Keeping Children Out of Hospitals: Parents' and Physicians' Perspectives on How Pediatric Hospitalizations for Ambulatory Care-Sensitive Conditions Can Be Avoided

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ABSTRACT. *Background.* **Avoidable hospitalization conditions (AHCs) are hospitalizations that potentially can be avoided with timely, appropriate outpatient care. The specific reasons for avoidability, and parents and physicians' perspectives on the proportion of actually avoidable pediatric AHCs, have not been examined adequately.**

Objectives. **To identify how pediatric hospitalizations might be avoided, and to determine the proportion of avoidable AHCs according to parents and physicians of hospitalized children.**

Methods. **Cross-sectional survey of parents, primary care physicians (PCPs), and inpatient attending physicians (IAPs) of a consecutive series of children who were admitted with AHCs to an urban hospital in a 14-month period.**

Results. **The 554 hospitalized children had a median age of 4 years; most were poor (median annual family income: $12 000), nonwhite (91%), and had public (73%) or no (16%) health insurance. The most frequent AHC diagnoses were asthma (43%), dehydration/gastroenteritis (16%), pneumonia (11%), seizure disorder (8%), and skin infections (8%). Only 25% of parents said that their child's admission was avoidable, compared with 29% of PCPs and 32% of IAPs. The proportion of AHC hospitalizations assessed as avoidable varied according to the source or combination of sources, from 13% for agreement among all 3 sources to 46% as identified by any 1 of the 3 sources. PCPs (71%) and IAPs (48%) significantly more often than parents (35%) cited parent/patient-related reasons for how hospitalizations could have been avoided, including adhering to and refilling medications, better outpatient follow-up, and avoiding known disease triggers. Parents (48%) significantly more often than PCPs (18%) and IAPs (37%) cited physician-related reasons for how hospitalizations could have been avoided, including better education by physicians about the child's condition, and better quality of care. Multivariate analyses revealed that an age ≥11 years, an asthma diagnosis, working poor family income, and having no health insurance were associated with approximately double to triple the odds of an avoidable hospitalization.**

Conclusions. **The proportion of AHCs assessed as avoidable varies from 13% to 46%, depending on the source. Adolescents, children with asthma, children from working-poor families, and uninsured children are at greatest risk for avoidable hospitalizations. Many pediatric hospitalizations might be avoided if parents and children were better educated about the child's condition, medications, the need for follow-up care, and the importance of avoiding known disease triggers. Direct assessment by parents and physicians of hospitalized children can be an informative way to examine the proportion of avoidable pediatric hospitalizations and how they can be prevented.** *Pediatrics* **2003;112:1021–1030;** ***avoidable hospitalizations, children, pediatrics, prevention, health services research, asthma, minorities, primary care.***

ABBREVIATIONS. PCP, primary care physician; AHC, avoidable hospitalization condition; IAP, inpatient attending physician.

The terms "avoidable hospitalizations," "preventable hospitalizations," and "ambulatory care-sensitive conditions" have been used interchangeably to denote hospitalizations that can be avoided with timely, effective outpatient care.[1] Factors that have been found to be associated with avoidable hospitalizations include poor access to care,[2] poverty,[1–8] lower educational attainment,[6] lack of health insurance,[1,9,10] and lack of a primary care physician (PCP).[7] Avoidable hospitalization rates have been used to assess access to ambulatory care, the performance of primary care delivery systems, the quality of outpatient care, and the impact of new programs.[4,5,11]

Avoidable hospitalizations include conditions whose onset can be prevented (such as through immunization), acute illnesses that could be controlled in ambulatory settings (such as a urinary tract infection), and chronic diseases that can be managed in outpatient settings (such as asthma).[12] Nevertheless, many hospital admissions for avoidable hospitalization diagnoses may be completely unavoidable. For example, hospitalizations are unavoidable for patients who have asthma and have been adherent with their medications and received timely, effective outpatient care, but experienced a severe asthma exacerbation refractory to emergency department treatment. Studies, however, have not examined the proportion of pediatric avoidable hospitalizations

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that are assessed as avoidable by parents and physicians. Indeed, authors of previous work on avoidable hospitalizations have noted this issue and called for additional research to examine this critical question.[3,11] In addition, little is known about the perspectives of parents and physicians on how children's hospitalizations might be avoided.

The aims of this study, thus, were to 1) develop a taxonomy for avoidable hospitalizations in children; 2) determine the proportion of avoidable hospitalizations perceived to be definitely or potentially avoidable by the parents and physicians of hospitalized children; and 3) identify the ways that pediatric hospitalizations might be avoided, according to parents and physicians.

METHODS

Definitions

An avoidable hospitalization condition (AHC) is any hospitalization diagnosis that potentially could have been avoided with timely, effective outpatient care, as defined in previous work.[1] For pediatric AHC diagnoses, we used the list of 20 conditions compiled by Casanova and Starfield.[13] In brief, AHCs fall into 3 categories: 1) immunization-preventable conditions, such as pertussis, and meningitis caused by *Haemophilus influenzae*; 2) acute illnesses, such as cellulitis or pyelonephritis, that might have been prevented had the child received timely outpatient treatment and care; and 3) acute exacerbations of chronic diseases, such as asthma or diabetes mellitus, that might have been prevented with timely, effective ambulatory care. When referring to a specific hospitalization, the term "avoidable" is used to denote any hospital admission that was considered to be preventable according to 1 or more of the sources interviewed (parents, PCPs, and inpatient attending physicians [IAPs]).

