



## special report

# Respiratory Diseases Disproportionately Affecting Minorities\*

*The NHLBI Working Group*

(*CHEST* 1995; 108:1380-92)

ACS=acute chest syndrome; NHLBI=National Heart, Lung and Blood Institute; SEER=Surveillance, Epidemiology, and End Results Program; TB=tuberculosis

**Key words:** ethnic groups; lung diseases; minority groups; risk factors

The United States is a multiethnic nation, comprising a non-Hispanic white majority and a multitude of minorities classified as blacks (native-born African-Americans, Africans, West Indians, Haitians, *etc*), Hispanics (Mexican-Americans; Puerto Ricans; Cubans; North, Central, and South Americans, and Spanish-speaking Caribbeans), native Americans (American Indians, Alaskan Eskimos, Aleuts, and native Hawaiians), Asians (from Far East, Southeast Asia, and Indian subcontinent), and Pacific Islanders. To date, most of the knowledge accumulated on incidence, risk factors, and natural history of respiratory diseases applies to the majority population, often having little or uncertain relevance to the minority groups. Most of these diseases seem to exhibit different characteristics in the various ethnic groups and there is only a limited understanding of the multiple pathways responsible for these differences in these populations. Failure to characterize the differences in disease characteristics, occurrence, and causes across minority groups and to address the reasons may have significant detrimental public health, social, and economic consequences.

Some epidemiologic evidence suggests that minority populations are more "susceptible" to certain systemic illnesses, especially to diseases that involve the respiratory system. For example, several studies comparing minority with nonminority populations have noted differences in the incidence and natural history of tuberculosis (TB), sarcoidosis, obstructive lung diseases, and lung cancer. These studies have also shown that a complex interplay of social, economic, behavioral, and biologic factors may cause varying disease patterns in minorities. Unfortunately, a lack of targeted health-care policies, and a shortage of motivated and knowledgeable health-care providers in many minority communities, pose a substantial barrier to the provision of adequate health care. Additionally, there are few minority or other researchers trained to address the diseases that occur disproportionately in minority populations. A concerted effort is required to address the enormous and complex challenge of the increasing burden of respiratory diseases in minorities.

The Division of Lung Diseases, National Heart, Lung and Blood Institute (NHLBI) asked a Working Group of the Pulmonary Diseases Advisory Committee to assess the problem of respiratory diseases in US minorities and provide an agenda for action in this important area. This document is the result of their efforts. It summarizes the findings and recommendations of the Working Group concerning the most common respiratory diseases that disproportionately affect blacks, Hispanics, and native Americans. It does not include respiratory health issues in Asian-American minorities because few reliable data are available. Wide differences were noted in the databases available for a particular disease or ethnic group; the brevity of some topics in contrast to others is a reflection of these differences (Table 1). In addition to providing an agenda for future epidemiologic, clinical, basic, behavioral, and health educational research, this report underscores the need for more clinicians and scientists trained in pulmonary research, particularly from minority communities at all levels of the academic ladder, and appropriate curriculum changes in schools training

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**Table 1—Data Available on Respiratory Diseases in Minorities\***

|                           | Black | American Indian | Hispanic |
|---------------------------|-------|-----------------|----------|
| Sarcoidosis               |       |                 |          |
| Incidence                 | 0     | 0               | 0        |
| Prevalence                | +     | 0               | 0        |
| Mortality                 | +     | 0               | 0        |
| Morbidity                 | +     | 0               | 0        |
| Natural history           | 0     | 0               | 0        |
| Risk factors              | 0     | 0               | 0        |
| Pattern of care           | 0     | 0               | 0        |
| Lung cancer               |       |                 |          |
| Incidence                 | +     | +               | +        |
| Prevalence                | N/A   | N/A             | N/A      |
| Mortality                 | +     | +               | +        |
| Morbidity                 | N/A   | N/A             | N/A      |
| Natural history           | +     | +               | +        |
| Risk factors              | +     | +               | +        |
| Pattern of care           | +     | +               | +        |
| Interstitial lung disease |       |                 |          |
| Incidence                 | 0     | 0               | +        |
| Prevalence                | 0     | 0               | +        |
| Mortality                 | +     | +               | 0        |
| Morbidity                 | 0     | 0               | 0        |
| Natural history           | 0     | 0               | 0        |
| Risk factors              | 0     | 0               | 0        |
| Pattern of care           | 0     | 0               | 0        |
| COPD                      |       |                 |          |
| Incidence                 | 0     | 0               | 0        |
| Prevalence                | +     | 0               | +        |
| Mortality                 | +     | +               | +        |
| Morbidity                 | 0     | 0               | 0        |
| Natural history           | 0     | 0               | 0        |
| Risk factors              | +     | +               | +        |
| Pattern of care           | 0     | 0               | 0        |
| Asthma                    |       |                 |          |
| Incidence                 | 0     | 0               | 0        |
| Prevalence                | +     | 0               | +        |
| Mortality                 | +     | +               | +        |
| Morbidity                 | +     | 0               | +        |
| Natural history           | 0     | 0               | 0        |
| Risk factors              | 0     | 0               | 0        |
| Pattern of care           | +     | 0               | 0        |
| Sickle cell disease       |       |                 |          |
| Incidence                 | N/A   |                 |          |
| Prevalence                | +     |                 |          |
| Mortality                 | +     |                 |          |
| Morbidity                 | 0     |                 |          |
| Natural history           | +     |                 |          |
| Risk factors              | N/A   |                 |          |
| Pattern of care           | 0     |                 |          |
| Pneumonia                 |       |                 |          |
| Incidence                 | 0     | +               | 0        |
| Prevalence                | N/A   | N/A             | N/A      |
| Mortality                 | +     | +               | +        |
| Morbidity                 | 0     | 0               | 0        |
| Natural history           | 0     | 0               | 0        |
| Risk factors              | +     | 0               | 0        |
| Pattern of care           | 0     | 0               | 0        |

*continued*

**Table 1—cont'd**

|                     | Black | American Indian | Hispanic |
|---------------------|-------|-----------------|----------|
| Tuberculosis        |       |                 |          |
| Incidence           | +     | +               | +        |
| Prevalence          | +     | +               | +        |
| Mortality           | +     | +               | +        |
| Morbidity           | +     | +               | +        |
| Natural history     | 0     | 0               | 0        |
| Risk factors        | +     | +               | +        |
| Pattern of care     | +     | +               | +        |
| Obesity/sleep apnea |       |                 |          |
| Incidence           | 0     | 0               | 0        |
| Prevalence          | 0     | 0               | +        |
| Mortality           | N/A   | N/A             | N/A      |
| Morbidity           | 0     | 0               | 0        |
| Natural history     | 0     | 0               | 0        |
| Risk factors        | +     | +               | +        |
| Pattern of care     | 0     | 0               | 0        |

\*0=No data available; +=some data available; N/A=not applicable.

health professionals. These recommendations should provide a blueprint for action by those individuals and institutions with the mission and responsibility for improving the respiratory health of minorities, vital to maintaining the overall health of our nation.

