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ORIGINAL ARTICLE

Does Pre-hospital Telephone Communication with a Clinician Result in More Appropriate Medication Administration by Parents during Childhood Asthma Exacerbations?

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Background. The National Heart, Lung and Blood Institute asthma guidelines recommend that parents communicate with a clinician during childhood asthma exacerbations when symptoms worsen or do not improve with initial therapy. This study tested the hypothesis that communication by parents with a clinician before an Emergency Department visit was associated with more appropriate medication administration for children with asthma exacerbations. **Methods.** This was a retrospective cohort study using data gathered from parents of children presenting with an asthma exacerbation to the emergency department. The communicating cohort included parents who communicated by telephone with a clinician during the exacerbation and the non-communicating cohort included parents who did not. Multivariate logistic regression models were used to test three hypotheses; communication with a clinician is associated with (1) administration of short-acting β -agonists (SABAs), (2) increased dosing frequency of SABAs, and (3) administration of an oral corticosteroid. **Results.** A total of 199 subjects were enrolled, with 104 (52.3%) in the communicating and 95 (47.7%) in the non-communicating cohort. There was an association between communication and provider practice type, with children who received routine care from a private practice provider more likely to communicate with the clinician than children in hospital-based clinics or community health centers (Adjusted OR 1.9, 95% CI 1.0–3.7). Impoverished children and children insured by Medicaid were less likely to communicate with a clinician (controlling for provider type). Parents who communicated with a clinician were more likely to administer a SABA (adjusted OR 3.6, 95% CI 1.3–9.4) and an oral corticosteroid (adjusted OR 3.3, 95% CI 1.3–8.4) but were not more likely to administer a SABA with increased dosing frequency (adjusted OR 0.9, 95% CI 0.5–1.6). **Conclusions.** Parents of children with asthma exacerbations who communicated with clinicians were more likely to administer SABAs and an oral corticosteroid before bringing their child to an emergency department. Frequency of SABA dosing was not associated with communication. Clinicians providing telephone advice to parents need to provide explicit instructions about medication administration, emphasizing the frequency with which SABAs should be administered.

Keywords Asthma; pediatrics; pre-hospital communication; pharmacotherapy

INTRODUCTION

Asthma affects over 7 million children in the U.S. and is a frequent cause of unscheduled medical visits (1). The National Heart, Lung and Blood Institute (NHLBI) asthma guidelines outline appropriate management strategies to be used in the home setting (2), but consistent implementation of these guidelines is challenging for many families (3–6).

“Yellow zone” exacerbations occur when children have the potential for clinical deterioration if interventions are not implemented. Four of five children in a primary care setting may experience this type of exacerbation in a given 3-month period (7). As pointed out in a systematic review of treatment for yellow zone exacerbations, there is an advantage to early and aggressive pharmacotherapy (8). Communication with a clinician can help guide asthma management by parents, including appropriate administration of short-acting β -agonist (SABA), administration of an oral corticosteroid (OCS) if

available, and referral to appropriate medical providers when exacerbations fail to improve or worsen. Although this communication should result in more appropriate medication administration by parents, to our knowledge this association has never been examined.

In this study, we collected data during the asthma exacerbation, when parents’ recall of the actions performed was most salient. This allowed for detailed questions about recent events, reducing potential recall bias. Our hypotheses were that communication with a clinician during the asthma exacerbation would be associated with (1) rates of SABA administration, (2) increased frequency of SABA dosing, and (3) rates of OCS administration. Our goal was to validate the importance of communication with clinicians as recommended in asthma guidelines and to clarify telephone guidance for parents.

METHODS AND MATERIALS

This was a cross-sectional study using a convenience sample of parents of asthmatic children 1 to 12 years of age who presented to a pediatric emergency department (ED) with an exacerbation. Children were considered to have asthma if

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the caregiver had been told by a clinician that the child had asthma and the child had been treated before for reversible wheezing episodes. Children were considered to have an acute exacerbation if they had wheezing in conjunction with any of the following objective findings: tachypnea, hypoxia, retractions, or use of accessory muscles. The upper age of 12 years has been used previously for identifying children who depend on adults for asthma care (9).

Participants were identified by a research assistant in the ED based on presenting reports in Medhost (Medhost Inc., Addison TX 2007), a real-time computerized patient log. Parents of the children were approached during the ED visit to determine study eligibility. Participants were excluded if the caregiver had previously participated in the study, if the caregiver did not speak English, if the child had serious comorbid illness, if participants came to the ED immediately at the start of the exacerbation, or if participants were instructed to come immediately to the ED during initial communication with their clinician. If eligible, informed consent was obtained.

