ARTICLE

Impact of Patient-Centered Decision Support on Quality of Asthma Care in the Emergency Department

Stephen C. Porter, MD, MPH[a], Peter Forbes, MA[b], Henry A. Feldman, PhD[b], Donald A. Goldmann, MD[a]

[a]Department of Medicine and the [b]Clinical Research Program, Children's Hospital Boston, Boston, Massachusetts

The authors have indicated they have no financial relationships relevant to this article to disclose.

ABSTRACT

OBJECTIVE. Communication barriers between parents of children with asthma and clinical emergency department (ED) providers and subsequent underrecognition of chronicity and severity impede improvements in disease management for patients with asthma in the ED setting. The asthma kiosk, a novel patient-driven decision-support tool, provides ED clinicians with tailored recommendations for guideline-based treatment. We evaluated the impact of the asthma kiosk on measures of quality during ED care, specifically, parent-reported satisfaction with dimensions of care related to communication and providers' adoption of guideline-endorsed processes of care.

METHODS. A clinical trial composed of a baseline and an intervention period was conducted at a single tertiary care pediatric ED. Eligible participants were English- or Spanish-speaking parents of children who were 1 to 12 years of age and had a respiratory complaint and history of asthma. Parents used the kiosk to report children's symptoms, current medications, and unmet needs. During a 2-month baseline, no output from the kiosk was shared, and usual care proceeded. During a 3-month intervention that followed a 1-week run-in period, the output was shared with ED clinicians. All parents completed a telephone follow-up interview 1 week after discharge. Primary outcomes were (1) prescription of controller medication to patients who had persistent asthma symptoms and were not on controllers and (2) mean problem scores for 2 specific dimensions of care: information-sharing and partnership.

RESULTS. Over 5 months, 1090 parent-child dyads were screened and 430 were eligible. A total of 286 (66.5%) of 430 parents enrolled in the trial. The kiosk generated severity classifications for 264 (92.3%) of 286 children. A total of 131 parents enrolled during baseline, 13 during a 1-week test phase, and 142 during intervention. Baseline participants were older (mean age: 5.3 years) compared with intervention (4.4 years) but did not differ on chronic severity, current use of controllers, or race. The total number of prescribed inhaled corticosteroids did not

www.pediatrics.org/cgi/doi/10.1542/peds.2005-0906

doi:10.1542/peds.2005-0906

Portions of this manuscript were presented in abstract form at the Pediatric Academic Societies Meeting; May 14–17, 2005; Washington, DC; and the Academy Health Meeting; June 26–28, 2005, Boston, MA.

Key Words
clinical decision-support systems, patient-centered care, emergency medicine, asthma, quality of health care

Abbreviations
ED— emergency department
MDI—metered dose inhaler

Accepted for publication Jun 29, 2005

Address correspondence to Stephen C. Porter, MD, MPH, Division of Emergency Medicine, MA-001, Children's Hospital Boston, 300 Longwood Ave, Boston, MA 02115. E-mail: stephen.porter@childrens.harvard.edu

PEDIATRICS (ISSN 0031 4005). Copyright © 2006 by the American Academy of Pediatrics

Downloaded from www.aappublications.org/news by guest on November 27, 2020

vary significantly between intervention and baseline (9 of 50 vs 4 of 43). Providers did prescribe inhaled fluticasone to eligible patients more often during intervention than baseline (9 of 50 vs 2 of 43). The number of reported information problems was unchanged between the baseline and intervention periods. The mean number of partnership problems increased from a mean of 1.5 (SD: 1.9) at baseline to a mean of 1.9 (SD: 1.4) during the intervention. This difference was marginally significant after adjustment for child gender, age, and severity category. When ED providers acted on kiosk data, reports of information problems were fewer (0.6 ± 0.8) than when no action was taken (1.1 ± 1.1).

CONCLUSIONS. The asthma kiosk demonstrated small and variable impact on quality. Physicians' nonuse of kiosk-generated recommendations may explain the limited impact of the intervention.

OPTIMAL HEALTH CARE requires effective collaboration between patients and providers. Idealized disease management for asthma requires that providers recognize patients' chronic symptoms, medication history, and environmental and social factors that influence disease.[1] Optimal patient-provider communication in the emergency department (ED) is constrained by noise, crowding, patient stress, provider stress, limited time for interviews, and other factors.[2]

In pediatric asthma, an ED visit is viewed as a marker of severity and may serve as a critical juncture for improving care. ED-based care for childhood asthma fails to conform with recommendations for history taking and discharge planning.[3] Recent studies have focused on how to connect patients who are discharged from the ED with comprehensive asthma management through their "medical home."[4,5] No work to date has measured attempts, made during an ED visit, to have a direct impact on chronic disease management of asthma and potentially improve quality of life.

Electronic interfaces such as computer kiosks collect valid data from parents and are ideally suited to automate the collection and analysis of parent-reported data.[6,7] Direct report from parents may have a distinct and important role in accurate information gathering.[8] Data capture and effective, real-time integration of information into the care process has the potential to improve the quality of care.[9–11]

This study introduced a patient-driven technology, the asthma kiosk, into the evaluation and treatment of pediatric asthma in the ED.[12] We evaluated the impact of the asthma kiosk on measures of quality during ED care, specifically, parent-reported satisfaction with the care dimensions of information giving and partnership and providers' adoption of guideline-endorsed processes of care.

