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Identifying which urban children with asthma benefit most from clinician prompting: Sub-analyses from the PAIR-UP Trial

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Abstract

Objective—Clinician prompts increase the likelihood of guideline-recommended corrective actions (preventive medication prescription, dose change, and/or adherence promotion) for symptomatic children with poorly controlled or persistent asthma in the primary care setting, but it is unclear if all children benefit equally. The objectives of this study were to identify whether asthma severity, visit type, and current preventive medication use were predictive of corrective actions during visits for children with symptomatic asthma, and determine whether these factors modified the impact of a prompting intervention.

Methods—We conducted pre-specified subgroup analyses of a cluster randomized controlled trial of physician prompting that promoted guideline-based asthma management for urban children with symptomatic asthma. We tested predictors of corrective actions with bivariate and

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Contributor's Statements:

Nicolas Goldstein: Mr. Goldstein conceptualized and designed the study, performed the data analysis, drafted the initial manuscript, and approved the final manuscript as submitted.

Sean Frey: Dr. Frey contributed to study design, collaborated in the drafting and revision of the initial manuscript, and approved the final manuscript as submitted.

Maria Fagnano: Ms. Fagnano served as the research coordinator during all stages of the original study, organized the data for analysis, reviewed and revised the manuscript, and approved the final manuscript as submitted.

Sande Okelo: Dr. Okelo contributed to study design, collaborated in manuscript revision, and approved the final manuscript as submitted.

Jill Halterman: Dr. Halterman served as the primary mentor and investigator for all stages of both the original and current study, contributed to study design, reviewed and revised the manuscript, and approved the final manuscript as submitted.

multivariate multilevel logistic regressions; compared intervention effects across factor categories via stratified analyses; and characterized effect modification with interaction term analyses.

Results—Prompting intervention exposure, moderate/severe disease, asthma-focused visits, and current preventive medication use were predictive of corrective actions. The prompting intervention significantly increased the rate of corrective actions for children across categories of disease severity, visit type, and preventive medication use. However the intervention effect was significantly smaller for children already using a preventive medication (adjusted OR=2.01; 95% CI 1.19 to 3.38) compared to children without preventive medication use (adjusted OR=6.25; 95% CI 3.39 to 11.54).

Conclusions—Prompting increases the likelihood of corrective actions during clinic encounters; however, children already using preventive medication benefit less. It is critical for providers to recognize the need for corrective actions among these symptomatic children.

Keywords

asthma; childhood; prevention; primary care; provider prompting; sub analysis

Introduction

National asthma guidelines recommend specific actions for all symptomatic children with poorly controlled or persistent asthma, including ensuring that these patients have a prescription for a daily preventive medication, and initiating corrective actions including a ‘step-up’ in therapy for those with poor control despite consistent use of a preventive medication.¹ Daily adherence with recommended preventive therapy reduces asthma morbidity including decreased emergency department visits and hospitalizations.^{2,3} Unfortunately, guideline-based care is not delivered consistently in the primary care office and many children are inadequately treated.^{4,5} Poor, urban, and minority children are at highest risk for suboptimal preventive treatment, and they also experience the most disease-related morbidity.^{5–9}

Clinical prompts that remind physicians to provide recommended treatment or counseling are a potential tool to help alleviate the morbidity associated with guideline non-adherence.^{10,11} Prompting has been associated with improved rates of preventive care delivery across many randomized controlled trials.^{12,13} Prompts can be effective when delivered in a variety of formats, including on the computer screen, on paper, and in person.^{12,14,15} However, several factors may limit the effectiveness of prompting. For example, the reason for a patient’s visit may supersede prompted information in the clinician’s treatment priorities, especially if the prompt is not related to the chief complaint.¹⁶ Prompts can be used to stimulate initiation of treatment or to trigger adjustments in existing therapy¹⁷, but these activities are distinct and may be impacted differently. Further, while prompts may be effective when directing care for patients with severe disease¹⁸, clinicians often underestimate disease severity¹⁹ and, thus, prompts may be even more impactful for patients with less obvious need for treatment modifications.

