

Diarrhea-associated Hospitalizations among Children in Hawaii

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Abstract

Objective. To estimate the burden of diarrhea-associated hospitalizations among children in Hawaii.

Design. Retrospective analysis of hospital discharge records.

Patients. Children from 1 month through 4 years of age with a diarrhea-associated diagnosis listed on the hospital discharge record in Hawaii.

Setting. Acute care hospitals in the state of Hawaii, 1994 through 1997.

Results. During 1994-1997, 2288 children (11.3% of all hospitalizations for children < 5 years of age) had a diarrhea-associated diagnosis listed at hospital discharge. The average annual incidence (per 10,000 children) of diarrhea-associated hospitalizations was 62.3; the incidence was higher for children < 1 year (101.6) than for those 1 through 4 years of age (52.7). Rates for Hawaii were lower than national rates during 1993 through 1995 (US annual rate of 89 per 10,000 children). The median length of hospital stay was 2 days for diarrhea-associated hospitalizations, and 3 days for hospitalizations specifically associated with rotavirus-related diarrhea. Diarrhea-associated hospitalizations were highest during the period December through June.

Conclusions. Diarrhea is an important cause of hospitalization among children in Hawaii, where approximately 1 in 32 children may be hospitalized by 5 years of age. The age-specific and temporal trends reported here are consistent with those previously described for rotavirus-associated hospitalizations, suggesting that this pathogen is a major contributor to the overall morbidity from diarrhea.

Introduction

Diarrheal illnesses cause about 150,000 - 170,000 hospitalizations per year among US children under 5 years of age, accounting for approximately 12% of all hospitalizations in this age group.^{1,2} Rotavirus is the most common pathogen detected in etiologic studies of US children hospitalized with diarrhea.^{3,4} However, this pathogen is not routinely tested for in children with diarrhea because such testing adds cost without significantly altering treatment. Consequently, estimates of the morbidity from rotavirus-associated hospitalizations are not readily available. Previous studies have suggested that the unique epidemiologic features of rotavirus (i.e., winter seasonality, predisposition for children 4-35 months of age) can be used to estimate the morbidity from this pathogen by using

nonspecific data on diarrhea in children.^{1,2,5-9} These indicators were used in this study to estimate the morbidity associated with rotavirus diarrhea among children in Hawaii by analyzing data on diarrhea-associated hospitalizations.

Methods

Hospital discharge data for the period 1994 through 1997 were obtained from the Hawaii Health Information Corporation (HHIC),¹⁰ a non-profit corporation that collects discharge information from all acute care hospitals in the State of Hawaii. Patient records are processed through a comprehensive error identification and correction process, and annual hospitalization records are available for analysis within the following year.

Hospital discharge data were examined for children 1 month through 4 years of age who had an International Classification of Diseases, 9th revision, Clinical Modification (ICD-9-CM) code for diarrhea listed as one of up to 10 diagnoses on the discharge record.¹¹ The ICD-9-CM codes used included diarrhea of determined etiology (bacterial [001 to 005, 008.0-008.5, excluding 003.2], viral [008.6-008.8], and parasitic [006-007, excluding 006.3-006.6]) and diarrhea of undetermined etiology, including those presumed to be infectious (009.0-009.3) and noninfectious (558.9, 787.91). Rotavirus-associated hospitalizations were defined by the specific ICD-9-CM code 008.61, which was introduced in October 1992. Neonates were excluded from the analysis because the ICD-9-CM classifies diarrheal illness in these infants with distinct neonatal codes.

Data were examined for trends in hospitalizations for diarrhea and for rotavirus by age, sex, season, and etiology. Data on race were unavailable. Hospitalization rates (per 10,000 children) were calculated by using the census state population of children for the corresponding age group (<1 year, 1-4 years, and <5 years of age).¹² Risk ratios (RRs) with 95% confidence intervals (CIs) were calculated using Poisson regression analysis.¹³ Hospital length of stay was compared using the Wilcoxon rank-sum test.