METHODS

We conducted an intervention trial at a single tertiary care pediatric ED from October 2003 to March 2004. A pre–post design was used with the following time periods: a baseline phase (8 weeks), a start-up phase to test the mechanics of the intervention (1 week), and an intervention phase (12 weeks). The Children's Hospital Boston Committee on Clinical Investigation approved the study (protocol 02-05-056).

Participants

Study participants were parents or primary caregivers of children who were aged 1 to 12 years and presented with a respiratory chief complaint and a history of asthma or chronic wheezing. The following words or phrases represented a respiratory chief complaint: "problems breathing," "cough," "wheezing," "asthma," "shortness of breath," "fast breathing," "noisy breathing," and "chest pain." Parents who reported English or Spanish as their primary language were eligible for enrollment. Previous enrollment in the study made a parent ineligible, and parents of children who were triaged as emergent and taken to a resuscitation room were not eligible.

Setting

The study site was the pediatric ED of a large, urban, tertiary hospital with an annual volume of 50 000 patient visits. A clinical practice guideline for ED-based care of asthma was in use during the study period, with a primary focus on timely administration of β-2 agonist therapy and initiation of oral systemic steroids for patients who do not respond to initial doses of albuterol. Discharge planning and efforts to initiate chronic control of disease, although part of the written guideline, were not key measures tracked by clinical leadership at this study site.

All patients at the study site are examined by a board-eligible or board-certified physician in pediatric emergency medicine. Clinical providers at the study site also include resident-level trainees in pediatrics and emergency medicine as well as fellow-level trainees in pediatric emergency medicine. The principal investigator for the trial was not a member of the ED leadership team. Physician and nursing leadership both endorsed the project in advance and facilitated communication with ED personnel.

The Asthma Kiosk

The asthma kiosk is a patient-driven decision-support technology that allows parents of children with asthma to report symptoms of chronic severity, current medications used for asthma, and assessment of care needs and environmental risk. The formative evaluation of the asthma kiosk has been described elsewhere.[12] The asthma kiosk uses an interface style similar to a bank automated tell machine with a multilanguage, multime-

Downloaded from www.aappublications.org/news by guest on November 27, 2020

dia touch-screen environment designed to allow users without technology experience to enter content. The asthma kiosk produces tailored plans of action for use by clinical providers (Appendix). Output for clinical providers highlights (1) level of chronic severity; (2) symptom data that support the severity rating; (3) current controller medications; (4) mismatches between severity level and current use of controllers; and (5) asthma-specific needs regarding environmental risks, access to primary care and prescription drugs, and educational topics endorsed by the parent. The kiosk generates the classification for level of chronic severity using an algorithm that maps parents' report of symptoms frequency over the past 4 weeks for cough, shortness of breath, wheeze, and night-time awakening to the categorical thresholds established by National Asthma Education Prevention and Promotion guidelines.[1,12]

Study Protocol

Potential participants were screened and recruited 7 days a week during the 5-month trial (4 PM to 12 AM on weekdays and 12 PM to 12 AM on weekends). Potential participants were identified through direct observation at triage and surveillance of an electronic patient tracking system that highlights age and chief complaints for patients who arrive for care. Parents were approached after the completion of nursing triage by trained bilingual research assistants and screened to identify those who were eligible for the research study.

During the baseline and intervention phases, parents completed a series of 3 steps: (1) informed consent; (2) use of the asthma kiosk; and (3) completion of a paper-based survey covering sociodemographic information, experience with technology, and previous experience with asthma. Parents completed the asthma kiosk independently after patient-specific demographic data were entered by the research assistant. Use of the kiosk occurred at triage and/or within a patient's treatment room. Research assistants were instructed to tell the parents to "do their best" and to choose the answer that they thought was best if asked for assistance on content and selecting an answer. A log of parental requests for assistance was not maintained during the clinical trial.

Baseline and intervention phases differed on which output was shared collaboratively with ED physicians and nurses. During baseline, parents received limited feedback through 2 on-screen tailored messages: "about your child" and "what help your child might need." No data generated by parents using the kiosk were shared with clinical providers during the baseline period. In contrast, the intervention period provided full sharing of information between the kiosk and the parent and between the kiosk and the provider. During the intervention period, a total of 4 classes of tailored messages were generated and shown to the parent: (1) "about your child"; (2) "what help your child might need"; (3) "how the doctors and nurses can help your child"; and (4) "how you as a parent can help the doctors and nurses care for your child." A tailored plan of action directed at the physicians and nurses was generated and included in the information available to treating physicians and nurses during care.

The plan of action generated by the kiosk targeting physicians and nurses was printed on yellow 8.5-in × 11-in paper and placed in the patients' active paper chart by the research assistant. Observational research that was done in advance of the clinical trial noted that the vast majority of ED physicians and nurses review the paper chart before entering a patient's room for the first time. Yellow sticky notes placed on the front of the chart by the research assistant alerted nurses and physicians that important information about the child's asthma was available for review and action. These sticky notes represent a paper-based alert or reminder that mimics the "just-in-time" reminders that are operational in electronic systems that are designed to improve the quality and the safety of physicians' decision making. Physicians and nurses in the ED were oriented to the intervention through a combination of in-person presentations, fliers, and e-mail alerts. No formal measurement of physicians' and nurses' acceptance of the intervention occurred.

