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Parental perception of a picture-based chronic asthma care management tool in an urban pediatric emergency department

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ABSTRACT

Background: National asthma guidelines recommend use of an asthma action plan (AAP) as part of chronic asthma care. Unfortunately, AAPs have not been tailored for use in acute care settings, where many patients at risk for poor chronic asthma care are seen, including those who are non-English-speaking or have low literacy levels. We previously developed a picture-based medication plan (PBMP), a unique type of AAP for use in an ambulatory setting and designed to increase patient use and understanding. However, little is known about how parents seeking emergency department (ED) asthma care would perceive the PBMP.

Objective: To assess parental attitudes toward an asthma PBMP in the largest pediatric ED in Los Angeles County.

Methods: We surveyed a consecutive sample of English- or Spanish-speaking parents of children 2-17 years seeking ED asthma care. Parents used a 5-point Likert scale for various statements regarding their perceptions of the PBMP. Responses were analyzed by sociodemographics, asthma control, and health literacy using Chi-squared and *t*-tests.

Results: 90 parents provided feedback on the PBMP. The majority of parents endorsed the PBMP. Endorsement was 20%-30% higher among Spanish-speaking parents and those who did not complete high-school compared to English-speaking parents and parents with a high school education or higher ($p < 0.05$ for both comparisons).

Conclusion: Spanish-speaking parents and parents with less than a high-school education overwhelmingly endorsed the PBMP. It may be useful to consider incorporating the PBMP as part of patient-centered chronic asthma care strategies for populations seen in ED settings.

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Asthma; picture based medication plan; emergency; asthma action plan; chronic care

Introduction

National Asthma Education and Prevention Program guidelines recommend the use of asthma action plans as they have been shown to improve chronic asthma care, including medication adherence, asthma control, asthma-related hospitalizations and emergency-department (ED) visits (1-8). However, less than 20% of children with asthma have received a written asthma action plan (9-11). Also, the majority of asthma action plans are written at a fifth grade reading level or higher (12,13), making them more difficult for those with low literacy levels which includes upwards of 30% of the adult United States population (14).

Studies involving parents and children show that patients and parents prefer educational materials with

plain language and pictographic information to enhance understanding (15-19). Recently developed, picture-based asthma action plans have been shown to improve pediatric asthma medication adherence and asthma outcomes by providing parents with a better understanding of asthma management as a solution to overcome parental low literacy (20-24).

We previously developed a picture-based medication plan (PBMP), a unique type of asthma action plan which incorporates pictures of controller and rescue medications, for use in the ambulatory setting. Designed to increase patient medication use and understanding, a high proportion of parents with low literacy (<9th grade reading level) endorsed the PBMP for use in ambulatory clinical encounters (25).

There are no published studies on the perceived utility of a picture-based asthma action plan among patients seen for asthma in an ED setting, where many patients at risk for low health literacy, high asthma morbidity and poor asthma control are often seen and where asthma action plans can be provided.

The purpose of this study was to assess parental perceptions of a picture-based asthma action plan (PBMP) in a pediatric ED setting with regard to its ability to (1): improve understanding of their child's asthma medications and medication regimen (2) make it easier to accurately explain what medications their child takes and with what frequency, and (3) provide a simple way to educate parents about their child's asthma medications. We also sought to determine if the PBMP was perceived differentially among sub-groups known to be at risk for poor asthma care and/or poor asthma outcomes, including ethnic/racial minorities, those on public health insurance and/or those of lower socioeconomic status.

Methods & materials

Setting, eligible subjects, enrollment

This was a prospective study held at the highest volume pediatric ED in Los Angeles from August 2017 to January 2018. A consecutive sample of parents of children 2–17 years of age seeking ED asthma care were approached in the emergency department by a bilingual (English–Spanish) trained research assistant (RA). Patients were screened for eligibility and informed consent was obtained from parents and assent from children older than 7 years of age. Inclusion criteria included any patients age 2–17 years who presented with a respiratory complaint and: (1) a history of asthma; and/or (2) screened positive for study participation using a validated algorithm that queried about a prior history of coughing, wheezing, chest tightness, or trouble breathing (26–28). Subjects were excluded if (1): the parents were non-English and non-Spanish-speaking (2), the patient had underlying complex pulmonary disease, including home oxygen use, a mechanical ventilator, tracheostomy, cystic fibrosis, lung cancer and pulmonary dysplasia; or (3) the patient had cardiac complications or a neurologic disorder. The Children's Hospital of Los Angeles Institutional Review Board approved this study.

Survey administration

The survey administered in the ED evaluated patient and/or parental sociodemographic characteristics (education, household income, race, ethnicity, health insurance

status and type) and clinical asthma status, and included a qualitative interview and a health literacy assessment (Short Assessment of Health Literacy) (29). Parents could choose whether to complete the survey in English or Spanish, and via self-administration or by interview with the RA. Parents who completed the survey received \$20 cash for their time.

PACCI-ED & asthma care

Survey questions regarding clinical asthma status were based on the PACCI-ED (Pediatric Asthma Control and Communication Instrument–Emergency Department) (see Figure 1), a validated asthma questionnaire which assesses asthma morbidity (disease trajectory, disease burden, risk for poor outcomes over a 12-month time-frame, and symptoms, rescue medication use, attacks, activity limitation and sleep disruption over a 1–2 week time-frame) (30–33). Parents were also surveyed about prior asthma care, including history of prior inhaled corticosteroid or oral steroid use, receipt of an asthma action plan, and emergency department visits and hospital admissions.

Picture-based medication plan

In accordance with the National Asthma Education and Prevention Program guideline recommendations, the picture-based medication plan (PBMP) was developed at a 4th grade reading level by the senior author (Figures 2 and 3) (8,25). (The Spanish version is available online as supplemental material.) Pictures of controller and rescue medications are included in the PBMP with the intent that the physician would circle the medications that the patient is supposed to take in addition to providing simple written directions.

