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Inhaled corticosteroid prescriptions in the ED for recurrent asthma using IT clinical decision support: revisit after cessation of an incentive program

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ABSTRACT

Introduction: The objective of this study was to assess whether inhaled corticosteroid (ICS) prescription rates for patients with poorly controlled asthma presenting to the emergency department (ED) remained high with a clinical support system in place, after a financial incentive program ended. This study is the second phase of a previous study done at our institution. The first phase demonstrated that the introduction of an electronic alert system advising providers to prescribe ICS to patients with poorly controlled asthma, along with a financial incentive, increased ICS prescription rates from 2% to 77%. Clinical support systems are necessary to improve control for patients with asthma, as prescribing ICS in the ED has not previously been standard of care.

Methods: This retrospective study identified 96 eligible patients during the study period of January 1, 2019 to December 31, 2019. Subjects included patients aged 4–18 with at least two ED visits for asthma within 365 days and no recent ICS prescription. For subjects meeting these criteria, an electronic alert activated, advising the provider to prescribe ICS.

Results: ICS prescription rate without the incentive remained high at 0.74 (0.59, 0.86) and was not significantly different than the rate with the incentive of 0.77 (0.65, 0.87), with *p* value 0.82. No significant differences were detected in baseline characteristics between patients discharged with and without an ICS prescription.

Conclusions: This study confirmed that an electronic alert advising ICS prescription in the ED for patients with recurrent asthma visits is effective, even without a financial incentive.

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Introduction

Asthma is one of the leading chronic illnesses of childhood, with significant morbidity and substantial impact on health resources utilization (1,2). In 2011, asthma was the primary diagnosis for 1.8 million United States emergency department (ED) visits among both children and adults (3), with asthma being the third leading cause of hospitalization among children (4). Although ICS are the mainstay of treatment for control of asthma (5,6), it is well-known that they are underutilized. As many patients view the ED as their primary site of medical care and have low rates of follow up with their primary care providers (PCPs), the ED encounter presents an opportunity for ICS prescription (7–9). Historically, ED providers have been reluctant to prescribe long-term medications, feeling that this is the roll of the PCP

(10–13). However, a recent survey showed most primary providers were in favor of ED physicians prescribing controller medications in the ED (14).

A quality improvement initiative took place in our ED in 2018 to improve rates of ICS prescriptions for patients meeting certain criteria. The initiative was two-fold; there was an electronic alert system created that reminded physicians to prescribe ICS, and there was also a financial incentive to providers for doing so. With these two interventions in place, ICS prescriptions upon discharge from the ED for asthma exacerbations increased from 2% to 77% (15).

The financial incentive for providers to make this clinical change ended on December 31st, 2018. The objective of this study was to determine whether providers continued to prescribe ICS to those that met study criteria even after there was no longer a financial incentive.

Methods

This study was conducted in the ED of an urban, free-standing, tertiary care children's hospital with an annual census of over 90 000. An acute exacerbation of asthma was defined as having a diagnosis of asthma with the initiation of an established asthma management protocol during the ED visit. ED providers comprise of board-certified physicians, fellows, residents, physician assistants and nurse practitioners. Study subjects included all patients triggering the alert between January 1, 2019 and December 31, 2019. Data collection included demographics (age, gender, race), insurance, type of ED provider, prior ICS at home, whether ICS were prescribed, and the reason for not prescribing.

Eligible patients were identified by the electronic alert, which activated after a physician initiated the ED asthma protocol order. The alert activated for patients meeting the following eligibility criteria: age 4–18 years (children less than 4 years of age excluded to avoid possibly enrolling children with bronchiolitis, which is a stipulation specific to this study), two or more past ED asthma protocol orders within 365 days, and no active ICS prescription within 90 days. Patients with comorbid conditions including developmental delay, bronchopulmonary dysplasia due to prematurity, cystic fibrosis, sickle cell disease, and/or interstitial lung disease were excluded from further consideration. For each patient confirmed eligible, the alert sent an e-notification to the ED provider indicating the frequency of “ED/Urgent Care visit(s) within 1 year, with the use of ED asthma protocol order set.” Providers were instructed to: “Please consider prescribing Fluticasone MDI 110 mcg 1 puff twice a day, if the primary diagnosis is asthma (and not other causes of wheezing) AND the patient was not already on inhaled steroids AND if no contraindications.” Fluticasone was suggested based on its availability through the State Medicaid's preferred drug list.