All parents completed a follow-up telephone interview with a trained bilingual research assistant 1 week after their ED visit. Attempts to contact parents by telephone began on day 4 or 5 and ended when either 10 attempts failed or >2 weeks had elapsed since the ED visit.

Background System-Level Efforts to Support Quality Improvement for Asthma

Before the initiation of the clinical trial, English- and Spanish-language materials covering basic educational topics for asthma were assembled and placed in the ED treatment area for use by physicians and nurses during parent/patient teaching and discharge planning. Nursing leadership endorsed a list of educational topics that represented essential aspects of asthma management and could be addressed in short 3- to 5-minute teaching sessions with parents. Before and during the clinical trial, motivational e-mails were sent to all MD and RN staff on a monthly basis and provided (1) core didactic material on idealized asthma care, (2) updates on the resources available for use in providing care to children with asthma, and (3) updates on the clinical trial.

A preformatted medication order sheet was placed in the active chart for enrolled patients during the intervention period. This order sheet formalized the process of ordering fluticasone metered dose inhaler (MDI). During the intervention period, provision of a controller medication directly to the patient was also simplified by stocking the ED-based Pyxis system stationed in the ED with fluticasone MDI in 44- and 110-μg formulations.

Downloaded from www.aappublications.org/news by guest on November 27, 2020

Outcome Measures

Primary outcomes targeted patient satisfaction with care and provider adoption of guideline-endorsed process measures. These outcomes were specifically examined for the subset of patients who were discharged to home from the ED.

Satisfaction with care was investigated during the follow-up telephone interview that was conducted with parents. Two domains of care that are relevant to successful communication were surveyed: (1) information sharing and (2) partnership. Questions that were specific to these domains were chosen from the National Research Corporation/Picker survey modified and validated by researchers at Children's Hospital Boston and used to survey parents' report of their child's care.[13,14] A total of 11 questions form the partnership domain, and 7 form the information-giving domain (Table 1 lists questions for each domain). The mean number of problems reported by the parent for each domain served as the primary outcome. Items that report on specific aspects of care are dichotomized as "problems" or "not problems." For items with >2 response categories, the responses are considered to represent problems when any of the least preferable 2 of 3 categories are chosen (eg, "never" or "yes, sometimes" on a scale including "yes completely"). Secondary outcomes included parents' responses to the specific questions within the domains.

TABLE 1 Listing of Questions for Domains

Partnership
When you saw the doctor in the ED, did he or she give you a chance to explain the reasons for your visit?
Did the doctor listen to what you had to say about your child?
Did the doctor taking care of your child treat you with dignity and respect?
Did you have confidence and trust in the doctor treating your child?
During the ED visit, did the doctor spend enough time with you?
Did the nurse in the ED listen to what you had to say about your child?
Did the nurse taking care of your child treat you with respect and dignity?
Did you have confidence and trust in the ED doctor and nurse treating your child?
Were you involved in decisions about your child's care as much as you wanted during the ED visit?
Was everything done for your child that you think should have been done?
Did you have any questions about your child's care or treatment that you wanted to discuss but did not?
Information giving
Was your child's problem explained to you in a way that you could understand?
Sometimes one doctor or nurse will say one thing and another will say something quite different. Did this happen to you during your child's visit?
Before leaving the ED, were you told what signs to watch for that might need further medical care?
Before you left the ED, were you given written instructions or information sheets about what to do at home?
Did you have trouble talking with your child's doctor or nurse in the ED because of a language problem?
Did you get as much information about your child's asthma and treatment as you wanted from the nurses and doctors in the ED?
Did you want an interpreter while you were in the ED?

Providers' prescription of controller therapy served as the primary measure of process-level quality. Strong evidence regarding the efficacy of controllers in preventing future ED visits and hospitalizations for children with persistent asthma supports the importance of this process-level measure of care.[15,16] A child who had persistent chronic symptoms and was not taking a controller was considered eligible and appropriate for such a prescription when they were being discharged from the ED to outpatient care. Prescribing by physicians was measured by parental report at the time of follow-up telephone interview as to prescriptions or medications given to them at the time of ED care.

Analysis

Primary outcomes were reported as baseline and intervention means and percentages with 95% confidence intervals. Simple comparison between the 2 periods was completed with Wilcoxon and Fisher's exact tests for continuous and categorical variables, respectively. Linear and logistic regression compared outcomes in the baseline and intervention periods and adjusted for child age category (0–2, 3–5, and 6–12 years), child gender, and asthma severity. All enrolled participants, regardless of whether they completed use of the kiosk, were considered "exposed" and were included in the analyses. Participants enrolled during the run-in period were excluded from analyses.

RESULTS

A total of 1090 parent-child dyads were screened, and 430 were considered eligible for the clinical trial. Reasons for ineligibility included lack of previous asthma diagnosis (477 of 660), lack of previous discussion with primary doctor about whether wheezing indicated asthma (477 of 660), primary language not English or Spanish (18 of 660), and no primary caregiver with child (15 of 660). A total of 286 (66.5%) of 430 enrolled in the trial. Of those who were eligible but not enrolled, 97 of 144 refused and the remainder were not enrolled as a result of process constraints (RN/MD busy with child, discharge was imminent, child out of department in radiology, etc). Of the 286 participants, 7 did not use the kiosk and 12 did not complete the kiosk interview. Tailored output was generated successfully by the kiosk for 267 (93.3%) of 286 children.