Our research team found that clinician prompting during outpatient visits increased the likelihood of guideline-based corrective actions (defined as a new preventive medication prescription, medication dose change, or adherence promotion) for symptomatic children with poorly controlled or persistent asthma.²⁰ We next aimed to determine whether all of those children benefit equally from point of care prompting. Specifically, we sought to determine whether the efficacy of prompting varies based on several key factors: the type of visit for which a child presents, current utilization of preventive medication, and level of asthma severity (as determined by NHLBI criteria for persistent asthma).²⁰ Accordingly, our objectives were to test if visit type, current preventive medication use, and asthma severity were predictive of corrective actions during primary care visits for children with symptomatic asthma, and determine whether the impact of a prompting intervention varied depending on these factors.

Methods

Parent Study

Prompting Asthma Intervention in Rochester—Uniting Parents and Providers (PAIR-UP) was a cluster randomized trial in 12 urban primary care practices that used clinician prompting to promote guideline-based management of children with asthma; the full details of the trial are described elsewhere.²⁰ Briefly, we enrolled symptomatic children (ages 2–12 years) with persistent or uncontrolled asthma in the waiting room prior to a visit. Exclusion criteria included mild intermittent asthma, a primary language other than English or Spanish, family involvement in previous asthma trials, complex medical history that could interfere with asthma assessments, and lack of telephone access. We matched practices into pairs based on size, type (pediatric, family medicine, or internal medicine-pediatric), and patient demographics, and then randomly assigned them to intervention or usual care (UC). We obtained informed consent from all caregivers and assent from children ≥ 7 years old. We implemented clinician prompting for guideline-based care at the time of the visit in intervention practices; the prompts were created with standardized forms on a computer, printed, and handed directly to the clinician by the child's caregiver (a simplified prompt was also provided to caregivers). The prompts were based on information reported by the caregiver to study staff in response to a structured screening tool in the waiting room, and included guideline-based recommendations based on asthma symptom severity or control, preventive medication use, and exposure to smoke. Intervention practices also received practice-level supports (seminars, resource guides, and access to asthma education programs) and biannual performance feedback. We contacted caregivers by telephone within two weeks to determine specific actions taken during the visit by means of a structured interview tool, and reviewed medical records; all information was recorded in a computer database. Results from the parent study demonstrated that prompts increased the likelihood of corrective actions at the time of the visit (adjusted OR=2.8; 95% CI 1.9 to 3.9) and reduced morbidity.

Current Analyses

We subsequently performed pre-specified subgroup analyses of the PAIR-UP trial with the main outcome of corrective actions at the time of the visit. To account for the increased

complexity of decision making about which corrective actions are appropriate for patients already receiving advanced therapy, we added the exclusion criterion of combined therapy utilization (inhaled corticosteroid/long-acting beta agonist) at the time of the visit; we repeated analyses including these patients to assess for differences in estimates.

We first compared the distribution of our independent variables of interest and important covariates (child gender, age, race, ethnicity, insurance type, and caregiver smoking) across intervention and UC with chi-square and two sample t-tests. Next, we performed bivariate and multivariate analyses between corrective actions and intervention exposure (intervention versus UC), visit type (asthma versus well-child or other), asthma symptom severity (moderate or severe versus mild persistent), and current preventive medication use (yes versus no). To improve estimation efficiency, we included the covariates noted above in our multivariate model. We then performed stratified multivariate analyses based on visit type, asthma severity, and current preventive medication use, and ran additional multivariate models with interaction terms for each stratification factor. For all analyses, we utilized multilevel logistic regression with matched pair fixed effects to account for the process of intervention assignment and practice random effects to adjust for clinic-level implementation (random effect = patients nested within clinics). We assessed model specification with the Link and Hosmer-Lemeshow Tests and performed all analyses using STATA 12.0.

Results

Originally, we enrolled 638 children (319 per arm) in PAIR-UP. We excluded 55 participants (8.6%) taking combined therapy for the current analysis; the remaining 583 were balanced between intervention and UC (291 and 292 children, respectively). In our overall sample, the majority of children presented to clinic for non-asthma visits (76.2%), had moderate or severe persistent asthma (63.0%), were currently using preventive medication (54.2%), were non-white (77.3%) and non-Hispanic (62.7%), and were enrolled in Medicaid (67.9%). The average age was 6.5 years (SD=2.9 years). We found no significant differences between intervention and UC in the distribution of independent variables or covariates in our sub-sample (Table 1).

