Implementation of a Simplified Asthma Action Plan in a Pediatric Pulmonary Practice

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Abstract

Problem: Personalized asthma action plans (AAPs) are the gold standard of care in all asthma guidelines and supported by Centers for Disease Control and Prevention and the American Academy of Pediatrics. AAPs improve asthma control, improve impact on parental self-efficacy for asthma management, reduce missed school days, and improve medication compliance. Despite this, the use of AAP's in the outpatient settings are inconsistent. A chart audit performed within an urban pediatric pulmonary practice located in Baltimore, MD showed 0-33% average rate of AAP use over 14 weeks in the Fall of 2022. **Purpose:** The purpose of this quality improvement project was to implement an electronic AAP (eAAP) for patients with asthma to improve asthma management and maintenance within a pediatric pulmonary outpatient clinic. **Methods:** Implementation of this personalized eAAP took place over a 14-week period fall 2023. Project team consisted of two pulmonologists, three nurse practitioner (NP) students, and four nurses. All patients seen in this clinic with a diagnosis of asthma under the age of 18 were included in this project. An electronic AAP template that could be personalized for each patient was developed to be reviewed, updated, and distributed to families in the after-visit summary (AVS) of each visit. Weekly chart audits were completed to track the percentage of patients with completed eAAP on visit discharge, oral steroid prescriptions, and asthma-related emergency room visits within the following 4 weeks. Biweekly meetings, reference card reminders, and email progress updates were used to encourage eAAP usage and compliance. **Results:** 154 patients with asthma were seen within this 14-week timeframe. Average eAAP compliance was 67% which was a 53% increase from the previous year. New oral steroid prescriptions needed ranged from 6 to 55% over the course of the project compared to a 58% average pre implementation. Asthma-related emergency care visits ranged from 5 to 20% during implementation compared to the 15% average pre-implementation. **Conclusions:** Implementation of the AAP smart phrase increased asthma action plan usage at an outpatient pediatric pulmonology clinic, fostering improved pediatric asthma self-management for patients and families. No statistically significant correlation between AAP compliance and ER visits and number of oral steroid prescriptions were found.

Keywords: electronic asthma action plan (eAAP); asthma in children, pediatric asthma, asthma action plan

Implementation of an Electronic Asthma Action Plan in a Pediatric Pulmonary Practice

Asthma is the leading cause of hospitalizations in children despite being a manageable disease with preventable exacerbations (McCarty & Rogers, 2012). There are roughly 4.6 million children living with asthma in America, with an estimated $50 billion spent annually to treat asthma (American College of Allergy, Asthma & Immunology, 2024). The 2022 Global Initiative for Asthma (GINA) guidelines outlines asthma action plans (AAP's) as essential tools necessary for asthma self-management. They have been deemed the gold standard of asthma care due to the significant impact on asthma education comprehension and improved self-efficacy (GINA, 2022). Asthma action plans (AAP) have been proven to increase the overall quality of life for patients with asthma. Asthmatics not using asthma actions plans have poorer adherence to prescribed pulmonary medications and no emergency action plan in case of severe exacerbation (Watts, 2009), contributing to missed school days, emergency room trips, and preventable hospitalizations (Hsu et al., 2016). AAPs are also associated with a decreased use of oral steroids as a results of improved asthma management. Despite this, most individuals with asthma do not have updated AAP's (Ducharme et al., 2011).

A chart review of an urban outpatient pediatric pulmonary clinic revealed that an average of 100-67% of patients with asthma did not have documented AAPs. Additional findings included high rates of oral steroid prescriptions and frequent emergency room visits for asthma exacerbations. Interviews with families and guardians identified unclear understanding of how to use asthma medications for maintenance or exacerbations. A chart audit of the clinic's electronic health records for showed low AAP completion rates by the health care providers (28%), high

oral steroid prescription rate (74%), and high number of emergency or urgent care visits related to asthma exacerbations within the last year (48%). A root cause analysis (Appendix D) to assess AAP underutilization performed by the team lead of this QI project showed the current eAAP structure available to providers was time consuming, entailed tedious clicking, and difficult for providers to navigate and complete during their allotted visit time.

Available Knowledge

Electronic asthma action plans (eAAPs) allow AAPs to be easily integrated into the electronic health record (EHR) to allow for personalization by providers and patients, can be reviewed and updated during visits, and allow for both electronic and printable access by health care team and families. A large body of evidence supports AAP use in asthma management. An evidence review (Appendix A) summarizes seven high quality studies to support the integration of eAAPs into pediatric asthma care. AAPs are associated with asthma self-efficacy, fewer missed school days, improved asthma control, and reduced emergency room visits when compared to no written asthma plan (((Ducharme et al. (2011), Shah et al. (2011), and Bell et al. (2010))).

Use of eAAPs decreased the need for oral steroid use by 33% when compared to receiving no AAP (Kuhn et al., 2025). Asthma action plans significantly increase pulmonary medication compliance in the pediatric population which improve overall outcomes of asthma patients (Shah et al., 2011). Simplified and personalized asthma actions plans were shown to reduce emergency room visits, asthma attacks, missed school days and unnecessary doctors' visits in one study within an outpatient pediatric clinic (Khan et al., 2014). Providing an asthma action plan for families increases medication compliance because it is a simple way to

differentiate medications that should be daily, as needed and emergency. Increased daily controller medication compliance results in increased overall asthma control (GINA, 2022).

Framework Rationale

This project was guided by the Promoting Action on Research Implementation in Health Services (PARiHS) model (Appendix C). The PARiHS model outlines that the success of project implementation is dependent on the interactions between three key elements for knowledge translation: function of evidence, facilitation, and context (Kitson et al., 1998). This framework was selected to guide this QI project because its core concepts best reflected the values and identified root causes within this clinic. The first construct of evidence addressed any provider doubt about the effectiveness of AAP in practice. There is strong evidence to support the use of AAPs into patient care of asthma management and this clinic values evidence-based practice. This clinic is a branch of a larger academic hospital and therefore utilizes the latest EBP available. The main buy in for the providers was the irrefutable support from the GINA guidelines that established AAPs as the national standard of care for asthma patients (GINA, 2022). This current clinic has a strong foundation of leaders who facilitate change through setting example. Getting the leaders of this clinic on board with this project was the first step in creating a practice change.

Methods

Specific Aims

The purpose of this qualitative improvement project was to implement the use of a simplified electronic asthma actions plans via a smart phrase for all patients with asthma to improve usage compliance among pulmonary providers. Ensuring that families are provided with an updated personalized copy upon visit discharge will improve asthma medication

understanding and medication compliance. The primary goal of this QI project is to see 100% of eligible patients seen in clinic receive an eAAP within their AVS. Secondary aims include improved self-management of asthma as evidence by reduced unnecessary oral steroid use and asthma related emergency room visits in the clinic's asthmatic patient population. The initial outcomes goals of this QI project aimed to see a 50% reduction in oral steroid prescriptions and ER/ urgent care visits after implementation of the eAAP.

Context

Asthma action plans can be generalized to any asthma patient, but evidence shows best understanding and usage when they are personalized and simplified (Ducharme et al, 2011; Khan et al., 2014). Electronic asthma action plans (eAAPs) can be integrated into the electronic health record (EHR), where providers can create, edit and reference back to at future visits. There are many contributing factors for this qualitative improvement project to be as successful as possible. Patients served at this clinic include a high volume of families who speak English as a second language. One of the pulmonologists is fluent in Spanish, while the other providers have expressed difficulty providing discharge instructions for their patients whose first language is not English. The pulmonologists in practice provided feedback on this current eAAP and one of their main reasons for their poor compliance is how time consuming it is to click through each individual medication option and the technical errors that occurs with the tedious clicking. All providers voiced their displeasure with the current eAAP and advocated for a simplified version. This clinic typically has medical students who frequently rotate every few weeks. There was also no current reminders within the EHR or in the clinic itself to remind the providers how to add the smart phrase into the after visit summary. As an academic center, this clinic has a constant influx of medical and nurse practitioner students rotating through who are designated to provide

discharge instructions and asthma education. These students are also delegated the task of adding the asthma action plan into the AVS. Most of these students are not educated on asthma action plans nor how to add an eAAP into the AVS, contributing to the patients not receiving their AAP's.

