

A Review of Asthma Admissions and Deaths at Children's Hospital of Pittsburgh from 1968 to 1985: A Sequel to a Previous Review from 1935 to 1968

GILBERT ANTHONY FRIDAY, JR., M.D. and PHILIP FIREMAN, M.D.

ABSTRACT

Asthma is the most common pediatric chronic lung disorder in the United States affecting two to five million children and is responsible for significant morbidity and mortality. The number of deaths related to asthma may also be increasing. Asthma admissions and deaths at Children's Hospital of Pittsburgh (CHP) were reviewed and compared with asthma deaths and hospital admissions for all ages in metropolitan Pittsburgh from 1968 through 1985. CHP hospital admissions for asthma increased from 6% of medical hospital admissions in the 1960s to 10% in the 1980s, despite the fact that metropolitan Pittsburgh's population has decreased. Only 1 asthma death has occurred at CHP during this period. Thus, an increase in pediatric hospital admissions was not accompanied by an increase in asthma deaths.

INTRODUCTION

MEDICAL ADMISSIONS for asthma at Children's Hospital of Pittsburgh (CHP) were reviewed from 1935 to 1968 and this report called attention to the increased number of children being hospitalized with asthma.⁽¹⁾ Subsequent data collected in the National Hospital Discharge Survey showed that hospital discharges of children with the primary diagnosis of asthma from birth to 14 years was 48 per 100,000 in 1965 and 166 per 100,000 in 1983.⁽²⁾ Therefore, over a 19-year period from 1965 to 1983, rates of hospitalizations from asthma in the United States have shown a 200% increase in children. Many other countries, including New Zealand, England, Wales, and Canada, have also noted increased hospital admission rates for asthma especially in children.⁽³⁻⁵⁾ There is some evidence that asthma currently may occur in about 25%

University of Pittsburgh School of Medicine, Children's Hospital of Pittsburgh, Pittsburgh, Pennsylvania 15213.

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of New Zealand children.⁽⁶⁾ In Canada, asthma hospital admissions in children have doubled between 1974 and 1983.⁽⁷⁾ Burney reports that in England and Wales, the greatest increase in asthma admissions between 1974 and 1983 occurred in children under 5 years of age.⁽⁴⁾

With this apparent increase in asthma morbidity as manifest by increased hospital admissions, an important question to address is whether there has been a concomitant increase in asthma mortality. Death rates and numbers of deaths from asthma is lowest in the age range from 0 to 14 years and increases steadily thereafter with an acceleration after age 65.⁽²⁾ Burney pointed out that in England and Wales, 1974–1984, the mortality has risen among 5–34 year olds especially.⁽⁴⁾ Therefore, the issue was raised that the number of deaths related to asthma may also be increasing worldwide.

Since a data base had already been established at CHP, we have reexamined and expanded hospital discharge diagnosis data for the past 50 years from 1935 to 1985. In an attempt to understand this problem better, additional data from the metropolitan Pittsburgh area were studied with the intent to explore potential factors such as air pollution or demographics to explain the increased numbers of hospitalizations. In addition, the death rate data for the metropolitan Pittsburgh area was analyzed and compared to asthma deaths at CHP.

METHODS

Data from a review of CHP medical admissions and asthma admissions, as well as death rates, were obtained from CHP medical record library statistics.

The greater metropolitan Pittsburgh area (Allegheny County) population data were obtained from the Allegheny County Population Bureau. Death certificates from the Allegheny County Health Department, which has maintained records from 1970 to the present time, were reviewed to ascertain deaths due to asthma in Allegheny County from 1970 to 1985.

Air pollution data was provided by the Allegheny County Health Department and tabulated from 1970 to 1985.⁽⁸⁾ This included data documenting quality of Pittsburgh air with regard to particulate matter per cubic microgram of air reported from various stations in Allegheny County by the Allegheny County Health Department Bureau of Air Pollution Control. This Bureau also measured mean sulfur dioxide levels, carbon monoxide levels, and ozone in daily air samples obtained.