The RA provided the parent with an example of the PBMP and then asked the parent to rate their level of agreement with 10 statements regarding the PBMP using a 5-point Likert scale (strongly agree, agree, neither agree nor disagree, disagree, strongly disagree). We inquired about the parent's perceptions of using the PBMP to enhance understanding of their child's asthma medication, comfort using these medications and confidence in treating their child's asthma (e.g. "I would feel more confident in my ability to treat my child's asthma if I could review pictures of the asthma medicines with my child's doctor"). Ratings were provided during the ED visit, prior to receiving any prescriptions for medications.

Communicate with Your Child's Doctor about His / Her Asthma

Asthma also includes reactive airway disease, regular coughing, wheezing, or difficulty breathing with or without colds.

Your child's name: _____ Today's Date: _____

When was your child's last asthma visit? _____. If your child has never had an asthma visit, check here: ☐

Please check ☒ one answer for each of the following questions. Your answers will help your doctor give you the best asthma care.

Questions 1-6 ask about how your child's asthma has been over the past 12 months, not just today. If your child has had asthma for less than 12 months, then think about how things have been since he/she started having breathing problems.

Over the past 12 months		Direction		
1. How has your child's asthma been?	Getting Better	Staying the Same	Getting Worse	
	☐	☐	☐	

Over the past 12 months		Bothered		
2. How much have you been bothered by your child's asthma?	Not Bothered	Somewhat Bothered	Very Bothered	
	☐	☐	☐	

Over the past 12 months		Risk				
<u>Before</u> today:	0	1	2	3	≥4	
3. How many times has your child been to urgent care for asthma over the past 12 months?	☐	☐	☐	☐	☐	
4. How many times has your child been to the emergency room for asthma over the past 12 months?	☐	☐	☐	☐	☐	
5. How many times has your child been hospitalized for asthma over the past 12 months?	☐	☐	☐	☐	☐	
6. How many times has your child used an oral steroid (Orapred, steroid pill, steroid liquid or steroid syrup) for asthma over the past 12 months? Don't include today.	☐	☐	☐	☐	☐	

FOR CLINICIAN USE ONLY:		Level of Chronic Asthma Control				
Assign patient's level of chronic asthma control by looking at the box checked farthest to the right on questions 3-6. Match the box color to the level of asthma control in this section.		Controlled	Partly Controlled	Mildly Uncontrolled	Moderately Uncontrolled	Severely Uncontrolled
		☐	☐	☐	☐	☐

Take Medicine		Frequency				
7. How often do you give your child's daily asthma medicine when he/she feels fine?	My child is not supposed to take a daily asthma medicine	All of the time 5-7 days/week	Most of the time 3-4 days/week	Some of the time 1-2 days/week	None of the time	
Daily asthma medicines include: Advair, Alvesco, Asmanex, Budesonide, Flovent, QVAR, Pulmicort, Singular, Symbicort	☐	☐	☐	☐	☐	

FOR CLINICIAN USE: If any of the answers in red ☐ are selected, this may be consistent with poorly controlled and/or undertreated asthma. Further assessment and follow-up in 2-6 weeks is recommended.

Figure 1. Pediatric asthma control and communication instrument – Emergency Department.

Sub-Acute AsthmaThese questions are about your child's recent asthma symptoms.

Asthma Symptoms					
8. During the past week , how many days has your child had asthma symptoms? For example: *Cough *Chest tightness *Shortness of breath *Sputum (spit, mucous, phlegm when coughing) *Difficulty taking a deep breath *Wheezy or whistling sound in the chest	Days				
	0	1-2	3-6	Every day (not all day long)	Every day (all day long)
	☐	☐	☐	☐	☐
Reliever Use					
9. During the past week , how many have you had to give your child medicine to quickly relieve asthma symptoms? For example: *Albuterol/Proventil/Proair/Ventolin/Xopenex via Inhaler/Spray/Pump or Machine/Nebulizer	Days				
	0	1-2	3-6	Every day (not all day long)	Every day (all day long)
	☐	☐	☐	☐	☐
Attacks					
10. During the past week , how many days did your child have an asthma attack? For example: *When it is harder for child to breath *When you give your child more quick-relief asthma medicine (e.g., Albuterol) *When asthma medicine does not work	Days				
	0	1	2-3	4-7	
	☐	☐	☐	☐	☐
Activity Limitation					
11. During the past week , how much has asthma limited your child's activities?	Not at all	Slightly	Moderately	Very much	Completely
	☐	☐	☐	☐	☐
Nighttime Symptoms					
12. During the past TWO weeks , how many nights did your child's asthma keep your child from sleeping or wake him/her up?	0	1	2	3-7	8-14
	☐	☐	☐	☐	☐
13. Please write down any concerns or anything else you would like your doctor to know about your child's asthma.					
PLEASE GIVE THIS TO YOUR PROVIDER. THANK YOU!					
FOR CLINICIAN USE ONLY: Control/Severity Assignment: Assign patient's current level of asthma control by looking at the box checked farthest to the right on question 8-12 and match the box color to the level of asthma control in this section					
Sub-Acute Asthma Severity / Control Classification					
☐ ☐ ☐ ☐					
Controlled/Intermittent Partly Controlled/Mild Persistent Uncontrolled/Moderate Poorly Controlled/Severe					

Figure 1. Continued.

Statistical analysis

Results were expressed as proportions and means of the Likert-scale score with standard deviations for each

statement. Responses to level of agreement (strongly agree, agree, neither agree or disagree, disagree, strongly disagree) were collapsed dichotomously into

Rescue Medications:

Take this only for a cold, wheezing or coughing. Take this medicine every 4 to 6 hours. Stop the medicine when the symptoms have been gone for a full day. Call or come in if this medicine is needed more than every 4 hours. Call or come in for trouble breathing.

Albuterol Inhaler



Nebulized Levalbuterol



Nebulized Albuterol



Using a spacer is the best way to get medicine into the lungs and avoid side effects. Please use the spacer, nebulizer face mask or mouthpiece circled below.



Figure 2. Sample of a picture-based medication plan for rescue medications.