Intervention

Prior to implementation, the project lead and clinical site representative (CSR) assessed current AAP structure, barriers to utilization, and provider preferences. A simplified eAAP was created within the electronic health record (Appendix F) to allow for easy personalization to occur during clinic visits. This eAAP could then added to the patients discharge forms in the AVS at the conclusion of their appointment to reinforce asthma teaching. As requested by clinic demand, a Spanish eAAP smart tool was also created to allow for easy education for English as a second language families. Staff were educated on the evidence behind eAAP use and how to use these smart phrases. In the weeks leading up to the intervention, in person education sessions with live demonstrations were held to ensure everyone is fully versed on why and how the eAAP will be implemented. Medical student education tip sheets were created and sent to medical and nurse practitioner students prior to the beginning of their clinical rotation to educate them on implementing AAPs. Weekly team meetings allowed for dissemination of chart audit results and discussion of barriers and facilitators to promote QI interventions. Laminated quick reference cards with directions on how to add all eAAPs were placed strategically at all provider workstations for visibility, easy access, and frequent reminders (Appendix F). There were also parent reminders located at the front desk to remind parents about their AAP before leaving their appointment (Appendix F). Weekly email communication to clinic members were used as

reminders to increase compliance rates and provide weekly feedback to team members. These emails were also utilized for open communication to assess for new barriers.

Measures

The primary measure of the qualitative improvement project was the completion of an AAP for every patient with asthma and inclusion in the after-visit summary. Rates of oral steroid prescription and asthma related emergency room visits within six weeks of visit were also collected to assess impact of AAPs on asthma management. Clinic champions were utilized to determine strengths and weakness throughout the project. Oral steroid use and admission to the emergency room/ urgent care visits were measured through Crisp chart audits and chart reviews after their clinic appointment.

Ethical considerations

The approval process for this project first was obtained by the office manager of the practice and then all the practicing pulmonologist and nurse practitioners who would be using the asthma action plan smart phrase. All patients seen in this clinic with a definitive asthma diagnosis from the age of 1 to 18 were included in the QI project. All patient below the age of 1 were excluded from this project. Non-human Subject's Research determination from the Human Research Protections Office (HRPO) of the UMSOM Institutional Review Board (IRB) was obtained prior to project implementation. Appendix H shows the site approval members and project approval dates. To maintain confidentiality of the information obtained during the project, chart audits were conducted by the project lead in a private location following the ethical principles of respect for persons, beneficence, and justice. Data collected was de identified and entered/ stored in REDCap which is VPN and password protected. This initiative poses no threat to physical or psychological harm to participants, is inclusive and conducted with honesty and

integrity. All measures were put in place to protect privacy and confidentiality. There are no conflicts of interests to report for this project.

Results

Appropriate usage of eAAP, oral steroid use, and asthma-related emergency room or urgent care visits in asthmatic patients were evaluated weekly over a 14-week period in the Fall. A run chart analysis was used to display these outcome measures during implementation (Appendix I). In the 14 week period, 154 asthma patients between ages 0-18 were seen, and the average eAAP compliance was 67%. This clinic compliance is 53% higher than last fall 2022. Weekly compliance rates of eAAP usage varied from 33% (Week 3) to 95% (Week 8). Oral steroid prescription usage and asthma-related ER visits are shown in Appendix I, Figure 3 and 4 via run charts. The percentage of patients seen in clinic who required a new oral steroid prescription ranged from the lowest 0% (Week 2) to the highest of 38% (Week 3). Asthma-related emergency room visits ranged from the highest 0% (Week 3) to the highest of 25% (Week 1) during implementation. 7.5% of patients had an ER or urgent care visit for an asthma exacerbation within 6 weeks following their clinic visit. 11% of patients required an oral steroid prescription within 6 weeks following their clinic visit. There are no obvious runs found within either of these run charts and therefore there is no statistically significant correlation between AAP compliance and ER visits and number of oral steroid prescriptions. The initial outcomes goals of this QI project, set for a 50% reduction in oral steroid prescriptions and ER/ urgent care visits were not met. While the process goals of 100% eAAP compliance were not met, there was an overall increase in eAAP use percentage. Overall, this QI project was successful increasing the number of patients receiving eAAPs.

Analysis

The primary method for data collection were weekly chart audits for average eAAP compliance. To assess if eAAP use was associated with improved asthma control, oral steroid use and emergency room visits in the 6 weeks after their clinic appointment were also tracked. Run charts were created with this data to assess the ongoing effectiveness of the AAP implementation uptake. This data was included in the mid -intervention feedback for the providers. Weekly communication reports with the site representative and the site champion to provide feedback, discuss barriers or needed changes occurred throughout project implementation. Increased provider eAAP compliance rate in conjuncture with a reduction in oral steroid use and emergency room visits will show a positive correlation between asthma action plan usage and overall asthma quality of life. All data was collected and captured within REDCaps. This data was then displayed in run charts (Appendix I) that show outcome and process goals of this QI project were not met, and compliance was variable.

Discussion

Key findings from this quality improvement project show that the implementation of an eAAP smartphrase increases overall asthma action plan usage and distribution by providers at an outpatient pediatric pulmonology clinic. There was minimal disturbance to providers and clinic workflow during the implementation of this QI project. There also is no cost associated with the continuation of eAAP smart phrase.

There are several limitations that may explain these differences between the anticipated and observed measures. One limitation is that the time frame for implementation was restricted to 14 weeks for this project. Prior to implementation, six out of seven staff members completed the project education sessions about navigating the eAAP smartphrases and the importance of AAPs. One student started their clinical rotations after implementation. This student saw patients

during weeks 3 and 4 but did not receive the education until week 5 which accounts for the decrease in eAAP compliance during those two weeks. Another limitation of this project was the implementation period occurred during peak fall virus season. Viruses are a very common asthma trigger. The fall season also generally sees more exacerbations due to the erratic changes in outside temperatures and peak viruses such as Flu, COVID and RSV. Weekly emails were deemed helpful reminders per providers, but the best compliance rates were found to be on weeks where in person site visitations occurred. Due to this, an AAP superuser should be delegated to continuously monitor compliance and act as a reminder for effective project sustainability. There were no significant financial benefits or additional costs of this project.

Conclusions

Despite not meeting intended outcomes, the impact of this study is still valuable to the pulmonology and pediatric community as it offers guidance for pediatric providers and future QI projects. The eAAP smartphrase will continue to improve clinic workflow and positively impact patient outcomes as they continue to be used. Therefore, measures will be taken to increase sustainability of this QI project. The simplified eAAP was a welcomed change to the practicing pulmonologists because of how efficient and time saving it proved to be. Since the eAAP is integrated into the EHR, modifications can easily be made to the original template by selected users or copied and pasted to make permeant changes if desired. Future considerations for the eAAP is to strengthen its applicability to patients of non-English-speaking populations. While the Spanish template was completed with this project, other languages can now be easily created as needed based on the clinic demographic needs. Future action can include involving parents and patients into a more active role in the clinic's eAAP usage through providing active feedback on its usability and effectiveness at home. Additional projects could include getting all patients

enrolled in MyChart to electronically access their asthma education and eAAP. Future QI initiatives implementing an eAAP should consider the time frame and season of implementation to avoid the limitations found within this project.

