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Outcomes from a pilot patient-centered hospital-to-home transition program for children hospitalized with asthma

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ABSTRACT

Objective: To evaluate a multi-component hospital-to-home (H2H) transition program for children hospitalized with an asthma exacerbation.

Methods: A pilot prospective randomized clinical trial of guideline-based asthma care with and without a patient-centered multi-component H2H program among children enrolled in K-8th grade on Medicaid hospitalized for an asthma exacerbation. H2H program includes 5 components: medications in-hand at discharge, school-based asthma therapy (SBAT) for controller medications, referral for home trigger assessments, communication with the primary care provider (PCP), and patient navigator support. Primary outcomes included feasibility and acceptability. Secondary outcomes included healthcare utilization, asthma morbidity, and caregiver quality of life.

Results: A total of 32 children were enrolled and randomized. Feasibility outcomes in the intervention group included: medications in-hand at discharge (100%); SBAT for controller medication initiated (100%); home visit referrals made (100%) and home visits completed within 4 weeks of discharge (44%); PCP communication (100%); patient navigator communication at 3 days (81.3%) and 14 days (46.7%). Acceptability outcomes in the intervention group included: 87.5% of families continued SBAT, and 87.5% of families reported it was extremely helpful to have the home visit referral. Adjusting for baseline differences in age, asthma severity and control, there was no significant difference in healthcare utilization outcomes.

Conclusion: These pilot data suggest that comprehensive care coordination initiated during the inpatient stay is feasible and acceptable. A larger trial is justified to determine if the intervention may reduce healthcare utilization for urban, minority children with asthma.

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Introduction

One in twenty children in the United States diagnosed with asthma is hospitalized every year (1). Hospitalizations make up one-third of the cost associated with pediatric asthma, leading to \$1.5 billion in hospital charges annually (2). These hospitalizations are also marked by persistent disparities; children in minority groups have hospitalization and ED visit rates two to three times that of white children (3–5). Research has shown that the disparity in readmission rates between African American and white children could be reduced by 80%

by addressing biologic, environmental, disease management, access to care, and socioeconomic differences (6). Acute exacerbations of asthma leading to hospitalizations may be opportunities to intervene and to prevent future asthma-related morbidity and healthcare utilization, as well as to address disparities in care and outcomes.

Hospital admission is often a marker of poor asthma control and a failure of the treatment plan (7). For this reason, the hospitalization may be a crucial opportunity to intervene and provide added support

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and additional resources for the family as part of the treatment plan. Inpatient asthma education alone has not shown to be effective in improving asthma outcomes for children who have been hospitalized for an exacerbation, and programs need to support behavior modification (8). The Task Force of Community Preventative Services highlights that a multifaceted, comprehensive approach is needed to improve asthma morbidity because individual steps alone are generally ineffective (9). Building on this preventative care approach, we sought to engage with families during their children's hospitalizations to improve their hospital to home transition to support medication compliance (in the home and school) and to reduce exposure to environmental triggers.

Using a patient-centered and stakeholder-led approach, we therefore designed and previously reported a multi-component hospital-to-home transition program to work closely with the families of hospitalized children with asthma (10). Our approach combines navigation support during the hospital to home transition to support aspects of care coordination, specifically ensuring discharge with medications in-hand, communicating with primary care providers (PCPs), partnering with schools and referring to a community-based home remediation programs to improve asthma care after hospitalization. The goal of this pilot study was to assess the feasibility and acceptability of enrolling and implementing this multi-component hospital-to-home transition program for children hospitalized with an asthma exacerbation. We additionally sought to assess preliminary effectiveness of the intervention in terms of improved asthma outcomes.

Methods

Overview

This project was a prospective pilot randomized clinical trial of guideline-based asthma care (11) with and without a patient-centered hospital to home (H2H) transition program for children on Medicaid hospitalized with an asthma exacerbation. Patient/caregiver dyads were enrolled during the inpatient hospitalization to optimize engagement with the family during the acute phase of the child's chronic illness which required hospital admission. The Children's National Hospital Institutional Review Board approved this study.