Controller Medications

Take the medicine circled below **every day** even when feeling well.
Take 2 puffs 2 times a day **every day**

Low Dose



Medium Dose



High Dose



**Using a spacer is the best way to get medicine into the lungs and avoid side effects.
Please use the spacer circled below with your inhaler.**



Figure 3. Sample of a picture-based medication plan for controller medications. (Of note, the version used in the study indicated a specific inhaled steroid).

‘strongly agree’ and ‘agree’ versus ‘neither agree or disagree’ and ‘disagree’ and ‘strongly disagree’. Chi-square tests were used to compare proportions and *t*-tests for means. We compared the proportion of parents who agree/strongly agree for each statement by language spoken (English versus

Spanish), insurance type and educational level (less than high school versus high school and higher). Some participants did not complete all survey items, but were still included in the analyses; therefore, sample sizes vary for some findings—this is indicated in the results when it occurred.

Table 1. Sociodemographic and clinical characteristics ($N = 90$).

Child	
Age (years), mean (std)	7 (4)
Gender: Male, n (%)	60 (67%)
Ethnicity: Hispanic, n (%)	54 (62%)
Race: Black/African American, n (%)	12 (14%)
Insurance: Public, n (%)	74 (84%)
Parent	
Education: Did not complete high school, n (%)	12 (14%)
Income < \$70,000 n (%)	72 (94%)
Low Health Literacy n (%)	14 (19%)
Survey conducted in Spanish, n (%)	15 (17%)
Previous Care Received Prior to ED Visit	
Parent reports child not on a daily controller medication, n (%)	44 (49)
Answered a validated asthma questionnaire, n (%)	3 (3%)
Received an asthma action plan, n (%)	29 (33%)
Seen an asthma specialist, n (%)	25 (29%)
Asthma Events in the Past 12 months	
1+ visits to Urgent Care	35 (39%)
1+ visits to ED	73 (81%)
1+ hospitalizations	25 (28%)
1+ oral steroids use	66 (75%)
Asthma Control, n (%)	
Intermittent	13 (7.3)
Mild	64 (36)
Moderate	62 (34.8)
Severe	39 (21.9)

Missing Data: Ethnicity = 3, Race = 7, Insurance = 2, Education = 4, Income = 13, Health Literacy = 18, Answered a validated asthma questionnaire = 2, Received an asthma action plan = 3, Seen an asthma specialist = 4, Urgent Care visits = 1, Oral steroid use = 2.

Analyses were performed with SAS 9.4 statistical software (SAS Institute Inc., Cary, NC).

Results

174 parents completed the parent study. Ninety parents provided feedback on the picture-based medication plan. Thirty-eight (42%) used the self-administration method and fifty-two (58%) opted to have the survey administered by the RA. The majority of children were Hispanic, male and on public health insurance. The average age of the child with asthma was 7 years ($SD = 4$). A minority of parents preferred a Spanish-language survey, did not complete high school or had low health literacy (all less than 20% of participants). A majority of children surveyed were on a controller medication (51%, $n = 46$). One third of patients had received an asthma action plan in the past. Further sociodemographic data of the respondents can be viewed in Table 1.

Overall, the majority of parents either agreed or strongly agreed with each survey item inquiring about the potential benefits of the PBMP (endorsement ranging from 67% to 88% of parents). Analyses of sub-groups revealed that compared to English-speaking parents, a larger proportion of Spanish-speaking parents agreed that with a PBMP they would: (1) feel more comfortable describing frequency of medication use ($p = 0.02$); (2) feel more confident talking to their

child's doctor ($p = 0.02$); (3) like their child's doctor to explain how to use asthma medications ($p = 0.02$); and (4) feel more confident to treat their child's asthma ($p = 0.04$) (Figure 4).

In addition, we observed that compared to parents with a high school education or higher, a larger proportion of parents who did not complete high school felt that with a PBMP: (1) it would be easier to understand the doctor's treatment plan ($p = 0.04$); (2) they would feel more comfortable describing frequency of medication use ($p = 0.05$); (3) they would feel more confident talking to their child's doctor ($p = 0.03$); and (4) they would like their child's doctor to explain how to use asthma medications ($p = 0.01$) (Figure 5). Figures 6 and 7 show stratification by language spoken and educational level. There was no statistical difference in level of endorsement for PBMPs by other sociodemographic (e.g. age, ethnicity, insurance, parental education, income, language and health literacy) or asthma characteristics. In particular, there was no statistical difference between English- and Spanish-speaking groups in PBMP endorsement when correcting for education level. And, there was no statistical difference in endorsement of the PBMP between patients who had previously received an asthma action plan vs. those that had never received an AAP.

Discussion

In this sample of parents of children with asthma presenting for care at an urban pediatric emergency department, we found that the majority endorsed an asthma action plan (AAP) made up of pictures of asthma medications (a picture-based medication plan [PBMP]). Parents who did not graduate high school and Spanish-speaking parents reported even more positive attitudes toward the PBMP. Importantly, only 33% had received an asthma action plan in the past, yet over 60% of the children were on controller medications; therefore, a PBMP could be particularly helpful to prevent confusion between rescue and controller medications.

