

Characteristics of Children Discharged From Hospitals in the United States in 2000 With the Diagnosis of Acute Rheumatic Fever

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ABSTRACT

OBJECTIVE. The goal was to describe characteristics of children discharged from hospitals in the United States in 2000 with the diagnosis of acute rheumatic fever.

METHODS. We explored characteristics of children <21 years of age who were hospitalized with a diagnosis of acute rheumatic fever by using the 2000 Kids' Inpatient Database, weighted to estimate the number and rate of acute rheumatic fever–associated hospitalizations in the United States.

RESULTS. In 2000, an estimated 503 acute rheumatic fever hospitalizations occurred among children <21 years of age, at a rate of 14.8 cases per 100 000 hospitalized children, with a mean age of 10 years. In comparison with all Kids' Inpatient Database admissions, acute rheumatic fever hospitalizations were more common in the age group of 6 to 11 years and among male patients. Chorea was more common in female patients (61.7%). White patients were significantly underrepresented, whereas Asian/Pacific Islander patients and patients of other races were overrepresented. Hospitalizations of patients with acute rheumatic fever were significantly more common in the Northeast and less common in the South. The highest rates of acute rheumatic fever hospitalizations occurred in Utah, Hawaii, Pennsylvania, and New York. Significantly more acute rheumatic fever admissions occurred in March. The expected payor was more likely to be private insurance and less likely to be Medicaid. Acute rheumatic fever hospitalizations were more likely to occur in teaching hospitals, freestanding children's hospitals, and children's units in general hospitals and in urban locations. The median length of stay for acute rheumatic fever hospitalizations was 3 days, and the median total charges were \$6349. The in-hospital mortality rate was 0.6%.

CONCLUSIONS. In 2000, we found that hospitalizations for acute rheumatic fever were infrequent and varied according to race, season, location, and type of hospital.

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Key Words

acute rheumatic fever, hospitalizations, epidemiology, children, United States

Abbreviations

ARF—acute rheumatic fever

KID—Kids' Inpatient Database

HCU—Healthcare Cost and Utilization Project

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ACUTE RHEUMATIC FEVER (ARF), an autoimmune response to group A streptococcal antigens, manifests commonly with joint, skin, heart, and central nervous system involvement. Although most symptoms of ARF resolve without sequelae, cardiac involvement may persist as rheumatic heart disease, the leading cause of acquired heart disease throughout the world. An estimated 12 million people are affected by ARF and rheumatic heart disease globally, although the estimated annual incidence of ARF differs substantially in non-industrialized countries (up to 150 cases per 100 000 population) versus industrialized countries such as the United States (<1 case per 100 000 population).¹ Susceptibility to ARF seems to be multifactorial, involving genetic factors, streptococcal virulence, and sociodemographic factors, including socioeconomic status and living conditions.¹⁻⁴

Although ARF accounts for up to 60% of all cardiovascular disease among children and young adults in underdeveloped countries, the disease is comparatively rare in the United States.¹ Reports in the early 1980s suggested that ARF within the United States had essentially become a “vanishing disease in suburbia.”⁵ Beginning in the middle 1980s, however, several reports of ARF resurgences in the United States emerged^{3,6-11}; it was unclear whether these were isolated incidents or representative of a broader nationwide trend. Taubert et al¹² undertook the first nationwide study using questionnaire-based responses and International Classification of Diseases, Ninth Revision codes for ARF hospital discharges between 1984 and 1990. Their survey suggested isolated resurgences and an actual decline in the national incidence of ARF.¹²

Although the lack of mandatory reporting laws for ARF makes conclusions challenging, we sought to estimate the recent incidence and epidemiologic characteristics of hospitalizations for ARF in the United States. Our analyses were based on the 2000 Kids' Inpatient Database (KID), weighted to estimate the number and rate of ARF-associated hospitalizations in the United States. Because reported hospitalization rates for children diagnosed as having ARF may vary between 4% and 50%^{13,14} and it is likely that socioeconomic, demographic, and local hospital factors influence the decision to hospitalize a child with ARF, we compared characteristics of ARF hospitalizations with those of all KID 2000 hospitalizations.