Study Participants

We enrolled a consecutive series of all children (≤18 years old) who were admitted with AHC diagnoses to the inpatient ward of an inner-city hospital (Boston Medical Center) during a 14-month period (May 1997–December 1998). Exclusion criteria were 1) direct admission to the pediatric intensive care unit; 2) children whose parents could not be interviewed at any point during the hospital stay, such as in cases being investigated for suspected neglect or abuse; and 3) children hospitalized for several conditions whose listed primary diagnosis was not an AHC. Children who were admitted for AHC diagnoses were identified by review of the daily inpatient ward census logs, with cross-referencing and confirmation via chart inspection.

Data Collected and Questionnaire

We abstracted baseline sociodemographic data on each patient from the medical record. We recorded the child's age, the admission diagnosis, the name of the child's regular pediatrician (if the child had one), the name of the IAP, the type of insurance coverage, the child's race/ethnicity (verified by the parent/legal guardian), the parent/legal guardian's highest level of education attained, and the combined monthly family income.

The parent/legal guardian (hereafter referred to as "parent") of each admitted child completed a questionnaire in English or Spanish that was orally administered by a trained, bilingual Latina research assistant. For parents who had limited English proficiency and spoke a language other than English or Spanish, the research assistant administered the questionnaire with the assistance of a medical interpreter from the hospital's interpreter services. Before study initiation, we conducted a 4-month pilot study to test and further refine the questionnaire. In the final questionnaire, parents were asked why their child was admitted to the hospital, whether they believed anything could have been done to prevent the hospitalization (and, if yes, what), and what was their understanding of the condition for which the child was hospitalized. When the parents said that their child had a regular doctor, we asked whether the child had visited the physician, or the parents had spoken to the physician before the hospitalization, and assessed the parents' general satisfaction with the care provided by the physician. When the parents reported that the child had no regular health care provider, they were asked where they took their child for check-ups and vaccinations, and where they took the child for acute care. All parents also were asked to assess whether their child had easy access to health care, about whether health care costs or health insurance problems ever caused them not to bring their child in for needed care, and whether they encountered difficulties in getting medications for their child due to excessive costs or because health insurance did not cover the medications.

Efforts were made to conduct a brief face-to-face or telephone interview with the IAP and the PCP (when the child had a regular physician) of every hospitalized child. Each physician was asked to assess whether the child's hospitalization was preventable and to provide detailed reasons for the assessment. When we were unsuccessful in reaching a physician on the first contact, we telephoned the physician at least 10 additional times for at least 1 month before scoring the physician as unavailable for a given patient. In the rare case of when the PCP also was the IAP on the inpatient ward, assessment of avoidability was recorded only for the PCP.

Data Analysis

Bivariate comparisons were done using the χ^2 test or Fisher exact test (for comparisons with low cell counts), with a 2-tailed $P < .05$ considered significant. To assess interobserver agreement on the avoidability of hospitalizations, we calculated simple κ coefficients using SAS, and coefficients were interpreted using the scale of Landis and Koch.[14] Multivariable analyses were performed using logistic regression. The dependent variable was the avoidability of the hospitalization (dichotomized as yes/no) according to 1 or more sources. The independent variables chosen for analysis were those found to be significant in bivariate analyses, supplemented by independent variables found to be significant in previous published work on AHCs.[1–10] In cases in which an independent variable was defined >1 way, separate models were run for each definition. The independent variables analyzed included 1) the child has poor access to health care by parental report (yes/no); 2) the child's age (dichotomized as ≥11 years old vs <11 years old, based on bivariate analysis findings); 3) a diagnosis of asthma versus all other diagnoses (yes/no); 4) parent not a high school graduate (yes/no); 5) combined annual family income below the federal poverty threshold (yes/no); 6) combined annual family income in the third highest quartile (range: $12 144–$18 000), equivalent to working poor (yes/no; analyzed separately from analyses with poverty as an independent variable); 7) uninsured (yes/no); and 8) public health insurance (yes/no; analyzed separately from analyses with uninsured as an independent variable). Initially, multivariate analyses were done using 2 additional independent variables—having a regular physician and reported difficulties in getting medications for children as a result of cost or insurance coverage problems—but these variables were eliminated from additional analysis because of excessively small numbers in certain variable states that resulted in statistically unstable estimates. Multivariate models were initially generated using stepwise logistic regression with an α-to-enter of 0.15, and the final multivariable analysis was performed using an α-to-enter of 0.05. Relevant confounding independent variables were forced into the final multivariable models to yield adjusted odds ratios. Pearson correlation analysis was performed to determine whether there was collinearity (none was found in any of the models). The Hosmer-Lemeshow test was used to check goodness of fit for multivariate models (and each model showed excellent fit). All statistical analyses were performed using SAS Version 8.2 software.[15]

We obtained written informed consent from the parent/legal guardian of each participating child. The study was approved by the Boston Medical Center Institutional Review Board.

