**Purpose:** To examine the time from the first physician visit to the diagnosis of sarcoidosis.

**Hypotheses:** The time required to diagnose sarcoidosis is dependent on the initial symptoms, socioeconomic status, referral to a specialist, race, and severity of pulmonary involvement.

**Methods:** Patients were recruited from the Case Control Etiology of Sarcoidosis Study (ACCESS) and had biopsy-confirmed sarcoidosis. Subjects were asked to recall the date of onset of symptoms of sarcoidosis, their first physician visit, number of physician visits, and types of physicians seen.

**Results:** One hundred eighty-nine patients were enrolled. The diagnosis of sarcoidosis was made on the first physician visit in only 15.3% of cases. The presence of pulmonary symptoms was associated with prolonged time (> 6 months vs ≤ 6 months, p = 0.02) until diagnosis, and the presence of skin symptoms with a shorter time (≤ 6 months vs > 6 months, p = 0.02) until diagnosis. Patients with pulmonary symptoms had more physician visits (mean ± SEM) until the diagnosis was made compared to those without pulmonary symptoms (4.84 ± 0.38 visits vs 3.15 ± 0.24 visits, p = 0.0002). The mean baseline FEV\(_1\) was greater in those diagnosed ≤ 6 months from the first physician visit than those diagnosed > 6 months (87.3 ± 1.52% predicted vs 81.2 ± 2.5% predicted, p = 0.04). There was a significant delay in diagnosis (> 6 months vs ≤ 6 months) from first physician visit with higher Scadding stages (stage 4 vs stage 2, or stage 3 vs stage 0 or 1, p = 0.04).

**Conclusions:** The diagnosis of sarcoidosis is often delayed and seems to be more a factor of disease presentation than patient or physician characteristics. The presence of pulmonary symptoms or higher radiographic stages is associated with a prolonged time until diagnosis. The presence of skin symptoms is associated with less delay in diagnosis. It is likely that the delay in diagnosis of pulmonary sarcoidosis relates to the fact that pulmonary symptoms and parenchymal involvement are nonspecific and are often regarded as manifestations of other pulmonary diseases.

(CHEST 2003; 123:406–412)

**Key words:** diagnosis; pulmonary; sarcoidosis; skin

**Abbreviation:** ACCESS = Case Control Etiology of Sarcoidosis Study

Sarcoidosis is a multisystem granulomatous disease of unknown cause.\(^1\) The diagnosis of sarcoidosis usually requires tissue confirmation of granulomatous inflammation, exclusion of known causes of such inflammation, and clinical evidence of involvement in more than one organ.\(^1\) On occasion, a presumptive diagnosis can be made based on a typical constellation of clinical findings, making histologic diagnosis unnecessary.

The diagnosis of sarcoidosis is often delayed following the onset of symptoms. Several reasons exist...
For the delay. First, the disease is often subclinical or self-limited, or the symptoms are minimal. Screening chest radiograph surveys have suggested that a large proportion of pulmonary sarcoidosis cases remain undiagnosed because patients are asymptomatic. Second, the disease can affect any organ system, so that cases are referred to a wide range of specialists, some of whom may not consider sarcoidosis in the differential diagnosis. Third, the symptoms of sarcoidosis are not specific and often suggest alternative pulmonary diseases. Finally, economic issues or barriers to access to medical care may affect the timeliness of diagnosis.

We designed this study to examine the diagnostic pathway to sarcoidosis from the onset of symptoms and first medical visit to the date of tissue biopsy, and to determine the factors responsible for the delay. We hypothesized that the time interval between (1) the onset of symptoms and the biopsy date and (2) the first physician contact for these symptoms and the biopsy date were dependent on the following: the specific symptoms, the organs involved with sarcoidosis, socioeconomic status, the delay in referral to a subspecialist, impaired access to medical care, or severity of pulmonary involvement. Other variables that were examined included age, race, urban vs rural residence, and health insurance status.