METHODS

Data Source

Data were obtained from the Healthcare Cost and Utilization Project (HCUP) 2000 KID. The KID was designed specifically to examine issues pertinent to health care delivery in children and consists of a stratified random sample of 2 516 833 discharges from 2784 institutions in

27 states. Only HCUP partner states (states that gave permission for their data to be included) are contained in the KID. Pediatric hospitals, academic medical centers, and specialty hospitals are included. To yield information that is nationally representative, the sample is weighted to represent the population of all pediatric discharges from community, nonrehabilitation hospitals in the United States that were open for any part of calendar year 2000. Standard patient demographic data, institutional information, and up to 15 diagnosis codes and 15 procedure codes (based on the International Classification of Diseases, Ninth Revision, Clinical Modification) are included. HCUP created race categorizations from information provided by each state.

Children's hospital status was assigned on the basis of information provided by the National Association of Children's Hospitals and Related Institutions. Teaching hospital status was obtained from the American Hospital Association Annual Survey of Hospitals. Teaching hospitals must have an approved residency program, be a member of the Council of Teaching Hospitals, or have a full-time-equivalent interns and residents/beds ratio of ≥ 0.25 . Similar to race, payor information was provided by the individual states and collapsed by HCUP. Medicaid includes both fee-for-service and managed care Medicaid cases. Private insurance includes Blue Cross, commercial carriers, private health maintenance organizations, and preferred provider organizations. States are classified according to region, as follows: (1) Northeast: Connecticut, Massachusetts, Maine, New Jersey, New York, and Pennsylvania; (2) Midwest: Iowa, Kansas, Missouri, and Wisconsin; (3) South: Florida, Georgia, Kentucky, Maryland, North Carolina, South Carolina, Tennessee, Texas, Virginia, and West Virginia; and (4) West: Arizona, California, Colorado, Hawaii, Oregon, Utah, and Washington.

Data Analysis

All hospital discharges with International Classification of Diseases, Ninth Revision, Clinical Modification diagnosis codes indicating ARF (codes 390, 391.0-2, 391.8-9, 392.0, and 392.9) were selected. In-hospital births were excluded. The prevalence of ARF among pediatric hospital admissions in the United States was estimated by using the sampling weights provided in the KID 2000 (SAS 9; SAS Institute, Cary, NC). Cases in the sample were tabulated according to patient and hospital characteristics. Patient characteristics explored were age, gender, race/ethnicity (white, black, Hispanic, Asian/Pacific Islander, American Indian, or other), median household income bracket (\$0-\$24 000, \$25 000-\$34 000, \$35 000-\$45 000, or more than \$45 000), expected primary payor (Medicare, Medicaid, private insurance including health maintenance organization, self-pay, no charge, or other), outcome, and month of admission. We explored hospital characteris-

tics including region of hospital, hospital location (rural or urban), type of hospital (teaching hospital, non-teaching hospital, not a children's hospital, freestanding children's hospital, or children's unit in a general hospital), and hospital size (small, medium, or large). Variables with $\geq 1\%$ missing information included race/ethnicity (18.1%), median household income (2.4%), month of admission (7.9%), and type of hospital (whether a children's hospital, 3%). Five states did not report any race information, which accounts in part for the large proportion of missing race data. Sampling weights were used to estimate the corresponding numbers of cases in the US population. All nonbirth hospital admissions in the KID, regardless of diagnosis, were summarized to provide a comparison group for the ARF admissions. Comparisons were performed on the weighted data by using the χ^2 test. If distributions were significantly different, then posthoc tests were used to determine which categories differed for the 2 groups.

