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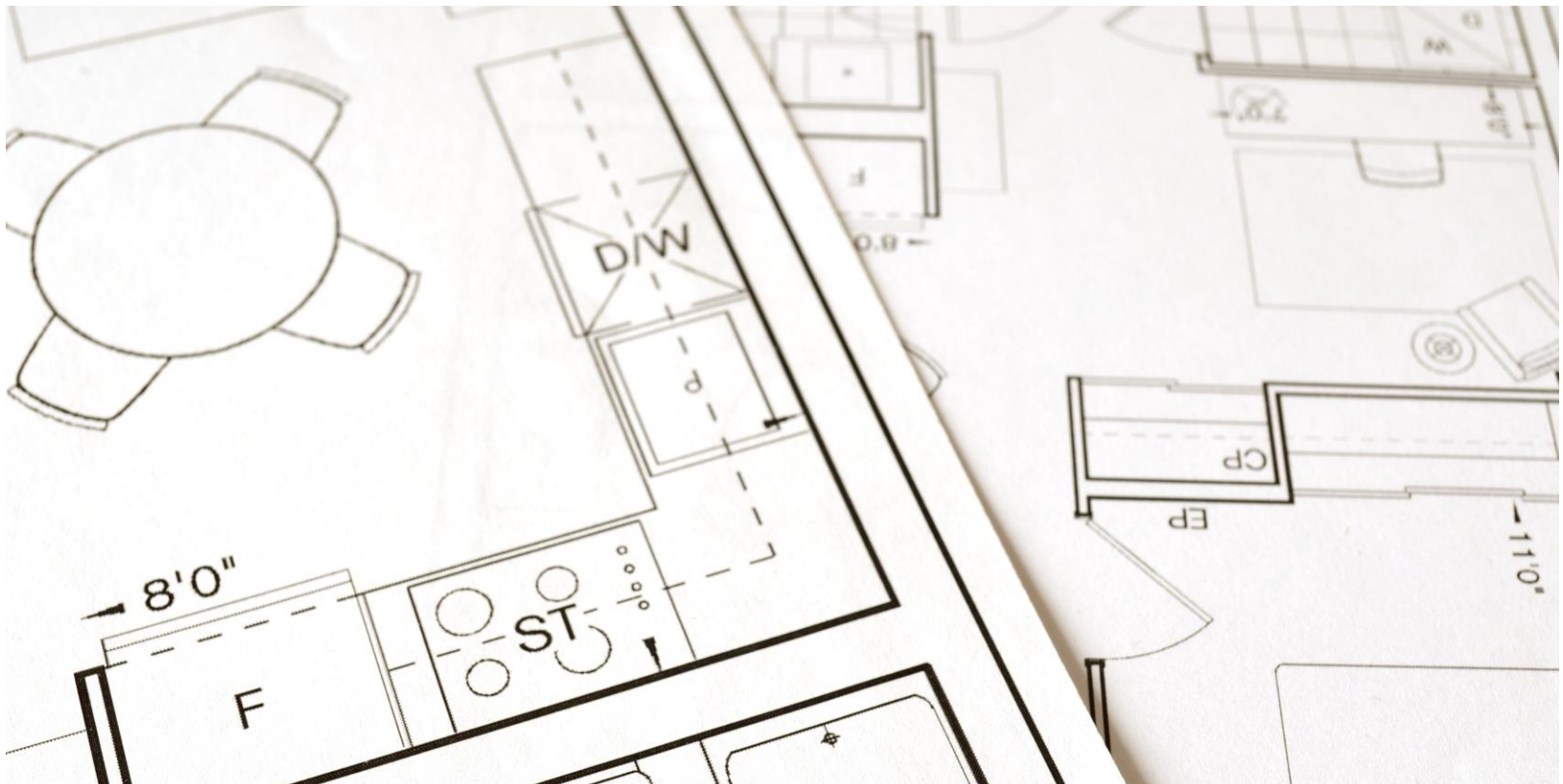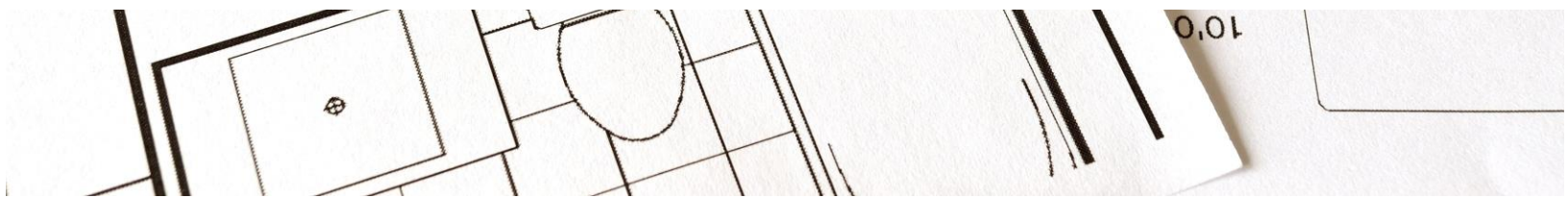
Healthy Homes and Asthma

A healthy housing blueprint to improving asthma outcomes

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The Green & Healthy Homes Initiative (GHHI), founded in 1986,
is a national 501(c)3 nonprofit, nonpartisan organization that provides evidence-based direct services and technical assistance to create healthy, safe and energy efficient homes to improve health, economic and social outcomes for low-income families
while reducing public and private healthcare costs.

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Executive Summary

An overwhelming amount of research and evidence[1] shows that healthy housing practices improve the control of asthma for children and adults. Medical treatment alone is insufficient in preventing asthma exacerbations for many patients; addressing the root causes found inside the home can be just as important as ensuring proper medication adherence.
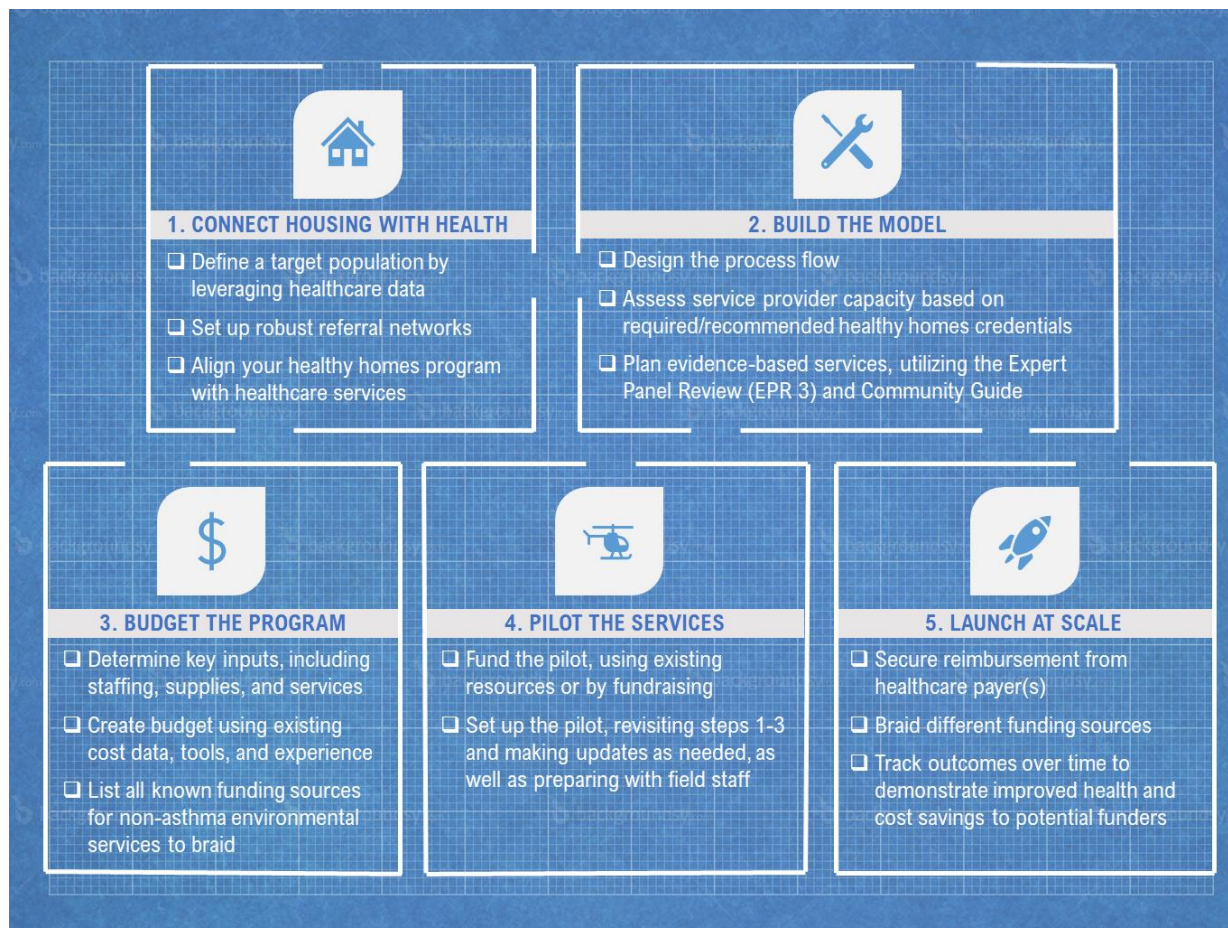
Every year, local agencies and service providers across the country perform vital home rehabilitation services funded by organizations such as the Department of Housing and Urban Development (HUD) to address numerous unhealthy housing conditions found in their communities. With a thorough understanding of how housing-related interventions can prevent asthma exacerbations, service providers can deliver these services more effectively, in alignment with the healthcare system, and for families that need them the most.