#### DATABASES ON RESPIRATORY DISEASES IN MINORITY POPULATIONS

##### *Defining Minority Populations*

Minority populations are defined as distinct groups within the general population distinguished from the majority by their racial or ethnic heritage. The principal minority populations within the United States, as defined by the US Office of Management and Budget, include blacks, Hispanics, American/Asian-Pacific Islanders, and American Indians/Alaska natives. Classifying race and ethnicity in a heterogeneous society is obviously difficult and fraught with uncertainty. Race is a term that incorporates notions of biologic and geographic origins,<sup>1,2</sup> while ethnicity reflects cultural identification and origins.<sup>3</sup> Race and ethnicity cannot be rigidly defined, nor can strict criteria be set out for classifying individuals. Also, classifications based on race and ethnicity are inherently incomplete from the health perspective because they do not incorporate such directly relevant factors as degree of enculturation, language, or socioeconomic status. These problems have hampered the development of databases and limited our ability to associate respiratory health statistics conclusively with the race/ethnicity of an individual or group. Such data are needed to improve our understanding of respiratory disease in minorities and to identify research needs.

Because of the difficulty of formulating clear and standardized criteria for classifying race and ethnicity, different investigators have employed different

**Table 2—Trends in the Prevalence of Asthma by Age Group (Rate per 1,000 Persons)\***

| Year | All Ages,<br>White-Black | <45 yr,<br>White-Black | 45-64 yr,<br>White-Black | 65-74 yr,<br>White-Black | 75+ yr,<br>White-Black |
|------|--------------------------|------------------------|--------------------------|--------------------------|------------------------|
| 1982 | 34.6-39.2                | 33.3-38.6              | 36.5-37.2                | 42.5-61.5                | 33.2-24.8              |
| 1983 | 37.7-45.1                | 38.8-47.1              | 35.0-35.5                | 46.0-63.2                | 20.3-12.7              |
| 1984 | 36.9-34.8                | 37.0-35.2              | 33.1-35.9                | 45.3-45.5                | 38.3----               |
| 1985 | 37.2-39.8                | 39.6-42.5              | 28.7-27.5                | 47.9-54.5                | 22.6-7.2               |
| 1986 | 40.9-42.5                | 42.2-41.5              | 37.3-36.5                | 42.1-83.7                | 35.4-29.7              |
| 1987 | 40.0-44.2                | 41.3-46.9              | 37.4-32.5                | 40.2-34.3                | 36.6-56.6              |
| 1988 | 39.8-55.5                | 41.6-58.2              | 33.5-48.5                | 42.9-50.8                | 36.7-31.6              |
| 1989 | 47.1-53.0                | 47.6-57.4              | 43.6-23.8                | 53.0-106.8               | 45.1-5.5               |
| 1990 | 41.2-46.6                | 43.1-48.0              | 39.3-37.6                | 31.8-45.1                | 38.7-59.1              |

\*Estimates for 65 to 74 and 75+ years are statistically unreliable. Data source: National Health Interview Survey, NCHS.

and diverse criteria for classification, including self-identification, national origin, family characteristics, cultural practices, and biologic markers. Despite the misclassifications that could result from these disparate criteria, most studies have demonstrated that race and ethnicity have significant impact on the health status of individuals and their communities.

### Databases

Strategies for controlling respiratory diseases in minorities should be based on a full knowledge of their incidence, prevalence, mortality, morbidity, and natural history. Relevant information that can be obtained from databases maintained by the federal government and other sources is limited because of several inherent deficiencies alluded to above.<sup>1</sup> The current guidelines for assigning racial and ethnic designations are based on *Directive 15—Race and Ethnic Standards for Federal Statistics and Administrative Reporting* published in 1978 by the Office of Management and Budget. The directive leaves race and ethnicity undefined while presenting criteria for classifying persons into four racial groups (American Indian or Alaskan native; Asian or Pacific Islander; black; or white) and two ethnic categories (Hispanic origin and not of Hispanic origin). The classification remains ambiguous and the approaches followed by various federal agencies in classifying certain ethnic groups during the last 50 years have not been uniform. In addition, a substantial proportion of Hispanics classify themselves as of “other race” rather than black or white. Therefore, it is recognized that trends in disease mortality among various racial and ethnic groups cannot be precisely defined, and patterns of disease occurrence across these groups should be interpreted with caution. Despite these potential sources of inconsistency in assigning race and ethnicity, federal databases represent the main current source of information on respiratory diseases in minorities.

### RESPIRATORY DISEASES DISPROPORTIONATELY AFFECTING MINORITIES

The following pages present a broad perspective of

the status of respiratory diseases in blacks, Hispanics, and native Americans. No attempt is made to provide an exhaustive review of the topic that is available elsewhere.<sup>4</sup>

### Asthma

About 13 million people in the United States are estimated to have asthma. The estimated prevalence of active asthma is 30 to 31/1,000 persons, and the cumulative prevalence of asthma (defined as physician diagnosis of asthma or frequent problems with wheezing in the past 12 months) is 106/1,000 persons for all ages.<sup>5</sup> Asthma prevalence among adults has increased steadily since 1982 in all age groups (Table 2). Significantly, the prevalence of asthma in adult blacks has increased from 39/1,000 in 1982 to 53/1,000 persons in 1989. A smaller increase was noted in whites during the same period, from 35 to 47/1,000. The cumulative asthma prevalence is slightly higher in blacks than in whites, 122 vs 104 per 1,000 persons, respectively.<sup>5</sup> Asthma prevalence among Hispanic adults in New Mexico is significantly lower than among non-Hispanic adults.<sup>6,7</sup> Asthma along with respiratory allergy and hay fever was the tenth most common reason for ambulatory visits by American Indians in 1987.<sup>8</sup> There is little information about asthma prevalence in native American and Alaskan natives.

