In the study reported, the authors examined risk factors for repeated hospital admissions for asthma in a rural/suburban setting. Charts of patients who were hospitalized two or more times with the diagnosis of asthma between June 1991 and January 1998 were reviewed. A questionnaire was completed for each admission for 65 patients. The results demonstrated an equal male-to-female ratio, with a mean age of 27 years. Hispanics represented 12% of the patients although they accounted for only 2.5% of the general population in the area under study. The mean number of hospital admissions was 3.2. A history of depression existed in 25% of the patients. Noncompliance was admitted in 38%. Twenty-five percent were active tobacco smokers. Acknowledged triggers of asthma included viral infections (74%), exercise (50%), weather conditions (43%), dust (38%), cats (36%), sinusitis (32%), pollen (32%), gastroesophageal reflux disease (31%), dogs (30%), smoke (28%), and emotional stress (15%). Medications at time of admission included albuterol (98%), salmeterol xinafoate (26%), theophylline (38%), ipratropium bromide (55%), nedocromil sodium (20%), cromolyn sodium (35%), prednisone (49%), and inhaled corticosteroids (69%). Ninety-five percent had access to a primary care physician. Fifty-seven percent had a pulmonary and 11% had an allergy consult. These data suggest that patients in rural/suburban areas with repeated hospitalizations for asthma have a high probability of noncompliance, depression, and allergenic triggers. Gastroesophageal reflux was a common recognized trigger. Inhaled steroids were underused, whereas ipratropium and theophylline were overused. Bilingual education on asthma and triggers and social support are necessary even in rural healthcare settings without a large minority population.

(Key words: asthma, risk factors, hospital admissions)
examined to see if variables are similar to data obtained mainly from urban areas. It is the intent that this information may help in management of patients by identifying factors that may lead to more appropriate intervention and reduce the need for readmissions.

Methods
A retrospective chart review was done for repeated hospital admissions to the Milton S. Hershey Medical Center, the Pennsylvania State University, for the treatment of asthma between June 1, 1991, and January 7, 1998. This medical center is a healthcare center in suburban/rural Pennsylvania. The study focused on patients who had two or more admissions to the Hershey Medical Center with the primary diagnosis of asthma. Patients younger than 2 years were excluded because bronchiolitis, an acute wheezing illness occurring mainly in children younger than 2 years, closely resembles asthma and may affect our data. Patients admitted to the hospital whose diagnosis code changed to nonasthma during hospitalization also were excluded.

A questionnaire was filled out for every admission for each patient after approval by the institutional review board. The following information was recorded for each patient when available: gender, age at first admission, race, triggers of asthma, family history of asthma and allergies, medications before admission, compliance with medications, history of smoking, presence of pets in the home, history of depression, and number of admissions to Hershey Medical Center between 1991 and 1998 for asthma. Data from the questionnaires were entered into the Minitab statistics program.

Results
Eighty-four patients were identified as having multiple admissions for asthma between 1991 and 1998. Of these, 15 were younger than 2 years and excluded from our study. Charts were unavailable for four patients. A total of 65 patient records were included in this study.

The demographic profile demonstrated an equal male-to-female ratio. The age of the subjects ranged from 2 years to 85 years, with a mean age of 27 years. A specific breakdown by age and gender appears in Table 1. The mean number of hospital admissions was 3.2. The number of admissions ranged from 2 to 6 for all but one patient who had 25 admissions.

Acknowledged triggers of asthma (Table 2) included viral infections (74%), exercise (50%), weather conditions (43%), dust (38%), cats (36%), sinusitis (32%), pollen (32%), gastroesophageal reflux disease (31%), dogs (30%), smoke (28%), and emotional stress (15%).

Table 3 shows family and social history risk factors. A history of depression existed in 25% of the patients. Thirty-eight percent admitted that they were noncompliant with medications, and 22% were active tobacco smokers. Sixty-five percent had a family history of asthma or allergies or both.

Table 4 lists the medications patients had been treated with before their hospital admissions. Nearly all patients had been placed on β-agonist therapy. Thirty
eight percent had been treated with theophylline. Sixty-nine percent were using inhaled corticosteroids (triamcinolone acetonide, beclomethasone dipropionate, fluticasone, fluticasone propionate, or budesonide). The majority of patients had access to a primary care physician.