Results

A total of 2288 diarrhea-associated hospitalizations were reported among children 1 month through 4 years of age in Hawaii during the 4-year study period (Table 1), accounting for 11.3% of all hospitalizations among <5-year-old children. Hospitalizations for children 1-11 months of age accounted for 32.0% of the diarrhea-associated hospitalizations for all children 1 month through 4 years old (Figure 1). Most (73.6%) diarrhea-associated hospitalizations were of unspecified etiology; of the remaining, viruses accounted for 21.4%, followed by bacteria (5.9%) and parasites (0.3%).

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Table 1. Diarrhea-associated hospitalizations among children 1-59 months of age in Hawaii, by diagnostic category, 1994-1997.

Diagnostic Category *	ICD-9-CM Codes	No.	(%)
Etiology Unspecified			
Presumed infectious	009-009.3	19	(0.8)
Presumed noninfectious	558.9, 787.91	1684	(73.6)
Etiology Specified			
Viral	008.6, 008.8	489	(21.4)
Rotavirus	008.61	47	(2.1)
Bacterial†	001-005.9, 008-008.5	135	(5.9)
Cholera	001-001.9	0	(0.0)
Salmonella‡	002-003.9	48	(2.1)
Shigella	004-004.9	19	(0.8)
Food poisoning	005-005.9	17	(0.7)
Escherichia coli and others	008.008.5	53	(2.3)
Parasitic‡	006-007.9	8	(0.3)
Ameba‡	006-006.9	1	(<0.1)
Other protozoa	007-007.9	7	(0.3)
Total		2288	(100)

* More than one diagnostic category (ICD-9-CM code) may be listed on each discharge record.

† Excludes localized salmonella infections (003.2).

‡ Excludes amebic liver abscess (006.3), amebic lung abscess (006.4), amebic brain abscess (006.5), and amebic skin ulceration (006.6).

The average annual incidence of diarrhea-associated hospitalizations among children 1 month through 4 years of age was 62.3 per 10,000. The incidence varied by year from 49.8 per 10,000 in 1994 to 70.1 per 10,000 in 1995, and no well-defined trend was observed (Figure 2). The average annual incidence was greater among infants than among children aged 1-4 years (101.6 per 10,000 [N = 733] compared with 52.7 per 10,000 [N=1555], respectively, RR = 1.9, 95% CI = 1.8 - 2.1) and among males than among females (66.7 per

Figure 1.— Diarrhea-associated hospitalizations and cumulative percent hospitalizations by age in months among children 1 month through 4 years of age in Hawaii, 1994 through 1997.

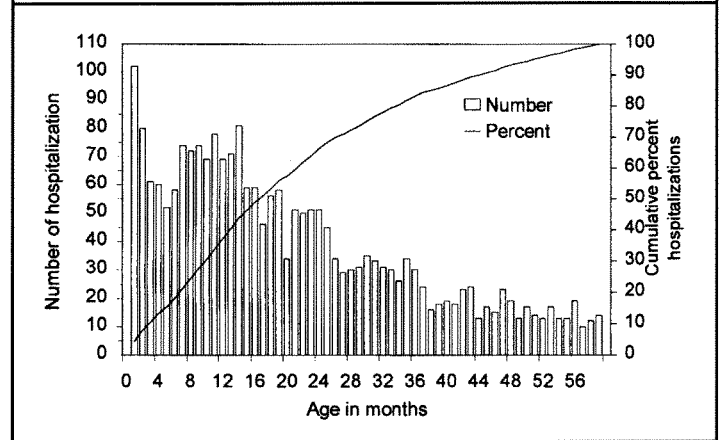
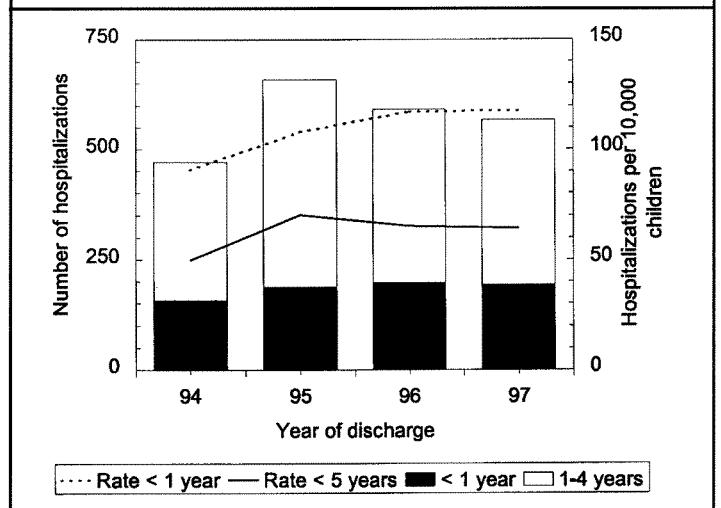