On bivariate multilevel logistic regression analyses with matched-pair fixed effects and practice random effects, the PAIR-UP intervention (unadjusted OR=3.14; 95% CI 2.22 to 4.43), asthma visit type (unadjusted OR=4.38; 95% CI 2.81 to 6.83), moderate to severe persistent asthma severity (unadjusted OR=1.68; 95% CI 1.17 to 2.41), and current preventive medication use (unadjusted OR=1.85; 95% CI 1.29 to 2.65) were each significantly associated with corrective actions (Table 2). Adjusting for independent variables and covariates, intervention (adjusted OR=3.31; 95% CI 2.28 to 4.80), asthma visit type (adjusted OR=4.16; 95% CI 2.62 to 6.61), and preventive medication use (adjusted OR=1.60; 95% CI 1.09 to 2.34) remained significantly associated with corrective actions, while severity (adjusted OR=1.38; 95% CI 0.93 to 2.06) was no longer a significant predictor. These results were similar to those obtained upon analysis including the 55 patients utilizing combined therapy.

Upon stratified multivariate multilevel logistic regression analysis controlling for independent variables and covariates, the prompting intervention, when compared with UC practices, significantly increased the likelihood of corrective actions across all categories of visit type, preventive medication use, and asthma severity (Figure 1). The impact of prompting did not differ based on visit type or asthma severity, but the intervention effect was smaller for children already using a preventive medication at the time of the visit (adjusted OR=2.01; 95% CI 1.19 to 3.38) compared to children without preventive medication use (adjusted OR=6.25; 95% CI 3.39 to 11.54). Effect modification was confirmed with multilevel multivariate logistic interaction term analysis for preventive medication use (adjusted OR=0.31; 95% CI 0.15 to 0.68); no significant evidence of effect modification was found for either visit type (adjusted OR=0.77; 95% CI 0.31 to 1.92) or asthma severity (adjusted OR=0.73; 95% CI 0.33 to 1.58).

Discussion

We found that symptomatic urban children with poorly controlled or persistent asthma by study inclusion criteria were more likely to receive corrective actions when presenting for an asthma-related visit, if they were already taking preventive medication, or if they were experiencing greater asthma severity. Severity was not a significant predictor on adjusted analysis, likely due to covariance with other independent variables. The PAIR-UP prompting intervention increased the likelihood of corrective actions during clinic encounters across all strata of these three factors. However, prompts were less effective for children already using preventive medication compared to those not utilizing preventive medication at the time of the visit. We believe that this effect modification is not driven by overly high rates of corrective actions for patients already taking preventive medication because many of these patients received no corrective actions, and every child in our study was symptomatic and, therefore, eligible for a corrective action.

Compared to previous studies,²¹ our sample had a rather large proportion of children with moderate or severe persistent asthma. We believe this is likely related to our method of screening and enrollment, which specifically aimed to identify symptomatic children presenting to the practice. A key strength of this analysis is the cluster randomized controlled design: unmeasured factors are balanced through matching and randomization while study contamination is limited.²⁰ Limitations include impaired generalizability (the study was conducted in one city with a convenience sample of practices) and potential for inaccurate estimation of benefit due to intra-cluster correlations and reliance on matching effectiveness.²⁰ However, the impact of prompts on physician decision making is likely comparable across regions due to the preserved psychological aspects of diagnostic reasoning,²² we accounted for intra-cluster correlation with practice-level random effects, and we found no significant evidence of a difference in observed factors between our intervention and UC groups.

This sub-analysis introduces additional strengths and limitations. Our robust statistical methodologies help account for intra-cluster correlation and random intervention assignment to identify heterogeneity in the intervention effect. Sub-analyses are more likely to suffer from both false-positives due to sequential hypothesis tests and false-negatives due to being

underpowered.²³ However, our study was designed to perform these sub-analyses a priori, decreasing the likelihood that results are the product of either random variation or inadequate sample, but further analysis is indicated.

Our results are meaningful for two reasons. First, they suggest that widespread use of prompting would likely benefit children with symptomatic asthma in urban practices, irrespective of visit type, preventive medication use, or asthma severity. In addition to the findings of other studies of electronic health record-based automated prompts,^{24,25} this prompting intervention serves as a model for future systems that could be automatically activated based on the results of a short screener provided to caregivers in the waiting room. Second, our findings highlight that children using a preventive medication whose asthma is nevertheless poorly controlled may be at increased risk of not receiving guideline-based adjustments in care despite prompting. While all children benefit from prompting, these children benefit less.