Studies have shown that families of low socioeconomic status (SES) and certain racial/ethnic minority groups have higher asthma-related morbidity and poorer asthma control (34,35) with low health literacy contributing to these inequities (36–39). In particular, children of parents with low literacy had more emergency department visits, hospitalizations and days missed from school (36). Although the National Asthma Education and Prevention Program guidelines recommend asthma action plans for all patients with asthma, the majority are written at greater than a fifth-

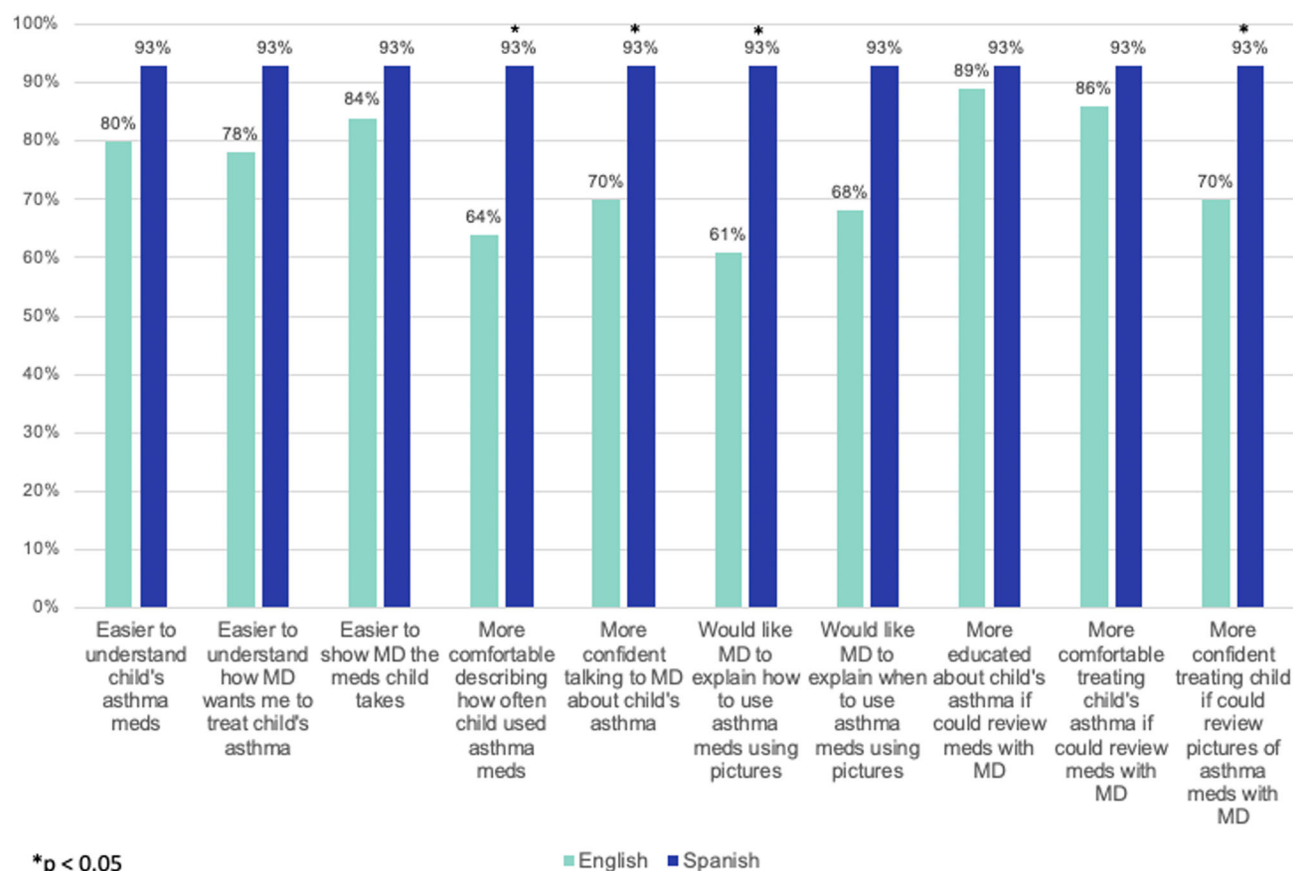


Figure 4. Percentage of parents who agree or strongly agree with the benefits of PBMP, by preferred language spoken.

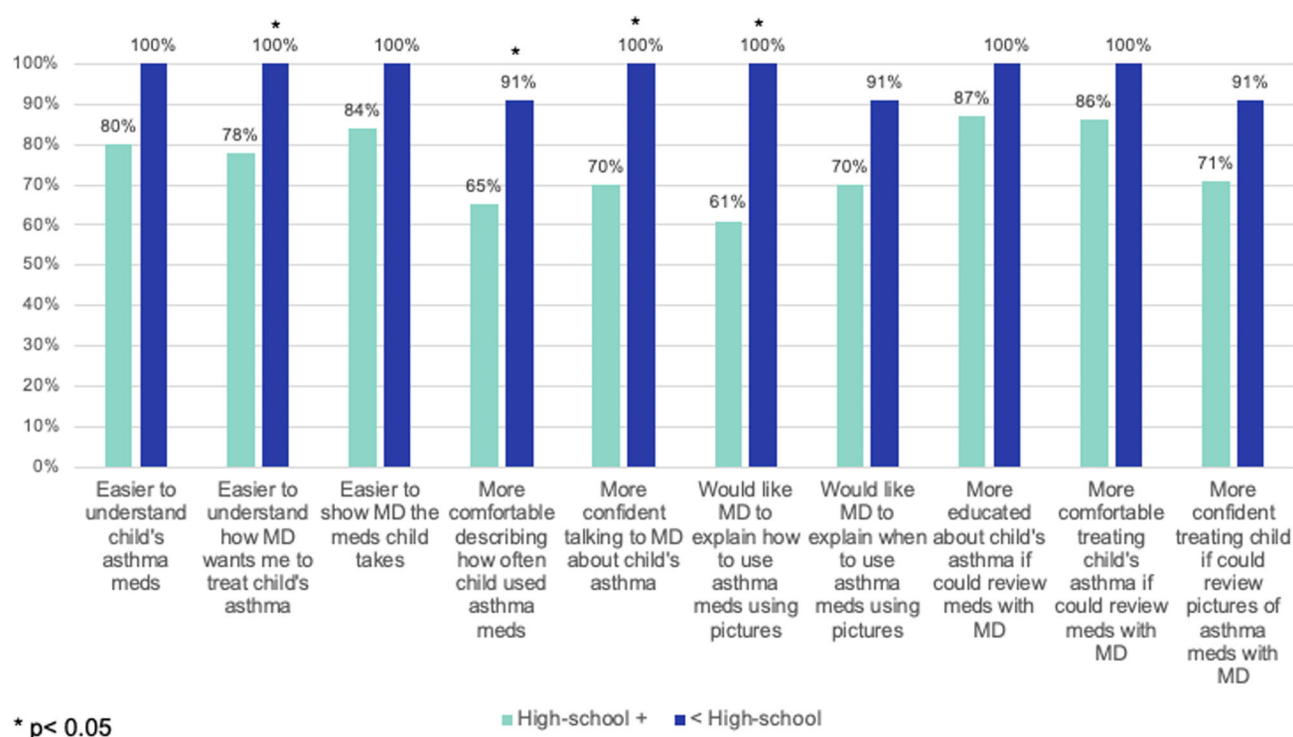


Figure 5. Percentage of parents who agree or strongly agree with the benefits of PBMP, by highest parent education level.