RESULTS

Figure 1 shows a comparison of hospitalizations of asthma patients to total medical patients admitted to CHP from 1968 through 1985. Asthma accounted for 6% of the hospital admissions from 1964 through 1968, 7% from 1968 to 1981, and 10% from 1982 through 1985, as noted in Fig. 2. There has been an increase of nearly 300 patients admitted per year during the period from 1970 to 1980. From 1980 to 1985 there were 2,317 admissions with a primary diagnosis of asthma, an average of 463 asthmatics per year. Although not graphically shown, in 1986 there were 500 asthma admissions.

Figure 3 shows the average distribution of asthma patients by month of hospitalization in the years 1982–1985. This is very similar to the monthly distribution reported in our previous study in 1968. Of the 2,317 patients admitted between 1980 and 1985 with a principal diagnosis of asthma, 1,334 (57%) were white, 974 (42%) were black, 6 asian, 2 Indian, and 1 hispanic. Since the total black pediatric population (ages 0–16 years) of the metropolitan Pittsburgh (Allegheny County) area is only 11% of the total pediatric population, there were proportionally more black children admitted for asthma.

In the greater Pittsburgh area (Allegheny County) from 1970 to 1980 there was a decrease in population from 1.6×10^6 to 1.4×10^6 . During this period there was a decrease in total

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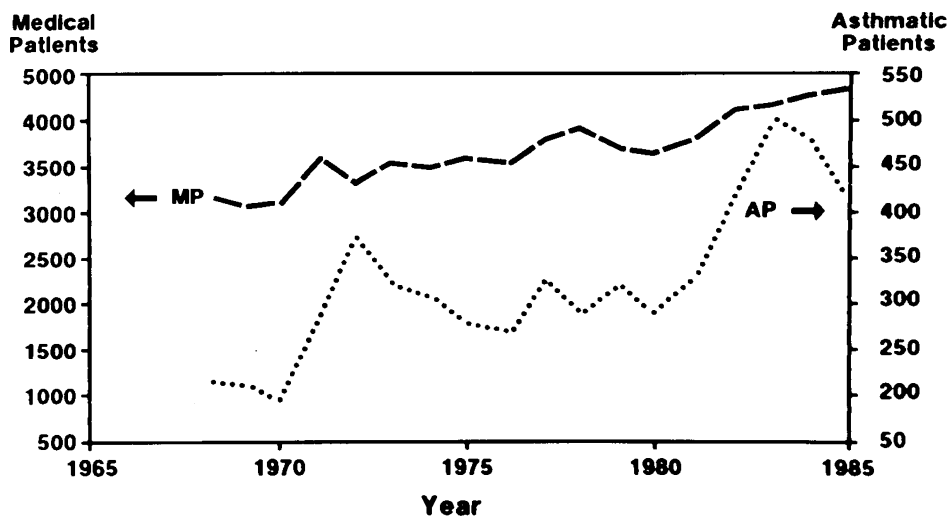


FIG. 1. Comparison of hospitalized asthma patients (scale to right) to total medical patients (scale on left) for the years 1968–1985. (Reprinted, with permission, from Friday GA, Fireman P. *Pediatr Clin N Am* 1988;35:1149–1162.)