Figure 2.— Diarrhea-associated hospitalizations and hospitalization rates by year and age group among children 1 month through 4 years of age in Hawaii, 1994 through 1997.



10,000 [N = 1259] compared with 57.7 per 10,000 [N = 1028], respectively, RR = 1.2, 95% CI = 1.1 - 1.3). The median duration of a diarrhea-associated hospitalization was 2 days. Two deaths were reported among the 2288 hospitalizations with diarrhea.

A diagnosis of rotavirus diarrhea was coded on 2.1% (N = 47) of all discharges for diarrhea, increasing from 1.3% in 1994 after the introduction of the new rotavirus-specific ICD-9-CM code to 3.5% in 1997. The incidence of hospitalizations coded as rotavirus diarrhea was not significantly greater among infants than among children aged 1-4 years (19.4 per 10,000 [N = 14] compared with 11.2 per 10,000 [N = 33], respectively, RR = 1.7, 95% CI = 0.9 - 3.2), and was similar among males and females (14.3 per 10,000 [N = 27] compared with 11.2 per 10,000 [N = 20], respectively, RR = 1.3, 95% CI = 0.7 - 2.3). The median duration of a rotavirus-associated hospitalization was greater than that of hospitalizations for diarrhea of other etiologies (3 days compared with 2 days, respectively, p < .001).

Figure 3.— Monthly diarrhea-associated hospitalizations over time by age group among children 1 month through 4 years of age in Hawaii, 1994 through 1997.

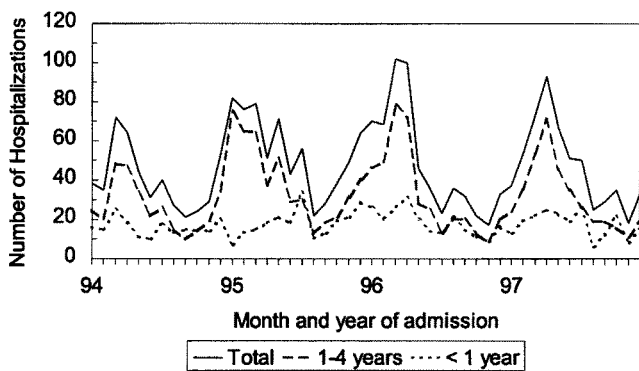
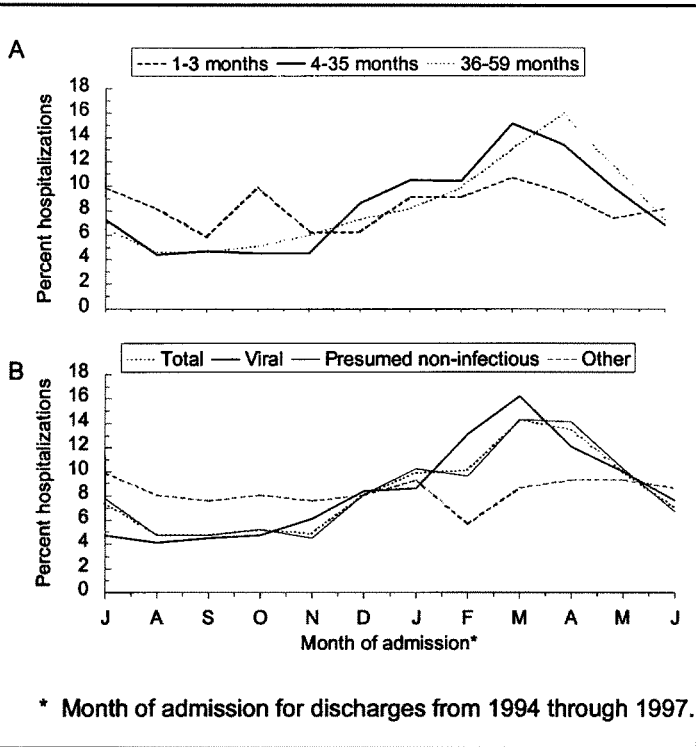


