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Improving Pediatric Asthma Outcomes Through Pictorial Asthma Action Plans

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B.S. Nursing, University of Missouri-St. Louis, 2019

A Dissertation Submitted to The Graduate School at the University of Missouri-St.  
Louis  
in partial fulfillment of the requirements for the degree  
Doctor of Nursing Practice with an emphasis in Pediatric Nurse Practitioner

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### Abstract

**Problem:** Asthma is the leading chronic disease of children and the leading cause of childhood emergency department (ED) visits, hospitalizations, and missed school days. Asthma action plans (AAPs), including photographs or pictures of asthma medications, symptoms, triggers, and devices, have improved parents' understanding of their child's asthma and have increased their comfort level in caring for their child.

**Methods:** An interventional pre-post study with a mixed-method research design, at a large, urban, primary care pediatric clinic with two locations, evaluated the effectiveness of a pictorial AAP on a child's asthma control. A pictorial AAP was provided, and a childhood asthma control test (C-ACT) tool was completed when a child was enrolled in the study from January-February 2023. Two months later, another C-ACT and the Pictorial AAP Perceptions Questionnaire were completed. During March-May 2022 and March-May 2023, retrospective and prospective chart reviews were completed to examine how many asthma-related ED visits occurred.

**Results:** Eighteen participants completed the study. A paired sample t-test determined the significance between the C-ACT scores pre-post intervention ( $p=0.002$ ), and the scores improved by a mean of 5 points. There were eight ED visits before the pictorial AAP was given and two occurred after. Although the reduction in ED visits was not statistically significant, there was a clinically significant reduction in ED visits. Based on the responses to the Pictorial AAP Perceptions Questionnaire, most parents endorsed the pictorial AAP.

**Conclusion:** The pictorial AAP intervention may be a favorable standard to decrease asthma morbidity and mortality.

### **Improving Pediatric Asthma Outcomes Through Pictorial Asthma Action Plans**

Asthma is the leading chronic disease of children and leading cause of childhood emergency department (ED) visits, hospitalizations, and missed school days (Asthma and Allergy Foundation of America, 2020). In the United States, asthma affects 7 million children, nearly 10% of children living in the United States have been diagnosed with asthma (Pletta et al., 2020; Yin et al., 2017). Asthma control is of extreme importance in children, especially in preventing asthma exacerbations. Asthma exacerbations may cause bronchial remodeling in children, which can cause permanent decreases in lung function well into adulthood (Pegoraro et al., 2022). Children with asthma who have lower values of Forced Expiratory Volume (FEV) in one second are directly correlated with a greater risk of developing Chronic Obstructive Pulmonary Disease (COPD) as an adult (Pegoraro et al., 2022).

Asthma is a chronic inflammatory respiratory disease, characterized by hyperresponsiveness to stimuli or triggers that cause bronchoconstriction and airflow limitation (Richardson, 2018). As the airways become increasingly inflamed, airway edema, and increased mucus production occurs. Common triggers that can cause an asthma exacerbation are animal and outdoor allergens, dust mites, cockroaches, mold, tobacco smoke exposure, air pollution, chemical cleaning products, upper respiratory infections, viral illnesses, rapid change in weather, and exercise (Richardson, 2018). Asthma exacerbation symptoms include coughing, wheezing, chest tightness, and chest pain, which can be life-threatening. Depending upon the severity of the child's asthma, their asthma may be successfully managed through avoiding triggers, regular use of controller medications, and an as-needed medication to prevent an asthma exacerbation

(Perry et al., 2019).

In 2013, the total direct cost of pediatric asthma was \$5.92 billion (Perry et al., 2019). The average annual costs were \$3,076 to \$13,612 per child (Perry et al., 2019). The primary contributors to cost were pharmaceutical needs, and inpatient and outpatient services. Asthma-related hospitalizations and ED visits have the highest economic burden. In 2010, the total cost to Medicaid was an estimated \$272 million due to asthma-related ED visits (Perry et al., 2019). In 2009, \$1.59 billion was the cost of asthma-related hospitalizations in the nation (Perry et al., 2019). Pediatric asthma exacerbations create quality-of-life impairments and impose a significant economic burden on the United States healthcare system. Quality-of-life impairments due to asthma exacerbations include children missing school and parents missing days of work, which can lead to financial, educational, and health delays (Martínez-González et al., 2020).

Healthy People 2020 objectives include increasing the number of written asthma action plans (AAPs) provided to patients diagnosed with asthma, and decreasing ED visits, hospitalizations, and deaths caused by asthma (Prigge et al., 2022). The Centers for Disease Control and Prevention and American Academy of Pediatrics recommend providing an AAP to pediatric patients to reduce quality-of-life impairments and health risks associated with asthma (Pletta et al., 2020). The Asthma and Allergy Foundation of America designed a plan to improve asthma health in underserved populations. Included in the plan was to provide personalized and culturally appropriate AAPs to patients, their families, and school nurses (Asthma and Allergy Foundation of America, 2020). AAPs are a well-established clinical guideline for asthma management because

they are effective in providing important home care management information, such as medication management, how to assess the severity of an asthma exacerbation, instructions on when to call the primary care provider, and when to seek emergency care (Wagner & Steefel, 2017). Despite AAPs being recommended for asthma management, AAPs are among the least frequently used strategies and are only provided during 25% of visits among urban children diagnosed with persistent asthma, aged 2 to 12 years (Afolabi & Fairman, 2022).

