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Receipt of Systemic Corticosteroids during Asthma Visits to US Emergency Departments, 2007–2009

Alan E. Simon, M.D.[1,*], **Lara J. Akinbami, M.D.**[1,2]

[1]Infant, Child, and Women's Health Statistics Branch, Office of Analysis and Epidemiology, National Center for Health Statistics, Centers for Disease Control and Prevention, Hyattsville, MD, USA.

[2]US Public Health Service, Rockville, MD, USA.

Abstract

Background.—National Asthma Education and Prevention Program recommended emergency department (ED) asthma treatment includes both providing systemic corticosteroids in the ED and a steroid prescription at discharge.

Objective.—To examine the prevalence of three types of substandard ED asthma care–providing a discharge prescription only, providing corticosteroids in the ED only, and providing neither—and how care varies with exacerbation severity.

Methods.—We used the National Hospital Ambulatory Medical Care Survey-Emergency Department (NHAMCS-ED) (2007, 2008, and 2009) to identify ED asthma visits (*International Classification of Diseases-9th Revision Clinical Modification* (ICD-9-CM codes 493.xx)) for patients aged 1 to <65 years. The primary outcome was the percent of visits receiving each type of substandard care, both overall and by exacerbation severity. Multinomial logistic regressions with predictive margins were used to obtain estimates adjusted for patient, visit, and hospital characteristics.

Results.—For 27.1% (confidence interval (CI): 24.0–30.2%) of visits, patients received corticosteroids both in the ED and as a discharge prescription. A discharge prescription only was provided for 12.3% of visits (CI: 10.2–14.6%), corticosteroids were provided in the ED only for 18.2% (CI: 15.6–21.2%), and no corticosteroids were provided for 42.4% (CI: 38.8–46.2%). Even among visits by patients with abnormal overall respiratory status (fast respiratory rates, pulse oximetry values <97%, or both), only 32.3% (CI: 27.8–36.8) were provided corticosteroids both in the ED and as a prescription, while the remainder received some type of substandard care. Adjusted and unadjusted results were similar.

Conclusions.—Substandard ED asthma care is common, even among visits by patients with more severe asthma exacerbations.

Keywords

asthma; emergency departments; healthcare quality; national data; systemic corticosteroids

[*]Corresponding author: Alan E. Simon, M.D., Medical Officer/Senior Service Fellow, National Center for Health Statistics, 3311 Toledo Road, Rm 6122, Hyattsville, MD 20782, USA; Fax: +301 458 4038; fpa8@cdc.gov.

Introduction

During 2009, there were approximately 2.1 million visits for asthma to emergency departments (EDs) in the United States (1). The National Asthma Education and Prevention Program (NAEPP) guidelines recommend that oral and/or intravenous systemic corticosteroids be provided to patients treated in the ED for moderate and severe asthma exacerbations (2). In addition, a follow-up 3–10 day course of oral corticosteroids is recommended to speed recovery and to reduce relapse rates (2, 3). Moderate to severe exacerbations are defined by several clinical factors (2) and represent the majority of asthma ED visits (4). However, recent evidence suggests that a third or more patients receive no corticosteroids when they visit the ED. That is, they neither receive corticosteroids during acute asthma ED visits nor receive corticosteroids as a prescription at discharge from the ED (5), although many would benefit from them (6, 7).

However, patients with asthma exacerbations may receive corticosteroids either in the ED or as a prescription at ED discharge, but not both, still resulting in substandard care that is not consistent with NAEPP guidelines. What remains unknown is the percentage of visits for which patients receive different types of substandard ED asthma care: receiving corticosteroids in the ED but not as a discharge prescription, receiving corticosteroids as a discharge prescription but not in the ED, or receiving neither ED corticosteroids nor a discharge prescription. Also, the severity and clinical characteristics of asthma exacerbations among those who receive substandard care are unknown.

This study builds on previous work using the National Hospital Ambulatory Medical Care Survey-Emergency Department (NHAMCS-ED) for years 2001–2007 showing that children ≤18 years of age did not receive corticosteroids for 37% of asthma ED visits (5). However, this previous analysis could not use newly available data in 2005 specifying whether medications given were given in the ED, as a prescription upon discharge, or both. Also, newer data have been released that include pulse oximetry values (2006) and respiratory rates (2007) allowing a more complete description of asthma exacerbations. In this study, we used this more recent NHAMCS-ED data to reexamine provision of corticosteroids for ED visits among children and adults, focusing on the rates of different types of substandard care and to assess the role of exacerbation severity in the provision of corticosteroids.

