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Asthma HOME:

Asthma Home Occupation-Based Modified Environmental (HOME) Assessment: An Adaptive Trial Pilot Study

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Abstract

Asthma is a chronic lung disease and the most common pediatric chronic condition affecting approximately 4.6 million youth in the United States between the ages of five and 17 years. Complications of asthma impact youth sleep, cognition, motivation, and stress, and limit school engagement and participation. Asthma disproportionately impacts Black youth and youth living in or near poverty, with prevalence rates for Black youth approximately double that of their peers, and for poor youth approximately 1.5 times that of the national average. Increased healthcare utilization increases costs associated with disease management and impacts educational achievement and attainment outcomes for youth through frequent school absence. Common environmental triggers in the home such as dust mites, pet dander, mold, chemical fumes, bugs, and poor-quality HVAC equipment are associated with increased asthma symptoms and complicate disease management.

Evidence-based interventions designed to reduce asthma triggers in the home, like home environment assessments, have demonstrated improvements in health outcomes and reductions in asthma related medical costs through reductions in healthcare utilization. Despite this evidence, asthma home environment assessments remain under-implemented, creating a gap in evidence-based practice for youth with high-risk asthma. We also lack a mechanism to identify youth with high-risk asthma. The objectives of this study are to (1) refine an implementation strategy set or bundle to support the identification youth ages 5-17 with high-risk asthma, and to (2) investigate the acceptability, usability, and effectiveness of the Asthma Home Environmental Assessment (Asthma HOME) program in a mixed methods pre-post feasibility pilot. Asthma HOME includes an evidence-based Medicaid approved asthma home environment assessment; measures assessing asthma control, impact, healthcare utilization, neighborhood factors, family support, and stress; and aligned implementation strategies.

This study provides a model for a sustainable asthma home environment assessment program., as well as a blueprint for a systematic referral process to identify patients with high-risk asthma. Results of this study will provide answers to key questions regarding the effectiveness and acceptability of the program that are necessary to conduct a larger randomized control trial to optimize and evaluate Asthma HOME in an R01 Research Project Award proposal.

1. Administrative Information

1.1 Title

Asthma HOME: Asthma Home Occupation-Based Modified Environmental Assessment: A Pilot Study

1.2 Funding

Departmental
CRE2 Seed and Small Grant
The American Occupational Therapy Foundation Nancy Talbot Postdoctoral Research Fellowship

1.3 Roles and Responsibilities

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2. Introduction

2.1 Background and Rationale

Significance

Asthma is a common yet challenging chronic condition, disproportionately impacting African American youth. Asthma is a difficult to manage chronic condition requiring ongoing medical support and limiting individuals' participation in daily activities. Asthma is one the most common chronic childhood illnesses impacting approximately 4.6 million children under 18 years of age in the United States, and disproportionately impacting vulnerable youth, with Black children and children living in poverty suffering the greater burden of the disease. Black children experience asthma at two times the rate of their non-Black peers, and children living in poverty experience asthma at 1.5 times the rate of children not living in or near poverty.(Akinbami et al., 2009; Centers for Disease Control and Prevention, 2020). For all ages, medical expenses associated with asthma in the United States are estimated to be $82 billion annually (Asthma and Allergy Foundation of America, 2020).

Asthma limits life opportunity, academic, and participation outcomes for youth, disproportionately impacting vulnerable youth and those with high-risk or poorly controlled asthma. Complications of asthma include (1) asthma exacerbations, which often present with cold-like symptoms and are characterized by coughing, wheezing, and trouble breathing, and (2) asthma attacks, characterized by severe and rapid worsening of asthma symptoms, and airway swelling, and can be life threatening. Nearly 20% of youth under 18 years of age are hospitalized because of symptoms associated with asthma (Centers for Disease Control and Prevention, 2020). Youth with asthma are more likely to experience chronic absenteeism, or missing >10% of the school year due to excused or unexcused absences. Youth with asthma miss two to three times the amount of school as their healthy peers (Fowler et al., 1992; Krenitsky-Korn, 2011). Frequent absence from school leads to lost learning opportunities. Youth with asthma have twice rate of grade retention or failure compared to healthy peers, and experience disruptions in sleep that are associated with decreased performance on tests of concentration and memory (Fitzpatrick et al., 1991; Fowler et al., 1992; Stores et al., 1998). Youth with asthma demonstrate cognitive deficits in executive functioning, processing speed, attention, visuospatial skills, language, learning, and memory tasks (Erwin et al., 2010; Taras & Potts-Datema, 2005). Youth with asthma have higher rates of learning disabilities (1.7 times the risk of learning disabilities), attention-deficit/hyperactivity disorder, depression, and developmental, emotional, and behavioral concerns than their healthy peers (Blackman & Gurka, 2007; Fowler et al., 1992). Cognitive deficits among youth with asthma are highest for those with severe asthma, younger children, male children, racial or ethnic minority youth, and youth in households with lower incomes (Irani et al., 2017). Those with more absenteeism have lower scores on standardized measures of academic achievement (King et al., 2014; Maslow et al., 2012; Moonie et al., 2008). Implementation of interventions to more effectively manage asthma among school age youth may limit or remove these negative effects and improve educational and life outcomes for our most vulnerable populations (Basch, 2011a, 2011b).

Environmental triggers complicate disease management particularly for youth with high-risk asthma. Common household elements such as dust mites, pet dander, mold, chemical fumes, bugs, and poor-quality HVAC equipment have been identified as environmental triggers and are associated with increased asthma symptoms and complicate disease management

(Butz et al., 2011; Campbell et al., 2015; Chapman et al., 2009; Chen et al., 2011; Edwards et al., 2011; Perry et al., 2003; Rosenstreich et al., 1997; J. M. Wilson & Platts-Mills, 2018; Zock et al., 2002). Evidence-based and cost-effective environmental modifications include using allergen safe materials such as allergen impermeable bedding covers; replacing or removing curtains or carpet; addressing moisture, mold, pollen, and insects by installing barriers; caulking windows; sealing foundation cracks; insulating homes; removing water-damaged materials; replacing old and energy-inefficient windows; and using high efficiency particulate air (HEPA) filters (Bryant-Stephens et al., 2009; Butz et al., 2011; Campbell et al., 2015; Chapman et al., 2009; Chen et al., 2011; Crain et al., 2002; Dumitru, 2009; Edwards et al., 2011; Kercsmar et al., 2006; Sheehan et al., 2010; Zock et al., 2002). In addition to examining the impact of the built environment within the home on asthma symptom management, the role of stress has been identified as a contributing factor to asthma morbidity in children residing in high-poverty, urban neighborhoods (Cagney & Browning, 2004; Chiu et al., 2014; Kercsmar et al., 2006; Sheehan et al., 2010; Sternthal et al., 2010; Wright, 2006; Wright et al., 2004). A recent study by Pollack et al. (Pollack et al., 2023) found that for participants, "neighborhood cohesion, neighborhood safety, and urban stress accounted for approximately one-fourth to one-third of the positive effect of relocation on asthma outcomes" (Pollack et al., 2023). Public health interventions outside the biomedical model like Asthma HOME need to be considered to reduce asthma in disadvantaged populations (Sternthal et al., 2010).

Programs and tools that successfully target asthma management through environmental interventions exist, but are under-implemented in vulnerable populations (Chinman et al., 2017)**.** Programs by the US Department of Housing and Urban Development, the Centers for Disease Control and Prevention, and others have created a blueprint for others to follow and are supported by policies such as the American Disabilities Act and Section 504 of the Rehabilitation Act of 1973 and in Missouri are reimbursed by Medicaid (Asthma and Allergy Foundation of America, 2022; Centers for Disease Control and Prevention, 2017, 2018; Marcus, 2017; National Institute of Environmental Health, 2012; Neltner, 2015; U. S. Environmental Protection Agency, 2004; UNC Gillings School of Public Health, 2020; U.S. Department of Housing and Urban Development Office of Lead Hazard Control and et al., 2018). Despite an abundance of evidence-based research, small and large-scale programming across the nation, resource allocation, and policy supporting environmental interventions, there is still an underutilization of asthma home environment assessments and interventions. EBIs are difficult to implement among vulnerable populations due to social and economic contextual barriers (i.e., poverty, lack of resources, poor environmental conditions). This intervention has the potential to have significant impact as it will meet the needs of the most vulnerable communities affected by asthma.

Challenges in the identification and referral of youth who would benefit from this EBI, and availability of certified assessors complicates the implementation of this intervention. We do not currently have a referral system or mechanism to identify those most in need of this intervention or a sustainable program through which to deliver this service. In our prior work we interviewed stakeholders from St. Louis Children's Hospital (SLCH), Healthy Kids Express, and other local organizations and found that only one, St. Louis County Healthy Homes, provided resources or information on asthma home assessments and no organization allocated funding to support implementation. Key themes from interviews with stakeholders that engage with patients at various points along the continuum of care included (a) the lack of understanding surrounding the benefits of an asthma home environment assessment, (b) the poor knowledge of the allocated resources for asthma care, and (c) the lack of communication pertaining to the use of assessments between leading organizations and healthcare providers in the area. Providers reported that due to limited knowledge and awareness of benefits,

accessibility, and resources of this EBI to mitigate asthma triggers in the home environment they were less likely to refer patients. These barriers to implementation informed this proposal.