RESULTS

Study Sample

A total of 676 pediatric hospitalizations fulfilled initial study enrollment criteria. Ninety-nine patients were excluded from additional analysis after medical

TABLE 1. Selected Sociodemographic Characteristics of Study Participants ($N = 554$)

Characteristic	Finding
Median age (range)	4 years (4 d–18 y)
Child's health insurance coverage	
Private	11%
Public	73%
Uninsured	16%
Race/ethnicity of child	
Black	62%
Latino	24%
White	9%
Asian/Pacific Islander	4%
Native American	1%
Parental education	
Not high school graduate	42%
High school graduate	31%
1–3 y of college	14%
College graduate	11%
Beyond college	2%
Median combined annual family income (range)	$12 000 ($1200–$84 000)
Combined annual family income below federal poverty threshold	70%
Child has regular physician	94%
Contact with physician (office visit or telephone call by parent) before hospitalization	51%
Parent satisfied or very satisfied with regular physician's care of child*	89%
Ever not brought in child for needed medical care because of expense or health insurance problem	8%
Ever had difficulty obtaining child's medication	15%
Child has easy access to medical care	90%

* Among 525 children who reported having a regular physician.

record inspection and/or discussion with the IAP revealed a primary diagnosis that was not an AHC. An additional 17 patients were excluded because of short hospital stays in which contact with the parent could not be established during or after the admission ($N = 9$), a language barrier was present and a medical interpreter was unavailable for assistance with questionnaire completion during the hospital stay ($N = 5$), and the parent was unavailable for questioning because of a Department of Social Services investigation of possible child abuse or neglect ($N = 3$). Of the remaining 560 potential subjects, 6 (1%) refused to participate in the study. The diagnosis for 4 of the 6 refusals was asthma, but there were no significant differences in age or race/ethnicity between study refusals and final participants.

The median age of the 554 hospitalized children was 4 years (Table 1). Approximately three quarters were covered by public health insurance, and 16% were uninsured. Almost two thirds of the children were black, and approximately one quarter were Latino, but all 5 major US racial/ethnic groups were represented. The median combined annual family income was $12 000, and 70% of children lived in poverty. Forty-two percent of parents had never graduated high school, and only 13% were college graduates.

Most of the hospitalized children had a regular physician (Table 1). The majority of parents reported high satisfaction with their child's medical care and having easy access to pediatric care. Approximately half of the parents had brought their children to a physician or spoke to the physician on the telephone before the hospitalization. Only a small proportion of parents reported difficulty obtaining medications for their child or deferring needed medical care for the child because of expense or health insurance problems.

Avoidable Hospitalizations

There were 16 AHC diagnoses among the 554 hospitalizations (Table 2). Asthma was by far the most common diagnosis, comprising 43% of admissions. The top 6 AHC diagnoses (asthma, dehydration/gastroenteritis, pneumonia, seizure disorder, skin infection, and urinary tract infection/pyelonephritis) accounted for 90% of admissions. Three immunization-preventable hospitalizations were for *Varicella* infections, and 1 was for pertussis. There were no admissions for the following AHCs: chronic obstruc-

TABLE 2. Frequency of Specific Avoidable Hospitalization Conditions in the Study Population ($N = 554$)

Avoidable Hospitalization Condition	Proportion of All Hospitalizations*
Asthma	43%
Dehydration/gastroenteritis	16%
Pneumonia	11%
Seizure disorder	8%
Skin infection	8%
UTI/pyelonephritis	4%
Failure to thrive	3%
Severe ear-nose-throat infections	2%
Pelvic inflammatory disease	2%
Diabetes mellitus	2%
Immunization-preventable conditions	0.7%
Tuberculosis	0.4%
Anemia	0.2%
Congenital syphilis	0.2%
Congestive heart failure	0.2%
Dental conditions	0.2%

UTI indicates urinary tract infection.
* Total exceeds 100% because of rounding.

TABLE 3. Avoidability of Hospitalizations ($N = 554$) According to Parents, PCPs, and IAPs

Source	Proportion of Hospitalizations Assessed as Avoidable	Percentage Agreement	κ Coefficient (95% Confidence Interval)
Parents ($N = 501$*)	25%	—	—
PCP ($N = 378$)†	29%	—	—
IAP ($N = 527$)‡	32%	—	—
Any of 3 sources	46%	—	—
2 or more sources	19%	—	—
Any physician source	37%	—	—
Parent + PCP	15%	72%	0.31 (0.2–0.4)
Parent + IAP	13%	68%	0.22 (0.1–0.3)
IAP + PCP	21%	79%	0.51 (0.4–0.6)
All 3 sources	12%	—	—

* Fifty nine parents said that they did not know whether their child's hospitalization was avoidable or not.
† PCPs for 182 subjects failed to respond after repeated contacts.
‡ Inpatient attending physicians for 33 subjects failed to respond after repeated contacts.

tive pulmonary disease, hypertension, angina, hypoglycemia, and nutritional deficiencies (except for a child with rickets whose primary diagnosis was failure to thrive).

The proportion of hospitalizations assessed as avoidable varied substantially according to the source or combination of sources (Table 3). Among the 3 individual sources, the proportion of avoidable hospitalizations varied from 25% when assessed by parents to 32% when assessed by IAPs. Examining combinations of sources, the proportion of avoidable hospitalizations varied from 12% for agreement among all 3 sources, compared with 46% as identified by any 1 of the 3 sources. The raw agreement index varied from 68% to 79%, with the highest agreement between the 2 physician sources (Table 3). Simple κ coefficients reveal fair agreement between parents and PCPs and between parents and IAPs, and moderate agreement between PCPs and IAPs.

The proportion of hospitalizations assessed as avoidable by specific diagnosis also varied substantially according to the source or combination of sources (Table 4). For asthma, for example, the proportion of hospitalization identified as avoidable varied from 18% when assessed through complete agreement among all 3 sources (parents, PCPs and IAPs) to 47% when assessed by any of the 2 physician sources. For pneumonia, the proportion of hospitalizations identified as avoidable varied from 0% when assessed by complete agreement among the 3 sources to 28% when assessed by parents alone. The greatest range occurred with skin infections, with only 12% assessed as avoidable by combined agreement between parents and IAPs, compared with 54% assessed as avoidable by any of the 2 physician sources.