The reason for this difference in effectiveness is unclear. In the setting of current use of preventive medication, a clinician may erroneously assume that their patient is adequately treated for their asthma. Furthermore, clinicians may have lacked comfort with prescribing more advanced therapy such as long-acting beta agonists or higher doses of inhaled corticosteroids. It is also possible that children who are not currently using a preventive medication are easier targets for a prompting intervention because the change in clinical management is more intuitive. This difference needs to be investigated further in order to facilitate the development of interventions that can more effectively target children with poorly controlled asthma despite preventive medication use. In order to achieve optimal control, it is critical for providers to recognize the need for corrective actions among these symptomatic children.

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Abbreviations

PAIR-UP	Prompting Asthma Intervention in Rochester–Uniting Parents and Providers
UC	Usual Care
OR	odds ratio
CI	confidence interval

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What's New?

Among children with symptomatic asthma, clinician prompts increase the likelihood of corrective actions irrespective of visit type, preventive medication use, or asthma severity. However, clinician prompts are less effective for children already utilizing preventive medication compared to children without use.

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Figure 1.

Adjusted Odds Ratio for Corrective Actions with PAIR-UP Intervention Stratified on Visit Type, Current Preventive Medication Use, and Asthma Severity

^a Multilevel logistic regression with matched pair fixed effects and practice random effects; covariates include gender, age, race, ethnicity, insurance type, and caregiver smoking status

Table 1

Demographic Characteristics

Variable	Overall (n = 583)	PAIR-UP Intervention (n = 291)	Usual Care (n = 292)	P-Value ^a
Visit Type				
Well-Child or Other, n (%)	444 (76.2%)	217 (74.6%)	227 (77.7%)	0.369 ^b
Asthma, n (%)	139 (23.8%)	74 (25.4%)	65 (22.3%)	
Asthma Severity				
Mild Persistent, n (%)	216 (37.0%)	104 (35.7%)	112 (38.4%)	0.513 ^b
Moderate or Severe Persistent, n (%)	367 (63.0%)	187 (64.3%)	180 (61.6%)	
Current Preventive Medication Use, n (%)	316 (54.2%)	167 (57.4%)	149 (51.0%)	0.123 ^b
Child Male Gender, n (%)	346 (59.4%)	166 (57.0%)	180 (61.6%)	0.258 ^b
Child Age (Years), average (S.D.)	6.5 (2.9)	6.5 (3.0)	6.5 (2.9)	0.972 ^c
Child Race, n (%)				
White	131 (22.7%)	65 (22.7%)	66 (22.7%)	0.062 ^b
Black	209 (36.2%)	116 (40.6%)	93 (32.0%)	
Other	237 (41.1%)	105 (36.7%)	132 (45.4%)	
Child Hispanic Ethnicity, n (%)	215 (37.3%)	96 (33.6%)	119 (40.9%)	0.069 ^b
Child Medicaid Insurance, n (%)	396 (67.9%)	199 (68.4%)	197 (67.5%)	0.812 ^b
Caregiver Smokes, n (%)	178 (30.9%)	88 (30.8%)	90 (30.9%)	0.967 ^b

^aP-value comparing PAIR-UP Intervention with Usual Care^bChi-square test^cPaired t-test

Table 2

Unadjusted and Adjusted Odds Ratio for Corrective Actions

Variable	Unadjusted Odds Ratio (95% CI) ^a (n = 573)	Adjusted Odds Ratio (95% CI) ^b (n = 567)
PAIR-UP		
Usual Care (Reference)	3.14 (2.22 to 4.43)	3.31 (2.28 to 4.80)
Intervention		
Visit Type		
Well-Child or Other (Reference)	4.38 (2.81 to 6.83)	4.16 (2.62 to 6.61)
Asthma		
Asthma Severity		
Mild Persistent (Reference)	1.68 (1.17 to 2.41)	1.38 (0.93 to 2.06)
Moderate or Severe Persistent		
Current Preventive Medication Use		
No (Reference)	1.85 (1.29 to 2.65)	1.60 (1.09 to 2.34)
Yes		

^a Multilevel logistic regression with matched pair fixed effects and practice random effects^b Multilevel logistic regression with matched pair fixed effects and practice random effects; covariates include gender, age, race, ethnicity, insurance type, and caregiver smoking status