Data collection was performed using a paper-based 47-item survey read to the respondents face-to-face with answers recorded by a research assistant. The survey was divided into three major sections. The first section collected detailed descriptions of actions that had been performed by families during the asthma exacerbation. The second section was used to determine asthma severity and recent health care utilization. The third section gathered demographic data about the child including socioeconomic status (SES), primary care provider, and family characteristics. This survey was an original instrument designed for this research project under the guidance of survey methodology experts at Brown University. Items were derived empirically, and the instrument was piloted with children with asthma in the appropriate age range. Based on the initial responses and feedback about the items, content was edited where necessary before use in the research study. Research assistants collecting data were not aware of any study hypotheses. This study was approved by the Institutional Review Board of the participating hospital.

Based on caregiver responses, participants were divided into one of two cohorts. The *communicating cohort* consisted of parents who communicated by telephone with a clinician during the child's asthma exacerbation, and the *non-communicating cohort* consisted of parents who did not. Three parental actions were examined. The first was whether the parent administered a SABA to the child before coming to the ED. The second action was frequency of SABA dosing. This variable was dichotomous with a positive classification meeting all of the following criteria: (1) the child was administered an appropriate SABA; (2) the child was administered a SABA within the 4 hours preceding ED arrival; and (3) for exacerbations greater than 4 hours long, the child was administered a SABA at least every 4 hours. The third outcome was OCS administration before bringing the child to the ED.

Data analysis was performed using STATA SE 10.0 (StatCorp LP, College Station, TX, 2007). In the univariate analyses, categorical variables were compared using χ^2 or analysis of variance (ANOVA). Continuous variables were compared using Student's *t* test. Statistical significance was set at an alpha level of $p < 0.05$. Multivariate logistic regression modeling was used to examine variables associated with

communicating versus non-communicating cohorts and to compare the communicating and non-communicating cohorts for the three parental actions. Independent variables considered for inclusion in the regression models were the child's age and gender, asthma severity, length of exacerbation in hours, clinician practice type, race, ethnicity, insurance type, combined annual household income, number of adult caregivers in the home, number of years the parent had managed child's asthma, and whether the parent had asthma or other children with asthma. Asthma severity was rated by a study clinician (AG), based on the 2007 NHLBI expert panel report using symptoms and activity limitations in the preceding 4 weeks (2). Primary doctor practice type included four possible categories: private practice, community health center, hospital-based clinic, and unable to identify a primary doctor. Income was ordinal with \$20,000 incremental categories for parent-reported annual combined household income. Insurance type was categorized as no insurance, Medicaid, or privately insured. Number of caregivers was categorized as either one or multiple adults who assisted care during the exacerbation.

RESULTS

Over an 18-month period in 2006 and 2007, 240 participants were approached for enrollment, of whom 37 were ineligible (22 non-English speaking; 5 parents came immediately to the ED at the start of the exacerbation; 5 parents told to come immediately to the ED when they communicated with the clinician; 3 participated in the study previously; and 2 children had comorbid illness). Four of the eligible subjects refused participation, resulting in 199 enrolled participants (response rate 98%). Of these participants, 104 (52.3%) communicated with a clinician and 95 (47.7%) did not. Demographic characteristics of participants by cohort are presented in Table 1, and clinical characteristics in Table 2.

In the univariate analysis, participants in the communicating cohort were more likely to be white, have private insurance, higher income, a private physician, and less years of experience managing their child's asthma. Multivariate

TABLE 1.—Demographic characteristics of participants by cohort.

	Communicating cohort (n = 104)	Non-communicating cohort (n = 95)	<i>p</i> value
Mean age (SD)	4.7 (3.3)	5.4 (3.4)	0.16
Gender (% male)	56.7%	69.5%	0.06
Race/Ethnicity			0.002
Non-Latino White	47.1%	29.5%	
Black	12.5%	29.5%	
Latino	24.0%	33.7%	
Asian	9.6%	6.3%	
Other	6.7%	1.0%	
Insurance Type			0.005
Private	48.1%	28.7%	
Medicaid	51.9%	71.3%	
None	0	0	
Income			0.004
<\$20,000	21.0%	47.3%	
\$20,001–\$40,000	35.0%	27.5%	
\$40,001–\$60,000	12.0%	6.6%	
\$60,001–\$80,000	9.0%	8.8%	
\$80,001–\$100,000	10.0%	3.3%	
>\$100,000	13.0%	6.6%	
More than one caregiver at home	69.2%	61.7%	0.26

TABLE 2.—characteristics of participants by cohort.