This publication is meant to assist current lead or healthy homes practitioners who perform, or seek to perform, home repairs to address asthma triggers. The document provides an overview of healthy homes interventions that improve health outcomes for individuals with asthma and lays out a five-step blueprint, summarized below, for how to develop and deliver effective, high-value program interventions that address the environmental triggers of asthma. Practitioners will also learn about steps in forming successful partnerships in the healthcare system, including funding and operational factors necessary to sustain effective programs.

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[1]   Based on a systematic review of research published to date, the National Institute of Health's (NIH) National Heart, Lung, and Blood Institute issued the Guidelines for Diagnosis and Management of Asthma (EPR-3) in 2007, which includes recommendations for addressing a number of asthma triggers within the home. In 2011, the Centers for Disease Control and Prevention's (CDC) Community Guide issued recommendations for home-based, multi-trigger, multicomponent interventions with an environmental focus for reducing asthma morbidity. Those interventions are discussed in this publication.

Infographic Summary
A Healthy Housing Blueprint to Improving Asthma Outcomes

1. CONNECT HOUSING WITH HEALTH

❑ Define a target population by leveraging healthcare data

❑ Set up robust referral networks

❑ Align your healthy homes program with healthcare services

2. BUILD THE MODEL

❑ Design the process flow

❑ Assess service provider capacity based on required/recommended healthy homes credentials

❑ Plan evidence-based services, utilizing the Expert Panel Review (EPR 3) and Community Guide

3. BUDGET THE PROGRAM

❑ Determine key inputs, including staffing, supplies, and services

❑ Create budget using existing cost data, tools, and experience

❑ List all known funding sources for non-asthma environmental services to braid

4. PILOT THE SERVICES

❑ Fund the pilot, using existing resources or by fundraising

❑ Set up the pilot, revisiting steps 1-3 and making updates as needed, as well as preparing with field staff

5. LAUNCH AT SCALE

❑ Secure reimbursement from healthcare payer(s)

❑ Braid different funding sources

❑ Track outcomes over time to demonstrate improved health and cost savings to potential funders

Contents

Background and Context
The opportunity to improve asthma outcomes in the U.S.

Asthma Burden in the United States

Asthma burden in the United States is staggering and provides an excellent opportunity to address one of the largest and most consistent public health issues in the country. One in 11 children and one in 12 adults have asthma in the United States. In 2017, asthma affected 25.2 million people in the United States, causing 1.78 million emergency department visits and claiming the lives of 3,600 people.[2] The annual cost of asthma is estimated to be $80 billion in the United States.[3]

The annual burden of asthma is staggering

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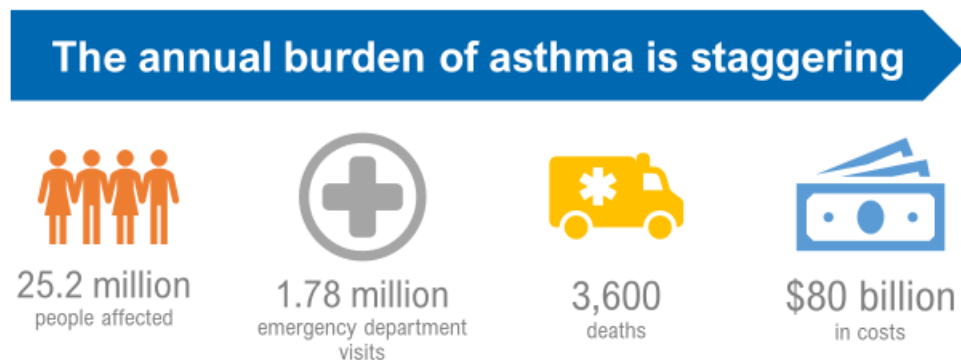
Health equity is also a critical issue that is deeply tied to asthma triggered by unhealthy home environments. Vulnerable and low-income families are disproportionally at risk of having poor asthma outcomes due to poor housing quality.

A large portion of these costs are avoidable if persons with asthma receive the necessary asthma care management services to prevent exacerbations and thereby prevent visits to the hospital and emergency room. The evidence base shows that delivering a comprehensive suite of care management and environmental remediation services through home visiting programs will prevent future medical utilization. If these services are delivered at scale, service providers will collectively reduce the asthma burden in this country.

Green & Healthy Homes Initiative and Asthma

As a direct service provider based in Baltimore, Maryland, Green & Healthy Homes Initiative (GHHI) has decades of experience advocating for and delivering home-based environmental health services. GHHI began as an organization addressing childhood lead poisoning and today has programs that address a wide range of healthy homes issue areas including lead poisoning,

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2   Centers for Disease Control and Prevention. 2017.
https://www.cdc.gov/asthma/most_recent_national_asthma_data.htm.
3   American Thoracic Society. 2018. https://www.thoracic.org/about/newsroom/press-releases/journal/2018/asthma-costs-the-us-economy-more-than-80-billion-per-year.php

asthma, trip and fall injury, energy efficiency, and weatherization. In 2014, GHHI published findings from an asthma Healthy Homes Demonstration project, which found that its intervention led to 66% reduction in asthma hospitalizations and 28% reduction in emergency department visits.[4]

Based on its innovative, community-based approach to addressing asthma, GHHI was a proud recipient of the 2015 EPA National Environmental Leadership Award in Asthma Management. In addition to performing direct services for families in Maryland, GHHI provides technical support to public- and private-sector partners across the country to develop, implement, and finance healthy homes programs. Many of our partners run programs supported by HUD Lead and Healthy Homes grants, as well as other agency or philanthropic programs.

In recent years, GHHI began exploring new funding sources to support the important work that service providers have been undertaking to improve asthma outcomes across the country. Traditionally, services like remediating mold, integrated pest management, or replacing carpets are supported by HUD grants, Community Development Block Grants (CDBG), and other community development programs and not by healthcare dollars, even though many of the benefits of doing such work accrue to the healthcare system. To better align and scale the initial investment in improving housing conditions with the resulting health benefits, GHHI has been developing projects with health plans, healthcare providers, environmental health service providers, and policymakers in jurisdictions around the country. The goal of these projects is to enable Medicaid funds to pay for home-based programs that decrease medical utilization related to asthma and address health inequities related to asthma. The broader policy objective of these projects is to enable Medicaid funds to reimburse for any preventive program that results in medical utilization, including environmental health services.

Across GHHI's portfolio of asthma-focused work[5], we have performed cost-benefit analysis of asthma programs using actuarial projections and detailed economic modeling. To date, all projects have shown a positive return on investment for asthma patients who are high utilizers of medical services (e.g. hospital stays or multiple emergency department visits). The high rates of

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[4]   https://s3-us-west-2.amazonaws.com/mcf-redesign-assets/multimedia/Environmental-Justice-journal-article-on-GHHI-2014.pdf?mtime=20170117142828

[5]   GHHI currently works on over two dozen asthma-focused projects across the country with healthcare and housing rehabilitation organizations; for each of these projects, we are looking at the potential for innovative financing mechanisms to support these asthma programs.

return for providing these services help build the case to healthcare payers that preventive asthma programs do indeed lead to overall cost savings as a result of improved health outcomes. Findings from preliminary projects can be found on the GHHI website.[6]

[6] https://www.greenandhealthyhomes.org/services/innovation/resources/

Multi-trigger, Multicomponent Intervention
Understanding the evidence to put it into practice

Research evidence has established that individually tailored environmental control practices, which are multi-trigger, multicomponent in-home interventions, are similar in efficacy and cost in reducing asthma symptoms and exacerbations to controller medications.[7] The burden of asthma is a growing problem that greatly contributes to social inequalities in health outcomes and health disparities, which are neither inevitable nor irremediable, in communities across the nation. Physical and social determinants of health related to indoor environment are known to be contributing causes of asthma morbidity and exacerbations and disproportionately burden populations, especially children and minorities, rendered systematically vulnerable by underlying social structures and political, economic and legal institutions.[8]

Four Components of Asthma Management
EPR 3's four components of asthma care include (1) assessment and monitoring, (2) patient education, (3) control of environmental factors and other conditions that affect asthma, and (4) medications.
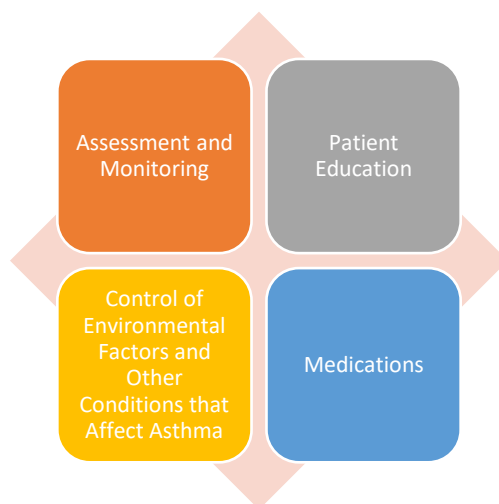
Clinic-based asthma programs are well equipped to address three of these four components. In some cases, asthma programs have the capacity to evaluate home environments to identify asthma triggers; however, in most cases they lack the capacity and resources to address and remediate these asthma triggers. To fully meet the recommendations of the EPR 3, GHHI works with jurisdictions across the country to fully integrate home-based interventions in coordination with clinical care to provide a comprehensive set of services.