The Asthma HOME program is an evidence-based initiative that has been informed by successful Missouri childhood lead remediation programs. Like asthma, the environment plays a significant role in childhood lead poisoning. Exposure to environmental toxins like lead-based paint and lead contaminated dust are the most common causes of lead poisoning for children (Missouri Department of Health and Senior Services, 2019). In response to this, a shift was made to treat lead as a public health rather than medical problem. Testing expanded to include testing of not just children but homes, Medicaid began to cover case management, HUD and EPA strengthened policy and funding, media campaigns to increase public awareness of lead poisoning were implemented, and cleaning kits and materials were distributed to families in the community to assist in environmental lead hazard remediation (Centers for Disease Control and Prevention, 2012). Partnerships among community organizations, medical institutions, abatement contractors, and funding agencies at the federal and state levels were established to build trust, share data, and promote inter-agency collaboration. Since the creation of lead programs, Missouri has seen a significant decline in lead poisoning among children ages five and younger. Between 2000 and 2016, the proportion of children with lead poisoning in Missouri decreased substantially, decreasing from 3.08% to 0.41%, an average decline of 14.6% annually from 2000-2011 and 7.1% annually 2011-2016 (Missouri Department of Health and Senior Services, 2019). In St. Louis city, the percentage of children who tested positive for lead decreased from 28% in 1971 to 8.4% in August 2006 (Centers for Disease Control and Prevention, 2012). The dramatic decrease in children with elevated blood lead levels was largely due to implementation of primary prevention, community partnerships, and the abatement of homes throughout the city. Asthma HOME can have a similar impact for youth with high-risk asthma.

Innovation

The innovation of this program lies primarily in its pragmatic approach to reducing asthma triggers in the home environment, reducing healthcare utilization, and improving outcomes for youth with high-risk asthma, ultimately reducing disparities for youth with asthma. Three primary study elements support this:

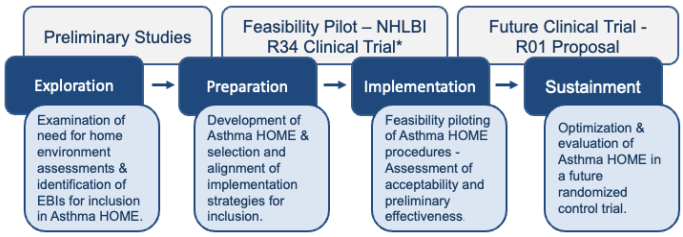
Extending the reach and impact of asthma programs will help reduce racial and ethnic disparities in outcomes. Occupational therapists (OTs) are well-suited to address this need. The National Institute of Health (NIH) suggests reducing barriers to implementation of guideline-based asthma management is a key strategy to reducing disparities in outcomes (National Institute of Environmental Health Sciences, 2012). NIH supported actions steps include training healthcare providers in primary care settings, like OTs, to expand the reach and impact of asthma programs and reducing environmental exposures in homes (National Institute of Environmental Health Sciences, 2012). OTs are experts in the interaction of person and environment factors impacting participation and performance, and health outcomes (Baum et al., 2015). As clinicians who are experienced in providing services both within clinical settings and community and home settings, OTs are skilled in utilizing client and caregiver education, goal setting, and problem-solving components and assessments to capture a client's functional performance and safety in their environment (Fields & Smallfield, 2022). This distinct skillset makes them experts in providing care for individuals with chronic illnesses like asthma. The evidence-based, holistic, and client-centered nature of the profession also ensures that OTs are experts in assessing and creating complex interventions that consider built, natural, and social environmental variables and how the interaction between the person and environment factors

impacts health and well-being, qualifying them to be valuable and essential members of interdisciplinary teams addressing complex environmental modifications for youth with high-risk asthma (Renda et al., 2015; Stark et al., 2017).

Asthma HOME provides both an identification and referral system and a program to deliver the service. Despite evidence on the effectiveness of environmental home assessments to identify and mitigate asthma triggers, no referral system or mechanism to identify those most in need of this intervention, or a sustainable program through which to deliver this service, exists. This study will serve as a blueprint for using an implementation strategy set or bundle with the electronic health record platforms such as EPIC to identify patients with high-risk asthma who would benefit from an asthma home environment assessment. This study will also raise awareness among providers and community members on the benefits of asthma home environment assessments and modifications to reduce asthma symptoms and healthcare utilization increasing referrals, state and national advocacy to increase funding, and policy enactment to reduce harmful air toxins.

This program uses the Exploration, Preparation, Implementation, and Sustainment (EPIS) framework to support the development and implementation of Asthma HOME and promote program sustainability. As a framework to help identify determinants for intervention, EPIS encourages a systematic analysis of the contextual factors influencing all stages of implementation of Asthma HOME (Aarons et al., 2011). EPIS considers inner and outer contextual organizational factors and bridging and innovation factors impacting implementation across all four stages of implementation (exploration, preparation, implementation, and sustainment). EPIS is well suited to the development and piloting of interventions, and this study specifically (see Figure 1). The exploration phase examines the existing health needs and determinants influencing the reach of supports and potential adaptations. The preparation phase focuses on determinants influencing the adoption of supports and development of a detailed implementation plan. Guided by the prior phases, the implementation phase initiates EBI implementation, implementation strategies employed, and on-going monitoring. The sustainment phases scales and maintains the EBI with any identified adaptations.

Figure 1. Application of EPIS to the current proposal.



2.2 Study Objective & Aims

SPECIFIC AIMS. Asthma is a difficult to manage condition affecting over 6 million children, and disproportionately impacting African American youth (at twice the national prevalence) (Akinbami et al., 2016; Centers for Disease Control and Prevention, 2009). Impacts of asthma include missed school days, more nights of troubled sleep, poor academic achievement (grades and test scores) and attainment (fewer years of school completed), and overall reductions in participation and quality of life (Erwin et al., 2010; Güzel et al., 2021; Jezioro et al., 2021; Krenitsky-Korn, 2011; Taras & Potts-Datema, 2005). Common household environmental

triggers such as dust mites, pet dander, mold, chemical fumes, bugs, and poor-quality HVAC equipment are associated with increased asthma symptoms and complicate disease management (J. Wilson et al., 2010). Evidence shows that reducing asthma triggers in the home can significantly improve health outcomes and reduce the high cost of repetitive emergency and in-patient care (Turcotte et al., 2014, 2018). Governing agency developed and endorsed programs and tools to target asthma management through environmental interventions exist. However, despite research and policy supporting this evidence-based intervention (EBI), an under-implementation of asthma home environment assessments remains.

Our **long-term goal** is to reduce healthcare utilization and improve health outcomes for youth with high-risk asthma. Our team, led by an asthma investigator with expertise in community-based asthma management and environmental asthma triggers, found that challenges in the identification and referral of youth with high-risk asthma and availability of certified assessors complicates the implementation of this intervention. We do not currently have a referral system or mechanism to identify those most in need of this intervention or a sustainable program through which to deliver the intervention. In our preliminary work, we developed the Asthma Home Environmental Assessment (Asthma HOME) program, which includes (a) an evidence-based Medicaid approved asthma home environment assessment, (b) measures assessing asthma control, impact, healthcare utilization, neighborhood factors, family support, and stress, and (c) aligned implementation strategies (Jaffee et al., 2005; Kennedy et al., 2017; Kraemer, 2007; O'Brien et al., 2018; Pollack et al., 2023; Salbach & Jaglal, 2011; Sampson, 2008, 2013; Schatz et al., 2006; Tate, 2012; Weiner et al., 2017; Yeatts et al., 2010). The **overall objective** of this proposal is to pilot Asthma HOME to determine feasibility or usability of the procedures, clinical effectiveness and acceptability among families of youth with high-risk asthma. Our **central hypotheses** are (1) a refined set of implementation strategies will improve our ability to identify youth with high-risk asthma, and (2) that Asthma HOME will be usable, acceptable, and effective at reducing healthcare utilization for youth with 'high-risk' asthma. 'High-risk' asthma is defined as asthma requiring one inpatient hospitalization, two or more visits to the emergency department (ED), or three or more urgent care visits; or one ED or urgent care visit related to asthma, and a high rate of short-acting beta-agonist inhaler fills and/or low rates of inhaled corticosteroid refills in a 12-month period. Specific aims follow:

> **Aim 1: Develop and refine a set of implementation strategies to support the identification and referral of youth with high-risk asthma ages 5-17 who may benefit from Asthma HOME.** Using the expert recommendations for implementing change (ERIC) strategies and the electronic health record (EHR) we will identify and refine a set of strategies (or "implementation strategy bundle") that increase our ability to identify and refer youth with high-risk asthma who may benefit from participation in Asthma HOME.
>
> **Aim 2: Conduct a mixed methods hybrid type II implementation-effectiveness pilot of the Asthma HOME program among youth with high-risk asthma ages 5-17.** We will pilot Asthma HOME, which includes an asthma home environment assessment and aligned implementation strategies in a trial with a representative sample of 52 families of youth with high-risk asthma. We will:
>
> > **Aim 2a:** Investigate the acceptability and usability of Asthma HOME among families of youth with high-risk asthma using pre-post analysis of the Acceptability of Intervention (AIM) (Weiner et al., 2017) and User Engagement

Scale Long-Form (UES-LF) (O'Brien et al., 2018) surveys, and brief qualitative interviews with families.

Aim 2b: Investigate the effectiveness of Asthma Home as indicated by pre-post measures of healthcare utilization, asthma control, participation (engagement in meaningful activities like education and play for youth), and parent/caregiver self-efficacy to manage identified home environment triggers in the 12-months prior to and following the home assessment.