Methods

We used 2007–2009 data from the NHAMCS-ED, a national probability-sample survey of ED visits at U.S. nonfederal hospitals conducted by the National Center for Health Statistics (NCHS). NHAMCS-ED uses a four-stage design which samples primary sampling units (PSUs) as the first stage, hospitals within PSUs as the second stage, emergency service areas within EDs as the third stage, and patient visits as the final stage. Details of the NHAMCS-ED survey and sampling design are published elsewhere (8, 9). Information about patient demographics, vital signs, reason for visit, three provider diagnostic codes, diagnostic services, procedures, medications, and visit disposition is abstracted from medical records by NCHS field representatives or hospital staff solely for the purposes of the NHAMCS-ED survey. Unweighted response rates ranged from 79.5% to 86.7% from 2007–2009 (10–12). Three years of data were combined to increase the stability of estimates. Estimates were considered unreliable if they had a relative standard error (SE) >30% or were based on fewer than 30 unweighted observations (13). Sample weights were calculated by NCHS using the reciprocals of sampling selection probabilities and nonresponse adjustments and were used to calculate national estimates. STATA/SE version 12.0 was used to conduct all analyses. The SVY suite of commands was used to account for the complex sample design.

Visits with acute asthma exacerbations were identified using *International Classification of Diseases-9th Revision Clinical Modification* (ICD-9-CM) diagnosis codes for asthma exacerbations (code 493). A relevant code in any of the three diagnosis fields indicated an asthma exacerbation. Visits were excluded if the patient was under 1 or over 65 years of age (due to possible difficulties distinguishing asthma from bronchiolitis in the young and Chronic Obstructive Pulmonary Disease in the elderly). Additionally, patients admitted to the hospital ($n = 191$) were excluded because they might have received corticosteroids during hospitalization but not in the ED. These criteria resulted in 1854 visits for asthma exacerbations. Of these, 70.3% had a diagnostic code for asthma in the first-listed position.

Our dependent variable included the following categories to reflect each type of substandard care and standard care: 1) No corticosteroids provided or prescribed, 2) corticosteroids provided in the ED, but not prescribed upon discharge, 3) corticosteroids not provided in the ED, but prescribed upon discharge, and 4) corticosteroids provided in the ED and prescribed upon discharge (standard of care). We hypothesized that the clinical characteristics of a patient may be associated with one type of failure to provide corticosteroids or the other, but perhaps not both. For example, less severe exacerbations might be associated with providing a prescription at discharge but failure to provide corticosteroids in the ED, while severe exacerbations might be associated with receiving corticosteroids in the ED and instructions to seek follow-up the next day in lieu of a discharge prescription.

We used NHAMCS-ED coding of medications “prescribed or provided at this visit” (up to eight) listed for each visit to identify the most commonly prescribed intravenous and oral corticosteroids (prednisone, prednisolone, methylprednisolone, and dexamethasone). Inhaled corticosteroids were analyzed separately, as the standard of care specifies that systemic corticosteroids should be provided for moderate to severe exacerbations in acute care settings. Inhaled corticosteroids (beclomethasone, budesonide, ciclesonide, flunisolide, fluticasone, mometasone, and triamcinolone) were also identified, either alone or in combination with other medications. In 25 cases, it was unclear from medication codes whether corticosteroids were for nasal or inhalational use. In these cases, diagnoses were reviewed, and in all cases except one, asthma was the only diagnosis for which the medication would likely have been prescribed. Therefore, these cases were likely to represent inhaled corticosteroids rather than nasal corticosteroids and were included as visits in which inhaled corticosteroids were provided. Whether corticosteroids were provided only in the ED, were provided only as a prescription, or both were identified using checkboxes on the NHAMCS-ED abstraction form. Nine visits for which corticosteroids were given but neither box was checked were excluded (0.49% of asthma visits).

Of the 839 visits for which no corticosteroids were received, 12 had the maximum number of eight medications listed. Therefore for only this small percentage of visits (1.4%), it was possible that corticosteroids were given but not recorded due to lack of space on the NHAMCS abstraction form.

Sub-group analysis was conducted for children and adolescents 1–19 years of age ($n = 898$) because the epidemiology and pathophysiology of asthma in children may differ from those of adults (14–16) and to allow more direct comparison to the previous analysis of NHAMCS data on corticosteroids provision for asthma ED visits (5). For this subgroup, 61 visits were excluded because they resulted in hospital admission, and 6 visits were excluded because the checkboxes identifying the mode of corticosteroids provision were blank. This resulted in 831 observations in this sub-group analysis.