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7   Matsui, E, S Abramson, and M Sandel. 2016. "Indoor Environmental Control Practices and Asthma Management." Pediatrics 138 (5).

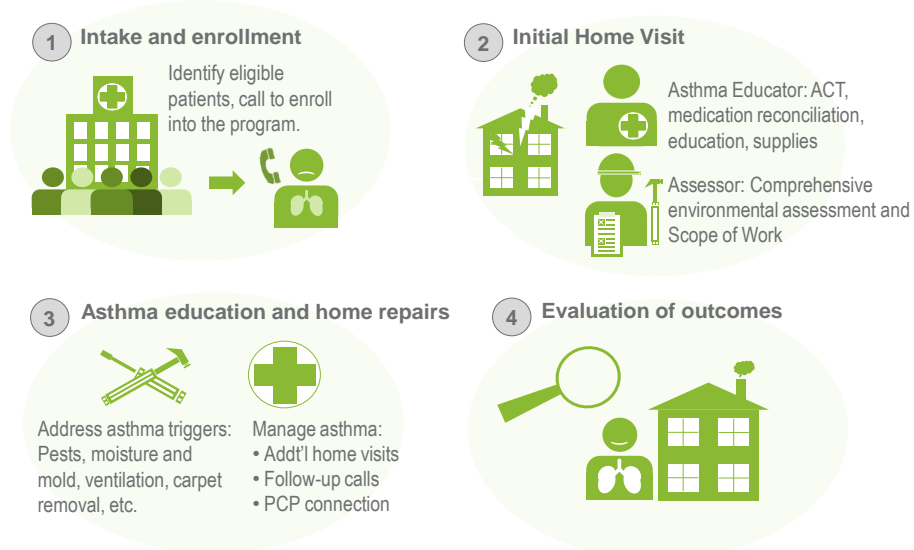8   Krieger, Nancy. 2001. "A glossary for social epidemiology." Journal of epidemiology and community health 55 (20): 693-700.

Exhibit 1 provides an example of a home-based program model that would complement the medical services that an asthma patient receives from his or her medical providers through standard channels. Programs across the country have their own unique program components but often follow this general model.

Exhibit 1

The multi-trigger, multi-component model is based on a rich body of evidence as well as GHHI's experience as direct service provider in MD.

Green & Healthy Homes Initiative®

1 **Intake and enrollment**

Identify eligible patients, call to enroll into the program.

2 **Initial Home Visit**

Asthma Educator: ACT, medication reconciliation, education, supplies

Assessor: Comprehensive environmental assessment and Scope of Work

3 **Asthma education and home repairs**

Address asthma triggers: Pests, moisture and mold, ventilation, carpet removal, etc.

Manage asthma:
• Addt'l home visits
• Follow-up calls
• PCP connection

4 **Evaluation of outcomes**

www.ghhi.org

The section of this publication *Step 2: Building the Model* provides further detail for organizations seeking to develop or expand programs to incorporate these services.

Evidence Base

Multiple research studies have produced evidence that comprehensive asthma interventions that include the four components of asthma care management recommended in the National Asthma Education and Prevention Program (NAEPP) Expert Panel Report 3 (EPR 3) reduce asthma-related hospitalizations and emergency department visits. The Centers for Disease Control and Prevention's Community Preventive Services Task Force implemented a systematic review of 22 studies focused on comprehensive asthma interventions and published results on the Community Guide website.[9] Below are a few of the key findings.

- The meta-analysis shows a median decrease of 0.57 acute healthcare visits per year and cost-benefit studies also show a return of $5.3 to $14.0 for each dollar invested.
- Program cost per participant ranged from $231 to $14,858 for all thirteen interventions.

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[9] Community Preventive Services Task Force. 2011. Asthma: Home-Based Multi-Trigger, Multicomponent Environmental Interventions - Children and Adolescents with Asthma. https://www.thecommunityguide.org/findings/asthma-home-based-multi-trigger-multicomponent-environmental-interventions-children-and.

- The Task Force recommends the use of home-based multi-trigger, multicomponent interventions with an environmental focus for children and adolescents with asthma based on strong evidence of effectiveness in improving overall quality of life and productivity.
- "The effectiveness of these interventions in adults is inconclusive due to the small number of studies and inconsistent results. Additional studies are needed to (1) evaluate the effectiveness of these interventions in adults and (2) determine the individual contributions of the various intervention components."[10]

Several additional studies outside of this review, most of which involve survey-generated data, indicate similar findings.

Policy Environment

In recent years, new opportunities have developed for healthy homes programs to partner with healthcare organizations to deliver environmental health services in the home setting, as social determinants of health such as housing conditions are increasingly recognized as areas that need to be addressed. Numerous efforts have launched around incorporating non-traditional services into the delivery of medical care. Several state Medicaid programs such as New York have utilized waivers to implement delivery system reform and incorporate upstream investments to address social determinants. Oregon has implemented healthy homes assessments for asthma as part of its Targeted Case Management Services.[11] North Carolina's 2019 waiver and Healthy Opportunities Pilot will scale SDOH services in a first-of-its-kind model.

Nonprofit hospitals are natural partners in collaborating on an asthma program, as they often have community-based initiatives to advance their missions of improving overall health for vulnerable populations. National policy is also shaping how nonprofit hospitals invest in their local community. As part of a 2013 IRS rule change under the Affordable Care Act, nonprofit hospitals are required to conduct community health needs assessments every three years and provide a plan to direct resources to address the findings (along with the traditional activities of hospitals using community benefits to cover the losses they assume from noninsured or underinsured patients). As part of each nonprofit hospital's 990, section Schedule H part II includes information on their community building activities, including housing, economic development, environmental improvements and other community supports that address the root cause of community health problems.

A Medicaid Rule Change in 2014 removed the restrictions on Medicaid from reimbursing non-clinical professionals for services. This creates the opportunity for professionals such as community health workers or environmental assessors to be reimbursed for services. The Rule Change did not, however, change which services are deemed eligible for reimbursement, so an activity that was restricted from reimbursement due to statutory or regulatory issues would still

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[10] Crocker, D. D., S. Kinyota, G. G Dumitru, C. B. Ligon, E. J. Herman, J. M. Ferdinands, D. P. Hopkins, B. M. Lawrence, and T. A. Sipe. 2011. "Effectiveness of home-based, multi-trigger, multicomponent interventions with an environmental focus for reducing asthma morbidity: a community guide systematic review." American journal of preventive medicine 41 (2): S5-S32.

[11] http://www.oregon.gov/oha/HSD/OHP/Policies/138rb040117.pdf

be ineligible. For a state to implement new reimbursements under the rule change, it must submit a State Plan Amendment that addresses which professionals they would now reimburse and what credentialing and training would be required. In 2016 CMS approved Missouri's State Plan Amendment that added home assessments as a covered service to address asthma triggers to its state plan.[12]

For healthy homes interventions, such as the removal of carpets, that may be deemed outside of the bounds of a traditional fee-for-service payment model, updates to value-based care regulations offers new opportunities as well. Value-based arrangements, which are increasing in prevalence across the country, allow healthcare payers to tie some portion (or all) of provider payments to outcomes rather than volume of services delivered. An update to the Medicaid Managed Care Regulations in 2016 clarifies that value-based payments and similar alternative payment models are allowable activities. Several states are looking at how non-traditional services can be supported through funding the services' health outcomes even if the services themselves cannot be directly funded. For example, using the savings from decreased asthma-related hospitalizations to fund the comprehensive healthy home services that are responsible for the avoided incident. Oregon was approved in 2017 for an 1115 waiver renewal that included a value-based payment model for "health-related services" with air-conditioners cited as an example. As of October 2019, GHHI is working with stakeholders in New York, including a Medicaid health plan, to construct an asthma Pay for Success project using value-based payments as the means to pay for non-medical services.

