise or unstable estimates. Nevertheless, the *Current Population Survey* is clearly the most widely cited source of estimates of the uninsured.[36] Most important, our principal analyses, which contrasted relative rates for AHCs with relative rates for non-AHCs, should be insensitive to estimates of the denominator population.

Finally, we note that our data showed similar rates of hospitalization for uninsured persons and those with private insurance in Massachusetts, whereas other national data suggest that rates are lower for the uninsured.[37] Part of the discrepancy is related to our omission of obstetrical cases, which account for one in five admissions and have a relative rate of admission for uninsured groups compared with insured groups of 0.61. Also, the regulatory environment in Massachusetts may cause patterns of hospital use to be atypical.

In summary, we conclude that persons who are uninsured or insured by Medicaid have higher rates of admission for AHCs than do those who are privately insured. We believe that our findings are conspicuous enough so that future clinical investigations should determine the relative contributions of access, quality of care, and other possible causes of the discrepancies. In the debate over insurance reform, concern over the added costs of providing coverage for the uninsured may fail to consider the potential for some offsetting savings that may accrue from expanded access. While financial cost is certainly a prominent policy concern, it is also important to consider the human cost. This study suggests that in some instances persons who lack insurance or who are insured by Medicaid may suffer serious illnesses or flare-ups of chronic illnesses that might have been avoided.

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