Across the time periods, 131 parents were enrolled at baseline, 13 during start-up, and 142 during the intervention phase. Thirty-four children were admitted during the baseline and intervention periods, respectively. Figure 1 outlines the study recruitment, enrollment, and follow-up statistics in detail. Follow-up interviews were completed with 242 (84.6%) of 286 participants. Completion of follow-up interviews did not vary across study periods.

Enrolled participants were comparable across the

Downloaded from www.aappublications.org/news by guest on November 27, 2020

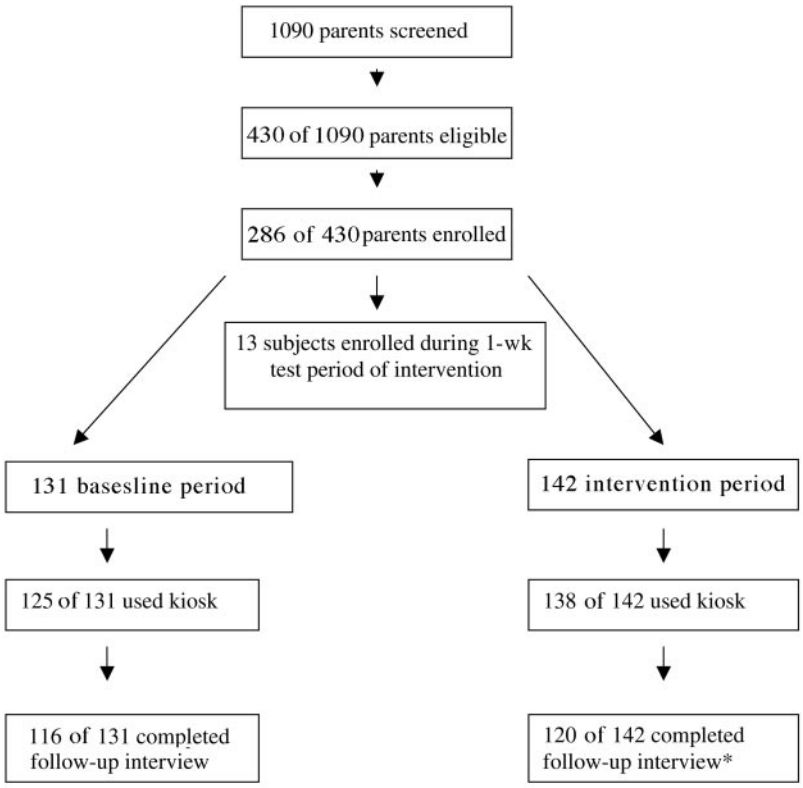

FIGURE 1
Outline of recruitment, enrollment, and follow-up of subjects. *The denominator includes 3 parent-child dyads who left the ED without being seen by the physician.

baseline and intervention periods save for patient age (mean age at baseline: 5.3 years [SD: 3.2]; mean age during intervention: 4.4 years [SD: 2.9]; see Table 2 for details of subject demographics and measures of asthma severity). Of note, the majority of parents in both study periods reported persistent disease severity for their children.

Satisfaction With Care

Parents' report of information problems and partnership problems served as domain-level measures of satisfaction with care. For patients who were discharged to home, the mean number of information problems did not vary across periods (mean at baseline: 0.8 [SD: 1.1]; mean during intervention: 0.7 [SD: 1.0]). The mean number of partnership problems increased from a mean of 1.5 (SD: 1.9) at baseline to a mean of 1.9 (SD: 1.4) during intervention ($P = .003$). Differences between time periods in partnership problems demonstrated marginal significance after adjustment for child gender, age, and severity category ($P = .08$).

Two questions were identified a priori as representative of the partnership and information-sharing domains: "Were you involved in your child's care as much as you wanted during the ED visit?" and "Did you get as much information about your child's asthma and treatment as you wanted from the doctors and nurses in the ED?" Each of these questions could be answered, "yes, completely," "yes, somewhat, " or, "no." Parent report of involvement varied by time period, with the percentage who answered, "yes, completely," dropping from 95% during baseline to 84% during the collaborative ($P = .008$). For the information question, most parents reported that they got as much information as they wanted during both periods (86% baseline, 85% intervention), but significantly more parents reported, "no," at baseline than during intervention (12% vs 2%; $P = .001$).

Provider Compliance

Providers' prescription of controller therapy to patients who were not currently taking a controller but whose disease severity was persistent was investigated. Forty-three patients during the baseline phase and 50 patients during intervention met this definition of symptom-medication mismatch. When both nebulized and MDI-based inhaled corticosteroids were considered (budesonide and fluticasone), the difference in number of appropriately treated patients was not significant (4 of 43 at baseline vs 9 of 50 during intervention; $P = .37$).

The plan of action that was generated by the kiosk specifically targeted the prescription of fluticasone. Fluticasone was prescribed for only 2 of 43 patients during baseline compared with 9 of 50 patients during the intervention period ($P = .06$). Adjustment for child gender, age, and severity category did not change the result (odds ratio: 4.9; 95% confidence interval: 0.9–26.9; $P = .07$). A summary of all primary outcomes is presented in Table 3.