Reasons for Avoidability of Hospitalizations

Reasons for how children's hospitalizations could have been avoided varied by the source (Table 5).

Parent/Patient-Related Reasons

Both physician groups significantly more often cited parent/patient-related reasons for how the hospitalizations could have been avoided, and PCPs were significantly more likely than IAPs to cite this category (71% vs 48%; $P < .001$). In the parent/patient-related reasons category, PCPs most often identified delayed or no follow-up, which was their most frequent reason cited overall. Although IAPs (17%) also frequently cited delayed/no follow-up, parents (2%) were significantly less likely to cite this reason than either physician group. All 3 groups frequently cited medication-related issues (adherence problems, running out of the child's medications, and not obtaining refills), and parents (and some older children) often admitted to inadequate preventive measures (failure to avoid known asthma triggers, such as cigarette smoke, pets, dust, and exposure to sick contacts with upper respiratory illness, as well as failing to use condoms). Other less frequent parent/patient-related reasons mentioned by parents included not telephoning a health care provider earlier, and parental failure to correctly di-

TABLE 4. Bivariate Analysis of the Proportion of Avoidable Hospitalizations ($N = 554$) in Children by Specific Diagnostic Categories

Diagnosis	Hospitalization Avoidable According to								
	Parent	PCP	IAP	2 or More Sources	Any MD	Parent + PCP	Parent + IAP	PCP + IAP	All 3 Sources
Asthma	26%	36%	43%	27%	47%	19%	19%	29%	18%
Dehydration/gastroenteritis	26%	30%	20%	15%	29%	11%	10%	16%	8%
Pneumonia	28%	13%	13%	10%	18%	7%	2%	5%	0%
Seizure disorder	11%	4%	18%	7%	20%	4%	5%	0%	0%
Skin infection	27%	48%	51%	20%	54%	21%	12%	41%	23%
UTI/pyelonephritis	11%	6%	4%	0%	8%	0%	0%	0%	0%
Other	30%	35%	32%	22%*	40%*	17%	13%	23%	11%

UTI indicates urinary tract infection.
* $P < .05$ by Mantel-Haenszel χ^2 test for trend.

TABLE 5. Reasons for Avoidability of Hospitalizations, According to the Parents, PCPs, and IAPs of Hospitalized Children ($N = 554$)

Reason Hospitalization Was Avoidable	Proportion Considered Avoidable by Source		
	Parent	PCP	IAP
Parent/patient-related	35.3%§	71.1%¶	48.1%††
Medication related (adherence problems, ran out, didn't call in refill)	15.8%‡	27.4%	22.7%
Inadequate prevention, including not avoiding known disease trigger	13.5%†	5.9%	7.0%#
Delayed or did not bring child in for follow-up care	2.3%§	33.3%¶	16.8%‡‡
Needed to call earlier	1.5%	1.5%	—
Child not immunized	—	0.7%	—
Did not monitor child's peak flow	—	0.7%	—
No transportation	—	0.7%	—
Appropriate care not provided at home	—	0.7%	—
Parent did not correctly diagnose child's condition	0.8%	—	—
Parents did not adequately educate themselves	—	—	1.1%
Parents don't have enough time to care for child	—	—	0.5%
Physician-related	48.1%§	17.8%¶	36.8%**
Inadequate or no intervention administered to child (including medications and intravenous fluids)	12.8%**	—	22.1%**
Physician did not adequately educate parent/child	10.5%	10.5%	11.4%
Poor quality of care	8.3%	—	—
Physician failed to make diagnosis	7.5%	—	—
No follow-up arranged	3.0%	1.5%	2.1%
Child discharged from hospital too early	2.3%	—	—
Physician failed to act on abnormal laboratory findings	0.8%	—	—
Child not referred to specialist	0.8%	—	0.5%
Long wait to see specialist	0.8%	—	—
Inadequate continuity of care	0.8%	—	—
Physician bias	0.8%	—	—
Inappropriate admission	—	5.2%‖	0.5%†
Primary care physician not contacted after last admission	—	0.7%	—
Primary care physician not involved	—	—	2.1%
Equipment/medication failure	4.5%*	0.7%	1.1%#
Housing conditions	3.0%	2.2%	2.2%
Financial issues	1.5%	—	—
Health care system issues	—	3.7%	3.8%
Social issues	—	1.5%	3.2%
Employment exposure	0.8%	—	—
No reason/don't know	5.3%	3.0%	4.9%
Other	1.5%	—	—

P values for comparison between parents and primary care physicians: * = .03; † = .02; ‡ = .01; § < .001.
P values for comparison between primary care and inpatient attending physicians: ‖ = .004; ¶ < .001.
P values for comparison between parents and inpatient attending physicians: # = .03; ** = .02; †† = .01; ‡‡ < .001.

agnose the child's condition. PCPs infrequently cited the parents' not telephoning a health care provider earlier, failure to immunize or monitor peak flows, lack of transportation, and inadequate care at home. IAPs infrequently mentioned inadequate parental self-education on the child's condition and not having enough time to appropriately care for the child.