Our team's experience in school and community-based management of pediatric asthma and expertise in implementation science and asthma home environment assessments well position us to successfully conduct this pilot. We have established community-based asthma partnerships to support the development and implementation of supports for youth with asthma. Asthma HOME engages Occupational Therapists (OTs) as implementers, an innovative strategy. OTs have experience providing clinical services in home and community settings and modifying home environments to improve safety. Completion of these aims will provide the data necessary to inform and conduct a larger randomized control trial to optimize and evaluate Asthma HOME. Development of a process to identify and refer youth with high-risk poorly controlled asthma for participation in Asthma HOME will improve clinical, participation, and outcomes for impacted youth.

3. Methods

3.1 Study Design Overview

This is a pilot study investigating the adaption and implementation of an existing home environmental assessment, the acceptability and usability of the adapted occupation-based asthma home environmental assessment, and the preliminary effectiveness of the assessment with aligned implementation strategies. The assessment will be developed in collaboration with stakeholders. Following assessment completion, it will be piloted during an initial approximately 1.5-hour on-site visit with families of youth with asthma. There will be follow-up phone calls and or emails and additional home visits. See adaptive trial design (Figure 6) below for more information on follow-ups. Both quantitative and qualitative data will be collected. Fifty-two (52) families will be recruited for participation. We will recruit a sample of 26 families of youth with high-risk asthma to participate in the intervention groups. We will also recruit and enroll 26 controls who were eligible for Asthma HOME, but decline to participate, instead agreeing to receive education materials. The education only group will serve as the control group. An additional control group will only receive the standard of care (no education) and no contact will be made with participants. Rather medical charts will be reviewed among those who meet eligibility criteria. Participants will be compensated $100 following completion of visit 1 and visit 2 during the visit 2 equipment drop off in-person home visit and $15 for the additional follow-up surveys and/or phone calls that they participate in at 3, 6, 9, and 12 months.

Following recruitment and consent, covariate adaptive randomization will be used to randomize enrolled participants to one of two conditions: (a) Asthma HOME Assessment, Trigger Mitigation Plan (TMP) education, PCP referral, allergen reducing equipment drop off, and parent/caregiver equipment training, or (b) Asthma HOME Assessment, TMP education, PCP referral, and allergen reducing equipment drop off ONLY (no parent/caregiver training on equipment). An adaptive trial design will be used (Figure 6). Controls will receive educational materials/PCP

referral only.

3.2 Study Intervention

3.2.1 Asthma Home Assessment

The Asthma Home assessment is a battery measure that assesses asthma symptoms, the home environment, occupational participation and performance, healthcare utilization, implementation outcomes, neighborhood factors (cohesion and safety), and caregiver stress. All assessments will be administered during study visit one under the assessment guidelines and completed via REDCap utilizing an iPad. The study team member will administer the asthma home assessment and complete all required fields on REDCap and ensure the assessment is completed to its entirety. See Protocol Section 3.8, Section 3.9, IRB section 1.13 and copies of attached assessments.

3.2.2 Trigger Mitigation Plan (TMP) education

The Trigger Mitigation Plan (TMP) is an individualized plan to address possible identified asthma triggers following completion of the asthma home environmental assessment and will be provided to all participants at the end of study visit one. The TMP will include areas for participants to address independently (e.g., keeping pets out of a child's bedroom, etc.) and any recommended resources that require local outside support will be addressed and recommended by the study team (e.g., mold remediation, etc.). Participants will be provided with recommendations and education regarding areas addressed on their individualized TMP.

3.2.3 PCP referral

Study team members will determine if all participants have an active primary care physician (PCP) and/or asthma physician. For participants that do not currently have an active PCP or asthma physician or standing appointment to a recently referred physician, we will assist in arranging a referral or scheduling a visit. For participants in Group A and Group B, a referral will be provided during study visit one. For participants in Group C, a referral will be done over the phone. Within one week of initiating this process, a study team member will call to follow-up.

3.2.4 Allergen reducing equipment drop off

During study visit two, allergen reducing equipment will be dropped off to all participants. This will be conducted approximately 1 week after study visit one. Allergen reducing items include items such as bedding covers, HEPA filters, and cleaning products. See Table 3 for more details regarding these items. A written plan and timeline for the provision of resources that cannot be provided immediately (e.g., pest control services) will be developed and the research team will provide the follow-up to ensure plan and timeline are met.

3.2.5 Parent/caregiver equipment training

During study visit two, participants in Group A will receive additional training supports to address use of supplied allergen reducing equipment. Study team members will address operation, maintenance, and troubleshooting regarding all items provided to the family. Any additional questions regarding these items will be addressed as well.

3.2.6 Educational materials

Educational materials will be provided to all participants, regardless of group assignment. These educational materials will consist of information regarding common asthma triggers in the home, tips to reduce common asthma triggers, and basic information about asthma in kids.

3.3 Study Population

Fifty-Two (52) families will be recruited for participation in the study. Families of children between the ages of 5-17 years old with moderate to severe asthma will be targeted as these families may most benefit from participation in Asthma HOME.

3.4 Eligibility

- Inclusion criteria
    a. Families/households of youth who are:
        - Between the ages of 5-17 years old
        - Have an asthma diagnosis
        - Meet the criteria for high-risk asthma as indicated by one of the following episodes related to asthma:
            - One or more inpatient hospital stays
            - Two or more ED visits
            - Three or more urgent acre visits
            - One ED visit or one urgent care visit related to asthma with a high rate of short-acting beta-agonist inhaler fills and/or low rates of inhaled corticosteroid refills
- Exclusion criteria
    a. Children younger than 5 or older than 17
    b. Adults
    c. People with occupational asthma
    d. Have participated in an asthma home environmental assessment at their current place of residence within the past 6 months
    e. Youth who lives across more than two different residences
    f. Legal guardian of child unable/unwilling to also enroll
    g. Families whose residence is more than 50 miles from the research office (4480 Clayton Avenue, St. Louis, MO, 63110)

We will enroll 52 families/households with youth with asthma meeting our eligibility criteria. Families/households refers to the pediatric participant and their parent or primary caregiver residing in the same residence as the pediatric participant. Only one caregiver will complete all surveys for the duration of the study. Youth who split time between two residences will remain eligible for participation. The home assessment will take place in the primary residence the participant resides in most. If the family reports the participant spends equal amounts of time between the two residents, the family will choose their preferred location for the one home assessment. If youth live across more than two different residences, they will not be eligible for study participation. They will, however, still be referred for a home assessment outside the context of the study. If they have participated in an asthma environmental home assessment in the past 6 months, they will also not be eligible for the study.

We will also recruit and enroll 26 controls who were eligible for Asthma HOME, but decline to participate, instead agreeing to receiving educational materials. The education only group will serve as the control group. An additional control group will only receive the standard of care (no education).

3.5 Recruitment Methods with Accompanied Eligibility Consent Procedures

Recruitment and consent for will be conducted and approved by the IRB. Participants will be recruited through two methods: EPIC, the electronic health record (EHR) system used at St. Louis Children's Hospital, and recruitment fliers. Depending on the method of recruitment, participants may have additional steps prior to completing the eligibility consent process, however all will undergo eligibility consent and screening.

EPIC Recruitment Procedures: Using the ERIC strategies and the electronic health record (EHR) the study team will develop an initial strategy bundle by selecting ERIC strategies and modifying them as necessary. We will begin iterative testing of the bundle to identify youth with high-risk asthma. We will use two primary methods to test the strategy bundle: (1) Best Practice Advisors and (2) manual searches in EPIC.

Best Practice Advisors
We will use Best Practice Advisors (BPAs) to identify potential participants. BPAs are part of EPIC's framework for clinical decision support, which can be configured to evaluate data and display information or suggest follow-up actions. Our BPA will be used to identify high risk asthma patients who meet the above-mentioned inclusion criteria that have recently visited the emergency department (ED), were admitted for an inpatient stay, or who have visited an urgent care location. In this context, "recently" pertains to inpatient stays or ED and urgent care visits occurring within 12 months of the BPA notification. The BPA will provide daily notifications of potentially eligible participants that can then be compared to our manual search data (described below) on a weekly basis. The study team will conduct patient chart reviews following BPA notification of potentially eligible patients to ensure patients have met the inclusion criteria. Two study team members will conduct the chart reviews, which will then be compared for discrepancies. Discrepancies will be address and refined until no further modifications are warranted.

Manual Search Reports
We will run manual searches in EPIC for patients who meet criteria for high-risk asthma. Manual searches will be conducted via EPIC's reporting/Slicer Dicer feature. Our initial search will identify all patients who have visited the ED, urgent care, or had an inpatient admission in the prior 12 months. Following the initial search, we will run weekly searches for participants who meet our eligibility criteria since our last search.

Manual searches and BPA strategies will be modified as needed to accommodate strategy bundle changes. This iterative process will continue on a weekly basis until no further modifications to the strategy bundle are warranted across 6 consecutive weeks, and the study team feels all eligible youth meeting the eligibility criteria are consistently identified by the search process. The search data will be compared across manual and BPA searches on a weekly basis to identify discrepancies and rate of eligible youth identified and missed or

unidentified by either strategy. Changes in the rate of youth identified and unidentified will be tracked on a weekly and monthly basis, and between the start and completion of aim 1 activities.