Asthma prevalence is increasing in black children in the United States as in adults. The prevalence of asthma among 6- to 11-year-old black children was 9.4% compared with 6.2% in white children. From 1971 to 1980, asthma prevalence increased among children from 4.8 to 7.6%. The overall prevalence of asthma for ages 3 to 17 years was 6.7%.<sup>9</sup> Nationwide, hospitalizations of black children for asthma more than doubled between 1964 and 1980.<sup>10</sup> In contrast, in the Washington, DC area, which has a majority of blacks, the rate of hospitalizations for asthma of children younger than 15 years increased over 300% between 1961 and 1981.<sup>11</sup> Health-care utilization by patients with asthma has been increasing as well, but more so by minorities. Hospitalization rates for nonwhites are almost three times the rates for whites; they are also

higher for female than for male subjects.<sup>5</sup> Six percent of all US asthma hospitalizations and 7% of all asthma deaths occur in New York City, with its many minorities and less than 3% of the US population.<sup>12</sup> Also, asthma hospitalizations increased in New York City, from 35.8/10,000 in 1982 to 43.1/10,000 in 1986, a growth of 17.4%.<sup>13</sup> The average annual rate of asthma hospitalizations per 10,000 population (1982 to 1986) was 12.2 for whites, 59.9 for blacks, and 62.9 for Hispanics.<sup>13</sup>

In the United States, there were 4,597 asthma deaths in 1988, for a mortality rate of 2.6/100,000.<sup>14</sup> Asthma mortality rates are nearly three times higher for blacks than for whites<sup>15</sup> and are slightly higher for women than for men (1.6 vs 1.2 per 100,000, according to 1989 data). Asthma mortality rates differ by age, with the rate for persons older than 45 years being 20 times higher than in children younger than 15 years (4.68 vs 0.24 per 100,000, respectively).<sup>5</sup> Asthma mortality rates are four to seven times higher for young blacks (age 5 to 34 years) than for young whites.<sup>15,16</sup> On the average, blacks die at a younger age than whites from asthma. Percent change in death rates from asthma for blacks is greater than for whites at all ages, but particularly over age 65. Black male and female subjects die at an average age of 47.1 and 52.4 years, respectively, from asthma. In contrast, the average age at death from asthma for white men and women is much higher, 64.4 and 65.9 years, respectively.<sup>14</sup> In New York City, from 1982 to 1987, the average annual asthma death rate was 1.2/100,000. Most deaths were among persons aged 20 to 34 years, and 76.2% of those who died from asthma were blacks and Hispanics. Annual deaths among blacks were 5.5 times greater than among whites, while the asthma mortality rate among Hispanics was 3.0 times the rate in whites. Asthma hospitalization and mortality rates were highest in New York City's poorest neighborhoods.<sup>13</sup> Information available about asthma hospitalization or mortality rates in Hispanics and American Indians is scant and it is not clear whether the high asthma mortality of blacks is shared by these groups as well.

There is a need for detailed data concerning the incidence, severity, and morbidity of asthma in minority populations along with information on risk factors. We also need more specific data concerning the natural history of asthma in minority populations, hospital admission practices, access to medical care, and compliance to asthma therapy.

### *Lung Cancer*

Lung cancer, rare at the start of the 20th Century, increased by epidemic proportions by midcentury and has become a leading cause of death in US men and women in the 1990s, particularly in blacks. Epidemiologic investigations show that the risk of lung cancer

increases with the number of cigarettes smoked and duration of smoking. Lung cancer cases in 1991 in blacks were estimated to be 20,500, accounting for 25% of all cancers in black men and 13% among black women.<sup>17</sup> The case-fatality ratio for lung cancer is extremely high; 5-year survival remains below 10%. Thus, for lung cancer, incidence and mortality rates are about the same and there are few prevalent cases.

Mortality rates for lung cancer are available by racial group, and a number of reports have compared mortality rates in blacks and whites.<sup>18,19</sup> The population-based cancer registries maintained in the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) Program that cover 10% of the US population provide incidence rates for lung cancer by racial and ethnic group.<sup>18,19</sup> A number of reports have addressed lung cancer mortality rates in Hispanics in western and southwestern states.<sup>20</sup> The National Center for Health Statistics is another source of mortality rates in Hispanics and others for selected causes of death, including lung cancer.

These data indicate marked variations in patterns of lung cancer incidence and mortality across the principal racial groups in the United States. Among male subjects, rates have been highest in blacks and somewhat lower in whites; Hispanic rates have been 50% of the white rates, and American Indian rates have been still lower. Survival is somewhat lower in blacks than in non-Hispanic whites. Among female subjects, rates have been similar for blacks and non-Hispanic whites (with both groups showing a parallel rapid increase), and much lower in Hispanics, Hispanic men being at threefold to fourfold increased risk compared with Hispanic women. The frequency of lung cancer is nonuniform among various American Indian groups, but overall, less than in non-Hispanic whites, male subjects being at increased risk. The patterns of lung cancer rates across the broad racial and ethnic groups within the United States in both genders generally reflect the patterns of smoking in the US population.

Cigarette smoking alone, however, does not explain the high rate of lung cancer in black men and indeed in other groups. Some studies indicate that environmental and socioeconomic correlates of being black rather than the African-American ethnicity itself are responsible for the excess lung cancer. However, some recent studies suggest that genetic factors indeed may contribute to the increased risk of lung cancer in blacks compared with whites. For example, differences between blacks and non-Hispanic whites have been reported in oncogenes and tumor suppressor genes,<sup>21-23</sup> and genes involved in the transformation of carcinogens in tobacco smoke,<sup>24,25</sup> and these genes may play a role in the increased lung cancer rates in blacks. These findings on genetic differences between blacks and whites are based on studies of small samples and

require confirmation. If confirmed, these findings provide exciting leads for explaining the increased susceptibility of blacks and possibly other minorities to lung cancer and other respiratory diseases.

In summary, various surveys indicate that lung cancer is more prevalent in minority populations, particularly in blacks. Factors such as cigarette smoking and occupational exposures do not entirely explain these disparities. More research is needed to assess the role of environmental, socioeconomic, genetic, and nutritional factors in the excess lung cancer risk and mortality in blacks. Current efforts to increase minority subject representation in clinical trials should help bring new information on the role of genetic and biologic factors in disease outcome.