Furthermore, providers were prompted to document whether ICS were prescribed, or the reason for not prescribing ICS (already on, ICS not appropriate, admitted to hospital or note other reason). If a discharge order was placed without an ICS prescription and reason, providers received a final reminder to prescribe ICS or to document the reason for not prescribing ICS. Instruction on the alert had already been provided prior to the first phase of the study via emails and several educational sessions before February 2018. A provider dashboard was created to list all patients triggering the alert with links to their charts, and to summarize information on alert frequency, provider type and compliance with ICS prescription for suitable patients. There was no financial incentive

Table 1. Description of study phases.

	Dates	Electronic alert in effect	Financial incentive in effect
Pre-Alert	(01/01/2014–12/31/2016)	No	No
Phase 1	(02/09/2018–12/4/2018)	Yes	Yes
Phase 2	(01/01/2019–12/31/2019)	Yes	No

during this phase of the study. Table 1 summarizes the differences between the “Pre-Alert,” “Phase 1,” and “Phase 2” portions of the study.

Statistical analysis

Patient demographic and clinical factors were summarized using count and percent for categorical variables, and the mean and standard deviation (SD), or the median and interquartile range for continuous measures. For patients without prior ICS who were discharged home, factors were compared between those with and without an ICS prescription from the ED provider, using the Fisher exact, the Fisher–Freedman–Halton test (estimated using Monte Carlo simulations based on 10 000 random samples), or the Kruskal–Wallis test, as appropriate for the data distribution. The rate of ICS prescription in the ED with the alert in place was estimated, along with exact 95% confidence intervals (CI) to indicate variability. The ED ICS prescription rate with the alert, but without an incentive, was compared to rate of ED ICS prescription with the alert and financial incentive in place, based on the study conducted in 2018 in our department, using a Fisher exact test. Demographical information was also compared between Phases 1 and 2 of the study. Statistical analyses were performed using the SAS software (Version 9.4 Copyright# 2002–2012 SAS Institute Inc. Cary, NC, USA) and the R program (R Core Team (2018). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL <https://www.R-project.org/>). All statistical tests were 2-sided with significance evaluated at the 5% level.

Results

Of the 96 study subjects meeting study criteria in 2019, the mean (standard deviation) age was 8.8 (3.9) years, with 67 (70%) being male and 29 (30%) being female. This was statistically significant from the age of patients during Phase 1 of the study, with the Phase 2 subjects being slightly older (8.8 vs 7.4 years, p 0.01) and also held true when sub-categorizing for patients not on prior ICS discharged home from the ED (9.7 vs 7.7 years, p 0.006). There was no significant difference in sex between the two phases of the study. There were

statistically significant differences in race in study subjects presenting during Phase 1 vs Phase 2 of the study, with there being higher percentages of Hispanics and Native Americans during Phase 1 and higher percentages of African Americans during Phase 2. However, there was not a statistically significant difference in race when accounting only for subjects without prior ICS who were discharged home from the ED. There were not significant differences in insurance type for subjects presenting to the ED during the two study phases, except when sub-categorizing into subjects without prior ICS discharged home from the ED, in which there was a greater percentage of non-Medicaid subjects during Phase 2 and a greater percentage of Medicaid and self-pay subjects during Phase 1 (p 0.03). There was a significant difference in provider type, with there being a greater percentage of physicians/fellow providers during Phase 2 vs Phase 1, with a greater percentage of residents or nurse practitioners during Phase 1 (p 0.02). However, this difference did not exist when only comparing providers for those subjects without prior ICS discharged home from the ED (p 0.10).