References

American College of Allergy, Asthma & Immunology. (2024). *Asthma Facts*. ACAAI Public Website. https://acaai.org/asthma/asthma-101/facts-stats/

Bell, L. M., Grundmeier, R., Localio, R., Zorc, J., Fiks, A. G., Zhang, X., Stephens, T. B., Swietlik, M., & Guevara, J. P. (2010). Electronic health record-based decision support to improve asthma care: a cluster-randomized trial. Pediatrics, 125(4), e770–e777. https://doi.org/10.1542/peds.2009-1385

Davis, J., & Fitzmaurice, L. (2021). Providing individualized written asthma action plans during the pediatric emergency department visit. *The Journal of asthma : official journal of the Association for the Care of Asthma*, *58*(6), 819–824. https://doi.org/10.1080/02770903.2020.1731824

Ducharme, F. M., Zemek, R. L., Chalut, D., McGillivray, D., Noya, F. J., Resendes, S., Khomenko, L., Rouleau, R., & Zhang, X. (2011). Written action plan in pediatric emergency room improves asthma prescribing, adherence, and control. American journal of respiratory and critical care medicine, 183(2), 195–203. https://doi.org/10.1164/rccm.201001-0115OC

Farber, H. J., Silveira, E. A., Vicere, D. R., Kothari, V. D., & Giardino, A. P. (2017). Oral Corticosteroid prescribing for children with asthma in a Medicaid Managed Care Program. *Pediatrics*, *139*(5). https://doi.org/10.1542/peds.2016-4146

Global Initiative for Asthma. (2022). *Global strategy for asthma management and prevention.* https://ginasthma.org/wp-content/uploads/2021/05/GINA-Main-Report-2022-V2-WMS.pdf

Hsu, J., Qin, X., Beavers, S. F., & Mirabelli, M. C. (2016). Asthma-related school absenteeism, morbidity, and modifiable factors. *American Journal of Preventive Medicine*, *51*(1), 23–32. https://doi.org/10.1016/j.amepre.2015.12.012

Khan, R., Rohan Maharaj, Natasha Seerattan, Feaz Babwah. (2014). Effectiveness of Personalized Written Asthma Action Plans in the Management of Children with Partly Controlled Asthma in Trinidad: A Randomized Controlled Trial, Journal of Tropical Pediatrics, Volume 60, Issue 1, February 2014, Pages 17–26, https://doi.org/10.1093/tropej/fmt063

Kitson, A., Harvey, G., & McCormack, B. (1998). Enabling the implementation of evidence based practice: A conceptual framework. *Quality and Safety in Health Care*, *7*(3), 149–158. https://doi.org//qualitysafety.bmj.com/content/qhc/7/3/149.full.pdf

Kuhn, L., Reeves, K., Taylor, Y., Tapp, H., McWilliams, A., Gunter, A., Cleveland, J., & Dulin, M. (2015). Planning for Action: The Impact of an Asthma Action Plan Decision Support Tool Integrated into an Electronic Health Record (EHR) at a Large Health Care System. *Journal of the American Board of Family Medicine : JABFM*, *28*(3), 382–393.

https://doi.org/10.3122/jabfm.2015.03.140248

McCarty, K., & Rogers, J. (2012, October). *Inpatient Asthma Education Program*. Pediatric Nursing Journal. Retrieved October 26, 2022, from http://pediatricnursing.net/ce/2014/article3805257269.pdf

Muhammad, J., Ngah, N. D., & Ahmad, I. (2023). Written Asthma Action Plan Improves Asthma Control and the Quality of Life among Pediatric Asthma Patients in Malaysia: A Randomized Control Trial. Korean Journal of Family Medicine, 44(1), 44–52. https://doi.org/10.4082/kjfm.22.0016

Reddel, H., & Boulet, L. (2023). *2022 Gina Main Report - Global Initiative for Asthma*. Global Strategy for Asthma Management and Prevention. Retrieved from https://ginasthma.org/gina-reports/

Shah S, Sawyer SM, Toelle BG, Mellis CM, Peat JK, Lagleva M, Usherwood TP, Jenkins CR, Shah, S., Sawyer, S. M., Toelle, B. G., Mellis, C. M., Peat, J. K., Lagleva, M., Usherwood, T. P., & Jenkins, C. R. (2011). Improving paediatric asthma outcomes in primary health care: a randomised controlled trial. Medical Journal of Australia, 195(7), 405–409. https://doi-org.proxy-hs.researchport.umd.edu/10.5694/mja10.11422

Shahid I. Sheikh, Marjorie Chrysler, Nancy A. Ryan-Wenger, Don Hayes Jr. & Karen S. McCoy (2016) Improving pediatric asthma care: A partnership between pediatric primary care clinics and a free-standing Children's Hospital, Journal of Asthma, 53:6, 622-628, DOI: 10.3109/02770903.2015.1126845

Watts B. (2009). Outpatient management of asthma in children age 5-11 years: guidelines for practice. *Journal of the American Academy of Nurse Practitioners*, *21*(5), 261–269. https://doi.org/10.1111/j.1745-7599.2009.00403.x

Zhu, K., Xiang, L., & Shen, K. (2020). Efficacy of Chinese Children's Asthma Action Plan in the management of children with asthma. *Allergy and asthma proceedings*, *41*(1), e3–e10. https://doi.org/10.2500/aap.2020.41.190010

Zemek, R. L., Bhogal, S. K., & Ducharme, F. M. (2008). Systematic review of randomized controlled trials examining written action plans in children: what is the plan?. *Archives of pediatrics & adolescent medicine*, *162*(2), 157–163. https://doi.org/10.1001/archpediatrics.2007.34

Appendix A

Table 1

University of Maryland School of Nursing – Evidence Review

Citation: Ducharme, F. M., Zemek, R. L., Chalut, D., McGillivray, D., Noya, F. J., Resendes, S., Khomenko, L., Rouleau, R., & Zhang, X. (2011). Written action plan in pediatric emergency room improves asthma prescribing, adherence, and control. American journal of respiratory and critical care medicine, 183(2), 195–203. https://doi.org/10.1164/rccm.201001-0115OC

Level and Quality: I-B **Type of Evidence Research Design:** single-masked randomized controlled trial

Purpose or Hypothesis	To determine the efficacy of providing a written action plan with a prescription (WAP-P) on asthma medication adherence.
Sample Population, Size, Setting	**Sampling Technique:** Convenience. **Eligible Participants:** Children aged 1–17 years with a previous clinical diagnosis of asthma. Asthma was defined as having two previous episodes of wheezing relieved with albuterol. They also had to have been discharged with an albuterol and fluticasone MDI. Children and or caregivers had to speak fluent French or English. **Setting:** Academic pediatric emergency department **Excluded:** Patients were excluded if they were treated with an inhaled corticosteroid other than fluticasone; used a dry powder inhaler that could not be fitted with an electronic dose counter; had another chronic lung disease, such as cystic fibrosis; or had a known hypersensitivity to albuterol or fluticasone. 2 patients were excluded based on these criteria. **Accepted:** 270 patients were eligible, 19% declined participation. 219 pediatric patients were accepted and randomized. **Control:** 110 participants were randomized to control group, 3 dose counters not provided = 107 analyzed patients in control data. **Intervention:** 109 participants were randomized to intervention group, 1 patient withdrew, 4 dose counters were not provided = 104 patients were analyzed for intervention group.
Intervention Procedures	**Control Protocol:** Control patients received an unformatted asthma action plan (not personalized to patient), which was standard practice prior to study. **Intervention Protocol:** Treating emergency physicians provided a “prescription” WAP which was personalized with the patient’s medications
Primary Outcome and Measures	**Dependent Variable:** Patient adherence to medication (fluticasone) for the 28 days after discharge. Secondary outcomes effectiveness of the WAAP on asthma control. **DV Measure:** The sum of daily percentage of actuations recorded by the electronic dose counter over the number prescribed for the individual. The WAAP effectiveness was measured by the number of unscheduled acute care visits after trial began and duration of albuterol use.

Results/Conclusions	**Statistical Results:** Adherence to medications was significantly higher in children who received a WAAP (mean group difference, 16.13% [2.09, 29.91]). There was also a statistically significant reduction in acute care visits and the duration of rescue albuterol use as seen in Table 2. Adhering to the recommended follow up visit and the overall score of quality of life were both higher in the intervention group as shown in Table 3. **Conclusions**: Providing a personalized written action plan significantly increased patient adherence to prescribed immediate and controller asthma medications as well as improved the overall control of their asthma.