The purpose of the study was to ascertain if providing pictorial AAPs to children between the ages of 4 and 11 years old enhances the child's asthma control and the child's and their parent's understanding of the child's treatment plan. The aim of the project was to improve childhood asthma control test (C-ACT) scores by 3 points, reduce the number of asthma-related ED visits between March-May 2022 and March-May 2023 by 25%, and improve parents' understanding of their child's asthma management plan. The primary outcome measure was the score of the C-ACT tool completed by the participant and participant's parent before and after receiving a pictorial AAP. A secondary outcome measure was the number of asthma-related ED visits before and after receiving a pictorial AAP. A secondary outcome measure was the score of a Pictorial AAP Perceptions Questionnaire completed after receiving the pictorial AAP. The evidence-based practice (EBP) framework used to guide the project was the revised Iowa Model (White et al., 2021). The question for the study was: In children diagnosed with asthma, aged 4-11 years, what is the effect of a pictorial AAP on their asthma control and understanding?

### **Review of Literature**

To conduct the literature search, CINAHL, PubMed, and Medline were utilized. A backward reference search was also used. Key terms and phrases included ‘asthma action plan’ OR ‘asthma management plan’ AND ‘pediatric’. Based on the key terms and phrases utilized 1,820 results were generated initially. Inclusion criteria were studies published from 2017-2022, scholarly (peer reviewed) journals in the English language, and two age filters were applied including: 2-5 years and 6-12 years. Exclusion criteria were publications only including adults, magazine articles, dissertations, newspapers, or any work not published in English. After inclusion and exclusion criteria were applied, 112 publications were generated and 19 were selected for this review of literature.

Asthma “self-management” is the patient and their family’s understanding of the disease, triggers for exacerbations, recognizing when and how to properly take their medications, and identifying when a higher level of care is needed (Greenberg et al., 2019). An essential component of asthma control is asthma self-management and is designated as important and necessary (Greenberg et al., 2019). AAPs support patients and their families with self-managing their asthma by promoting shared decision making between the patient and their provider, and increasing communication between the provider, patient, patient’s family, school, and caretakers (Prigge et al., 2022). A retrospective study, including 200 children receiving primary care at a Federally Qualified Health Center (FQHC), concluded a statistically significant predictor of ED utilization was absence of an AAP ( $p < 0.001$ ) (Shechter et al., 2019). According to Kennedy et al. (2022), a retrospective study including a sample of 81 children who were either discharged from an ED or hospital due to an asthma exacerbation, only 10% had an AAP prior to going to the ED or being hospitalized (Kennedy et al., 2022).

Beliefs regarding asthma self-management were found to be different among caregivers with different demographics. A qualitative study, including nine African American caregivers residing in three Newark, New Jersey housing communities, reported 56% had never heard of an AAP and only 11% of the participants used an AAP (Wagner & Steefel, 2017). According to Wagner and Steefel (2017), 44% of participants in the study who had heard of an AAP did not understand an AAP's intended use. A limitation to this study is the findings were collected from a very small sample of extremely low-income urban African American caregivers and may not be generalizable to all African American caregivers providing care to children with asthma (Wagner & Steefel, 2017). According to a national cross-sectional online survey, parents reported they agreed/strongly agreed AAPs were helpful in managing their child's asthma (446/544, 82%), decreasing missed parental workdays (367/544, 68%), decreasing their child's school absences (396/542, 73%), increasing their child's ability to do normal activities (437/540, 81%), and are helpful for their child at school (422/541, 78%) and when they are with other caregivers (434/543, 80%) (Pletta et al., 2020). Limitations to this study included all the participants had to be English-speaking, have internet access, and only 11% of the sample were African American (Pletta et al., 2020).

Health literacy is a major component to the ability to self-manage an asthma diagnosis. Studies have shown parents and children prefer education provided in simple phrases and pictographs to enhance their understanding (Pade et al., 2021). According to a randomized controlled trial, parents who received a low literacy written AAP, consisting of short phrases and pictures, had better knowledge of how to manage their child's asthma in comparison to the parents who received a standard written AAP (Yin



et al., 2017). The parents who received the low literacy written AAP had fewer errors in knowledge of which medications to give their child every day and when their child is sick and made fewer errors regarding the importance of using a spacer with inhaled medications (Yin et al., 2017). Parents in both randomized groups found the low literacy written AAP was easier to understand than the standard plan (Yin et al., 2017). A qualitative study was conducted and included 174 parents who completed a survey on the usability and their comfortability of using a pictorial AAP (Pade et al., 2021). Findings included Spanish-speaking parents agreed that the pictorial AAP made it easier for them to describe medication frequency ( $p<0.02$ ), enjoyed their doctor's explanation of medication usage ( $p<0.02$ ), found confidence in communicating with the doctor who manages their child's asthma plan ( $p<0.02$ ), and built confidence in managing their child's asthma ( $p<0.04$ ) (Pade et al., 2021). Similar findings were found for parents without a high school degree and these parents agreed the pictorial AAP would allow them to feel confident in communicating with the doctor who manages their child's asthma plan ( $p<0.03$ ), confidence in the doctor's education of how to administer medications to manage asthma ( $p<0.01$ ), would give them confidence in describing the medication frequency ( $p<0.05$ ), and ease of understanding the treatment plan ( $p<0.04$ ) (Pade et al., 2021). According to Gillette et al. (2018), caregivers who participated in a cross-sectional analysis stated that having pictures would improve written AAPs. This finding was consistent with another qualitative study where caregivers and their children preferred AAPs to include simple, cartoon-like pictures (Duncan et al., 2018). A strength of this qualitative study was physicians were also interviewed and emphasized the importance of including pictures of controller medications, given their importance in

preventing asthma exacerbations (Duncan et al., 2018). Other suggestions found in this study were the stoplight format commonly used in AAPs, pictures of medications and how to take them, symptoms, and short words or phrases accompanying pictures to further clarify the AAPs (Duncan et al., 2018).