Clinical severity of the episode was measured using respiratory rate and pulse oximetry. Respiratory rate was classified as normal, increased, or fast for age based on the asthma scoring system used by Children's National Medical Center (Table 1) (17). Overall, clinical severity of the exacerbation was categorized as: "normal respiratory status" (normal pulse oximetry value of 97–100% (18) and normal respiratory rate) and "abnormal respiratory status" (abnormal value recorded for pulse oximetry, respiratory rate, or both). The abnormal respiratory status category identified the group likely to have moderate or severe exacerbations. To provide validation of our asthma severity measures, we compared the rate of hospital or observation unit admission among those in different respiratory groups using logistic regressions. The odds ratios (ORs) of admission were significantly greater among those with abnormal compared to normal respiratory status (OR = 1.87, $p < .01$). The ORs of admission were greater in the fast respiratory rate group compared to those in the normal group (OR = 2.13, $p < .01$), and the ORs of admission were greater in the lowest pulse oximetry group compared to those in the normal pulse oximetry group (OR = 2.84, $p < .001$). This suggests that these measures are indeed reflective of asthma severity.

We used three categories of covariates to assess whether factors other than clinical severity could be associated with the provision of the standard care: patient demographics, hospital characteristics, and other visit characteristics. Patient demographics included age group (1–5, 6–19, and 20–64 years of age), race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, and other), sex, expected source of payment (private insurance, Medicaid/SCHIP, and no charge/charity/workers comp/Medicare), median income of ZIP-code of residence, and urban-rural status of patient's ZIP-code (based on the NCHS classification system: large central metro, large fringe metro, medium metro, small metro/micropolitan/noncore) (19). Hospital characteristics included ED volume (<30,000, 30,000–50,000, 50,001–70,000, and >70,000), teaching hospital vs. nonteaching hospital, and Census region (Northeast, Midwest, South, and West). Other visit characteristics included season of visit (December–February, March–May, June–August, and September–November) and daytime vs. night-time arrival in ED (7AM to 6: 59PM vs. 7PM to 6:59AM).

No data were missing for age, sex, region, season of visit, and ED volume. Race and ethnicity were imputed by NCHS for 14.4% and 19.5% respectively of observations in the analysis (26.6% of visits had at least one of these values imputed). Four percent of records were missing data for urban-rural status, 6.5% for expected source of payment, 0.7% for time of arrival in ED, 1.0% for teaching status, and 5.7% for median income of ZIP-code. Pulse oximetry was missing for 13% and respiratory rate for 6.1% of records.

Observations with missing values for variables with a missing rate of <5% were excluded from analyses using those variables. For observations with missing values for variables with a missing rate of ≥5% (expected source of payment, median income of ZIP-code, pulse oximetry, and respiratory rate), we conducted multiple imputation (five imputed data sets) using chained equations. The underlying regressions for the imputations were multinomial logistic regression for expected source of payment and linear regression for the three continuous variables. None of the three continuous variables was normally distributed. Therefore, respiratory rate and median income of ZIP-code were log-transformed prior to imputation and later back-transformed. Because a large percentage of pulse oximetry values were equal to 100%, transformation was not possible. Hence, predictive mean matching was used to limit imputed pulse oximetry values to those already in the data set. All other variables mentioned above, including the dependent variable, were included in all imputation regression equations. We also added to the imputation models whether asthma was a first-, second-, or third-listed diagnosis. Finally, sample design strata were added to the imputation models to account for the complex sample design. The strata represent a combination of region, survey year, and the probability with which PSUs, the first sampling stage of the survey representing geographic areas, are selected into the survey. Because there were too many PSUs to achieve convergence, PSU was not included in imputation models.

Univariate Analyses

The proportion of visits in each category of the dependent outcome was compared using pairwise Wald tests. Also, the percentage of visits for which patients received any inhaled corticosteroids was calculated.

Bivariate Analyses

For clinical severity variables (pulse oximetry, respiratory rate, and overall respiratory status), frequencies were calculated for each dependent variable category (no corticosteroids, corticosteroids given in the ED only, corticosteroids prescribed at discharge only, and corticosteroids given in the ED and prescribed at discharge). Also, the percentage of visits for which patients received inhaled corticosteroids in each category of the dependent variable was calculated. Comparisons of frequencies were conducted using pairwise Wald tests. Finally, three separate multinomial logistic regressions were conducted using each of the three clinical severity variables as the independent variable and the standard of care representing the reference category for the dependent variable.

Multivariate Analyses

We used two multivariate multinomial logistic regression models with exacerbation severity as the main independent variable of interest and with the dependent variable and covariates described above. The first model included pulse oximetry and respiratory rate as measures of exacerbation severity, and the second model included overall respiratory status as a measure of exacerbation severity. Urban/rural status and teaching versus nonteaching hospital were highly correlated with ED volume. None of the three variables were found to be significant in bivariate analyses. We believed ED volume would best capture the variation in ED practice, and thus this was the only variable of the three included in the models. Predictive margins were used to determine the adjusted percentages in each dependent variable category for patients with different clinical characteristics.