Several states have also advanced funding non-traditional services through awards from the Center for Medicare and Medicaid Innovation (CMMI) including the State Innovation Model awards.[13]

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[12] https://www.medicaid.gov/State-resource-center/Medicaid-State-Plan-Amendments/Downloads/MO/MO-16-04.pdf
[13] https://innovation.cms.gov/initiatives/state-innovations/

5-Step Blueprint for Addressing Asthma with Healthy Homes Services

How to set up and implement a healthy homes program to improve asthma outcomes

There are many factors that go into setting up and running an effective asthma program; this document summarizes the process using a 5-step blueprint.

STEP 1: CONNECT HOUSING WITH HEALTH

Comprehensive asthma care depends on a coordinated approach to the medical and environmental needs of each patient. Building strong relationships with healthcare partners is the crucial first step in setting up effective referral pathways and leveraging healthcare financial and analytic capacities to identify subpopulations of high-utilizers in target communities.

STEP 2: BUILD THE MODEL

Once connected, healthcare providers and healthy homes practitioners need to build out the steps for referral, intake, and coordination of services. A smooth process flow is key to a successful program.

STEP 3: BUDGET THE PROGRAM

The overall program cost will depend on local conditions, the level of existing reimbursement for existing healthcare services, and other key assumptions.

STEP 4: PILOT THE SERVICES

Operationalizing the program design is the only way to test plans that are on paper. A small-scale pilot lets the program team test the model and budget that has been planned in steps 3 and 4.

STEP 5: LAUNCH AT SCALE

With a pilot completed, there are various ways to support a full-scale program to serve as many clients as possible.

Step 1: Connect Housing with Health

Establishing key partnerships between housing and healthcare entities

The intersection of health and housing is built on a foundation of strong relationships between stakeholders in the healthy homes and healthcare sectors. Establishing key partnerships with local hospitals, health plans, and government agencies will open doors to the necessary data and capacities to serve the highest need asthma patients.

Key Takeaways

Access to healthcare data is essential for identifying a target population.

Robust referral networks depend on strong relationships with health plans, healthcare providers, and health departments.

Aligning healthy homes services with medical services is key to delivering an effective asthma care model.

Define a Target Population

Hospitals and health plans (and other health agencies, in some cases) maintain patient-level data that allow them to track utilization such as emergency department visits and hospitalizations over time- health plans hold medical claims records while hospitals hold charge records. Both types of data allow the healthcare organization to identify asthma patients who are the highest utilizers of healthcare services. These "super utilizers" are prime candidates for referral to healthy homes service providers; addressing home-based environmental triggers for these patients have the greatest potential to prevent future medical utilization related to asthma exacerbations.

To accurately define a target population suitable for receiving home remediation services, the healthy homes service provider should work with the healthcare partner to determine enrollment criteria. Such criteria may include the following:

- **Utilization level.** Example: hospitalization or multiple emergency department visits with primary diagnosis of asthma in the past 12 months.
- **Geography.** Example: patients who reside in Washington County, due to geographic restrictions of the service providers.
- **Insurance enrollment.** Example: if working with an insurance provider, there may be a specific enrolled population that would benefit from the services such as patients enrolled in a Medicaid product.
- **Other.** Healthcare partners may have strategic priorities that inform decisions about enrollment criteria.

Set up Referral Networks

Depending on the healthcare partner(s) engaged in the initiative, there are a number of ways that partners can build referral pathways to a healthy homes program.

Health plan disease management and case management programs

Health plans often have disease management and case management programs that connect plan members with specialized resources. Care or case managers directly connect with members who have been identified by the plan because of medical utilization, such as a hospitalization, or a medical diagnosis-based indication for additional services. These staff work to connect members with the services they need, which include referrals to providers and programs. Healthy Homes programs should reach out to these divisions of their local health plans to begin discussing the identification of members for setting up referrals.

Hospitals and clinics

Hospitals and clinics are also prime sources of referrals. Hospitals increasingly have case management services for their admitted patients that work with physicians to identify and connect patients with programs and services. There are some programs based within emergency room departments as well, such as Health Leads. Sometimes hospitals have departments such as community health that play that role; incorporating community-based services with the clinical services that the hospital delivers. Outpatient clinics, either hospital-based or separate providers of clinical services, can also be referral sources. In a given community, the majority of patients with asthma may receive clinical services from a handful of locations. This concentration should make engaging with hospitals and clinics for referrals more manageable for healthy homes programs.

Local health departments

Local health departments can also be primary sources of referrals, and many health departments have established arrangements with health plans or hospitals and could connect healthy homes programs to these parties. Schools may also be referral candidates for asthma healthy homes programs.

Methods of referrals have traditionally been through fax, emails, or phone calls from the referral source to the healthy homes program, with enough information provided so that the program can attempt to contact the patient. The information provided in the referral is often part of the business associate agreement or memorandum of agreement both parties sign prior to establishing a formal relationship. Arrangements wherein the clinical provider performs outreach to the patient about the healthy homes program prior to the program's own outreach have been found more effective. The timing of the referral also impacts the success rate of healthy homes programs enrolling contacts. The closer the outreach is to the occurrence of the medical event that caused the healthcare partner to make the referral, the better the chance the patient will accept healthy homes services.

With more electronic health records and healthcare information exchanges coming online, there is the opportunity for healthy homes programs to integrate into those networks to streamline the

information exchange pertinent to referrals. For all methods of referrals, healthy homes programs need to be trained on HIPAA compliance.

Align with Healthcare Services

As discussed under the four components of effective asthma management, a comprehensive program relies on coordinated delivery of both clinic-based medical and home-based environmental health services. In addition to inpatient and emergency room services, healthcare partners may have existing clinical programs that specifically help their patients manage asthma. Primary care physicians and other healthcare professionals may also have an existing relationship with the patient and established asthma care plans (e.g. asthma action plan). An effective healthy homes program will include coordination with the patient's regular providers, including primary care physician, care manager, school nurse, and others.

The coordination of healthcare, home remediation, and other social support services can be performed by a healthy homes service provider or from within the healthcare system. Some health plans prefer that coordination services be housed internally, in which case the healthy homes service provider focuses on delivering the home assessment and remediation services.

Step 2: Build the Model

Operationalizing the evidence-based interventions

Service providers who already deliver healthy homes interventions know what it takes to assess and rehabilitate homes most effectively in their communities. The process for addressing environmental asthma triggers is similar to that of other home-based environmental hazards, but includes some unique considerations when aligning services with those delivered by healthcare professionals.

Key Takeaways

Documenting the program model is important to establish formal referral paths and create a common understanding of how the program functions.

Leverage internal and external capacities to deliver program services at the necessary scope and scale.

Look to the evidence base to build the program model and apply knowledge and experience from existing healthy homes programs.

Design the Process Flow

The first step in designing the program model involves a collaborative effort with all service providers involved (medical providers, healthy homes providers, other integral social service providers) to lay out a process flow. Initial stages of planning can include drafting a process flow diagram and operating manual. Exhibit 2 is an example process flow template.

It is important that any process flow design documents clearly indicate where referrals occur between providers, where key decision points must be made, and how roles and responsibilities are segregated between parties. A full version of this process flow template, as well as other planning tools, is available on GHHI's website.

An important aspect of the process flow is performance management and tracking data related to service delivery. In most cases, healthy homes providers and their local healthcare organizations operate on separate data systems. Healthcare data is especially sensitive, given considerations around receiving, storing, and transmitting patient health information (PHI). To access patient-level data, healthy homes providers will need to sign necessary data agreements with all involved parties. In the majority of cases where healthy homes providers do not share a common data platform with their healthcare partners, ad hoc solutions will need to be adopted. For example, a health plan may track their own patients through case management software and generate a weekly list of patients who are eligible for environmental assessment. The healthy housing provider may then download this list into their own data platform to track the patient as they continue through the program.

Assess Service Provider Capacity

A critical piece of the service delivery model is understanding the current capacity of service provider organizations and what is required to meet the scale of expected enrollment. If, for example, a healthy housing agency has historically completed 100 lead units per year and a potential asthma project may include 200 asthma units per year, how does that affect staffing? Does the current staff have existing expertise and capacity? Is hiring and training required?

GHHI works with a diverse group of service providers across and country, and many have experience performing lead and healthy homes services, energy efficiency and weatherization services, but not necessarily asthma-specific services. Oftentimes, these organizations are well aware of health and safety hazards in the home; these issues can be reasons for deferral from many energy or weatherization services. A background in any type of home assessment is a useful foundation for performing asthma trigger assessments. In many cases, environmental asthma trigger assessment can overlap with other types of assessment. For example, assessing for areas of air infiltration as part of an energy audit overlaps with assessing for potential pest (leads to asthma-exacerbating allergens) and water infiltration (leads to mold). The assessment measures are similar, so applying an asthma lens is a natural extension of existing practices.

Below is a list of example organizations that GHHI has or is currently working with; all did not have direct experience with asthma trigger reduction, but have related capacities that lend well to those intervention measures.

- County housing and regional development offices
- Consortium of nonprofit housing service providers
- City housing departments
- City health departments
- Nonprofit housing rehabilitation organizations
- Nonprofit energy efficiency / weatherization organizations

Healthy Homes assessors may hold a variety of certifications and credentials, which establish a strong basis for asthma-focused assessment and scope development. Below is a list of required

and recommended credentials that may be helpful in ensuring a strong knowledge base for health and safety assessment, which includes identification of asthma triggers.