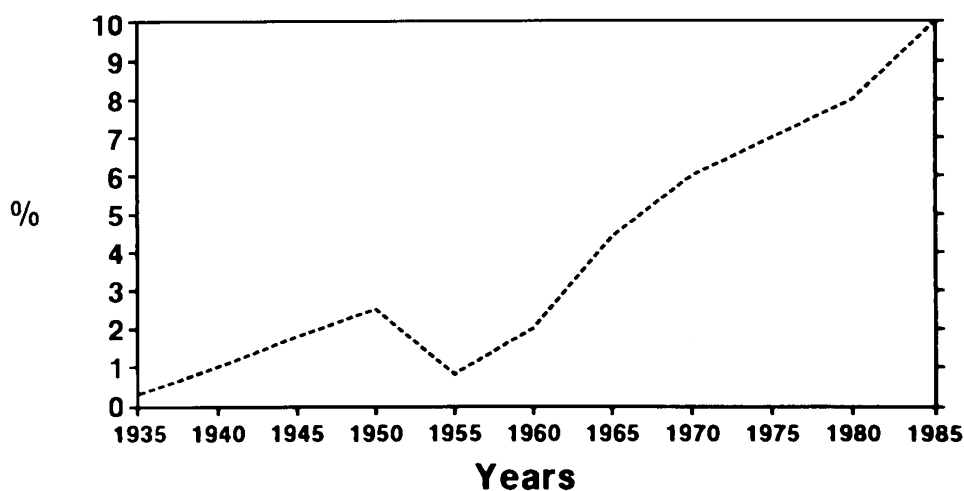


FIG. 2. Asthma admissions related by percentage to total medical admissions at Children's Hospital of Pittsburgh from 1935 to 1985. (Reprinted, with permission, from Friday GA, Fireman P. *Pediatr Clin N Am* 1988;35:1149–1162.)

pediatric population (ages birth to 18 years) from 0.5×10^6 to 0.3×10^6 . Despite this approximate 200,000 decrease in pediatric population due to a fall in birth rate, as well as decreased total population, the rate of asthma admissions to CHP increased: There were 1.6 asthma admissions per 10,000 population in 1960, 4.6 per 10,000 in 1970, and 10.8 per 10,000 in 1980. Thus, there has been a 40% increase in the rate of asthma admissions to CHP in the past 30 years.

Air quality has also been studied, as shown in Fig. 4. The Allegheny County Health Department Bureau of Air Pollution Control kept data from 1970 to 1985. The annual mean total for suspended particulates (ash, silica, etc.) from heavy industry measured at three city sites had shown a decrease from a high of $129 \mu\text{g}/\text{m}^3$ in 1973 to a low of $53 \mu\text{g}/\text{m}^3$ in 1985. The annual mean sulfur dioxide content of the air measured at the same sites had fallen from a high

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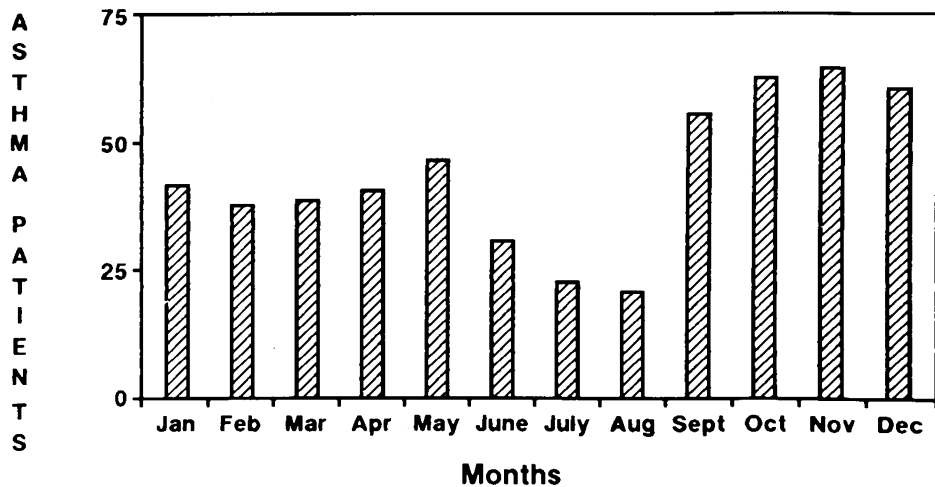


FIG. 3. Asthma patients by month of hospitalization at Children's Hospital of Pittsburgh for 1985. (Reprinted, with permission, from Friday GA, Fireman P. *Pediatr Clin N Am* 1988;35:1149-1162.)