Citation: Bell, L. M., Grundmeier, R., Localio, R., Zorc, J., Fiks, A. G., Zhang, X., Stephens, T. B., Swietlik, M., & Guevara, J. P. (2010). Electronic health record-based decision support to improve asthma care: a cluster-randomized trial. Pediatrics, 125(4), e770–e777. https://doi.org/10.1542/peds.2009-1385

Level and Quality: I-B Type of Evidence Research Design: Research: Prospective cross-sectional cluster randomized trial

Purpose or Hypothesis	To determine if the addition of clinical decision support into an electronic health record impacts the use of asthma management tools.
Sample Population, Size, Setting	**Sampling Technique:** Convenience. **Eligible Participants:** Children 2-18 years of age with previously diagnosed persistent asthma (mild, moderate, or severe) **Setting:** 12 urban and suburban primary care locations **Excluded:** Patients without a previous ICD-9 asthma diagnosis were excluded from this trial. **Accepted:** 19,450 asthmatic pediatric patients were included within the analysis **Control:** 9,035 total patients were randomized into the control group. **Intervention:** 10,415 patients were randomized into the intervention group. **Group Homogeneity**: intervention and control groups homogeneous asthma severity and but race was not homogeneous based on P levels in Table 1.
Intervention Procedures	**Control Protocol:** Asthma management tools were available for use in the EHR with no decision support alerts. **Intervention Protocol:** Decision support alerts were incorporated into the EHR to prompt use of the asthma management tools
Primary Outcome and Measures	**Dependent Variable:** number of patients in compliance with national asthma guidelines (with an annual asthma action plan in electronic health chart). **DV Measure:** The DV was measured through a calculation and chart review of patients who had at least one prescription controller medication, an updated asthma care plan within the past year, and documentation of an annual spirometry.
Results/Conclusions	**Statistical Results:** Clinician compliance of filling out the asthma action plan and use of other asthma management tools increased 14 % in the intervention group and decreased 4% in the control group. There was a 6% more prescribed controller

	medications and 3% more documented spirograms in the intervention group. **Conclusions**: The clinical decision support embedded into the EHR was effective in improving clinician compliance of following the national asthma protocols. This study suggests that CDS alerts embedded into an electronic health record can increase acceptance and use of asthma management tools in practices with low compliance.

Citation: Muhammad, J., Ngah, N. D., & Ahmad, I. (2023). Written Asthma Action Plan Improves Asthma Control and the Quality of Life among Pediatric Asthma Patients in Malaysia: A Randomized Control Trial. Korean Journal of Family Medicine, 44(1), 44–52. https://doi.org/10.4082/kjfm.22.0016

Level and Quality: II-C **Type of Evidence Research Design:** single-blind, parallel, randomized control trial

Purpose or Hypothesis	To observe the effect of a written asthma action plan on asthma control and quality of life
Sample Population, Size, Setting	**Sampling Technique:** Convenience **Eligible Participants:** 129 uncontrolled or partially controlled asthmatic children aged 6 to 12 years old in a multidisciplinary pediatric specialty clinic. **Setting:** Pediatric specialty clinic in Kuala Terengganu, Malaysia. **Excluded:** 9 patients were excluded who did not attend their follow up visit. **Accepted:** 120 patients were accepted into the study **Control:** 65 patients were randomly allocated to control group, 6 patients were lost due to no follow up. **Intervention:** 64 patients were computer generated randomized into intervention group, 3 patients were lost in follow up.
Intervention Procedures	**Control Protocol: C**omputer based simple randomization. The patients and caregivers in the control group received standard asthma education (completed a pre interventional ACQ and PAQLQ) and a verbal asthma action plan during the first visit. **Intervention Protocol:** The patients and caregivers in the intervention group received asthma education (completed a pre interventional ACQ and PAQLQ) like the control group but in addition, an individualized written asthma action plan was given to the patients in addition to verbal educations.
Primary Outcome and Measures	**Dependent Variable:** asthma quality of life through a total pediatric asthma quality of life questionnaire. **DV Measure:** The asthma control and quality of life were assessed using the ACQ and PAQLQ questionnaires. Asthma Control Questionnaire and Pediatric Asthma Quality of Life Questionnaire (PAQLQ) at baseline and 3 months after asthma education. The questionaries surveyed frequency and severity of symptoms, activity limitation and emotional function.

Results/Conclusions	**Statistical Results:** The ANOVA analysis showed significantly higher total PAQLQ score in the intervention group at the 3 month follow up demonstrated by a P value of 0.001, indicating an overall increased quality of life in the patients who received a written asthma action plan. **Conclusions:** This study recommends that an individualized WAAP be given to caregivers of pediatric asthma patients in order, to improve the disease outcomes.

Citation: Davis, J., & Fitzmaurice, L. (2021). Providing individualized written asthma action plans during the pediatric emergency department visit. *The Journal of asthma : official journal of the Association for the Care of Asthma*, *58*(6), 819–824. https://doi.org/10.1080/02770903.2020.1731824

Level and Quality: II-C **Type of Evidence Research Design**: Prospective, double blind randomized controlled trial

Purpose or Hypothesis	Does providing a personalized asthma action plan during a pediatric emergency visit compared to standard asthma discharge education lead to fewer unplanned ED/ primary care visits?
Sample Population, Size, Setting	**Sampling Technique:** Convenience. **Eligible Participants:** Pediatric asthmatic patients between the ages of 2-17 who presented to an emergency room with an acute asthma exacerbation with no current asthma action plan in their chart. **Setting:** Pediatric emergency department **Excluded:** All children requiring a hospital admission were excluded from this trial. Patients with any chronic cardiac or pulmonary disease, not fluent in English or had already received a WAAP were also excluded from this trial. Does **Accepted:** 1242 children were screened. 292 children were eligible / 951 children did not meet above criteria. 91 children were accepted / 201 children were not enrolled due to exclusion by provider or parental/ child refusal. **Control:** 46 children with partially controlled asthma were randomized, 38 completed both follow up surveys. **Intervention:** 45 children with partially controlled asthma / 39 completed at least one follow up survey and 35 completed both follow up surveys.
Intervention Procedures	**Control Protocol:** Received standard asthma treatment discharge instructions upon being discharged from ED. **Intervention Protocol:** Received a personalized written asthma action plan upon discharge from ED.
Primary Outcome and Measures	**Dependent Variable:** The number of unplanned asthma related healthcare visits within a 3 month follow up period. Overall asthma control was a secondary outcome studied. **DV Measure:** Outcomes were measures through a parental survey at one- and three-months post emergency room visit and the

	primary care provider and pediatric asthma control tool (PACT scores). Mean pediatric control test score at three month follow up visit was used to measure overall asthma control.
Results/Conclusions	**Statistical Results:** 18% of children in the intervention group required an unplanned visit to a HCP while 39% of patients in the control required an unplanned visits to a HCP within the follow up time period with a p value of 0.038. Over asthma control in the intervention was 6.6 [Cl 4.0 to 9.1] and in the control 5.7 [Cl 3.9 to 7.4]. **Conclusions**: Children provided with WAAP were less likely to have an unplanned HCP visit due to asthma during the follow up 3 months. Implementing WAAP may have impacted subsequent acute healthcare visits. There was no difference in the parental confidence to provide asthma treatment.

Citation: Shah S, Sawyer SM, Toelle BG, Mellis CM, Peat JK, Lagleva M, Usherwood TP, Jenkins CR, Shah, S., Sawyer, S. M., Toelle, B. G., Mellis, C. M., Peat, J. K., Lagleva, M., Usherwood, T. P., & Jenkins, C. R. (2011). Improving paediatric asthma outcomes in primary health care: a randomised controlled trial. Medical Journal of Australia, 195(7), 405–409. https://doi-org.proxy-hs.researchport.umd.edu/10.5694/mja10.11422

Level and Quality: **I-B** **Type of Evidence Research Design:** Randomized controlled trial

Purpose or Hypothesis	To evaluate the effectiveness of an asthma education program and pediatric asthma management for general practitioners.
Sample Population, Size, Setting	**Sampling Technique:** Convenience. **Eligible Participants:** 1200 pediatric patients invited to participate **Setting:** General pediatric practices in a metropolitan area in Sydney, Australia between 2006-2008 **Excluded:** 1,017 excluded due to no reply of initial invitation, 33 excluded due to ineligibility, 30 excluded due to withdrawal, 11 excluded due to no 6 month follow up. Children without a formal asthma diagnosis and those with caregivers who did not speak fluent English were excluded. **Accepted:** 150 general practitioners and 221 pediatric patients with an asthma diagnosis between the ages of 2-14. **Control:** 72 pediatric patients and 56 pediatric practitioners **Intervention:** 78 pediatric patients, 66 pediatric practitioners.
Intervention Procedures	**Control Protocol:** General practitioners were randomly allocated to intervention or control group using a computer generated algorithm. Control group of practitioners did not receive PACE education. **Intervention Protocol:** The general practitioners in the intervention group participated in two separate two hour workshops pertaining to communication and education on providing quality asthma action plans (PACE education).
Primary Outcome and Measures	**Dependent Variable:** Patient receipt of a written asthma action plan, appropriate medication use, frequency of providing a written asthma action plan.

