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Disparities in Asthma Hospitalization in Massachusetts

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Objectives. We examined racial disparities in asthma morbidity in Massachusetts.

Methods. We used Massachusetts case-mix data from 1994 to 2002 to screen and track individual asthma morbidity and hospitalizations, which resulted in a sample of 10 145 patients who were first hospitalized for asthma between 1997 and 2000. We followed these patients for 2 years after their first hospitalization. Because asthma is widely considered a preventable cause of hospitalization, we interpreted a readmission for asthma as an indication of failed asthma management.

Results. We found substantial racial/ethnic disparities in readmission rates that persisted after control for comorbidities, payer type, and income. We estimated that the costs of repeat hospitalizations for asthma are in excess of one quarter of all asthma hospitalization costs.

Conclusion. Racial/ethnic disparities in asthma readmission rates show that Massachusetts is not on the frontier of asthma treatment. (*Am J Public Health.* 2006;96:358–362. doi:10.2105/AJPH.2004.050203)

Asthma is a chronic disease marked by inflammation and hyperresponsiveness of the lower airways and is a complex challenge for the public health community. In the United States, the direct health care cost for treating asthma is almost $13 billion per year,[1] and in Massachusetts, inpatient hospitalization for asthma accounts for $55 million in health care costs.[2]

According to the 2001 Centers for Disease Control and Prevention Asthma Surveillance Survey, which used data from the National Health Interview Survey, 31.3 million people reported a positive diagnosis for asthma during their lifetimes.[3] Asthma is one of the most dangerous childhood illnesses—1 of every 6 pediatric emergency room visits is the result of asthma—and it also disproportionately afflicts senior citizens. Some studies have shown an increasing prevalence of asthma in the United States.[4] Although there are disagreements about whether the upward trend in reported asthma cases is the result of increased prevalence or increased diagnosis, it is clear that the burden of asthma increased between 1980 and 1999.[4] Furthermore, the direct cost—the cost of medical services and supplies—reflects only a portion of the burden associated with asthma; the indirect cost includes lost workdays of caregivers, lost workdays of asthmatics, and loss of lifetime earnings because of asthma mortality.

The etiology of asthma is contestable, but medical, behavioral, and environmental methods for managing asthma are both well known and effective. The Healthcare Cost and Utilization Project of the Agency for Healthcare Research and Quality lists both adult and pediatric asthma as 2 of the 16 causes of preventable hospitalizations.[5] Proper management of asthma requires a combination of medication for long-term maintenance and short-term relief and some environmental modifications to limit exposure to triggers. High rates of hospitalization for preventable episodes of asthma generally indicate a lack of adoption of best practices by health care providers, a lack of communication between providers and patients, a lack of patient self-management, and a lack of access to care.

Previous studies have shown substantial disparities in the hospitalization rates for asthma by race/ethnicity and by income groups.[6–8] Even when sociodemographic variables were controlled within the same Medicaid population, Black and Hispanic children had worse asthma status—higher rates of hospitalizations, emergency room use, and school absences—than White children did.[9]

According to Smith et al., 20% of asthma patients are responsible for 80% of annual hospitalizations and the associated costs.[10] There have been few studies on repeat hospitalizations for asthma that used datasets with comprehensive longitudinal patient data. In studies of Medicaid programs, where coverage is consistent across the patient population, Black and Hispanic children were less likely than White children to use anti-inflammatory medication.[9,11] It remains uncertain whether the difference in anti-inflammatory medication use is the result of a difference in adherence or prescribing patterns. In a retrospective study of children who were in the non–health maintenance organization (HMO) portion of the Massachusetts Medicaid program, there was no difference in the pattern of prescribing anti-inflammatory medication; however, timely follow-up care after an emergency room visit was less likely among Hispanic and Black children.[12]

There have been studies that used hospitalization data to examine a subset of payment types during a calendar year, a time frame that is too short for determining hospitalization patterns.[13] In studies that followed a cohort of patients after they were discharged from a hospital, factors that were associated with the probability of readmissions for asthma included lack of an asthma management plan and asthma management style,[14] caretaker characteristics,[15] race/ethnicity,[13] gender, and a history of allergies.[16] There is no consistent evidence that medications prescribed upon discharge play a statistically significant role in readmissions.[16–18] By contrast, there is evidence that follow-up visits with pediatricians and pediatric pulmonologists reduce the probability of readmissions among children.[17,18]

The disparity in hospitalization rates may be partially explained by differences in diagnosis and the subsequent differences in management of asthma across racial/ethnic groups. For example, differences in insurance coverage, access to health care providers, and health care utilization may lead to differences in diagnosis of asthma. Asthma morbidity can be compared across individuals who have been diagnosed with asthma by examining

repeat hospitalizations for asthma. Therefore, we examined the sociodemographic correlates of repeat hospitalizations for asthma among persons who were first admitted between 1997 and 2000 in Massachusetts.