Notably only 35 (36%) of patients indicated prior ICS home use during Phase 2 of the study, which was not significantly different from Phase 1 of the study, where 39 (31%) indicated prior ICS use (p 0.47). While ICS were prescribed to a larger percentage of all study subjects in Phase 1 vs Phase 2 (60% vs 43% p 0.01), there was no statistically significant difference when only comparing those subjects without prior ICS discharged home from the ED, in which ICS were prescribed in 77% and 74% of patients, respectively (p 0.82).

Of the 61 patients without prior ICS during Phase 2 of the study, 46 (75%) were assessed, treated and discharged home from the ED. There were not significant differences in the percentage of patients admitted to the hospital in Phase 1 vs Phase 2 (25% vs 23%, p 0.87). There were significant differences in the reasons subjects were not prescribed ICS in the two phases of the study, with the reason being “Admitted” or “Other” indicated more frequently in Phase 2 vs “Already on,” “No reason,” or “Was prescribed” being indicated more frequently in Phase 1. Table 2 presents the distribution of additional demographic and clinical factors for all study patients.

Table 2. Demographic and clinical factors of study subjects.

Factor	All subjects		p value	No prior ICS and discharged home		p value
	Financial incentive			Financial incentive		
	Yes (N=125)	No (N=96)		Yes (N=62)	No (N=46)	
Age (years)		8.8 (3.9)	0.01			0.006
Mean (SD ^a)	7.4 (3.1)	8.5 (5, 12)		7.7 (3.4)	9.7 (3.9)	
Median (Q1, Q3 ^b)	7 (5, 10)			7 (5, 10)	9.5 (6, 12)	
Gender, N (%)			0.39			0.39
Male	80 (64)	67 (70)		42 (68)	35 (76)	
Female	45 (36)	29 (30)		20 (32)	11 (24)	
Race, N (%)			0.04			0.31
Hispanic/Latino	24 (19)	18 (19)		40 (64)	22 (48)	
White	14 (11)	25 (26)		9 (15)	10 (22)	
Black/African American	8 (6)	4 (4)		9 (15)	12 (26)	
Native American	1 (1)	2 (2)		3 (5)	1 (2)	
Other				1 (2)	1 (2)	
Insurance, N (%)			0.76			0.03
Medicaid	100 (80)	75 (78)		50 (81)	33 (72)	
Non-Medicaid	18 (14)	17 (18)		6 (10)	12 (26)	
Self-Pay	7 (6)	4 (4)		6 (10)	1 (2)	
Provider, N (%)			0.02			0.10
Resident	55 (44)	26 (27)		29 (47)	13 (28)	
Fellow/Physician	66 (53)	68 (71)		32 (52)	32 (70)	
Nurse practitioner	4 (3)	2 (2)		1 (2)	1 (2)	
Prior ICS, N (%)						
No	86 (69)	61 (64)	0.47	—	—	—
Yes	39 (31)	35 (36)				
ICS prescribed, N (%)			0.01			0.82
No	50 (40)	55 (57)		14 (23)	12 (26)	
Yes	75 (60)	41 (43)		48 (77)	34 (74)	
Admitted to hospital, N (%)						
No	94 (75)	74 (77)	0.87	—	—	—
Yes	31 (25)	22 (23)				
Reason ICS not prescribed, N (%)			<.001			0.007
Already on	31 (25)	22 (23)		—	—	
Admitted	5 (4)	21 (22)		—	—	
No Reason	14 (11)	6 (6)		14 (23)	6 (13)	
Was prescribed	75 (60)	41 (43)		48 (77)	34 (74)	
Other	0 (0)	6 (6)		0 (0)	6 (13)	

^aSD=standard deviation.

^bQ1, Q3=first and third quartile.

