Asthma Surveillance in the United States*

A Review of Current Trends and Knowledge Gaps

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CDC = Centers for Disease Control; DRG = diagnosis-related group; HHANES = Hispanic Health and Nutrition Examination Survey; NAMCS = National Ambulatory Medical Care Survey; NCHS = National Center for Health Statistics; NHANES = National Health and Nutrition Examination Survey; NHDS = National Hospital Discharge Survey; NHIS = National Health Interview Survey; NVSS = National Vital Statistics System

Asthma is a common malady, affecting persons of all ages. Much of our understanding of the natural history of this condition has come from community-based studies,[1,2] including the Harvard Six Cities Study, discussed elsewhere in this issue (see article by Speizer, this issue). However, information on prevalence of asthma, mortality due to asthma, and the impact of the disease in the US population comes from national population-based data systems maintained by the National Center for Health Statistics (NCHS) of the CDC.[3] Data on asthma can be found in a number of these data systems. These systems include interview surveys (the National Health Interview Survey, NHIS), examination surveys (the National Health and Nutrition Examination Survey, NHANES), record-based surveys (the National Hospital Discharge Survey, NHDS, and the National Ambulatory Medical Care Survey, NAMCS), and the mortality data from the National Vital Statistics System (NVSS). Through the combined information provided by these data systems over time, the US Public Health Service has a mechanism for disease surveillance in the United States.

There are a few additional sources of population-based information on asthma. Elsewhere in this issue, Matte and his colleagues describe the SENSOR program of the National Institute for Occupational Safety and Health of the CDC. The SENSOR program, which is in the pilot stage in several states, is designed to identify the prevalence of occupationally related asthma. Another source of national information on asthma is the National Prescription Audit.[4] Unlike the NCHS data systems, the National Prescription Audit is not based on a national probability sample. However, it does provide some insight into the pharmaco-epidemiology of asthma care.[5]

The NCHS provides a large amount of information from its data systems by way of the NCHS Series Reports. Rather than focusing on specific diseases, the NCHS Series Reports focus on data systems. With few exceptions, each NCHS Series Report presents data that are specific to a single data system. Therefore, the NCHS data related to asthma are disaggregated. From time to time disease specific data from multiple NCHS data systems are synthesized and reported in the medical literature, including several reports examining asthma.[6-11] We review the published literature on the changing patterns of asthma in the US population, based on information derived from the NCHS data systems. In addition, we discuss the limitations of these national population-based information systems with respect to identifying factors contributing to these changing patterns.

Prevalence of Asthma in the United States

Two reports have appeared recently that together give a comprehensive description of the prevalence of asthma in the United States as revealed in NCHS data. Evans and colleagues examined estimates of prevalence in the United States that were obtained from both the NHANES and the NHIS for all ages.[6] The NHIS is based on respondent-report interview data and the NHANES uses self-reported medical history and physician examinations. This report describes the most recent data in both these systems, as well as temporal trends. The report by Gergen and colleagues focuses on information from one survey, NHANES, and examines asthma prevalence in children.[7]

The estimated asthma prevalence varies according to the survey design and the questions used to define asthma (Table 1). However, data from these 2 surveys suggest that the estimated total prevalence of active asthma is between

Table 1—*Estimates of Asthma Prevalence: Results from Two National Population-Based Surveys*[6]

Survey and Questionnaire	Rate per 100 Population
National Health and Nutrition Examination Survey (Persons aged 6 months to 74 years, 1976-1980)	
Did a doctor ever tell you that you had asthma?	6.2
Do you still have asthma?	3.0
During the past 12 months, not counting colds or the flu, have you frequently had trouble with wheezing?	6.5
Has a doctor ever told you that you had asthma and/or wheezing?	10.5
Do you still have asthma and/or wheezing?	7.7
National Health Interview Survey (All ages, 1979-1981)	
During the past 12 months, did you (or anyone in your family) have asthma?	3.0