Sensitivity analyses that used complete case analyses included a total of 1385 observations or approximately 75% of the total records available. Also, sensitivity analyses were conducted that included only those visits with asthma exacerbation codes listed in the first position, as those with asthma exacerbation codes listed in second or third position may be less severe. For visits by children <20 years of age, some estimates of each outcome by pulse oximetry and respiratory rate categories were not reliable for this sensitivity analyses, so only the second model with overall respiratory status was analyzed.

Results

For 27.1% of ED asthma visits by patients 1 to ≤65 years of age, corticosteroids were provided both in the ED and as a discharge prescription (Figure 1 and Table 2). For another 12.3% of visits, corticosteroids were not provided in the ED, but a prescription was provided at discharge. For 18.2% of visits, corticosteroids were provided in the ED, but not upon discharge. For 42.4% of visits, patients received no corticosteroids, either in the ED or as a prescription at discharge.

For 7.4% (95% CI: 5.6–9.2%) of all visits, inhaled corticosteroids were received, and this occurred in 5.2% (CI: 3.2–7.3%) of visits in which no systemic corticosteroids were provided and 9.1% (CI: 5.5–12.8%) of visits in which corticosteroids were provided both in the ED and as a prescription. The rates of provision of inhaled corticosteroids were not statistically reliable for other categories.

Examination of visits by exacerbation severity showed that for 32% of visits for patients with abnormal overall respiratory status (high respiratory rate and/or decreased pulse oximetry value), the standard of care was received, compared with 22.1% of visits for patients with normal respiratory status ($p < .001$) (Figure 2 and Table 2, unadjusted percentages). However, when indicators of respiratory status were analyzed separately (normal versus abnormal pulse oximetry rate and normal versus fast respiratory rate), rates of receiving the standard of care were not statistically different. Indeed, those with pulse oximetry of ≤94% (30.8%) and those with pulse oximetry of 97–100% (24.5%) received the standard of care at a similar rate ($p > .05$) and those with a fast respiratory rate (31.5%) and those with a normal respiratory rate (24.9%) also received the standard of care at a similar rate ($p > .05$). When assessing the most substandard care, the rate of failure to provide any corticosteroids was lower for visits of patients with an abnormal respiratory status (32.5%) compared to those with normal respiratory status (52.0%) ($p < .001$) (Figure 2). Similarly, there were significant differences in care received when the individual indicators of respiratory status were assessed. The rate of failure to provide any corticosteroids was lower among visits for patients with a fast respiratory rate (26.1%) than for those with a normal respiratory rate (47.7%) ($p < .001$) and was lower for those with pulse oximetry ≤94% (32.1%) compared to those with pulse oximetry of 97–100% (46.5%) ($p < .01$).

In bivariate multinomial logistic regression, visits for patients with lower pulse oximetry values, higher respiratory rates, and abnormal overall respiratory status were all found to be significantly inversely related to failure to provide any corticosteroids compared to the standard of care (OR = 0.61 for pulse oximetry values of 95–96%, OR = 0.55 for pulse oximetry values of ≤94%, OR = 0.40 for increased respiratory rate, OR = 0.43 for fast respiratory rate, and OR = 0.43 for abnormal overall respiratory status) (Table 3, unadjusted OR). However, neither pulse oximetry values, respiratory rate, nor overall respiratory status were significantly related to receiving a prescription for corticosteroids only or corticosteroids in the ED only, compared to the standard care.

Adjusted rates of receiving corticosteroids in each category were very similar to the unadjusted rates: adjusted estimates were within a single standard deviation of the unadjusted estimates, and overall patterns were the same (Table 2, adjusted percentages). Similarly, in multivariate multinominal logistic regression analyses, adjusted ORs were similar to unadjusted ORs, and there were no changes in significance of associations (Table 3, adjusted OR). In sensitivity analyses to test the impact of using multiply imputed data, we used only records with non-missing data and found that coefficients were uniformly in the same direction and of similar magnitude, and all findings presented above remained statistically significant (data not shown). Sensitivity analyses using only observations with asthma as a primary diagnosis yielded similar results to the main analyses, although the finding that pulse oximetry scores predicted receiving no corticosteroids lost significance (data not shown).