**Materials and Methods**

All patients recruited in this study were enrolled in the Case Control Etiology of Sarcoidosis Study (ACCESS) conducted by the National Heart, Lung, and Blood Institute. ACCESS was a multicenter case control study examining the etiology of sarcoidosis, and has been described in detail elsewhere. Eight of the 10 ACCESS clinical centers participated in this study (Appendix). All subjects enrolled were required to have had a tissue biopsy sample demonstrating noncaseating granulomas within 6 months of enrollment. We excluded all known causes of granulomatous inflammation as part of recruitment into ACCESS by demonstration of negative stains of the biopsy specimens for mycobacterial and fungal organisms and absence of particulate matter by polarized light determination. As part of ACCESS, all subjects had data collected concerning their demographic characteristics, socioeconomic status, pulmonary function, chest radiograph results, and extent of extrapulmonary involvement with sarcoidosis. Chest radiographs were classified by Scadding stages: 0, normal chest radiographic findings; I, bilateral hilar adenopathy with normal lung parenchyma; II, bilateral hilar adenopathy with pulmonary infiltrates; III, pulmonary infiltrates without hilar adenopathy; IV, pulmonary fibrosis/fibrocystic parenchymal changes.

We asked patients to identify the time of onset of their first symptom(s) of sarcoidosis, the date of their first physician visit related to that symptom, the number of physician visits, number of physicians, and types of physicians seen for sarcoidosis symptoms prior to the histologic diagnosis of sarcoidosis. For questions that required the patients to give times or dates, we classified responses into one of the following categories related to the date of the histologic diagnosis of sarcoidosis: within 3 months, 3 to < 6 months, 6 to < 12 months, 12 months to < 2 years, or ≥ 2 years. We classified physicians (which includes nonphysicians such as doctors of osteopathy) according to the following categories: emergency department physician, family practice physician, internist, subspecialist, surgeon, and other. Presenting symptoms of sarcoidosis were judged by the principal investigator or study coordinator as being related or unrelated to sarcoidosis. We classified these symptoms in the following categories: pulmonary, asymptomatic (abnormal chest radiographic findings with no symptoms), skin (presence of a skin lesion), eye, systemic (fever, weight loss, night sweats), and other.

All independent variables in this analysis were categorised. Dependent variables were analyzed using contingency table analysis for categorical outcome variables; p values for these analyses were calculated from the χ² statistics. Continuous outcome variables were analyzed using Student t test; p values were calculated from the t statistic with appropriate degrees of freedom. The study had sufficient power to detect covariates that were responsible for a 20% lower incidence in detection by 6 months (70% vs 50%) and 17.5% increase (70% vs 87.5%), assuming both that patients with the attribute comprised 50% of the study population and α = 0.05.

**Results**

One hundred eighty-nine subjects were enrolled in the study. The demographic data of the participants are shown in Table 1. The study population was approximately 60% female, and two thirds were white (four study subjects were not black or white, and they were excluded from all analyses concerning race). Approximately equal numbers of subjects were < 40 years and > 40 years of age. Less than 15% of the study population lived in a rural residence within

**Table 1—Demographic Data**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>81 (42.9)</td>
</tr>
<tr>
<td>Female</td>
<td>108 (57.1)</td>
</tr>
<tr>
<td>Race</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>124 (65.6)</td>
</tr>
<tr>
<td>Black</td>
<td>61 (32.3)</td>
</tr>
<tr>
<td>Age, yr</td>
<td></td>
</tr>
<tr>
<td>&lt; 40</td>
<td>91 (48.1)</td>
</tr>
<tr>
<td>≥ 40</td>
<td>98 (51.8)</td>
</tr>
<tr>
<td>Rural residence†</td>
<td>26 (13.8)</td>
</tr>
<tr>
<td>Nonrural residence</td>
<td>163 (86.2)</td>
</tr>
<tr>
<td>Public or private insurance</td>
<td>176 (93.1)</td>
</tr>
<tr>
<td>No insurance</td>
<td>13 (6.9)</td>
</tr>
<tr>
<td>Total family income, $‡</td>
<td>40,288 ± 1108 $</td>
</tr>
<tr>
<td>White patients</td>
<td>43,927 ± 1189 $</td>
</tr>
<tr>
<td>Black patients</td>
<td>32,658 ± 2098 $</td>
</tr>
</tbody>
</table>

*Data are presented as No. (%) or mean ± SEM.
†Within 3 years of the diagnosis of sarcoidosis.
‡Truncated. ≥ $37,500 was analyzed as $37,500.

$p = 0.0001$ vs black race.
3 years of the diagnosis of sarcoidosis. Ninety-three percent of subjects had some form of private or public health insurance. Annual family income was coded in increments with the maximum truncated at $57,500. The participants were relatively prosperous, with a mean annual coded family income of at least $40,288. The annual coded family income was higher in white subjects than in black subjects ($43,927 vs $32,658, p = 0.0001).

