Dedicated Asthma Center Improves the Quality of Care and Resource Utilization for Pediatric Asthma: A Multicenter Study

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Abstract. **Objectives:** To determine the relative effectiveness of pediatric asthma care among patients treated by a dedicated asthma center (AC) vs children who use the emergency department (ED) as a site of primary asthma care. **Methods:** A retrospective case–control design was used. A random sample of AC cases was selected from a designated comprehensive AC over a 12-month period. Concurrent ED control patients were identified from all cases of pediatric asthma from five urban hospitals based on two or more ED visits. Cases and controls were matched (1:2) based on age and National Heart, Lung, and Blood Institute (NHLBI) asthma severity of illness classification. A telephone survey was administered to the caregivers of all enrolled patients in the study sample. **Results:** Four elements of pediatric asthma care were examined: quality, access, hospital utilization, and functional impact of disease. Demographic data were similar between the ED cases and the AC controls. In terms of quality of care, the AC patients were more likely to use maintenance anti-inflammatory medications, 60.2% vs 22.5% (OR = 5.3; 95% CI = 2.9 to 9.7) and more likely to be taking medications at school, 71.4% vs 48.1% (OR = 2.7; 95% CI = 1.5 to 4.7). In terms of access to care, the AC families were more likely to have a physician to call to assist with outpatient management, 98.2% vs 65.0% (OR = 25.3; 95% CI = 9.0 to 76.9). Frequent ED utilization (≥1 visit/month) was less likely in the AC patients, 9.2% vs 22.0% (OR = 0.35; 95% CI = 0.16 to 0.79) and school absenteeism was lower as well (9.5 ± 6.7 days vs 16.6 ± 10.3, $p < 0.001$). Additionally, the caregivers of the AC patients missed fewer workdays (4.7 ± 2.8 vs 7.4 ± 4.1; $p = 0.03$). **Conclusions:** Significant disparities in quality, access, resource utilization, and functional impact exist between AC and ED patients. Emergency physicians have a unique opportunity to improve the public health by directing ED patients toward pediatric AC treatment. **Key words:** pediatrics; asthma; asthma center; emergency department utilization. ACADEMIC EMERGENCY MEDICINE 2001; 8:709–715

ASTHMA is currently the most common chronic condition affecting children in the United States and has been the leading cause of childhood disability over the last 25 years.[1] There are approximately 5 million children in the United States diagnosed as having asthma,[2] and the prevalence of pediatric asthma has increased by approximately 50% over the last decade. Asthma accounts for more than 10 million missed school days annually and an estimated loss of more than $1 billion in productivity by working parents of asthmatic children.[3] The direct and indirect monetary costs relating to asthma were estimated to be $11.3 billion in 1998.[4]

Hospital visits for pediatric asthma have increased significantly. Over the last decade, asthma admission rates for infants 0–4 years old have nearly doubled, and for school-aged children 5–14 years old, the rate of hospital admission has increased nearly 65%.[2,4,5] Additionally, emergency department (ED) use by asthmatic children has markedly increased over the same period. In 1985, children under 15 years of age accounted for approximately 11 million annual ED visits in the United States, and by 1995 that number had increased to more than 23 million visits.[6]

Though the overall impact of pediatric asthma has been well studied, there exist few data on the magnitude of the disparities in quality of care and outcome between populations treated by a comprehensive asthma center (AC) and those children who routinely access the ED for their care. The

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objective of our study was to quantify the differences in quality of care, access to care, resource utilization, and functional impact of disease between pediatric patients using a comprehensive pediatric AC as the site of primary asthma care and a sample of children who routinely use the ED as their primary source of asthma care.

METHODS

Study Design. A retrospective case–control design was used to determine the relative effectiveness of pediatric asthma care among patients treated by a dedicated AC vs children who use the ED as a site of primary asthma care. Primary outcome measures of quality of care included utilization rates of anti-inflammatory medication and rates of school-based asthma therapy. Secondary outcomes included measures of access to care, resource utilization, and functional impact. Institutional review board (IRB) approval was obtained for this study at each participating institution in order to perform a medical chart review and caregiver telephone survey.

Study Setting and Population. The setting for this study was the New York Presbyterian Healthcare (NYPH) System, an integrated health care delivery system in the New York metropolitan region, serving a diverse population of patients. Ethnic minorities comprise approximately 47% of this patient population. In terms of payor mix, 27.1% of the patients admitted to hospitals within the NYPH System are enrolled in private commercial or commercial managed care, 34.2% in Medicare, and 24.7% in Medicaid programs, and 3.6% of the patients are uninsured/self-pay.