Population

We prospectively enrolled a sample of children and caregivers during an inpatient admission for an

asthma exacerbation at a pediatric urban tertiary care hospital in Washington, DC. Patients were enrolled between September and December 2018, and then followed for 6 months. Eligibility criteria for participants included: age 5 to 12 years, enrollment in grades kindergarten to 8th grade at a DC public school, hospitalization with a primary diagnosis of exacerbation of asthma, coverage with public (Medicaid) insurance, and discharge with a prescription for an inhaled corticosteroid (ICS) medication by the inpatient medical team. Patients/caregiver dyads were excluded if the patient had a chronic disease other than asthma including but not limited to serious cardiorespiratory disorder, sickle cell disease, or seizure disorder, if the primary caregiver was non-English speaking, or if the patient was enrolled in another asthma study.

Enrollment and randomization

We identified potential patient/caregiver dyads through a daily review of the inpatient census, and trained research assistants (RAs) approached caregivers of potentially eligible children for study enrollment prior to discharge from the hospital. A RA obtained written informed consent before obtaining baseline demographic data and baseline asthma intake form. Enrolled dyads were then randomized using a 4-block system generated by the RedCap (12) web-based data collection tool. This was done to account for seasonal variation during the 3-month study enrollment period. Since DC public schools are in session from September to June, study enrollment was limited to September to December to allow for coordination with the schools as well a 6-month follow-up while the student was still in school. Both groups received asthma management plans at hospital discharge consistent with the guidelines of the National Heart, Lung, Blood Institute (11) including referral to an asthma-specialty clinic at Children's National Hospital (13).

Intervention

This intervention was designed based on stakeholder engagement, including caregivers, providers, school nurses, and payor (10,14). One-on-one interviews or focus groups were conducted with stakeholders to better understand the barriers and facilitators for optimal asthma management for children with asthma, and these findings were used to develop the components of this intervention (14). The intervention group was exposed to 5 main study interventions. The patient-centered components include: medications in-hand at the time of discharge (15), PCP communication, patient navigator support for 6 months after discharge,

Table 1. Descriptions of intervention components.

Component	Description	Responsible Individual(s)	Comments	Feasibility Measure
Medications in-hand at discharge	Established process with local in-house pharmacy to ensure that patients had medications in-hand for discharge (15)	Patient Navigator and In-house Pharmacy	All patients covered with public insurance so there were no co-payments	Proportion of patients who had medications in-hand at discharge
Primary care physician communication	Email communication with the PCP to share information about the pilot program and the asthma action plan	Patient Navigator	Email allowed bi-directional communication to answer any questions	Proportion of patients who had discharge plan emailed to PCP
Patient navigator support	Trained asthma educator established relationship with enrolled caregivers to help resolve any questions or problems with asthma care after discharge	Patient Navigator	Contact was made 3 days, 14 days, and then monthly after discharge for 6 months	Proportion of patients who had contact at 3 and 14 days after discharge
School-based asthma therapy	Working with local in-hospital pharmacy, medications (rescue and controller medications) were mailed directly to the school nurse with the necessary paperwork for in-school administration	Patient Navigator and In-house Pharmacy	Prior pilot work with the DC schools had established a process for this program	Proportion of patients who had medications and medication administration paperwork directly sent to the schools
Home visit for Trigger Assessment	Connected caregivers with an established public health organization that does home evaluations and makes recommendations for improvements to minimize asthma trigger risks for patients	Patient Navigator and Community-based home evaluation program	Program supports families to make home adjustments to reduce trigger exposure. For example, air purifiers, vacuums, or pillow covers may be given to families.	Proportion of patients who had referrals to home visit program sent; % of patients who had home visit completed in 4 weeks after discharge

school-based asthma therapy (SBAT), and referral to a home visit program to address home-based asthma triggers. Table 1 gives description of intervention components.

In this pilot trial, the patient navigator was hired by the study team and was a certified asthma educator working in our outpatient asthma specialty clinic. The patient navigator had knowledge about asthma pathophysiology, medications, and resources to support the family, and supported key components of the intervention, specifically, medication adherence, communication with providers and school, and home remediation efforts. During the post-hospital phone calls, the patient navigator reinforced education, answered clarifying questions regarding medications, and scheduled visits with the primary care provider. The SBAT component facilitated medication access at the schools as the rescue and controller medications were mailed directly to the schools' nurses with the authorization to administer the medications at school. The home visit program included a single visit during which educational materials, mattress covers, referrals for pest, and/or HEPA vacuums as indicated were provided.