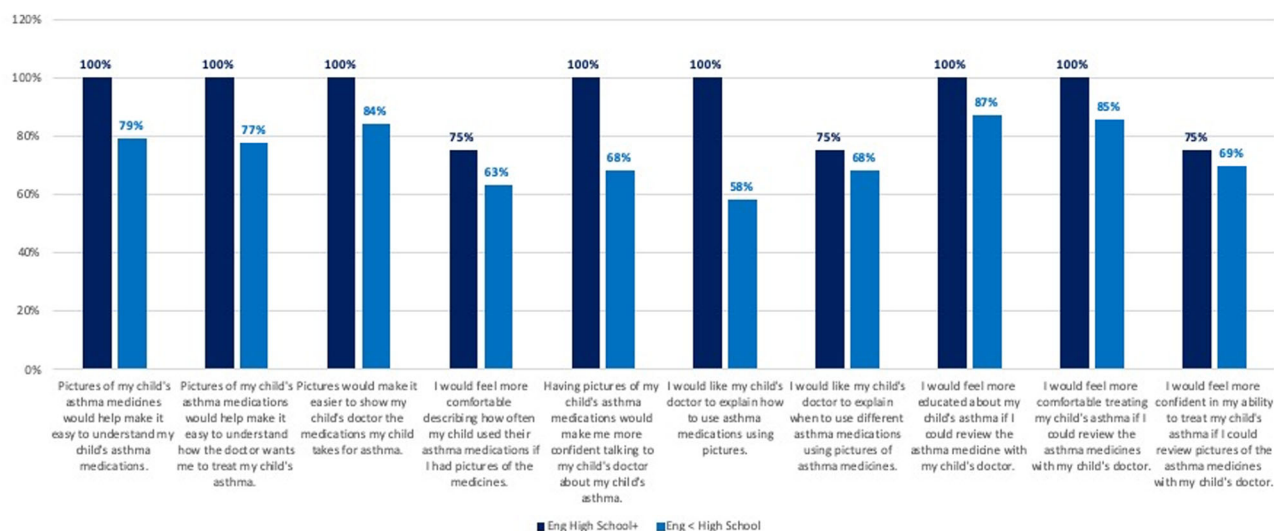


Figure 6. Percentage of English-speaking parents who agree or strongly agree with the benefits of PBMP, by highest parent education level.

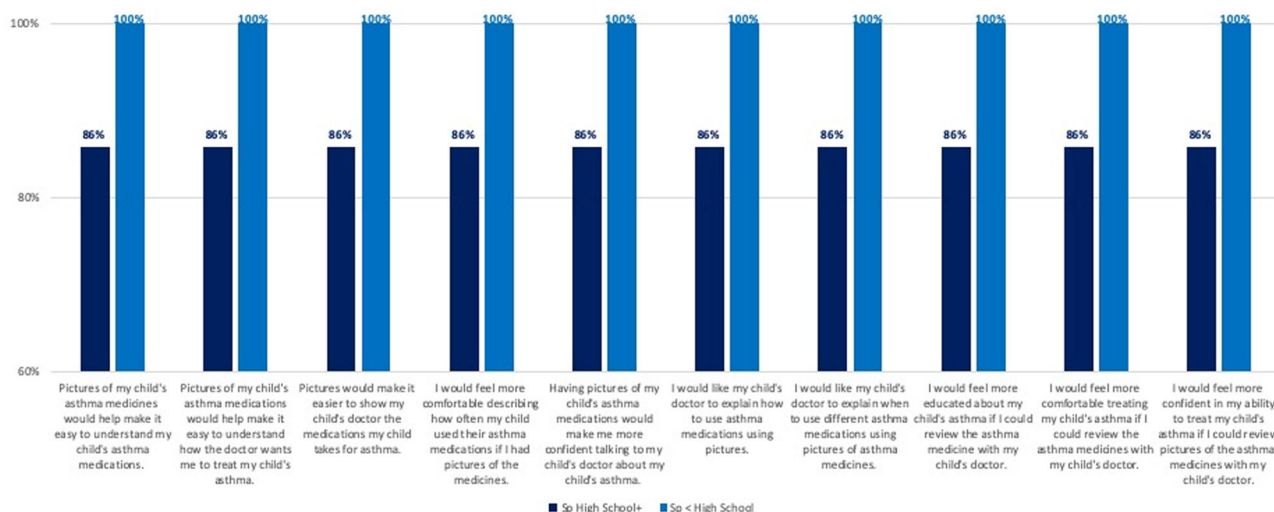


Figure 7. Percentage of Spanish-speaking parents who agree or strongly agree with the benefits of PBMP, by highest parent education level.

grade reading level (8,12,13). Given that one-third of US adults have low-health literacy (14,40), these asthma action plans may not be effective in parents with low health literacy and have been shown to be used less in parents with limited English proficiency (41). It is not surprising that we found that parents who did not complete high-school and who were Spanish-speaking endorsed the PBMP more than English-speaking parents and parents who graduated high-school.

Low-literacy written asthma action plans typically include pictures of when and how to take medications, but do not include pictures of specific asthma medications. They have been shown to reduce asthma medication errors (21) and improve asthma counseling by providers (42), however parents with low SES and low

health literacy often have poor understanding of the need to give everyday preventive (controller) medications, even when using a low-literacy asthma action plan (43,44). In addition, these often do not include pictorial images of specific medications. In fact, parents and children prefer educational materials with plain language and pictographic information (15–18,20,21,42), and studies have shown that instructions for patients that involve pictures are even more effective for those patients with lower health literacy (45–48).