Downloaded from www.aappublications.org/news by guest on November 27, 2020

TABLE 2 **Participant Characteristics According to Study Period**

Variable/Characteristic	Baseline	Intervention
Age, mean (SD), y[a]	5.3 (3.2)	4.4 (2.9)
Male, %	63	54
Admitted, %	26	24
Parent education, %		
Some high school	16	10
High school graduate	23	27
Some college	33	27
College graduate	13	19
Postgraduate work	16	19
Race, %		
White	28	37
Black	30	31
Other	19	15
No response	23	17
Asthma severity, %		
Mild intermittent	22	18
Mild persistent	44	54
Moderate persistent	31	20
Severe persistent	3	8
No. of controller medications, %		
0	50	45
1	31	38
2	18	14
3	02	03
Has written asthma plan, %	62	56
Has regular doctor, %	98	97
Knows how to use medicine, %	83	88

[a] Baseline and intervention comparison: $P < .05$.

Impact of the Kiosk-Generated Action Plan During the Intervention Period

The theoretical model of how patient-centered data capture improves care assumes that clinicians need to see and then act on patient-provided information. We examined the specific items marked as completed on the plans of action to judge the kiosk's impact for patients for whom the ED physician and the nurse were responsible for discharge planning. Patients who were enrolled during the intervention period and discharged to home from the ED (109 of 142) formed this subset. Original copies of the kiosk-generated plans were available for review in 83 (76.2%) of 109 of these patients. Fifty-three (63.8%) of 83 forms had at least 1 medication-specific recommendation on which providers could act. Eighty (96.4%) of 83 forms had at least 1 education-specific recommendation on which providers could act. Individual recommendations on the action plan were variably completed by clinical providers. The percentage of individual items that were marked as completed ranged from 0% to 50%. Table 4 summarizes the recommended actions presented to clinicians using the kiosk output and the subset of documented actions that were marked as completed.

We completed a secondary analysis to investigate whether providers' completion of at least 1 recommendation from the kiosk output altered parents' report of partnership or information exchange. The mean number of partnership problems that were reported by parents did not vary when output forms with documented actions taken were compared with forms for which no action was documented (mean problems: 1.7 [SD: 1.1] vs 1.8 [SD: 1.5]). The mean number of information problems decreased when action was documented com-

TABLE 3 **Study Outcomes According to Study Period**

	Baseline	Intervention	*P*[a]
Patient satisfaction with care			
Information-sharing problems			
No. of participants	93	106	
Mean (SD)	0.8 (1.1)	0.7 (1.0)	.84
Median	0.0	0.0	
Partnership problems			
No. of participants	93	106	
Mean (SD)	1.5 (1.9)	1.9 (1.4)	.003
Median	1.0	1.0	
Provider compliance with prescriptions			
Fluticasone			
No. of prescriptions/no. eligible	2/43	9/50	.06
Any corticosteroid			
No. of prescriptions/no. eligible	4/43	9/50	.37

[a] *P* values are for tests of difference in the number of problems and the percentage of prescribed medication between the baseline and intervention periods. Satisfaction outcomes are counts of problems, and the Wilcoxon test was used. Compliance outcomes are proportions, and Fisher's exact test was used.

TABLE 4 **Summary of Recommendations Presented to Clinicians and Number of Endorsements**

Itemized Recommendation	No. of Patients for Whom Recommendation Is Present (% Total Forms Analyzed)	No. of Patients for Whom Recommendation Is Endorsed (% of Patients for Whom Recommendation Is Present)
Refer patient to asthma subspecialist	15/83 (18.0)	7/15 (50.0)
Prescribe fluticasone	32/83 (38.5)	8/32 (25.0)
Prescribe new formulation of fluticasone	10/83 (12.0)	4/10 (40.0)
Increase dose of fluticasone	1/83 (1.2)	1/1 (100.0)
Increase frequency of fluticasone	4/83 (4.8)	2/4 (50.0)
Prescribe peak flow meter	6/83 (7.2)	0/6 (0.0)
Educate on why medicines are necessary for asthma	17/83 (20.5)	1/17 (5.8)
Educate on what asthma is	61/83 (73.5)	13/61 (21.3)
Educate on how to use inhaler	12/83 (14.4)	2/12 (16.7)
Educate on how to use nebulizer	9/83 (10.8)	2/9 (22.2)
Educate on smoke exposure and asthma	37/83 (44.6)	8/37 (21.6)
Educate on mold exposure and asthma	27/83 (32.5)	4/27 (14.8)
Educate on pet dander and asthma	24/83 (28.9)	5/24 (20.8)
Educate on dust mites and asthma	39/83 (47.0)	5/39 (12.8)

Downloaded from www.aappublications.org/news by guest on November 27, 2020

pared with no action documented (mean problems: 0.6 [SD: 0.8] vs 1.1 [SD: 1.1]; $P = .06$.)

DISCUSSION

We report on the successful deployment and impact of a parent-driven informatics technology to support the quality of asthma care delivered in the ED setting. More than 90% of parents who started use of the kiosk successfully completed the interview and produced an automated plan of action for use during care. This patient-driven technology had small and variable impact on the quality of care as measured by parental report of satisfaction and by the process-level event of prescribing controller medication.

