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Are We Closing the Disparities Gap?

Small-Area Analysis of Asthma in Chicago

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Disparities in asthma outcomes in the Chicago area have been observed between geographic areas and ethnic and socioeconomic groups. As efforts to close this gap have moved beyond the initial characterization of the problem to implementation of concrete programs to address these disparities, objective measures of success are essential. We present a variety of data from the Chicago area to assess whether any improvement in previously reported disparities can be demonstrated. While some process outcomes such as medication usage have improved over time, death from asthma has failed to demonstrate an equivalent improvement. More importantly, the differential in asthma mortality and hospitalization rates between African Americans and European Americans has failed to close in the years following the release of the National Asthma Education and Prevention Program asthma guidelines. ***(CHEST 2007; 132:858S–865S)***

Key words: asthma; asthma hospitalizations; asthma medication use; asthma mortality; asthma outcomes; health disparities

Abbreviations: ED = emergency department; ICD-9 = International Classification of Diseases, Ninth Revision; ICD-10 = International Classification of Diseases, Tenth Revision

In the early 1990s, it became increasingly apparent that marked geographic disparities in asthma outcomes existed throughout the United States. Research as early as 1990 identified excess asthma mortality rates in the central plains states as well as three urban areas: Chicago, New York City, and Phoenix.[1] Further characterization of asthma outcomes in Chicago demonstrated a strong association with variations in asthma morbidity and mortality with factors such as race and socioeconomic status.[2,3] These early studies served as a call to action in the Chicago area and elsewhere, prompting responses from both local and national organizations.[4] With numerous initiatives in place to address the asthma epidemic, asthma surveillance has acquired the additional role of assessing the success (or failure) of these initiatives.

The identification of appropriate measures to assess changes in the burden of asthma and specifically disparities in that burden is by no means straightforward.[5,6] Complicating the assessment of disparities in asthma is that much of the available data lacks information on race/ethnicity or socioeconomic status. For this reason, area of residence or other surrogates are often used for these important factors.

The choice of the best measure to highlight disparities is also controversial. Mortality rates, which have been used as a standard measure in many other diseases, markedly underestimate the true impact of asthma. While theoretically preventable and therefore tragic, death due to asthma is fortunately rare when compared to the millions of individuals with this disease.

Assessment of asthma prevalence through survey instruments can provide an indication of the magnitude of the problem and provide a denominator for other outcome measures. As it is uncertain that

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individuals are truly "cured" of asthma,[7] and the actual cause of asthma remains controversial, prevalence numbers alone may not provide a useful benchmark to assess the effect of asthma intervention programs. Cross-sectional, small-area analysis can be used to help ascertain whether observed disparities in Chicago are due to a greater burden of disease, directing the focus of interventions toward prevention, or due to greater morbidity among individuals already having asthma, with ongoing focus on treatment and secondary prevention of exacerbations and progression of disease.

We present a variety of assessments of health-care utilization. These have been used as a surrogate for asthma morbidity as well as a means of assessing the quality of asthma care benchmarked against a standard such as the National Asthma Education and Prevention Program asthma guidelines.[8] These markers suffer inherent limitations, with no single approach providing definitive answers, but rather providing a piece in an overall picture of asthma disparities.

Materials and Methods

Data Sources Cited

The data sources cited can be used to assess disparities from a spatial, or cross-sectional, as well as a temporal or longitudinal standpoint. Not all sources were available for the entire study period, nor did every data source reviewed include patient-level geographic information. Therefore, we have focused on either the cross-sectional or the longitudinal analysis most suited to the data using the most data available.

Cross-Sectional Data

Behavioral Risk Factor Surveillance System From 2001 to 2003: This was a telephone survey of adults with weighted cluster sampling, with joint state and national design and implementation.[9] The Illinois administration is designed with Chicago as its own stratum, making accurate local estimates possible. Asthma questions were added to core modules in 2000.