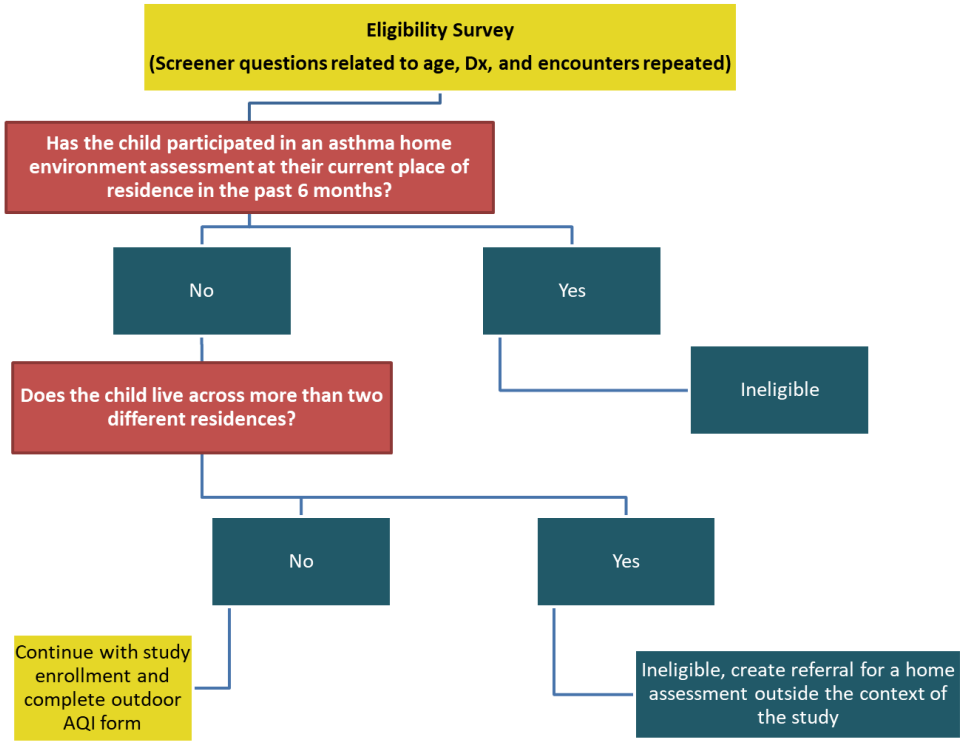
While recruiting, if we find that specific geographic areas are underrepresented, we may use targeted recruitment to sample from those underrepresented zip codes.

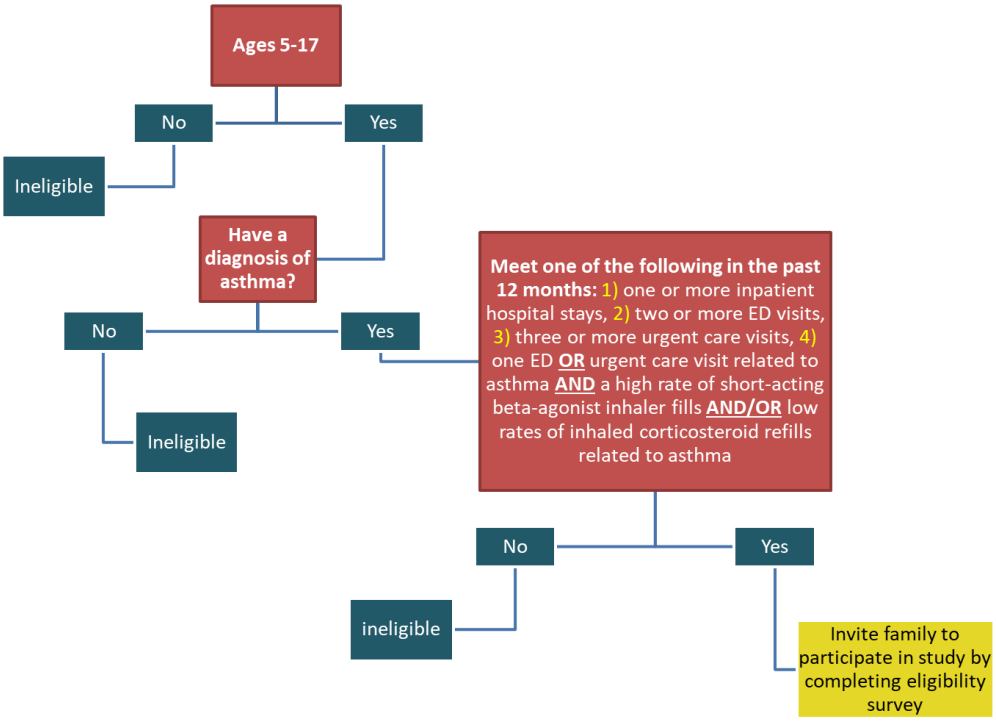
Eligibility Procedures

Prior to eligibility consent procedures, potential participants may be directed to the study interest form. They would need to complete this form if they were recruited through fliers or they were unable to or needed more time to consider completing the eligibility consent and screening survey when first contacted by a team member after being identified through EPIC. This interest form will collect basic information and confirm that the individual may be interested in the study. Those who complete the form will be contacted by a team member to complete a phone eligibility consent and eligibility survey.

The eligibility phone consent and survey will be completed on REDCap by a study team member on behalf of the participant. When completing the eligibility phone consent, potential participants will be provided with an overview of the study. Following eligibility phone consent, the phone eligibility screening survey will be completed. The eligibility survey will assess the eligibility of the child with asthma to participate in the study. See Figure 2 for eligibility questions. If they are found to be eligible, the survey will also inquire about their preferred contact method and prompt them to again provide their phone number and/or email address. When providing this information, they will be asked to complete an Authorization to use Unsecured Email or Text for Research Studies form, a document used to obtain permission to use email/text messaging to communicate protected health information for research studies. Procedures to obtain informed consent and assent are discussed further below. See Figure 3 for sequencing of consent documents

Figure 2. Patient Eligibility Flow Chart





If at any point a participant is no longer eligible for the study, a member of the research team will contact them by phone to notify them of their withdrawal. (See Phone Script for Participant Withdrawal attachment). Participants may be withdrawn for no reason or because they are no longer healthy enough to participate.

3.6 Data/Variables

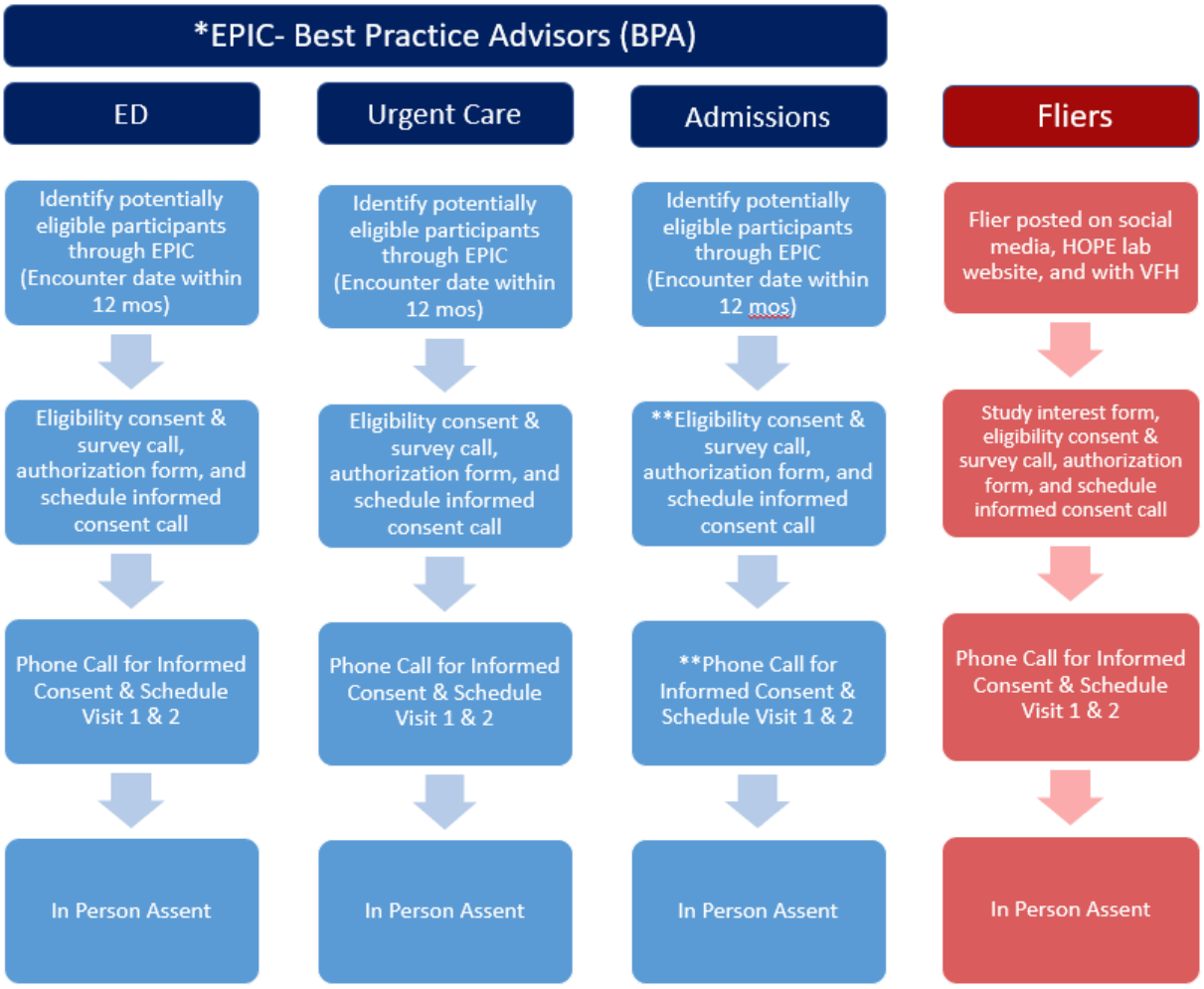
Data elements that will be accessed from medical records to identify potential participants for recruitment or any individual data elements that will be included on a screening log prior to consent include patient's name, contact information, age, DOB, MRN, phone number, mailing address, zip code of residence, diagnosis and date of diagnosis, medications, past medical history (including visits related to asthma diagnosis, and any co-morbidities or diagnoses of other chronic conditions), Asthma Control Test Score, appointment time and primary provider, and hospitalizations/ER/urgent care visits in the last year.