Asthma cases for this study were identified from the pediatric asthma center (AC) at the New York Hospital Medical Center of Queens, a member institution within the NYPH System. This comprehensive pediatric AC offers a team-based approach to the care of pediatric asthma, incorporating the skills of physicians, nurses, nurse practitioners, social workers, and trained asthma educators. The AC case management team provides office-based, telephone-based, and community-based asthma evaluation and monitoring. Additionally, the AC offers an extensive asthma educational program to patients and their families.

Asthma control patients for this study were identified from among five ED sites that voluntarily elected to participate in this study. Two control ED sites were based at tertiary care, academic medical centers within the NYPH System. Three control ED sites were urban community-based hospitals within the NYPH System. There were no significant differences in hospital characteristics (bed size, teaching status, or payer mix) between the hospitals that volunteered to participate and those that did not (data not shown).

Cases and controls were identified from January 1999 through December 1999. Patients were considered eligible for this study based on defined criteria. *AC eligible cases:* 1) the patient was 2–16 years of age; 2) the patient was enrolled in the AC program for more than one year; and 3) the patient met the National Heart, Lung, and Blood Institute's (NHLBI's) clinical criteria for mild persistent asthma, moderate persistent asthma, or severe persistent asthma. *ED eligible controls:* 1) the patient was 2–16 years of age; 2) the patient had two or more ED visits for asthma exacerbation within the six months prior to the survey; 3) the caregiver identified the ED as a primary source of the patient's asthma care or failed to identify an alternative source of asthma primary care; and 4) the patient met the NHLBI's clinical criteria for mild persistent asthma, moderate persistent asthma, or severe persistent asthma.

Study Protocol. Cases and controls were identified using ICD-9 billing codes for pediatric asthma. A trained research assistant, blinded to case–control designations, conducted telephone surveys among the caregivers of the eligible pediatric asthma patients. Telephone surveys were conducted in both English and Spanish, and verbal consent was obtained from the caregiver at the time of telephone survey.

A random sample of 141 eligible AC cases and 440 eligible concurrent ED controls were contacted to participate in this study. A minimum of 50 control patients were recruited from each control site. Of those contacted, 110 AC cases (78%) and 263 ED controls (58%) agreed to participate and were surveyed. Each enrolled patient was then categorized into one of three NHLBI severity of illness classifications (mild persistent asthma, moderate persistent asthma, or severe persistent asthma) based on a 1998 NHLBI asthma severity of illness classification table.[4,7] To develop our study sample for analysis, cases and controls were matched (1:2) based on age and severity of illness. Our final study sample consisted of 110 AC cases and 220 ED controls. Forty-three unmatched controls were excluded from our analysis.

Measurements. A 35-item asthma questionnaire was developed and modified after initial pilot testing. Demographic information, including age, gender, and insurance status, was obtained from hospital administrative databases. The patient's caregiver was asked about self-identified ethnicity of the patient.

Severity of illness was assessed at the time of

the interview using the clinical features of the 1998 NHLBI classification of pediatric asthma.[4,7] Caregivers were asked closed-ended five-part multiple-choice questions to semiquantitatively assess the following parameters: 1) the frequency and intensity of their child's daytime symptoms over the last four weeks; 2) the frequency and intensity of their child's nocturnal symptoms over the last four weeks; 3) the degree of disability and activity as a result of their child's asthma over the last four weeks; and 4) the frequency and intensity of home-based treatment over the last four weeks.

Our primary outcome measures for this study included two measures of quality of care, reported rates of inhaled steroid use, and reported rates of school-based medication treatment. Secondary outcome measures included a measure of access to care, a measure of resource utilization, and two measures of functional impact of disease. To assess access to care, we measured positive response rates of caregivers to the question, "Do you have a physician to call for advice when your child becomes short of breath or starts to wheeze?" To measure resource utilization, we examined rates of high ED utilization for the six-month period prior to the telephone survey. High ED utilization was defined as being treated at least one time per month in the ED for the six months prior to the telephone survey data. These data were obtained from administrative records from each participating study site. To measure functional impact, we assessed caregiver-reported days of missed school for all school-aged children and days of missed work for all working caregivers for the six-month period prior to the telephone survey. In this analysis, all children more than 5 years old were considered school-aged.