After examining racial/ethnic differences in health outcomes, we developed some alternative interpretations for these differences. First, racial/ethnic gaps in health may reflect direct discrimination, either in the provision of health services or in the attainment of access to care via employment and insurance. Second, racial/ethnic gaps may be the result of differences in social or cultural orientation toward the health care system. Third, health disparities that are most evident among minorities may be the result of inadequacies in preventative medicine among disempowered people of all races and ethnicities.[19] We cannot distinguish among the 3 mechanisms that may generate racial/ethnic differences in health outcomes, but there is evidence that these disparities persist even after a diagnosis of asthma.

Addressing asthma morbidity is particularly important in Massachusetts, where there is a higher percentage of people who have been diagnosed with asthma than the national average (9.4% vs. 7.1%, respectively, in 2001).[20] In Massachusetts, there were more than 8000 hospital admissions for asthma in 1998, and in 2002, the costs for inpatient asthma hospitalization totaled $55.5 million.[2]

METHODS

We extracted records of hospital admission for asthma (1994–2002) from the Massachusetts Division of Health Care Finance and Policy (DHCFP) Acute Hospital Discharge Data. Criterion for inclusion in our study were a primary diagnosis of asthma (*International Classification of Diseases, Ninth Revision,* code 493), being aged 5 to 64 years when first admitted, having no admissions for asthma during the 2 years before the first admission, and not being diagnosed with emphysema at the time of first admission. Patient characteristics included the individual's unique medical record number for tracking patients over time, race/ethnicity (White, Black, Hispanic, other), zip code of residence, anticipated type of reimbursement ("payer type": self-pay/out-of-pocket, worker's compensation, Medicare, Medicaid, commercial insurance), and a dichotomous indicator of any major comorbidities (additional diagnoses associated with the primary diagnosis). Between 1997 and 2000, 86% (n=20 000) of asthma patients aged 5 to 64 years (N=23 317) had valid unique patient identifiers. Almost one third (n=1003) of the 3317 invalid observations were from a single hospital; the results were insensitive to including or excluding these observations. The data identified the hospital where the patient was admitted, the date of admission, the severity level of asthma (APR-V12 Severity Level), and total charges.

We matched the zip code of residence with zip code–level economic data from the 2000 Census of Population and Housing. After combining some zip codes into small-area zip codes[21] and adjusting for splits in zip codes in 1998,[22] we were able to match more than 99% of the sample to the zip code data from the census. Median household income for the zip code provided the best available proxy for the asthma patient's household income. Median neighborhood household income was associated with the race/ethnicity of patients; therefore, we included both income and race/ethnicity to explore the independent effects of both variables.

The outcome variable was the number of hospital admissions for asthma that each patient had during the 2 years after a first admission. By screening patients for no previous hospitalizations during the 2 years before the first hospitalization, we ensured that the index hospitalization was the initial indicator of severe manifestation, i.e., the first hospitalization was an indicator of active asthma. After this hospitalization for asthma, the patient should have been discharged with resources, including medication, for asthma management.

We analyzed a 100% asthma-prevalent subpopulation. There is no reason to believe that the well-documented higher prevalence of asthma among Blacks and Hispanics compared with Whites[23] implied a greater risk for readmissions among this subpopulation.

A successful intervention should prevent additional episodes of asthma that are severe enough to require hospitalization. We followed patients for 2 years after their first hospitalization to assess the effectiveness of subsequent preventive care. The 2-year follow-up is a reasonable length of time to expect the patient to be exposed to asthma triggers, but it is not too long that the sample is reduced by attrition or by the introduction of confounding effects.

We examined contingency tables for the outcome variable—readmission—by the covariates of interest: race/ethnicity, gender, payer type, age, and presence of major comorbidities. We then estimated multivariate logits where the outcome variable was any readmission, and the covariates included characteristics of the patient and characteristics of the first episode of asthma.