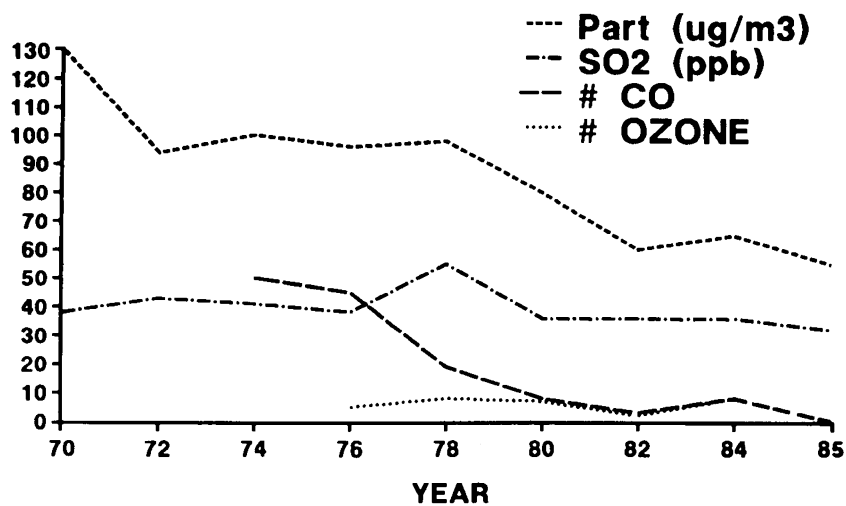


FIG. 4. Pittsburgh air quality trends from 1980 to 1985. Annual mean total suspended particles ($\mu\text{g}/\text{m}^3$) (—). Annual mean sulfur dioxide (ppb) (-.-). Number of 8-hour carbon monoxide violations (— —). Number of ozone violation days (. . .). EPA's annual standards for total suspended particles are 75 and SO₂ 30. (Reprinted, with permission, from Friday GA, Fireman P. *Pediatr Clin N Am* 1988;35:1149-1162.)

of 44 ppb in 1972 to 20 ppb in 1985. The Environmental Protection Agency Annual Standards for total particles and sulfur dioxide are 75 and 30, respectively. Carbon monoxide levels measured by number of 8-hour violations has fallen from a high of 62 in 1935 to zero in 1985. Ozone measured by number of ozone violation days has slightly risen since 1976 and has been at a low level since 1981.

From 1935 to 1985, there have been 10 deaths due to asthma at CHP. The first 9 deaths occurred between 1935 and 1968 and were reported in the previous study. Only 1 death

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TABLE 1. DEATHS ASSOCIATED WITH ASTHMA AT THE CHILDREN'S HOSPITAL OF PITTSBURGH (1935-1985)

<i>Patient/sex</i>	<i>Year of death</i>	<i>Age at year of death</i>	<i>Cause of death: pathologic diagnosis</i>
1/F	1936	3.9	Bronchopneumonia, lung abscess and asthma
2/F	1940	1.5	Aspiration pneumonia and asthma
3/F	1947	1.4	Status asthmaticus (no postmortem)
4/F	1952	2.7	Bronchial obstruction: massive atelectasis
5/M	1952	6.3	Asthma bronchopneumonia
6/F	1955	15.0	Asthma, cor pulmonale, pulmonary embolism
7/M	1958	0.6	Tracheobronchitis, cardiac hypertrophy
8/F	1962	6.2	Asthma, cor pulmonale, cerebral anoxia
9/F	1966	12.0	Asthma, bronchopneumonia, cerebral anoxia
10/F	1970	10.0	Status asthmaticus (no postmortem)

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occurred from 1968 to 1985, as noted in Table 1. The deaths in all age groups due to asthma in Pittsburgh (Allegheny County) from 1970 to 1985 have been fairly stable. Table 2 points out that there have been a total of 15 deaths from birth to 24 years. Six of these deaths occurred in the group from 5 to 14 years and 9 in the group from 15 to 24 years. There were no deaths under 4 years, but there were 195 deaths in the age range from 25 to 85+ years. Also, there were no deaths at CHP from 1970 to 1985. There has been one additional death from asthma during the years 1985-1988 in CHP. This was a 16-year-old black male who arrived moribund and later succumbed in the intensive care unit.

DISCUSSION

This study was undertaken to evaluate the morbidity and mortality of asthma in children in a relatively stable community such as the Pittsburgh area in which data has been collected for the past 50 years. In an attempt to explain the increased morbidity related to asthma, several factors have been considered. There do not appear to be major changes in the number of available hospital facilities in metropolitan Pittsburgh or a decrease in the number of pediatric beds in regional or community hospitals. There has also been no significant change in the pattern of patient referrals. The incidence of asthma is difficult to ascertain, but is usually thought to affect at least 5%, and possibly 10% of the population at some time in their lives. Such possible factors as increased survival of low-birth-weight children with respiratory distress syndrome and subsequent pulmonary hyperactivity, increased survival from pulmonary infections, and other