Control

Both groups received asthma management plans at hospital discharge consistent with the guidelines of

the National Heart, Lung, Blood Institute (11) including referral to an asthma-specialty clinic at Children's National Hospital (13). In addition, patients in the control group were offered the medications in-hand at the time of discharge, and communication with the PCP was initiated by the primary inpatient team. Patients in the control group did not have on-going contact with the patient navigator, SBAT, or referral to the home visit program initiated during the hospitalization.

Primary outcomes

Feasibility

We tracked rates of implementation of each specific component. *Acceptability*: To assess overall acceptability of the program, intervention caregivers were asked questions of assessing study and component acceptability at after the 6-month follow-up interview. This was a short survey that included 6 questions with a 5-point Likert scale (1 = extremely helpful to 5 = not helpful at all) as well as open-ended questions regarding each study component. In addition, we assessed acceptability of SBAT and home visit referral by tracking the rate of refusal or withdrawal from these program components.

Table 2. Study design overview.

Study Arm	Baseline Data*	Navigator Contact				Blinded Follow-up		Navigator Contact	Blinded Follow-up		Un-Blinded Study close-out interview
		X (3 days ± 1 days)	X (14 days ± 4 days)	X (1 month ± 5 days)	X (2 month ± 5 days)	X (3 month ± 5 days)	X (3 month)	X (4 month ± 5 days)	X (5 month ± 5 days)	X (6 month ± 5 days)	
Intervention	X						X (3 month)	X (4 month ± 5 days)	X (5 month ± 5 days)	X (6 month)	X
Standard Care	X						X (3 month)			X (6 month)	

*Baseline data collected before randomization at the time of consent.

Secondary outcomes

Efficacy

Intervention effectiveness was assessed in terms of healthcare utilization, asthma morbidity, and caregiver quality of life. Healthcare utilization was defined as emergency department (ED) visit or readmissions related to asthma during the 3 and 6 months following discharge. Symptom free days and asthma morbidity were measured over the 14 days preceding the interview and included signs or symptoms of asthma, such as wheezing, coughing, tightness in the chest or shortness of breath, during the day or night. Asthma morbidity also included missed days of school. Caregiver quality of life was assessed using the Pediatric Asthma Caregiver's Quality of Life Questionnaire (16). These patient-centered outcomes were identified as secondary outcomes, but since this was a pilot trial, we were unable to power on these outcomes.

Data collection and compensation

Baseline and follow-up data were entered directly into REDCap (12). Blinded RAs conducted structured follow-up interviews 3 and 6 months after enrollment. Follow-up interviews addressed questions similar to the baseline intake. At the end of the intervention study period, a survey was administered to the intervention group along with the 6-month follow-up interview by the patient navigator. Chart review was done 12 months after enrollment to collect data related to ED visits and/or hospital admissions related to asthma. Table 2 shows the study design. We compensated caregivers for their time by providing credit card gift cards: \$10 after the initial baseline assessment, \$20 after the 3-month assessment, and \$30 after the 6-month assessment.

Analysis

Descriptive statistics were used to assess the comparability of randomized groups. Feasibility was assessed by participation rates and acceptability of SBAT and home visit were evaluated by completion rates and by survey responses. Thematic analysis was used for qualitative data. Time-to-event analyses utilized a Cox Proportional Hazards model controlling for baseline differences in age, asthma classification, and level of asthma control. Given size of the pilot project, variables selected for inclusion in the multivariable model were chosen based on the magnitude of differences between groups. No sample size calculation was performed.