Table 2 lists the initial symptoms of sarcoidosis in the study subjects. Slightly more than one half the individuals presented with pulmonary symptoms, and approximately one half of these had only pulmonary symptoms. Nearly 13% had skin symptoms as the initial presentation of sarcoidosis. Only 12 subjects (6.3%) presented with systemic symptoms (fever, malaise, night sweats); therefore, no analysis was performed on this small subgroup. Approximately 16% had initial symptoms other than those mentioned above (eye, musculoskeletal, abdominal).

The number of physician visits required to make the diagnosis of sarcoidosis starting with the first visit for a symptom of sarcoidosis is shown in Table 3. The diagnosis was made on the first physician visit in only 15.3% of the cases. Slightly less than one half of the cases required four or more physician visits, and > 20% of cases required six or more visits until the diagnosis was established. One subject required 23 physician visits before sarcoidosis was diagnosed.

Table 4 displays the cumulative distribution for the time until the diagnosis of sarcoidosis following (1) the development of the first symptom of sarcoidosis, and (2) the first physician visit for a symptom in the study population. Approximately one half of the subjects received a diagnosis of sarcoidosis > 3 months after the onset of symptoms or an initial physician visit for a symptom of sarcoidosis. Sarcoidosis was not diagnosed in more than one fourth of the subjects within 6 months of initial symptoms, and in approximately 10% within 2 years of initial symptoms. The reason that at most time periods a diagnosis was made more rapidly after the first office visit than after onset of symptoms is that some patients presented to a physician without symptoms (eg, an abnormal pre-employment chest radiographic findings).

The presence of pulmonary symptoms was associated with a prolonged time (> 6 months vs ≤ 6 months) from the first physician visit until the diagnosis of sarcoidosis was made compared to subjects without pulmonary symptoms (Table 5; p = 0.02). The presence of skin symptoms was associated with a shorter time (≤ 6 months vs > 6 months) before the diagnosis of sarcoidosis was made compared to those without skin symptoms (Table 5; p = 0.02). Factors that had no effect on the time between first physician visit and diagnosis included the presence of systemic symptoms, other symptoms, whether the first physician visit was with a generalist or a specialist, gender, the patient’s race, having health insurance, annual family income, or rural vs urban residence.

Of the above-referenced variables, only the presence of pulmonary symptoms was associated with a prolonged time (> 6 months vs ≤ 6 months) from the first physician visit until the diagnosis of sarcoidosis was made compared to subjects without pulmonary symptoms (Table 5; p = 0.02). The presence of skin symptoms was associated with a shorter time (≤ 6 months vs > 6 months) before the diagnosis of sarcoidosis was made compared to those without skin symptoms (Table 5; p = 0.02). Factors that had no effect on the time between first physician visit and diagnosis included the presence of systemic symptoms, other symptoms, whether the first physician visit was with a generalist or a specialist, gender, the patient’s race, having health insurance, annual family income, or rural vs urban residence.
### Table 5—Factors Affecting the Time Between First Physician Visit and Diagnosis*

<table>
<thead>
<tr>
<th>Factors</th>
<th>≤ 6 mo</th>
<th>&gt; 6 mo</th>
<th>p Value†</th>
</tr>
</thead>
<tbody>
<tr>
<td>With pulmonary symptoms</td>
<td>64 (68.8)</td>
<td>29 (31.2)</td>
<td>0.02</td>
</tr>
<tr>
<td>Without pulmonary symptoms</td>
<td>72 (83.7)</td>
<td>14 (16.2)</td>
<td></td>
</tr>
<tr>
<td>With skin symptoms</td>
<td>21 (95.5)</td>
<td>1 (4.5)</td>
<td>0.02</td>
</tr>
<tr>
<td>Without skin symptoms</td>
<td>115 (73.2)</td>
<td>42 (26.8)</td>
<td></td>
</tr>
</tbody>
</table>

*Data are presented as No. (%).  
†χ² test (p < 0.05 considered significant).

The presence of pulmonary symptoms had an impact on prolonging the time between the onset of symptoms and the diagnosis of sarcoidosis. Thirty-eight percent of patients with pulmonary symptoms required > 6 months for sarcoidosis to be diagnosed compared to 24% without pulmonary symptoms (p = 0.04).

