

Trends in the Hospitalization for Acute Childhood Asthma, 1970–84

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Abstract: Data from the 1970 through 1984 National Hospital Discharge Surveys indicate that the rate of hospitalization for children under 15 years old with asthma has increased at least 145 per cent while the average length of stay for children with asthma decreased by 26 per cent from 5 days in 1970 to 3.6 days in 1984. Over an analogous period (1970 to 1980), data from the National Health Interview Survey

indicate that the prevalence of childhood asthma has increased by approximately 28 per cent for children 6 to 16 years of age. Several potential explanations for the hospital trend are discussed, including changes in the disease classification and information system, criteria for admission, organizational factors, changes in therapy, and changes in morbidity. (*Am J Public Health* 1986; 76:1308–1311.)

Introduction

Asthma is a common chronic condition of childhood and is the most frequently reported cause of childhood disability.¹ Unfortunately, several recent reports indicate that both morbidity and mortality of childhood asthma are increasing. Surveys from several countries, including the United States, have demonstrated slight upward trends in mortality due to asthma in all age groups.^{2,3} Morbidity is more difficult to measure, but hospital admission rates may serve as a useful proxy for morbidity. Reports from the United Kingdom, Canada, New Zealand, and Australia indicate a trend toward increasing hospitalizations for children with asthma.^{4–8} In the US, reports from Washington, DC, hospitals indicate that hospitalization rates for childhood asthma have increased substantially from 1961–81, whereas reports from Philadelphia hospitals show no distinctive trend.^{9,10}

This study was undertaken to assess national trends in hospital utilization for childhood asthma between 1970 and 1984, using data from the National Hospital Discharge Survey (NHDS); to corroborate this trend, we draw upon prevalence estimates from the National Health Interview Survey (NHIS) and data from other sources.

Methods

The National Hospital Discharge Survey (NHDS) is a continuous survey of hospital discharges from non-federal, short-stay hospitals in the United States conducted by the National Center for Health Statistics (NCHS). The universe of the survey consists of 6,965 short-stay hospitals contained in the 1963 Master Facility Inventory of Hospitals and Institutions, updated in 1972, 1975, 1977, 1979, 1981, and 1983. In 1983, data were collected from 418 of 553 sampled hospitals. These 418 hospitals provided 206,000 patient abstracts from which the national estimates were generated. The sample design, data collection, and estimation procedures as well as the calculation of sampling errors have been well described elsewhere.¹¹

For the purpose of this analysis, published and unpublished tabulations from the NHDS were used. Because the NHDS utilizes a complex sampling method, standard errors were computed from specially prepared NHDS variance tables that incorporate survey design effects. Based on these

tables, 95 per cent confidence intervals for differences over time in admissions and length of stay were computed and presented.

In 1979, the NHDS implemented the Ninth Revision of the International Classification of Diseases (ICD-9-CM) in order to classify conditions. An important change in condition classification was implemented with ICD-9-CM. Previously, in the Eighth Revision (ICD-8) bronchitis, unspecified as acute or chronic, when indicated with asthma or an asthmatic component, was classified as bronchitis (490). In ICD-9-CM, the same condition was coded as asthma, unspecified (493.3). Other investigators have attempted to assess the magnitude of this coding revision. An analysis of death certificates which compared both coding schemes suggested a shift of 35 per cent of cases from the bronchitis code to the asthma code.⁹ A special study of these coding problems prepared for the NCHS by JRB Associates found that, of a sample of 791 cases coded as asthma (493) using ICD-9-CM, only 62 per cent were coded as asthma (493) using ICD-8. The remaining 38 per cent were mostly coded as bronchitis (490 or 466). Because of the coding changes and the inability to determine the exact magnitude of the "cross-over effect", trends were separately analyzed from 1970 to 1978 (ICD-8) and from 1979 to 1983 (ICD-9-CM).