TABLE 2. DEATHS DUE TO ASTHMA ALLEGHENY COUNTY (1970-1985)

<i>Age</i>	<i>White</i>		<i>Non-White</i>		<i>Total</i>
	<i>Male</i>	<i>Female</i>	<i>Male</i>	<i>Female</i>	
<4	0	0	0	0	0
5-14	0	2	2	2	6
15-24	3	2	3	1	9
Total					15

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insults to the pulmonary system may have increased the potential population for asthma. Studies in many parts of the world are also showing a definite increase in morbidity and mortality.^(3-6,11)

There has been less industrial air pollution in the Pittsburgh area probably due to decreased steel production related to closing of steel mills from 1970 through 1985. This improvement in air quality is probably best illustrated by the decreased particulates in the air. The sulfur dioxide level has not changed appreciably, because most commercial fuel used in this community is still coal and there are operational coke works where soft coal is converted to coke for the steel industry. A decrease in carbon monoxide presumably has followed the better control of automobile exhaust fumes. The slight rise in ozone production is probably not unique to the Pittsburgh area.

Most CHP admissions for asthma appear to be related to respiratory infection. These infections usually peak during the months of September through December each year in the Pittsburgh area.

A recent review of the prevalence of asthma in the pediatric population of the United States from 1976 to 1980 was presented by Gergen.⁽⁷⁾ The trend is toward an increase in reported asthma among children and adolescents 3-17 years of age using data from the second National Health and Nutrition Examination Survey (4.8-7.6%). Asthma was reported for 6.7% of children with black/white: 9.4% versus 6.2%. Mullally⁽¹⁰⁾ showed the hospital admissions for childhood asthma in the Washington, DC area had increased at least 18-fold, whereas the overall population of children increased less than 1.5-fold. He speculated that the increase in hospitalizations for asthma had resulted from increase in the prevalence of asthma in children. It must be noted that the population in the Washington DC area was largely black and the increase in asthma admissions in CHP was noted to be increased disproportionately in the black population. At an International Workshop held in June, 1985, at the Fogerty International Center, four data sources—the Vital Statistics System, the National Health, Nutrition and Examination Surveys, the National Health Interview Survey, and the National Hospital Discharge Survey—were used to assess the epidemiology of asthma for the National Center for Health Statistics. These data suggest that in the United States today there is a mild increase in the prevalence of asthma and a very marked increase in hospitalization for asthma. The reasons for these are not known.^(2,7) Factors that have been considered include: overcrowding, socioeconomic factors, and different geographic locations. Recent studies have shown no significant relationship. It is possible that asthma is diagnosed more frequently with increased hospital utilization due to more aggressive or perhaps more defensive medical practice.

In 1984, Sly reviewed the deaths from asthma in various age groups between 1968 and 1982 using the National Center for Health Statistics.⁽¹¹⁾ He found a decrease in deaths from asthma between 1968 and 1978, and, thereafter, from 1978 to 1982 an increase in deaths from asthma. Part of this increase could be accounted for by a change in the International Classification of Diseases (ICD) coding system during the ninth revision in 1978. A major change in the revision occurred by coding asthmatic bronchitis, which was formerly coded as bronchitis, as asthma. The 1987 proceedings of an asthma mortality task force dealt with various factors involved in asthma mortality in the United States and other parts of the world.⁽¹²⁾ A retrospective case controlled study of asthma deaths by Strunk concluded that several factors are relevant for increased mortality in asthma for patients in all age groups.⁽¹²⁾ These include: (1) failure of recognition of asthma and its severity, (2) failure to provide adequate prophylactic treatment, (3) inadequate treatment of acute attacks in the office, emergency room, or hospital, (4) failure to comply with prophylactic recommendations, and (5) delay in obtaining adequate treatment for acute attacks. Kravis pointed out that there are certain patients with high-risk asthma who need to be recognized as possessing a peculiar tendency to develop sudden intense airway narrowing.⁽¹⁴⁾ These individuals are at special risk and must be followed closely.