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3.0 and 3.1 per 100 persons. The cumulative prevalence of asthma (defined as a physician diagnosis of asthma or frequent problems with wheezing in the past 12 months) is 10.6 per 100 persons, for all ages. The cumulative prevalence appears to be higher in males than in females (11.4 vs 9.7 per 100 persons) and slightly higher in blacks than in whites (12.2 vs 10.4 per 100 persons). Also, the cumulative asthma prevalence appears to be higher in the South and West census regions (12.7 and 11.6 per 100 persons) than in the Northeast and Midwest (9.1 and 8.6 per 100 persons, respectively). Prevalence rates were significantly higher for those living below the poverty level than in those at or above the poverty level (13.1 and 10.3 per 100 persons, respectively). There was no significant difference in self-reported asthma prevalence between urban and rural environments.[6]

During the early 1980s, the NCHS conducted a health and nutrition examination survey of the Hispanic population (the Hispanic Health and Nutrition Examination Survey, HHANES). This unique population-based survey of Hispanics provided estimates of asthma prevalence among the 3 largest Hispanic groups in the United States. A single study reported the findings of asthma from that survey. Among Hispanic children aged 6 months to 11 years old, Puerto Ricans had a point prevalence 2 to 4 times higher than that of any other group, 11.2%, as compared to Mexicans (2.7%), Cubans (5.2%), non-Hispanic blacks (5.9%), and non-Hispanic whites (3.3%).[12]

These NCHS surveys also provide some information on the social impact of this chronic disease. The NHIS provides information on activity restriction caused by asthma. Individuals with asthma were estimated to have limitation of activity--defined as bed days or school loss days—for an average 15.0 days per year.[6]

Health Care Utilization by Asthmatic Subjects

Our understanding of asthma morbidity in the ambulatory care setting in the United States is limited. NAMCS provides the only ongoing source of population-based information on asthma care in the ambulatory care setting. This survey is designed to provide estimates of the frequency of ambulatory care given by office-based private physicians. NAMCS is conducted periodically, and the most recent published information is from 1985.[13] In 1985, there were 6.5 million visits to physicians' offices for asthma care. There is no information available on asthma outpatient health care utilization of hospital-based practices such as outpatient clinics.

The sudden exacerbation of asthma, seen most often in the emergency room, is a well-known and frequent expression of this disease. The NHIS is the only NCHS data system that could provide information on emergency room utilization. This survey collects self-reported information on the use of emergency rooms for asthma. There have been no reports to date describing the NHIS data on self-reported emergency room utilization for asthma.

Asthma is a frequent cause of hospitalizations. In 1987, there were 454,000 hospitalizations with asthma as the first-listed diagnosis.[14] Asthma hospitalization rates are age-specific, with the high rates occurring in young children, 28.4 per 10,000 population less than 15 years old, and the elderly, 33.8 per 10,000 population for persons 65 years old and older. Hospitalization rates are higher for females than for males, and rates for nonwhites are more than twice the rates for whites. Asthma is a frequent cause of hospitalization and, on rare occasions, leads to mortality.

Asthma Mortality in the United States

In 1987 there were 4,360 deaths with asthma as the underlying cause, yielding a crude mortality rate of 1.80 per 100,000 persons.[15] Asthma mortality rates differ by age: rates for persons over 45 years old are nearly 20-fold higher than in children less than 15 years old (4.68 vs 0.24 per 100,000 population, respectively). Mortality rates are slightly higher for females than for males (2.11 vs 1.48 per 100,000 population) and on average are nearly twice as high for blacks as for whites (3.13 vs 1.63 per 100,000 population, respectively). (These figures are based on 1987 NCHS vital records, underlying cause of death, and 1987 US census figures.) Little is known about asthma hospitalization or mortality rates in the Hispanic or other racial/ethnic minorities.