RESULTS

In 2000, an estimated 503 ARF hospitalizations occurred among children <21 years of age in the United States, at a rate of 14.8 cases per 100 000 hospitalized children. Codes for ARF hospitalizations with cardiac involvement were present for 30.4% of all patients, arthritis for 11.5%, and Sydenham's chorea for 18.7%. Of all ARF hospitalizations, 2.0% included cardiac surgical repair (95% confidence interval: 1.0%–3.6%). Because virtually all patients with rheumatic fever have 1 of these 3 clinical features, it is likely that many hospitalizations were coded only as ARF, without additional coding for the presence of individual clinical criteria. The absolute number of patients (6 in the unweighted sample) who underwent cardiac surgery was too small to generate accurate national estimates. Of those 6 patients, 4 underwent valve replacement (3 mitral and 1 aortic) and 2 underwent valvuloplasty (1 mitral and 1 not specified). The mortality rate for ARF hospitalizations was 0.6% (95% confidence interval: 0.1%–1.7%).

The distributions of age and gender among ARF hospitalizations are shown in Fig 1. The median age of the children at the time of ARF hospitalization was 10 years (range: 0–20 years; interquartile range: 7–12 years). In comparison with all KID admissions, ARF admissions were significantly more common in children 6 to 11 years of age (46.7% vs 11.8%) and less common in children ≤ 5 years of age (19.9% vs 37.1%) or 18 to 20 years of age (9.5% vs 27.4%; $P < .001$). Male patients accounted for a significantly greater proportion of ARF admissions, compared with all KID admissions (56.1% vs 38.3%; $P < .001$). Female patients accounted for 61.7% of patients with chorea. We explored race and ethnicity among patients for whom these data were known (Fig 2). In comparison with all KID admissions, white patients were significantly underrepresented in

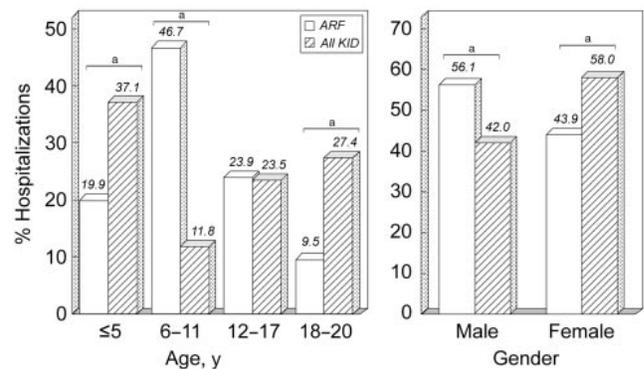


FIGURE 1
ARF hospitalizations according to age and gender. In comparison with all children in the KID, children 6 to 11 years of age with ARF were significantly more likely to be hospitalized, whereas children ≤ 5 years or 18 to 20 years of age were less likely to be hospitalized. Male patients were also significantly more likely and female patients less likely to be hospitalized with ARF, in comparison with all KID hospitalizations. $^a P < .05$ for posthoc comparison.

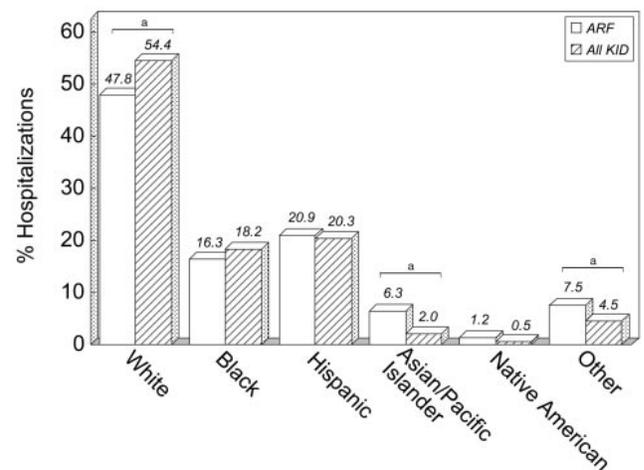


FIGURE 2
ARF hospitalizations according to race/ethnicity. In comparison with all KID hospitalizations, Asian/Pacific Islander children and children of other races were statistically more likely to be hospitalized, whereas white children were less likely to be hospitalized. $^a P < .05$ for posthoc comparison.