Chicago Asthma Surveillance Initiative, 1996–1997: This was a cross-sectional, self-administered survey to characterize asthma-care practices conducted among medical directors of 89 emergency departments (EDs) serving the Chicago metropolitan area. Surveys included asthma-specific demographics and selected utilization statistics; assessment practices; treatment practices; discharge and follow-up activities; and familiarity with, attitudes toward, and utilization of guidelines/protocols. While primarily cross-sectional in nature, the follow-up surveys associated with this project provide some longitudinal information.[10]

Illinois Emergency Department Asthma Collaborative, 2003–2004: Quality data from six EDs in Illinois, including three in Chicago, covering a diverse spectrum of patient demographics. Data were abstracted from 15 charts monthly per site over a 15-month period.[11]

Chicago Respiratory Health Survey, 1999: This stratified, random-digit telephone survey conducted by the Chicago Department of Public Health queried Chicago residents with proxy response about asthma and respiratory disease and symptoms using questions based on the European Community Respiratory Health Survey.[12]

Longitudinal Data

Illinois Department of Public Health Mortality Files, 1992 to 2003: These files included Chicago residents dying anywhere in the United States. Death certificates include demographic variables and causes of death, coded by a standard methodology, using the International Classification of Diseases, Ninth Revision (ICD-9) for data from 1992 to 1998, and International Classification of Diseases, Tenth Revision (ICD-10) for data from 1999 to 2003. ICD-9 data were adjusted to provide continuity when comparing with ICD-10 data. Underlying cause of death code 493 was used to identify asthma in ICD-9 data, and codes J45 and J46 were used for ICD-10.

Illinois Health Care Cost Containment Council Research-Oriented Data Set From 1992 to 2001: Discharge data for all acute-care hospitals in Illinois for patients residing in Chicago-designated (area code 606) zip codes were analyzed from 1992 to 1994 and from 1999 to 2001. Principal and secondary diagnosis and procedure codes were provided. Diagnoses and procedures were coded by a standard methodology, using ICD-9, Clinical Modification. Patient demographics included age, sex, and zip code. Discharges with a primary diagnosis code of 493 were included.

NDC Health Information Systems Data Set 1996 Through 2000: Prescriptions written for asthma-related medications aggregated by the specialty and by the zip code of provider. Associated ICD-9 codes for the individuals filling these prescriptions were unavailable.

Illinois Medicaid Administrative Data set Fiscal Year 1995–1999: Medication and health service utilization data for all individuals with a diagnosis of asthma enrolled in Illinois Medicaid from July 1995 to June 1999 was included. Tracking of individual level data was done using a coded identification number to prevent identification of individual subjects. Subjects with regular asthma medication use (defined by four or more prescription fills in a 1-year period) were assessed for appropriate inhaled steroid use. Inhaled steroid use was judged appropriate if subjects had the following: (1) fewer than four prescription fills for β-agonist medications, or (2) if four or more of these fills were present, four or more prescriptions for inhaled steroids were also used. Subjects with more than three prescription fills for short-acting β-agonists are likely to have daily symptoms at some point in that year and warranting inhaled steroid therapy. The requirement for multiple inhaled steroid refills is to assess persistence of use.

Osco Prescription Database 2001: Osco Pharmacy (New Albertsons; Eden Prairie, MN) is a pharmacy chain with a large market share throughout the Chicago area. Individual level prescription data were provided for customers in the Chicago area who filled at least one asthma-related prescription linked by means of a coded identification number to prevent loss of confidentiality. As ICD-9 codes were not provided, individuals with diseases other than asthma may be included in the cohort.

US Census, 1990 and 2000: Data from Summary Form 1 were used to characterize geographic and ethnicity specific populations used in rate calculations. Data from Summary Form 3 were used to characterize geographic subdivisions of the city socioeconomically. The City of Chicago Department of Planning produced a census file with bridged race categories by age for the 1990 census that was used for denominators for the white population for the calculation of age-adjusted mortality rates from 1992 to 1994. There are no detailed intercensus estimates by age and ethnicity for local areas; therefore, Census 1990 data were used for calculations from 1992 to 1994. Census 2000 data were used for calculations from 2000 to 2003.

Results

Asthma Prevalence

Although there are no proven primary prevention measures for asthma, understanding asthma prevalence is key to interpreting trends and differences between groups. While population-based asthma surveillance is a routine part of national surveillance systems, obtaining relevant data for local areas is a recent phenomenon. Interpretation of data in pediatric populations is especially challenging given the difficulty of establishing a diagnosis in individuals < 5 years old. Investigator-initiated studies routinely use different instruments than national surveillance systems, making comparisons between local and national childhood asthma data problematic. Such surveys are also often not population based, with restrictions in age or in cohort definition (*ie*, school-based studies) allowing insight into these specific populations but preventing comparisons of prevalence rates between populations.