One study included in this review created a new written AAP and used pictures of asthma symptoms, colorful pictures of medications, and devices (Lakupoch et al., 2018). In the prospective study, 49 children were included, and data was collected 6 months prior to the new written AAP being provided to the sample and 6 months after (Lakupoch et al., 2018). Of the parents using the new written AAP with colorful pictures, 87% reported having a positive feeling of having and using the written AAP and 83% felt increased confidence in self-management of their child's asthma symptoms (Lakupoch et al., 2018). After the new written AAP was provided to the children, there was a significant reduction in ED visits ( $p=0.005$ ), hospitalizations ( $p=0.026$ ), unscheduled outpatient visits ( $p=0.046$ ), and missed-school days ( $p=0.022$ ) (Lakupoch et al., 2018). A gap in the literature exists for how pictorial low health literacy AAPs impact patient asthma outcomes, such as ED visits, unscheduled visits, hospitalizations, and missed school days. Most of the literature reviewed were qualitative studies regarding caregivers' perception of pictorial AAPs.

The revised Iowa Model is a commonly used framework for implementation of EBP. The revised Iowa Model was chosen to guide the project because the model uses the concept of clinical problem-focused "triggers" for EBP (White et al., 2021). The clinical problem-focused triggers are primary care home health nurses, clinical staff nurses, and phone triage nurses identifying AAPs are not being created for patients. This

model also focuses on initial pilot testing versus implementation of practice change, which was the reasoning for the research to begin and be localized in the pediatric primary care office (White et al., 2021).

Clinical problem-focused triggers set an EBP inquiry into motion (White et al., 2021). Many clinical problem-focused triggers exist for an ongoing problem such as the rates of pediatric patients diagnosed with asthma and the number of ED visits, hospitalizations, and missed school days caused by their asthma. Providing patients with AAPs has been recommended by national organizations for many years. New knowledge has been found on what information is most beneficial and should be included in AAPs to improve asthma outcomes and reduce economic burdens. Due to the complex nature of treating pediatric patients diagnosed with asthma, continuous monitoring, and evaluation of the process of providing AAPs to patients is needed, which is consistent among the revised Iowa Model (White et al., 2021).

In summary, self-management of asthma is foundational to reduce asthma exacerbations and to achieve better asthma control. Interventions need to be catered towards a person's health literacy level. Varying AAPs exist and are being used in the United States. According to Lakupoch et al. (2018), there is no specific format of a written AAP worldwide. Standardization of the items needed to be included in pediatric AAPs could improve asthma outcomes (Pegoraro et al., 2022). AAPs including photographs or pictures of asthma medications, symptoms, triggers, and devices have been found to improve parents' understanding of their child's asthma and has increased their comfortability level in providing care for their child (Duncan et al., 2018; Lakupoch et al., 2018; Pade et al., 2021; Yin et al., 2017). Parents at all levels of

education have preferred a pictorial AAP over a standard AAP (Pade et al., 2021; Yin et al., 2017). Further research is needed to identify how a pictorial AAP influences asthma control as evidenced by C-ACT scores, rates of ED visits, unscheduled outpatient visits, hospitalizations, and missed school days.

## **Methods**

### **Design**

The design of the change implementation project was an interventional, pre-post study. The study had a mixed-method research design. The intervention was a pictorial AAP, provided to participants between January-February 2023 (see Appendix A and B). A retrospective and prospective record review containing quantitative data was collected. Pre-intervention data collected included a C-ACT score, collected on the same day the pictorial AAP was provided to the participant and participant's parent, and quantitative data from a retrospective record review included the number of asthma-related ED visits that were completed by the participant during the months of March-May 2022. The prospective, post-intervention, quantitative data collected included a C-ACT score two months following the initial visit, when the pictorial AAP was given, and the number of asthma-related ED visits that occurred between the months of March-May 2023. The qualitative data collected included parent responses to a Pictorial AAP Perceptions Questionnaire regarding the pictorial AAP and their child's asthma control, which was collected from the participant's parent two months after the pictorial AAP was provided.

### **Setting**

The setting for the study included a large, urban, primary care pediatric clinic,

located in St. Louis, MO. The clinic has two different locations and about 22,000 visits take place between the two locations each year. The families who are seen at the clinic represent a wide variety of races, gender, economic, cultural, and ethnic backgrounds. The pediatric clinic has roughly 23 providers. The clinic is also a teaching clinic, so many medical students and medical residents rotate between the clinic's two locations.

### **Sample**

This study used a convenience sample. The inclusion criteria for the study included English-speaking children who were between the ages of 4 and 11 years old with an asthma diagnosis, including all severities, being seen for any type of visit. All forms of insurance, including Medicaid and commercial, as well as children who were uninsured were included. The exclusion criteria for the study included children who were less than 4 years old and greater than 11 years old, non-English speaking, and were receiving single maintenance and reliever therapy (SMART) asthma treatment. The group included was selected because the C-ACT tool was developed specifically for children who are 4 to 11 years old (see Appendix C). The C-ACT tool is a validated instrument (Liu et al., 2007; Liu et al., 2010). Only English-speaking children were included because the Principal Investigator (PI) was not fluent in another language than English and the study included a follow-up phone call. Children being treated with SMART asthma treatment were excluded because the pictorial AAP was not designed for this type of treatment, due to the treatment requiring the use of only one inhaler rather than a preventative and rescue inhaler. The desired sample size was approximately 50 participants. This number was determined based on the number of children diagnosed with asthma at the study's site, between the ages of 4 and 11 years,

and the time range to recruit participants.