The National Health Interview Survey (NHIS) is a continuing nationwide survey conducted by the US Bureau of the Census for the National Center for Health Statistics. A national probability sample of approximately 40,000 households is selected which includes approximately 30,000 children less than 17 years old in each yearly sample.¹² The average response rate exceeds 95 per cent in each year studied. Information on respiratory conditions in children was collected in 1970 for the full sample of 30,000 children less than 17 years old, and in 1978, 1979, and 1980 on a subsample of approximately 5,000 children each year. In order to improve the precision and comparability of the estimates of childhood asthma, the data from 1978, 1979, and 1980 were combined, providing a sample size of approximately 15,000 children. The prevalence of asthma in a sample of 30,000 children in 1970 was compared to a combined sample of 15,000 children in 1978–80.

The same considerations regarding changes in disease coding were not relevant to NHIS data because respondents replied to a specific checklist, and if respondents suggested that the child had a mixed disorder, i.e., asthmatic bronchitis, both asthma and bronchitis would then be listed separately.¹³ Because the NHIS uses a multistage cluster sampling method, standard errors were also computed from specially prepared NHIS variance tables that incorporate survey design effects.

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TABLE 1—Hospital Discharge Rate for Select Respiratory Illnesses per 10,000 Children under Age 15 Years*, 1970–78 and 1979–84

Year	Asthma (ICD-493)	Bronchitis (ICD-490, 491)	Acute Bronchitis/Bronchiolitis (ICD-466)
ICD-8			
1970	5.7 (0.5)	12.6 (1.0)	17.3 (1.2)
1971	5.5 (0.5)	13.3 (1.0)	17.8 (1.2)
1972	8.6 (0.7)	14.0 (1.0)	20.6 (1.2)
1973	9.9 (0.8)	13.2 (1.0)	18.0 (1.3)
1974	10.1 (0.8)	13.0 (1.0)	16.3 (1.2)
1975	10.9 (0.9)	15.1 (1.1)	20.3 (1.4)
1976	11.2 (1.2)	12.0 (1.2)	18.9 (1.8)
1977	13.1 (1.4)	14.6 (1.4)	22.4 (1.8)
1978	12.1 (1.1)	12.9 (1.2)	20.9 (1.6)
ICD-9			
1979	19.8 (1.7)	10.1 (1.0)	21.4 (1.8)
1980	24.3 (1.9)	8.4 (0.8)	19.7 (1.7)
1981	24.9 (1.9)	10.3 (1.0)	19.7 (1.7)
1982	29.4 (2.1)	8.0 (0.7)	20.2 (1.6)
1983	26.4 (1.7)	9.5 (0.8)	21.9 (1.6)
1984	28.9 (1.5)	5.4 (0.4)	15.8 (0.9)

*Based on published and unpublished estimates from the National Hospital Discharge Survey (NHDS).
NOTE: Standard error is provided in parentheses.

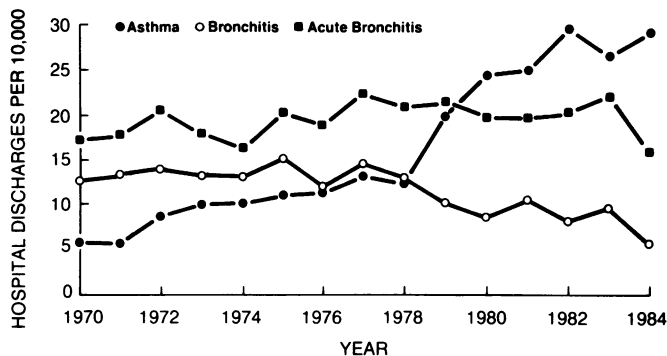


FIGURE 1—Hospital Discharge Trend Data for Respiratory Illnesses per 10,000 Children under Age 15, 1970–84

Results

Both Table 1 and Figure 1 present the trend data for hospital discharges for children less than 15 years old. Discharge rates for bronchitis and acute bronchitis or bronchiolitis are provided for comparison purposes. From 1970 to 1978, the rate of discharges for childhood asthma increased 112 per cent, from 5.7 per 10,000 population less than 15 years to 12.1 per 10,000 ($\Delta = 6.4$, 95% CI = 4.0, 8.8). This trend continued from 1979 to 1984 with an increase from 19.8 to 28.9 per 10,000 population less than 15 years old ($\Delta = 9.1$, 95% CI = 6.8, 11.4).