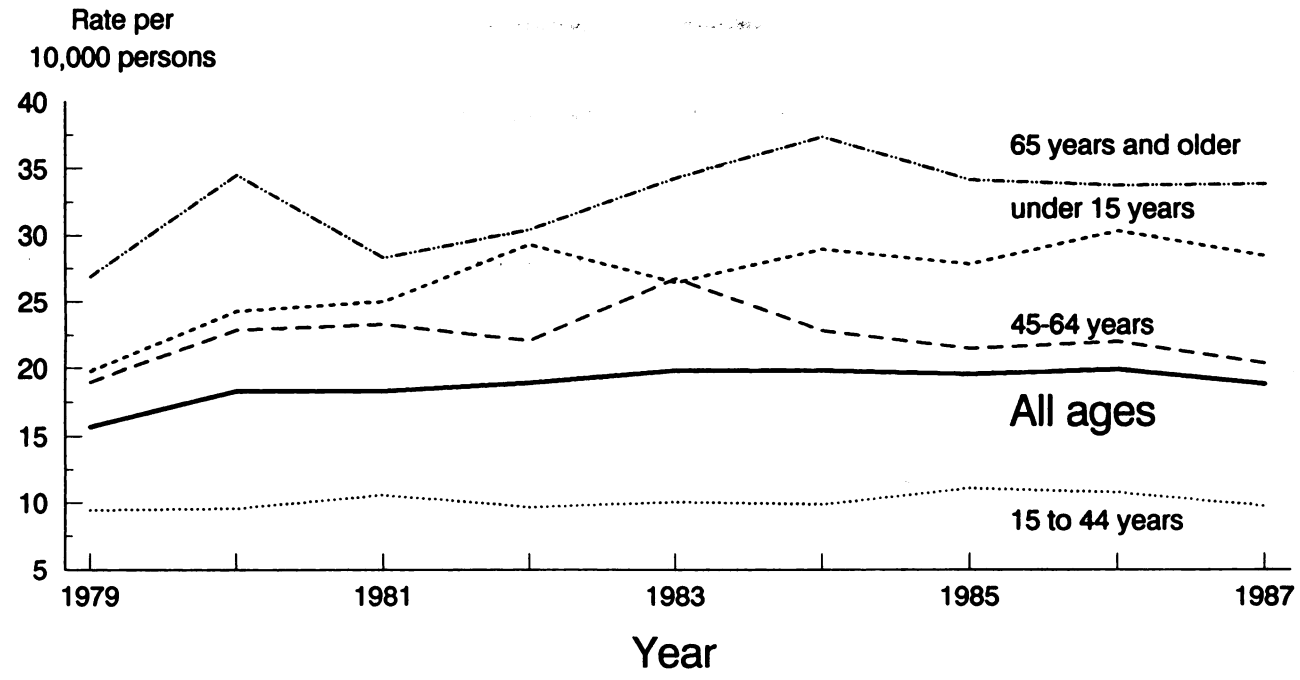
National Trends in Asthma Morbidity and Mortality

The NCHS data systems are ongoing; several are continuous (NVSS, NHDS, and NHIS) and others are periodic (NHANES and NAMCS). Whether continuous or periodic, these surveys can provide information over time, and therefore describe trends in rates. The trends in asthma prevalence are not well defined. Between the NHIS surveys of 1970 and 1979-81, the asthma prevalence for persons of all ages appears similar.[17,18] However, the distribution of asthma seems to be shifting to the younger age group. Prevalence rates for children under 17 years old are reported to have increased as much as 50% between 1964 and 1980.[6,7]

Between 1979 and 1984 asthma mortality rates increased.[6,10,19] There have also been reports of increases in asthma hospitalization rates during this time period.[6,8,16] However, the validity of these trends can be questioned because the time period spans 2 International Classification of Diseases (ICD) revisions. In 1979, the ICD 8th revision was replaced by the ICD 9th revision. In the 9th revision (ICD-9), much of what the ICD-8 had classified as asthmatic bronchitis was reclassified from bronchitis (ICD-8 code number 492) to asthma (ICD-9 code number 493). This reclassification, therefore, would cause a dramatic expected increase in rates.

However, it has been nearly a decade since the ICD 9th revision was adopted. Therefore, enough time has elapsed since the change in ICD revision to reevaluate these trends. Between 1979 and 1987, hospitalization rates for persons all ages increased from 15.7 to 18.8 per 10,000 population (Fig 1).[14,20] This increase occurred at a time when US hospitalization rates, including those for respiratory disease, were declining. As shown in Figure 1, this increase in asthma hospitalizations differs by age groups. The greatest increase in hospital admissions occurred in children less than 15 years old. Increases in hospitalization were also noted among individuals 65 years of age or older.