Chicago was a site in one such study,[13] the landmark International Study of Asthma and Allergies in Childhood, which used a standardized set of instruments and survey administration techniques to assess children 6 to 7 years old and 13 to 14 years old across the world. Chicago was 1 of 155 centers that participated in the survey for children 13 to 14 years old. This study differed from current US national surveillance efforts in the use self-report by children, rather than an adult proxy, preventing direct comparison to measures such as the National Health Interview Survey.

Sixteen percent of the Chicago respondents in the International Study of Asthma and Allergies in Childhood study reported a diagnosis of asthma at some time in their lives. This finding was similar to that found in Seattle, the other US center, and lower than in the United Kingdom, where the majority of centers reported lifetime asthma prevalence of $> 20\%$. The investigators did not assess individual race in Chicago, but in a subanalysis of the data students in predominately ($> 98\%$) black schools were 39% more likely to have a lifetime diagnosis of asthma than students enrolled in schools with other predominant ethnicities.

A number of prevalence studies[14–16] have focused attention on younger children in Chicago, targeting communities suspected to have higher-than-average expected asthma prevalence, and not generalizable to the community overall. For example, children 3 to 5 years old enrolled in the Head Start program were reported to have a 14% lifetime prevalence for asthma[15]; kindergartners enrolled in a higher-risk community area had a lifetime prevalence of nearly 11%.[16]

The two available adult asthma prevalence measures in Chicago both have the advantage of similarly surveyed populations. Although the Chicago Respiratory Health Survey was used to generate a total population estimate, the parent survey from which it was derived, the European Community Respiratory Health Survey, was initially validated and administered internationally to subjects 20 to 44 years old.[12] The prevalence of Chicago in this age group was similar or lower than other English-speaking cities, and asthma prevalence varied strongly with income, and to a lesser extent by race. Non-Hispanic blacks had a modestly (20%) higher asthma prevalence than non-Hispanic whites, and Hispanics had a 30% lower asthma prevalence than non-Hispanic whites. When compared to a similar (but not identical) national measure of current asthma prevalence nationally, asthma prevalence in Chicago was modestly higher, a finding that was consistent across income and ethnic groups.

The Behavioral Risk Factor Surveillance System incorporated asthma-related questions into the core questionnaire in 2000.[17] Although the Behavioral Risk Factor Surveillance System does not produce a true national estimate, the national median for states and territories provides a useful measure for comparisons. The 9% prevalence of adult asthma in Chicago from 2001 to 2003 was virtually identical to the estimate provided by the Chicago Respiratory Health Survey, and is higher than the Illinois rate of 7.4% and the national average rate of 7.5%. Non-Hispanic blacks were 30% more likely to report current asthma than non-Hispanic whites, and Hispanics were 25% less likely to report current asthma than non-Hispanic whites, similar to the findings for the Chicago Respiratory Health Survey.

These data indicate that asthma prevalence in Chicago is slightly higher than the nation overall and that differences can be seen across racial/ethnic groups. These differences are not large enough to fully account for the marked racial differences in asthma morbidity and mortality seen in Chicago.

Longitudinal Assessment of Asthma Medicine Utilization

Asthma medications have been regularly used as a marker of appropriate asthma care.[18,19] Such studies have been performed in Medicaid populations as well as in closed model Health Maintenance Organizations.[20,21] The presence or absence of prescription fills for controller medication in patients in whom it would be indicated is one of the quality measures currently used by the Center for Health Care Quality.[22]

Pharmacy marketing data indicates that there has been a substantial improvement in the prescribing patterns of Chicago pediatricians since

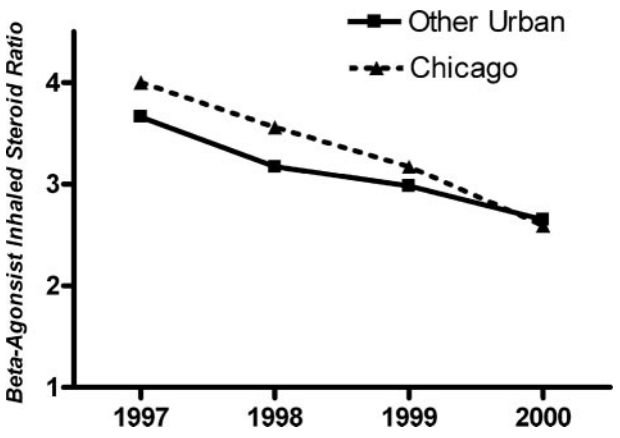

FIGURE 1. Ratio of β-agonist prescriptions to inhaled steroid prescriptions written by Chicago pediatricians compared to ratios for pediatricians in other urbanized areas of Illinois as defined by zip code population density. Each point represents the aggregate value for each year. Source: NDC Health Information Systems Incorporated, Inc, Phoenix, AZ.