Discussion
Asthma can affect patients regardless of gender, race, or age, though hospitalization rates have been highest for minorities and children. Although our results show an equal ratio overall between male and female patients, there were differences within age groups. Between ages 2 years and 15 years, there was a 2:1 male-to-female ratio, whereas among those older than 15 years, the ratio was reversed. This finding is consistent with several studies that have noted higher readmission rates for girls, despite the increased prevalence of asthma in male children. It should be noted, however, that among those older than 35 years, there is a higher rate of misdiagnosis of asthma. Because we did not directly assess the patients in this study, we cannot assume that diseases such as vocal cord dysfunction were not inappropriately diagnosed as asthma.

In this study, Hispanics represented 12% of the patients even though they accounted for only 2.5% of the general population. Asthma rates among Puerto Ricans are higher than those of the general US population. Previous studies in urban areas have noted that minorities have higher rates of asthma, which may be more reflective of socioeconomic difficulties than of ethnicity.

In a study of risk factors for multiple visits to the emergency department, Dale and colleagues noted that patients usually had moderate to severe asthma chronically under poor control, with exposure to any trigger probably becoming the “last straw.” It is important to identify potential triggers and enforce control measures to reduce the amount of exposure that patients have with these irritants. Common triggers include animal dander, dust mites, pollen, tobacco smoke, molds, perfumes and strong odors, cockroaches, and occupational irritants and allergens. Gastroesophageal reflux is frequently asymptomatic; however, 31% of patients noted gastroesophageal reflux as a trigger of their asthma attacks.

Twenty-five percent of the patients in our study had a history of depression. Because psychological problems may increase the risk for life-threatening episodes of asthma, physicians should assess the psychosocial and emotional aspects of the patient’s life. Such variables include wheezing with stress, poor self-care, disregard of perceived asthma symptoms, family dysfunction, reaction to separation or loss, emotional disturbance, manipulative use of asthma, depression, and conflict among the physician, patient, and caregivers.

The use of three or more categories of asthma drugs in past years was associated with an increased risk of death from asthma or readmission for asthma. Independently, the recent need for oral corticosteroids is a marker of increased risk of hospitalization and mortality. Inhaled corticosteroid prophylaxis is effective in controlling symptoms and reducing hospitalizations and death. Because our patients all had previous hospitalization, we anticipated that all, if not the vast majority, would be on inhaled corticosteroid therapy. Inhaled anti-inflammatory therapy was underutilized in urban settings, and in our cohort, only two thirds were using inhaled corticosteroids.

Ninety-five percent of our study patients had access to a primary care physician. Fifty-seven percent had been treated with theophylline. Sixty-nine percent were using inhaled corticosteroids. The majority of patients had access to a primary care physician.

<table>
<thead>
<tr>
<th>Variable No. (%)</th>
<th>Treatment</th>
<th>Medical Care and Management</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Albuterol</td>
<td>64 (98)</td>
</tr>
<tr>
<td></td>
<td>Salmeterol xinafoate</td>
<td>17 (26)</td>
</tr>
<tr>
<td></td>
<td>Theophylline</td>
<td>25 (38)</td>
</tr>
<tr>
<td></td>
<td>Ipratropium bromide</td>
<td>36 (55)</td>
</tr>
<tr>
<td></td>
<td>Nedocromil sodium</td>
<td>13 (20)</td>
</tr>
<tr>
<td></td>
<td>Cromolyn sodium</td>
<td>23 (35)</td>
</tr>
<tr>
<td></td>
<td>Prednisone</td>
<td>32 (49)</td>
</tr>
<tr>
<td></td>
<td>Inhaled corticosteroids</td>
<td>45 (69)</td>
</tr>
<tr>
<td></td>
<td>Primary care physician</td>
<td>62 (95)</td>
</tr>
<tr>
<td></td>
<td>Pulmonary consult/referral</td>
<td>37 (57)</td>
</tr>
<tr>
<td></td>
<td>Allergy consult/referral</td>
<td>7 (11)</td>
</tr>
</tbody>
</table>
few patients had primary care physicians, and patients used the emergency room for their primary care.23,24

Comment
Patients in rural/suburban areas with repeated hospitalizations for asthma appear to have a high probability of noncompliance, depression, underuse of inhaled corticosteroids, and communication barriers. Risk factors in rural settings are similar to those in urban environments. Unlike patients in urban settings, however, most of the patients in this study had access to a primary care physician. Hispanic-speaking minorities accounted for a large percentage of readmissions, demonstrating a need for patient education in Spanish even when the population at large has few Hispanics. More frequent follow-up visits and explicit written instructions in the appropriate language are needed if the patient has poor compliance with medications or has a serious psychological problem.25

References