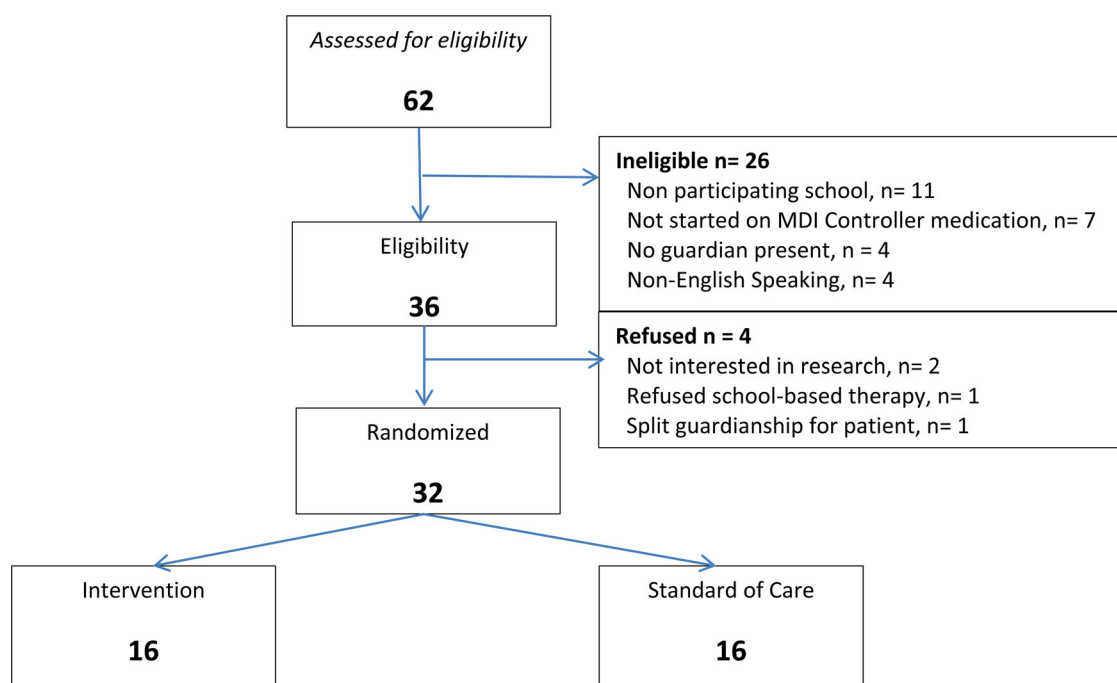


Figure 1. CONSORT diagram.

Results

A total of 62 patient/caregiver dyads were screened for eligibility, and 26 dyads were deemed ineligible (Figure 1). Eleven dyads were ineligible because the patient's school was not a DC public or charter school; 7 patients were not started on a controller medication at hospital discharge; 4 caregivers were not present for study enrollment; and 4 caregivers were non-English speaking. Of the 36 eligible dyads, 4 caregivers refused participation (2 were not interested in research and 2 caregivers refused school-based asthma therapy). The remaining 32 dyads were randomized into this pilot trial: 16 dyads per arm.

Participants' baseline variables are reported in Table 3. The groups did not differ in sex, race, body mass index, or hospital length of stay, but were different in age (median age 6 years in intervention vs 8.5 years in usual care group), asthma classification, and asthma control. The majority of participants in both groups were African American and non-Hispanic. Nine patients in each study arm had a follow-up outpatient visit with the asthma-specialty clinic at Children's National Hospital.

Primary outcomes

Feasibility outcomes in the intervention group included: medications in-hand at discharge (100%); SBAT for controller medication initiated (100%); home visits referrals made (100%) and home visits completed within 4 weeks of discharge (44%); PCP communication (100%); and

patient navigator communication at 3 days (81.3%) and 14 days (46.7%). Over the 6 month study period, the number of contacts between the navigator and the family averaged 4.4 (SD 1.7). Acceptability outcomes in the intervention group included: 87.5% of families continued SBAT for the entire study period, and 87.5% of families reported it was extremely helpful to have the home visit referral.

End of study interviews to further explore acceptability were completed in 50% (8 of 16 caregivers) of the intervention group. Patient navigator, SBAT, and medications-in hand were components of the program that 100% of the surveyed parents found "extremely helpful" and that they would recommend in a future program. Home visits and communication with PCP were found to be "extremely helpful" to 75% and 87.5%, of surveyed parents, respectively. (Table 4)

Secondary outcomes

After adjusting for baseline differences in age, asthma severity and control, there was no statistical difference in healthcare reutilization. While not statistically significant, there was a trend toward a lower readmission rate during the follow-up period comparing intervention to standard care participants [1.1 vs. 4.6 readmissions/100 person months respectively, HR = 0.20 (0.03, 1.23; 95% CI)]. See Figure 2. Changes in ED revisit rates, symptom-free days, or asthma morbidity did not approach statistical significance (Supplemental Table).

Table 3. Population characteristics.