RESULTS

Between 1997 and 2000, nearly 11 000 people were hospitalized for asthma in Massachusetts who met our study inclusion criteria. The people who were hospitalized for asthma were disproportionately females and minorities compared with the overall population of Massachusetts (Table 1). For example, 12% of the asthma patients were Black, which is double the 6% of Blacks in the overall state population. The number of Hispanics also was disproportionately high. We could not distinguish between alternative hypotheses for the higher rate of first incidence of asthma among minority populations. For example, Blacks and Hispanics may be disproportionately exposed to triggers or may have less opportunity for diagnosis (e.g., less contact with primary care providers).

During the study period, 55.3% of the patients who were hospitalized for asthma had private insurance, 11.2% paid out-of-pocket, 23.3% had Medicaid, and 10.2% had other government insurance. Almost 20% of the patients who were hospitalized for asthma were hospitalized again within the next 2 years. Table 2 shows the frequency of individuals who were admitted for asthma. Each year contributed about one fourth of the total, and the distribution of single and repeat hospitalizations was similar for each year.

Table 3 shows the difference in the frequency of readmissions by race/ethnicity for all asthma admissions. The statistically significant gap between readmissions for Whites and Blacks is more than 6 percentage points,

TABLE 1—Characteristics of Patients First Hospitalized for Asthma: Massachusetts, 1997–2000

	Hospitalized Population, Frequency (%)	Massachusetts Population Age Categories, %
Total	10 145	
Female	6 842 (67.4)	50.6
Race/ethnicity		
White, non-Hispanic	7 255 (71.5)	80.5
Other	532 (5.2)	6.2
Black, non-Hispanic	1 162 (11.5)	6.0
Hispanic	1 196 (11.8)	7.3
Age, y		
5–14	1 068 (10.5)	16.9
15–39	4 026 (39.7)	44.8
40–64	5 051 (49.8)	38.2

Note. The hospitalization columns represent all persons who had first hospitalizations for asthma between 1997 and 2000. In the Massachusetts case-mix data, the race/ethnicity classifications are exclusive. In the Census 2000 data, each respondent reported up to 6 races as well as Hispanic or non-Hispanic. We classified White, no other races, and non-Hispanic as White; Black, any other race, and non-Hispanic as Black; and Hispanic and any race as Hispanic. Other includes Asian, Native American, other, and unknown.

TABLE 2—Frequency of Asthma Hospitalizations: Massachusetts, 1997–2000

Number of Asthma Hospitalizations	Number of Patients (%)
1	8 238 (81)
2–3	1 620 (16)
≥4	287 (3)
Total	10 145 (100)

TABLE 3—Number of Hospitalizations for Asthma by Race/Ethnicity: Massachusetts, 1997–2000

Race	1	2–3	≥4
Black	76.3	20.4	3.4
Hispanic	76.5	19.2	4.3
Other	81.8	16.2	2.1
White	82.7	14.7	2.6

and the difference between Whites and Hispanics is 6 percentage points. We tabulated admissions by age and by race/ethnicity separately (data not shown). Among children aged 5 to 14 years, the lowest rate of readmissions was 15.8% among White children, and the highest rate was 22.5% among Black children, a gap of almost 7 percentage points.

At the time of first admission, about 60% of cases were determined to have minor severity (vs moderate, major, or extreme severity). Blacks (61.4% minor) and Hispanics (60.3% minor) had a distribution of severity similar to that of Whites (58.9% minor) at the time of first admission (Pearson $\chi^2=8.77$; $P=.19$). Hispanics (10.1%), but not Blacks (5.7%), were slightly more likely than Whites (6.9%) to have major comorbidities at the time of first admission.

The cost of the first admission was very similar regardless of future readmissions. Among patients who did not return to the hospital during the succeeding 2 years, the mean cost of the first (only) admission was $5392; among patients who returned once or twice, the mean cost of the first admission was $5396; among patients who had multiple readmissions, the mean cost of the first admission was $5337. The striking similarity in the cost of first admission by subsequent admissions persisted when we compared the cost of first admission by race/ethnicity. Also, patients who had major comorbidities at the time of first admission also had a substantially different probability of additional admissions ($\chi^2=4.17$; $P=.12$). The bivariate association suggests that the probability of readmission is governed by a social process rather than by clinical severity of asthma. The systematic differences in race/ethnicity for the clinical severity of asthma cases is not a likely explanation for the racial/ethnic differences in repeat hospitalizations, and clinical factors at the time of first admission do not to provide an explanation for readmissions.