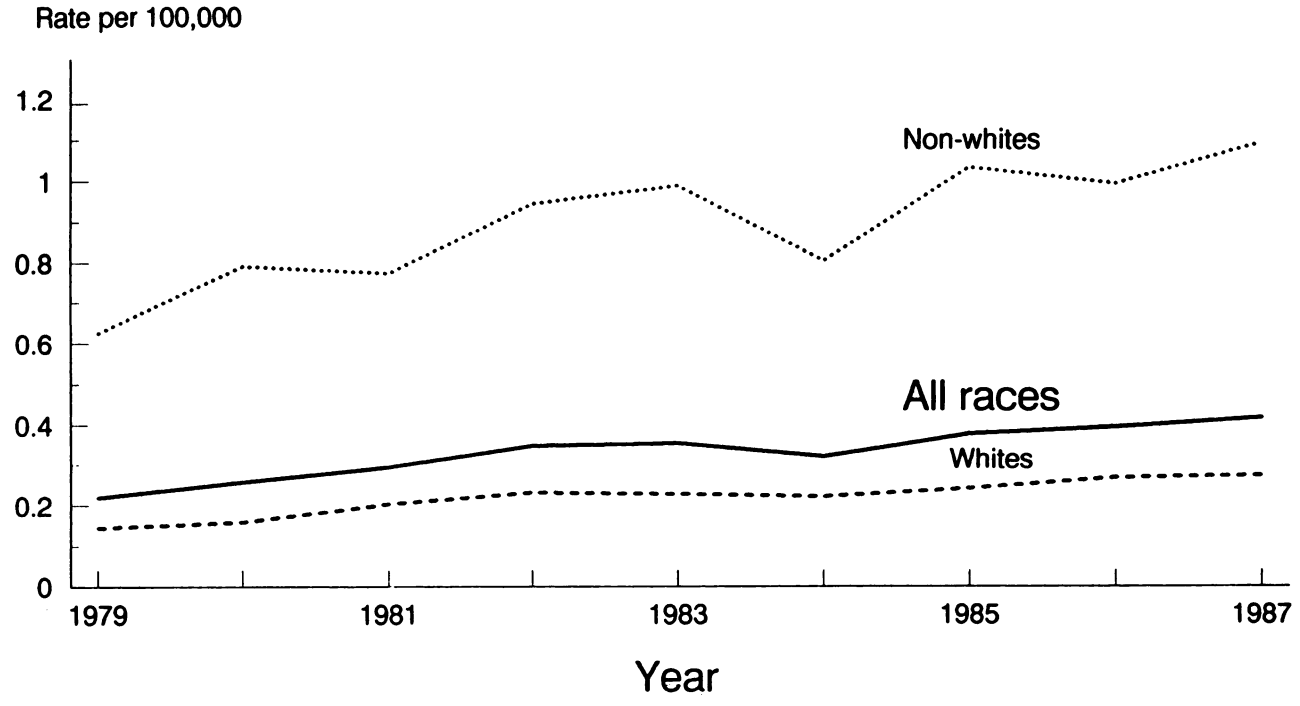
In light of the reports of increasing mortality rates, concern has arisen over the accuracy of death certificates to correctly identify asthma mortality.[21,22] These studies have shown that death certificates often misclassify other respi-