For participants not in the control only group, study involvement will initially include two in-person sessions at the participant's home, lasting approximately 1.5 hours. There will be follow-up calls or electronic surveys sent at 3 months, 6 months, 9 months, and 12 months following the initial in-person visit. At a minimum, there will be 4 follow-up contact points. These will be 5-10 minutes in length. Medical records 12 months prior to the in-person visit and 12 months after the visit will be accessed.

3.7 Analysis Plan

The Asthma HOME assessment battery measures asthma symptoms, the home environment, occupational participation and performance, healthcare utilization, implementation outcomes, neighborhood factors (cohesion and safety), and caregiver stress. All assessments will be scored according to the assessment guidelines. Descriptive statistics and repeated measures will be used to describe (a) environmental asthma triggers identified, (b) Asthma HOME acceptability and usability (Aim 2a), (c) healthcare utilization (Aim 2b), (d) participation domains impacted by asthma symptoms for youth with asthma, (e) asthma control and asthma impact, (f) neighborhood factors, (g) stress, (h) parent/caregiver self-efficacy, and (h) family supports and follow through. Data will be reported as the statistic with 95% confidence bounds (CBs). We will also estimate the association between asthma triggers identified and participation, and asthma severity rating (according to provider diagnosis) using Pearson or Spearman correlations, as appropriate, with associated 95% CBs. Additional analyses will compare participation outcomes across determinants using analysis of variance (ANOVA) for continuous outcomes and ordered logistic regression with a cumulative logit for the ordinally scaled PAIS outcome. If the required assumptions for ANOVA are not satisfied, we will explore data transformations or revert to semi-parametric analysis using ranks. A generalized ordered logit model will replace the ordered logistic model if the proportional odds assumption is not satisfied. Repeated measures will compare ‘asthma’ survey results at baseline and study completion and between all study time points, as well as healthcare utilization data from the EHR in the 12-months prior to and following the intervention.

Figure 3. Consenting Documents Flow Chart



*If the family is considering participating and needs more time to decide, the research team will ask a caregiver to complete the study interest form

** These items could be obtained in person if a study team member visits the patient while still admitted

3.8 Study Procedures

Following recruitment, eligible and consented participants will be enrolled in the study, at which time covariate randomization will occur to place participants in Group A or Group B. Following randomization, all participants will be scheduled for an initial in-person visit at the participant's residence (visit 1) where they will receive their assigned intervention. Participants in Group A and Group B will receive a second in-person visit (visit 2). Visits will be scheduled using Microsoft Bookings. Reminder emails will be sent automatically via Booking 3 days prior to each home visit. The 3-month follow up call will serve as the first decision point where tailoring for second-stage intervention will occur based upon self-efficacy and follow through survey responses and participant status as responder or non-responder. Non-responders, or participants who are having difficulty managing asthma triggers in their home environment, will receive additional tailoring (monthly phone support). During these calls any questions regarding environmental triggers and the individualized environmental asthma trigger mitigation plan will be addressed. If the parent/caregiver has questions we are unable to address, we will obtain

that information and provide it to the family or connect them to the resource that can address their question.

Group C (control) will consist of participants who were eligible to the study; however, they declined participation in a home visit but were open to receiving educational materials. Group C participants will not receive any home visits. These participants will receive educational materials and/or a PCP referral.

Responders, or participants who are able to manage asthma triggers in their home environment, will continue with their current intervention condition. The 6-month follow up visit will serve as the second decision point to determine tailoring for the third and final-stage intervention. Non-responders at this decision point will receive an additional home visit. Responders will continue with their current intervention condition. Participants will remain in the third-stage intervention condition for the remainder of the trial (months 6-12). Additional follow-up electronic surveys will be completed following each home visit and at already scheduled 3-, 6-, 9-, and 12-month time points following visit 1.To address PCP referral, for all groups the study team will determine if the participant has already been referred or already has a standing appointment. We will do this prior to the visit by checking ED, urgent care, or admission discharge notes to see if they have been given a referral. For those in Group A and Group B, if they do not have a referral or standing appointment then the study team will initiate the process during study visit one. For those in Group C, this process will be done over the phone. Within one week of initiating this process, a study team member will call to follow-up.

Medical records 12 months prior to visit 1 and 12 months after visit 1 will be accessed via the EHR to assess changes in healthcare utilization outcomes. Survey instruments listed below will be used to inform future study procedures as well as measure asthma symptoms, occupational participation and performance, the home environment, caregiver reported healthcare utilization, implementation outcomes, neighborhood cohesion and safety, and caregiver stress.

If at any point a participant is no longer eligible for the study, a member of the research team will contact them by phone to notify them of their withdrawal. (See Phone Script for Participant Withdrawal attachment). Participants may be withdrawn for no reason or because they are no longer healthy enough to participate.

Survey Instruments

Child Response Required:

- Asthma Control Test (ACT)- for all children, the research team members will read the questions aloud and mark answers in REDCap. For children 4-11, there will be a total of 4 questions. For children 12-17, there will be a total of 5 questions to answer. This assessment examines how well a patient's asthma is being controlled.
- PMROIS Asthma Impact- for all children, a research team member will read the questions aloud and mark answers in REDCap. This measure assesses symptoms and the impact of symptoms on daily life.
- Child and Adolescent Scale of Participation (CASP)- The research team member will allow the participants to complete the CASP in REDCap on the iPad. Depending on the child's abilities and comfort, the research team member can go through each question with the participant or allow them to move through on their own. This measure assesses participant participation in daily activities at home, school and in the community.

Note: If a participant is unable to complete the child response surveys for various reasons (such as an intellectual disability) a parent/caregiver may answer on behalf of the child.

Researcher Observation:

- Occupation-Based Asthma Home Environment Assessment- for all participants, the research team will complete the assessment by observing the home environment. As outlined in the attached assessment document, open ended questions will also be used to learn more about the home environment and performance patterns that can influence home environmental triggers. The assessment was developed by Dr. John C Kraemer and his team out of Southeast Missouri State University. The assessment is currently utilized for the Missouri Asthma Prevention and Control program, is eligible for Medicaid reimbursement in Missouri, and is the designated assessment for training certified asthma assessors in Missouri (AsthmaReady.org, 2020).

Caregiver Response Required:

- Asthma Control Test (ACT) Parent Questions- Completed by caregivers of children 5-11 years old. Caregivers of children 12-17 years old will not complete the ACT.
- PROMIS Asthma Impact Parent Proxy- Will be completed by all parents.
- Acceptability of Intervention Measure (Weiner et al., 2017)- Four item instrument measuring the acceptability of an intervention
    a. V1: Acceptability of Asthma HOME
    b. V2: Acceptability of equipment drop off visit (with and without parent/caregiver education)
    c. V3: Acceptability of monthly phone calls
    d. V4: Acceptability of third home visit
- User Engagement Scale Long Form (UES-LF) (O'Brien et al., 2018)- Tool developed to measure user engagement. For the purpose of this study, we will only be using the portion of the tool that measures perceived usability.
    a. V1: Usability of Asthma HOME
    b. V2: Usability of equipment drop off visit (with and without parent/caregiver education)
    c. V3: Usability of monthly phone calls
    d. V4: Usability of third home visit
- Community Healthcare for Asthma Management and Prevention of Symptoms (CHAMPS) Baseline- this form is used to collect information about the patient's asthma. The answers on this form will be compared to the answers at 6 months and at 12 months to chart patient changes.
- Community Healthcare for Asthma Management and Prevention of Symptoms (CHAMPS) Follow Up- this form is used to collect information about the patient's asthma at the 6-month and 12-month time point. The answers on this form will be compared to the answers at baseline to chart patient changes.
- Neighborhood Factors (Pollack et al., 2023), Social cohesion (Sampson et al., 1997) and daytime and nighttime safety (National Bureau of Economic Research, 1994) were measured. Social cohesion measured caregiver perception of resident connectedness within their neighborhood while daytime and nighttime measured how safe caregivers felt on the street near their home. Higher scores with these measures indicate better outcomes.
- Modified Urban Stress Scale (Jaffee et al., 2005)- Measures caregiver stress about raising a child, the neighborhood, physical health, and housing. Higher scores for all variables indicated worse outcomes.
- Additional Questions- Questions developed by the research team for study aims were developed. These questions investigate family support, preferred education resource

medium, recommendation follow through and self- efficacy. The self-efficacy questions were modified from the EBP confidence scale (Salbach & Jaglal, 2011).