Limitations

There are some limitations to our study findings. First, the study was performed at a single academic

center and may not be generalizable to other populations, although this ED serves populations that routinely experience poor quality asthma care: poor, Hispanic and African American patients. Since we only enrolled parents who spoke either English or Spanish, we cannot generalize these findings to other non-English/Spanish speaking parents. However, Spanish is the 2nd most common language spoken in the United States and includes groups that routinely experience disparate asthma care and outcomes (49–51). In addition, the average age of our patients with asthma was 7 years of age, and thus we may not be able to generalize the use of the PBMP to all teenagers as only 8.6% of children in our study were between the ages of 13 and 18 ($n = 15$). Last, we did not directly compare the PBMP to a written asthma action plan (without medication pictures) or other previously developed picture-based asthma action plans and thus cannot compare parental preference between them. However, given the well-described prevalence of low literacy, we expect that the PBMP would be widely endorsed among populations at risk for low English literacy. Future studies to evaluate parental preference between different types of asthma action plans and evaluation of the impact of the PBMP on asthma outcomes, including utilization of the PBMP at home, medication adherence, asthma medication management and overall asthma burden and morbidity.

Conclusion

Parents of children with asthma, including Spanish-speaking parents and parents with less than a high-school education strongly endorsed the PBMP. It may be useful to consider incorporating the PBMP as part of patient-centered chronic asthma care strategies for populations seen in ED settings.

Declaration of interest

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

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References

1. Ducharme FM, Bhogal SK. The role of written action plans in childhood asthma. *Curr Opin Allergy Clin Immunol*. 2008;8(2):177–188. doi:10.1097/ACI.0b013e3282f7cd58.
2. Ducharme FM, Zemek RL, Chalut D, McGillivray D, Noya FJD, Resendes S, Khomenko L, Rouleau R, Zhang X. Written action plan in pediatric emergency room improves asthma prescribing, adherence, and control. *Am J Respir Crit Care Med*. 2011;183(2):195–203. doi:10.1164/rccm.201001-0115OC.
3. Bhogal S, Zemek R, Ducharme FM. Written action plans for asthma in children. *Cochrane Database Syst Rev*. 2006;(3):CD005306.
4. Dinakar C, Van Osdol TJ, Wible K. How frequent are asthma exacerbations in a pediatric primary care setting and do written asthma action plans help in their management? *J Asthma*. 2004;41(8):807–812. doi:10.1081/JAS-200038418.
5. Lieu TA, Quesenberry CP, Jr., 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(3):334–341. doi:10.1542/peds.100.3.334.
6. Zemek RL, Bhogal SK, Ducharme FM. Systematic review of randomized controlled trials examining written action plans in children: what is the plan? *Arch Pediatr Adolesc Med*. 2008;162(2):157–163. doi:10.1001/archpediatrics.2007.34.
7. Agrawal SK, Singh M, Mathew JL, Malhi P. Efficacy of an individualized written home-management plan in the control of moderate persistent asthma: a randomized, controlled trial. *Acta Paed (Oslo, Norway)*. 1992;74(12):1742–1746. doi:10.1111/j.1651-2227.2005.tb01847.x.
8. Expert Panel Report 3 (EPR-3). Guidelines for the diagnosis and management of asthma-summary report 2007. *J Allerg Clin Immunol*. 2007;120(5 Suppl):S94–S138.
9. Sheares BJ, Du Y, Vazquez TL, Mellins RB, Evans D. Use of written treatment plans for asthma by specialist physicians. *Pediatr Pulmonol*. 2007;42(4):348–356. doi:10.1002/ppul.20586.
10. Partridge MR. Written asthma action plans. *Thorax*. 2004;59(2):87–88. doi:10.1136/thx.2003.016451.
11. McNally AJ, Frampton C, Garrett J, Pattemore P. Application of asthma action plans to childhood asthma: national survey repeated. *The New Zealand Medical Journal*. 2004;117(1196):U932.
12. Yin HS, Gupta RS, Tomopoulos S, Wolf MS, Mendelsohn AL, Antler L, Sanchez DC, Lau CH, Dreyer BP. Readability, suitability, and characteristics of asthma action plans: examination of factors that may impair understanding. *Pediatrics*. 2013;131(1):e116–e126. doi:10.1542/peds.2012-0612.
13. Forbis SG, Aligne CA. Poor readability of written asthma management plans found in national guidelines. *Pediatrics*. 2002;109(4):e52–e52. doi:10.1542/peds.109.4.e52.
14. Yin HS, Johnson M, Mendelsohn AL, Abrams MA, Sanders LM, Dreyer BP. The health literacy of parents in the United States: a nationally representative study. *Pediatrics*. 2009;124(Suppl 3):S289–S298. doi:10.1542/peds.2009-1162E.
15. Katz MG, Kripalani S, Weiss BD. Use of pictorial aids in medication instructions: a review of the literature.