Physician-Related Reasons

Parents were significantly more likely than either physician source to cite physician-related reasons for prevention of hospitalizations, with approximately half of parents citing this general category. IAPs, however, were twice as likely as PCPs to cite physician-related reasons (37% vs 18%; $P < .001$). The leading physician-related reason cited by both parents and IAPs was inadequate or no intervention administered to the child, including medications and intravenous fluids. Although no PCP cited this reason, they most often cited inadequate education by physicians of the parent and/or child about the child's condition. PCPs (5%) most often cited inappropriate hospital admissions as a reason for preventing hospitalizations, and significantly more often than IAPs. Other physician-related reasons frequently cited by parents included poor quality of care, physician failure to make the diagnosis, and no follow-up arranged for by the physician. Parents less frequently identified premature hospital discharge, physician failure to act on an abnormal laboratory finding, no referral or long waits to see a specialist, inadequate continuity of care, and physician bias. IAPs also infrequently cited failure to refer to a specialist, as well as inadequate involvement of the PCP, and both physician sources mentioned physician failure to arrange for follow-up visits. PCPs rarely cited a failure of IAPs to contact the PCP after hospital discharge.

Other Reasons

The 8 remaining categories of reasons how pediatric hospitalizations could be avoided (Table 5) were cited substantially less frequently. Parents identified equipment and medication failure issues significantly more often than either physician group. Most of the specific reasons in this category involved broken nebulizers used for home treatment of asthma. All housing conditions mentioned consisted of indoor environmental triggers for children with asthma that had not been addressed by landlords, including cockroaches, mold, carpet, lack of heat, and homes in disrepair. Financial issues cited by

parents included inability to afford a nebulizer for asthma treatment, and having no money for treatment of a child's dental abscess. Both physician groups cited health care system issues that included children lacking PCPs, absence of a short-stay unit in the emergency department, the pharmacy's failing to provide prescribed medications to the family, lack of time to manage complicated issues in a busy pediatric practice, failure of the Department of Social Services to do their job, and lack of outreach nurses. Social issues were cited by both physician sources, and 1 asthma hospitalization occurred because of a work exposure in an adolescent. Equal proportions of all 3 sources gave no reason or were uncertain about why the child's hospitalization was avoidable.

Bivariate Analyses

In bivariate analyses (Table 6), age was the independent variable most consistently associated with avoidable hospitalizations, as assessed by parents and physicians. For 8 of 9 sources, older age was significantly associated with the hospitalization being avoidable ($P \leq .005$). The highest proportions of avoidable hospitalizations were seen among children 15 to 18 years of age, with a range of from 29% to 63%. Having made no physician visit before the illness was significantly associated with an avoidable hospitalization for 3 of the 9 sources. Having no regular physician, not being covered by public health insurance, and having a "working poor" combined family income (in the third quartile) were found to be significantly associated with avoidable hospitalizations for only 2 of 9 sources, and nonpoor children were found to have a significantly higher rate of avoidable hospitalizations only when the source was PCPs. None of the remaining independent variables (telephone contact before hospitalization, parental satisfaction with care, visit deferral due to expense or lack of insurance, difficulty obtaining medications, easy access to medical care, lack of insurance coverage, private insurance coverage, race/ethnicity, or parental educational attainment) was significantly associated with avoidable hospitalizations according to any source.

Multivariate Analyses

After adjustment for relevant covariates in multivariate analysis, older age (≥11 years) and having a diagnosis of asthma were most consistently significantly associated with a hospitalization's being avoidable, as assessed by parents and physicians (Table 7). Older age was associated with avoidable hospitalizations for 6 of 9 sources, with significant odds ratios ranging from 1.8 to 2.8. The diagnosis of asthma also was associated with avoidable hospitalizations for 6 of 9 sources, with significant odds ratios ranging from 2.2 to 3.2. Being a child from a working poor family (combined annual family income in the third quartile, equivalent to $12 144 to $18 000) was significantly associated with avoidable hospitalizations for 4 of the 9 sources, all of which included the parents, and the odds ratios ranged from 2.0 to 3.2. Lack of insurance was significantly associated with increased odds of an avoidable hospitalization for 3 of the 9 sources, with uninsured children having 1.8 to 2.8 odds of avoidable hospitalizations in these 3 cases, but in 2 of 3 cases, lack of insurance was associated with avoidable hospitalizations only when family income was dichotomized by poverty status (and not by quartiles). Poor access to care was associated with a reduced odds of an avoidable hospitalization only for 1 of the 9 sources. Poverty, parental educational attainment, and having public health insurance coverage were not found to be significantly associated with avoidable hospitalizations according to any of the 9 sources.

DISCUSSION

We found that the proportion of AHC hospitalizations that is avoidable varies substantially according to the source used to make the assessment. If one defines an avoidable hospitalization as one that is unanimously agreed on as avoidable by parents, PCPs, and IAPs, then only 12% of AHCs are definitely or potentially avoidable. If one defines an avoidable hospitalization as one that any of these 3 sources assesses as avoidable, however, then almost half (46%) of all AHCs are definitely or potentially avoidable. Similar substantial variability was noted when considering the avoidability of hospitalizations for individual diagnoses, which ranged from 0% to 54% (Table 4). The study findings thus indicate that great caution should be exercised when analyzing AHCs in administrative databases and secondary data sets, because 1) 54% to 88% of all AHCs may be unavoidable, 2) 46% to 100% of specific AHC diagnoses may be unavoidable, and 3) the proportion of AHCs that are avoidable varies considerably according to the source or combination of sources making the assessment. These findings also suggest that "ambulatory care-sensitive conditions" would be the most accurate term to use when considering AHCs in analyses of administrative databases and secondary data sets.