The hospital discharge rate for bronchitis remains virtually unchanged from 1970 to 1978, with approximately a 22 per cent decrease occurring with the ICD change between 1978 and 1979. There are inconsequential fluctuations in bronchitis rates between 1979 and 1983, but there is an additional 43 per cent decrement occurring between 1983 and 1984, from 9.5 to 5.4 ($\Delta = 4.1$, 95% CI = 2.4, 5.8). Hospitalization rates for acute bronchitis and bronchiolitis are more stable over both the homologous segments (1970–78 and 1979–84), but this category also shows a 28 per cent decrease between 1983 and 1984, from 21.9 to 15.8 ($\Delta = 6.1$, 95% CI = 2.5, 9.7).

TABLE 2—Hospital Discharge Rate for All Respiratory Conditions and All Conditions per 10,000 Children under 15 years*, 1970–84

Year	All Respiratory Conditions (ICD 460–519)	All Conditions
1970	254 (8.9)	671 (23.5)
1971	258 (9.8)	702 (24.6)
1972	266 (10.1)	732 (25.6)
1973	256 (11.6)	708 (31.1)
1974	243 (11.7)	718 (33.0)
1975	229 (11.0)	715 (32.2)
1976	223 (14.0)	715 (35.8)
1977	226 (12.4)	733 (32.3)
1978	215 (10.3)	688 (29.6)
1979	217 (10.8)	727 (29.1)
1980	202 (10.0)	718 (28.7)
1981	202 (10.0)	729 (29.1)
1982	201 (10.0)	712 (25.0)
1983	209 (11.5)	708 (24.8)
1984	170 (6.0)	620 (17.5)

*Based on published and unpublished estimates from the National Hospital Discharge Survey (NHDS).
NOTE: Standard error is provided in parentheses.

TABLE 3—Average Length of Hospital Stay for Asthma and All Conditions for Children Under 15 Years*, 1970–84

Year	Asthma (days)	All Conditions (days)
1970	5.0 (1.5)	4.9 (.1)
1971	4.5 (1.6)	4.7 (.1)
1972	4.3 (1.2)	4.5 (.1)
1973	4.8 (1.1)	4.5 (.1)
1974	4.3 (.9)	4.6 (.1)
1975	4.1 (.9)	4.6 (.1)
1976	4.1 (.7)	4.4 (.2)
1977	3.9 (.6)	4.2 (.2)
1978	3.9 (.4)	4.4 (.2)
1979	3.8 (.3)	4.3 (.2)
1980	3.9 (.3)	4.4 (.2)
1981	3.6 (.3)	4.6 (.2)
1982	3.6 (.3)	4.6 (.1)
1983	3.7 (.2)	4.6 (.1)
1984	3.6 (.2)	4.5 (.1)

*Based on published and unpublished estimates from the National Hospital Discharge Survey (NHDS).
NOTE: Standard error is provided in parentheses.

In order to provide a context for assessing the trends for asthma, bronchitis, and acute bronchitis/bronchiolitis, it is useful to consider both the hospitalization rates for all respiratory conditions and for all conditions (Table 2). The discharge rate for all conditions remained relatively stable until 1983–84 when there was a 12 per cent decrease in hospitalizations from 708 to 620 ($\Delta = 88$, 95% CI = 57.7, 118.3). From 1970 to 1983, the hospitalization rate for all respiratory conditions steadily declined by approximately 19 per cent from 254 to 209 ($\Delta = 45$, 95% CI = 16.5, 73.5), and between 1983 and 1984 it decreased an additional 19 per cent, from 209 to 170 ($\Delta = 39$, 95% CI = 13.6, 64.4). Thus not only is the relative increase in hospitalizations for asthma occurring in the face of falling rates for all respiratory conditions, but between 1983 and 1984 when decreases were registered for all conditions, for all respiratory conditions, as well as for bronchitis and acute bronchitis/bronchiolitis, the rates for asthma continued to increase.

TABLE 4—Estimated Cost of Hospitalization for Children under 15 Years with Asthma, 1970–83

Year	Average Cost* per Admission (1983 dollars)	Total Cost per Year (1983 dollars)
1970	NA	NA
1971	NA	NA
1972	1098	52,802,000
1973	1277	70,173,000
1974	1159	64,931,000
1975	1163	67,433,000
1976	1211	72,696,000
1977	1199	82,649,000
1978	1234	75,292,000
1979	1231	121,877,000
1980	1285	159,286,000
1981	1242	158,957,000
1982	1282	193,442,000
1983	1367	185,926,000

*Based on average cost per hospital day for community hospitals from American Hospital Association Annual Survey; adjusted by the U.S. Medical Care Price Index.
NA = Data not available.