ARF hospitalizations (47.8% vs 54.4%), whereas Asian/Pacific Islander patients (6.3% vs 2.0%) and patients of other races (7.5% vs 4.5%) were overrepresented ($P < .001$). All Asian/Pacific Islander children with ARF were from California, Hawaii, or New York. The proportions of Asian/Pacific Islander patients in ARF hospitalizations, compared with all KID hospitalizations, in the 3 states were as follows: California, 17.0% vs 5.4%; New York, 7.2% vs 2.2%; Hawaii, 71.8% vs 60.9%. Hispanic, black, and Native American patients made up 20.9%, 16.3%, and 1.2% of ARF admissions, respectively.

Figure 3 demonstrates ARF hospitalizations according to geographic region. ARF hospitalizations were significantly more common in the Northeast (27.8% vs 18.8%) and less common in the South (32.8% vs 38.5%; $P < .001$), compared with all KID admissions.

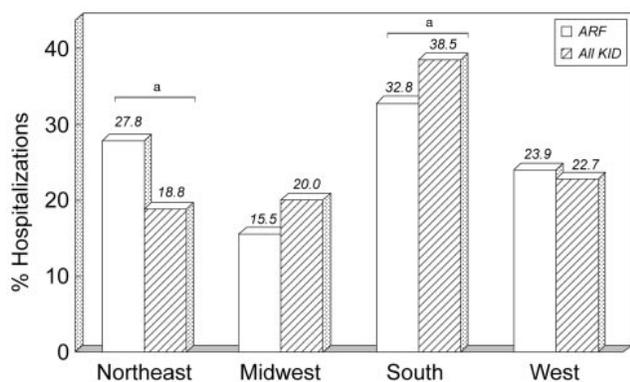


FIGURE 3
ARF hospitalizations according to geographic region. Children hospitalized with ARF, in comparison with all KID hospitalizations, were more likely to come from the Northeast and less likely to come from the South. The states with the highest rates of ARF admissions were Hawaii, New York, Pennsylvania, and Utah. ^a $P < .05$ for posthoc comparison.

ARF hospitalizations occurred more commonly in Utah (4.4% vs 1.3%), Hawaii (3.4% vs 0.3%), Pennsylvania (9.3% vs 5.4%), and New York (14.9% vs 7.3%), compared with overall KID hospitalizations.

The expected payor for ARF hospitalizations was significantly more likely to be private insurance (57.9% vs 47.1%) and less likely to be Medicaid (32.0% vs 42.5%; $P < .001$), compared with all KID hospitalizations (Fig 4). ARF hospitalizations and all KID hospitalizations were distributed similarly between family income brackets.

The greatest number of ARF admissions occurred in the month of March; the proportion of hospitalizations occurring in March in the year 2000 was significantly greater for ARF admissions than for all KID admissions (11.7% vs 8.3%; $P < .001$). A greater proportion of ARF hospitalizations occurred in teaching hospitals (as opposed to non-teaching hospitals), compared with all KID admissions (77.1% vs 56%; $P < .001$). In comparison with all KID admissions, significantly greater proportions

