

The Unequal Burden of Pediatric Asthma: A Call for an Equity-Driven, Multimodal, Public Health Approach to Asthma in Baltimore

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The Unequal Burden of Pediatric Asthma: A Call for an Equity-Driven, Multimodal, Public Health Approach to Asthma in Baltimore

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Executive Summary

Pediatric asthma is a significant contributor to health care utilization and spending, missed school days, and other negative social outcomes, and to overall health and well-being in American children. There is a particular burden of uncontrolled asthma symptoms in low-income, racial and ethnic minority, and urban children, including in Baltimore. Asthma can be controlled in the majority of cases, but the lack of a comprehensive, population-wide approach to its management results in preventable emergency department visits and hospital admissions, as well as reduced educational opportunities and quality of life for children living with asthma.

Children from low-income families and under-resourced neighborhoods experience disproportionate barriers to medical care and self-management of asthma. Intervention strategies aimed at mitigating the burden of uncontrolled asthma focus on addressing barriers to accessing health care services, achieving substantial and long-term reduction in allergen and environmental trigger exposure, and tailoring supports for families to help them manage the contributors to and treatment of this chronic disease. Research indicates that adequately managing asthma in children at high risk for uncontrolled symptoms may require addressing all of these factors through cross-sector, multimodal intervention.

In this report, we present promising approaches for mitigating uncontrolled symptoms of asthma and reducing exposure to allergens and triggers, and we offer recommendations for policy and systems-level strategies to enable a citywide, equity-driven, multimodal approach to asthma management in Baltimore. We estimate that an investment of \$3.5 million per year in the multimodal approach outlined in this report, plus an additional \$860,000 in start-up expenses, would directly support at least 5,000 children per year with uncontrolled asthma, delivering targeted interventions that would reduce their asthma symptoms and improve their quality of life. We project that the implementation of a citywide, multimodal approach to asthma treatment would lead to a 30% reduction in hospitalizations and emergency department visits for pediatric asthma in Baltimore over five years.

The cost savings associated with averted hospitalizations and emergency department care alone could cover an estimated 60% of the annual program costs associated with the proposed approach, including costs associated with sustaining existing, effective services. Beyond the direct health benefits, we expect that this approach would result in improved school attendance and academic success for children served, as well as improved quality of life for their families.

INTRODUCTION: Pediatric Asthma as a Public Health Challenge

The COVID-19 pandemic has highlighted and intensified long-standing health inequities in the United States. It is more urgent now than ever to address profound and avoidable racial and socioeconomic health inequities in chronic illnesses like asthma. Nearly 6 million children in the United States, and over 440,000 in Maryland, have a current asthma diagnosis.¹ Nationwide each year, childhood asthma accounts for 14 million absences from school² and almost \$6 billion in health care expenses.³ Asthma is the single leading health-related cause of school absenteeism in the United States, and an asthma diagnosis doubles a low-income child's risk of failing a grade.⁴ Asthma also has important impacts on a child's overall health: Children with asthma are less likely to be physically active and more likely to develop depression.^{5, 6, 7}

Asthma and Baltimore's Children

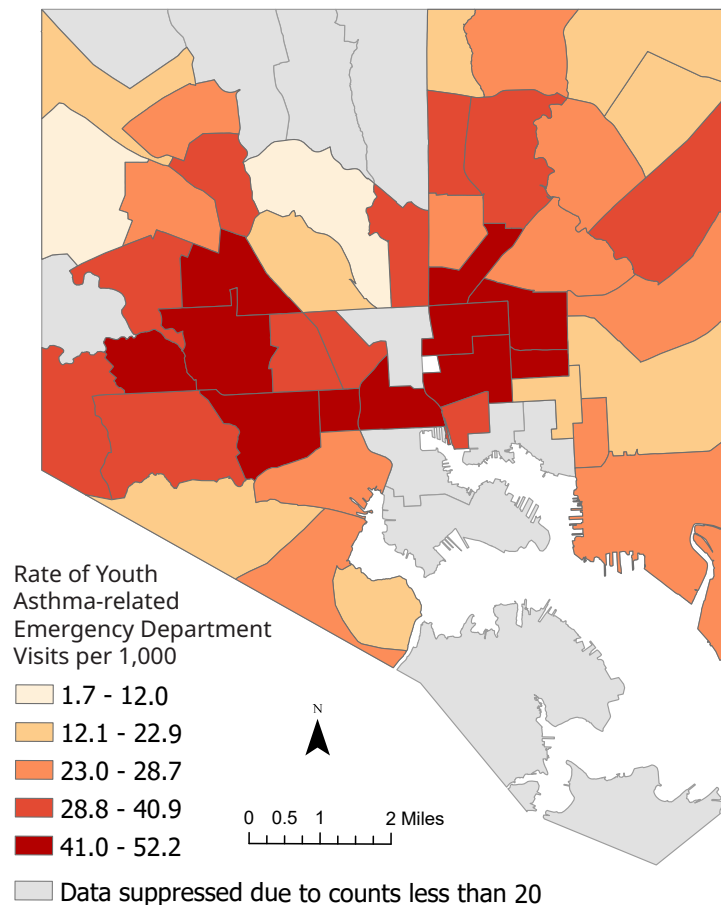
The health, social, and economic burdens of pediatric asthma make the disease one of the most urgent public health challenges facing the country and, in particular, Baltimore City. In Baltimore City, 20% of children (about 24,000) have an asthma diagnosis, which is more than double the national prevalence of 9%.⁸ Pediatric asthma-related emergency department visits occur in Baltimore at more than double the statewide rate.⁹ According to the Maryland Health Services Cost Review Commission (HSCRC), in 2019, children in Baltimore City were hospitalized 964 times with asthma as one of the reasons for hospitalization, and 389 times with asthma as the primary reason for admission. Children in Baltimore went to the emergency department 11,527 times with asthma as a reason for their visit, and 3,457 times with asthma as the primary reason for the visit.¹⁰ Emergency department visit rates for asthma are eight