Among visits for children 1 to 19 years of age, corticosteroids were provided both in the ED and as a discharge prescription for 23.6% of visits. For another 12.3% of visits, only a prescription at discharge was provided and for 20.7% of visits, corticosteroids were provided in the ED only. For 43.5% of visits, no corticosteroids were provided (Table 4). Rates of receiving the standard of care were lower among visits for children with normal overall respiratory status (18.6%) than for those with abnormal respiratory status (28.9%) ($p < .05$). Lower rates of the most substandard care (failure to provide any corticosteroids) were observed for those with an abnormal overall respiratory status (32.7%) compared to those with normal respiratory status (53.6%) ($p < .001$).

Discussion

Substandard care in the US for asthma ED visits may be more common than previously reported. Indeed, while Bekmezian et al. found that systemic corticosteroids were not given or prescribed in 37% of asthma visits among children (5), our results show that suboptimal care, more broadly defined as any outcome falling short the recommended standard of care— provision of corticosteroids both in the ED and as a discharge prescription—is even more common. Our results suggest that while systemic corticosteroids were not given or prescribed in 43.5% of asthma visits among children, care was suboptimal in 76.4% (CI 72.2–80.2%) of asthma visits for children and in 72.9% (CI 69.7–75.9%) of asthma visits across all age groups. While this assumes that corticosteroids should be provided for all asthma ED visits, even among more severe exacerbations (visits with lower pulse oximetry values and fast respiratory rates recorded), substandard care was provided more than 60% of the time. Therefore, inappropriate use of ED services for mild exacerbations does not fully explain the rates of suboptimal care observed.

The relationship between exacerbation severity and differing categories of substandard care does not follow a strictly linear pattern. For less severe exacerbations (lower respiratory rates and higher pulse oximetry values), there were greater odds of patients receiving no corticosteroids (rather than the standard of care) compared to exacerbations with either higher respiratory rates, lower pulse oximetry scores, or both. However, there was no association between exacerbation severity and intermediate suboptimal outcomes—either receiving corticosteroids in the ED only or only receiving a prescription at discharge.

Nonetheless, understanding intermediate suboptimal outcomes is important. In 18.2% of all visits, ED physicians recognized the need for corticosteroids and provided them in the ED, but failed to continue the course of corticosteroids with a prescription, perhaps relying on patient follow-up at their own physician. However, previous studies suggest that more than half of patients do not follow up with their physician after ED asthma visits (20, 21). Hence, efforts to increase ED discharge prescriptions for corticosteroids may represent an opportunity to improve care.

There was little difference between unadjusted and adjusted estimates for each outcome category within exacerbation severity categories. This suggests that the included covariates for factors other than exacerbation severity had little impact on the provision of corticosteroids. In this regard, we also tried to duplicate the finding of Bekmezian, et al. that pediatric EDs were more likely to provide corticosteroids (5). However, in our model for children 1–19 years of age which included the additional information about exacerbation severity, being treated in a pediatric ED was not found to be a significant factor, and predictive margins changed by less than 2 percentage points.

This study has several limitations. Missing data for some variables, particularly respiratory rate and pulse oximetry, may bias regression results. Although likely the best option for addressing missing data (22), multiple imputation is only as sound as the imputation models used, and predictive mean matching for imputation of non-normally distributed variables has not been fully tested (23). Further, using singly imputed values for race/ethnicity in the multiple imputation models of other variables may result in underestimated SEs in the final models. However, our analysis using the multiply imputed data was very similar to results of a sensitivity analysis using complete case analysis.

Conclusion

Substandard care in asthma care in the ED is more common than previously identified. While some types of substandard care are associated with indicators of less severe exacerbation, this relationship is not seen in other types of substandard care. Finally, even among visits for more severe exacerbations, substandard care was provided for more than half of the visits.

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Declaration of Interest

The authors have no conflicts of interest to disclose.