### *Chronic Obstructive Pulmonary Disease*

The term chronic obstructive pulmonary disease (COPD) is applied to the condition of permanent air-flow obstruction associated with significant physiologic impairment. The impairment may relate to enlargement and destruction of air spaces (emphysema) or chronic sputum production (chronic bronchitis), two usually coexisting components of COPD.<sup>26</sup> Cigarette smoking is believed to be the major cause of COPD, but other factors that place individual smokers at risk have not yet been adequately characterized.<sup>26,27</sup> Occupational and other factors also contribute to the excessive decline of lung function that eventually leads to COPD.<sup>28</sup> Like lung cancer, COPD became a far more frequent condition during the 20th Century.

Limited data are available on morbidity and mortality from COPD among blacks, Hispanics, and native Americans, compared with non-Hispanic whites. For 1990/1991, while COPD is the fourth leading cause of death for all Americans, it is only the ninth leading cause of death for native Americans, tenth for blacks, and less than tenth for Hispanics.<sup>29</sup>

In one study, the prevalence of COPD in black men was 3.2% compared with 7.7% among white men.<sup>30</sup> The 1990 National Health Interview Survey (NHIS) on the prevalence of COPD among blacks and non-Hispanic whites revealed that blacks in age groups 45 to 64 years and 65 years and over, respectively, reported lower frequencies of chronic bronchitis and emphysema than non-Hispanic whites of similar age.<sup>31</sup> Mortality from COPD in blacks is also lower (12.8/1,000) than non-Hispanic whites (16.6/1,000).<sup>10</sup> Black ethnicity appeared to be associated with lower risk of COPD compared with non-Hispanic whites. Several studies of Hispanics showed that prevalence of COPD and mortality from the disease are less than in non-Hispanic whites.<sup>6,7,20,31-33</sup> Mortality in Hispanic male and female subjects was less than 50% of the rates in non-Hispanic whites but the trend toward increases

was evident for both male and female Hispanics. In Hispanics, it appeared that ethnicity was not a significant predictor of chronic bronchitis or emphysema when cigarette smoking was taken into account.

Limited information is available on COPD in American Indians. Rhoades<sup>8</sup> reported on mortality for American Indians and Alaskan natives from 1980 to 1986. Mortality rates for COPD-related diagnoses in these two groups were about 30% of the US rates. Mortality data for New Mexico show very low rates among the state's Navajo, Pueblo, and Apache tribes.<sup>20,32</sup> A 1987 survey of native Americans and Alaskan natives eligible for care by the Indian Health Service<sup>34</sup> showed a lower prevalence of emphysema in both male and female native Americans compared with the general US population (2.4% vs 2.7% for men and 1.4% vs 2.3% for women). Mortality rates from COPD among American Indians were about two thirds of the rate for the US population. These differences appear to be largely due to differing rates of smoking in the two populations.<sup>4</sup>

Only a small number of studies have addressed the prevalence of COPD in minority populations in contrast to non-Hispanic whites; and the existing mortality data are also incomplete for blacks, American Indians, and Hispanics. Improved approaches are needed for estimating mortality rates in these populations and for examining the rates within the distinct groups defined by geographic origins. There is also a need for understanding the natural history of COPD in both non-Hispanic whites and in the minority populations. Whether the incidence of COPD is indeed lower in black and Hispanic smokers needs to be verified.

In summary, more epidemiologic studies are needed on the incidence and prevalence of COPD in minority populations. The effects of genetic, environmental, and socioeconomic factors on the prevalence of COPD also need to be elucidated. Studies should also verify the apparent reduced susceptibility of blacks to smoking-related lung disease and determine the biologic and genetic factors, if any, that might contribute to this phenomenon.

### *Interstitial Lung Diseases*

Interstitial lung diseases, a heterogeneous group of disorders affecting the lung parenchyma, are relatively rare. They comprise over 100 distinct entities. Sarcoidosis and TB, which belong to this, are discussed separately below because of their unique relevance to blacks and minorities. Some 5,000 to 6,000 deaths annually have interstitial lung disease as the underlying cause.<sup>35</sup> Most interstitial lung diseases have no known cause but have well-defined clinical and pathologic characteristics. Occupational exposures to asbestos, silica and coal dust, drugs, poisons, radiation, and cer-

tain biologic agents are considered important risk factors. However, little information is available on how these agents cause disease either in whites or in minority populations. Corticosteroid therapy is the mainstay of therapy for many of these disorders, but information on treatment efficacy in different racial groups is limited. To our knowledge, mortality data have not been compiled for various types of interstitial lung diseases and analyses of mortality rates by racial and ethnic groups have not been reported.

In general, scant data are available on the incidence of, or mortality from, interstitial lung diseases among blacks, Hispanics, or native Americans. More epidemiologic data and population-based approaches, such as registries, are needed. Studies are also needed on how occupational exposures might lead to interstitial lung diseases and whether the natural histories of the disease are similar in both whites and minority groups.

**Sarcoidosis:** Sarcoidosis is a multisystem granulomatous disorder of unknown causes which primarily affects the lungs. Sarcoidosis poses a much greater burden of morbidity and mortality on blacks than whites in the United States. The data on occurrence, gathered primarily from chest radiograph surveys for TB or from military populations, indicate that incidence of sarcoidosis ranges from 1 to 10 per 100,000, and prevalence from 5 to 50 per 100,000. Prevalence is highest for young adults aged from 25 to 40 years, higher in women than men, and much greater in blacks (40/100,000) than in whites (5/100,000).<sup>36,37</sup> Blacks tend to develop the more chronic and severe form of sarcoidosis compared with whites. In the United States, sarcoidosis is an infrequent cause of death. In 1982, only 339 deaths had sarcoidosis listed as the underlying cause, and an additional 266 as a contributing cause.<sup>37</sup> However, mortality rates for blacks with sarcoidosis are nearly tenfold greater than for whites. For 1979 to 1984, age-adjusted mortality rates per 100,000 were 0.85 and 1.22, respectively, for black men and women, compared with 0.07 and 0.10 for white men and women. In 1981, there were over 10,000 discharges from US hospitals of both blacks and whites diagnosed with sarcoidosis.<sup>37</sup> The black-to-white ratio of age-adjusted hospital discharge rates was 8.2.