Visit 1 - The initial study visit will be conducted at the participant's residence by a two to three-member study team and last 60-90 minutes. All questions across all assessments in the assessment battery will be completed on an iPad during visit 1. One study team member will complete the observational environmental home assessment, while the second study team member conducts the youth and parent/caregiver survey with the child and their parent or caregiver. Youth participant and parent assessments and surveys will be presented visually and orally as needed. The procedures during visit 1 will vary slightly based on the age of the participant (See Figure 4). The youth participant will complete the survey on an iPad with assistance from a research team member as needed to read and understand the questions. The parent/caregiver will complete their survey on an iPad with assistance from a research team member as needed. Paper forms will be available for these assessments and surveys should there be any technical difficulties with iPad administration. Once the observational environmental home assessment and surveys are complete, the study team members will review identified triggers with the parent/caregiver, address any parent/caregiver questions, and create an individualized environmental asthma trigger mitigation plan (TMP). Educational materials and training on asthma triggers and specifically how to address identified triggers will be provided to families. Before the completion of the visit, a team member will place a Dylos meter to measure indoor air quality (IAQ) between visit one and visit 2. If significant safety concerns are identified during the assessment, appropriate measures consistent with the protection of human subjects and safety monitoring plans will be taken. See figure 4 for initial home visit procedures.

Visit 2- Visit 2 will be conducted approximately within a week of visit 1. Based upon findings from the initial assessment and recommendations provided by the TMP, allergen reducing items (i.e. bedding covers, HEPA filters, cleaning products, etc.) will be provided to all participants. See Table 3 for more details regarding allergen reducing items. A written plan and timeline for the provision of resources that cannot be provided immediately (i.e., pest control services, large items like HEPA vacuums or air purifiers, etc.) will be developed and the research team will provide follow-up to ensure plan and timeline are met. The Dylos meter previously placed in the home to measure IAQ will be collected. Participants in Group A will receive additional training supports to address use of supplied allergen reducing equipment. Study team members will address operation, maintenance, and troubleshooting regarding all items provided to the family. Any additional questions regarding these items will be addressed as well. Parents/caregivers will receive a gift card at the end of visit 2 and $100 will be upload on the giftcard following the completion of visit 2 surveys by the caregiver.

Scheduled Contact Points – Following completion of visit 1 and 2, follow-up phone calls to conduct brief qualitative interviews and electronic surveys will be scheduled at 3, 6, 9, and 12-months following visit 1 and last 5-15 minutes. A study team member will place a follow-up call to families at the identified time points. During these calls, any questions regarding environmental triggers and the individualized environmental asthma trigger mitigation plan will be addressed. If the parent/caregiver has questions we are unable to address, we will obtain that information and provide it to the family or connect them to the resource that can address

their question. Following any initial question and answer time, participants will be sent the follow up survey link for that study visit for completion during or after the call. In addition to this, some questions at 3-6 months will be conducted over the phone, utilizing our phone script, as part of our tailoring methods. The single link will include both the youth and parent/caregiver survey for that follow up visit (e.g., parents will receive 3-month follow-up survey link including the 4-question youth participant survey, followed by the 17-question parent/caregiver survey). Participants can opt to have the questions read to them and completed by phone. If not completed during the call, up to 3 follow-up reminder calls or emails will be made to families to complete the follow up survey. Once each follow-up survey is completed, $15 will be added to the parent/caregiver gift card. In addition to trigger mitigation materials and resources, families/households will receive a total compensation of $160 per participant/family. See Figure 5 for follow up visit procedures.

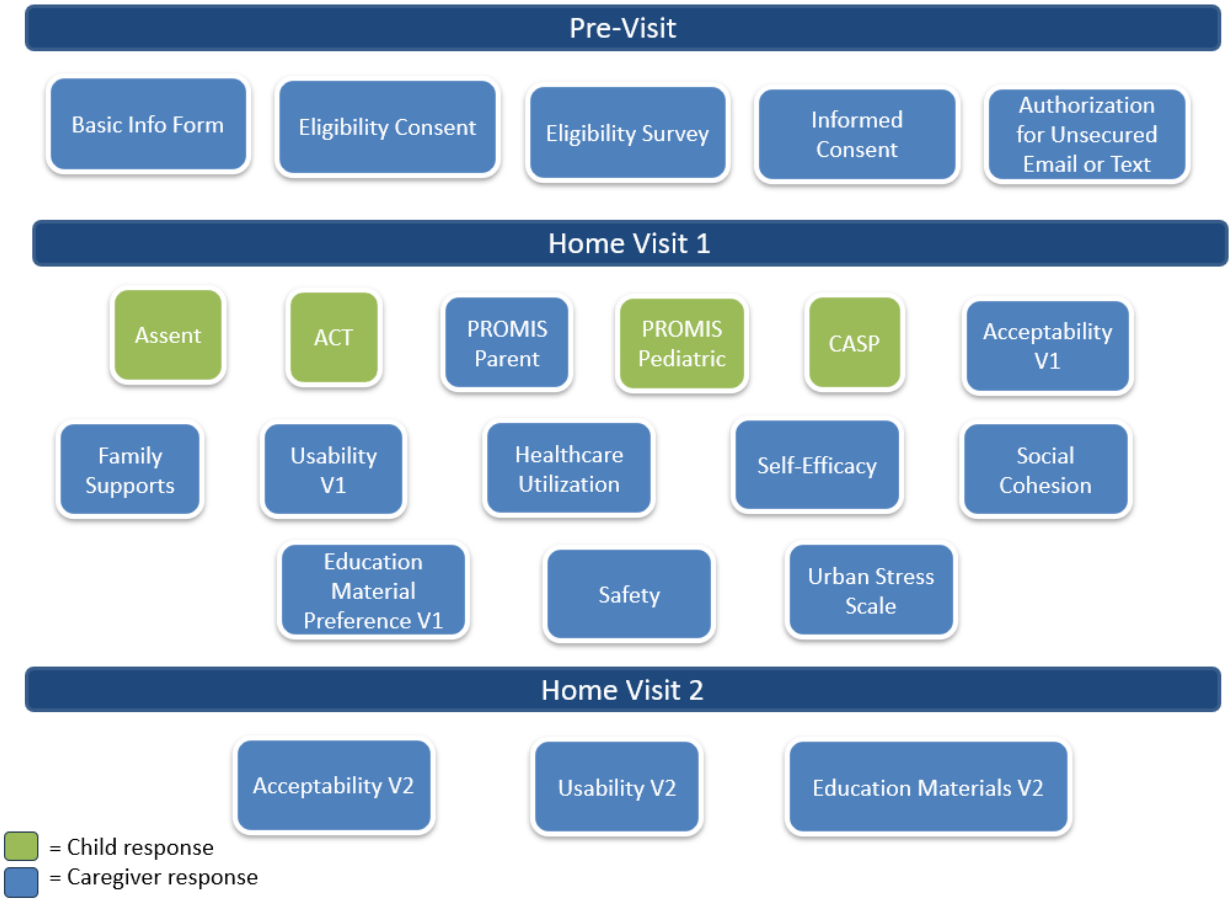
Tailoring Contact Points

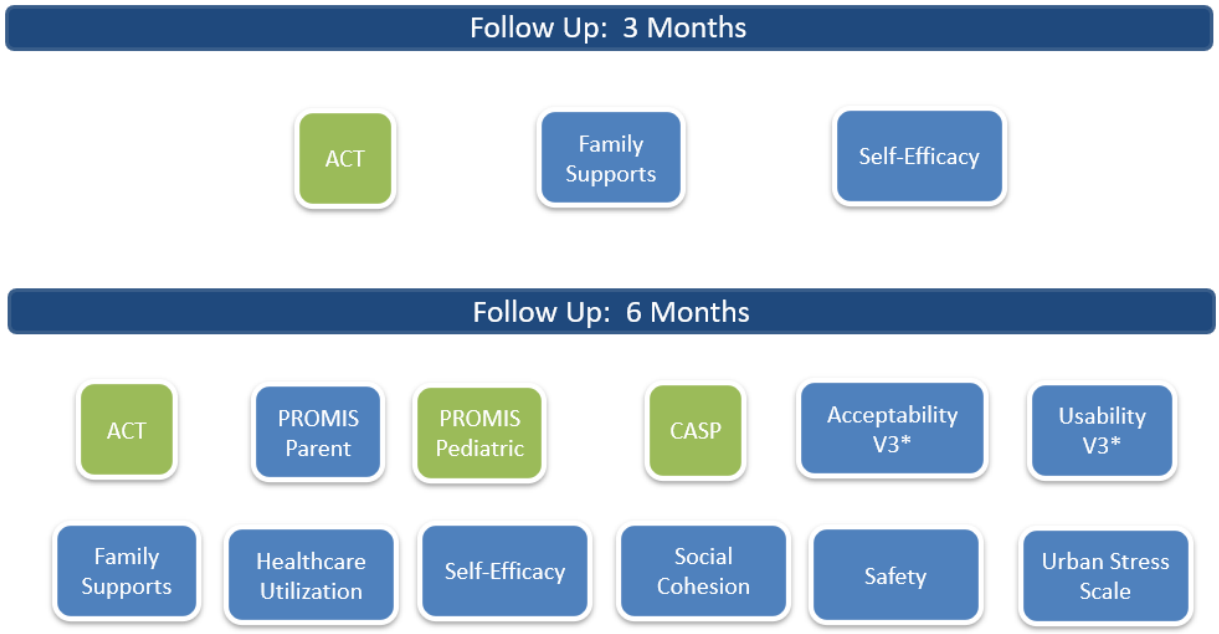
Additional phone calls outside of the 3, 6, 9, and 12-month data collection points as well as an additional home visit after month 6 will be provided if a participant is deemed a non-responder at tailoring time points. See section 4.8 and figure 6 for more details.