times as high in Baltimore City as in nearby Carroll County.¹¹

Asthma is not only a contributor to poor public health outcomes, but also a driver of taxpayer spending on health care utilization. Baltimore City's Community Asthma Program reports that there are approximately 9,000 children in Baltimore City who are enrolled in Medicaid and at high risk for poorly controlled asthma symptoms as a result of social risk factors. Each year, asthma costs the state of Maryland more than \$69 million in health care spending alone.¹² According to the HSCRC, in Baltimore City, the average cost of a pediatric asthma-related emergency department visit is more than \$1,000, and the average cost of a pediatric asthma-related hospitalization is more than \$9,000. The HSCRC estimates that total annual spending on pediatric emergency department visits in Baltimore with asthma as the primary reason for the visit is more than \$3.6 million, with hospitalizations costing more than \$3.5 million.¹³ This does not include the cost of asthma-related emergency department visits or hospitalizations when asthma was a secondary or tertiary visit reason, or the cost of office visits and prescriptions for asthma medication. Additionally, this does not include the societal costs attributed to asthma such as missed work and school days.

Health care utilization for asthma also differs by zip code within the city of Baltimore, with increased burden in lower-income neighborhoods. For example, the Harriet Lane Clinic in East Baltimore reports that more than 30% of its patients have an asthma diagnosis, compared to 20% citywide. In recent years, the asthma-related emergency department rate for zip code 21223 has been more than 28 times higher than the rate for zip code 21210.¹⁴ See Figure 1 for youth emergency department visit rates by Community Statistical Area.

Figure 1: Youth Emergency Department Visits Per 1,000 by Community Statistical Area, Baltimore City, 2016



Notes: Community Statistical Areas are groupings of census tracts that approximate neighborhoods.

Data Source: Baltimore City Health Department (BCHD) analysis of data provided by the Maryland Health Services Cost Review Commission with CRISP EID for CY 2016; asthma ICD-10-CM code in principal diagnosis; youth denominators from 2010 decennial census. Map prepared by BCHD, Feb 5, 2019.

Asthma Health Disparities

There are stark racial and socioeconomic disparities in the burden of uncontrolled asthma and resulting health care utilization, suggesting that uncontrolled asthma is not a biological inevitability. A large body of literature indicates that pediatric asthma can be well controlled in the majority of children, but that success in controlling the symptom burden is significantly influenced by a child's access to health care and community resources, as well

as a child's social and physical environment.¹⁵ Asthma disproportionately affects children of color and children from low-income families.^{16, 17} Compared to white children, Black children have a three- to fivefold higher risk of asthma-related emergency department visits and hospitalizations, and a sevenfold higher risk of asthma related mortality.¹⁸ The HSCRC reports that, in 2019, 88% of pediatric asthma-related hospitalizations and 87% of emergency department visits in Baltimore City were for Black or African American children.

Additionally, 90% of pediatric asthma-related hospitalizations and 85% of asthma-related emergency department visits in Baltimore City were for children with Medicaid health insurance coverage.¹⁹ Because of the central role of housing and environment in exacerbating asthma symptoms, the pediatric asthma burden is higher in neighborhoods that have been historically disadvantaged, including communities impacted by historical redlining and other forms of structural discrimination.^{20, 21, 22, 23} This makes pediatric asthma a significant issue of social and racial justice.