Differences in family economic resources and socioeconomic environments are more likely explanations for differences in readmission. Payer type varied significantly across racial/ethnic groups: first-admission costs of 57.9% of Hispanic patients, 43.6% of Black patients, and 27% of White patients were paid by Medicaid or another government payer. Furthermore, the average Black or Hispanic patient was from a substantially poorer zip code than the average White patient was. Median family earnings in the zip code of residence averaged $43 600 among Blacks, $39 300 among Hispanics, and $59 300 among Whites.

To investigate the factors associated with readmissions, we estimated 2 logits (odds ratios in Table 4). In the first model, we estimated the correlates of the probability of any repeat hospitalization versus no repeat hospitalization during the 2 years after the first admission. In the second model, we considered the correlates of the probability of many readmissions (≥4) versus 3 or fewer during the 2 years after the first admission.

Within each model, we controlled for age, gender, and major comorbidities to show the racial/ethnic gap in readmissions. We then controlled for payer type and the median neighborhood income of the patient's zip code of residence. Overall, both models were significant at the 1% level. The odds ratios show the relative likelihood of a positive outcome associated with a unit increase in the explanatory variable.

Our results show that race/ethnicity played a significant role in predicting repeat hospitalizations, even after we controlled for age, payer type, and median neighborhood income. For example, Black patients had odds for readmission that were roughly half again as high as those for White patients. The probability of having a repeat hospitalization was

TABLE 4—Odds Ratios (With 95% Confidence Intervals) for Asthma Readmission (N = 10 145): Massachusetts, 1997–2000

	Any Readmissions			Many Readmissions		
	1	2	3	4	5	6
Race[a]						
Black	1.515** (1.298, 1.767)	1.424** (1.225, 1.655)	1.289** (1.101, 1.509)	1.385 (0.973, 1.973)	1.249 (0.875, 1.784)	1.039 (0.716, 1.507)
Hispanic	1.495** (1.304, 1.712)	1.328** (1.145, 1.539)	1.169 (0.998, 1.370)	1.738** (1.276, 2.367)	1.436* (1.042, 1.979)	1.135 (0.798, 1.613)
Other	1.082 (0.846, 1.386)	1.014 (0.789, 1.303)	0.971 (0.756, 1.247)	0.832 (0.439, 1.577)	0.751 (0.395, 1.428)	0.682 (0.356, 1.306)
Age categories, y[b]						
5–14	0.854 (0.713, 1.024)	0.807* (0.673, 0.968)	0.794* (0.662, 0.952)	0.586* (0.356, 0.965)	0.543* (0.324, 0.910)	0.532* (0.318, 0.892)
40–64	0.906 (0.810, 1.014)	0.893* (0.798, 1.000)	0.897 (0.802, 1.005)	0.830 (0.641, 1.075)	0.816 (0.629, 1.060)	0.823 (0.634, 1.068)
Male gender	0.865* (0.766, 0.976)	0.879* (0.778, 0.994)	0.881* (0.780, 0.996)	0.907 (0.686, 1.199)	0.929 (0.703, 1.227)	0.932 (0.706, 1.232)
Major comorbidities	0.801* (0.642, 0.998)	0.779* (0.625, 0.971)	0.778* (0.624, 0.970)	1.109 (0.699, 1.761)	1.061 (0.666, 1.692)	1.061 (0.665, 1.693)
Payer type[c]						
Medicaid/government		1.441** (1.297, 1.601)	1.357** (1.224, 1.504)		1.786** (1.363, 2.341)	1.600** (1.216, 2.107)
Out-of-pocket		1.126 (0.945, 1.342)	1.073 (0.899, 1.281)		1.321 (0.883, 1.978)	1.214 (0.811, 1.817)
Median neighborhood income[d]			0.925** (0.894, 0.958)			0.862** (0.787, 0.945)

Note. Numbers 1–6 represent variations in the regression models. The dependent variable in columns 1 through 3 is an indicator (1 = yes) of whether the patient was hospitalized again during the 2 years after the first hospitalization. The dependent variable in columns 4 through 6 is an indicator (1 = yes) of whether the patient was hospitalized more than twice during the 2 years after the first hospitalization.

[a]Omitted category = White.

[b]Omitted category = aged 15–39 years.

[c]Omitted category = private insurance.

[d]Median neighborhood income of the zip code of residence (measured in $10 000 increments).