the release of the National Asthma Education and Prevention Program guidelines in 1997. Figure 1 focuses on pediatricians in Chicago over that time period compared to pediatric providers in other urban areas of Illinois. Both sets of providers show improvement in prescribing patterns with respect to inhaled steroids; however, pediatricians practicing in Chicago have caught up to and surpassed the ratio for pediatricians practicing in other urban areas in Illinois.

Individual patient-level data on asthma prescriptions have been obtained from a number of sources; however, access to this data has been severely curtailed following the implementation of the Health Insurance Portability and Accountability Act privacy guidelines. Again as with studies of prevalence, a tradeoff can often be seen be the level of detail available in a data set and the inclusiveness of that data. A common example is the Medicaid population, which has been assessed in a number of studies.[18,23] This high-risk population is of great interest because it accounts for a disproportionate number of hospital admissions for asthma, but due to means testing and other requirements for enrollment is not representative of the general population. Pharmacy prescription data, in contrast, may be more representative of the general population, but the absence of other patient data, such as ICD-9 coding, may result in the inclusion of patients with other disease states who may be utilizing asthma-related medications.[24]

Figure 2 demonstrates a comparison of data from the Illinois Department of Public Aid database from fiscal year 1996 to data from fiscal year 1999. Analysis of Osco Pharmacy prescriptions filled by Medicaid pediatric recipients provides an "apples and oranges" comparison to a later time point not available in the Medicaid data set, which should be interpreted with caution. Each map represents the portion of individuals ages 5 to 17 years with appro-