Data Analysis. We used descriptive statistics (SPSS statistical software v10.0, SPSS Inc., Chicago, IL) to characterize our study sample. We report rates for the following descriptive measures: 1) % 2–5 years old, 2) % >5 years old, 3) % male, 4) % ethnic minority, 5) % commercial/health maintenance organization (HMO) insurance, 6) % Medicaid, 7) % self-pay, 8) % mild persistent asthma, 9) % moderate persistent asthma, and 10) % severe persistent asthma. In comparing case and control descriptive measures for the above nonmatched categorical variables, we used a chi-square test to assess statistically significant differences. Two-sided p-values ≤ 0.05 were considered significant.

An independent analysis was performed for each of our four major areas of interest: 1) quality; 2) access; 3) resource utilization; and 4) functional impact. Definitions of our outcome measures are given above (see Measurements section, above). For continuous outcomes, we report means and standard deviation from the mean. Univariate measures of association for continuous variables were tested using a Student's t-test. Two-sided p-values ≤ 0.05 were considered statistically significant. For categorical outcomes, we report rates. Univariate measures of association for categorical variables are reported using odds ratios (ORs) with 95% confidence intervals (95% CIs).

RESULTS

The NYPH System is an integrated health care delivery system located in the New York metropolitan region. As such, the six centers participating in the study provided a sample of AC cases and ED controls that are representative of an urban and inner-city population.

Demographic data of our sample are presented in Table 1. Distributions of gender, ethnicity, and payor status were similar between the AC and ED subgroups. Approximately two-thirds of the patients identified were male (62% AC cases vs 68% ED controls; p = 0.32) and more than 80% of the patients were self-reported ethnic minorities (84% AC cases vs 81% ED controls: p = 0.59). Payor status was predominantly Medicaid (78% AC cases vs 82% ED controls: p = 0.31). Among the five control sites, no statistically significant differences in gender, ethnicity, or payor status were identified (data not shown).

Additionally, the study sample was matched for both age and severity of illness. Thirty percent of the study sample were children in the 2–5-year age subgroup. Seventy percent were children in the 6–16-year age subgroup. The distributions within each age subgroup were similar between the AC cases and ED controls. Additionally, all patients in this study met the 1998 NHLBI definition for persistent asthma.[4,7] Thirty-five percent of this matched sample had mild persistent asthma, 58% had moderate persistent asthma, and 7% had severe persistent asthma.

In this analysis we examined four elements of pediatric asthma care: quality, access, resource utilization, and functional impact of disease. Rates of reported use of maintenance anti-inflammatory medications as well as rates of school-based administration of asthma medications are shown in Figure 1, panel A. This top panel demonstrates that the AC patients were significantly more likely to report using maintenance anti-inflammatory medications than their age- and severity-matched ED controls, 60.2% vs 22.5% (OR = 5.3; 95% CI = 2.9 to 9.7). As well, the caregivers of school-aged AC patients were more likely to report their children to be taking asthma medications at school as compared with the school-aged ED controls, 71.4% vs 48.1% (OR = 2.7; 95% CI = 1.5 to 4.7).

TABLE 1. Demographics and Severity of Illness for the Study Population

	Asthma Center Cases (n = 110)	Emergency Department Controls (n = 220)	Odds Ratio	95% Confidence Interval	p-value
Age group					
2–5 years	30	30		Matched sample	
>5 years	70	70		Matched sample	
Gender—% male	62	68	0.7	0.4, 1.3	0.37
% Ethnic minority	84	81	0.8	0.4, 1.7	0.57
% Commercial/HMO	12	9	0.7	0.3, 1.8	0.64
% Medicaid	78	82	1.2	0.6, 2.8	0.47
% Self-pay	10	9	0.8	0.4, 2.3	0.81
% Mild persistent	35	35		Matched sample	
% Moderate persistent	58	58		Matched sample	
% Severe persistent	7	7		Matched sample	

Asthma severity was classified using self-reported clinical characteristics based on the 1998 NHLBI asthma severity of illness classification.[4,23]

Access to care and resource utilization measures are shown in Figure 1, panel B. The AC families were more likely to report having access to a physician to call to assist with outpatient management than the ED controls, 98.2% vs 65% (OR = 25.3; 95% CI = 9.0 to 76.9). Also, in terms of resource utilization, ED administrative records revealed that high ED utilization (>1 visit/month) was less likely in the AC patients, 9.2% vs 22.0% (OR = 0.35; 95% CI = 0.16 to 0.79).