The geographic and racial variation in the occurrence of sarcoidosis has been well documented; this has sparked diverse hypotheses concerning environmental and genetic risk factors.<sup>36</sup> However, few epidemiologic studies have been conducted and little is known about risk factors or the reasons for difference in incidence among blacks and whites, severity, or progression of the disease. There are studies showing that cigarette smokers may be at reduced risk of getting sarcoidosis.<sup>38-41</sup> Sarcoidosis seems to occur in families, suggesting that genetic factors may play a role

in the development of the disease.

Race-related differences in the human leukocyte antigen (HLA) haplotypes associated with sarcoidosis have been reported; for example, an increased frequency of the A1, B8, and DR3 haplotypes in white patients with sarcoidosis, but not in blacks. Patients with sarcoidosis who express these haplotypes tend to present with acute disease with a good prognosis. In Japan, there is an increased frequency of the DRW52 haplotype, also associated with acute disease and a good prognosis. Thus, HLA haplotypes may not determine susceptibility to the disease but may play a role in the clinical expression.

In summary, while sarcoidosis is widely recognized as a common clinical problem among blacks in the United States, surprisingly sparse information is available on the incidence, prevalence, risk factors, and natural history of the disease in blacks or in other population groups. Mortality data provide only an insensitive measure of the extent of the disease burden posed by sarcoidosis. Additional data systems should be developed and utilized for addressing the gaps in understanding sarcoidosis with regard to racial and ethnic differences. The recently announced NHLBI initiative for a case-control study of etiology of sarcoidosis should help fill a major informational gap in our understanding of this disease.

**Tuberculosis:** There are 10 to 15 million persons in the United States who are infected with *Mycobacterium tuberculosis* (MTB). Since 1984, the year with the lowest number of reported cases of TB, more than 28,000 new cases have accumulated in the United States. There was a 55% increase in blacks, 77% increase in Hispanics, and a 25% increase in non-Hispanic whites. Minorities are disproportionately affected by TB, accounting for 70% of cases. For all age groups younger than 65 years old, TB is strikingly a disease of minorities in socioeconomically depressed urban communities.<sup>42</sup> Among non-Hispanic whites, TB is more common in persons 65 years old or older, with the most susceptible age group being 70 to 74 years. Minorities in the United States and the foreign-born appear to be at increased risk for extrapulmonary TB; and, its association with minority status or birth in a foreign country is even stronger than that for pulmonary TB.<sup>43</sup> After controlling for other variables, the proportion of extrapulmonary TB cases among all patients with TB was largest in children and decreased with advancing age. In 1986, 17.5% of all US TB cases were extrapulmonary, and 71.2% of these cases occurred among racial/ethnic minorities.<sup>43</sup> The exponential increase in cases of multidrug-resistant TB is an ominous development.

The evolution of the current TB epidemic is closely linked with that of the AIDS epidemic; the overwhelming distribution of cases is in urban, especially inner-

city areas, among blacks and Hispanics aged 25 to 44 years.<sup>42</sup> In fact, human immunodeficiency virus (HIV) infection is the strongest predictor for progression from latent to active TB, with an annual risk of active disease of about 8%.<sup>44</sup> The prevalence of HIV infection is greater in urban blacks and Hispanics than in other racial/ethnic groups. The incidence of TB is also greater in these groups and is primarily responsible for the increased rates of TB noted nationally.<sup>45</sup>

Nonadherence to prescribed drug therapy appears to be the main risk factor for the development of drug resistance. A 1991 study found that 89% of patients with active TB in a municipal hospital in New York City failed to complete therapy and 68% of the patients were either homeless or unstably housed. This study also described the deterioration of the public health infrastructure in that city as a specific risk factor.<sup>46</sup>

Increased susceptibility to TB infection has been hypothesized to contribute to the high TB incidence observed in some minority subpopulations. No definitive evidence has yet accumulated for implicating genetic differences in the varying susceptibility of blacks or other minorities to TB. In one study involving a small number of subjects, tubercle bacilli grew faster in infected macrophages from six black than from seven white donors, especially in the presence of black donor serum.<sup>47</sup> HLA phenotypes have also been associated with TB in different ethnic groups.<sup>48,49</sup> Interpretation of these associations is complicated by the nonspecificity of these haplotypes within and across ethnic groups. Consequently, it is not certain that race-related risk can be attributed to distributions of HLA haplotypes. While racial differences in susceptibility to MTB infection may exist, a genetic rather than socioeconomic basis for this phenomenon has not been demonstrated to date. Since available drugs are effective against TB in individuals of all races, regardless of their HIV status, differences in susceptibility are unlikely to explain racial differences in the burden of suffering from this disease. Most studies of the racial differences in the incidence of active TB led to the conclusion that these were attributable mostly to differences in risk of TB infection, which in turn, are related to socioeconomic status. Once infected, blacks are as likely as whites to develop active TB. However, because of race-specific disparity in the rates of decline in the prevalence of infection, blacks constitute a more concentrated reservoir for reactivation of disease.<sup>50</sup> The principal problem may be the societal failure to identify and appropriately treat those infected with MTB.

In summary, socioeconomic status rather than genetic constitution appears to be the major factor responsible for the unfavorable incidence, prevalence, and mortality data on TB in minorities.<sup>51</sup> Nevertheless, the contribution of host factors to the pathogenesis of TB should be clarified in further studies, controlling for

the major confounding variable, namely, socioeconomic status. In addition, modern tools of chemistry, molecular biology, and genetics, eg, DNA probes of mycobacteria, should be employed for improved and faster diagnosis of TB and in developing new antituberculous drugs. Finally, there is an urgent need for racially and ethnically appropriate strategies to improve care of minority patients, increase patient adherence to treatment regimens, and establish drug sensitivity and treatment efficacy.