Six AHC diagnoses (asthma, dehydration/gastroenteritis, pneumonia, seizure disorder, skin infections, and urinary tract infections/pyelonephritis) accounted for 90% of avoidable pediatric hospitalizations. This finding suggests that efforts focused on preventing hospitalizations for these 6 conditions have the potential to result in considerable reductions in children's hospitalizations and the associated costs.

Parents and physicians consistently identified several measures for preventing pediatric hospitalizations, most of which are easy to integrate into clinical practice. Parents cited their failure to pay greater attention to medication-related issues as the single most common reason for children's avoidable hospitalizations. This also was the most common reason cited by IAPs and the second most common reason cited by PCPs. Parents also frequently admitted that their failure to take adequate preventive measures was responsible for their child's avoidable hospitalization, an issue often cited by both groups of physicians as well. Parents and both physician groups, however, also frequently cited inadequate education about the child's condition by a physician as a reason

TABLE 6. Bivariate Analysis of Associations Between Selected Sociodemographic Factors and Avoidability of Hospitalizations

Variable	Hospitalization Avoidable According to								
	Parent	PCP	IAP	2 or More Sources	Any MD	Parent + PCP	Parent + IAP	PCP + IAP	All 3 Sources
Child's age									
<12 mo	26%	27%	15%	13%	26%	13%	3%	10%	2%
12–23 mo	23%	23%	21%	14%	26%	13%	10%	14%	10%
24–35 mo	14%	25%	32%	17%	36%	8%	8%	20%	8%
3–5 y	25%	22%	30%	19%	32%	14%	13%	19%	11%
6–10 y	26%	30%	38%	22%	44%	17%	18%	20%	3%
11–14 y	23%	34%	44%	22%	49%	12%	15%	23%	10%
15–18 y	44%	63%†	56%§	37%†	59%§	38%*	29%‡	58%§	40%‡
Child has regular physician									
No	20%	50%	40%	11%	40%	100%	13%	50%	100%
Yes	25%	29%	32%	20%	37%	14%‖	13%	20%	11%¶
Child visited physician before illness (if has regular physician)									
No	24%	32%	36%	22%	41%	15%	14%	25%	13%
Yes	26%	25%	25%#	17%	31%‡	14%	11%	15%#	10%
Parent spoke to doctor by telephone before hospitalization									
No	26%	34%	37%	23%	42%	16%	15%	26%	13%
Yes	15%	27%	31%	18%	36%	10%	13%	21%	11%
Parent very satisfied with care									
No	25%	28%	26%	19%	36%	14%	12%	19%	10%
Yes	23%	34%	34%	23%	39%	16%	15%	25%	14%
Parent very satisfied or satisfied with care									
No	31%	21%	36%	19%	38%	11%	15%	16%	9%
Yes	24%	30%	31%	20%	37%	15%	13%	21%	11%
Has ever not brought child to doctor because of expense/problem with insurance									
No	25%	29%	32%	19%	37%	14%	13%	20%	12%
Yes	25%	31%	30%	24%	33%	17%	13%	25%	10%
Has had difficulty getting medications									
No	24%	29%	32%	19%	36%	15%	13%	21%	12%
Yes	27%	27%	34%	22%	40%	14%	15%	17%	10%
Child has easy access to medical care									
No	33%	32%	42%	28%	45%	21%	13%	26%	12%
Yes	24%	28%	31%	19%	36%	14%	13%	20%	12%
Uninsured (only those who say "no")									
No	24%	24%	31%	19%	36%	13%	12%	20%	10%
Yes	32%	35%	39%	24%	45%	26%	18%	25%	20%
Public health insurance									
No	30%	34%	38%	23%	42%	22%	17%	26%	18%
Yes	22%	27%	29%	18%	35%	12%**	11%	18%	9%#
Private insurance									
No	25%	28%	31%	20%	36%	14%	13%	20%	11%
Yes	25%	34%	39%	19%	42%	17%	13%	27%	16%
Race/ethnicity									
White, non Latino	29%	19%	24%	17%	27%	10%	12%	13%	7%
Latino	23%	32%	30%	18%	38%	15%	8%	19%	9%
Black	24%	29%	38%	21%	42%	15%	14%	23%	14%
Caribbean black	32%	31%	28%	24%	33%	15%	18%	22%	11%
Asian	15%	23%	18%	16%	21%	13%	0%	18%	0%
Other	30%	25%	36%	16%	40%	25%	20%	20%	25%
Parents' education									
Less than high school graduate	26%	31%	32%	19%	39%	15%	12%	20%	11%
High school graduate or more	24%	28%	32%	20%	36%	14%	13%	21%	12%
Poverty status									
Poor	26%	23%	31%	12%	35%	13%	14%	16%	11%
Nonpoor	22%	36%**	33%	23%	41%	18%	14%	24%	14%
Combined annual family income by quartiles									
1 (lowest)	22%	21%	35%	18%	37%	13%	14%	16%	10%
2	25%	25%	31%	16%	35%	11%	10%	17%	8%
3	34%††	31%	29%	25%	34%	23%	22%††	24%	20%
4 (highest)	18%	32%	30%	19%	39%	12%	10%	19%	8%

P value by Mantel-Haenszel χ^2 test: * $< .05$; † $< .005$; ‡ $= .001$; § $< .0001$.
‖ $P = .02$ by Fisher exact test for comparison between "no" and "yes" groups.
¶ $P = .01$ by Fisher exact test for comparison between "no" and "yes" groups.
# $P < .05$ by Mantel-Haenszel χ^2 test for comparison between "no" and "yes" groups.
** $P = .02$ by Mantel-Haenszel χ^2 test for comparison between "no" and "yes" groups.
†† $P < .05$ by likelihood ratio χ^2 test.