The functional impact of asthma was assessed from both the patient's and the caregiver's perspectives (Fig. 1, panel C). We measured caregiver-reported school absenteeism for all eligible school-aged patients and days of lost work from all working caregivers. In the six-month period prior to the survey, the AC school-aged patients had significantly lower rates of school absenteeism as compared with the ED control patients (9.5 $\pm$ 6.7 days vs 16.6 $\pm$ 10.3; $p < 0.001$). Similarly, days missed from work were significantly lower for the caregivers of AC cases than for the caregivers of ED controls (4.7 $\pm$ 2.8 vs 7.4 $\pm$ 4.1; $p = 0.03$).

DISCUSSION

Asthma is the most prevalent chronic illness in the pediatric population today, affecting nearly 5 million children in the United States and increasing at near epidemic rates,[2] particularly in urban centers. In New York City, childhood asthma is a major public health problem. In 1995, the pediatric asthma hospitalization rate in New York City was 2.8 times the national rate and accounted for 44% of all New York City pediatric hospital admissions.[8]

The root cause of this widespread increase in pediatric asthma is multifactorial and has been attributed to socioeconomic[1,5,9,10] and environmental[11–16] factors. Additionally, lack of adequate access to health care,[17–19] lack of use of appropriate medications,[20–23] and lack of adequate asthma education[10] have been shown to be significant contributors. In a study by James et al., only 40% of patients with moderate persistent asthma and 50% of patients with severe persistent asthma were using bronchodilators regularly and correctly.[23] In the same study, only 19% of moderate and 36% of severe persistent asthmatic patients were taking maintenance inhaled corticosteroids.[23] Factors that were significantly associated with inadequate medication therapy included: age <5 years old, Medicaid insurance, and Spanish language.[21]

Our data are consistent with these prior investigations and reveal significant disparities in quality of care, access to care, ED resource utilization, and functional impact between the patients who were treated by a comprehensive pediatric AC and the patients whose caregivers identified the ED as a primary source of asthma care. In this study, age- and severity-of-illness-matched AC patients were more likely to use maintenance anti-inflammatory medications, use asthma medications at school, and have telephone access to a physician for outpatient treatment guidance. The AC patients were less likely to be high ED utilizers for asthma (>1 visit per month). Also, the school-eligible AC patients missed significantly fewer days from school and their caregivers missed significantly fewer days from work.

In 1998, the U.S. Department of Health and Human Services (HHS) revised its guidelines for the diagnosis and management of pediatric asthma.[4,7] These guidelines recommended that all

children with persistent asthma receive maintenance anti-inflammatory medications, use a peak expiratory flow meter at home, and have a written asthma treatment action plan in cases of acute exacerbations. Our data suggest that a significant number of children with asthma, particularly those who use the ED as a source of primary care, are not receiving appropriate care as defined by the HHS guidelines.

A large percentage of patients with pediatric asthma use the ED as their primary source of asthma care. However, many of these patients have suboptimally managed chronic persistent asthma.[24,25] Despite the fact that most pediatric asthma patients receive appropriate ED treatment, education, and referral, many of these patients remain suboptimally managed because their outpatient care lacks the continuity, home-based support and early medical interventions that characterize aggressive outpatient management by comprehensive ACs. In a recent study by Rand et al., asthma management that relied on episodic ED care was less likely to conform to outpatient treatment guidelines than usual care by general pediatricians.[17]

Several studies have looked at the effectiveness of asthma case management and comprehensive asthma care centers. Sperber et al. compared cohorts of asthmatic children using ACs with those using general pediatricians. Patients in the AC subgroup had reduced rates of total walk-in visits, ED visits, and hospitalizations as compared with the non-AC group.[26] Stout et al. found that children enrolled in a comprehensive asthma management program had a statistically significant decrease in the annual number of ED visits and a significant increase in follow-up clinic visits as compared with patients receiving usual care by their pediatricians.[27] This study, however, has served to quantify the magnitude of the differences in quality, access, resource utilization, and functional impact between those patients receiving comprehensive case management and those who use the ED for routine primary asthma care.

Limitations and Future Questions

These data must be interpreted within the context of the observational study design, respecting the possibility of selection and recall bias. For example, measurements of school absenteeism and days of lost work were based on single-question estimates of the patient's caregiver and therefore could potentially be influenced by the caregiver's recall, particularly if school absenteeism and lost work levels were high, as was the case for the ED control patients. However, our estimates are generally consistent with prior studies and, therefore, the differences observed likely represent a correct estimate.