	DV Measure: 6 month and 12 month follow up of both general practitioners reported measures of asthma management and family reported measures of asthma management and patient outcomes.
Results/Conclusions	**Statistical Results:** 15% more children received a written asthma action plan than the control group at the 12 month follow-up. There was no significant difference in frequency of hospital visits for urgent asthma care between groups at 12 months. Favorable changes in family-reported use of inhaled corticosteroids and long- acting -agonists were associated with the intervention at 12 months **Conclusions**: The PACE program improved the general practitioner's asthma management practices and led to improvements in provider WAAP compliance, patient medication compliance, and provider confidence in writing WAAP.

Citation: Kuhn, L., Reeves, K., Taylor, Y., Tapp, H., McWilliams, A., Gunter, A., Cleveland, J., & Dulin, M. (2015). Planning for Action: The Impact of an Asthma Action Plan Decision Support Tool Integrated into an Electronic Health Record (EHR) at a Large Health Care System. Journal of the American Board of Family Medicine, 28(3), 382–393. https://doi-org.proxy-hs.researchport.umd.edu/10.3122/jabfm.2015.03.140248

Level and Quality: II-A **Type of Evidence Research Design:** Quasi-experimental

Purpose or Hypothesis	To incorporate an electronic asthma action plan support tool into the electronic medical record to increase utilization of evidence-based asthma guidelines for providers and evaluate the effects on disease outcomes within a large heath care system.
Sample Population, Size, Setting	**Sampling Technique:** convenience sampling **Eligible Participants:** Children with diagnosed moderate-severe asthma between the ages of 0-17 and adults >18 **Setting:** 40 primary care facilities in southern states. **Excluded:** All patients without an official asthma diagnosis were excluded. **Accepted:** 10,348 participants were initially included. **Control:** 5,1754 patients were **Intervention:** 5,174 patients received an asthma action plan. 4,259 participants were children and only 915 were adults.
Intervention Procedures	**Control Protocol:** Did not receive an AAP **Intervention Protocol:** Received an AAP
Primary Outcome and Measures	**Dependent Variable:** Compliance with evidence based treatment for acute exacerbations (medication compliance) asthma control / occurrence of asthma exacerbations.

	DV Measure: Asthma exacerbations were measured through the frequency of asthma related ED visits/ hospitalizations, oral steroid use, and rescue inhaler use using the CAC-3. The CAC-3 score was calculated at 3, 6 and 12 month follow ups.
Results/Conclusions	**Statistical Results:** Intervention group received 33% less oral steroids than that the control group (P<.001). There was an insignificant decrease in hospitalizations among the child intervention group, however, emergency room visits decreased by 30-40% in the intervention group (p<0.001). **Conclusions**: Pediatric patients who received an AAP had fewer asthma exacerbations and needed less systemic steroids.

Citation: Khan, R., Maharaj, R., Seerattan, N., & Babwah, F. (2014). Effectiveness of personalized written asthma action plans in the management of children with partly controlled asthma in Trinidad: a randomized controlled trial. *Journal of tropical pediatrics*, *60*(1), 17–26. https://doi.org/10.1093/tropej/fmt063

Level and Quality: I-C. **Type of Evidence Research Design:** Single blinded randomized controlled trial

Purpose or Hypothesis	To evaluate the use of a personalized written asthma action plan in the management of pediatric patients with partially controlled asthma.
Sample Population, Size, Setting	**Sampling Technique:** Convenience. **Eligible Participants:** Pediatric patients with partially controlled asthma with a history of presenting to the ER or pediatric clinic for acute treatment in the past 6 months. **Setting:** Pediatric primary care clinic in Trinidad **Excluded:** Patients less than 3 years of age and all patients with uncontrolled asthma were excluded in this study. Parents of children who showed an inability to follow direction and patients with other respiratory co-morbidities were also excluded. **Accepted:** 91 children were eligible and randomized into trial. **Control:** 46 children with partially controlled asthma were randomized **Intervention:** 45 children with partially controlled asthma **Group Homogeneity**: every child was diagnosed with "partially controlled asthma" by the same provider.
Intervention Procedures	**Control Protocol:** received standard asthma education and no written asthma action plan. **Intervention Protocol:** received a personalized written asthma action plan in addition to standard asthma education.
Primary Outcome and Measures	**Dependent Variable:** number of emergency room visits, acute asthma attacks, missed school days and unscheduled doctors' visits.

	DV Measure: The level of "asthma control" was measured through reported data via a survey/ testing at the 6 month follow up visit for the presence of daytime/nighttime symptoms, activity limitations, usage of rescue inhaler, asthma exacerbations, and spirometry measures such as PEF and FEV1.
Results/Conclusions	**Statistical Results:** Children who were provided with a personalized asthma action plan had fewer ER visits (p=0.78), asthma attacks, (p=0.84), missed school days (p=0.28), and unscheduled doctors visits (p=0.69). **Conclusions**: personalized written asthma action plans are useful in the role of asthma management of partially controlled pediatric asthma patients. Asthma control may be impacted by the provision of a WAAP.

Table 2

Univeristy of Maryland School of Nursing – Evidence Synthesis

Project Title: **Outcomes of an EHR reminder on asthma action plan compliance**			
JHNEBP Model Level	**Total Number of Sources**	**Author and Quality Rating of each study**	**Synthesis of Findings**
Level 1 Experimental study · Randomized Controlled Trial (RCT) · Systematic review of RCTs wi2th or without meta-analysis	4	1) Ducharme – B 2) Shah - B 3) Khan- C 4) Bell- B	1) A written asthma action plan significantly increased medication compliance in an acute care setting among pediatric patients (not a primary care setting). Good sample size and control group. Recommendations are supported with evidence. 2) Pediatric provider compliance to AAP completion increased with PACE education, which increased medication compliance but no affect on hospitalization. WAAP are useful in increasing provider confidence in asthmas education. -Ducharme, Shah and Bell all support the use of a WAAP on increasing asthma medication compliance -Ducharme and Kahn suggest WAAP's improve overall asthma outcomes. 3) Provision of a WAAP was found to be effective in asthma control/ management among partially controlled asthmatic patients in a primary care setting however statistically insignificant compared to control.

			Sample size was small.
Level II Quasi-experimental studies · Systematic review of a combination of RCTs and quasi-experimental studies, or quasi-experimental studies only, with or without meta-analysis	3	1) Muhammad - C 2) Davis - C 3) Kuhn – B	1) PAQLQ is a useful tool to evaluate asthma patients overall quality of life. Good randomization, Small sample size. 2. Providing AAP may impact the number of unplanned HCP visits. Small sample size, some recommendations had data to support evidence and some were inconsistent. 3. Large sample size that incorporated adults and children. Mostly children (not homogeneous) but divided evidence up by adults vs. children. Good and consistent evidence. Muhammad and Kuhn both strongly suggest the WAAP improves asthma symptoms.
Overall Quality Rating w/rational and Recommendation: Good and consistent evidence to support practice change.			