Wagner's model for idealized collaborative care emphasizes the cooperation between an "informed, activated patient" and a "prepared, proactive provider."[17] However, in the ED setting, providers and patients have no a priori relationship and must establish common ground for the agenda of the visit.[2] Lack of common ground puts 2 critical functions of the patient visit in jeopardy: (1) assessment of the full spectrum of patients' concerns and (2) the development of an educational and treatment plan.[18] The asthma kiosk successfully coupled patient-driven data capture to "doing the right thing" in prescribing a controller when an ED provider cared for a patient with persistent asthma symptoms. The actual improvement in prescription of a specific controller was small but may represent a trend toward significant improvement. Given the well-documented barriers to asthma guideline adoption and implementation at the provider level, even small success is an important result for this intervention in the ED, where system-level factors also constrain adoption.[19,20]

The asthma kiosk failed to improve parents' satisfaction regarding partnership with ED providers. Providers' inattention to parents' concerns that were communicated via the kiosk may explain a trend toward worsening partnership noted in the adjusted results. Parents who completed the asthma kiosk in the intervention period knew that their computer-generated information was available to the ED providers. Of note, a minority of plans that were generated by the kiosk were acted on by providers. A mismatch between an activated patient and a less-than-proactive provider may have widened a gap in partnership that the kiosk was meant to narrow.

The asthma kiosk did not demonstrate a measurable benefit for the domain of information-sharing. We had hypothesized that when the output from the asthma kiosk was shared collaboratively, parents would report improvements in receipt of information from providers. Two aspects of the intervention may explain the lack of impact. Parents in both baseline and intervention periods received on-screen text/audio messages that covered the topics "about your child" and "what help does your child need." Parents may not have perceived additional benefit to the paper-based tailored message and a more detailed "how the ED can help" message produced during the intervention period. In addition, providers' lack of action on information needs despite prompts from the system may have mitigated parents' satisfaction with the exchange of data. Information sharing did improve for the subgroup of parents in the intervention period whose kiosk output was acted on by ED providers, suggesting that positive change did occur when the collaborative model was fully operational.

The potential impact of the asthma kiosk on the quality of ED care depends on multiple interdependent events and circumstances: (1) valid data discovery from parents' use of the kiosk, (2) communication of tailored recommendations to ED providers, (3) ED providers' belief in the correctness of the recommendations and their ability to act on the presented data, and (4) system-level factors to support the improvement effort. The intervention with the asthma kiosk purposefully coupled the availability of educational resources, a preprinted order sheet for inhaled corticosteroid prescribing, and Fluticasone stocked in the ED-based Pyxis machine to reduce the barriers between providers' willingness to act and the completion of the act. We targeted specific steps in the process of asthma care that were considered critical to the success of improvement.[21] We did not formally use techniques such as academic detailing or use of opinion leaders, although the ED clinical leadership for physicians and nursing staff was supportive of the technology deployment. Despite our efforts to identify key process-level barriers and implement a supportive infrastructure, the ability of individual ED providers to accept and incorporate a technology-derived "to-do" list into their communication with patients was limited.

Strong rationale exists for why chronic disease management of pediatric asthma should not be left solely to primary care providers but should include interventions within the ED. Up to one quarter of pediatric patients who have asthma and are discharged from the ED on oral steroids evidence persistent disease symptoms 4 weeks later.[22] Previous efforts that originated in the ED to facilitate follow-up with primary caregivers and coach parents on how to treat asthma demonstrated limited impact on visit attendance and initiation of controller therapy.[4,5] Use of inhaled corticosteroid protects against future visits to the ED or need for hospital admission.[15,16,23,24]

Although the ED visit represents an opportunity to improve treatment and chronic management of pediatric asthma, the time and personnel resources to deliver targeted education, and, in select cases, prescribe and teach use of a controller medication remain scarce. Our intervention did not provide resources for time or additional personnel to support the improvement effort. Future work should consider alternative means of infor-

Downloaded from www.aappublications.org/news by guest on November 27, 2020

mation delivery to parents. The tempo of how asthma care is delivered in the ED often results in parents and children with "down time" between respiratory treatments. Use of educational videos that can target select informational needs of parents may reduce the time burden on the ED providers in the provision of core content for asthma.

The cost of implementing the asthma kiosk was not a primary focus of this research effort. The clinical trial relied on research personnel to load demographic data into the kiosk and identify eligible and willing participants as part of an informed consent protocol. The time and effort for these steps, as well as the steps needed to link the paper-based output to the patients' charts, must be recognized. Idealized integration into workflow to promote efficiency and contain costs would include prepopulated electronic data from administrative records; patient identification via scanning technology to validate the parent as the correct reporter for the patient of record; and use of electronic tracking and documentation systems to highlight parents' data to eliminate the need for additional paper to be generated, stamped, and bundled with the active chart.

Our study includes important methodologic limitations. We completed a 5-month trial with a baseline and intervention phase that should be viewed as a preliminary study of the technology's effect on quality. Our pre–post design cannot account and adjust for all potential confounders. A stronger design would include a postintervention period and a subsequent second intervention period to account for temporal trends. A randomized trial of the technology implementation was considered untenable as patients who arrive for ED care cannot be assigned in advance to a particular physician and nurse, and contamination across assigned groups would result. Despite the methodologic limitations, our assessment of chronic severity and detailed parental report of the child's current asthma care provide robust evidence for significant undertreatment with controllers and informational needs that are amenable to intervention.