### **Data Collection/Analysis**

The data collection instruments used included a C-ACT tool and Pictorial AAP Perceptions Questionnaire (see Appendix C and D). The C-ACT is a validated tool and permission to use was received by the Mapi Research Trust, Lyon, France.<sup>1</sup> The C-ACT tool includes seven total questions. The first four questions are to be completed by the child and the remaining three questions are to be completed by the child's parent. The questions include asking about how the child's asthma is the day of completion of the test, how big of a problem their asthma has been while exercising, how often they are coughing and/or wheezing during the day and at night. The Pictorial AAP Perceptions Questionnaire has been validated in other research studies. The first, fourth, and fifth questions of the Pictorial AAP Perceptions Questionnaire were adapted from a national cross-sectional online survey, which asked questions regarding parent's perceptions of helpfulness of an AAP for everyday management (Pletta et al., 2020). The second question was adapted from a randomized controlled trial, which included the knowledge of spacer use after receiving a pictorial AAP as an outcome measure (Yin et al., 2017). The third question was adapted from a retrospective study, which used a questionnaire to assess family satisfaction and confidence after using a pictorial AAP (Lakupoch et al., 2018). The data collected on the database collection instrument included C-ACT scores, Pictorial AAP Perceptions Questionnaire responses, and number of asthma-related ED visits pre-post intervention (see Appendix E). Additional demographic data collected on the instrument included age, asthma diagnosis, gender, race, zip code, and language

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<sup>1</sup> The Mapi Research Trust, Lyon, France may be contacted at <https://eprovide.mapi-trust.org>.

spoken (see Appendix E).

The data was coded, and a key was created. The data was coded by using a unique alphanumeric identifier. The unique ten-digit identifier used the patient's first and last name initials followed by their 8-digit date of birth. The list was stored on the PI's password protected computer (see Appendix E).

Descriptive statistics included a paired sample t-test and one sample t-test, which was employed via Statistical Package for the Social Sciences (SPSS) to better understand the effects a pictorial AAP had on the child's and their parent's knowledge and understanding of the child's asthma treatment plan and asthma control.

### **Approval Processes**

The approvals obtained included the site's Institutional Review Board (IRB), University of Missouri - St. Louis' IRB, and the doctoral committee prior to implementation. Approvals received included formal, written approval from the Director of Advanced Practice Providers for the site's company, Medical Directors of the pediatric primary care clinic, Pediatric Ambulatory Care Practice Council, and from the Unit Practice Council of the site.

Potential risks included were possible perceived invasion of privacy, probing for information an individual might consider to be personal or sensitive, and using too much of a participant's time. Measures that were taken to minimize risks included coding the patients after collecting consent to protect their health information and being conscious of time spent with participants.

Benefits for the individual participating in the study included enhancing their understanding of how to manage their asthma diagnosis, increasing their confidence in

understanding their prescribed medications and their frequency, reducing missed parental workdays, reducing school absences, increasing the child's ability to do normal activities, reducing asthma-related ED visits, hospitalizations, unscheduled outpatient visits, and reducing healthcare costs due to the reduction of visits.

### **Procedures**

The Doctor of Nursing Practice (DNP) candidate led the change implementation project. The research began once IRB approval was received. Once consent and assent, if the child was seven to 11 years old, were received a pictorial AAP was provided to the participant (see Appendix A and B). The C-ACT was collected and placed into a locked storage cabinet.

Two months from the date the C-ACT was collected, and the pictorial AAP was provided, a follow-up phone call was completed. At this time, the participant and participant's parent were asked to complete another C-ACT and answer the Pictorial AAP Perceptions Questionnaire (see Appendix C and D). The C-ACT score and questionnaire responses were locked in a storage cabinet.

A prospective and retrospective chart review were conducted to examine how many asthma-related ED visits occurred for the participants during the months of March-May 2022 and March-May 2023. The data was stored on a password-locked computer. After all the data was received, the PI began analyzing the data using SPSS.

## **Results**

### **Demographics**

A total of 28 patients were enrolled in the study. Completion of the study included 18 patients aged 4 to 11 years. The mean age was 8. A total of 6 (33.3%) male



and 12 (66.7%) female patients completed the study. All the patients were African American (100%) and spoke English (100%). The most frequently identified zip code was 63118 (33.3%). Of the children who completed the study, eight had a mild persistent asthma diagnosis (44.4%) (see Appendix F).

### **Childhood Asthma Control Test Scores**

The study's primary outcome measure was the C-ACT scores before receiving the pictorial AAP and after. The C-ACT scores improved by a mean of 5 points (see Appendix G). The mean test score of the C-ACTs completed before receiving the pictorial AAP was 17. The mean test score of the C-ACTs completed after receiving the pictorial AAP was 22. According to the C-ACT tool, a score of 19 or less displays the child's asthma control may not be as well controlled as it could be, and a score of 20 or greater displays the child's asthma may be well controlled. A paired sample t-test determined the significance between the C-ACT scores pre-post intervention, and the findings were statistically significant ( $p=0.002$ ) (see Appendix H).

### **ED Visits**

An ED visit was considered asthma-related if asthma, breathing problem, or wheezing was listed in the visit as the clinical impression. There were eight total asthma-related ED visits before the pictorial AAP was provided and two occurred after. There was a 75% decrease in asthma-related ED visits after the pictorial AAP was received. There was no statistically significant difference between the two variables due to the small occurrence of ED visits before and after receiving the pictorial AAP, but a clinically significant reduction existed.

### **Knowledge Based Questionnaire**

During the follow-up phone call, two months after the pictorial AAP was provided to the patient and their family, the questions in the Pictorial AAP Perceptions Questionnaire were asked (see Appendix D). All the patients' parents agreed the pictures included in the AAP were helpful (100%), made them feel more confident in managing their child's asthma diagnosis since receiving the asthma action plan with pictures (100%), and made them miss less work since receiving the pictorial AAP (100%). One out of 18 parents (5.6%) reported feeling neutral regarding the statements, "The picture of a spacer included on the asthma action plan reminded me to use the spacer," and "Since receiving the asthma action plan with pictures, my child has missed fewer days of school." The other 17 parents (17/18, 94.4%) agreed with these statements (see Appendix I).