Figure 4. Study Initial Visit Flow Chart

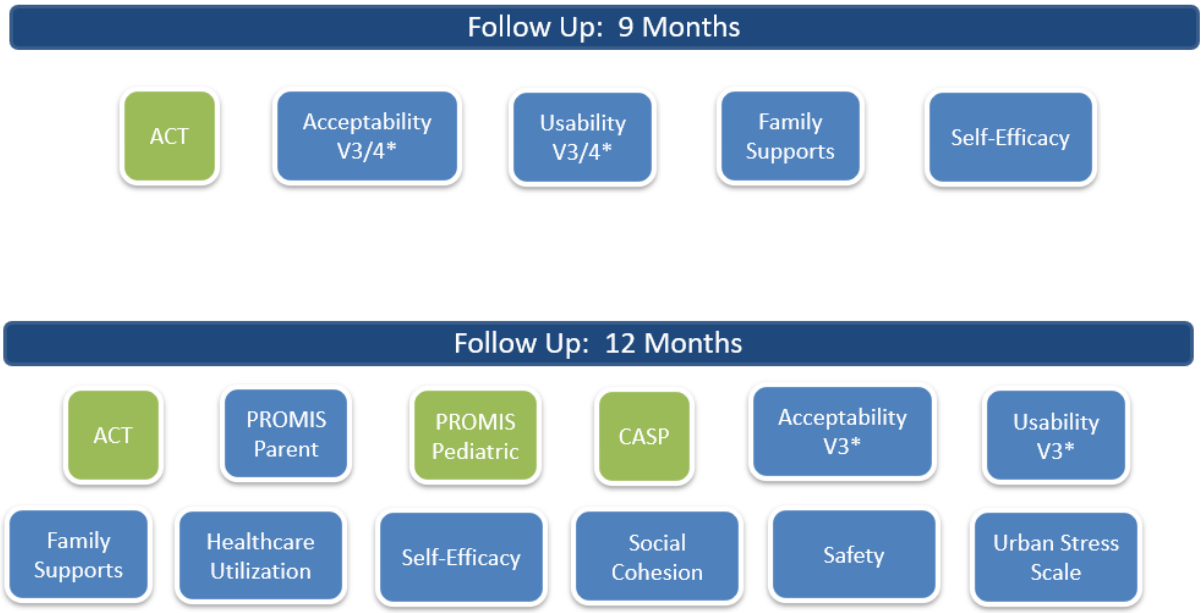
Initial Home Visit Procedure			
Parents 5-11	**5-11 Youth**	**Parents 12-17**	**12-17 Youth**
❑ ACT Parent Proxy [only ages 4-11]	❑ Assent	❑ ACT Parent Proxy [12+]	❑ Assent
❑ PROMIS Parent	❑ ACT [only ages 4-11]	❑ PROMIS Parent	❑ ACT [12+]
❑ Acceptability V1	❑ PROMIS Pediatric	❑ Acceptability V1	❑ PROMIS Pediatric
❑ Usability V1	❑ CASP	❑ Usability V1	❑ CASP
❑ Education Materials Preference V1		❑ Education Materials Preference	
❑ Family Supports & Follow Through		❑ Family Supports & Follow Through	
❑ Healthcare Utilization (CHAMPS)		❑ Healthcare Utilization (CHAMPS)	
❑ Self-Efficacy		❑ Self-Efficacy	
❑ Social Cohesion		❑ Social Cohesion	
❑ Safety		❑ Safety	
❑ Urban Stress Scale		❑ Urban Stress Scale	

Figure 5. Follow-Up Visits Flow Chart





*Only required of participants that are determined to be a non-responder



*Only required of participants that are determined to be a non-responder

Figure 6. Adaptive Trial Design

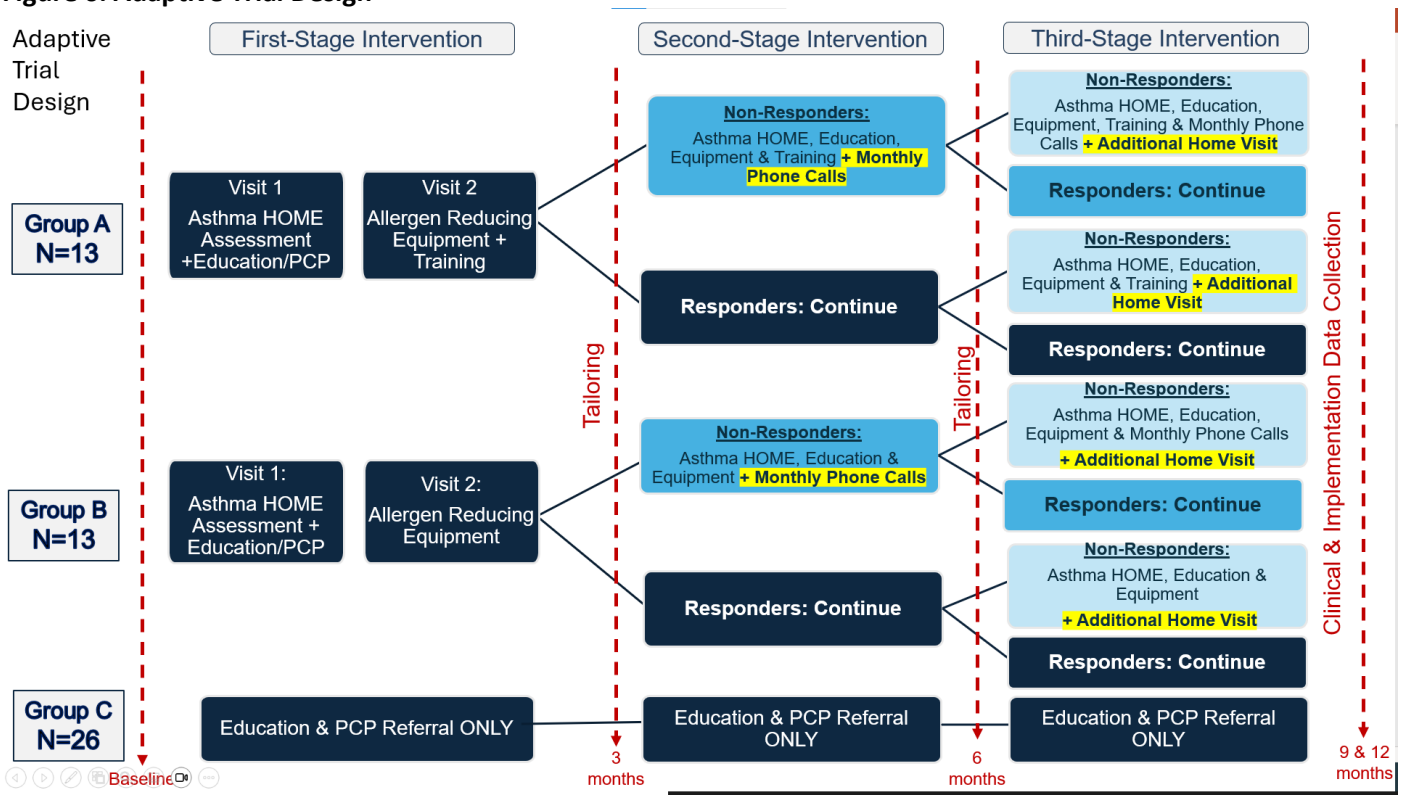
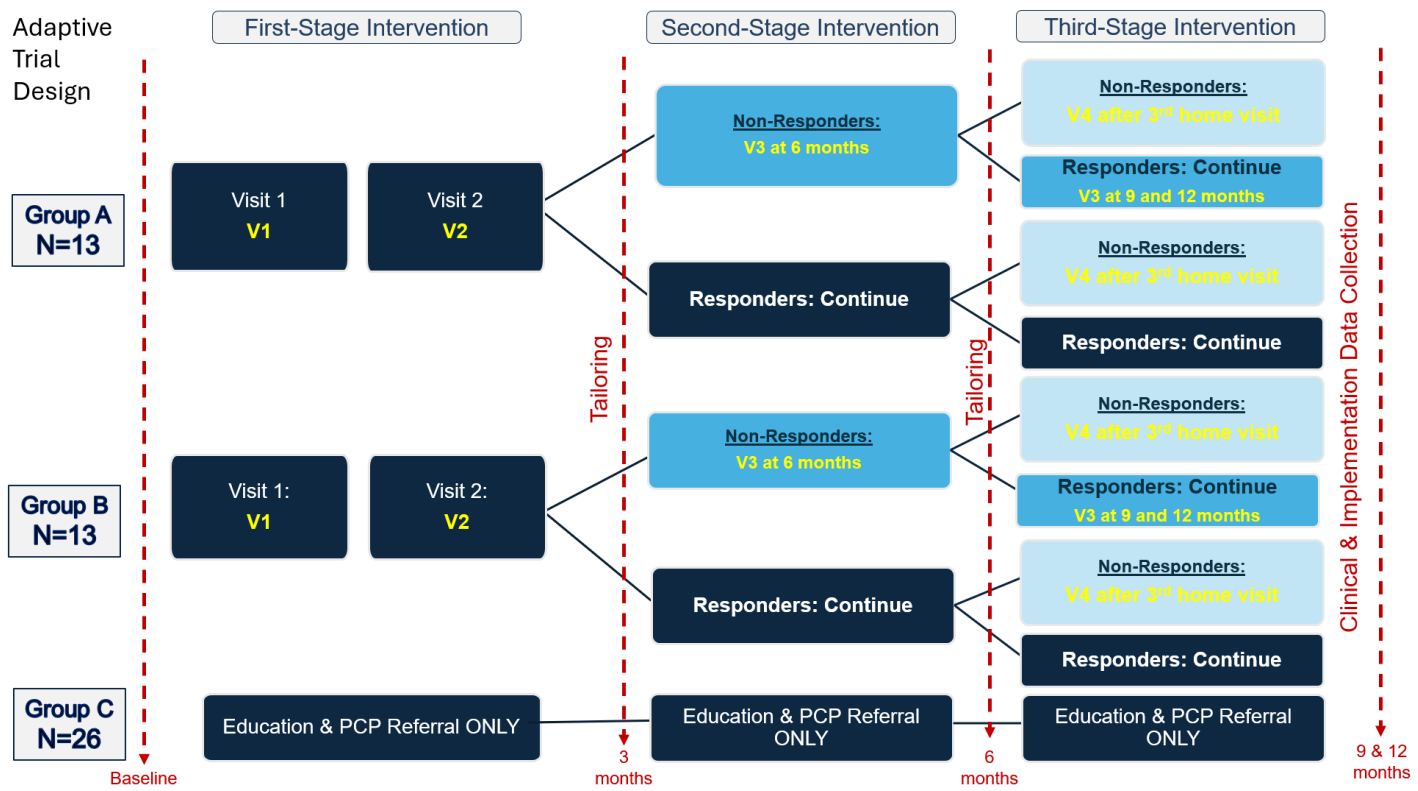