Yet, deaths from asthma are not a frequent occurrence in a tertiary care pediatric hospital, as indicated by our data from the CHP during the past 20 years. There have also been no deaths in

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Children's Hospital of Philadelphia of patients admitted for treatment of asthma⁽¹⁴⁾; nor have there been any deaths at Children's Hospital National Medical Center in Washington DC since 1971. The decrease in mortality at CHP was not reflected in the decrease in asthma mortality in Allegheny County. There appears to be an increasing number of asthma fatalities occurring before the children or young adults reach the hospital, usually at home or in transit to the hospital. Many deaths occurring outside the hospital environment may be largely preventable as suggested by Strunk.⁽¹³⁾ Increased or early hospitalizations may be preventing the potential for an increase in the death rate especially in our children's hospitals.

SUMMARY

In studying the morbidity and mortality of asthma in children admitted to CHP in the past 50 years, we found that the incidence of asthma seems to be increasing. This trend has also been reported in studies from other countries.⁽⁵⁾ The reasons for this are largely unknown, although various factors have been suggested such as better reporting, better medical attention to asthma problems, and more adequate facilities available to treat asthma. The possibility of increased exposure to environmental irritant chemicals or allergens has also been suggested.

An apparent slight increase in asthma mortality noted in population studies is not confirmed in hospital statistics. Deaths in the pediatric age group are occurring, but seem to be related more to problems that occur before the child arrives at the CHP tertiary medical center. These factors include age, race, economic status, psychological, and physiological predisposing factors, as well as changes in methodology of treatment. Another hypothesis is that more aggressive medical management in tertiary care centers such as CHP are probably keeping down the mortality of asthma once the patient is admitted, despite an increase in prevalence and severity.

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REFERENCES

1. Palm CR, Murcek MA, Roberts TR, Mansmann HC, Fireman P. A review of asthma admissions and deaths at Children's Hospital of Pittsburgh from 1935 to 1968. *J Allergy* 1970;46:257-269.
2. Evans R, Mullally DI, Wilson RW, Gergen PJ, Rosenberg HM, Grauman JS, Chevarley FM, Feinleib M. National trends in the morbidity and mortality of asthma in the United States (Prevalence, hospitalization and deaths from asthma of over two decades: 1965-1984). *Chest* 1987;91:65S-74S.
3. Benatar SR. Fatal asthma. *N Engl J Med* 1986;314:423-429.
4. Burney PGJ. Asthma mortality in England and Wales: Evidence for a further increase 1974-1984. *Lancet* 1986;2:323-326.
5. Mitchell EA. International trends in hospital admission rates for asthma. *Arch Dis Child* 1985;60:376-378.
6. Sears MR, Rea HH, Beaglehole R. Asthma mortality: A review of recent experience in New Zealand. *J Allergy Clin Immunol* 1987;80:319-325.
7. Gergen PJ, Mullally MB, Evans R. National survey of prevalence of asthma among children in the United States, 1976 to 1980. *Pediatrics* 1988;81:1-7.
8. Savukas RA: Personal Communication: Allegheny County Health Department, Bureau of Air Pollution Control, 1987.

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9. Friday GA, Fireman P. Morbidity and Mortality of Asthma. *Ped Clin North Am* 1988;35:1149-1162.
10. Mullally DI, Howard WH, Hubbard TJ, Grauman JS, Cohen SG. Increased hospitalizations for asthma among children in the Washington, DC area during 1961-1981. *Ann Allergy* 1984;53:15-19.
11. Sly RM. Increase in death from asthma. *Ann Allergy* 1984;53:20-25.
12. Proceedings of the asthma mortality task force. *J Allergy Clin Immunol* 1987;80 (Suppl).
13. Strunk RC, Mrazek DA, Fuhrmann GSW, La Brecque JF. Physiologic and psychological characteristics associated with deaths due to asthma in childhood. (A case controlled study) *J Am Med Assoc* 1985;254:1193-1198.
14. Kravis LP, Kolsky GB. Unexpected death in childhood asthma. *Am J Dis Child* 1985;150:558-563.

Address reprint requests to:
Gilbert Anthony Friday, Jr., M.D.
Children's Hospital of Pittsburgh
3705 Fifth Avenue at
Pesoto Street
Pittsburgh, PA 15213

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