### **Discussion**

Although asthma "self-management" is important and necessary in managing an asthma diagnosis, and AAPs help support patients and their families self-manage their asthma, AAPs are not always provided to children with an asthma diagnosis. There has been limited quantitative data on the effectiveness of AAPs containing pictures. Much of the data collected has been qualitative, and many parents and children have stated AAPs containing pictures of asthma symptoms, medications, devices, and short phrases improved or would improve their knowledge of how to manage their asthma (Duncan et al., 2018; Pade et al., 2021; Yin et al., 2017).

In this interventional pre-post study, qualitative and quantitative data were collected. The pictorial AAP had a positive effect on the child and parent's understanding of the asthma management plan and improved the child's asthma control.

The C-ACT scores pre-intervention and post-intervention were found to be statistically significant. There was a reduction in asthma-related ED visits after the pictorial AAP was received, but these findings were not statistically significant. There was an improvement in parents' understanding of their child's asthma management plan, which was demonstrated by the improved C-ACT scores, reduced ED visits, and Pictorial AAP Perceptions Questionnaire responses.

Limitations of the study included a small sample size. Another limitation was the completion of the second C-ACT over the phone versus in person, like the initial completion of the test. There were also times when the child was not around the parent to be asked how they felt their asthma was doing and the parent would answer the C-ACT questions with what they thought their child would say. Another limitation included the low number of ED visits over the two 3-month time periods. Most of the sample had not had any asthma-related ED visits during the months of March to May, pre and post-pictorial AAP being given. The sample also consisted of urban, primarily low socioeconomic status, African American, English-speaking parents and the results may not be generalizable to other populations.

Recommendations for future studies include examining the rate of ED visits over a larger range of time or during the months of respiratory season when asthma exacerbations typically occur the most. If a C-ACT score is an outcome measure, then the tool should be completed in person and at a minimum of 3 months after the previous C-ACT was completed at an asthma follow-up visit.

### **Conclusion**

Using a pictorial AAP containing short phrases and pictures of symptoms, an

inhaler spacer, and medications printed in color resulted in better child and parent understanding demonstrated by improved C-ACT scores, reduction in ED visits, and positive Pictorial AAP Perceptions Questionnaire responses. The child and parent better understood when the child should use their Albuterol inhaler versus their Symbicort or Flovent inhaler due to the pictures in color of their medications. The pictorial AAP increased spacer use adherence due to the plan containing a picture of a spacer. The children and parents reported the pictorial AAP helped them better understand how to manage their asthma diagnosis and helped them gain confidence in doing so. The pictorial AAP intervention may be a favorable standard, instead of the current standard AAP without pictures of medications, symptoms, and devices, to decrease asthma morbidity and mortality.

## References

- Afolabi, T., & Fairman, K. A. (2022). Association of asthma exacerbation risk and physician time expenditure with provision of asthma action plans and education for pediatric patients. *The Journal of Pediatric Pharmacology and Therapeutics*, 27(3), 244-253. <https://doi.org/10.5863/1551-6776-27.3.244>
- Asthma and Allergy Foundation of America. (2020). *Asthma disparities in America: A roadmap to reducing burden on racial and ethnic minorities*. <https://www.aafa.org/media/2743/asthma-disparities-in-america-burden-on-racial-ethnic-minorities.pdf>
- Duncan, C. L., Walker, H. A., Brabson, L., Williford, D. N., Hynes, L., & Hogan, M. B. (2018). Developing pictorial asthma action plans to promote self-management and health in rural youth with asthma: A qualitative study. *The Journal of Asthma*, 55(8), 915–923. <https://doi.org/10.1080/02770903.2017.1371743>
- Gillette, C., Rockich-Winston, N., Shepherd, M., & Flesher, S. (2018). Children with asthma and their caregivers help improve written asthma action plans: A pilot mixed-method study. *The Journal of Asthma*, 55(6), 609–614. <https://doi.org/10.1080/02770903.2017.1355379>
- Greenberg, J., Prushinskaya, O., Harris, J. D., Guidetti-Myers, G., Steiding, J., Sawicki, G. S., & Gaffin, J. M. (2018). Utilization of a patient-centered asthma passport tool in a subspecialty clinic. *The Journal of Asthma*, 55(2), 180–187. <https://doi.org/10.1080/02770903.2017.1323916>
- Harrison, P., Duggan, W., Preddy, J., & Moline, A. (2019). Asthmatic children from lower-income families are less likely to own an individualised asthma action

plan. *Journal of Paediatrics and Child Health*, 56(2), 194–200.

<https://doi.org/10.1111/jpc.14553>

Kennedy, L., Gallagher, G., Maxwell, B., Bartholme, B., Fitzsimons, A., Russell, C., Mallon, O., Hughes, J. L., Beattie, S., Vasi, V., O'Donoghue, D. B., & Shields, M. D. (2022). Implementation of a children's safe asthma discharge care pathway reduces the risk of future asthma attacks in children-A retrospective quality improvement report. *Frontiers in Pediatrics*, 10, 865476.

<https://doi.org/10.3389/fped.2022.865476>

Lakupoch, K., Manuyakorn, W., Preutthipan, A., & Kamalaporn, H. (2018). The effectiveness of newly developed written asthma action plan in improvement of asthma outcome in children. *Asian Pacific Journal of Allergy and Immunology*, 36(2), 88–92. <https://doi.org/10.12932/AP-010217-0002>

Liu, A. H., Zeiger, R., Sorkness, C., Mahr, T., Ostrom, N., Burgess, S., Rosenzweig, J. C., & Manjunath, R. (2007). Development and cross-sectional validation of the childhood asthma control test. *Journal of Allergy and Clinical Immunology*, 119(4), 817.