Table 1
Healthy homes credentials

Required	Recommended
• Essentials of Healthy Homes Practitioner Course • Pest Control Applicator Certification • Healthy Homes Rating System (HHRS) training	• Mold Assessor/Inspector Training • Home Inspector License • Fire Inspector License • Building Performance Institute (BPI) Healthy Homes Micro-credential (for energy auditors)

Plan Evidence-based Services

As discussed earlier in this document, the Expert Panel Review (EPR 3) and Community Guide set forth recommendations for environmental remediation services that can help reduce environmental asthma triggers. In the Table 2 in the Appendix, we summarize recommendations from EPR 3 and the Community Guide, and how they relate to healthy homes activities.

During an initial home visit, a home assessment professional should use a comprehensive tool to look for asthma triggers (in addition to other healthy home conditions as applicable by program). HUD has utilized a healthy homes rating system (HHRS) as part of its healthy homes supplemental funding for lead grantees that incorporates risk assessment.[14] This method allows assessors to stratify hazards and make informed decisions on how to utilize resources. GHHI's comprehensive assessment is one example tool that consolidates energy, health, and safety issues, but there are many other effective examples as well. An excerpt of the GHHI tool is available at www.greenandhealthyhomesinitiative.org.

Once a home assessment has been performed, the healthy homes professional creates a scope of work to address the identified asthma triggers. When considering available services to address the triggers, we categorize these services into two tiers. Tier 1 services are those services and supplies that can be delivered without performing physical modifications to the home. Tier 2 services are those that do result in some kind of home modification, often performed by construction crews or housing rehabilitation specialists. By using a tiered approach, we can efficiently deploy staff persons with specialized capacities depending on the job requirements. For example, if we categorize a home as "Tier 1," a community health worker may perform home visits and provide mattress and pillow covers, vacuum, and cleaning supplies. If home modifications are required, then a larger team of healthy housing technicians would be deployed for Tier 2 services. While all healthy housing organizations may not use this tiered approach, we find that some level of categorization is helpful in managing process, staff, and resources.

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[14] https://portal.hud.gov/hudportal/HUD?src=/program_offices/healthy_homes/hhrs

Step 3: Budget the Program

Determining how much it will cost to implement an asthma program

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The cost of running an asthma program varies widely across the country and is dependent on a variety of factors, including but not limited to: type of organizations delivering services, credentialing of field staff, number of supplies provided at home visits, number of home visits and phone calls, extent and sophistication of data collection, state of local housing stock, and local consumer price index. Despite these factors, the process that we follow for budgeting an asthma program is fairly consistent across sites.

Key Takeaways

Begin with a strong understanding of all program elements, including staffing, supplies, and services required to carry out an effective program.

In the absence of existing cost data, leverage experience and tools from others as well as data from similar or related healthy homes programs.

Key Inputs

The program budget is comprised of key categories and assumptions, many of which have a significant impact on the total cost of service delivery:

Table 3
Budget categories and assumptions

Category	Assumption
Enrollment	• Target annual enrollment. • Enrollment/capture rate. • Estimated proportion of enrollees requiring Tier 2 services. • Annual rates for inflation and salary adjustments.
Personnel	• List of required positions for program delivery. The number and type of positions often depend on locality if there are existing programs in place. For example, asthma education can be delivered by a community health worker, nurse practitioner, respiratory therapist, or any combination of those and other positions.

	• Estimated full-time-equivalent (FTE) per position. • Service capacity per person or team. • Estimated salary per position.
Tier 1 Services	• List of supplies and services to be provided to all enrolled clients. This list is similar from site to site but may contain some variation based on local context or history of an existing program. For example, a program may not include the provision of smoke alarms in their standard safety kit because the local fire department provides them free of charge. • Estimated prevalence of each service. For example, a program may expect that 90% of all families served will require a HEPA vacuum because they do not own one. • Estimated cost of each service.
Tier 2 Services	• List of services to be provided to Tier 2 clients. • Estimated prevalence of each service. • Estimated cost of each service.
Capital Expenditures	• Equipment needed (e.g. trucks) • Information technology investments
Annual Expenses	• Assessor supplies • Credentialing fees
Indirect Costs	• Organization indirect rate (federal rate if applicable)

Reference Class

In working with a number of jurisdictions to develop local asthma programs, we have consolidated a reference class of budget line items for Tier 2 services. For example, across a cohort of initial asthma projects, we see that on average, asthma programs expect that 30% of enrolled families will require carpet removal and replacement, costing $600 per occurrence. While we know that each project has its own unique characteristics such as quality of housing stock and cost of living, this type of cross-site comparison allows us to verify that assumptions are realistic and provide a baseline for other sites that are beginning to budget a new program.

Exhibit 3 in the Appendix provides an example reference class of budget line items.

Budget Template

There is no one correct way to create a budget, but the example shown below in Exhibit 4 in the Appendix is one that captures the necessary information. A standard budget template usually includes categories such as personnel and fringe expense, supplies, home repairs, annual expense, and upfront capital needs.

Leveraged Services

As many healthy housing professionals know, there are often not enough resources available from one funding source to address all environmental hazards found in a home. In some cases, clients must be deferred from a program if an environmental hazard present in the home is not covered and inhibits further repairs. When budgeting an asthma program we list all known, available funding sources that can be leveraged for non-asthma environmental services. For example, the city housing department may have a program for low-income homeowners that can pay for roof repairs. Additional programs and funding streams can be braided in with a funding stream dedicated to the asthma trigger reduction services.

Step 4: Pilot the Services
Stress testing the planned program services

If a jurisdiction would like to develop an asthma program but has limited experience in delivering these services, it is advisable to test these services through a pilot phase. Typically, a pilot may service from 10 to 30 patients based on resources available. A pilot may be performed in phases as resources become available; doing so allows the team to reflect on pilot effectiveness and lessons learned, and to then make adjustments for future pilot homes.

Key Takeaways		
Understand the benefits and limitations of performing a pilot.	MCOs often use pilots to assess trends in utilization and cost before larger scale investment in a program.	Funding a pilot may include using existing resources or fundraising.

Purpose of a Pilot

The purpose of a pilot is twofold- to test the operational plans for program delivery and to generate case studies for scaling the program. When building a new program in coordination with a healthcare entity (like a managed care organization), a pilot phase allows all parties involved to set up referral mechanisms and communication channels. In some cases, data management systems may be shared across organizations and would need to be configured as well. Case studies are helpful in gaining feedback from clients and collecting information to share with external stakeholders, including potential future funders.

While a pilot is beneficial on many levels, it is not an effective way to collect statistically significant outcomes. Due to the small scale of pilots, program outcomes are limited to client-level case studies. If program outcomes are needed to prove effectiveness or perform research, a pilot would need to be expanded for larger enrollment.

That being said, MCOs do tend to use pilots to assess pre/post trends in health care costs for members who receive services. So even if outcomes are not statistically significant due to number of enrolled members, MCOS are still very much interested in financial trends related to a program. Positive trends for utilization and cost may lead to direct investment in program services.

Fund the Pilot

There are several potential funding sources for a pilot depending on what organizations are involved. Below are some examples of potential pilot funding sources.

- Existing operational funds: Perhaps the easiest way to fund a pilot (or portion of a pilot) is to use existing operational funds that are meant to support this type of program. For example, a nonprofit hospital may have operational funds to support an asthma clinic. Coordinating clinic- and home-based services with a housing service provider could potentially fall under the regular operations of the hospital.
- Existing grant funds: Another easy way of funding a pilot is to use existing resources. For example, if a HUD Lead Grantee holds Healthy Homes grant funds, those funds pay for Tier 2 services.
- New grant funds: If there are no existing resources to support a pilot, the team may seek grant funds from a new source. In many cases, this may be a grant proposal to a local philanthropy.
- Hospital community benefit funds: Nonprofit hospitals can utilize these resources to invest in housing-related services for their immediate community. If the pilot team includes members of a local hospital system or has a strong relationship with one, then access to these funds is a good option.

Set up the Pilot

Once pilot funding has been secured, the next step is to revisit steps 1 through 3 of this blueprint and to make updates as needed for the pilot. For example, plans for a full-scale pilot may include the use of a sophisticated data sharing platform. If a pilot is to be implemented before this data platform is ready, the team will need to understand how data will be communicated and stored in the interim. A solution could be creating a protocol of email and saving client records in a secure database that is saved locally with one of the pilot organizations.

Preparation with field staff is also key in setting up the pilot. The relationships and plans created in steps 1 through 3 were likely made at an administrative level. Field staff who will implement the program may not be aware of all program details that have been developed to date. As a result, teams should set up several meetings between administrative and field staff at all organizations to discuss the pilot plans. Additionally, regular meetings should be set for the teams to discuss pilot progress throughout the implementation phase.