### *Pneumonia*

Pneumonia is the sixth leading cause of death in the United States. *Streptococcus pneumoniae* is the most common causative agent in community-acquired pneumonia in the United States. The incidence of *S pneumoniae* pneumonia is estimated to be greater than 500,000 cases a year.<sup>52</sup> A total of 40,000 deaths a year are attributed to pneumococcal disease.<sup>53</sup> Higher morbidity and mortality are noted at all ages in men compared with women, and in nonwhites compared with whites. Black men had a 58% higher mortality rate from pneumonia compared with white men; the corresponding figure for black women was 26%.<sup>54</sup> Pneumonia occurs predominantly at the extremes of age, but has been noted with increasing frequency during midlife as a result of HIV infection. In 1987, the mortality rates for pneumonia and influenza were 18.2/100,000 for blacks, and 12.5/100,000 for whites, for a black:white ratio of 1.46:1.<sup>54</sup>

For Hispanics, there is marked variation in mortality rates for pneumonia by the country of origin. For example, the mortality from pneumonia in Hispanics of Cuban origin was 30% less than that of non-Hispanic whites.<sup>55</sup> However, mortality rates for Hispanics of Mexican origin were similar to those for non-Hispanic whites, and the rates for Hispanics of Puerto Rican origin were 58% higher.<sup>54</sup> In contrast, native Americans and Alaskan natives had a mortality rate 10% greater than that for the US population as a whole.<sup>54</sup> In 1988, blacks aged 45 to 64 years were 2.7 times more likely than their white counterparts to die from pneumonia.<sup>54</sup> This disparity in pneumonia-related deaths persists to a lesser extent in the 65- to 74-year-old age group for blacks and native Americans.

Administration of the 23-valent pneumococcal vaccine to prevent pneumonia is recommended for individuals 65 years and older and for certain other high-risk groups.<sup>56</sup> Vaccine efficacy is estimated at 60- to 70%.<sup>57,58</sup> However, in the population 65 years old or older, only 22% were vaccinated against influenza and only 10% had received the pneumococcal vaccine.<sup>59</sup> Further, whites are more likely than persons from other racial/ethnic groups to be vaccinated against pneumonia and influenza, and nearly twice as likely to receive influenza vaccine in the 65 years old or older



**Table 3—Mortality From Sickle Cell Anemia (SCA)**

| Deaths                    | 1979 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 |
|---------------------------|------|------|------|------|------|------|------|------|
| SCA as underlying cause   | 301  | 317  | 286  | 339  | 341  | 372  | 326  | 389  |
| SCA as contributing cause | 451  | 151  | 177  | 154  | 194  | 190  | 195  | 203  |

age group.<sup>54</sup> The public health implications of these missed opportunities for vaccination on pneumonia-influenza mortality in US minorities are obvious.

In summary, while pneumonia is an important cause of death in the United States, particularly in minority populations, significant gaps exist in information on incidence and patterns of care. Mortality data grossly underestimate the burden of suffering due to pneumonia. The National Hospital Discharge Survey provides data on patients admitted to the hospital, but excludes subjects who do not come to medical attention. Questions remain, particularly in low-income minority communities, regarding the impact of socioeconomic factors, including informal social networks, lack of access to health care, inadequate vaccination and preventive care, and environmental factors on the incidence and severity of disease. Data on outpatient visits for pneumonia and influenza are needed, including databases from health maintenance organizations and Medicaid.

#### *Sickle Hemoglobinopathies and Lung Disease*

The disorders of structure and synthesis of hemoglobin are among the most common lethal hereditary diseases in humans. Included among these disorders is sickle cell disease, a generic term for a group of genetic disorders characterized by the predominance of hemoglobin S. Sickle cell disorders include sickle cell anemia, the sickle- $\beta$  thalassemia syndromes, and hemoglobinopathies in which hemoglobin S is associated with another abnormal hemoglobin. This results in the formation of hemoglobin polymers that lead red blood cells to sickle. There are more than 200 million carriers of sickle cell trait worldwide, and 200,000 to 300,000 people are born annually with major hemoglobinopathies.<sup>60,61</sup>

Sickle cell disorders are found in people of African, Mediterranean, native-American, and Middle-Eastern heritages. In the United States, such disorders are most commonly seen in blacks, as well as Hispanics from the Caribbean, Central America, and parts of South America. There are 50,000 to 60,000 patients with sickle cell anemia in the United States, with an incidence of 1:540 births (1,189 cases each year) in blacks, in whom sickle cell anemia and its variants are a substantial cause of major illness. The number of deaths from sickle cell anemia during 1979 and 1989 is shown in Table 3. In blacks, the frequency of the sickle cell trait varies from 8 to 12% of the population, whereas overt sickle cell

anemia affects 1 in every 300 to 400 African-Americans.<sup>61</sup>

The lung is often involved in patients with sickle cell disease. Three pulmonary syndromes associated with sickle cell anemia have been described: (1) acute chest syndrome (ACS), (2) fat embolization syndrome, and (3) syndrome of sickle cell chronic lung disease. Perhaps because of improved management of the early complications of sickle cell disease, profound chronic changes are seen with increasing frequency.<sup>62</sup> Chronic restrictive lung disease with pulmonary hypertension and cor pulmonale in its late stage is a result of previous vaso-occlusive episodes throughout the lung microvasculature and has a poor prognosis.

There is substantial individual variation in the susceptibility to ACS. The reasons for this variability are not clear but are thought to reflect differences in haplotypes. Patients with Central African Republic haplotype have more severe and frequent episodes than do those with Benin type, while the Senegal variant is associated with the lowest incidence of ACS and the longest survival.<sup>63</sup>

Pulmonary consequences of sickle cell disorders have not been addressed in any detail. More detailed epidemiologic studies are needed to establish the incidence, prevalence, natural history, and methods of diagnosis of sickle cell chronic lung disease. Also, the role of the sickled red blood cell in pulmonary endothelial adherence and altered endothelial function needs to be clarified as well as the role of inflammation and thrombosis in the acute and chronic pulmonary syndromes. The relationship between specific genotypes of sickle cell disease and lung disease needs to be confirmed.

#### *Obesity and Sleep-Related Lung Disorders*

Compared with the general population, obesity is more prevalent in African-Americans, Hispanics, and native Americans,<sup>54</sup> placing these groups at high risk of obesity-related respiratory morbidity such as sleep-disordered breathing. For example, a high prevalence of snoring has been described in a Hispanic population in New Mexico.<sup>64</sup> However, information on the prevalence, natural history, and the magnitude of the burden of sleep-related respiratory disorders in the general population as a whole and minorities in particular is generally nonexistent.

Gaps in the respiratory epidemiology of obesity in relation to minorities need to be filled. Also, how pat-



terns of obesity, for example, hip vs truncal, differ in causing respiratory morbidity within minority populations, also needs to be examined. Existing data should be analyzed to determine whether current methods of diagnosis and treatment of sleep-related disorders are equally applicable to all races and ethnic groups. The relationship between sleep disorders and socioeconomic status also needs to be explored. Familial aggregation studies may help develop new hypotheses about patterns of inheritance and the interaction between genetic and environmental risk factors for obesity in minority populations.<sup>65</sup>

#### GENERAL COMMENTS AND OVERALL RECOMMENDATIONS

Table 1 underscores the dearth of information on disease occurrence and risk factors in minority populations. The following steps are recommended to address the gaps identified in the current understanding of the etiology, pathophysiology, diagnosis, treatment, and prevention of lung diseases that disproportionately occur in blacks, Hispanics, and native Americans.