Subjects with pulmonary symptoms required an average of 1.7 more physician visits (4.9 ± 0.38 visits vs 3.15 ± 0.24 visits, mean ± SEM; p = 0.0002) until the diagnosis of sarcoidosis was made compared to those without pulmonary symptoms. The presence or absence of skin symptoms, systemic symptoms, and other symptoms had no statistically significant effect on the number of physician visits required to make the diagnosis of sarcoidosis.

The patients who received a diagnosis > 6 months after their first physician visit had a slightly lower percent predicted FEV₁ as compared patients with diagnoses received before 6 months (81.2 ± 2.5 vs 87.3 ± 1.5, p = 0.04). Results were similar if one compared the percent predicted FEV₁ between those whose symptoms began > 6 months prior to diagnosis compared to those whose symptom onset was within 6 months of diagnosis (81.7 ± 2.2 vs 87.9 ± 1.5, p = 0.02). No differences were observed for FVC or dyspnea levels, or for mean level of annual family income.

Table 6 shows the relationship between onset of symptoms and first physician visit with Scadding stage of sarcoidosis. There was a significant delay in diagnosis (> 6 months vs ≤ 6 months) from onset of symptoms of sarcoidosis with higher Scadding stages (stage IV vs stage II, or stage III vs stage 0 or I, p = 0.003). Similarly there was a significant delay in diagnosis (> 6 months vs ≤ 6 months) from first physician visit with higher Scadding stages (stage IV vs stage II, or stage III vs stage 0 or I, p = 0.04).

### Discussion

This study confirms that there is commonly a delay between the onset of symptoms of sarcoidosis and the eventual diagnosis of the disease. In addition, there is often a delay between the time of first physician visit for sarcoidosis symptoms and the eventual diagnosis. In this study, approximately one half of the patients received a diagnosis > 3 months after the onset of symptoms, and more than one fourth received a diagnosis > 6 months from symptom onset. The diagnosis of sarcoidosis was made on the first physician visit in only 15.3% of cases, and slightly less than one half of the cases required four or more physician visits until the diagnosis of sarcoidosis was made.

Certain factors affected the time required to make the diagnosis of sarcoidosis. The presence of pulmonary symptoms was associated with a prolonged time (> 6 months vs ≤ 6 months) from both onset of symptoms until diagnosis and time of first physician visit until diagnosis. One possible explanation of these findings is that pulmonary symptoms of sarcoidosis, such as cough, wheezing, chest pain, and dyspnea, are nonspecific and may be mistaken for alternative pulmonary diseases, such as bronchitis, asthma, or other more common lung diseases for which empiric therapy may be tried prior to diagnostic evaluation. The initial physician visit of a patient with pulmonary complaints may not prompt chest radiography, which would likely suggest sarcoidosis as a possible diagnosis since hilar adenopathy and/or interstitial infiltrates are usually seen.

Although we believe that this is a plausible explanation of our findings, it must remain a supposition as we do not have data concerning the timing of chest radiography in our patients. The fact that some patients with pulmonary disease presented with asymptomatic chest radiographic findings would

### Table 6—Relationship of Scadding Stage to Time Until Diagnosis*

<table>
<thead>
<tr>
<th>Scadding Stage</th>
<th>Time to Diagnosis From First Physician Visit, mo</th>
<th>Time to Diagnosis From Symptom Onset, mo</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≤ 6 mo</td>
<td>&gt; 6 mo</td>
</tr>
<tr>
<td>0 or I</td>
<td>74 (80)</td>
<td>19 (20)</td>
</tr>
<tr>
<td>II or III</td>
<td>57 (76)</td>
<td>18 (24)</td>
</tr>
<tr>
<td>IV</td>
<td>5 (45)</td>
<td>6 (55)</td>
</tr>
</tbody>
</table>

*Data are presented as No. (%).  
†χ² test (p < 0.05 considered significant).
tend to bias our results away from our conclusion that pulmonary symptoms are associated with a delay in diagnosis because many of these patients had pulmonary symptoms develop after their first physician visit.

The presence of skin symptoms (usually a skin lesion) was associated with a shorter time (≤ 6 months vs > 6 months) to diagnose sarcoidosis from the time of first physician visit. This is likely because skin lesions are obvious and usually will undergo biopsy if they do not respond to conservative measures.