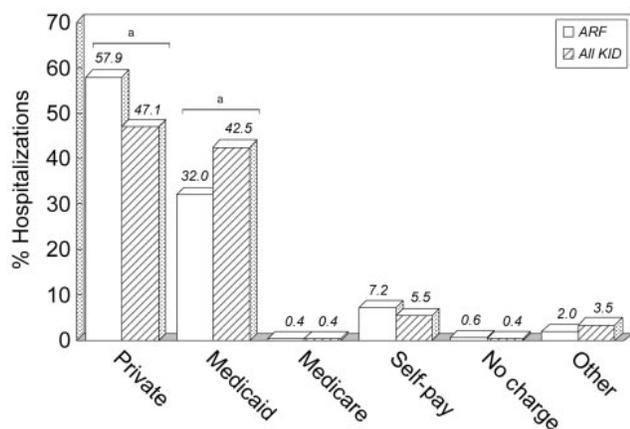


FIGURE 4
ARF hospitalizations according to expected primary payor. In comparison with all KID hospitalizations, children with ARF were more likely to have private insurance and less likely to have Medicaid. ^a $P < .05$ for posthoc comparison.

of ARF admissions occurred in freestanding children's hospitals (20.7% vs 13.3%) and children's units in general hospitals (25.8% vs 16.2%), and a smaller proportion of ARF admissions occurred in non-children's hospitals (50.5% vs 67.5%; $P < .001$). ARF hospitalizations were significantly more likely to occur in urban locations (90.5% vs 85.0%) and less likely to occur in rural locations ($P < .001$). There was no difference between ARF hospitalizations and all KID admissions according to hospital size. The median length of stay for ARF hospitalizations was 3 days (range: 1–41 days; interquartile range: 2–5 days), and the median total charges were \$6349 (range: \$1062–\$552 236; interquartile range: \$3515–\$13 457).

DISCUSSION

We found that children hospitalized with ARF were significantly more likely to be of nonwhite race/ethnicity, with overrepresentation of patients of Asian/Pacific Islander and other descent. In 2000, Asian/Pacific Islander patients accounted for 6.3% of ARF hospitalizations, although they represented <4% of the US population¹⁵ and, interestingly, only 2.0% of all KID hospitalizations. Although significantly higher rates of ARF have been reported in New Zealand among the local Asian/Pacific Islander and Maori populations,^{16,17} increased susceptibility among Asian/Pacific Islander individuals living within the continental United States has not been reported previously. The reasons for increased relative risk among this group of children are not known. Children of Asian/Pacific Islander descent may be more likely to come from immigrant families or to have a greater number of household occupants, which was suggested previously as a risk factor.³ However, it could be expected that these same factors would be reflected in the proportion of Asian/Pacific Islander patients in all KID hospitalizations. Alternatively, Asian/Pacific Islander children may have greater genetic susceptibility to ARF, similar to their increased relative risk for Kawasaki disease.¹⁸

Several published reports explored susceptibility to ARF in multiracial populations in the United States. In Hawaii, where 60% of children are of Asian or Pacific Islander descent, Chun et al^{19,20} found that, between 1976 and 1984, children of part-Hawaiian or Samoan descent had relative risks up to 7 times and up to 80 times greater, respectively, than that of white children. Similarly, Kurahara et al²¹ investigated rheumatologic disease in children living in Hawaii between 1993 and 1998 and found that ARF was significantly overrepresented among Polynesian children (including part-Hawaiian, Samoan, and other Pacific Islander children), compared with white children. Filipino children were also over-represented. Interestingly, in the latter 2 studies combined, no Japanese children and only 1 child of Chinese descent was affected. These data suggest that,

within the category of Asian/Pacific Islander in the United States, the relative risk of ARF may vary according to ethnicity (eg, Samoan, compared with Japanese). However, the KID did not allow us to distinguish between racial/ethnic groups within the Asian/Pacific Islander category.