Appendix B

Table 1

Measures

Measures		
Project Goals	Measure Pre-Implementation	Measure During Implementation
Structure		
1. By September 25th, 2023 all nurses and providers will have received education on how to add asthma action plan into EHR AVS.	**Numerator:** # of clinic employees who have received any type of training on adding AAP **Denominator**: total # of employees	**Numerator:** # of clinic employees who received AAP education **Denominator**: total # of employees
2. By September 25th, 2023, all providers will know how to add, edit, and personalize asthma action plan within AVS as evidenced by the staff competency via the Staff education audit.	**Numerator:** # of pulmonary providers who can demonstrate how to add AAP into the AVS **Denominator**: total # of pulmonary providers	**Numerator:** # of clinic employees who can demonstrate how to add AAP into AVS **Denominator**: total # of employees
Process		
1. 100% of patients with asthma diagnosis will receive an asthma action plan at discharge of every visit by the end of project implementation. 2. By the end of implementation, caregivers will be able to teach back when it would be appropriate to give oral steroids and when to take their child to the emergency room during follow up call.	**Numerator:** # of asthma patients seen in clinic who received an asthma action plan **Denominator**: total # of asthma patients seen in clinic **Numerator:** # of asthma caregivers who can effectively describe when to give oral steroids **Denominator**: total # of asthma patients seen in clinic	**Numerator:** # of asthma patients seen in clinic who received an asthma action plan **Denominator**: total # of asthma patients seen in clinic **Numerator:** # of asthma caregivers who can effectively describe when to give oral steroids **Denominator**: total # of asthma patients seen in clinic
3. By the end of implementation, all medical students will have received an onboarding AAP orientation.	**Numerator:** # of medical students who received AAP education. **Denominator**: total # of medical students in clinics	**Numerator:** # of medical students who received onboarding AAP education. **Denominator**: total # of medical students in clinics
Outcome		
1. There will be a 50% reduction in the unnecessary usage of oral steroids among	**Numerator:** number of asthma patients requiring oral steroids within four weeks of their clinic visit.	**Numerator:** number of asthma patients requiring oral steroids within four weeks of their clinic visit

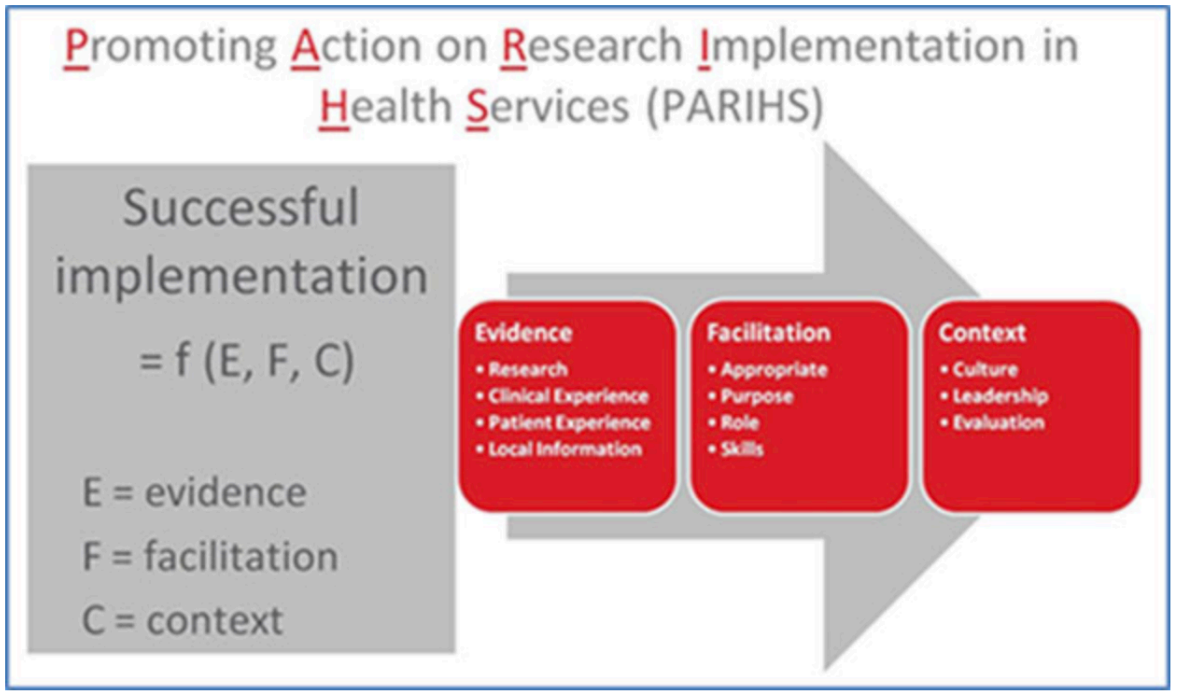
asthma patients at the end of project implementation	**Denominator**: number of asthma clinic visits	**Denominator**: number of asthma clinic visits
2. There will be a 50% decreased rate of admission to the emergency room by the end of project implementation.	**Numerator:** number of asthma patients requiring emergency room visit for asthma exacerbation within four weeks of their clinic visit **Denominator**: number of asthma clinic visits	**Numerator:** number of asthma patients requiring emergency room visit for asthma exacerbation within four weeks of their clinic visit **Denominator**: number of asthma clinic visits

Table 2

Measurement Plan		
Project Goals	Data Collection Procedures (who, how, when)	Name of Data Collection Tool
By September 25th, 2023 all nurses and providers will have received education on how to add asthma action plan into EHR AVS	Who: Team leader (student) How: All names of stakeholders will be When: September 4th – September 25th 2023	Staff Education Audit
By September 25th, 2023, all providers will know how to add, edit, and personalize asthma action plan within AVS.	Who: Team leader (student) How: signatures of all staff members who receive education will be recorded When: By September 25th	Staff Education Audit
By the end of implementation, 100% of patients with asthma diagnosis will receive an asthma action plan at discharge of every visit by the end of project implementation.	Who: Team Leader (student) How: manual chart audit of clinic patients When: Weekly during implementation period (October 2nd – November 27th)	AAP EHR Audit Tool

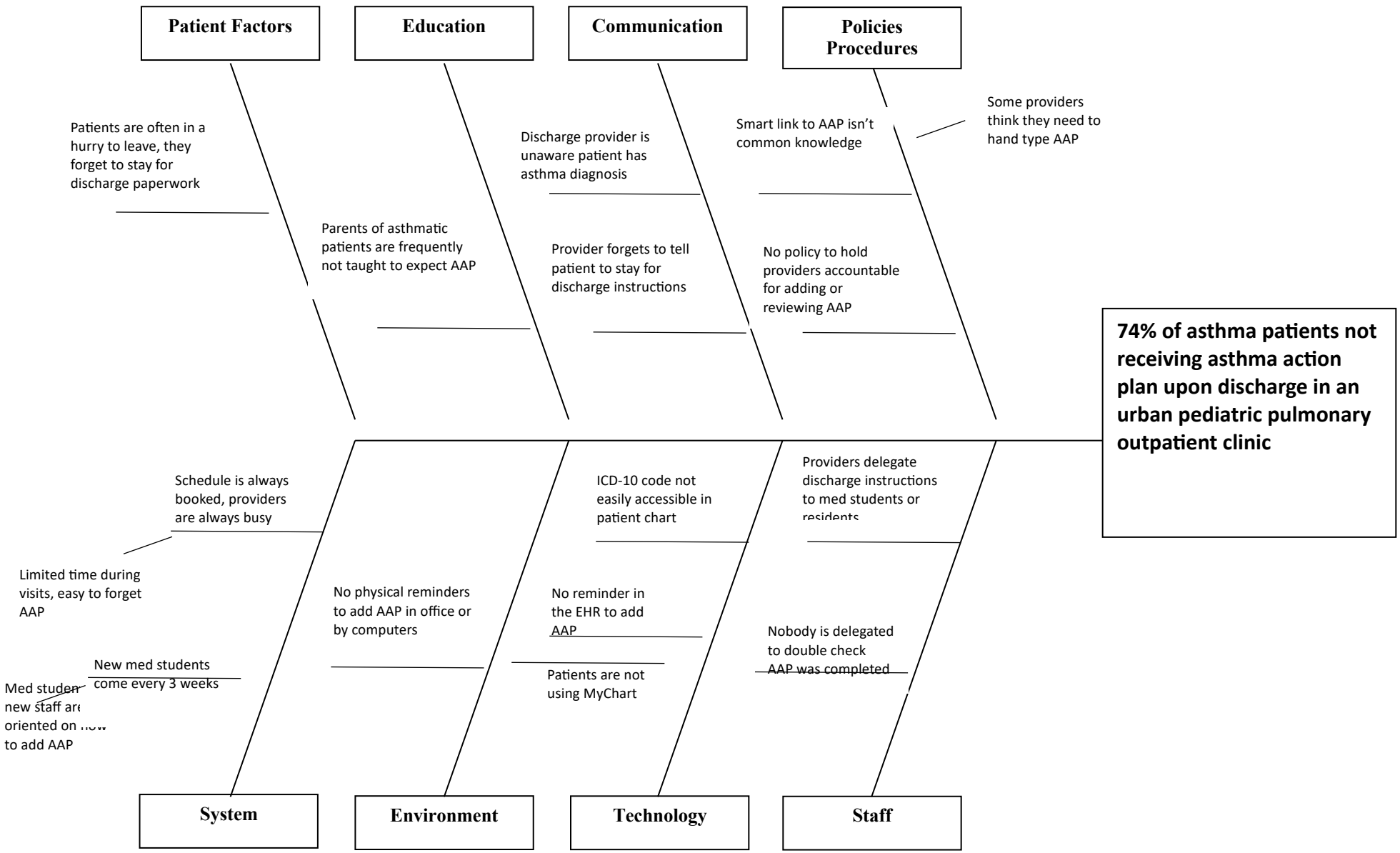
Appendix C

Figure 1
PARiHS Framework



Appendix D

Figure 3. Fishbone diagram



Appendix E

Figure 1. *Current Process for Asthma Patients at an Outpatient Pulmonary Clinic*