In the late 19th century, sarcoidosis was initially thought to be an isolated skin disease because pulmonary complaints were nonspecific, and limited technology made visceral involvement difficult to diagnose.\(^1\)\(^7\) Similarly, a physician performing an office visit today initially relies on the medical history and physical examination. Although the physician has sophisticated technology available, it is expensive and only appropriate to use if it has a reasonable chance of offering the patient some benefit. Although it is unnecessary to perform a chest radiograph for every patient with a pulmonary complaint, a chest radiograph should be considered when pulmonary symptoms persist or do not respond to initial therapy. The fact that patients with pulmonary symptoms required a mean of 4.84 ± 0.38 visits until the diagnosis of sarcoidosis was made (which was also more visits than those without pulmonary symptoms) suggests that there may have been inappropriate delay in performing a chest radiograph or additional diagnostic tests in many of these patients.

The time until diagnosis of sarcoidosis (both from initial symptoms and time of first physician visit) was not affected by gender, race, annual family income, having health insurance, type of physician seen, or urban vs rural residence. Although socioeconomic status had no effect on the time until the diagnosis of sarcoidosis in this study, our study population was not poor (mean family income was at least $40,288) and 93% had some form of private or public health insurance. Therefore, it is possible that this study failed to detect an effect due to socioeconomic status on delay in diagnosis because there were not enough subjects enrolled with low socioeconomic status. Although a visit to a subspecialist physician for symptoms related to sarcoidosis had no relationship to the speed of diagnosis, it is possible the time to diagnose sarcoidosis is affected by visits to certain physician groups. However, our subgroups of different types of physicians was too small to perform such an analysis.

Although this study failed to demonstrate that barriers to health care affect the speed of diagnosis, study limitations compromise the certainty of this conclusion. There were very few subjects who reported no health insurance or barriers to health care. In addition, we did not collect information on the type of health insurance, which might have affected the rapidity of diagnosis by placing restrictions on diagnostic tests.

Another potential limitation of these data is that there may have been potential recruitment biases and the subjects of this study may not have been representative of sarcoidosis patients in the United States. The study subjects were a consecutive patient subgroup of ACCESS, and the demographics of this subgroup were not different from the entire group of ACCESS subjects,\(^8\) who tended to be older and have more white patients than in other series of US sarcoidosis patients.\(^9\) It is possible, albeit unlikely, that recruitment biases in terms of age and race might delay the diagnosis because sarcoidosis might not be considered as readily in elderly and white patients. These biases should not affect our conclusions concerning delays in diagnosis related to pulmonary signs or symptoms.

It is also possible that sarcoidosis symptoms developed in subjects prior to the onset of granuloma formation, thereby delaying the diagnosis of sarcoidosis. In our clinical experience, this is a very rare occurrence.

The FEV\(_1\) of the patients with sarcoidosis diagnosed > 6 months after both symptom onset and time of first physician visit was lower than in those with sarcoidosis diagnosed within 6 months of symptom onset and their first physician visit. Interestingly, FVC was not significantly different between these two patient groups. This suggests that sarcoidosis is often not considered in the differential diagnosis when the disease presents with airflow obstruction. Airflow obstruction is common in sarcoidosis,\(^10\) but symptoms in these patients may be initially attributed to asthma, bronchitis, or another obstructive lung disease, especially if a chest radiograph is not performed. These results also suggest that a delay in diagnosis of pulmonary sarcoidosis allows some parameters of pulmonary dysfunction to progress without therapy.

We identified a relationship between Scadding stage and time until diagnosis. Patients with stage 0 or I chest radiographs had sarcoidosis diagnosed more frequently within 6 months of symptom onset than those with stage II or III radiographs, while those with stage IV radiographs were least likely to have sarcoidosis diagnosed within 6 months of symptom onset (\(p = 0.003\)). The same relationship was found between Scadding stage and time to diagnosis from the first physician visit (\(p = 0.04\)). Our rationale for partitioning the Scadding stages in this way was to separate chest radiographs into those without parenchymal infiltrates (stages 0 and I) and those with parenchymal infiltrates (stages II and III). We
Further believed that stage IV radiographs showing pulmonary fibrosis should be classified separately from other radiographs showing parenchymal infiltrates. One explanation of these findings is that patients with stage 0 or stage I radiographs are less likely to have pulmonary symptoms, and are therefore more likely to come to medical attention for an extrapulmonary manifestation of sarcoidosis such as skin disease that could prompt a diagnostic biopsy. Another explanation is that sarcoidosis might be considered prominently in the differential diagnosis of a stage I radiograph, whereas many other pulmonary diseases may be considered in the differential diagnosis when infiltrates (stages II, III, or IV) are present (eg, pneumonia, other interstitial lung diseases). This is especially likely for patients who present with stage IV radiographs, in whom sarcoidosis may not often be considered because these patients usually have had pulmonary sarcoidosis for many years.