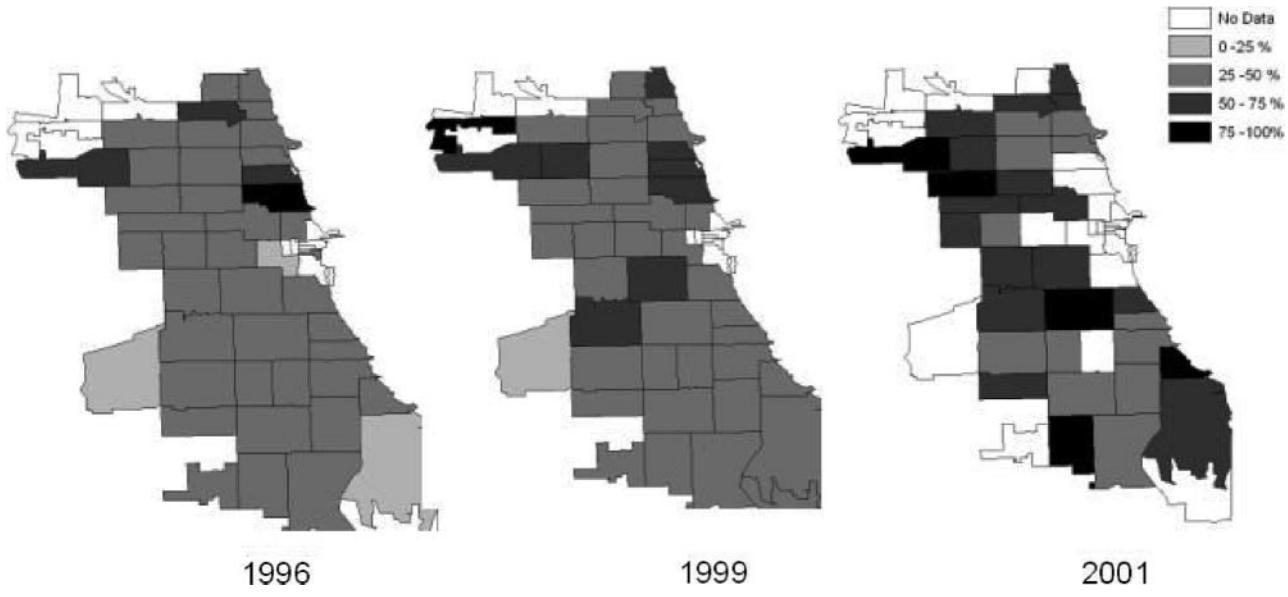

FIGURE 2. Comparison of prescription data for Medicaid recipients from 1996 and (data from Illinois Department of Public Aid) and 2001 (data Osco Pharmacy, a division of New Albertsons) for recipients aged 5 to 17 years. Maps represent the percentage of recipients in each zip code filling four or more asthma-related medications exhibiting appropriate inhaled steroid use (at least four prescriptions for inhaled steroids in a 1-year interval if using four or more β-agonists per year).

priate inhaled steroid use separated by zip code. Two essential findings should be noted: areas with the lowest percentage of patients with appropriate inhaled steroid use also correspond to those zip codes with the highest proportions of African-American individuals; secondly, the improvements seen in the aggregate physician grouped data are also seen at the patient level, although the observed improvement is not uniformly distributed.

Survey instruments have also been heavily used nationally and in the Chicago area to assess the appropriateness of asthma care. One exceptional study,[25] the Chicago Asthma Surveillance Initiative, surveyed self-reported care by various components of the medical system in Chicago. In one manifestation of this initiative, pediatric use of inhaled steroid therapy was assessed in 1997 and then again in 2003. Self-report of the use of inhaled steroids in that interval increased significantly both for patients < 5 and > 5 years of age, paralleling the findings in the National Drug Code marketing database. Similar before-and-after comparisons in ED and in hospital process measures demonstrated small but for the most part not statistically significant changes. A less-than-optimal percentage of patients are receiving inhaled steroids or written education materials in the ED.[10] Significant ongoing deficits in appropriate care were also confirmed in a study by the Illinois Emergency Department Asthma Collaborative.[26]

Longitudinal Assessment of Asthma Morbidity

Asthma hospitalizations represent the severe end of the spectrum of asthma morbidity, and should be theoretically avoidable in most cases with appropriate disease management; the data available allow assessments of both geographic and temporal disparities in asthma. Hospitalization rates show random