Characteristics	Intervention Group (N = 16)	Control Group (N = 16)
Age*, median (IQR), years	6.0 (5.0-7.5)	8.5 (6.5-10.0)
Female, n (%)	9 (56.25)	7 (43.8)
Race, n (%)		
White	0 (0)	0 (0)
Black	14 (87.5)	14 (87.5)
Other	2 (12.5)	2 (12.5)
Hispanic Ethnicity, n (%)	1 (6.25)	2 (12.5)
Body Mass Index, median (IQR), kg/m ²	17.7 (15.1-24.0)	18.8 (15.8-24.5)
Length of stay, median (IQR) d	2 (1-2)	2 (1-2)
Asthma Classification *+, n (%)		
Intermittent		
Mild Persistent	1 (6.25)	0 (0)
Moderate Persistent	5 (31.25)	11 (31.25)
Severe Persistent	6 (37.5)	2 (12.5)
	4 (25)	3 (18.75)
Asthma Control *+, n (%)		
Well controlled	3 (18.75)	6 (37.5)
Not well controlled	12 (75)	10 (62.5)

*Important differences, including baseline severity and asthma control be adjusted for in outcomes analysis.

+Based on classification criteria from National Health Lung Blood Institute, Guidelines for the Diagnosis and Management of Asthma (EPR-3), www.nhlbi.nih.gov/guidelines/asthma.

Table 4. Feedback on intervention components from end of study interviews (N = 8).

Component	Component was "extremely helpful"	Themes
Patient Navigator	Yes (8/8)	- Shows concern for the patient & family - Helped to overcome some of the typical hurdles and barriers that are common after hospital discharge
School Based Asthma Therapy	Yes (8/8)	- Reassuring to have medications be given by the school because the child will always go to school - Time-saving on the family's side - Encouraged better communication with the school nurse
Medication in Hand	Yes (8/8)	- Convenient to have medications and be able to go straight home - Transportation to the pharmacy can be an issue
Communication with the pediatrician	Yes (7/8)	- There can be better communication between doctors - A seminar or check in could be helpful for pediatricians to know more about hospitalizations than what they get from the inpatient note
Home Visit	Yes (6/8)	- Informational pamphlets - Pillow covers - Allergen management and information - One family was not contacted

Qualitative outcomes at study close-out

When describing the experience with the patient navigator, one caregiver noted that the navigator was extremely helpful because the navigator "shows concern for the patient and family," specifically when it came to giving information about medications and ensuring that some of the barriers that they had experienced in the past after discharge did not happen again. When describing the experience with SBAT, one caregiver noted that they were able to make fewer trips to the pharmacy and were able to worry less about if their child was getting their medications. Another family noted that they "may forget to give the medication but [they] won't forget to take him to school." When describing the PCP communication, all interviewed caregivers reported seeing their PCP after discharge, and one caregiver suggested that there be meetings or seminars to help engage the pediatricians

because "they play one of the biggest roles in ensuring that children get the care they need." When describing the home visit program, one caregiver raised concerns – this family was living with a third party and did not want to invite the program staff into the house where they were staying as a guest, but were open to having a home visit once they established a more permanent living situation. Aspects of the home visit program that were mentioned as helpful were the distribution of vacuum cleaners and hypoallergenic pillow covers, as well as pamphlets containing information on managing allergens and common in-home asthma triggers.

Discussion

The intervention design is patient-centered and connects hospitalized patients and their families directly with schools, home remediation efforts, and the