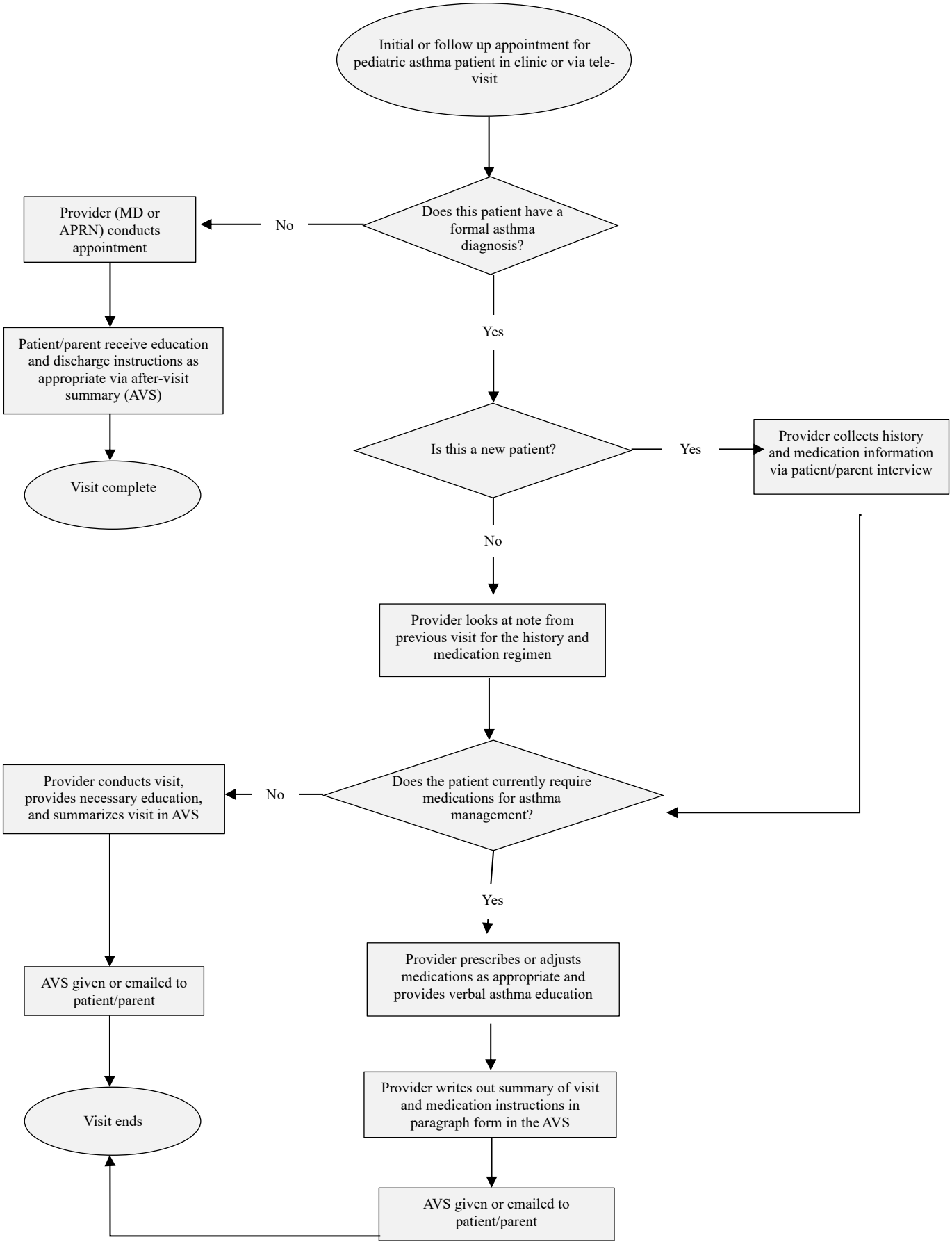
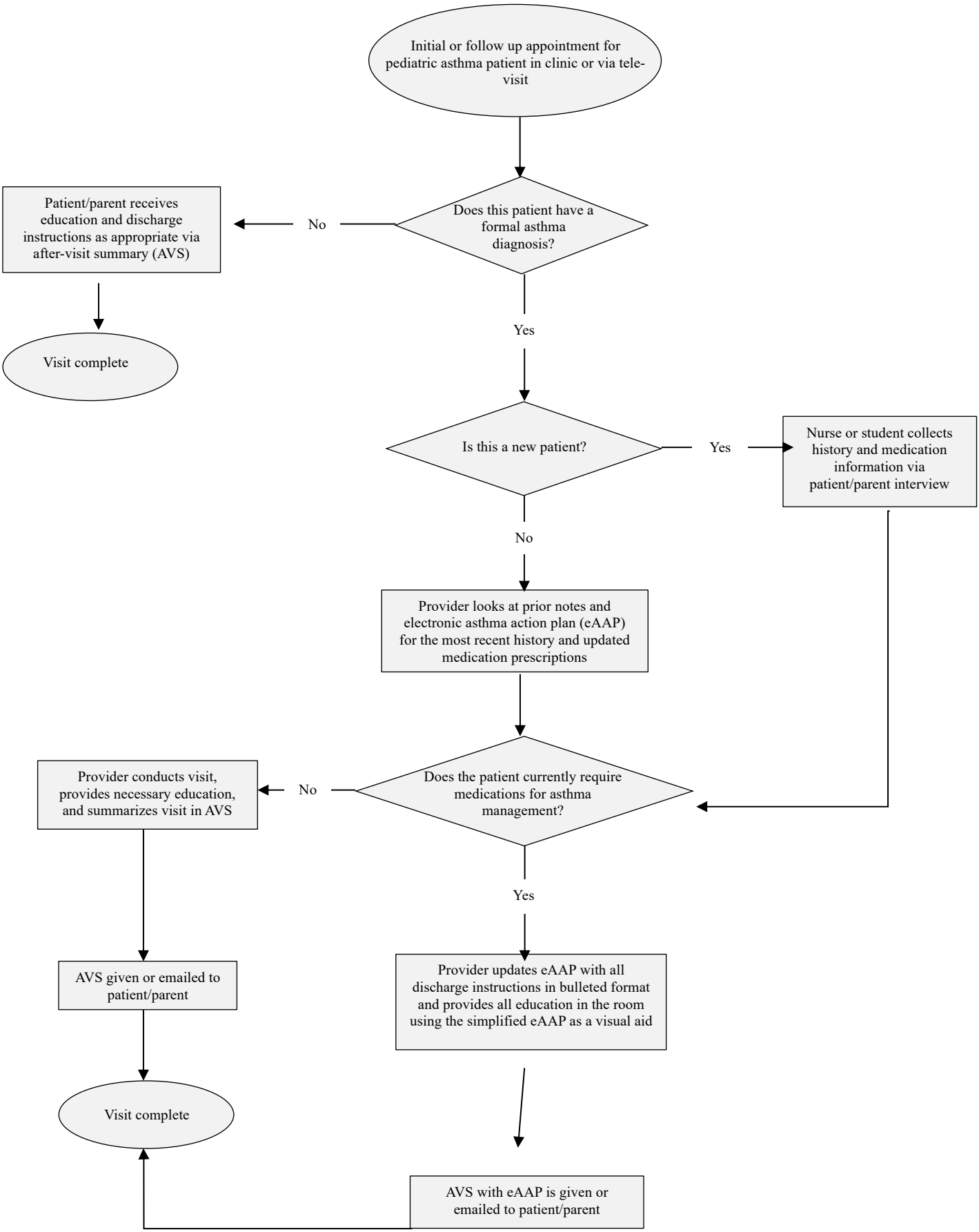