	Communicating cohort (n = 104)	Non-communicating cohort (n = 95)	p value
Asthma Severity			0.11
Intermittent	43.3%	35.8%	
Mild persistent	28.9%	45.3%	
Moderate persistent	21.2%	14.7%	
Severe persistent	6.7%	4.2%	
Length of Exacerbation			0.13
<4 hours	3.9%	8.4%	
4–12 hours	30.8%	34.7%	
12–24 hours	26.9%	32.6%	
>24 hours	38.5%	24.2%	
Primary Clinician Practice Type			0.003
Private practice	67.3%	44.2%	
Community health Center	12.5%	16.8%	
Hospital-based clinic	19.2%	34.7%	
Caregiver unable to Identify	1.0%	4.2%	
Mean # of years experience managing child's asthma (SD)	2.6 (2.6)	3.6 (3.2)	0.027
Caregiver has asthma or other children with asthma	49.0%	56.1%	0.27

logistic regression was used to model the likelihood of communication based on demographic and clinical characteristics. Insurance was used as a marker of SES in the regression model because of significant collinearity between income and insurance type (Spearman's $P = 0.68$). In a multivariate logistic regression model, only provider practice type and insurance were associated with the likelihood of communication. The likelihood of communicating with a clinician was higher for private practice settings (adjusted odds ratio (AOR) 1.9, 95% confidence interval (CI) 1.0–3.7) when compared with community health centers and hospital-based clinics. There was no statistically significant difference for communication rates between community health centers and hospital-based clinics. Families with private insurance were more likely to communicate with a clinician (AOR 1.9, 95% CI 1.0–3.6) than families insured by Medicaid.

Multivariate regression analysis was used to examine three parental actions: administration of a SABA, frequency of SABA administration, and administration of an OCS (see Table 3). Parents who communicated with a clinician were more likely to administer a SABA (AOR 3.6, 95% CI 1.3–9.4). In the regression model for SABA administration, increasing number of years of experience were more likely to be associated with SABA administration (AOR 1.3/yr,

95% CI 1.0–1.6). Parents who communicated with a clinician were not more likely to have administered a SABA with increased dosing frequency (AOR 0.9, 95% CI 0.5–1.6). In the regression model for frequency of SABA dosing, having private insurance was associated with increasing odds of appropriate dosing frequency (AOR 1.9, 95% CI 1.0–3.5). Parents who communicated with a clinician were more likely to administer an OCS (AOR 3.3, 95% CI 1.3–8.4). In the regression model for OCS administration, increasing number of years of experience managing the child's asthma (AOR 1.2/yr, 95% CI 1.0–1.4) and having private insurance (AOR 5.0, 95% CI 2.2–11.7) were associated with higher rates of OCS administration.

All study participants reported having a SABA at home, 14% used a written asthma plan, and 31.1% reported having access to an OCS at home. In a separate analysis, we compared the association between calling a clinician and home administration of OCS for parents who reported having an OCS readily available in the home. OCS administration occurred in 27 of 40 (67.5%) of these households when parents communicated with a clinician, and 9 of 22 (40.9%) when they did not ($p = 0.04$).

DISCUSSION

This study examined the hypothesis that communication by parents with a clinician is associated with more appropriate medication administration for children who present to the ED with asthma exacerbations. This communication is included in published asthma guidelines (2), but the effectiveness of this communication has not been rigorously examined. Our data provide support for the notion that communication with a clinician results in improved medication administration by parents, as demonstrated by higher rates of SABA and OCS administration. This study also identifies an area for improved communication in instructing parents about appropriate frequencies of SABA administration.

Administration of medications early during an asthma exacerbation has been demonstrated to improve short-term outcomes (10–13). Children in both cohorts had high rates of SABA use; however, there was a higher administration rate for families who communicated with their clinician. There are two possible explanations for this finding. The first explanation is that clinicians instructed parents to administer SABAs during the communication. The other explanation is that parents who are more likely to communicate with a

TABLE 3.—Comparison of medication administration between communicating and non-communicating cohorts.

	Communicating cohort (n = 104)	Non-communicating cohort (n = 95)	Adjusted or of med. admin. for communicating cohort (95% CI)	Modifiers (AOR, 95% CI)
Administered SABA	96	75	3.6 (1.3–9.4)	Years of experience managing child's asthma (AOR 1.3/yr, 95% CI 1.0 – 1.6)
Increased frequency of SABA administration	45	40	0.9 (0.5–1.6)	Private insurance (AOR 1.9, 95% CI 1.0 – 3.5)
Administered OCS	27	9	3.3 (1.3–8.4)	Years of experience managing child's asthma (AOR 1.2/yr, 95% CI 1.0 – 1.4) Private insurance (AOR 5.0, 95% CI 2.2 – 11.7)

clinician are also more likely to administer these medications. This is not supported by our findings, as more experienced parents in this study were less likely to communicate with a clinician, but more likely to administer SABAs.