#### *Databases and Instruments for Data Collection*

The currently available federal, state, and local databases such as Medicaid files or records of large public institutions and health maintenance organizations are inadequate for characterizing respiratory diseases in minorities. A comprehensive catalogue of federal databases containing relevant information should be developed and databases from nonfederal sources should be solicited. Many of the methods used for investigating respiratory diseases were aimed at white populations and are not readily applicable to minority populations whose classifications by race and ethnicity has presented many problems. A step toward solving this problem would be to convene a workshop of physicians and scientists with the relevant expertise to evaluate the available databases and devise optimal means of collecting new data. The workshop should also address the strengths and weaknesses of available instruments for assessing respiratory health, environmental and occupational exposures, and lung function in minority populations, and develop a consensus on guidelines for classifying race and ethnicity as well as the important correlates of educational attainment, occupational status, and income to assure comparability in data sets. As standardized definitions and questionnaires are developed, translations should be prepared and tested. Another helpful device to stimulate the generation and analysis of data would be a program of small grants, specifically designed for this purpose.

#### *Epidemiologic, Basic, and Clinical Research Needs*

Differences in patterns of disease occurrence be-

**Table 4—Pathways by Which Minority Group Status May Affect Disease Risk**

| Pathway  |
|--|
| 1. Environmental pathway<br>Disease due to environmental exposures, smoking, occupation, diet, air pollution   |
| 2. Genetic<br>Altered susceptibility to disease due to genetic differences   |
| 3. Genetic-environmental<br>Disease from special environmental exposures, <i>eg</i> , radiation, mitogenic chemicals, <i>etc</i> , which cause gene changes and increase susceptibility to disease |

tween the white majority and the ethnic-minority populations may be due to environmental factors, genetic factors, or environmental-genetic interactions (Table 4). Designing studies to distinguish among alternative pathways by which minority group status may affect disease risk is a complex but much needed task. A major rationale for performing research in this area is to identify new opportunities for developing and testing hypotheses that relate to health and disease in special populations and for the design of new intervention strategies.

Epidemiologic studies are needed to identify and assess risk factors for respiratory diseases in minority populations and to examine if and how the effects of the risk factors differ with different ethnic and racial groups. A finding that the degree of risk for a disease is different in a specific minority population could reflect any of the three alternative pathways described in Table 4. Understanding the relative impacts of genetic and social/environmental factors (*eg*, pollution, occupation, housing, nutrition, HIV risk) is central to developing preventive approaches. Epidemiologic research relevant to respiratory diseases that tend to occur at disproportionately lower degrees in minority populations also would help understand the factors that might protect a population from a particular disease.

An interaction of genetic and environmental factors may play a determining role contributing to race/ethnicity-specific differences in physiologic and immunologic responses, respiratory disease occurrence, and repair processes. Knowledge of the underlying cellular and molecular mechanisms should provide insights into the pathophysiology of disease and potential differences in therapeutic response. Polednak<sup>66</sup> examined the autoimmune basis and HLA associations of some connective tissue disorders that show preponderance in black individuals and hypothesized that immunogenetic differences that may have developed as genetic adaptations to other conditions and maintained by natural selection may be partly responsible for race-specific differences in disease.

It is well known that different strains and species of

animals differ in their susceptibility to a variety of diseases. For example, certain strains of mice develop a pulmonary granulomatous reaction in response to cell surface components of *M tuberculosis*, while other strains are unaffected.<sup>67</sup> Development of natural and experimental models of respiratory diseases will provide valuable tools for the elucidation of factors underlying the variable susceptibility of ethnic minorities to respiratory illness. Some relevant research issues that need to be addressed utilizing human and/or animal systems as appropriate, include the following: does the response of human immune and nonimmune cells to various stimulants vary with ethnicity of the host? What humoral or cellular factors are involved in the response to lung injury? Are there differences in these factors among racial or ethnic groups that could explain the disparity in disease among races? Are biologic differences among racial or ethnic groups expressed as quantitative differences in the relative amounts of various cell populations? Further clinically relevant research should be encouraged in animal and cell culture experiments to examine the relative efficacy of various therapeutic approaches in different population groups.

#### *Health Education, Behavioral Research, and Training*

A program with potential for successfully addressing the problem of respiratory diseases in minorities needs to be multifaceted. In addition to promoting biomedical research, the program should include strategies to educate the public, physicians, scientists, and policymakers on issues unique to minorities. It should also help increase the pool of trained individuals, particularly minorities engaged in pulmonary research by enticing new recruits as well as encourage established investigators to redirect their ideas, expertise, interests, and resources to the study of respiratory diseases disproportionately affecting minorities.

#### *Educational and Behavioral Research Needs*

Education, including the professional education of health-care providers and the health education of the general public, patient, and the family, is central to developing an effective, nationwide approach to a public health problem. Coordinated programs that incorporate medical and behavioral elements have been developed for cardiovascular and other nonrespiratory illnesses, but little emphasis has been given to respiratory diseases in minority groups.

Among health-care providers those receiving this education should include medical students, nurses, respiratory therapists, pharmacists, and other professionals in related areas. This will require additions to the current professional school curricula to cover the cultural, religious, and family practices and beliefs in

alternative medicine, uniquely relevant to minority health in general, and in particular, their respiratory health. New programs are needed to generate the requisite curriculum changes in the entire spectrum of health professional and caregiver education. Also group-specific new interventions may need to be developed, implemented, and evaluated.

The existing educational and behavioral interventions that might be suitable for the majority population need to be modified to accommodate the cultural, societal, and religious attitudes and beliefs of minority populations.

Public health programs are needed that focus on respiratory diseases in minorities and educate patients and their families, the general public, and health-care providers about the differences in disease patterns, potential causes, and remedies, with the ultimate goal of bringing about behavioral changes that would decrease or prevent respiratory diseases in minorities. Also needed are programs that evaluate the effectiveness of various initiatives designed for these purposes and modify them as necessary.