Figure 4.— Composite monthly diarrhea-associated hospitalizations among children 1 month through 4 years of age in Hawaii, by (A) age-group and (B) etiology, 1994 through 1997. The proportion of monthly hospitalizations is provided for each group separately.



* Month of admission for discharges from 1994 through 1997.

When diarrhea-associated hospitalizations were examined by month of admission, an increase was observed in the months of December through June each year (Figure 3). Examination of the composite monthly number of diarrhea-associated hospitalizations by age-group and etiology identified several trends (Figure 4). By age-group, the seasonal peak in diarrhea-associated hospitalizations was most prominent for children 4-35 and 36-59 months of age, but

was not seen in children 1-3 months of age (Figure 4A). By etiology, the seasonal peak in diarrhea-associated hospitalizations was most noticeable for those of viral and presumed non-infectious etiologies and was not seen among those of other etiologies (Figure 4B).

Discussion

Diarrhea remains an important cause of morbidity among children in Hawaii. If each child is admitted for diarrhea only once, this would mean that, on average, 1 of every 32 children is hospitalized for diarrhea by the age of 5 years. The winter seasonality of diarrhea-associated hospitalizations, most prominent among children 4-59 months of age, is consistent with the epidemiologic characteristics of rotavirus and likely reflects hospitalizations caused by this pathogen. However, only a small fraction (~ 2%) of diarrhea-associated hospitalizations were coded specifically as rotavirus, possibly because of under-diagnosis and under-reporting. These findings are consistent with those of other studies based on national and state data on diarrhea-associated hospitalizations among children and demonstrate the importance of rotavirus as a cause of severe diarrhea in US children.^{1,2,5-9}

While this study provides useful estimates of the morbidity from rotavirus diarrhea among children in Hawaii, it has several limitations. First, because information about outpatient visits and emergency room admissions was not examined, this study presents a limited picture of the total morbidity associated with rotavirus diarrhea among children Hawaii. Second, because data on hospitalization costs were not available, no assessment was made of the economic burden of hospitalizations associated with rotavirus diarrhea. Third, because only limited diagnosis-specific information about rotavirus diarrhea was available, the morbidity associated with rotavirus-associated hospitalizations among children in Hawaii could not accurately be ascertained. A more comprehensive and accurate assessment of the disease burden of rotavirus diarrhea in Hawaii could be obtained through a network of sentinel hospitals in which every child admitted with diarrhea and a representative sample of children who visit the emergency room and outpatient clinics for a diarrheal illness is tested for rotavirus and information about the costs associated with these events is gathered.

A rotavirus vaccine that is approximately 80% efficacious against rotavirus-associated hospitalizations was licensed in 1998 for use in the United States and was recommended in 1999 for routine immunization of US infants at 2, 4, and 6 months of age.¹⁴⁻¹⁸ In July 1999, the use of rotavirus vaccine in the United States was suspended because of reports of intussusception among infants who received the vaccine.¹⁹ Studies are ongoing to evaluate the association between rotavirus vaccine and intussusception. Hospital discharge data used can be used to study the epidemiology of intussusception and other adverse events that might be associated with vaccines.

Our findings demonstrate the need for interventions against rotavirus and other causes of childhood diarrhea and indicate that hospital discharge data can be used to evaluate the effect of such interventions. In view of the suspension of use of rotavirus vaccines, health care providers should encourage parents and caretakers to use oral rehydration solutions (ORS) to prevent the development of dehydration in children with diarrhea.^{20,21} Early and effective ORS use should reduce childhood diarrhea hospitalizations caused by rotavirus and other enteropathogens.

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