This study should be interpreted in light of its limitations. We report data from only the year 2000 and thus cannot assess secular trends. A minority of children with ARF are admitted to a hospital, and practices regarding hospitalization vary among centers and practitioners. Therefore, hospitalizations underestimate significantly the true number of ARF cases. Furthermore, we cannot exclude the possibility of selection bias in rates of hospitalization, related to patient characteristics. Patients might have been admitted for diagnostic evaluation because the diagnosis of ARF was not considered initially, especially in settings where ARF is not commonly seen. Because the KID does not include individual patient identifiers, we could not distinguish between ARF readmissions and transfers between hospitals, although we think that the proportions of such events are likely to be small. Misdiagnosis and improper coding might have caused underestimation or overestimation of ARF cases, and we cannot exclude the possibility of bias in coding practices among institutions. Improper coding also may explain the small proportions of cases with arthritis, carditis, and chorea in this study. Because detailed clinical information is missing from the coded data, we cannot determine the criteria used to diagnose ARF cases.

In addition, we cannot provide follow-up data after discharge for patients hospitalized with ARF. Our data are consistent with previous reports that ARF in US children is not overrepresented among those of lower socioeconomic status.^{2,3} The predominance of cases with private insurance (as opposed to Medicaid) is similar to that reported by Veasy et al,² which suggests that the majority of patients came from families with ready access to medical care. However, we could not determine the number of household occupants, a potential contributing factor in middle-income ARF incidence.³ Inferences concerning ethnic and sociodemographic risk factors might have been limited by the level of available data in the KID. Despite these limitations, our study is the first to examine the recent incidence and characteristics of hospitalizations for ARF in the United States.

CONCLUSIONS

In the year 2000, we found that hospitalizations for ARF were infrequent (14.8 cases per 100 000 hospitalizations among children <21 years of age) and varied according to race, season, location, and type of hospital. In comparison with all KID 2000 hospitalizations, those for ARF were more likely to occur in the month of March and among children 6 to 11 years of age, of male gender, of

Asian/Pacific Islander race/ethnicity, with private insurance, and residing in the Northeast. The highest rates of ARF, compared with all KID admissions, occurred in Utah, Hawaii, Pennsylvania, and New York. ARF hospitalizations were also more likely to take place in teaching hospitals and children's hospitals or units and in urban locations. Children hospitalized with ARF, compared with all KID admissions, were less likely to be white, to be hospitalized in the South, and to have Medicaid as the primary payor.

These data raise important questions about risk factors for ARF, including the possibility of genetic susceptibility among children of Asian/Pacific Islander descent. Future studies should explore the incidence and characteristics of all patients (ie, treated with or without hospitalization) in the United States, including susceptibility of different ethnic groups within the Asian/Pacific Islander category, practice variations in hospitalization, and temporal trends.

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SCIENCE ON TRIAL

“Autism awareness has spread throughout the globe. Societies that never had a word for autism are inventing them, and autism societies are being formed on every continent. Whereas there is considerable agreement about how to define the signs and symptoms of autism, every society has their own ideas and beliefs about what causes it and how to treat it. Autism has been linked to witchcraft in Africa, to poor mothering in France and South Korea, to divine blessings among some communities in Israel and India, and to measles in the United Kingdom. In most places, there are competing, co-existing systems of thought about autism, and the United States is no exception. Over the last three weeks, I listened to testimony in the first of nine test cases in the US Vaccine Court (*Cedillo v Health and Human Services*) considering the question of whether a mercury-based vaccine preservative called thimerosal (which used to be in many vaccines), or the measles-mumps-rubella (MMR) vaccine, or both together caused autism in Michelle Cedillo, the plaintiffs’ daughter. My own view, as a parent of a child with autism, and as someone involved with epidemiological research on autism, is that neither vaccines nor anything ever contained in vaccines is related to autism or the increase in the prevalence of autism. We should not expect too much out of this trial, or the next eight. The scientific community and antivaccine parent groups will each continue to look for clues under their own lampposts, because that is where the light is. However, we should pay careful attention to this conflict. The antivaccine movement may be evidence that public confidence in science is eroding, which means that public health is at risk too.”

Grinker RR. *Wall Street Journal*. July 3, 2007

Noted by JFL, MD

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