TABLE 5—Estimated Prevalence of Asthma and Bronchitis in the United States, 1970–80*

	1970	1978–80	Difference	(95% CI)
Asthma <6 years	2.9 (.2)	3.2 (.3)	.3	(-.4, 1.0)
Asthma 6–16 years	3.2 (.1)	4.1 (.3)	.9	(.3, 1.5)
Bronchitis 0–16 years	3.9 (.1)	3.7 (.2)	.2	(-.2, 0.6)

*Based on published estimates and microdata from the National Health Interview Survey.

NOTE: Standard Error is provided in parentheses.

Because patterns of care could have changed over the intervening years, length of hospital stay for children with asthma was compared between 1970 and 1984 to all other conditions. Table 3 demonstrates that the length of stay for children with asthma decreased by approximately 26 per cent over this period from 5 days per hospitalization in 1970 to 3.6 days per hospitalization in 1984 ($\Delta = 1.4$ days, 95% CI = -1.5, 4.4). The length of stay for all other conditions showed little change.

In order to estimate the approximate cost per hospitalization, information on length of stay from the NHDS was combined with American Hospital Association (AHA) data on an average adjusted cost per hospital day. The AHA data are not specific for children and thus provide only a rough estimate of actual costs. Table 4 presents the cost estimates for the 1972–83 period adjusted by the medical care component of the US Consumer Price Index for 1983 dollars. Although the average cost per admission shows very little change, total costs are estimated to have increased almost four-fold.

To further assess whether there has been a true increase in the prevalence and/or severity of childhood asthma, Table 5 presents NHIS prevalence estimates for asthma in two age categories, 0 to 5 years and 6 to 16 years for 1970 and 1978–80. There was a 10 per cent increase in children less than age 6 and a 28 per cent increase in children 6 to 16 years of age. Over the same time period, there was a 5 per cent decrease in the reported prevalence of chronic bronchitis.

Discussion

The data from the NHDS indicate that the rate of hospitalizations for childhood asthma increased more than

100 per cent from 1970 to 1978 and by 45 per cent from 1979 to 1984. Even accounting for the possible effect of ICD changes, the increase in hospitalizations occurred in the face of an overall decline in hospitalizations for all respiratory conditions. Over an analogous period (1970–80), data from the NHIS indicate that the reported prevalence of childhood asthma also increased in children 6 to 16 years old by approximately 28 per cent. Although both surveys suggest trends in a similar direction, the discrepancy in magnitude is not easily explained.

Unfortunately, this analysis is constrained by limitations in the available data source. Although hospital admission rates can be a useful proxy for morbidity, this proxy is more representative when distinctions are made between first admissions and readmissions. The data collected by the NHDS do not permit distinctions between admissions and readmissions.

Data from the National Ambulatory Medical Care Survey (NAMCS) indicate that from 1975 to 1981 (earlier data not available) the rate of pediatric office visits for asthma increased by approximately 40 per cent.¹⁴ The only other national data set which could be used to evaluate this trend is data collected as part of the National Health and Nutrition Examination Survey (NHANES) which has yet to be analyzed.

With the transition from ICD-8 to ICD-9-CM, respiratory conditions with an asthmatic component (i.e., asthmatic bronchitis, wheezy bronchitis, etc.) previously classified in one of the bronchitis categories are now classified as asthma. This accounted for a 30–40 per cent increase in the number of reported cases of asthma between 1978 and 1979. However, within homologous ICD segments of 1970 to 1978 and 1979 to 1983, clear increases are apparent. Furthermore, part of the 62 per cent increment from 1978 to 1979 may also include a portion of genuine increase in addition to the portion accountable to the ICD change.