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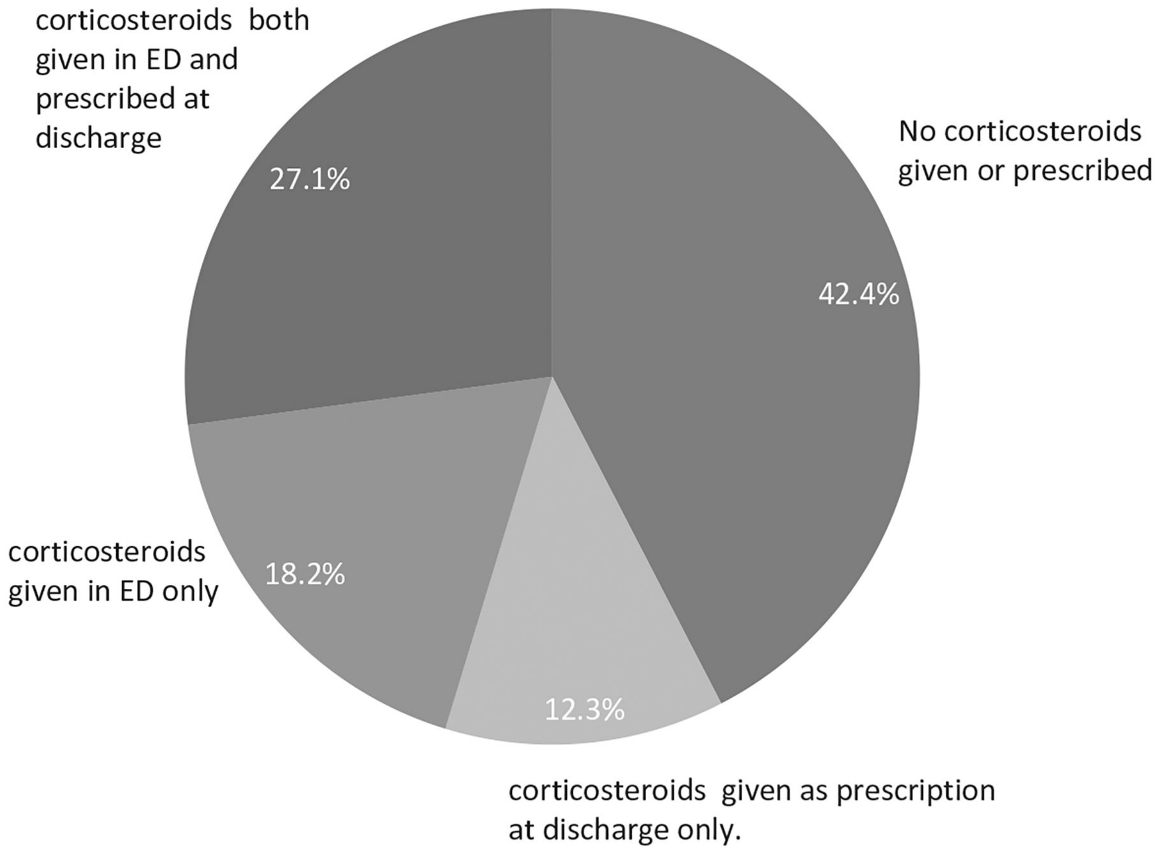

Figure 1.—.

Percent distribution of systemic corticosteroids provided in the ED and as a discharge prescription, United States (NHAMCS-ED, 2007–2009).