Liu, A. H., Zeiger, R. S., Sorkness, C. A., Ostrom, N. K., Chipps, B. E., Rosa, K., Watson, M. E., Kaplan, M. S., Meurer, J. R., Mahr, T. A., Blaiss, M. S., Piault-Louis, E., & McDonald, J. (2010). The childhood asthma control test: Retrospective determination and clinical validation of a cut point to identify children with very poorly controlled asthma. *Journal of Allergy and Clinical Immunology*, 126(2), 267.

Martínez-González, C. L., Camargo-Fajardo, M. C. C., Segura-Medina, P., & Quezada-

- Bolaños, P. (2020). Therapeutic patient education with learning objects improves asthma control in Mexican children. *Journal of Medical Systems*, 44(4), 79-79. <https://doi.org/10.1007/s10916-020-1539-3>
- Pade, K. H., Thompson, L. R., Ravandi, B., Chang, T. P., Barry, F., Halterman, J. S., Szilagyi, P. G., & Okelo, S. O. (2021). Parental perception of a picture-based chronic asthma care management tool in an urban pediatric emergency department. *The Journal of Asthma*, 58(8), 1013–1023. <https://doi.org/10.1080/02770903.2020.1753210>
- Pegoraro, F., Masini, M., Giovannini, M., Barni, S., Mori, F., Toit, G. d., Bartha, I., & Lombardi, E. (2022). Asthma action plans: An international review focused on the pediatric population. *Frontiers in Pediatrics*, 10, 874935-874935. <https://doi.org/10.3389/fped.2022.874935>
- Perry, R., Braileanu, G., Palmer, T., & Stevens, P. (2019). The economic burden of pediatric asthma in the United States: Literature review of current evidence. *PharmacoEconomics*, 37(2), 155–167. <https://doi.org/10.1007/s40273-018-0726-2>
- Pletta, K. H., Kerr, B. R., Eickhoff, J. C., Allen, G. S., Jain, S. R., & Moreno, M. A. (2020). Pediatric asthma action plans: National cross-sectional online survey of parents' perceptions. *JMIR Pediatrics and Parenting*, 3(2), e21863. <https://doi.org/10.2196/21863>
- Prigge, K., Holtz, K. K., Mara, K., & Meek, A. (2022). Providing asthma management in the retail clinic setting. *Journal of Primary Care & Community Health*, 13, 1-9. <https://doi.org/10.1177/21501319221092256>

Richardson, B. (2018). *Pediatric primary care practice guidelines for nurses* (4th ed.).

Jones & Bartlett Learning.

Shechter, J., Roy, A., Naureckas, S., Estabrook, C., & Mohanty, N. (2019). Variables associated with emergency department utilization by pediatric patients with asthma in a Federally Qualified Health Center. *Journal of Community Health, 44*(5), 948-953. <https://doi.org/10.1007/s10900-019-00653-6>

Wagner, F., & Steefel, L. (2017). Beliefs regarding asthma management relating to asthma action plans (AAPs) of African American caregivers residing in Newark, New Jersey public housing communities. *Journal of Pediatric Nursing, 36*, 92-97. <https://doi.org/10.1016/j.pedn.2017.05.001>








































White, K. M., Dudley-Brown, S. & Terhaar, M. F. (2021). *Translation of Evidence into Nursing and Healthcare* (3rd ed.). Springer Publishing Company, LLC. <https://doi.org/10.1891/9780826147370>

Yin, H. S., Gupta, R. S., Mendelsohn, A. L., Dreyer, B., Van Schaick, L., Brown, C. R., Encalada, K., Sanchez, D. C., Warren, C. M., & Tomopoulos, S. (2017). Use of a low-literacy written action plan to improve parent understanding of pediatric asthma management: A randomized controlled study. *The Journal of Asthma, 54*(9), 919. <https://doi.org/10.1080/02770903.2016.1277542>
