These results have several important implications. A delay in the diagnosis of sarcoidosis probably results in significant unnecessary health-care costs. Extra office visits, unnecessary diagnostic tests, and inappropriate therapies were probably used in many patients prior to establishing the diagnosis of sarcoidosis. Patients may also become frustrated, anxious, or depressed if physicians fail to diagnose or treat their medical conditions in a timely manner.

It is also possible that a delay in the diagnosis of sarcoidosis may affect patient outcome. At present, there is little in the literature to support this contention. Patients affected with sarcoidosis for longer periods of time have decreased rates of resolution. However, it remains controversial if early therapy is beneficial for sarcoidosis. Corticosteroids have been shown to improve radiographic findings and spirometry for several months relative to placebo as initial treatment of pulmonary sarcoidosis. However, studies examining the long-term benefit (≥ 5 years after therapy) of corticosteroids have found no benefit or a small but significant benefit only in certain subgroups. One study suggested that corticosteroids may promote relapse of sarcoidosis, although this study was retrospective and the untreated and corticosteroid groups were not matched.

In conclusion, this study suggests that a delay in the diagnosis of sarcoidosis occurs commonly. Nearly one half of our patients had sarcoidosis diagnosed > 6 months after their first physician visit for a complaint related to sarcoidosis, and almost one half required at least four physician visits until the diagnosis was made. Patients with pulmonary symptoms had a longer delay in diagnosis compared to those without pulmonary symptoms. Patients with sarcoidosis diagnosed ≥ 6 months after symptom onset or after their first physician visit had a lower FEV1 but not FVC than those with sarcoidosis diagnosed within 6 months of symptom onset or first physician visit. The delay in diagnosis was prolonged in patients with higher Scadding stages on chest radiography. These results suggest that pulmonary sarcoidosis is not considered in the differential diagnosis when a patient presents with pulmonary symptoms, even after returning to a physician several times. Sarcoidosis is particularly less often considered in patients with airflow obstruction and those with pulmonary infiltrates on chest radiograph.

These results imply that health-care costs might be reduced if the diagnosis of sarcoidosis, especially pulmonary sarcoidosis, is considered at an earlier stage. Although it may not always be appropriate to subject patients with new onset pulmonary complaints to a chest radiograph or other diagnostic tests, a chest radiograph should be considered if the patient does not respond to initial therapy, or if the clinical course of the suspected illness is atypical. A chest radiograph should also be considered early in the diagnostic evaluation if a patient who presents with pulmonary symptoms has extrapulmonary signs or symptoms compatible with sarcoidosis. Once a chest radiograph is obtained, it should be examined carefully for the presence of interstitial lung disease and thoracic adenopathy; sarcoidosis should be considered if either is found. We therefore believe that these results suggest the diagnosis of sarcoidosis would be made more rapidly if physicians initially included sarcoidosis as a possible diagnosis and were familiar with the clinical and radiographic manifestations of the disease.

Appendix

The ACCESS clinical centers that participated in this study were as follows: Medical University of South Carolina, Charleston, SC; Georgetown University Medical Center, Washington, DC; Johns Hopkins Medical Center, Baltimore, MD; National Jewish Medical and Research Center and University of Colorado Health Sciences Center, Denver, CO; University of Cincinnati Medical Center, Cincinnati, OH; Mount Sinai Medical Center, New York, NY; Beth Israel Deaconess Medical Center, Boston, MA; University of Iowa College of Medicine, Iowa City, IA; and Clinical Trials and Surveys Corporation, Baltimore, MD (Clinical Coordinating Center).

Additional authors at clinical centers include the following: Beth Israel Deaconess Medical Center (Steven E. Weinberger, MD; Patricia Finn, MD; and Allison Moran, RN); Georgetown University Medical Center (Henry Yeager, Jr., MD, and Susan Stein, MA); Case Western Reserve University–Henry Ford Health Sciences Center (Michael C. Iannui, MD; Benjamin Rybicki, PhD; Marcie Major, RN; Mary Malik, PhD; and John Popovich, Jr., MD); Johns Hopkins University School of Medicine (David R. Moller, MD, and Carol J. Johns, MD [deceased]); and Medical University of South Carolina (Susan D’Alessandro, RN, [deceased]).
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