Despite the improvements noted in SABA administration, parents in both cohorts administered doses relatively infrequently. To assess frequency of dosing we used a definition of no more than 4 hours between SABA doses, based on the NHLBI asthma guideline recommendations for a good response to initial therapy (2). We consider this a conservative definition, as it is likely that many of the children in our study probably required even more frequent therapy for inadequate initial responses. Despite this conservative definition, 55.3% of participants did not administer SABAs with adequate frequency. Communicating with a clinician did not result in improved administration rates. This failure to convey the importance of increased frequency of SABA administration is even more concerning when coupled with the fact that few families had a written asthma plan at home. Encouraging more frequent use of SABAs should clearly be a goal of clinicians providing telephone guidance. Potential barriers to frequent SABA administration include lack of understanding about expected side effects of SABAs and parental concerns that adverse effects of medication outweigh the benefits (14).

Parental administration of OCS is controversial. In theory, administration of OCS in the home setting would result in better short-term outcomes, as studies have demonstrated the benefit of this medication (11, 12). In addition, there is evidence that delayed medication administration results in lower efficacy as an exacerbation progresses (15, 16). Despite this, the only randomized control trial of parent-administered OCS failed to demonstrate improvement using this technique (17). Nevertheless, the recommendations for parent-administered OCS have been included in published asthma guidelines (2, 18). This study demonstrated that pre-hospital use of OCS was more than three times as likely in children who communicated with a clinician. When limited to parents who had OCS available in the home, rates of OCS administration remained higher when parents communicated with a clinician.

Modeling of variables associated with the likelihood of communicating with a clinician identified two risk factors for lower communication rates: routine care in non-private practice settings and lower SES. The difference in communication rates by provider type was not explained by SES. Lower communication rates in hospital-based clinics and community health centers may be attributed to difficulty contacting a clinician by telephone or a lack of parental knowledge that clinicians in these practices are available for telephone advice. There is evidence that children who receive routine care in hospital-based clinics and community health centers are more likely to use EDs routinely for exacerbations (19, 20), suggesting they may perceive a visit to the ED as a substitute for communication with clinicians in the setting where they routinely receive care. There is also evidence that lack of continuity of care results in children seeking sick care in a venue other than where they obtain routine medical services (21). In community health centers and hospital-based clinics, this continuity of care may not be as consistent as in private practice settings (21), resulting in lower likelihood of attempted communication by participating patients.

Likelihood of communicating with a clinician before presenting to the ED was also associated with socioeconomic status, as indicated by insurance type and income. Poverty was strongly associated with lower rates of communication, with nearly half of the non-communicating cohort impoverished, as compared to only 21% of the communicating cohort. Insurance type was also associated with communication, with Medicaid participation associated with lower rates of communication. This association was not explained by differential access-to-care as provider type remained an independent predictor of communication when SES variables were controlled. The SES variables were more likely characteristic of the urban population that disproportionately uses EDs for medical care. We did not collect data to test this hypothesis, but previous research has demonstrated that in urban populations, families often report the usual source of care for their child's asthma as the ED (22, 23).

LIMITATIONS

This was a single site study at an urban ED, and as a result findings may not be applicable to other locales or health care settings. Despite this, the population included represents a high-risk asthma population and can be applied to similar urban environments in the catchment area of a tertiary care children's hospital.

Because data collection occurred in the ED, we were unable to collect data on children who had an asthma exacerbation that was successfully treated at home. Therefore, we could not include children who improved with home interventions, and our data may over-represent children who received less appropriate pharmacotherapy at home. It is not clear whether the "missed" children would be more or less likely to communicate with a clinician. Additionally, although our survey was empirically derived and pilot-tested, it was not subject to extensive evaluation of its psychometric properties.

Owing to financial constraints, this study was limited to English-speaking families and therefore excluded an important group of families encountered in urban settings. The findings of this study cannot be applied to the non-English speaking population, as cultural differences as well as barriers to accessing care may result in different patterns of communication with clinicians. Data for this population will be collected in future planned studies at our institution.

CONCLUSIONS

Parents who communicate with clinicians are more likely to administer a SABA and an OCS in the home before bringing their child to an ED. Communication was not associated with increased frequency of SABA dosing. This study supports published asthma guidelines that recommend early communication with clinicians during a childhood asthma exacerbation. In certain settings, particularly hospital-based clinics and community health centers, steps must be taken to facilitate and encourage this communication. In addition, the evidence suggests that the clinicians providing this communication should emphasize the frequency with which SABAs should be administered by parents.

DECLARATION OF INTEREST

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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