Step 5: Launch at Scale

Achieving program sustainability

Many effective asthma programs are funded in the short-term or medium-term with grants funds; while extremely valuable, they often do not exist in perpetuity. In this section, we explore the different ways in which an asthma program can be funded. In many cases, organizations must braid different funding sources together to support the multiple components of the coordinated program. It is important that asthma programs track outcomes over time to demonstrate to potential funders and payers that the services lead to improved health outcomes and healthcare cost savings.

Key Takeaways

There are several pathways for long-term funding an asthma program, but the most sustainable option will likely include *reimbursement from healthcare payer(s).*

Reimbursement for non-medical services such as environmental assessment and home repairs provides a sustainable funding stream for asthma-focused healthy home services and will require in-depth discussions with healthcare payers.

Grant-Supported Program

Traditionally, many healthy homes service providers have used grants from U.S. Department of Housing and Urban Development (HUD) to address health and safety hazards in their community. Service providers are often multi-year recipients of HUD lead grants, and the use of healthy homes funds is a natural extension of environmental health remediation. Healthy homes grants run on multi-year cycles and require that local agencies prepare a detailed grant application. Unfortunately, demand for these grant funds far outweighs the supply. Given the limited annual budget of healthy homes supplemental funding, even awarded healthy homes providers are limited in the scale of families they can reach.

Local philanthropy is another source of grant funds that may support an asthma program. Each community has its own set of philanthropic players, so service providers should understand the mission and funding priorities of each.

Direct Service Contract

Perhaps the most sustainable funding option for service providers is a contract directly with a managed care organization (or any other healthcare entity). Setting up a contract like this usually

depends on a strong existing relationship between the organizations, proven outcomes from a program that was previously grant funded, and discussions/negotiations that may take years to develop. A service contract provides a secure revenue stream for the service provider and could be set up on a fee-for-service basis or an outcomes-basis.

For example, a fee-for-service contract may look like this: Service Provider ABC is paid by Managed Care Organization XYZ $5,000 per patient that is referred from the MCO to the asthma program. This payment would cover a set number of home visits and follow-up phone calls, an environmental assessment, a pre-approved list of supplies, and some set of home repairs to address asthma triggers.

An outcomes-based payment contract may look like this: Service Provider ABC performs a comprehensive asthma program for a patient enrolled with Managed Care Organization XYZ. Managed Care Organization XYZ compares the cost of medical care for this patient 12-months before and 12-months after the program ends. If there is a drop in medical cost for this patient's asthma, then XYZ pays ABC a portion of the savings.

Direct service contracts between service providers and insurers are not widespread and they are often limited to Tier 1 services. Most, if not all, are currently fee-for-service or reimbursed on a bundled payment basis. However, with the development of value-based and accountable care models in recent years, we expect to see some future movement to contracts that are value-based or share savings between insurers and providers. Ultimately, the structure of the contract will depend on negotiations between all parties involved.

Pay for Success

Pay for Success (PFS) is a financing model in which upfront funding for the asthma program is provided by investors. A payer (managed care entity and/or state Medicaid office) pays the investor only if an evaluation confirms that the program has created value for the payer (this can be cost savings). This financing model is relatively new in the United States, and has been used to address various social issues like homelessness and criminal justice. As of the fall 2019, there has not yet been a PFS project launched that addresses asthma.

Since 2015, GHHI has been developing asthma-focused PFS projects across the country. As of the summer of 2017, GHHI is leading 11 PFS projects in 10 states. The majority of these projects have completed a comprehensive feasibility study and a number are moving into negotiations with investors and payers. As of fall 2019, we plan to launch an asthma PFS project in New York City in 2020.

PFS is an innovative and promising model because it allows service providers to access capital needed to scale and transfer financial risk from payers to external funders. These projects do take many months (or years) to set up, so project partners must be committed to undergoing a lengthy project development process. The ultimate goal of PFS is to demonstrate to payers and the healthcare system that preventative, home-based services should be covered by Medicaid funds

in the long term. As such, a large piece of GHHI's PFS work has been focused on the necessary policy development and advocacy at the local, state, and federal levels.

State Plan Amendment

State policy makers can decide to amend their Medicaid state plan with federal CMS to include services that are typically not reimbursable as medical services. This policy measure can provide a reimbursement pathway for home-based asthma education and home assessment; however, it will not allow reimbursement for home remediation. Missouri's state plan amendment approved in 2016 provided state-wide reimbursement for the aforementioned services,[15] which was a first of its kind in the country.

CHIP Health Services Initiative

States' Children's Health Insurance Plan (CHIP) allows for a plan amendment called Health Service Initiative (HSI).[16] An HSI allows a state to a) leverage federal funds through an enhanced matching rate, often at least 3:1 federal-to-state share and b) apply unused administrative funds to non-medical services for children.

In recent years states like Michigan have used an HSI to increase investment in combatting child lead poisoning, including lead hazard control of home-based hazards. Maryland passed a similar HSI for lead poisoning prevention efforts and is the only state to also include funding for asthma home visiting education and environmental assessment. In Maryland, these services are carried out by local health departments.

These existing HSI examples pave the way for states to pass HSIs that can provide funding for asthma home vits, home assessments, *and* home remediation for asthma triggers.

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[15] https://dss.mo.gov/mhd/providers/pdf/bulletin39-48_2017january27.pdf
[16] Background information for CHIP HSI: https://www.macpac.gov/wp-content/uploads/2019/07/CHIP-Health-Services-Initiatives.pdf

Conclusion
Asthma and beyond

A successful asthma program ultimately hinges on the strength of partnerships between diverse stakeholders. Addressing the root cause of public health issues like asthma requires coordination by professionals who many not traditionally work together in a coordinated fashion. By drawing on the capacities of medical and community-based experts, we can provide the holistic services that lead to long term prevention of chronic disease. In fact, asthma is just one example of how healthy homes service providers can work across sectors to address today's important public health issues. We are hopeful that this blueprint for addressing asthma is just the tip of the iceberg for broader work at the intersection of housing and health.

Appendix

Process flow diagram template

Green & Healthy Homes Initiative®
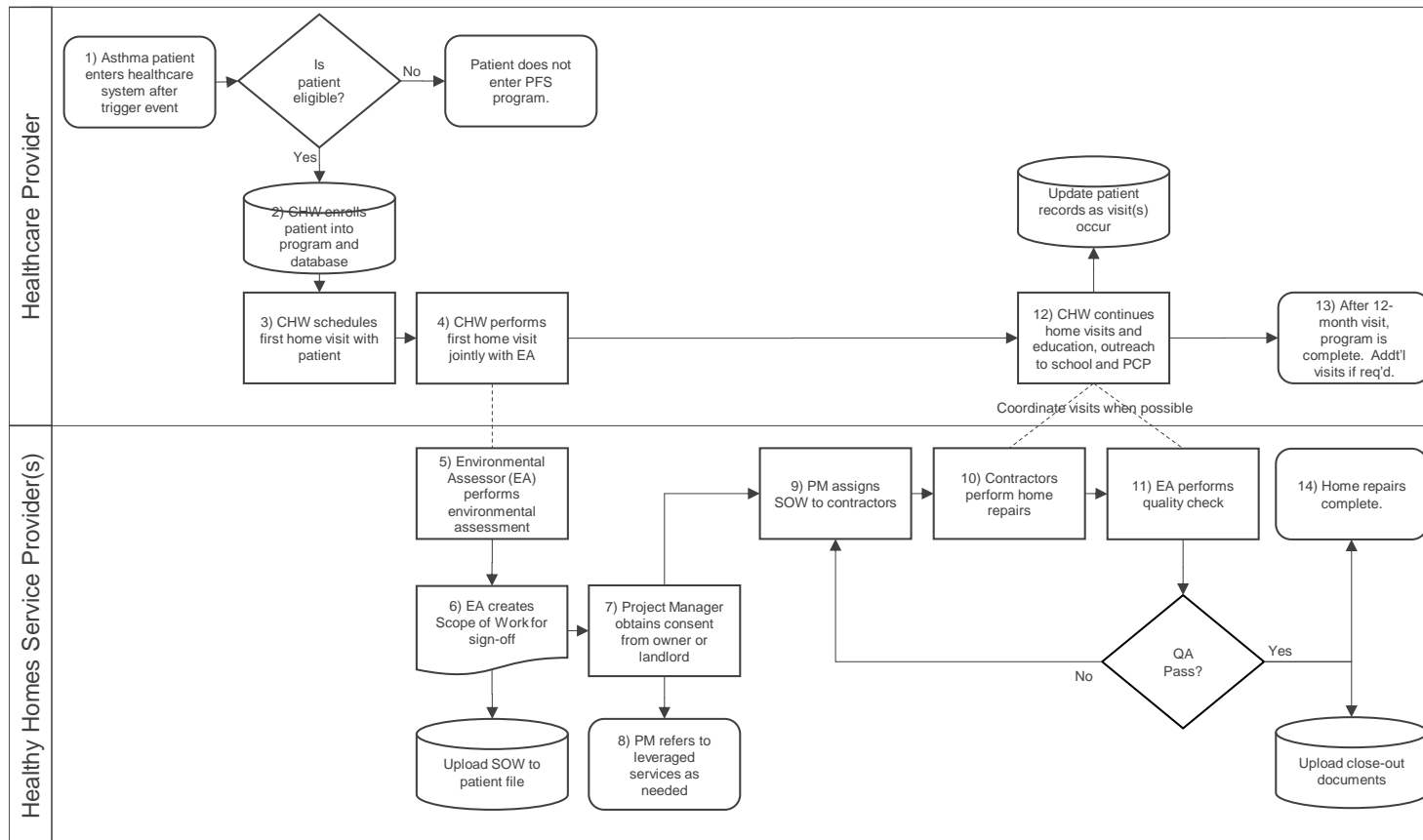
Table 2
Summary of recommended asthma interventions