Appendix A

Asthma Action Plan  
The Traffic Light System

<b>Green Zone: Feeling Good</b>					
 <p>Your child is feeling good:</p> <ul style="list-style-type: none"> <li>• No trouble breathing</li> <li>• No cough or wheeze</li> <li>• Sleeps well</li> <li>• Can play as usual</li> </ul>	<p><b>Everyday</b> Keep your child healthy. Give medicine when healthy or sick.</p> <table border="1" style="width: 100%; text-align: center;"> <tr> <td style="width: 50%;">  <b>Morning</b>  <b>AND</b> </td> <td style="width: 50%;"> <b>Flovent</b> 2 puffs with spacer   </td> </tr> <tr> <td style="width: 50%;">  <b>Evening</b> </td> <td style="width: 50%;"></td> </tr> </table>	 <b>Morning</b>  <b>AND</b>	<b>Flovent</b> 2 puffs with spacer  	 <b>Evening</b>	
 <b>Morning</b>  <b>AND</b>	<b>Flovent</b> 2 puffs with spacer  				
 <b>Evening</b>					
<b>Yellow Zone: Sick</b>					
 <p>Your child is having:</p> <ul style="list-style-type: none"> <li>• Some trouble breathing</li> <li>• Coughing day or night</li> <li>• Mild wheeze</li> <li>• Tightness in chest</li> <li>• Difficulties playing as usual</li> </ul>	<p><b>Sick</b> Add sick medicine <b>and</b> give everyday medicine. If not feeling better after using sick inhaler. Call your doctor. If symptoms improve, give sick inhaler every 4 hours.</p> <table border="1" style="width: 100%; text-align: center;"> <tr> <td style="width: 50%;"> <b>Albuterol</b> 2 puffs with spacer   <p><u>Do this every 30 minutes.</u> 3 times.</p> </td> <td style="width: 50%;"> <b>Flovent</b> 2 puffs with spacer   <b>AND</b>    </td> </tr> </table>	<b>Albuterol</b> 2 puffs with spacer   <p><u>Do this every 30 minutes.</u> 3 times.</p>	<b>Flovent</b> 2 puffs with spacer   <b>AND</b>   		
<b>Albuterol</b> 2 puffs with spacer   <p><u>Do this every 30 minutes.</u> 3 times.</p>	<b>Flovent</b> 2 puffs with spacer   <b>AND</b>   				
<small>**Your albuterol (sick) Inhaler may come in a different color depending on the brand the pharmacy provides**</small>					
<b>Red Zone: Very sick</b>					
 <p>Your child is having:</p> <ul style="list-style-type: none"> <li>• Hard and fast breathing</li> <li>• Ribs show and neck pulls in when breathing</li> <li>• Coughing that won't stop</li> <li>• Inability to talk, walk, or play well</li> </ul>	<p><b>Very Sick</b> The asthma is getting worse. Give sick medicine. Get help now!</p> <table border="1" style="width: 100%; text-align: center;"> <tr> <td style="width: 50%;"> <b>Albuterol</b> 2 puffs with spacer   </td> <td style="width: 50%;"> <b>AND</b> <table border="1" style="width: 100%;"> <tr> <td style="width: 50%; text-align: center;">  </td> <td style="width: 50%; text-align: center;">  </td> </tr> </table> </td> </tr> </table>	<b>Albuterol</b> 2 puffs with spacer  	<b>AND</b> <table border="1" style="width: 100%;"> <tr> <td style="width: 50%; text-align: center;">  </td> <td style="width: 50%; text-align: center;">  </td> </tr> </table>		
<b>Albuterol</b> 2 puffs with spacer  	<b>AND</b> <table border="1" style="width: 100%;"> <tr> <td style="width: 50%; text-align: center;">  </td> <td style="width: 50%; text-align: center;">  </td> </tr> </table>				
					
<b>Contact information: Danis Pediatrics 314-268-4070</b>					

















Appendix B

Asthma Action Plan  
The Traffic Light System

<b>Green Zone: Feeling Good</b>	
 <p>Your child is feeling good:</p> <ul style="list-style-type: none"> <li>• No trouble breathing</li> <li>• No cough or wheeze</li> <li>• Sleeps well</li> <li>• Can play as usual</li> </ul>	<p><b>Everyday</b> Keep your child healthy. Give medicine when healthy or sick.</p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p> <b>Morning</b>      <b>Symbicort</b> 2 puffs with spacer</p> <p style="text-align: center;"><b>AND</b></p> <p> <b>Evening</b>      </p> </div>
<b>Yellow Zone: Sick</b>	
 <p>Your child is having:</p> <ul style="list-style-type: none"> <li>• Some trouble breathing</li> <li>• Coughing day or night</li> <li>• Mild wheeze</li> <li>• Tightness in chest</li> <li>• Difficulties playing as usual</li> </ul>	<p><b>Sick</b> Add sick medicine <u>and</u> give everyday medicine. If not feeling better after using sick inhaler. Call your doctor. If symptoms improve, give sick inhaler every 4 hours.</p> <div style="display: flex; justify-content: space-between; border: 1px solid black; padding: 5px; margin-top: 10px;"> <div style="width: 45%;"> <p><b>Albuterol</b> 2 puffs with spacer</p>  <p><u>Do this every 30 minutes.</u> 3 times.</p> </div> <div style="width: 10%; text-align: center;"><b>AND</b></div> <div style="width: 45%;"> <p><b>Symbicort</b> 2 puffs with spacer</p> <p style="text-align: center;"> <b>AND</b> </p>  </div> </div>
**Your albuterol (sick) inhaler may come in a different color depending on the brand the pharmacy provides**	
<b>Red Zone: Very sick</b>	
 <p>Your child is having:</p> <ul style="list-style-type: none"> <li>• Hard and fast breathing</li> <li>• Ribs show and neck pulls in when breathing</li> <li>• Coughing that won't stop</li> <li>• Inability to talk, walk, or play well</li> </ul>	<p><b>Very Sick</b> The asthma is getting worse. Give sick medicine. Get help now!</p> <div style="display: flex; justify-content: space-between; border: 1px solid black; padding: 5px; margin-top: 10px;"> <div style="width: 45%;"> <p><b>Albuterol</b> 2 puffs with spacer</p>  </div> <div style="width: 10%; text-align: center;"><b>AND</b></div> <div style="width: 45%;"> <p>Call a doctor or 911 Go to the hospital</p> <div style="display: flex; justify-content: space-around; border: 1px solid black; padding: 5px;">   </div> </div> </div>
Contact information: Danis Pediatrics 314-268-4070	

Appendix C

Have your child complete these questions.

1. How is your asthma today?				SCORE
 <b>0</b> Very bad	 <b>1</b> Bad	 <b>2</b> Good	 <b>3</b> Very good	<input type="checkbox"/>
2. How much of a problem is your asthma when you run, exercise or play sports?				
 <b>0</b> It's a big problem, I can't do what I want to do.	 <b>1</b> It's a problem and I don't like it.	 <b>2</b> It's a little problem but it's okay.	 <b>3</b> It's not a problem.	<input type="checkbox"/>
3. Do you cough because of your asthma?				
 <b>0</b> Yes, all of the time.	 <b>1</b> Yes, most of the time.	 <b>2</b> Yes, some of the time.	 <b>3</b> No, none of the time.	<input type="checkbox"/>
4. Do you wake up during the night because of your asthma?				
 <b>0</b> Yes, all of the time.	 <b>1</b> Yes, most of the time.	 <b>2</b> Yes, some of the time.	 <b>3</b> No, none of the time.	<input type="checkbox"/>