We also compared only those children who used the ED as a primary source of asthma care with those using the pediatric asthma care center. We did not study children who had other sources of

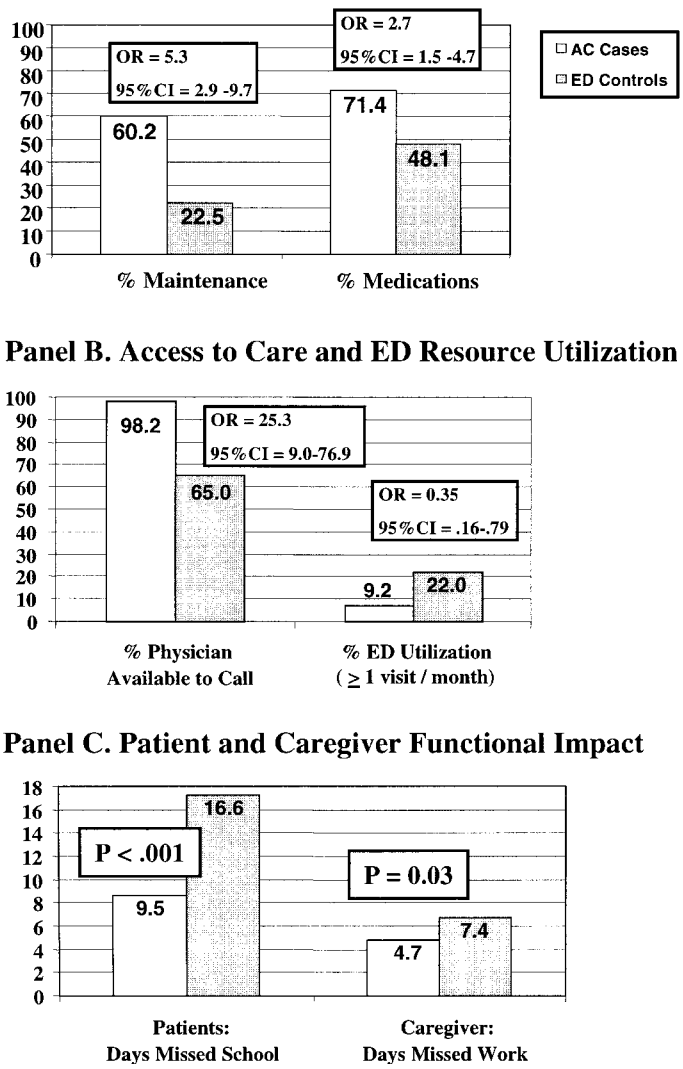

Figure 1. Frequency distributions are shown comparing asthma center (AC) cases vs emergency department (ED) control patients for the following measures: **Panel A,** quality of care measures (*left:* caregiver-reported rates of patients taking maintenance anti-inflammatory medication; *right:* caregiver-reported rates of patients receiving asthma therapy at school); **Panel B,** access to care and resource utilization measures (*left:* reported rates of patients' caregivers who have access to a physician to call during an asthma exacerbation; *right:* measured rates of patients who have used emergency services at least once per month for the six months prior to survey); and **Panel C,** patient and caregiver functional impact measures (*left:* reported mean days missed from school; *right:* reported mean days missed from work). Functional impact measures were based on eligible responders (i.e., school-aged children and working caregivers). OR = odds ratio; 95% CI = 95% confidence interval.

asthma care such as an office-based general pediatrician or subspecialist or care delivered in a nonemergent walk-in clinic. Therefore, these data may not apply to these other populations of patients. Additionally, to participate in this study, the caregivers of identified patients had to have a working telephone, biasing against the most economically indigent or transient populations. The results of the ED use by both populations need to be considered in light of the sampling methodology. Although we matched on severity of illness (which correlates with frequency of ED use), the patients in our ED cohort likely use the ED more frequently than the AC cohort because of choice, access issues, or other issues not related to the severity of their asthma.

Another important limitation to consider, and inherent in our observational study design, is our inability to control for many of the environmental and nonenvironmental risk factors that contribute to asthma exacerbation. Such unmeasured confounding could potentially contribute to the differences observed in this study and reduce the apparent effectiveness of AC interventions. Finally, this study recruited patients from the New York metropolitan region, an epicenter to pediatric asthma in terms of overall prevalence and severity of illness. As such, these data may not be widely generalizable to other regions throughout the United States.

Future prospective studies will be necessary to address some of these limitations as well as to study the effectiveness of an ED-based intervention that identifies high-risk pediatric asthma patients and facilitates referral to a dedicated AC for ongoing outpatient care.