Housing Condition	Healthy Homes Activity / Supplies and tools	EPR-3			Community Guide	
		Inter.	Quote or Partial Quote	Evidence	Inter.	Quote or Partial Quote
Dampness (Mold risk factor)	Sealing of structural air leakages	pp. 172	"Because an association between indoor fungi and respiratory and allergic disease is suggested by some studies… measures to control dampness or fungal growth in the home may be beneficial".	C	pp.7	"Mold-sensitive people can be protected by removing mold from hard, nonporous surfaces; discarding mold contaminated materials (e.g., carpet, ceiling tiles);and addressing the source(s) of moisture responsible for mold growth" (moderate to major)*
Humidity (Mold risk factor)	Ventilation of dryers, bathrooms and kitchen Air sealing Dehumidifier and air conditioners (EPR-3 pp. 129)	pp. 188	"Consider reducing indoor humidity to or below 60 percent, ideally 30–50 percent. Dehumidify basements if possible"			
Water Infiltration(Mold risk factor)	Sealing of structural air leakages Reroute Sub Pump Drain Waterproofing	pp. 188	"Fix all leaks and eliminate water sources associated with mold growth…"			
Mold Present		pp.188	"…Clean moldy surfaces…"		pp.7	Removing mold from hard, non-porous surfaces (moderate); discarding mold contaminated materials (e.g., carpet, ceiling tiles) (Major);

Housing Condition	Healthy Homes Activity / Supplies and tools	EPR-3			Community Guide	
		Inter.	Quote or Partial Quote	Evidence	Inter.	Quote or Partial Quote
CO and fuel combustion products	Replace/ repair furnace Replace/ repair hot water heater Replace/ repair gas stove	pp.188	Reduce or remove; Wood-burning stoves or fire-places and Unvented gas stoves or heaters	C	pp. 7	"…recent studies suggest that single-component interventions or those that address a single asthma trigger may not be as effective as interventions that address multiple triggers using multiple intervention components."
Volatile Organic Compounds	Whole house ventilation Education	pp. 188	Discuss way of reducing exposure to - Other irritants (e.g., perfumes, cleaning agents, sprays) -Volatile organic compounds (VOCs) such as new carpeting, particle board, painting			
Environmental tobacco smoke (ETS)		pp. 112	"…specifically consider referring to smoking cessation programs adults who smoke and have young children who have asthma in the household.	B	pp.7	"…smoking cessation counseling as part of treatment for smokers with asthma, or smokers with children who have asthma." (Minor) "Complete smoking bans in the home have been shown to …reduction in ETS exposure in caregivers who are unwilling to stop smoking"(Minor)
					pp.7	Limited evidence "that air filters and ventilation can reduce the indoor concentration of ETS particles in the air…"(Moderate to Major)

Housing Condition	Healthy Homes Activity / Supplies and tools	EPR-3			Community Guide	
		Inter.	Quote or Partial Quote	Evidence	Inter.	Quote or Partial Quote
Pets		pp.170	If the patient is sensitive to an animal, remove animal from the home	D	pp.6	"Removing pets from the home is the most effective method to reduce exposure to pet dander in sensitized patients."
		pp.170	If Removal is not an option, keep animal from the patient's bedroom and keep bedroom door closed. "Remove upholstered furniture and carpets from the home, or isolate the pet from these items to the extent possible"		pp.6	"Alternately, keeping pets out of bedrooms can reduce airborne pet dander allergen levels fivefold"
Dust Mites allergens	HEPA filter Vacuums (EPR-3, pp. 130) Impermeable mattress and pillow covers/case (EPR-3, pp.170)	pp. 171	"Encase the mattress and pillow in allergen impermeable cover or wash it weekly. Wash the sheets and blankets on the patient's bed weekly in hot water"	A	pp.6	"This asthma trigger can be removed by using allergen-impermeable pillow and mattress covers, washing bedding in hot water 130°F (minor). Removing old carpet (Major). Reducing home humidity to 60%, (Moderate) Washing stuffed animals weekly (Minor)"
	Dehumidifier and air conditioners (EPR-3, pp. 129 & 174)	pp. 171	2.Reduce indoor humidity to or below 60 percent; Ideally 30–50 percent.			

Housing Condition	Healthy Homes Activity / Supplies and tools	EPR-3			Community Guide	
		Inter.	Quote or Partial Quote	Evidence	Inter.	Quote or Partial Quote
Domestic Hygiene, pests and refuse	Insects: Integrated Pest Management	pp. 171	Cockroaches, if patient has sensitized to cockroaches and there is an infestation in the home, control measures should be implemented	B	pp.6	**Cockroaches**--Integrated pest management strategies: teaching residents to remove food and water sources, clean surfaces and floors, seal trash containers, store food carefully (minor-moderate). Use gel baits to exterminate roaches, and seal cracks and small holes in the residence to keep roaches out (moderate).
	Rodents: Integrated Pest Management Vacuum Traps Pesticides	pp.171	Mouse allergen exposure can be reduced by a combination of blocking access, low-toxicity pesticides, traps, and vacuuming and cleaning	D	pp. 6	**Mice and Rats**—Integrated pest management techniques: holes, vacuuming cleaning, using low-toxicity pesticide, placing traps, (Moderate) and storing food carefully (minor)
Long term Asthma Care	Asthma Management Behaviors	pp.35-37	Measures of asthma assessment and monitoring. Emphasis on current severity, control and treatment response, in addition to future risk.	A through C	pp.9 & 18-19	Both environmental and educational asthma interventions intent to improve asthma outcomes through improved asthma management behaviors (AMBs). AMBs include more frequent use of asthma controller medications, better recognition of asthma symptoms, and use of peak flow meters. AMBs could also include reducing asthma triggers by using integrated pest management to decrease both the number of insect and rodent pest and by washing bedding in hot water to reduce dust mites.
		pp.93	Education for a partnership in asthma care should be integrated into all aspects of asthma care and involves all members of the health care team;	A or B, Depending on point of care		
		pp.35 & 165	"Control of environmental factors and comorbid conditions that affect asthma. " (35)	A		

Housing Condition	Healthy Homes Activity / Supplies and tools	EPR-3			Community Guide	
		Inter.	Quote or Partial Quote	Evidence	Inter.	Quote or Partial Quote
			"Know that effective allergen avoidance requires a multifaceted, comprehensive approach; individual steps alone are generally ineffective" (165)			9 out of 10 studies that measured and reported outcomes for AMBs, reported improvements in AMBs compared to baseline values (18-19).

Four of six controlled studies (67%) showed a significant improvement in at least one AMB compared to the control group |
| | | | Pharmacologic therapy | | | |

*Environmental remediation, major: Major structural improvements to the home, which may include some combination of carpet removal, replacement of ventilation systems, or extensive repairs to restore structural integrity (e.g., to roof, walls, floors)

Environmental remediation, moderate: Providing multiple low-cost materials with the active involvement of the trained home visitor(s); activities in this category may include providing and fitting mattress and pillows with allergen-impermeable covers, installing small air filters and dehumidifiers, integrated pest management, professional cleaning services or equipment, and minor repairs of structural integrity (e.g., patching holes)

Environmental remediation, minor: Minor changes to the home, which at a minimum include providing advice on recommended environmental changes to be performed by the members of the household and may include providing low-cost items such as mattress and pillow allergen-impermeable covers

EPR-3 evidence ranking

Evidence Category A: Randomized controlled trials (RCTs), rich body of data. Evidence is from end points of well-designed RCTs that provide a consistent pattern of findings in the population for which the recommendation is made. Category A requires substantial numbers of studies involving substantial numbers of participants.

Evidence Category B: RCTs, limited body of data. Evidence is from end points of intervention studies that include only a limited number of patients, post hoc or subgroup analysis, of RCTs, or meta-analysis of RCTs. In general, category B pertains when few randomized trails exist; they are small in size, they were undertaken in a population that differs from the target population of the recommendation, or the results are somewhat inconsistent.

Evidence Category C: Nonrandomized trials and observational studies. Evidence is from outcomes of uncontrolled or nonrandomized trials or from observational studies.

Evidence Category D: Panel consensus judgement. This category is used only in cases where the provision of some guidance was deemed valuable, but the clinical literature addressing the subject was insufficient to justify placement in one of the other categories The Panel consensus I based on clinical experience or knowledge that does not meet the criteria categories A through C.