An analysis of asthma admission rates at Children's Hospital National Medical Center in Washington, DC, showed that readmissions accounted for 22 per cent of the admissions from 1960 to 1964 and for 44 per cent of admissions from 1970 to 1974.⁹ Anderson's analysis of two suburban London hospitals between 1959 and 1974 indicated that readmission rates for children age 5–14 rose from 11 per cent to 27 per cent, and the proportion of individuals admitted more than once increased from 12 per cent to 19 per cent.⁴ These studies may not be enough to draw conclusions about a national trend in the United States, however.

Increases in the readmission rate suggest that the severity of asthma has increased; the more than 20 per cent decrease in the length of hospital stay suggests that hospitalized children were less ill or that hospital therapy had improved. Data from Children's Hospital National Medical Center showed a sharper reduction in the length of hospital stay from 1960–64 to 1970–74: length of stay decreased by 50 per cent.⁹

A change in admission criteria could also affect the hospitalization rate. Anderson's assessment of British hospitals was unable to demonstrate a shift toward patients with milder symptoms but did show an increase in self-referrals through the casualty department.^{4,15} Changes in emergency department utilization may be reflected in the US hospitalization trend. An analysis of emergency department utilization in the mid-1970s from a large midwestern pediatric hospital demonstrated that asthma was the fourth leading cause for emergency department visits and the leading cause

for hospital admission from the emergency department.¹⁶ Furthermore, a Baltimore, Maryland study showed a significant difference in emergency department utilization between racial groups with 44 per cent of Black children and 24 per cent of White children reporting the emergency department as primary source of care.¹⁷

Data from the 1978–80 NHIS as well as the Baltimore public schools' study indicate that the prevalence of asthma is greater in Blacks than in Whites.^{17*} Changes in the financing and organization of health care services in the late 1960s increased access for many Blacks. Greater access to emergency departments and subsequent hospitalization may account for some of the observed trend. Mullally and colleagues, in their analysis of asthma hospitalizations in Washington, DC, demonstrated an 18- to 20-fold increase for all Black children in two hospitals and a three-fold increase in the third hospital they analyzed.⁹ This increase occurred at a time when the Black population increased only 23 per cent, indicating that demographic shifts would not account for the dramatic increase in hospitalization rates for Black children.⁹ Although the evidence is indirect, increased access to health care might account for increased hospitalization rates independent of prevalence and morbidity of the condition.

Since the mid-1960s, several changes have been initiated in asthma drug therapy. Most of these facilitate outpatient management and should decrease the need for hospitalization.¹⁸ These changes include: a wider variety of long-acting bronchodilators reported to have fewer side effects (including both theophylline and beta agonists); more aggressive use of oral steroid preparations on an outpatient basis; and a wider variety of easily used inhalation preparations.^{18–20} Although the short-term efficacy of drug therapy has been repeatedly demonstrated in numerous trials, it has been conjectured that prolonged drug use may have adverse long-term effects and may be related to increased hospitalizations.²¹

The data from the NHIS indicate that there has been an increase in reported cases of asthma from 1970 to 1980. However, this 25 per cent increase in prevalence can account for only part of the trend in hospitalizations. From the available data it is impossible to draw any firm conclusions about frequency of acute episodes or severity.

Irrespective of ICD labeling changes, physicians may be more inclined to label a child with asthma rather than the relatively non-specific syndrome, bronchitis. Within the pediatric literature during this time period, there has been substantive debate about the labeling of wheezing associated respiratory illness in children.^{22–24} Reports that chronic cough syndromes are really variants of asthma and can be similarly treated may have increased the likelihood that physicians are actually changing their labeling behavior. If physicians were significantly more inclined to label a child with the diagnosis of asthma rather than other respiratory diagnoses, then this should be evident in shifts from the other ICD categories to asthma (Table 1). This does not appear to be the case.

The increased hospitalization for childhood asthma may be partially accounted for by the reported increase in prevalence, as well as the indirect evidence that readmissions have increased and that access has improved. Since asthma is one of the most common chronic illnesses of childhood, increases in primary hospitalization, readmissions, or preval-

ences all have significant policy ramifications. Close monitoring of these trends along with specific risk factor analyses will be useful to further explain their causes.

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*Unpublished tabulations presented by Halfon N, Robert Wood Johnson Clinical Scholars National Meeting, Orlando, Florida, 1984.