TABLE 7. Multivariate Analysis of Factors Associated With Avoidable Hospitalizations in Children (as Assessed by Their Parents and Physicians)

Independent Variable*	Odds Ratio (95% Confidence Interval) of Hospitalization Being Avoidable According to							
	Parent	PCP	IAP	Any Source (Parent, PCP or IAP)	Any MD	Parent + PCP	Parent + IAP	PCP + IAP	All 3 Sources
Family income below federal poverty threshold	1.1 (0.6–1.8)	0.5 (0.3–0.8)	0.9 (0.6–1.4)	0.7 (0.4–1.2)	0.7 (0.5–1.1)	0.5 (0.3–1.1)	1.0 (0.5–1.9)	0.6 (0.3–1.1)	0.6 (0.3–1.3)
Third quartile of family income	**2.0 (1.2–3.2)**	1.3 (0.8–2.3)	0.8 (0.5–1.3)	1.5 (0.9–2.6)	0.9 (0.5–1.3)	**2.4 (1.2–4.9)**	**2.3 (1.2–4.4)**	1.5 (0.8–3.0)	**3.2 (1.4–7.5)**
Parent not high school graduate	1.1 (0.7–1.8)	1.2 (0.7–2.1)	1.0 (0.6–1.5)	1.0 (0.6–1.6)	1.2 (0.8–1.8)	1.2 (0.6–2.4)	1.0 (0.5–1.7)	0.9 (0.4–1.7)	0.97 (0.4–2.2)
Asthma diagnosis	1.1 (0.7–1.7)	1.6 (0.97–2.7)	**2.6 (1.7–4.0)**	**2.3 (1.5–3.8)**	**2.2 (1.5–3.3)**	1.9 (0.97–3.8)	**3.0 (1.6–5.5)**	**2.5 (1.3–4.7)**	**3.2 (1.4–7.8)**
Child ≥11 y of age	1.5 (0.9–2.7)	**2.0 (1.1–3.9)**	**2.5 (1.4–4.3)**	**1.8 (1.0–3.2)**	**2.1 (1.2–3.5)**	1.4 (0.6–3.1)	**2.2 (1.1–4.3)**	**2.8 (1.3–5.8)**	2.4 (0.9–5.8)
Poor access to care	0.6 (0.3–1.2)	0.7 (0.3–1.4)	0.6 (0.3–1.1)	**0.5 (0.2–0.96)**	0.6 (0.4–1.2)	0.6 (0.2–1.4)	0.9 (0.4–2.6)	0.6 (0.2–1.4)	0.9 (0.3–3.4)
Uninsured	1.7 (0.9–3.0)	1.6 (0.8–3.0)	1.7 (0.98–3.0)	1.5 (0.8–2.8)	**1.8 (1.1–3.1)**†	**2.8 (1.2–6.4)**	1.8 (0.8–3.8)	1.6 (0.7–3.5)	**2.7 (1.0–7.0)**†
Public health insurance	0.8 (0.5–1.3)	0.8 (0.5–1.5)	0.7 (0.4–1.0)	1.0 (0.6–1.6)	0.7 (0.5–1.1)	0.6 (0.3–1.2)	0.8 (0.4–1.5)	0.8 (0.4–1.5)	0.6 (0.3–1.3)

* The reference group for each independent variable is the corresponding alternate variable state (see Data Analysis section in Methods for detailed explanation).
† Uninsured significantly associated with dependent variable only when run with family income dichotomized as poor/nonpoor but not when family income analyzed by quartiles.

that a child was hospitalized for an AHC. These findings suggest that many pediatric hospitalizations potentially could be prevented if more effort and time were spent educating parents and children on 1) ensuring adequate medication adherence, including instruction on proper dosages, dose frequency, treatment duration, and how to obtain needed refills efficiently; 2) taking proper preventive measures, including avoiding known disease triggers (such as cigarette smoke, pet allergens, dust, and ill contacts in children with asthma) and having sexually active adolescents use condoms; and 3) more thoroughly understanding the child's medical condition, including the clinical course and optimal preventive and treatment measures.

Study findings underscored the importance of timely, effective outpatient care in the prevention of hospitalizations. Delayed or no follow-up outpatient visits for a child's condition was the reason for avoidable hospitalizations most often cited by PCPs, and frequently cited by IAPs. Parents, however, were significantly less likely than either physician group to cite this reason. This finding suggests that parents would benefit from more education on the importance of follow-up visits in managing their child's illness, and that telephone or postal reminders of upcoming follow-up appointments might be an important tool in preventing hospitalizations. In addition, both parents and physicians reported that physicians and their staff sometimes were responsible for follow-up problems, because follow-up appointments were never made. Clinicians thus should verify that adequate mechanisms are in place in their practices to ensure that patients who need follow-up visits can easily obtain appointments.

Although equipment/medication failures, housing conditions, financial and social issues, and health care system issues individually accounted for a small proportion of the reasons that hospitalizations were avoidable, collectively these issues were responsible for a considerable number of avoidable hospitalizations (11%–17%, depending on the source). These findings suggest that a fairly substantial number of children's hospitalizations could be avoided by having nebulizers in good working order, safer indoor home environments for children with asthma (including adequate heat and living conditions without cockroaches, mold, and other known disease triggers), adequate family health and dental insurance coverage, access to social services and outreach nurses, and establishment of short-stay units in pediatric emergency departments.