Among the 46 patients without prior ICS who were discharged home from the ED, ICS were prescribed for 34 (74%). No statistically significant differences were detected in baseline characteristics between patients without prior ICS who were discharged home from the ED with and without ICS prescription (Table 3). This was similar to the findings in the first phase of the study, in which there were also no significant differences in demographic characteristics in those discharged with and without ICS prescription (16). In Phase 2, ICS were prescribed

by a larger proportion of physicians (45%) compared to residents (27%) and fellows (26%) and statistical significance was reached in this category (Fisher exact p values 0.02). This finding was different than in the first phase of the study, in which there was no significant difference in provider ICS prescription rate. However, fellows were not classified into their own category during the first phase, which may have accounted for this difference.

For the 12 patients who were discharged home without ICS, no reason was provided to indicate why ICS were not prescribed in 6 cases. Reasons provided in other cases were: that the reason for repeat visits was within the same asthma exacerbation (repeat visits within a few days of each other), that there was another more likely diagnosis (croup), that the patient did not have a formal asthma diagnosis, and that the patient only had intermittent asthma. In one patient's chart, the provider discussed intent to prescribe ICS, but the prescription was missed during a provider hand-off time.

Following the implementation of an electronic asthma alert but without a financial incentive in place, the ICS prescription rate (95% CI) was estimated at 0.74 (0.59, 0.86), and was significantly higher than the previous rate of 0 (0.0, 0.07) prior to any interventions (Table 4). In comparison to the post-alert phase with a financial incentive in place, there was not a significant difference in rate of ICS prescription (0.77 vs 0.74, p values 0.82).

Discussion

This study confirmed our hypothesis that an electronic alert prompting ED physicians to prescribe ICS for pediatric acute asthma ED visits is effective and can significantly increase the ICS prescription rates for patients with poorly controlled asthma, even without a financial incentive.

Overall, for the 12 (26%) of cases that were classified as missed opportunities for ICS prescription,

Table 3. Association of factors with ICS prescription in the ED for study subjects.

Factor	Total (<i>N</i> = 46)	ICS prescribed in ED prior to discharge home		<i>p</i> value ^c
		No (<i>N</i> = 12)	Yes (<i>N</i> = 34)	
Age (years)				0.82 ^d
Mean (<i>SD</i> ^a)	9.7 (3.9)	9.4 (3.3)	9.8 (4.2)	
Median (Q1, Q3 ^b)	9.5 (6.0, 12.0)	8.5 (7.5, 12.0)	10 (6.0, 13.0)	
Gender, <i>N</i> (%)				1.0
Male	35 (76)	9 (75)	26 (76)	
Female	11 (24)	3 (25)	8 (24)	
Race, <i>N</i> (%)				0.82
Hispanic/ Latino	22 (48)	7 (58)	15 (44)	
White	10 (22)	3 (25)	7 (21)	
Black/African American	12 (26)	2 (17)	10 (29)	
Native American	1 (2)	0 (0)	1 (3)	
Other	1 (2)	0 (0)	1 (3)	
Insurance, <i>N</i> (%)				0.79
Medicaid	33 (72)	8 (67)	25 (74)	
Non-Medicaid	12 (26)	4 (33)	8 (24)	
Self-Pay	1 (2)	0 (0)	1 (2)	
Provider, <i>N</i> (%)				0.02
Resident	13 (28)	4 (33)	9 (26)	
Fellow	14 (31)	7 (58)	7 (21)	
Physician	18 (39)	1 (8)	17 (50)	
Nurse practitioner	1 (2)	0 (0)	1 (3)	

^aSD = standard deviation.

^bQ1, Q3 = first and third quartile.

^c p values from Fisher exact test, unless otherwise noted.

^d p values from Kruskal-Wallis test.

Table 4. ICS prescribing rates in the ED before and after the introduction of an asthma alert.