Any change in the quality of care that is attributed to the technology-based intervention assumes that other factors that are in play within the ED environment are not responsible for the effect. Our results did adjust for measurable patient-level factors such as age and chronic severity. However, additional adjustments for variation in ED census (a factor that might affect the care experience with regard to waiting time and providers' ability to provide personalized care) were not completed because of the limitations of the number of participants and power concerns. It is possible that temporal trends related to volume and wait times may drive the results reported for this trial instead of the intervention itself.

The intervention itself combined a parent-driven technology solution and specific adjuncts (eg, sticky notes, formatted order sheet, availability of fluticasone in Pyxis, availability of English and Spanish educational handouts) to facilitate implementation of the action plan. Our evaluation cannot identify whether the technology itself or the adjuncts were responsible for any change in the quality of delivered care.

The clinical trial of the asthma kiosk represents a novel effort to measure the quality-related effects of a patient-driven technology solution in the pediatric ED. The technology itself incorporates rules specified by the Institute of Medicine for system redesign: customization based on patient needs, the patient as source of control, shared knowledge, evidence-based decision making, and anticipation of needs.[25] The impact of the asthma kiosk was limited, with a notable negative effect on parents' report of partnership with clinical providers. The computer-generated, tailored plan of action, operationalized as a paper-based reminder, allowed providers to "opt into" the right action as opposed to requiring them to "opt out" of doing the right thing. We would expect a stronger effect to arise from electronic reminders that are delivered at the point of ordering and deciding in an electronic prescribing environment. However, few ED settings have adopted electronic decision-support systems and computerized physician order entry; there is little published evidence regarding the benefits and risks of these technologies in the ED.[26] In the absence of these technologies, improvements in ED-based asthma disease management must be based on solutions that tightly couple the ED system's responsiveness to the needs of patients communicated through technologies such as the asthma kiosk.

Downloaded from www.aappublications.org/news by guest on November 27, 2020

APPENDIX: EXAMPLE OF ACTION PLAN

Idealized Asthma Care

Parents told us what they know. Now let's act on their data and help!

Current symptoms and medications → recommended actions

1) Chronic severity for asthma: moderate persistent

2) Data that support this severity:

Symptom	4-wk Frequency
Cough	Most
Wheezing	Some
Shortness of breath	Few
Night time awakening	Some

3) Current controller medications:

Flovent 44 μg 1 puff Less often than every day

4) Recommendations for fake patient 1, age 10 y:

#1 Prescribe new form of Flovent 110 μg **Completed Y/N _____**

#2 Increase frequency of use to twice daily **Completed Y/N _____**

Current parent-child needs → recommended actions

1) In support of best medication practice

What asthma is and how to prevent it **Completed Y/N _____**

How to give medication using inhaler and spacer **Completed Y/N _____**

How to use peak-flow meter **Completed Y/N _____**

2) In support of environmental risk reduction

Eliminating smoke exposure* **Completed Y/N _____**

3) In support of better access to care

Patient requires Spanish translator **Completed Y/N _____**

Help with getting prescription medicines* **Completed Y/N _____**

*Consult social work for help in needs identification and resource management.

Downloaded from www.aappublications.org/news by guest on November 27, 2020

ACKNOWLEDGMENTS

This work was supported by a grant from the Charles H. Hood Foundation (Boston, MA) and an award to Dr Porter from the Agency for Healthcare Research and Quality (K08 HS 11660).

We gratefully acknowledge the contributions of Sandra Lopez in the completion of the telephone interviews.