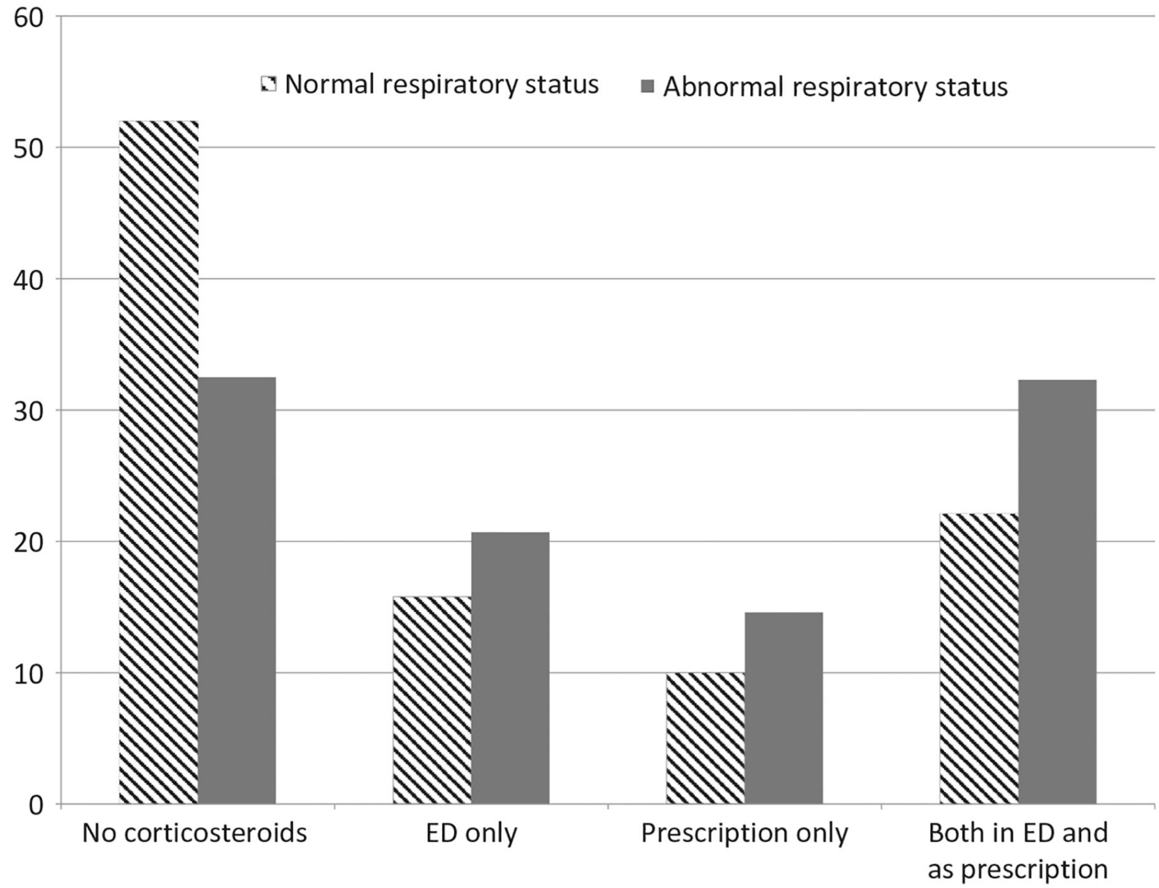

Figure 2.—.
Percent distribution of systemic corticosteroids provided in the ED and as a discharge prescription, by overall respiratory status, United States, (NHAMCS-ED, 2007–2009).

Table 1.—

Respiratory classification by age group.

Age	Normal rate	Increased rate	Fast rate
1–3 years	≤ 34	35–39	≥ 40
4–5 years	≤ 30	31–35	≥ 36
6–12 years	≤ 26	27–30	≥ 31
>12 years	≤ 23	24–27	≥ 28

Note: Adapted from Children's National Medical Center, CNMC Emergency Department Asthma Flow Sheet.

Table 2.—

Unadjusted and adjusted percentages of visits with standard of care and substandard care provided, by exacerbation severity indicators (NHAMCS-ED, 2007–2009).

	Standard of care	Substandard care		
	Corticosteroids provided both in ED and as prescription (*n* = 466)	**Corticosteroids provided as prescriptions only (*n* = 232)**	**Corticosteroids provided in ED only (*n* = 308)**	**No corticosteroids provided (*n* = 839)**
Total weighted percentages (SE)	27.1 (1.6)	12.3 (1.1)	18.2 (1.4)	42.4 (1.9)
		Unadjusted percentages (SE)		
Respiratory rate				
Normal (*n* = 1403)	24.9 (1.8)	10.8 (1.1)	16.6 (1.5)	47.7 (2.2)
Increased (*n* = 227)	35.7 (4.4)	19.0 (3.7)	18.4 (3.4)	27.0 (3.8)
Fast (*n* = 215)	31.5 (3.6)	14.3 (3.8)	28.1 (3.9)	26.1 (3.4)
Pulse oximetry				
97–100% (*n* = 1224)	24.5 (1.9)	12.2 (1.5)	16.7 (1.7)	46.5 (2.3)
95–96% (*n* = 334)	32.6 (4.0)	15.3 (3.0)	14.2 (2.9)	37.9 (4.0)
94% or less (*n* = 287)	30.8 (3.7)	9.1 (2.1)	28.1 (3.7)	32.1 (3.7)
Overall respiratory status[b]				
Normal (*n* = 982)	22.1 (2.1)	10.0 (1.3)	15.8 (1.8)	52.0 (2.7)
Abnormal (*n* = 863)	32.3 (2.3)	14. 6 (1.7)	20. 7 (2.0)	32.5 (2.2)
		Adjusted percentages[a] (SE)		
Respiratory rate				
Normal (*n* = 1403)	24.7 (1.8)	10.1 (1.1)	16.6 (1.5)	48.7 (2.3)
Increased (*n* = 227)	34.0 (4.5)	19.5 (3.7)	17.7 (3.6)	28.8 (4.5)
Fast (*n* = 215)	34.8 (4.3)	13.6 (4.1)	24.2 (4.0)	27.4 (3.9)
Pulse oximetry				
97–100% (*n* = 1224)	24.6 (1.9)	11.8 (1.4)	16.9 (1.7)	46.7 (2.3)
95–96% (*n* = 334)	33.8 (4.1)	14.3 (3.0)	13.9 (2.8)	38.0 (4.2)
94% or less (*n* = 287)	29.9 (3.7)	8.2 (2.1)	26.8 (3.9)	35.0 (4.2)
Overall respiratory status[b]				
Normal (*n* = 982)	21.4 (2.1)	9.5 (1.3)	15.6 (1.7)	53.5 (2.7)
Abnormal (*n* = 863)	32.9 (2.3)	13.9 (1.7)	20.2 (2.0)	33.0 (2.2)

Notes:

[a]Adjusted for other characteristics of visit (season of visit and daytime vs. night-time arrival in ED), patient demographics (age group, race/ethnicity, sex of patient, expected source of payment, and median income of ZIP-code of residence,), and hospital characteristics (ED volume and U.S. census region).