CONCLUSIONS

We found that a comprehensive asthma care center has a significant impact on measures of quality of care, access to care, resource utilization, and functional status for pediatric asthma patients and their families. Similar impacts on care may occur when provided by general pediatricians and family physicians in settings where appropriate care and follow-up are available, although we did not examine children cared for in these settings in this study. Emergency physicians, as patient advocates, have a unique opportunity to improve the effectiveness of pediatric asthma care by identifying moderate- to high-risk patients and referring them to settings where comprehensive care and follow-up may be delivered.

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SAEM RESEARCH GRANTS FOR 2002

The following is a summary of the research grants that will be funded by SAEM in academic year 2002. Further information and application materials can be obtained via the SAEM website at www.saem.org.

SAEM Research Training Grant (formerly known as the Resident Research Year Award)

This grant provides financial support of $75,000 per year for two years of formal, full-time research training for emergency medicine fellows, resident physicians, or junior faculty. The trainee must have a concentrated, mentored program in specific research methods and concepts, and complete a research project. Deadline for applications is **November 1, 2001.**

SAEM Institutional Research Training Grant

This grant is currently under development, but SAEM expects to call for applications in the summer of 2001 for a start date of July 2002. The grant will provide financial support of $75,000 per year for two years for an academic emergency medicine program to train a research fellow. The sponsoring program must demonstrate an excellent research training environment with a qualified mentor and specific area of research emphasis. The training for the fellow may include a formal research education program or advanced degree. It is expected that the fellow who is selected by the applying program will dedicate full time effort to research, and will complete a research project. The ultimate goal of this grant is to help establish a departmental culture in emergency medicine programs that will continue to support advanced research training for emergency medicine residency graduates. Tentative deadline is **November 1, 2001.**

SAEM Scholarly Sabbatical Grant

This grant provides funding of $10,000 per month for a maximum of six months to help emergency medicine faculty at the level of assistant professor or higher obtain release time to develop skills that will advance their academic careers. The ultimate goal of the grant is to increase the number of independent career researchers who may further advance research and education in emergency medicine. The grant may be used to learn unique research or educational methods or procedures which require day-to day, in-depth training under the direct supervision of a knowledgeable mentor, or to develop a knowledge base that can be shared with the faculty member's department to further research and education. Deadline for applications is **November 1, 2001.**

SAEM Emergency Medical Services Research Fellowship

This grant is sponsored by Medtronic Physio-Control. It provides $50,000 for a one year fellowship for emergency medicine residency graduates in EMS at an approved fellowship training site. The fellow must have an in-depth training experience in EMS with an emphasis on research concepts and methods. The grant process involves a review and approval of emergency medicine training sites as well as individual applications from potential fellows. Deadline for applications is **November 1, 2001.**

SAEM Neuroscience Research Fellowship

This grant is sponsored by AstraZeneca. It provides one year of funding at $50,000 for an emergency medicine resident, graduate, or junior faculty member to obtain a mentored research training experience in cerebrovascular emergencies. The research training may be in basic science research, clinical research, or a combination of both, and the mentor need not be an emergency medicine faculty member. Completion of a research project is required, but the emphasis of the fellowship is on the acquisition of research skills. Deadline for applications is **November 1, 2001.**

EMF/SAEM Medical Student Research Grants

This grant is co-sponsored by the Emergency Medicine Foundation and SAEM. It provides up to $2400 over 3 months for a medical student or resident to encourage research in emergency medicine. More than one grant is awarded each year. The trainee must have a qualified research mentor and a specific research project proposal. The final deadline for the 2002 grants has not been announced, but will likely be in **January 2002.**

EMF/SAEM Innovations in Medical Education Grant

This grant is co-sponsored by the Emergency Medicine Foundation and SAEM. It provides up to $5,000 to support projects that use novel techniques, programs, or products to improve emergency medicine education. The final deadline for the 2002 grants has not been announced, but will likely be in **January 2002.**

SAEM Medical Student Interest Group Grants

These grants provide funding of $500 each to help support the educational or research activities of emergency medicine medical student organizations at U.S. medical schools. Established or developing interest groups, clubs, or other medical student organizations are eligible to apply. It is not necessary for the medical school to have an emergency medicine training program for the student group to apply. The application deadline is **September 1, 2001.**

The above descriptions may be subject to modification by the Board of Directors and Grants Committee. Please check the SAEM website, or call the SAEM office at (517) 485-5484 for grant instructions, application materials, and confirmation of deadlines.