*$P < .05$; **$P < .01$.

greater among Blacks and Hispanics compared with Whites (significant at the 1% level). When we controlled for median neighborhood income, the odds for Blacks declined slightly, but the odds remained significant at the 1% level. The odds for Hispanics fell by half, and the *P* value increased. The odds for median neighborhood income showed a small but significant protective effect against readmission.

Blacks and Hispanics had a higher probability of multiple readmissions than Whites did (statistically significant at the 5% level), which indicated multiple failures of asthma management among those patients. When we controlled for median neighborhood income, the odds for the race/ethnicity variables fell by more than half and lost statistical significance. Median neighborhood income had a significant protective effect against multiple readmissions; however, even high median neighborhood income did not compensate for racial/ethnic disparities among those who had any readmissions.

Age did not have an effect on readmissions or multiple readmissions. Males were substantially and significantly less likely to have repeat admissions, but the difference by gender was not significant for multiple readmissions. The presence of major comorbidities at the time of first admission made readmission less likely.

Patients who were insured by Medicaid or other government payers had a much higher probability of readmission than patients who were privately insured. Patients who paid out of pocket were slightly, but not statistically significantly, more likely to be readmitted compared with privately insured patients. We had expected self-paying patients to have the poorest access to health care and, therefore, be the most likely to experience readmission, but our prediction proved wrong. It is possible that the out-of-pocket group included some persons who were enrolled in indemnity plans, i.e., they paid the hospital bill out of pocket—which was recorded by the hospital—and then were reimbursed by their private insurance company. When we controlled for payer type, there was no mediating effect on the association between race/ethnicity and readmission.

We also estimated negative binomial regressions for the count of repeat hospitalizations with the same covariates. The results confirmed the logit results (data not shown).

DISCUSSION

Because we could not disentangle the socioeconomic correlates of the causes of asthma, we instead examined readmissions to assess the quality of asthma management among clearly identified cases (in individuals who had received a doctor's diagnosis of asthma). Asthma management includes access to appropriate specialists and medicines, patient compliance, and environmental modifications. Individuals who manage their asthma should experience minimal or no chronic symptoms or exacerbations and normal (or near normal) pulmonary function.[24] Hospitalization for asthma is considered a preventable outcome[25] and, therefore, is used as a measure for evaluating health care in Massachusetts.[26] However, despite the advances in asthma control, asthma hospitalizations are a persistent problem.

Our analysis of the Massachusetts data from 1997 to 2000 shows the persistence of racial/ethnic disparities in asthma management and outcomes. Income, which is associated with race/ethnicity, explains some but not all of the disparity. Economic disadvantage was an important factor in the racial/ethnic readmission gap; however, the multivariate analysis showed that the observable economic factors did not fully explain the gap. The simple ability to afford health care does not fully explain outcomes.

Health insurance plays an important role in the proper management of asthma. Medicaid patients have readmission rates that are 50% higher than privately insured patients, which shows that improvements must be made in the discharge and follow-up of Medicaid patients. Yet again, the racial/ethnic gap in readmission is not explained by Medicaid coverage. The differences within payer type were consistent with evidence that there are racial/ethnic differences in the prescription and the use of preventive medications within the Medicaid population.[9,11]

By examining repeat hospitalizations, we can assess the management of asthma rather than the incidence or diagnosis of the disease. The 2-year period for readmission gave us a sufficient amount of time to assess the quality of interventions after diagnosis. Previous research has found disparities in styles and intensity of asthma management. Our analysis extends these results to show strong differences in measured health outcomes.

The overall 20% readmission rate shows that one fifth of asthma hospitalizations were repeat hospitalizations. The average cost of the first admission was $5400, which varied little by the number of readmissions. During the 2-year period, patients who had 2 or 3 admissions incurred about $7000 in additional costs beyond the cost of their first admissions; patients who had 4 or more admissions incurred about $27 000 in additional costs. The excess costs show that improvements in asthma management could have reduced the direct costs for the Massachusetts patients by $20 million between 1997 and 2002, or one quarter of the total direct costs for our subset of 10 145 patients. Therefore, there is a substantial opportunity to save on the preventable costs of hospital admission.

Racial/ethnic disparity in asthma readmissions is *prima facie* evidence that Massachusetts is not on the frontier of asthma treatment. Improvements in asthma management may be possible throughout the population. At the minimum, if the health care system in Massachusetts moves minorities toward parity in asthma outcomes with Whites, the direct savings can be reallocated to other salubrious ends. ■

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Human Participant Protection

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