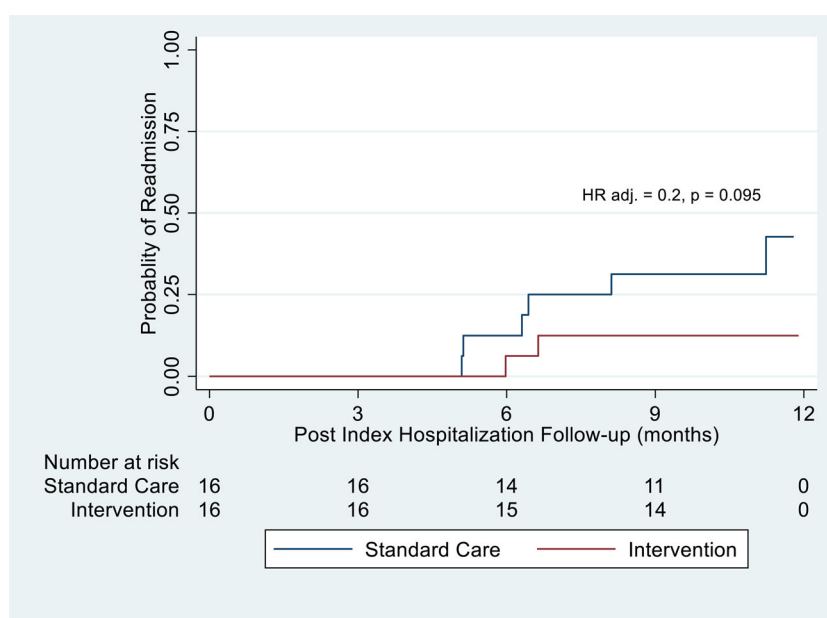


Figure 2. Time to event analysis for readmission after index hospitalization controlling for baseline differences in age, asthma class and asthma control.

medical home thereby working to address the tremendous disparities in asthma care. Studies have shown that family supports (often community health workers) which help with communication with PCPs and which make home visits to educate families were associated with a reduction in healthcare utilization (17–19). Our pilot project expands on these models of care coordination with a new addition to foster medication adherence through two key components: medications in-hand at discharge, and SBAT. With continued gaps in asthma disease management for children and persistent communication fragmentation among caregivers, patients, primary care providers, teachers, school nurses, and others involved in the child's asthma management, new strategies to promote partnerships and help caregivers to have a more active role in a child's asthma management are needed. There is increasing evidence that children with chronic illness may benefit from individualized assistance to navigate the health care system, and we used this model of navigation to facilitate the core components of the intervention.

Individualized assistance: Addressed by patient navigator

Our current study utilized a hospital-based navigator to communicate with the caregiver after discharge, to help navigate questions or issues and to ensure that the other intervention components were successful. In another study that utilized patient advocates to help

support asthma management, qualitative interviews with the patient advocates highlighted 5 themes to describe the concerns addressed with families: medication adherence, follow-up, communication, social determinants of health, and time management (20). Our patient-centered intervention design yielded similar focus areas for the navigator to address, specifically medication adherence facilitated by medications in-hand at discharge and school-based asthma therapy, communication with the primary care provider, and referrals to home/environmental remediation program to address the poor housing quality social determinant of health.

Medication adherence: Medications-in hand

Medication adherence is one core aspect of asthma management, and a central component of medication adherence is access to medications. However, studies have shown that many patients discharged after a hospital admission for asthma exacerbations fail to fill discharge prescriptions for a multitude of reasons including lack of transportation, language barriers, and problems with insurance coverage (5). A Medicaid database study demonstrated that 3 days after an asthma hospitalization, only 55% of families have filled a beta-agonist prescription, 57% have filled an oral steroid prescription and 37% have filled inhaled steroid prescription (21). In a recent review of inpatient asthma discharge interventions, medications in-hand showed promise in impacting subsequent

healthcare utilization (22). Recently, a few hospital systems have focused on increasing medication access by ensuring that patients are discharged from their inpatient encounter with their asthma medications in their possession (23–26). In these single center efforts, increasing medications-in hand at discharge has been shown to increase patient satisfaction and decrease healthcare utilization (23,24,27).

Medication adherence: School-Based asthma therapy

School-based asthma therapy is a promising strategy to improve asthma management in areas that struggle with high asthma morbidity. The majority of US school-aged children spend one-third of their weekday at school during the school year, which makes schools a valuable setting to promote medication adherence. Work over the last decade in Rochester, NY has demonstrated the impact that school-based programs can have due to their ability to reach many children in a setting where they regularly spend much of their time. Parents of the children in the SBAT group had improvement in their quality of life scores compared to the usual care group, and children in the school-based therapy group missed fewer days of school and had more symptom-free days (28). A randomized-controlled trial based in Rochester enrolled 400 students into an intervention that incorporated school-based asthma therapy and telemedicine, and found significant improvement in symptoms and health care utilization (ED visits or hospitalizations dropped from 15% to 7% in control versus intervention, respectively) (29). A recent systematic review of nine SBAT trials in different cities suggests that SBAT is beneficial for children in urban schools who require daily inhaled corticosteroids, and students receiving SBAT have more symptom-free days, fewer day and night time symptoms, and decreased need of rescue medication and visits for acute asthma symptoms (30).