Source: NCHS, National Hospital Discharge Survey, first listed diagnosis

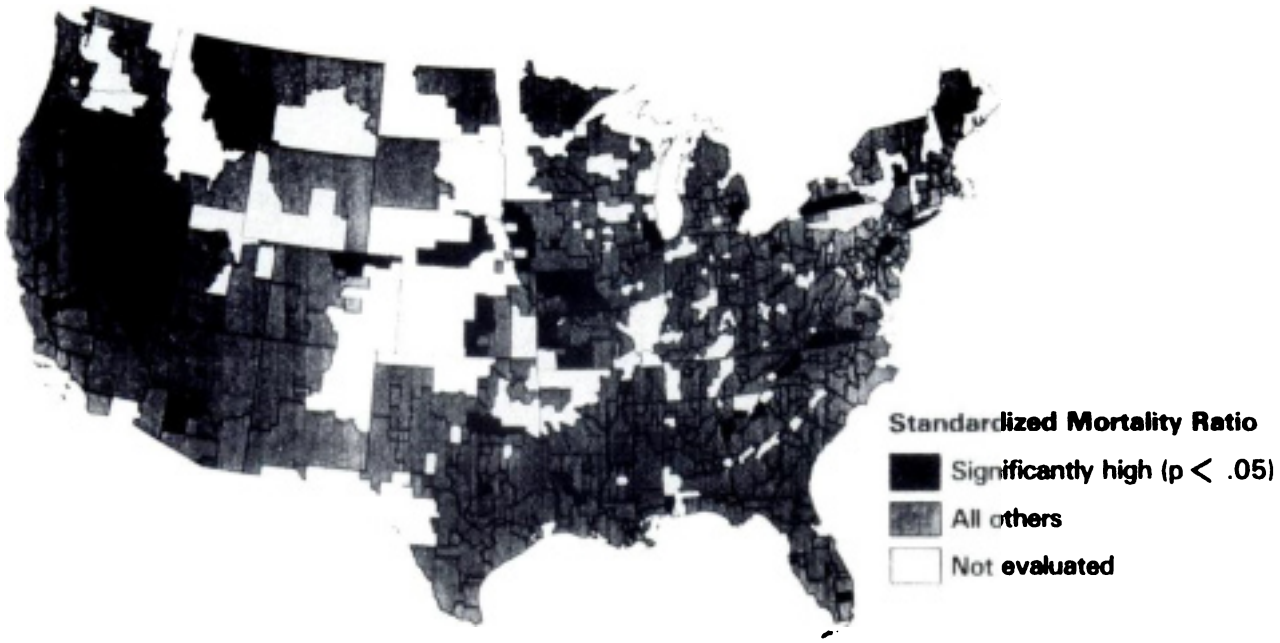
FIGURE 1. Trends in US asthma hospitalizations for selected age groups, 1979-1987.

ratory diseases as asthma for persons 35 years and older. This has made the interpretation of the trends for older adults difficult. However, mortality trends do appear to be increasing for persons aged 5 to 34 years (Fig 2), an age range in which death certification for this disease is more accurate. Still, there is little information on whether this increase is shared equally by all US population subgroups. We need to know how various subpopulations are contributing to the trends, or what other factors may be driving these national trends.



Source: NCHS, National Vital Statistics System, underlying cause of death.

FIGURE 2. US asthma mortality by race for persons aged 5 to 34 years, 1979-1987.



SOURCE: NCHS, National Vital Records, Compressed Mortality File

FIGURE 3. Asthma mortality for persons aged 15 to 34 years, 1981-1985. Standardized mortality ratios are given for state economic areas.

POPULATIONS AT RISK

With the exception of mortality records, the NCHS data systems are designed to provide US estimates based on probability samples of the population. The problem with sample populations is that when the sample is subdivided into many subpopulations, often there are insufficient numbers of observations to make reliable estimates. Therefore, only the mortality system, which provides complete information on all members of the US population, can be used for a detailed geographic analysis of subpopulations.

A recent study examined small area variation in asthma mortality.[23] This study identified a limited number of substate areas with asthma mortality rates significantly in excess of the US rates for persons aged 15 to 34 years during the 1981-1985 time period (Fig 3). The results of this study suggest that there may be subpopulations in the United States that can be targeted for further study of etiology. The study, is limited, however, in that it examined mortality, the rare and most severe expression of asthma. It is uncertain if asthma mortality rates correlate with the occurrence of other, more frequent morbid events, such as hospitalizations and emergency room admissions or chronic ambulatory care utilization.

There have been few reports examining the contribution by age, race, or sex to the recent increase in hospitalizations and mortality.[9,11] It is known, for example, that the black population experiences a higher rate of asthma prevalence, hospitalization, and mortality than the white population. Also, the increase in rates is most dramatic in the younger population. However, neither the NHDS nor national mortality records can adequately examine how the Hispanic and other racial or ethnic minority populations may be affecting this trend.