Exhibit 3
Example reference class of budget line items

Asthma Services and Supplies	Min of Prevalence, %	Average of Prevalence, %	Max of Prevalence, %	Average of Unit cost, USD	Sum of Cost per home, USD
⊞ APPLIANCE	10.00	54.56	100.00	169.05	757.20
⊟ CLEANING / HYGIENE	5.00	79.84	100.00	113.81	1,120.06
Bed, mattress, box spring	17.00	17.00	17.00	224.00	38.08
HEPA-type vacuum and parts	45.00	87.00	100.00	106.20	466.00
Home cleaning supplies	100.00	100.00	100.00	53.16	159.49
Mattress and pillow covers	80.00	96.00	100.00	46.60	222.99
Other bedroom supplies: sheets	80.00	80.00	80.00	35.00	28.00
Other cleaning: pet wipes, additional laundry	60.00	80.00	100.00	27.50	45.00
Trash removal	5.00	22.50	40.00	462.50	160.50
⊟ FLOORING	25.00	38.76	60.00	465.00	1,129.96
Carpet removal and replacement	25.00	31.00	40.00	590.00	607.25
Carpet steam clean	30.00	46.52	60.00	340.00	522.71
⊞ IPM	16.67	61.60	100.00	160.06	795.14
⊞ MEDICATION / EDUCATION	100.00	100.00	100.00	16.63	149.65
⊞ MOISTURE / MOLD	2.00	25.66	100.00	814.61	3,066.81
⊞ OTHER	100.00	100.00	100.00	200.00	200.00
⊞ SAFETY	25.00	60.42	100.00	42.31	315.10
⊞ WEATHERIZATION / ENERGY EFFICIENCY	25.00	41.67	71.43	166.67	98.81

Exhibit 4
Example budget template

Green & Healthy Homes Initiative

Service Delivery Budget

Assumptions

Hours per year	2,080.00
Inflation rate, *percent annual increase*	1.50
Salary increase rate, *percent annual increase*	3.00
Federal indirect rate, *percent of direct cost*	15.00
Fringe benefits, *percent of base salary*	25.00
Contingency, *percent of total expense*	-
Total program years	10.00
Percent tier 2	66.67

Housing referral assumptions

	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00
Intervention year	TRUE	TRUE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
Cohort size	250.00	250.00	250.00	-	-	-	-	-	-	-
Percent of Tier 2 referrals	66.67	66.67	66.67	-	-	-	-	-	-	-
Tier 2 referral count	166.67	166.67	166.67	-	-	-	-	-	-	-

Summary

Intervention cost conditions logic

	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00
Is project year	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE
Is intervention year	TRUE	TRUE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE

Intervention cost calculations

	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	Per unit
Personnel expense	-	-	-	-	-	-	-	-	-	-	-
Fringe expense	-	-	-	-	-	-	-	-	-	-	-
Project initiation expense	-	-	-	-	-	-	-	-	-	-	-
Tier 1 intervention expense	-	-	-	-	-	-	-	-	-	-	-
Tier 2 intervention expense	-	-	-	-	-	-	-	-	-	-	-
Other annual direct expense	-	-	-	-	-	-	-	-	-	-	-
Indirect expense	-	-	-	-	-	-	-	-	-	-	-
Contingency	-	-	-	-	-	-	-	-	-	-	-
Total	-	-	-	-	-	-	-	-	-	-	-

Budget by sub-category

Base number of units	100.00
Tier two units, percent of total	66.67
Tier two units, number of	66.67

Personnel budget, *FTE*	Tier / level	Salary, USD per hour	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	Y1 implied capacity (units per FTE)
Is project year			TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE		
Cohort size (Tier 1)			250.00	250.00	250.00	-	-	-	-	-	-		
Tier 2 referral count			166.67	166.67	166.67	-	-	-	-	-	-		Notes / Assumptions

Tier 1 intervention service	Organization responsible	Category	Primary housing condition	Evidence level	Prevalence, % of homes	Unit Cost, USD	Intervention service, number per 100 units	Intervention service, USD per 100 units	Notes / assumptions
Binder / pamphlets		MEDICATION / EDUCATI	Long term asthma care	A-C			-	-	
Combination reliever/controller		MEDICATION / EDUCATI	Long term asthma care	A-C			-	-	
Medicine bag (inhalers)		MEDICATION / EDUCATI	Long term asthma care	A-C			-	-	
Spacers		MEDICATION / EDUCATI	Long term asthma care	A-C			-	-	
HEPA-type vacuum and parts		CLEANING / HYGIENE	Dust mites and allergens	A			-	-	
Home cleaning supplies		CLEANING / HYGIENE	Long term asthma care	A-C			-	-	Green cleaning solution, sponges, buckets, mops
Mattress and pillow covers		CLEANING / HYGIENE	Dust mites and allergens	A			-	-	
Base IPM supplies		IPM	Domestic hygiene, pests, and refuse	B			-	-	Bait, traps, Gentrol, wire mesh
Food storage		IPM	Domestic hygiene, pests, and refuse	B			-	-	
Garbage cans		IPM	Domestic hygiene, pests, and refuse	B			-	-	
CO alarm		SAFETY	CO and fuel combustion products	C			-	-	
Replacement batteries (9V/pack 2)		SAFETY	CO and fuel combustion products	C			-	-	
Replacement batteries (AAA/pack 4)		SAFETY	CO and fuel combustion products	C			-	-	
Smoke detector (10 yr. life)		SAFETY	Safety	NR			-	-	
Total per 100 units								-	

Tier 2 intervention service	Organization responsible	Category	Primary housing condition	Evidence level	Prevalence, % of T2 homes	Unit Cost, USD	Intervention service, number per 100 units	Intervention service, USD per 100 units	Notes / assumptions
Carpet removal and replacement		FLOORING	Dust mites and allergens	A			-	-	
Carpet steam clean		FLOORING	Dust mites and allergens	A			-	-	
IPM contractor		IPM	Domestic hygiene, pests, and refuse	B			-	-	
Gutter repair		MOISTURE / MOLD	Mold risk factor	C			-	-	
Landscaping re-grading		MOISTURE / MOLD	Mold risk factor	C			-	-	Divert runoff away from dwelling
Mold major (>10ft2)		MOISTURE / MOLD	Mold risk factor	C			-	-	
Mold minor (<10 ft2)		MOISTURE / MOLD	Mold risk factor	C			-	-	
Plumbing major		MOISTURE / MOLD	Mold risk factor	C			-	-	Minor leaks and clogs
Plumbing minor		MOISTURE / MOLD	Mold risk factor	C			-	-	Replace plumbing, toilets, etc.
Roof repair major		MOISTURE / MOLD	Mold risk factor	C			-	-	Roof patching
Roof repair minor		MOISTURE / MOLD	Mold risk factor	C			-	-	Roof replacement
Venting, bathroom		MOISTURE / MOLD	Mold risk factor	C			-	-	
Venting, dryer		MOISTURE / MOLD	Mold risk factor	C			-	-	
Venting, kitchen		MOISTURE / MOLD	Mold risk factor	C			-	-	
Air conditioners (window units)		APPLIANCE	Dust mites and allergens	C			-	-	
Air purifiers		APPLIANCE	Dust mites and allergens	C			-	-	
Dehumidifier		APPLIANCE	Mold risk factor	C			-	-	
Furnace cleaning		APPLIANCE	CO and fuel combustion products	C			-	-	
Furnace replacement		APPLIANCE	CO and fuel combustion products	C			-	-	
Furnace filters		APPLIANCE	CO and fuel combustion products	C			-	-	
Gas stove/oven replacement		APPLIANCE	CO and fuel combustion products	C			-	-	
Hot water heater replacement		APPLIANCE	CO and fuel combustion products	C			-	-	
Refrigerator replacement		APPLIANCE	Domestic hygiene, pests, and refuse	NR			-	-	
Weatherization / Energy Efficiency major		WEATHERIZATION / ENE	Other	NR				-	Window and door replacement, extensive insulation
Weatherization / Energy Efficiency minor		WEATHERIZATION / ENE	Other	NR				-	Flue repair, backdraft, air sealing, LED bulbs
Safety / Injury prevention (Major)		SAFETY	Other	NR				-	Handrail, stair replacement
Safety / Injury prevention (Minor)		SAFETY	Other	NR				-	Trip hazards, handrail repair
Total per 100 units								-	

Leveraged services (NOT INCLUDED IN BUDGET)	Category	Prevalence, % of T2 homes	Unit Cost, USD	Intervention service, number per 100 units	Intervention service, USD per 100 units	Notes / assumptions
				-	-	
				-	-	
Total per 100 units					-	

Program initiation expense	Quantity	Unit Cost, USD	Y1 Total	Notes / assumptions
			-	
Total per 100 units			-	

Other annual direct expense	Quantity	Unit Cost, USD	Annual total	Notes / assumptions
			-	Annual totals shown are for Y1. Subsequent years include inflation.
			-	
Total per 100 units			-	