Given the evidence-base support of school-based asthma therapy, our pilot project engaged school-nurses in the development period of stakeholder engagement to better align schools in our intervention. Prior to our intervention, Teach et al. conducted a SBAT pilot to assess feasibility among DC residents on Medicaid from DC public schools (31). They demonstrated that 91.7% of expected doses of preventative asthma medications were given to the study group over the 60-day period. Through our focus groups with school nurses, barriers to widespread adoption of SBAT were found to include lack of availability of a

full-time nurse at school and access to medications at school (14). In order to address these barriers, our pilot program used a novel approach to mail the medications with the asthma care plan to the school and authorization to administer the medications at the school. This approach was greatly appreciated by the families because it circumvented the need for caregivers to bring the medication and necessary paperwork to themselves, as well as the school nurses who felt supported with the right resources (medications and authorization to give the medications) in the school environment.

Follow-up and communication: Addressed with PCP coordination

An important part of reducing readmission is improving outpatient asthma symptom management in the primary care setting, and ensuring patients have follow up visits with their PCP. Baren et al. found that among adolescent and adult patients seen in the ED who were subsequently given vouchers for transportation to their PCP and a telephone reminder to schedule the visit had over 3 times the odds of having following up encounter with their PCP than those who were not (32). Similarly, Smith et al. found that having an asthma coach call families twice after their children had an asthma ED visit to emphasize the importance of scheduling the PCP visit, and then incentivizing parents with \$15 to complete the visit also resulted in greater likelihood of PCP follow up (33). Reducing barriers and incentivizing follow-up PCP visits after an ED encounter for an asthma exacerbation can improve PCP follow-up, but Zorc et al. examined the benefit of scheduling the PCP follow up appointment while children were being discharged from the ED after an acute asthma exacerbation (34). Though they found that those who were given appointments were more likely to complete a PCP follow up visit, they did not find these patients less likely to have return ED visits or have fewer days of missed school. This finding is paramount because PCP follow-up alone is often insufficient to improve asthma care for underserved children, which supports the multi-component aspect of this pilot intervention.

Social determinants of health: Addressed with home remediation referral

Multiple studies have demonstrated that home visits for children with asthma can improve patient

outcomes, reduce costs and reduce asthma co-morbidities (18,19,35–37). A recent review studied the impact of home-based asthma education concluded that home-based asthma education and environmental interventions are effective (38). Of note, an economic analysis of a home remediation and case management program among Detroit's Medicaid population found that this type of multicomponent intervention has the greatest potential cost savings when applied to children who have experienced at least one hospitalization for asthma such as participants in the current study (39). Successful programs are patient-centered, and included a home assessment and individualized education. A quality improvement effort at an urban academic children's hospital was successfully able to initiate community-based home mitigation efforts during the inpatient stay (40), and we used a similar approach in our project. In our study, a majority of families reported it was extremely helpful to have the home visit referral, yet only 44% of patients completed the visit within 4 weeks of the index hospitalization.

Future steps and sustainability

While this pilot study was not powered to detect change in healthcare utilization related to asthma exacerbations, we successfully demonstrated feasibility and acceptability of initiation of a multicomponent hospital-to-home transition program during the hospitalization. Next steps will include a larger trial building upon the collaboration with schools and home remediation efforts to improve care for high-risk children with asthma. Future studies will strengthen consistency of care, for example, ensuring medication refills and ongoing provider communication. Our future larger trial will also ensure that age and asthma severity are equal in both arms, and include design modifications for patient-centered outcomes like symptom free days and missed days of work, as well as healthcare utilization.

In addition, crucial to interventions is considering sustainability outside of the study period. The patient navigator in our pilot trial was a certified asthma educator in our outpatient clinic, and ongoing use of a navigator in this role is feasible. We are exploring potentially less expensive staffing models such as parent peer navigators. We also have successful experience in winning support from with local Medicaid payors to support the core IMPACT DC intervention (41). Finally, we will continue to foster collaborations with the school nurses to facilitate SBAT in a broader group of schools. Through our focus groups with

school nurses, they reported time and frustration with outreach to families of children with poor asthma control, so ongoing collaboration may actually save time for the school nursing team and provide more comprehensive care coordination for students.