Figure 2. *Desired Process for Asthma Patients at an Outpatient Pulmonary Clinic*



Appendix F

Figure 1.
eAAP smartphrase

Recommendations from @me@	Anticipatory Guidance
•	1. Stay up to date on all recommended vaccines for age

1. GREEN - GO

You have ALL of these:	Take this medication EVERY DAY to control your asthma:
• Breathing is good • No cough or wheeze • Sleeps through the night	*Use spacer (and mask if needed) with all inhalers *Brush teeth after using inhalers

2. YELLOW - CAUTION

You have ANY of these:	Continue taking daily controller medications +
• Daytime or nighttime cough • Wheeze • Shortness of breath or chest tightness • Exposure to known triggers (colds, allergies, etc.)	-ADD rescue inhaler every 4-6 hours AS NEEDED

3. RED - DANGER

You have ANY of these:	Asthma is severe - take the following steps:
• Breathing is hard & fast and/or wheezing is worse • Nostrils open wide when breathing • Area around ribs and neck sink in with each breath • Can't talk well, cry, or make sounds	• **Take Albuterol 2 puffs every 20 minutes x3** • **Call 911 or go to the emergency room right away!**

University of Maryland Asthma and Allergy Practice 410-706-2443 Fax: 410-706-0694
Electronically signed by: @me@ @TODAY@
For school form use:
Patient allowed to self-carry? Yes☐ No ☐
For school year 2023-2024 ☑ OR form use not to exceed 12 months from signed date above ☐
Parent/Guardian Signature: _____

Figure 2.
AAP instructions

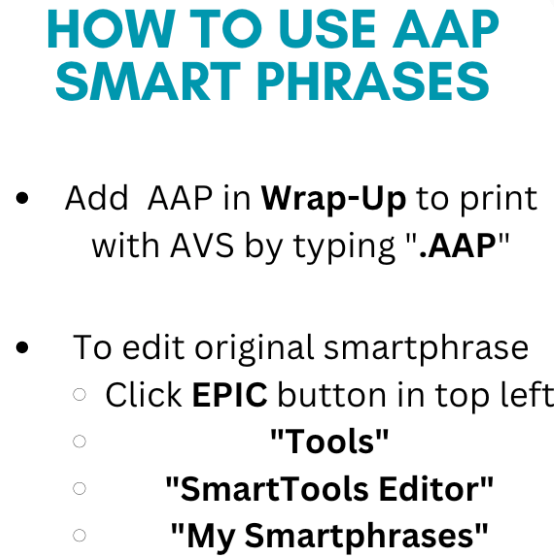


Figure 3.

Smart phrases

Figure 4.
Parental Reminder

Appendix G

REDCap Tools
Figure 1 – AAP EHR AUDIT TOOL

AAP EHR Audit Tool

Record ID	_____
MRN	_____
When was this patient seen in clinic?	_____
Date seen in clinic?	_____
Which provider did they see?	☐ Dr. Lasso ☐ Dr. Kotwal ☐ Nurse practitioner
Was the AAP included in the the discharge instructions?	◯ Yes ◯ No
Did the patient receive the AAP discharge instructions	◯ Yes ◯ No

Appendix H

Figure 1
Ethical site requirements

UMMS Pediatric Pulmonary Clinic Approval Team

- Dr. Anayansi Lasso alasso@som.umaryland.edu
- Dr. Nidhi Kotwal nkotwal@som.umaryland.edu
- Shawan Fullard, Office manager sfullard@som.umaryland.edu
- Monika Bauman – Director of nursing mbauman1@umm.edu
- Peggy Dorr – APP Clinical Program Manager pdorr@umm.edu

Approval of Project Participation by Site	December 2022
Project Plan Approval – eAAP integration into EHR	January 2023
IRB approval	July 2023

Appendix I – Run Charts

Figure 1
eAAP Compliance

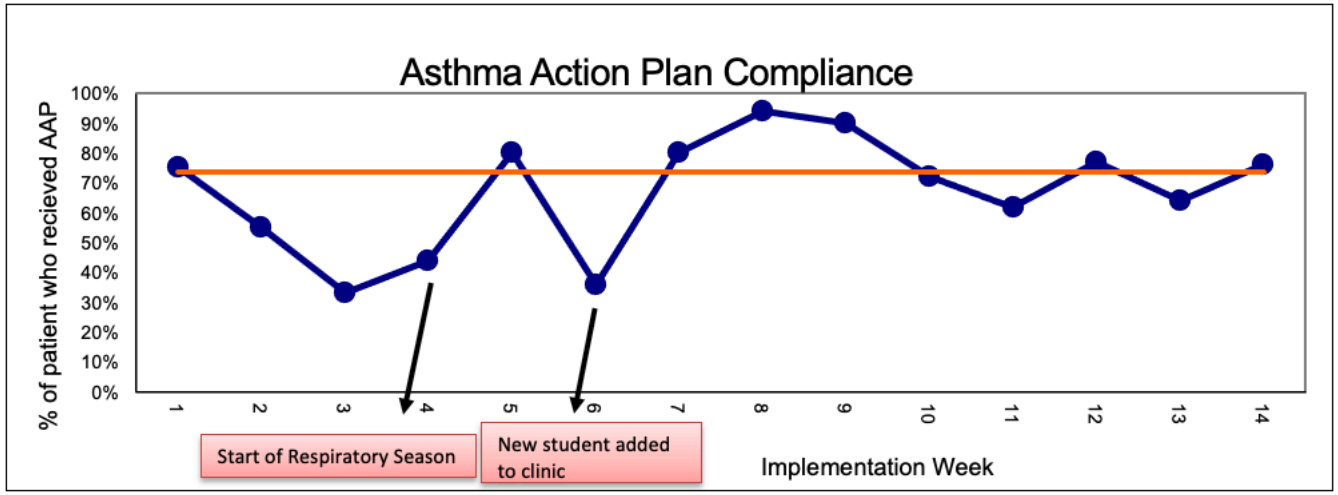


Figure 3

Asthma Patients with New Oral Steroid Prescriptions

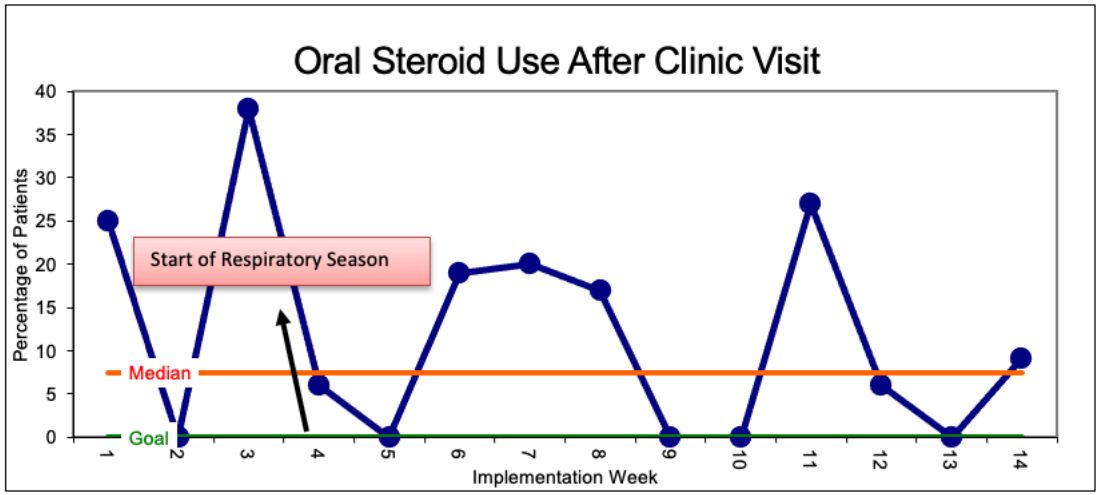


Figure 4

Asthmatic Patients with Asthma-Related ER/Urgent Care Visits