- Am J Health-Syst Pharm. 2006;63(23):2391–2397. doi:[10.2146/ajhp060162](https://doi.org/10.2146/ajhp060162).
16. Michielutte R, Bahnson J, Dignan MB, Schroeder EM. The use of illustrations and narrative text style to improve readability of a health education brochure. *J Cancer Educ*. 1992;7(3):251–260. doi:[10.1080/08858199209528176](https://doi.org/10.1080/08858199209528176).
17. Butow P, Brindle E, McConnell D, Boakes R, Tattersall M. Information booklets about cancer: factors influencing patient satisfaction and utilization. *Patient Educ Counsel*. 1998;33(2):129–141. doi:[10.1016/S0738-3991\(97\)00071-2](https://doi.org/10.1016/S0738-3991(97)00071-2).
18. Gillette C, Rockich-Winston N, Shepherd M, Flesher S. Children with asthma and their caregivers help improve written asthma action plans: a pilot mixed-method study. *J Asthma*. 2018;55(6):609–614. doi:[10.1080/02770903.2017.1355379](https://doi.org/10.1080/02770903.2017.1355379).
19. Yin HS, Vuong C, Parker RM, Sanders LM, Mendelsohn AL, Dreyer BP, Velazquez JJ, Wolf MS. Identifying and advancing best practices for the labeling and dosing of pediatric liquid medications: progress and challenges. *Acad Pediatr*. 2019;19(1):1–3. doi:[10.1016/j.acap.2018.07.012](https://doi.org/10.1016/j.acap.2018.07.012).
20. Duncan CL, Walker HA, Brabson L, Williford DN, Hynes L, Hogan MB. Developing pictorial asthma action plans to promote self-management and health in rural youth with asthma: A qualitative study. *J Asthma*. 2018;55(8):915–923. doi:[10.1080/02770903.2017.1371743](https://doi.org/10.1080/02770903.2017.1371743).
21. Yin HS, Gupta RS, Mendelsohn AL, Dreyer B, van Schaick L, Brown CR, Encalada K, Sanchez DC, Warren CM, Tomopoulos S, et al. Use of a low-literacy written action plan to improve parent understanding of pediatric asthma management: A randomized controlled study. *J Asthma*. 2017;54(9):919–929. doi:[10.1080/02770903.2016.1277542](https://doi.org/10.1080/02770903.2016.1277542).
22. Roberts NJ, Mohamed Z, Wong PS, Johnson M, Loh LC, Partridge MR. The development and comprehensibility of a pictorial asthma action plan. *Patient Educ Counsel*. 2009;74(1):12–18. doi:[10.1016/j.pec.2008.07.049](https://doi.org/10.1016/j.pec.2008.07.049).
23. Yin HS, Dreyer BP, van Schaick L, Foltin GL, Dinglas C, Mendelsohn AL. Randomized controlled trial of a pictogram-based intervention to reduce liquid medication dosing errors and improve adherence among caregivers of young children. *Arch Pediatr Adolesc Med*. 2008;162(9):814–822. doi:[10.1001/archpedi.162.9.814](https://doi.org/10.1001/archpedi.162.9.814).
24. Tulloch J, Irwin D, Pascuet E, Vaillancourt R. Evaluation, modification and validation of a set of asthma illustrations in children with chronic asthma in the emergency department. *Can Respir J*. 2012; 19(1):26–31. doi:[10.1155/2012/367487](https://doi.org/10.1155/2012/367487).
25. Mitchell SJ, Bilderback AL, Okelo SO. Feasibility of picture-based asthma medication plans in urban pediatric outpatient clinics. *Pediatr Aller Immunol Pulmonol*. 2016;29(2):95–99. doi:[10.1089/ped.2016.0640](https://doi.org/10.1089/ped.2016.0640).
26. Kachru R, Morpew T, Kehl S, Clement LT, Hanley-Lopez J, Kwong KYC, Guterman JJ, Jones CA. Validation of a single survey that can be used for case identification and assessment of asthma control: the Breathmobile Program. *Ann Aller Asthma Immunol*. 2006;97(6):775–83. doi:[10.1016/S1081-1206\(10\)60969-6](https://doi.org/10.1016/S1081-1206(10)60969-6).
27. Jones CA, Clement LT, Hanley-Lopez J, Morpew T, Kwong KYC, Lifson F, Opas L, Guterman JJ. The Breathmobile Program: structure, implementation, and evolution of a large-scale, urban, pediatric asthma disease management program. *Dis Manag*. 2005;8(4): 205–222. doi:[10.1089/dis.2005.8.205](https://doi.org/10.1089/dis.2005.8.205).
28. Jones CA, Morpew T, Clement LT, Kimia T, Dyer M, Li M, Hanley-Lopez J. A school-based case identification process for identifying inner city children with asthma: the Breathmobile program. *Chest*. 2004; 125(3):924–934. doi:[10.1378/chest.125.3.924](https://doi.org/10.1378/chest.125.3.924).
29. Lee SY, Stucky BD, Lee JY, Rozier RG, Bender DE. Short assessment of health literacy-Spanish and English: a comparable test of health literacy for Spanish and English speakers. *Health Serv Res*. 2010; 45(4):1105–1120. doi:[10.1111/j.1475-6773.2010.01119.x](https://doi.org/10.1111/j.1475-6773.2010.01119.x).
30. Goldberg EM, Laskowski-Kos U, Wu D, Gutierrez J, Bilderback A, Okelo SO, Garro A. The Pediatric Asthma Control and Communication Instrument for the Emergency Department (PACCI-ED) improves physician assessment of asthma morbidity in pediatric emergency department patients. *J Asthma*. 2014;51(2): 200–208. doi:[10.3109/02770903.2013.859267](https://doi.org/10.3109/02770903.2013.859267).
31. Okelo SO, Eakin MN, Patino CM, Teodoro AP, Bilderback AL, Thompson DA, Loiaza-Martinez A, Rand CS, Thyne S, Diette GB, et al. The pediatric asthma control and communication instrument asthma questionnaire: for use in diverse children of all ages. *J Allergy Clin Immunol*. 2013;132(1):55–62. doi:[10.1016/j.jaci.2013.01.007](https://doi.org/10.1016/j.jaci.2013.01.007).
32. Patino CM, Okelo SO, Rand CS, Riekert KA, Krishnan JA, Thompson K, Quartey RI, Perez-Williams D, Bilderback A, Merriman B, et al. The asthma control and communication instrument: a clinical tool developed for ethnically diverse populations. *J Aller Clin Immunol*. 2008;122(5):936–943.e6. doi:[10.1016/j.jaci.2008.08.027](https://doi.org/10.1016/j.jaci.2008.08.027).
33. Okelo SO, Eakin MN, Riekert KA, Teodoro AP, Bilderback AL, Thompson DA, Loiaza-Martinez A, Rand CS, Thyne S, Diette GB, et al. Validation of parental reports of asthma trajectory, burden, and risk by using the pediatric asthma control and communication instrument. *J Aller Clin Immunol Pract*. 2014; 2(2):186–192. doi:[10.1016/j.jaip.2013.10.005](https://doi.org/10.1016/j.jaip.2013.10.005).
34. Akinbami LJ, Moorman JE, Liu X. Asthma prevalence, health care use, and mortality: United States, 2005–2009. *Natl Health Stat Rep*. 2011;(32):1–14.
35. Akinbami L. The state of childhood asthma, United States, 1980–2005. *Adv Data*. 2006;(381):1–24.
36. DeWalt DA, Dilling MH, Rosenthal MS, Pignone MP. Low parental literacy is associated with worse asthma care measures in children. *Ambulat Pediatr*. 2007;7(1): 25–31. doi:[10.1016/j.ambp.2006.10.001](https://doi.org/10.1016/j.ambp.2006.10.001).
37. Canino G, McQuaid EL, Rand CS. Addressing asthma health disparities: a multilevel challenge. *J Aller Clin Immunol*. 2009;123(6):1209–1217. doi:[10.1016/j.jaci.2009.02.043](https://doi.org/10.1016/j.jaci.2009.02.043).
38. Wittich AR, Mangan J, Grad R, Wang W, Gerald LB. Pediatric asthma: caregiver health literacy and the