Measure	Pre-Alert (01/01/2014-12/31/2016)	Phase 1: Post-alert with Incentive (02/09/2018-12/4/2018)	Phase 2: Post-alert without Incentive (01/01/2019-12/31/2019)	<i>p</i> value ^c	
				Phase 2 vs Pre-Alert	Phase 2 vs Phase 1
ED asthma visits that qualified for ICS prescription	54	62	46	<0.0001	0.82
ICS prescribed, <i>N</i> (%)	0 (0)	48 (77)	34 (74)		
Rate of ICS prescription (95% CI) ^{a,b}	0.0 (0.00, 0.07)	0.77 (0.65, 0.87)	0.74 (0.59, 0.86)		

^aCI = confidence interval.

^bBinomial Clopper-Pearson exact calculation.

^c p value from Fisher exact test.

we felt that 3 of the cases were mis-classified. In 2 of the cases, the repeat ED visits were within 3 days of the initial presentation and were likely bounce-backs within the same exacerbation. In one case, the asthma protocol was initiated but the clinical documentation later reflected that the patient had croup. Although 5 other subjects had their repeat ED presentations within different respiratory seasons (i.e. two different winter seasons), we feel these patients would have still benefited from an ICS controller medication to lessen their exacerbation severity and so were correctly classified. If the 3 mis-classified patients were not included in the visits that qualified for ICS prescription, the rate of ICS prescription would have increased even further, from 0.74 to 0.79.

Our findings were consistent to a recent study by Andrews et al. showing a sustained improvement in prescription rate for several years up to 79% (16) for pediatric patients with frequent visits to the ED for asthma exacerbations. In both studies, the intervention was an electronic discharge order set with a prompt to prescribe ICS (17). The electronic alert in our study very specifically prompted physicians to prescribe a moderate dose of Fluticasone, which was thought to limit confusion in terms of which inhaled corticosteroid should be prescribed. During the first phase of the study, our ED physicians were offered a financial incentive if prescribing ICS for eligible patients at least 75% of the time. During the second phase of the study, there was no financial incentive in place.

While ICS prescription rates increased overall, several factors may have contributed to not prescribing ICS, even with the alert in place. First, ED providers included residents who rotate through the ED infrequently, and might have not received adequate instruction regarding the alert. This standard of care in the ED, however, should be part of the rotating residents' orientation and ongoing education throughout the month. Handoffs are a known cause of error in every area of health care and for this specific initiative, providers should write the prescription before handing off if it is already known the patient will need it. If unable to do this, providers should emphasize need for certain prescriptions in their plan to their colleagues. Finally, intermittent reinforcement and education for all the providers also would be helpful, especially regarding less obvious cases, where the patient was seen during two different respiratory seasons, does not have a formal diagnosis of asthma, or only has intermittent asthma symptoms.

This study was made possible through close collaboration with the IT department at PCH with the expertise and time resources required to develop and

integrate the electronic alert within the hospital electronic medical record system. The provider dashboard created by IT enabled the data collection and real-time monitoring of alert frequency and compliance. Despite direct query through the alert, providers sometimes did not provide complete information regarding the reason why ICS was not prescribed, especially for those patients without prior ICS. Ideally, the prescription for ICS should be coupled with asthma education, including giving the family an asthma action plan, however this information was not captured by the present alert.

In accordance with the latest Global Initiative for Asthma (GINA) report, our electronic alert dictating clinical management may benefit from periodic updates. GINA now recommends that children, adolescents and adults use ICS during asthma exacerbations, regardless of asthma disease severity. This is due to the finding that patients whose asthma is treated with short-acting beta agonists (SABA) alone are at increased risk of asthma-related death and urgent asthma-related health care (6). It may be an area of interest and further initiative in our department to further expand our ICS prescribing practices via the electronic alert.

This study confirmed that an electronic alert advising ICS prescription in the ED for patients with recurrent asthma visits is effective, even without a financial incentive, which makes it highly sustainable. The strategy of using electronic alerts to remind providers to prescribe recommended controller medications for chronic diseases can further be implemented in other acute care settings and for other disease processes. Further work is warranted to examine prescription fill data and whether ED prescription of ICS decreased return visit rates, which has been found to be true in other studies (17,18).

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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