[b]Normal respiratory status is defined as normal pulse oximetry value (97–100%) and normal respiratory rate. Abnormal respiratory status is defined as either abnormal pulse oximetry value, respiratory rate, or both.

Table 3.—

Odds of substandard care versus standard of care (corticosteroids provided in the ED and as a discharge prescription), United States (NHAMCS-ED 2007–2009).

	Corticosteroids prescription only provided (vs. standard of care)	Corticosteroids provided in ED only (vs. standard of care)	No corticosteroids provided (vs. standard of care)
Unadjusted odds ratios (95% CI)			
Respiratory rate			
Normal	Ref	Ref	Ref
Increased	1.23 (0.71–2.14)	0.77 (0.44–1.35)	0.40 (0.25–0.64)**
Fast	1.05 (0.53–2.09)	1.34 (0.85–2.11)	0.43 (0.28–0.67)**
Pulse oximetry			
97–100%	Ref	Ref	Ref
95–96%	0.94 (0.51–1.72)	0.64 (0.34–1.18)	0.61 (0.39–.97)*
94% or less	0.59 (0.31–1.11)	1.34 (0.80–2.23)	0.55 (0.36–0.85)**
Overall respiratory status[b]			
Normal	Ref	Ref	Ref
Abnormal	1.00 (0.63–1.57)	0.90 (0.60–1.33)	0.43 (0.31–0.59)**
Adjusted odds ratios (95% CI)[a]			
Respiratory rate			
Normal	Ref	Ref	Ref
Increased	1.41(0.79–2.52)	0.77 (0.43–1.40)	0.43 (0.26–0.72)**
Fast	0.96 (0.45–2.03)	1.04 (0.61–1.75)	0.40 (0.25–0.65)**
Pulse oximetry			
97–100%	Ref	Ref	Ref
95–96%	0.88 (0.47–1.64)	0.60 (0.32–1.12)	0.59 (0.37–0.94)*
94% or less	0.57 (0.30–1.11)	1.30 (0.75–2.26)	0.62 (0.39–0.98)*
Overall respiratory status[b]			
Normal	Ref	Ref	Ref
Abnormal	0.95 (0.60–1.50)	0.85 (0.56–1.29)	0.40 (0.29–0.56)**

Notes:

[a]Odds adjusted using multinominal logistic regression for other characteristics of visit (season of visit and daytime vs. night-time arrival in ED), patient demographics (age group, race/ethnicity, sex of patient, expected source of payment, and median income of ZIP-code of residence), and hospital characteristics (ED volume and U.S. census region).

[b]Normal respiratory status is defined as normal pulse oximetry value (97–100%) and normal respiratory rate. Abnormal respiratory status is defined either abnormal pulse oximetry, respiratory rate, or both.

*$p < .05$,

**$p < .01$.

Table 4.—

Percentages of asthma visits by children 1–19 years of age with standard of and substandard care provided, by exacerbation severity indicators (NHAMCS-ED, 2007–2009).

	Standard of care	Substandard care		
	Corticosteroids provided both in ED and as prescription (*n* = 188)	**Corticosteroids provided as prescriptions only (*n* = 105)**	**Corticosteroids provided in ED only (*n* = 140)**	**No corticosteroids provided (*n* = 398)**
	Weighted percentage (SE)			
Total	23.6 (2.1)	12.3 (1.6)	20.7 (2.1)	43.5 (2.7)
Overall respiratory status—Unadjusted Percentages (SE)				
Normal	18.6 (2.8)	9.2 (1.8)	18.7 (2.9)	53.6 (3.9)
Abnormal	28.9 (3.1)	15.6 (2.8)	22.9 (3.4)	32.7 (3.1)
Overall respiratory status—Adjusted Percentages[a] (SE)				
Normal	18.1 (2.7)	8.2 (1.6)	18.1 (2.9)	55.6 (3.9)
Abnormal	30.0 (3.0)	14.0 (2.6)	22.6 (3.5)	33.5 (3.2)

Note:

[a]Adjusted for other characteristics of visit (season of visit and daytime vs. night-time arrival in ED), patient demographics (race/ethnicity, sex of patient, expected source of payment, and median income of ZIP-code of residence,), and hospital characteristics (ED volume and U.S. census region).