*Note.* From “Development and Cross-sectional Validation of the Childhood Asthma Control Test,” by A. H. Liu, R. Zeiger, C. Sorkness, T. Mahr, N. Ostrom, S. Burgess, J. C. Rosenzweig, & R. Manjunath, 2007, *Journal of Allergy and Clinical Immunology*, 119(4), 817 (<https://doi.org/10.1016/j.jaci.2006.12.662>); “The Childhood Asthma Control Test: Retrospective Determination and Clinical Validation of a Cut Point to Identify Children With Very Poorly Controlled Asthma,” by A. H. Liu, R. S. Zeiger, C. A. Sorkness, N. K. Ostrom, B. E. Chipps, K. Rosa, M. E. Watson, M. S. Kaplan, J. R. Meurer, T. A. Mahr, M. S. Blaiss, E. Piault-Louis, & J. McDonald, 2010, *Journal of Allergy and Clinical Immunology*, 126(2), 267, (<https://doi.org/10.1016/j.jaci.2010.05.031>). Copyright 2005 by GlaxoSmithKline Research and Development Limited (GSK). Childhood Asthma Control Test, contact information and permission to use: Mapi Research Trust, Lyon, France, <https://eprovide.mapi-trust.org>.

Appendix D

**The Pictorial Asthma Action Plan (AAP) Perceptions Questionnaire**

Two months following the child receiving the pictorial asthma action plan, these questions were asked during the follow-up session via a telephone call, after the childhood asthma control test was completed for the second time.

	<b>Disagree (1 point)</b>	<b>Neutral (2 points)</b>	<b>Agree (3 points)</b>
<b>1. The pictures included on the asthma action plan were helpful.</b>			
<b>2. I feel more confident in managing my child’s asthma diagnosis since receiving the asthma action plan with pictures.</b>			
<b>3. The picture of a spacer included on the asthma action plan reminded me to use the spacer.</b>			
<b>4. Since receiving the asthma action plan with pictures, I have missed fewer days of work.</b>			
<b>5. Since receiving the asthma action plan with pictures, my child has missed fewer days of school.</b>			

A 3-point Likert Scale will be used. 1=disagree, 2=neutral, or 3=agree.

Appendix E

**Database Collection Instrument**

Identifier	EXAMPLE: DD01191994
Age	8
Asthma Diagnosis	Mild intermittent
Gender	M
Race	African American
Language	English
Zip Code	63139
<b>Initial Asthma Control Test Scores</b>	
Question 1	2
Question 2	1
Question 3	3
Question 4	2
Question 5	3
Question 6	5
Question 7	4
<b>Test Total</b>	<b>20</b>
<b>Post Intervention Asthma Control Test Scores</b>	
Question 1	3
Question 2	3
Question 3	3
Question 4	3
Question 5	3
Question 6	3
Question 7	3
<b>Test Total</b>	<b>21</b>
<b>Pictorial AAP Perceptions Responses</b>	
Question 1	2
Question 2	3
Question 3	2
Question 4	3
Question 5	1
<b>Test Total</b>	<b>11</b>
<b>ED Visits March-May 2022</b>	
Asthma related Visits	6
<b>ED Visits March-May 2023</b>	
Asthma related Visits	2

**Appendix F**

Table 1				
<i>Demographic Characteristics of participants, n = 18</i>				
		Mean	Count	Column N %
Age		8		
Gender	Female		12	66.70%
	Male		6	33.30%
Race	African American		18	100.00%
Language	English		18	100.00%
Zip Code	63118		6	33.30%
Asthma Diagnosis	Mild Intermittent		2	11.10%
	Mild Persistent		8	44.40%
	Moderate Persistent		5	27.80%
	Severe Persistent		1	5.60%
	Asthma		2	11.10%
<i>Note. Output obtained using IBM SPSS Statistics for Windows, version 27.0</i>				

**Appendix G**

Table 2					
<i>Paired Samples Statistics</i>					
	Mean	Mean	N	Std. Deviation	Std. Error Mean
Pair 1	C-ACTscore1	16.8333	18	5.30538	1.25049
	C-ACTscore2	21.8333	18	3.56865	0.84114

*Note.* Output obtained using *IBM SPSS Statistics for Windows, version 27.0*

**Appendix H**

Table 3									
<i>Paired Samples Test</i>									
		Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference					
				Lower	Upper				
Pair 1	C-ACTscore1 – C-ACTscore2	-5	5.68796	1.34067	-7.8286	-2.1714	-3.729	17	0.002

*Note. Output obtained using IBM SPSS Statistics for Windows, version 27.0*



**Appendix I**

Table 4			
<i>The Pictorial Asthma Action Plan (AAP) Perceptions Questionnaire</i>			
		Count	Column N %
1. The pictures included on the asthma action plan were helpful.	Agree	18	100.00%
	Neutral	0	0.00%
	Disagree	0	0.00%
2. I feel more confident in managing my child's asthma diagnosis since receiving the asthma action plan with pictures.	Agree	18	100.00%
	Neutral	0	0.00%
	Disagree	0	0.00%
3. The picture of a spacer included on the asthma action plan reminded me to use the spacer.	Agree	17	94.40%
	Neutral	1	5.60%
	Disagree	0	0.00%
4. Since receiving the asthma action plan with pictures, I have missed fewer days of work.	Agree	18	100.00%
	Neutral	0	0.00%
	Disagree	0	0.00%
5. Since receiving the asthma action plan with pictures, my child has missed fewer days of school.	Agree	17	94.40%
	Neutral	1	5.60%
	Disagree	0	0.00%

*Note. Output obtained using IBM SPSS Statistics for Windows, version 27.0*