Both parents and physicians identified several quality-of-care issues associated with avoidable hospitalizations that warrant additional study. These include inadequate or no administration of medications or intravenous fluids, premature hospital discharge, no referral to specialists, physician bias, and parents' perceptions of poor quality of care and failure to make a diagnosis in a timely manner. These identified issues are consistent with studies[16,17] indicating that the quality of outpatient care for asthma can have an important influence on rates of hospitalization.

Multivariate analyses revealed 4 risk factors most consistently associated with avoidable hospitalizations, as assessed by parents and physicians. Adolescents, children with asthma, children from families with working poor incomes, and uninsured children were found to have approximately double to triple the odds of being hospitalized for an avoidable hospitalization. These findings suggest that a substantial number of pediatric hospitalizations might be avoided by targeting these at-risk populations for more intensive education, monitoring, follow-up, and preventive measures.

Although previous research found poor access to care,[2] poverty,[1–8] and lower educational attainment[6] to be associated with avoidable hospitalizations, we found no consistent, significant relationship between any of these variables and avoidable hospitalizations as assessed by parents and physicians. Indeed, poor access to care was associated with a significantly reduced odds of avoidable hospitalizations as assessed by 1 source (Table 7). Two possible explanations may account for the absence of association and selected paradoxical findings. First, prior analyses were performed based on the assumption that most or all AHCs are avoidable, but our study findings suggest that most AHCs (54%–88%) are actually unavoidable, from the perspective of parents and physicians of hospitalized children. Second, our results indicate that parent- and physician-identified reasons for avoidable hospitalizations may be powerful factors that override other important independent variables known to be associated with hospital admissions. Factors such as lack of adherence with medications, failure to avoid known disease triggers, and no outpatient follow-up may be among the most significant determinants (individually and in concert) of avoidable hospitalizations, regardless of whether a child has excellent access to care or comes from a wealthy, well-educated family.

Certain limitations of this study should be noted. The study population consisted of predominantly low-income, urban, minority children, most of whom had public or no insurance coverage. The findings, therefore, may not apply to populations of children who have higher family income, live in suburban or rural areas, are white, or have higher proportions of private insurance coverage. Data were collected on the admitting diagnosis but not the discharge diagnosis for each hospitalization. Future studies might consider examining the discharge diagnosis to determine whether it matches the admitting diagnosis, and whether the admitting diagnosis appears among the top 3 discharge diagnoses for each hospitalization. Although a considerable proportion of children with skin infections were assessed to have had avoidable hospitalizations, the sample size was not large enough to provide statistically stable estimates in multivariate analyses. Studies of larger populations may reveal that skin infections, like asthma, are associated with greater odds of an avoidable hospitalization. Similarly, the number of children without a regular PCP was not large enough to provide statistically reliable estimates in multivariate analyses, although bivariate analyses revealed no significant association with an avoidable hospitalization as assessed by 7 of 9 sources (Table 6).

Recent national data reveal that 4.4 million US children have asthma, 3.8 million experience an asthma exacerbation each year, and >174 000 are hospitalized annually for asthma.[18] Childhood asthma has reached epidemic proportions[19]: the number of US children with asthma has essentially doubled since 1980,[19,20] and pediatric asthma hospitalizations increased an average of 1.4% per year since 1980, despite concomitant declines in pediatric hospitalizations for other causes, and advances in asthma treatment.[19,20] Our study findings revealed that a diagnosis of asthma is associated with a significantly higher odds of an avoidable hospitalization. Parents and physicians of children hospitalized with asthma identified several potential mechanisms for preventing pediatric asthma hospitalizations: 1) high adherence to prescribed medication; 2) ensuring that medication refills are provided and easily obtainable; 3) avoiding known disease triggers (including cigarette smoke, pets, dust, and exposure to sick contacts with upper respiratory illness); 4) scheduling and making needed outpatient follow-up visits; 5) educating parents and children about asthma and its optimal management; 6) ensuring that home nebulizer machines are in proper working order; and 7) addressing high-risk housing conditions, including problems with cockroaches, mold, carpet, lack of heat, and homes in disrepair.

Consistent with a previous study of Medicaid-covered children, race/ethnicity was not found to be significantly associated with avoidable hospitalizations.[21] Nevertheless, the findings that an asthma diagnosis, working-poor family income, and having no health insurance were associated with an increased odds of avoidable hospitalizations may have important implications for racial/ethnic disparities in health. For example, data document that the asthma epidemic in the United States disproportionately affects minority children: the asthma hospitalization rate in African-American children is 3.7 times higher than that of non-Latino white children,[20] the asthma death rate in African-American children is 4.6 times higher than that of non-Latino white children,[20] and Puerto Rican children have the highest asthma prevalence of any racial/ethnic group of US children.[22,23] In addition, minority children are significantly more likely to be poor[24] and uninsured.[25] Our study sample consisted of predominantly African-American (62%) and Latino (24%) children and their families, most of whom were poor and many of whom were uninsured. Thus, the 7 potential mechanisms for preventing pediatric asthma hospitalizations described above may prove to be especially useful in eliminating the substantial racial/ethnic disparities in childhood asthma morbidity and mortality, particularly among those who are poor and/or uninsured.

In conclusion, the results of this study suggest that many pediatric hospitalizations might be avoided if parents and children were better educated about their child's condition, medications, the need for follow-up care, and the importance of avoiding known

disease triggers. One of the most powerful and informative approaches for assessing the proportion of avoidable pediatric hospitalizations and how they can be prevented may be to ask directly parents and physicians of hospitalized children.

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