FACTORS THAT MAY HAVE CONTRIBUTED TO TRENDS OF INCREASING RATES

Many factors are known to contribute to asthma morbidity, including indoor and outdoor environmental antigens, inadequate medical care, and inadequate patient education. Such factors may be changing over time and thereby contributing to these trends. For example, environmental factors may be critical. This theory is supported by reports which suggest asthma morbidity or mortality may be increasing in other countries.[24-26] Other factors such as increasing poverty and lack of adequate medical care may also be driving recent increases in asthma-related morbidity. A recent study demonstrated that much of the increase in hospitalization rates in blacks could be related to poverty.[27] Another recent study noted that the prevalence of asthma within the population served by Medicaid may be increasing.[28] Changes in the pharmacotherapy of asthma might be contributing to these recent trends. The pharmacotherapy of asthma has changed dramatically in the past decade. The use of both corticosteroids and metered-dose inhalers of beta-agonists has increased dramatically.[5] Also, methods to quickly and easily measure serum theophylline levels have made it possible to more closely titrate methylxanthine therapy. Nevertheless, despite the many apparent improvements in asthma pharmacotherapy, US asthma morbidity and mortality appear to have increased.

PROBLEMS WITH NATIONAL ASTHMA SURVEILLANCE

The NCHS data systems provide an important—and the only national—source of population-based information on the prevalence, morbidity, and mortality from asthma. Yet there are limitations to these data systems with regard to asthma surveillance. The NHIS reflects respondent-re-

ported data. Evaluations of this type of data suggest a large amount of both over- and underreporting of self-reported diagnostic information.[29] The biases introduced by respondent-reported asthma on the NHIS study are not known. The NHANES, because of its examination survey design, may provide more certain prevalence estimates of asthma. However, NHANES, is periodic and results of the current (third) version of this survey (1989-1994) will not be available for a number of years.

The NCHS currently does not have data systems based on emergency room utilization. Emergency room utilization for asthma is particularly important as an indicator of optimal treatment and an index of adequate access to chronic ambulatory care. The NCHS is developing a new set of surveys to monitor health services utilization. These new surveys will include information from emergency rooms. But this data system is still in the planning stages, and data will not be available for several years.

The NVSS provides information on all deaths; however, asthma deaths, particularly in persons over 35 years old, are often misclassified. Therefore, the utility of this kind of data is limited to younger populations.

The mandate of NCHS is to provide information on all aspects of health in the US population. Information from one or more of these data sets should be able to identify major issues in US health. However, the data sets have limited information relevant to the 2 focus areas of this workshop, environmental and occupational asthma. There is as yet no way of using the current survey designs to reliably attribute asthma to either of these specific settings. The respondent cannot accurately attribute the causes for his disease. Physicians need detailed personal histories. Further, the examination studies of NCHS are cross-sectional. Therefore, some subjects may have developed the disease many years earlier, and obtaining reliable information with long recall periods is difficult. Only the record-based systems (NHDS and NAMCS) might be able to provide information that could differentiate these causes of asthma. However, this would require specific codes and disease definitions for occupational asthma (vs asthma of unknown or other causes) to be used by the physician and hospital. The disease coding is heavily influenced by diagnosis-related groups (DRGs), none of which differentiates these causes.

Conclusions

The national population data systems are designed to monitor broad changes in health status of the US population. These data sets have provided valuable surveillance data that constitute our knowledge of the changing trends in asthma. These same data systems are designed to understand major aspects of health and therefore are unlikely to provide much detailed diagnostically specific epidemiologic information. The recent increase in illness and deaths from asthma, as described by the NCHS data systems, suggest important changes that need further investigation. Although much of the NCHS data have been used to define these recent trends, these data have not been fully evaluated to describe the role of subpopulations in this decade of increasing morbidity and mortality. These recent changes in asthma may be driven by single or multiple causes, including increasingly frequent, increasingly severe, or new environmental exposures; changes in medical care, such as pharmacotherapy, or inadequate access to high quality health care. The NCHS data systems do not have adequate information to identify how these factors may be contributing to illness and deaths from asthma. Therefore, further investigations of the factors that are contributing to these trends will have to be conducted with other sources of data.

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