#### *Promoting Respiratory Research Careers for Minorities*

Increasing the number of minorities engaged in respiratory research and health-care fields is essential for the success of programs directed at ameliorating respiratory diseases in minorities. In 1970, blacks accounted for 11.1% of the US population but only 2.1% of physicians and 2.8% of students enrolled in US medical schools.<sup>68,69</sup> Blacks, Hispanics, and native Americans now together comprise more than 20% of the population, but their overall participation in the nation's biomedical enterprise is quite small as a proportion of their relative numbers (Fig 1). The patterns of minority representation in academic medicine presented herein clearly identify the career stages at which assistance programs may be initiated to improve the numbers of minorities.

Several studies<sup>68-71</sup> show that although there has been a steady increase in the numbers of various ethnic groups entering the biomedical field, the progress is uneven and small. During 1978 to 1992, the proportion of minority applicants to US medical schools increased from 9.1 to 10.8%, but Asians contributed in a large measure to this improvement.<sup>71</sup> In 1974, enrollment of underrepresented minorities was 8.1%, but it took 15 years (to 1989) for this figure to move up to 9.1%. The progress was relatively faster since then, with underrepresented minority applicants reaching 10.3% by 1993, with black enrollment of about 7%, Hispanic enrollment of 13.5%, and native American enrollment of 0.5%. Over the last 10 years, the percentage of underrepresented minorities increased from 7.8 to 8.3%.<sup>71</sup> In 1987, the total enroll-

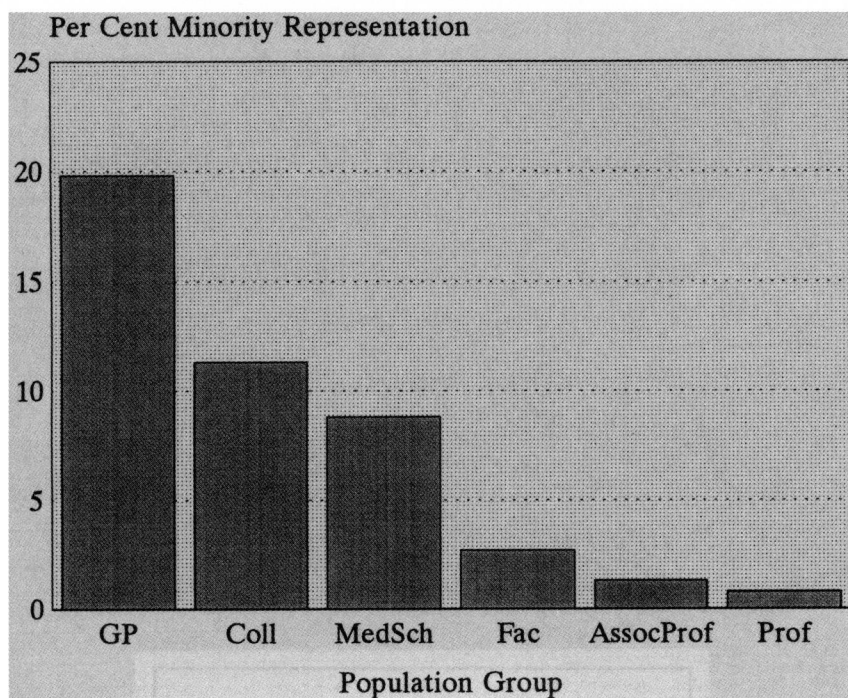


FIGURE 1. The progressive decline of minority representation in academic medicine. GP=general population; Coll=college students; MedSch=medical school enrollment; Fac=MD/PhD faculty; AssoProf=associate professors; Prof=professors.

ment of underrepresented minorities was only 8.8%—6% blacks; 1.7% Mexican-Americans; 0.7% mainland Puerto Ricans; and 0.4% native Americans.<sup>68-71</sup>

In 1990, blacks constituted more than 13% of the population between ages 20 and 29 years, but accounted for only 5.5% of the college graduates.<sup>68</sup> Some of the other minorities fared even more poorly relative to their representative proportions in the general population. For example, Mexican-Americans, who constituted 7.1% of the age group, accounted for 1.6% of the graduates; mainland Puerto Ricans, 1.3% of those between ages 20 to 29 vs 0.6% of graduates; and native Americans, 0.9% of the 20- to 29-year-old age group vs 0.3% of graduates.<sup>68,69</sup> These ratios are unlikely to improve because of the high attrition rate of minorities in science curricula at the undergraduate and secondary school levels.

In 1992, about 8% of minorities graduated from medical schools among which two thirds were blacks, down from 72% in 1980. This reflects an increase in the number of American Indians and Hispanics in medical schools. In 1992, compared with about 82% for other students, less than 56% of minority students graduated from medical schools, ranging from 50% for blacks to 70% for Mexican-Americans.<sup>71</sup>

Minorities accounted for about 3.5% of medical school faculties in 1992, compared with 2.7% in 1980. If minority faculties of historically black medical schools are excluded from this calculation, minorities account only for 2.7% of the faculties of the remaining US medical schools.<sup>71</sup>

Correcting for the shortage of minorities in the

biomedical research sciences and health-care-related fields will require a multifaceted and coordinated effort on the part of federal, state, and local authorities, institutions of higher education, philanthropic foundations, and voluntary agencies. It is gratifying that several programs have been initiated at the National Institutes of Health (NIH) to attract and train minorities at various levels of the career ladder. These efforts need to be intensified and expanded to provide academic enrichment programs at medical and graduate schools. Current career development programs at NIH should be assessed for their success in easing the transition of minority scientists to productive careers as established investigators in lung research.<sup>72</sup> More opportunities should be provided for minorities in master's degree programs at minority institutions to obtain PhD degrees at research-intensive majority institutions engaged in lung research. Efforts should also focus more on the precollege years (Fig 1) and should include programs that provide enrichment experiences for high school students through improved science curricula and development of demonstration and education programs within secondary school systems in minority communities. Programs should be designed to enable school systems to develop curricula and special activities that promote interest in lung disease research, and expand opportunities for teachers and students in minority communities to participate in summer research activities at NIH-funded laboratories. Also, new initiatives should be promoted that encourage local colleges and universities with biomedical research programs to develop closer relationships with precollege institutions by providing support for week-

end and summer enrichment activities for students and teachers. Finally, strategies must be developed to increase the number of minority faculty with special training in biomedical research to serve as role models for students considering careers in the sciences.

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