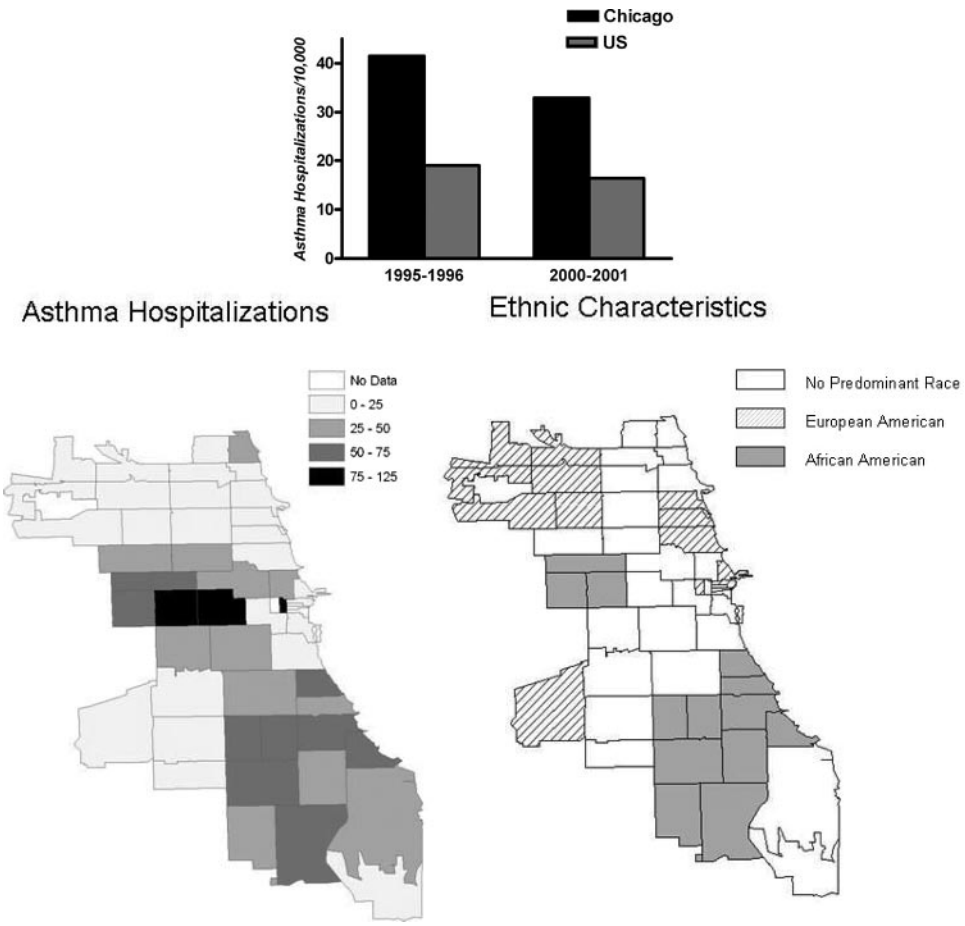

FIGURE 3. *Top*: Asthma hospitalization rates per 10,000 intervals for Chicago and the United States from 1995 to 1996 compared to rates from 2000 to 2001. Source: Illinois Health Care Cost Containment Council research-oriented data set from 1992 to 2001. *Bottom*: Asthma hospitalization rates per 10,000 population per year for Chicago by zip code from 2000 to 2001 (*left*) compared to Chicago zip codes with majority ethnic makeup (*right*). Source: Illinois Health Care Cost Containment Council research-oriented data set from 1992 to 2001, US Census 2000 data.

variation from year to year, so it is critical to evaluate multiple data points to appropriately evaluate trends. Nationally, asthma hospitalizations have shown a slight decline over an 8-year period, with rates from 2001 to 2002 that are 12% lower than rates from 1994 to 1996. The asthma hospitalization rate in Chicago has consistently been over twice the national hospitalization rate during the 1990s. There was some evidence from 1999 to 2001 that the ratio in Chicago compared to the rest of the United States might be declining slightly: it was consistently below 2.2 for all 3 years, with a 3-year 2.0 average, representing a 15% decline from the ratio from 1994 to 1996, which averaged at 2.3 (Fig 3, *top*). While this improvement is encouraging, it would take 20 years to achieve parity with national rates at this pace of change.

Compared to prevalence, asthma hospitalizations show greater variation both geographically and by ethnicity. Hospitalization data collection in Illinois is not coded by race. Chicago, however, remains one of the most racially segregated large cities in the country; thus, using census data on race for zip code of residence as a proxy for individual race can be considered a legitimate approximation. The 59 residential zip codes in Chicago were classified into primarily non-Hispanic white or primarily non-Hispanic black if one of the above-mentioned ethnic groups constituted $\geq 67\%$ of the population of that zip code.

For 1990 and 2000, 27 predominantly one-race zip codes were identified: 13 were predominantly African American, and 14 were predominantly white (47% of the city population; Fig 3, *bottom*). We compared individual zip codes as well as aggregated zip codes (by race) for asthma hospitalizations. Total asthma hospitalization rates were similar in the segregated and nonsegregated zip codes.

Predominately non-Hispanic black neighborhoods had a 4.3-times higher rate of asthma hospitalizations from 1992 to 1994, and this difference increased slightly by 1999 to 2001. Even after accounting for a modestly higher asthma prevalence rate in non-Hispanic blacks, the estimated racial differences would still be at least more than threefold.

If racial differences are determined by differential access to resources, more privileged non-Hispanic blacks would expect to see more improved health status relative to non-Hispanic whites sooner than the overall rates. For Chicago, however, the non-Hispanic black neighborhood with the best outcome had a rate more than twice as high as the non-Hispanic white neighborhood with the worst outcome, although both neighborhoods had similar median income levels. This measure has not shown improvement over time.

Asthma Mortality

National asthma mortality rates, which had previously shown a sustained increase, have decreased by 25% for the 10-year period ending in 2002. Chicago has historically had much higher asthma mortality rates than for the country overall, and over the same time period local rates declined by $< 10\%$, leading to widening of this gap (Fig 4, *left*). The degree of possible elevation of asthma prevalence in Chicago is insufficient to explain the magnitude of the elevation in Chicago. Local data for 2003 show a potentially encouraging drop in deaths from asthma, but this needs to be compared to corresponding national data when they become available to put it into context.