Figure 6. Adaptive Trial Design with Usability and Acceptability Surveys Based on Non-Responders



3.9 Relevant Data Management Procedures

All survey data will be collected via the Research Electronic Data Capture (REDCap) system hosted by the Washington University School of Medicine Institute for Informatics. The REDCap system facilitates data quality with a variety of real time quality control procedures such as branching logic, range checks and cross-form edit checks. The study team has experience building and managing surveys and datasets in REDCap. The study team will build the initial visit assessment battery consisting of the instruments described previously as well as the follow-up visit surveys in in REDCap for electronic administration, scoring, and data storage. The study team will conduct initial quality control checks of all data using the Data Quality application in REDCap. REDCap data will be converted into a study database using SAS. Additional quality control programs will verify study identification numbers and check for incomplete or peculiar data. Missing or potentially erroneous data will be reported for investigation and resolution using a study-specific data query system. Routine reporting will monitor study progress, recruitment and data completeness and quality.

The name of the parent and child will be reported in the consent form, along with the child's birthday. They will then be given a participant ID with first and last initial and participant number (i.e. AEC0001). The participant number will then be used in the other REDCap instruments and assessments, so as to not include PHI. Identifiers for those who do NOT enroll will be destroyed at the earliest opportunity, consistent with the conduct of the research (for example when recruitment and enrollment are completed). All PHI generated from this study will be stored in password protected and restricted folders on WUSTL Box (only authorized study members have access).

Participants will be asked qualitative questions verbally, and responses will be audio recorded on two tape recorders. The extra tape recorder is functioning as a back-up device. Audio files will be uploaded to a secure WUSTL Box folder (password protected and only authorized study members have access). The recordings will be named with the identifier (i.e. AEC0001). Once uploaded to WUSTL Box secure, recordings will be deleted from devices.

The informed consent and authorization for unsecured messaging will be completed via DocuSign. DocuSign is a WUSTL Human Subjects Research approved E-consent platform. DocuSign enables researchers to easily collected eSignatures on documents sent to collaborators, colleagues, and potential participants. With DocuSign, electronic signatures can be securely and easily collected. All informed consent and authorization for unsecured messaging forms from this study will be stored in password protected and restricted folders on WUSTL Box (only authorized study members have access).

The WashU IT sponsored Google Voice pilot will be used to contact participants as needed when outside of the office. The Google Voice account will only be accessed by team members that are a part of the Asthma HOME team and those who have been added to the account, which is limited to 5 members, by the WashU IT department.

Microsoft Bookings is a scheduling tool and is part of the Microsoft Office. Bookings will be used for Asthma HOME to manage the home visit schedule. Bookings is associated with team member emails, which requires sign in for access. Only those on the Asthma HOME will have access to Booking in order to schedule home visit appointments and create a visit reminder email.

4. Expected Outcomes and Limitations

We expect that the developed occupation-based asthma home environmental assessment will be perceived as acceptable to caregivers. We expect that caregivers and implementers will perceive the home assessment, procedures, and implementation strategies to be usable. We expect that the assessment and implementations strategies will be found to be effective, with effectiveness measured as outlined in the aims.

Potential benefits for individual families include receiving an individualized report on what asthma environmental triggers were present in their homes, recommendations on evidence-based interventions to mitigate or reduce identified triggers, as well as resources on funding opportunities if they choose to modify their home in the future based on environmental trigger identification. Larger societal outcomes could include creating an assessment that could be valuable to and used by OTPs, providers that are already in the school system and providing home health services, settings where children spend the most time. Engaging OTPs could lead to increases in the number of professionals conducting assessments, increasing accessibility to this evidence-based intervention. This study could serve as a blueprint for using electronic health record platforms such as EPIC to identify patients that could benefit from participating in an occupation-based asthma home environmental assessment. Last, this study could raise awareness among healthcare workers and community members on the benefits of asthma home assessments and clean environments and lead to further advocacy on the state or national level for further funding of these services as well as new policies aimed at reducing harmful air toxins.

As with any program, there are potential challenges that could arise and should be thoughtfully considered to best build in safeguards and protect the success of the program. Potential limitations include (a) challenges navigating the EPIC system to identify potential participants across the three medical settings, (b) challenges in recruitment of participants and potential low follow-up response rate for the electronic surveys, and (c) challenges with scheduling a convenient time for research team members to visit residences.

To address these potential challenges, we will (a) schedule meetings at the front end with EPIC staff to ensure that methods are as accurate and efficient as possible, (b) oversample to reach the targeted number of participants and offer monetary incentives to participate in the follow-up surveys, and (c) allow study visits to be scheduled outside of typical office hours to increase availability of team members to participants. We will leverage EPIC and our relationships with St. Louis Children's Hospital (SLCH) and WUSM providers to address recruitment challenges and to ensure that we meet enrollment goals.

5. Timeline

Table 1: Initial and Follow-Up

	Pre-Visit	Initial Visit	Visit 2	3 Month Follow Up	6 Month Follow Up	9 Month Follow Up	12 Month Follow Up
Basic Information Form							
Consent for Eligibility							

Eligibility Survey							
Informed Consent							
Authorization for Unsecured Email or Text							
Informed Consent							
Assent							
ACT							
PROMIS							
CASP							
Acceptability					**	**	**
Usability					**	**	**
Education Materials Preference							
Family Supports and Follow Through*							
Healthcare Utilization							
Self- Efficacy							
Social Cohesion							
Safety							
Urban Stress Scale							

*Varies based on question. See Implementation and Additional Questions Document in Box

** Only required of participants that are determined to be a non-responder

Table 2: Study Timeline

Research Aims & Activities	Pre-Year 1	Year 1				Year 2				Year 3			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Aim 1 Activities													
▪ Develop strategy bundle	DONE												
▪ Iterative refinement of strategy bundle													
Dissemination Activities													
▪ Manuscript preparation													
▪ Conference Abstract Submission													
Aim 2 Activities													
▪ Developing study protocol & materials	DONE												
▪ Obtain study equipment													
▪ Recruitment & Enrollment													

▪ Data collection													
▪ Data analysis													
▪ Refine future clinical trial design													
▪ Prepare R01 proposal for submission													
Dissemination Activities													
▪ Manuscript preparation													
▪ Conference Abstract Submission													

Table 3: Allergen Kit

Category	Item	Quantity per household	Cost per item	Total Cost per household
Air Cleaners	LG USA – 360 Hit_NANO HEPA Filter	1	259.99	259.99
HVAC Air Filters	TBD			
Cleaning Supplies	mop with washable scrubbing pads	1	19.97	19.97
	castile soap 8 oz (liquid)- unscented	1	9.99	9.99
	castile soap (bars)- unscented 4-pack	5 bars of soap	4.98	6.23
	spray bottle	2	1.25	2.5
	white vinegar	1	1.58	1.58
	lemon juice	1	1.78	1.78
	baking soda- 64oz	1	3.24	3.24
	washing soda- 55oz	1	5.11	5.11
	wool dryer balls- 6 pack	2 dryer balls	8.97	2.99
	rubber gloves- 3 pack	3	7.99	7.99
	face masks- 50 count	1	2.99	2.99
	hand held scrubbers	2	1.97	3.94
	measuring cups and spoons	1	7.99	7.99
	HEPA vacuum	1	79.99	79.99
Bedding	Mattress encasing	1	57.6	57.6
	Pillow encasings (2pk)	2	20.99	20.99
	Pillows (2pk)	2	14.99	14.99
Pest Management	Glue traps- 2 pack	2	2.18	4.36

			Total:	**514.22**

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