REFERENCES

1. National Heart, Blood, and Lung Institute. *Expert Panel Report 2: Guidelines for the Management of Asthma.* Bethesda, MD: National Institutes of Health; 1997. Publication no 97-4051
2. Knopp R, Rosenzweig S, Bernstein E, Totten V. Physician-patient communication in the emergency department, part 1. *Acad Emerg Med.* 1996;3:1065–1069
3. Crain EF, Mortimer KM, Bauman LJ, et al. Pediatric asthma care in the emergency department: measuring the quality of history-taking and discharge planning. *J Asthma.* 1999;36:129–138
4. Zorc JJ, Scarfone RJ, Li U, et al. Scheduled follow-up after a pediatric emergency department visit for asthma: a randomized trial. *Pediatrics.* 2003;111:495–502
5. Smith SR, Jaffe DM, Fisher EB, Trinkaus KM, Highstein G, Strunk RC. Improving follow-up for children with asthma after an acute Emergency Department visit. *J Pediatr.* 2004;145:772–777
6. Porter SC, Silvia MT, Fleisher GR, Kohane IS, Homer CH, Mandl KD. Parents as direct contributors to the medical record: validation of their electronic input. *Ann Emerg Med.* 2000;35:346–352
7. Porter SC, Fleisher GR, Kohane IS, Mandl KD. The value of parental report for diagnosis and management of dehydration in the emergency department. *Ann Emerg Med.* 2003;41:196–205
8. Porter SC, Kohane IS, Goldmann DA. Parents as partners in obtaining the medication history. *J Am Med Inform Assoc.* 2005;12:299–305
9. Bates DW, Pappius EM, Kuperman GJ, et al. Measuring and improving quality using information systems. *MedInfo.* 1998;9:814–818
10. Kaplan B, Brennan PF. Consumer informatics supporting patients as co-producers of quality. *J Am Med Inform Assoc.* 2001;8:309–316
11. Giloth BE. Promoting patient involvement: educational, organizational, and environmental strategies. *Patient Educ Counsel.* 1990;15:29–38
12. Porter SC, Cai Z, Gribbons W, Goldmann DA, Kohane IS. The asthma kiosk: a patient-centered technology for collaborative decision support in the emergency department. *J Am Med Inform Assoc.* 2004;11:458–467
13. Cleary PD, Edgman-Levitan S, Walker JD, Gerteis M, Delbanco T. Using patient reports to improve medical care: a preliminary report from 10 hospitals. *Qual Manage Health Care.* 1993;2:31–38
14. Homer CJ, Marino B, Cleary PD, et al. Quality of care at a children's hospital. The parents' perspective. *Arch Pediatr Adolesc Med.* 1999;153:1123–1129
15. Lieu TA, Quesenberry CP, Capra AM, Sorel ME, Martin KE, Mendoza GR. Outpatient management practices associated with reduced risk of pediatric asthma hospitalization and emergency department visits. *Pediatrics.* 1997;100:334–341
16. Donahue JG, Weiss ST, Livingston JM, Goetsch MA, Greineder DK, Platt R. Inhaled steroids and the risk of hospitalization for asthma. *JAMA.* 1997;277:887–891
17. Wagner E. Organizing care for patients with chronic illness. *Millbank Q.* 1996;74:511–528
18. Lazare A, Putnam S, Lipkin M. *The Medical Interview: Clinical Care, Education, and Research*. New York, NY: Springer; 1995
19. Cabana MD, Ebel BE, Cooper-Patrick L, Powe NR, Rubin HR, Rand CS. Barriers pediatricians face when using asthma practice guidelines. *Arch Pediatr Adolesc Med.* 2000;154:685–693
20. Holroyd BR, Wilson D, Rowe BH, Mayes DC, Noseworthy T. Uptake of validated clinical practice guidelines: experience with implementing the Ottawa Ankle Rules. *Am J Emerg Med.* 2004;22:149–155
21. Elson RB, Faughnan JG, Connelly DP. An industrial process view of information delivery to support clinical decision making: implication and systems design and process measures. *J Am Med Inform Assoc.* 1997;4:266–278
22. Stevens MW, Gorelick MH. Short-term outcomes after acute treatment of pediatric asthma. *Pediatrics.* 2001;107:1357–1362
23. The Childhood Asthma Management Program Research Group. Long-term effects of budesonide or nedocromil in children with asthma. *N Engl J Med.* 2000;343:1054–1063
24. Adams RJ, Fuhlbrigge A, Finkelstein JA, et al. Impact of inhaled anti-inflammatory therapy on hospitalization and emergency department visits for children with asthma. *Pediatrics.* 2001;107:706–711
25. Committee on Quality of Care in America. *Crossing the Quality Chasm: A New Health System for the 21st Century*. Washington, DC: Institute of Medicine, National Academies Press; 2001:8–9
26. Handler JA, Feied CF, Coonan K, et al. Computerized physician order entry and online decision support. *Acad Emerg Med.* 2004;11:1135–1141

Downloaded from www.aappublications.org/news by guest on November 27, 2020

Impact of Patient-Centered Decision Support on Quality of Asthma Care in the Emergency Department

Stephen C. Porter, Peter Forbes, Henry A. Feldman and Donald A. Goldmann

Pediatrics 2006;117;e33
DOI: 10.1542/peds.2005-0906

Updated Information & Services	including high resolution figures, can be found at: http://pediatrics.aappublications.org/content/117/1/e33
References	This article cites 23 articles, 4 of which you can access for free at: http://pediatrics.aappublications.org/content/117/1/e33#BIBL
Subspecialty Collections	This article, along with others on similar topics, appears in the following collection(s): **Emergency Medicine** http://www.aappublications.org/cgi/collection/emergency_medicine_sub **Allergy/Immunology** http://www.aappublications.org/cgi/collection/allergy:immunology_sub **Asthma** http://www.aappublications.org/cgi/collection/asthma_sub
Permissions & Licensing	Information about reproducing this article in parts (figures, tables) or in its entirety can be found online at: http://www.aappublications.org/site/misc/Permissions.xhtml
Reprints	Information about ordering reprints can be found online: http://www.aappublications.org/site/misc/reprints.xhtml

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN®

Downloaded from www.aappublications.org/news by guest on November 27, 2020

PEDIATRICS
OFFICIAL JOURNAL OF THE AMERICAN ACADEMY OF PEDIATRICS

Impact of Patient-Centered Decision Support on Quality of Asthma Care in the Emergency Department

Stephen C. Porter, Peter Forbes, Henry A. Feldman and Donald A. Goldmann

Pediatrics 2006;117;e33
DOI: 10.1542/peds.2005-0906

The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://pediatrics.aappublications.org/content/117/1/e33

Pediatrics is the official journal of the American Academy of Pediatrics. A monthly publication, it has been published continuously since 1948. Pediatrics is owned, published, and trademarked by the American Academy of Pediatrics, 345 Park Avenue, Itasca, Illinois, 60143. Copyright © 2006 by the American Academy of Pediatrics. All rights reserved. Print ISSN: 1073-0397.

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN®

Downloaded from www.aappublications.org/news by guest on November 27, 2020