Although there are ethnic disparities in asthma mortality rates at the national level, those observed

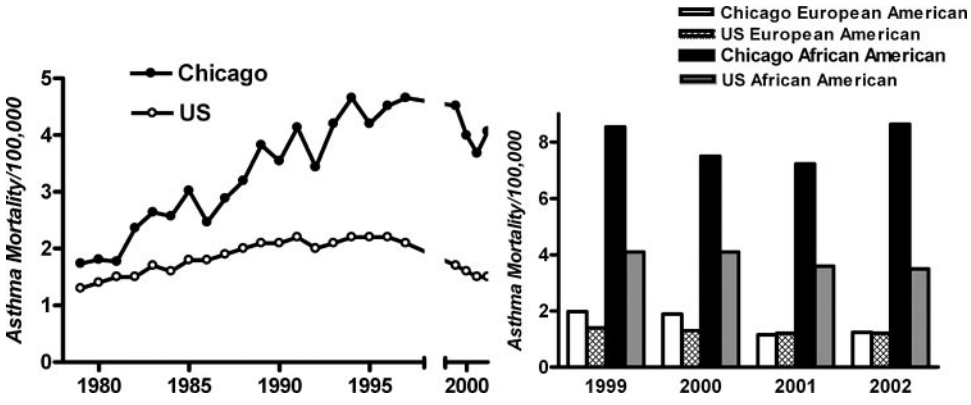

FIGURE 4. *Left*: Asthma mortality rate for Chicago and the United States per 100,000 individuals. Years 1979 through 1997 are based on ICD-9 coding; years 1999 to 2002 are based on ICD-10 standards. Comparison data for the United States are age adjusted. *Right*: Asthma mortality rates for Chicago and the United States per 100,000 individuals by ethnicity using the ICD-10 standard. US comparison data are age adjusted. Source: Chicago Department of Public Health.

in the City of Chicago are extreme. After adjusting for age, non-Hispanic black residents are nearly eight times more likely to die than non-Hispanic white residents. Non-Hispanic whites have asthma mortality rates that are very close to national rates, so nearly all of the overall asthma mortality rate elevation in Chicago is due to the adverse outcomes of one ethnic group (Fig 4, *right*). When looking at age-specific data, the degree of difference is most pronounced in children and younger adults. Between the years 1992 and 2003, only two non-Hispanic white children < 15 years old died of asthma. During the same period, at least one non-Hispanic black child < 15 years old died of asthma annually, with 83 non-Hispanic black children deaths in total. Nationally, the disparity in asthma mortality rates for non-Hispanic blacks and non-Hispanic whites has decreased slightly between 1992 and 2002, but in Chicago it actually increased. This was due to a faster rate of decline of deaths in non-Hispanic white asthma than for non-Hispanic blacks. The local data for 2003 do show some reduction in the non-Hispanic black/non-Hispanic white mortality disparity, but this needs to be confirmed with additional years of data and with comparison to corresponding national data when they become available.

Conclusions

Chicago may have a modestly elevated prevalence of asthma in comparison with the nation overall, but this difference is relatively small in comparison to elevated rates in morbidity and mortality. Asthma prevalence in Chicago varies strongly by socioeconomic status and more modestly by race. More time points need to be collected at the local level to determine trends in asthma prevalence. Asthma care in Chicago overall has been demonstrated to be inadequate and associated with poor outcomes. While some improvements in surrogate markers of care have occurred, these changes have not been widespread enough to have changed population outcome.

Asthma hospitalization rates in Chicago are beginning to show some improvement in their relationship to national rates, but the observed rate of change would take decades to produce parity with the rest of the nation. Most regrettably, this improvement belies a growing racial disparity in asthma hospitalizations and other markers of asthma morbidity over the last 8 years of data. Death from asthma in Chicago is also declining, again at a slower rate than that seen nationally. Despite improvement in the overall mortality rate, extreme racial disparities in Chicago have persisted throughout the last decade. While the hard work of many individuals who are striving to improve asthma care in Chicago has demonstrated some modest gains, we have yet to make substantive gains on the black/white gap.

It is clear that increased data sharing will facilitate the evaluation of population-wide asthma interventions. This can be done within the existing Health Insurance Portability and Accountability Act privacy provisions because surveillance is an exempt activity under existing law. It is also evident that a more uniform approach to surveillance and outcome instruments is needed. Efforts to educate and coordinate stakeholders in accomplishing these two important goals should be driven by state and local health agencies.

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