Our study has several limitations. First, this pilot was done among a largely homogenous population of children in a single urban city so findings may not be generalizable to other populations in other urban environments. Second, this pilot was limited to elementary and middle school students, and English-speaking caregivers; it may not be generalizable to younger or older students, or to non-English speaking families. Third, in this multicomponent program, we are not able to distinguish which component or combination of components were the most effective for each individual patient/caregiver dyad. Fourth, fidelity for each component was variable for example the variable rate of navigator contact. And lastly, qualitative outcomes for study close-out were only obtained from half of the participants and there could be response bias. Despite the limitations of generalizability, in this pilot we were able to demonstrate feasibility and acceptability of initiating a comprehensive asthma transition to home program for patients and caregivers at the time of hospitalization, and capitalize on the sentinel event of a disruptive and often scary hospitalization. We were also able to demonstrate trends in reducing healthcare utilization in the intervention group, which we will continue to study in future programs to understand the impact of each component.

Conclusion and key findings

Individualized, multicomponent interventions initiated during an asthma-related hospitalization are feasible and acceptable in an urban, minority population. Existing efforts that utilize navigator support and/or home visit programs need to be broadened to increase medication adherence – our pilot did this by ensuring medications in-hand at discharge and facilitating school-based asthma therapy from the inpatient stay. Combining evidence-based interventions such as these into programs anchored in a health system or health department is important to ensure the viability of these projects.

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Declaration of interest

The other authors have no conflicts of interest to disclose.

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Supplemental Table: Results of Analyses Comparing Outcomes in Patients at 6 Months

	Events over past 14 days ¹			
	Intervention (N=12)	Control (N=14)		
	Rate	Rate	Rate Ratio	95% Conf Interval
Asthma Morbidity				
Symptom Free Days	11.70	11.47	1.02	0.78, 1.34
Day Time Symptoms	2.25	1.95	1.16	0.51, 2.64
Night Time Symptoms	1.41	0.90	1.57	0.39, 6.33
Used Quick Relief Med	1.57	1.65	0.95	0.39, 2.33
Nights w/ Parent Sleep Loss	0.74	0.78	0.95	0.13, 7.05
Days Parent Changed Schedule	0.60	0.56	1.07	0.05, 24.90
Missed School/Day Care	1.02	0.93	1.10	0.28, 4.28
Missed School Days due to Asthma	0.74	1.63	0.46	0.08, 2.56
	Quality of Life Scores (5 point Likert Scale) ^{1,2}			
Caregiver Quality of Life				
During the Past Week How Often Parent:	Intervention (N=12)	Control (N=14)	Difference	95% Conf Interval
Felt Helpless, Frightened	4.59	4.77	-0.18	-0.95, 0.59
Changed Plans due to Asthma	4.82	4.68	0.14	-0.18, 0.27
Felt Frustrated, Impatient due Child Irritability	4.81	4.59	0.22	-0.29, 0.72
Had Child's Asthma Interfere w/ Job, Housework	4.75	4.67	0.08	-0.48, 0.64
Felt Upset due to Child's Asthma Symptoms	4.87	4.95	-0.08	-0.28, 0.13
Had Sleepless Nights due to Child's Asthma	4.70	4.51	0.19	-0.44, 0.81
Was Bothered due to Child's Asthma	4.88	5.05	-0.17	-0.50, 0.16
Was Awakened due to Child's Asthma	4.64	4.70	-0.06	-0.68, 0.57
Felt Angry that Child has Asthma	4.28	4.85	-0.57	-1.74, 0.59
Was Concerned about Child's Performance of Daily Activities	4.43	4.54	-0.11	-0.56, 0.34
Was Concerned about Asthma Meds Side Effects	4.12	4.33	-0.21	-0.78, 1.19
Was Concerned about Being Over-protective	2.65	2.47	0.18	-1.65, 2.01
Was Concerned about Child's Ability to Lead Normal Life	4.23	3.47	0.76	-0.83, 2.34

¹ Results were controlled for baseline level of each outcome as well as age, asthma class, baseline asthma control

² Higher scores indicate better quality of life