- clinician's perception. *J Asthma*. 2007;44(1):51–55. doi:[10.1080/02770900601125672](https://doi.org/10.1080/02770900601125672).
39. Harrington KF, Zhang B, Magruder T, Bailey WC, Gerald LB. The impact of parent's health literacy on pediatric asthma outcomes. *Pediatr Allergy Immunol Pulmonol*. 2015;28(1):20–26. doi:[10.1089/ped.2014.0379](https://doi.org/10.1089/ped.2014.0379).
 40. Kutner M, Greenberg E, Jin Y, et al. The health literacy of America's adults: results from the 2003 National Assessment of Adult Literacy (NCES 2006-483). U.S. Department of Education. Washington, DC: National Center for Education Statistics; 2006.
 41. Riera A, Navas-Nazario A, Shabanova V, Vaca FE. The impact of limited English proficiency on asthma action plan use. *J Asthma*. 2014;51(2):178–184. doi:[10.3109/02770903.2013.858266](https://doi.org/10.3109/02770903.2013.858266).
 42. Yin HS, Gupta RS, Tomopoulos S, Mendelsohn AL, Egan M, van Schaick L, Wolf MS, Sanchez DC, Warren C, Encalada K, et al. A low-literacy asthma action plan to improve provider asthma counseling: a randomized study. *Pediatrics*. 2016;137(1):e20150468. doi:[10.1542/peds.2015-0468](https://doi.org/10.1542/peds.2015-0468).
 43. Diaz T, Sturm T, Matte T, Bindra M, Lawler K, Findley S, Maylahn C. Medication use among children with asthma in East Harlem. *Pediatrics*. 2000;105(6):1188–1193. doi:[10.1542/peds.105.6.1188](https://doi.org/10.1542/peds.105.6.1188).
 44. Smith LA, Bokhour B, Hohman KH, Miroshnik I, Kleinman KP, Cohn E, Cortes DE, Galbraith A, Rand C, Lieu TA, et al. Modifiable risk factors for suboptimal control and controller medication underuse among children with asthma. *Pediatrics*. 2008;122(4):760–769. doi:[10.1542/peds.2007-2750](https://doi.org/10.1542/peds.2007-2750).
 45. Houts PS, Doak CC, Doak LG, Loscalzo MJ. The role of pictures in improving health communication: a review of research on attention, comprehension, recall, and adherence. *Patient Educ Counsel*. 2006; 61(2):173–190. doi:[10.1016/j.pec.2005.05.004](https://doi.org/10.1016/j.pec.2005.05.004).
 46. Delp C, Jones J. Communicating information to patients: the use of cartoon illustrations to improve comprehension of instructions. *Acad Emerg Med*. 1996; 3(3):264–270. doi:[10.1111/j.1553-2712.1996.tb03431.x](https://doi.org/10.1111/j.1553-2712.1996.tb03431.x).
 47. Dowse R, Ehlers MS. The evaluation of pharmaceutical pictograms in a low-literate South African population. *Patient Educ Counsel*. 2001;45(2):87–99. doi:[10.1016/S0738-3991\(00\)00197-X](https://doi.org/10.1016/S0738-3991(00)00197-X).
 48. Hersh L, Salzman B, Snyderman D. Health literacy in primary care practice. *Am Fam Physician*. 2015;92(2):118–124.
 49. Thakur N, Barcelo NE, Borrell LN, Singh S, Eng C, Davis A, Meade K, LeNoir MA, Avila PC, Farber HJ, et al. Perceived discrimination associated with asthma and related outcomes in minority youth: the GALA II and SAGE II studies. *Chest*. 2017;151(4):804–812. doi:[10.1016/j.chest.2016.11.027](https://doi.org/10.1016/j.chest.2016.11.027).
 50. Lara M, Ramos-Valencia G, González-Gavillán JA, López-Malpica F, Morales-Reyes B, Marín H, Rodríguez-Sánchez MH, Mitchell H. Reducing quality-of-care disparities in childhood asthma: La Red de Asma Infantil intervention in San Juan, Puerto Rico. *Pediatrics*. 2013;131(Supplement 1):26–37. doi:[10.1542/peds.2012-1427d](https://doi.org/10.1542/peds.2012-1427d).
 51. Canino G, Vila D, Normand S-LT, Acosta-Pérez E, Ramírez R, García P, Rand C. Reducing asthma health disparities in poor Puerto Rican children: the effectiveness of a culturally tailored family intervention. *J Allergy Clin Immunol*. 2008;121(3):665–670. doi:[10.1016/j.jaci.2007.10.022](https://doi.org/10.1016/j.jaci.2007.10.022).