The Need for a Coordinated Effort to Address the Unequal Burden of Pediatric Asthma in Baltimore City

The current “system” for addressing uncontrolled asthma symptoms and asthma disparities in Baltimore City is inadequate and uncoordinated. Asthma disparities perpetuate existing racial and socioeconomic disparities in the city, and are a major contributor to poor educational, health, and quality of life outcomes, as well as to avoidable taxpayer spending. The COVID-19 pandemic has highlighted how a lack of prevention and management of chronic diseases can exacerbate public health crises. People with pre-existing comorbidities, including asthma, are experiencing more severe symptoms and are more likely to die if they contract COVID-19.²⁴ Investing in a coordinated prevention and management effort for asthma will not only have direct benefits related to the disease itself, but also have positive impacts on the city’s long-term health, including during unexpected public health crises like the current pandemic.

Given the scope of asthma disparities and their impact in the city, Medicaid Managed Care Organizations, hospitals, the city of Baltimore, and the state of Maryland have an urgent responsibility to invest in a coordinated effort to address asthma disparities at the population

level. Currently, every major program in the city that cares for children with asthma who are at high risk for uncontrolled symptoms is understaffed and under-resourced. As outlined in this report, Baltimore’s potential for a coordinated and successful asthma response has many strengths, including committed and well-established individual organizations. However, the current lack of financial investment and leadership focus on coordinating a response to this public health crisis prohibits us from actualizing the potential of these organizations. Prioritizing a bold, citywide response to pediatric asthma would allow us to reduce unnecessary spending on emergent health care services while also ensuring that a Baltimore City child’s zip code, race, or household income does not dictate his or her risk for uncontrolled asthma symptoms.

PART I: Promising Approaches for Managing Pediatric Asthma

There have been thousands of research studies analyzing the contributors to pediatric asthma exacerbations and testing interventions aimed at mitigating the impact of the disease on health care utilization, school absenteeism, and symptom burden. In this section, we provide a brief overview of challenges to managing asthma and highlight examples of interventions that have demonstrated promise in addressing those challenges.

CHALLENGE: Children miss recommended doses of asthma medication.

In most children, persistent asthma symptoms can be well controlled with inhaled corticosteroids. However, many children who are prescribed preventive inhaled corticosteroids receive inadequate doses, experience gaps in prescription refills, or do not receive regular follow-up care to manage medication changes that may be needed over time.^{25, 26} Researchers estimate that children take corticosteroids as prescribed less than 50% of the time, with lowest rates among

low-income and non-white children.²⁷ Evidence from Baltimore City pharmacy data shows that only 12% of patients from one of the city's largest pediatric clinics filled their prescriptions for controller medications in a three-month period.²⁸ Sometimes referred to as "nonadherence," missed doses can be caused by challenges including lack of access to transportation needed to pick up medications at the pharmacy, lack of access to a consistent health care provider to prescribe and refill medications, health insurance coverage issues, and inadequate support for families and children regarding proper and consistent use of inhalers.^{29, 30, 31, 32, 33}

Families face many barriers in accessing asthma care. In one study, just 5% of children who were at high risk for asthma exacerbation had received the recommended two or more preventive asthma visits in the prior year.³⁴ Evidence-based asthma care requires frequent follow-up visits with providers to assess symptoms, address environmental issues, provide education on medication use, and titrate prescriptions when needed.³⁵ This intensive and long-term self-management can be challenging for families who have limited access to transportation or an inability to attend appointments during the workday. In addition, children who have poorly controlled asthma for years may experience "normalizing" of preventable symptoms. In other words, they may believe that symptom exacerbations are inevitable when in fact they can almost always be averted. Without effective education and support on symptom management and medication use, children and their families may not continue to engage in self-management activities.

A combination of factors creates significant challenges with medication use in children with asthma, particularly in under-resourced areas like many parts of Baltimore City. Reducing missed medication doses will be an important contributor to reducing racial and socioeconomic health disparities

in asthma morbidity in Baltimore. Below, we outline promising approaches to addressing missed doses of medication through asthma interventions.

PROMISING APPROACH: Directly observed therapy in schools

Looking ahead to when schools reopen for in-person instruction, one approach to reducing missed doses of asthma medications is directly observed therapy (DOT). Often facilitated in schools, directly observed therapy involves a school nurse or other health care professional supervising a child using his or her inhaler at a set time during the school day. While children may still need to take additional doses of medication outside of the school day, these in-school programs have the potential to ensure that children receive a majority of their recommended doses. A randomized controlled trial in Rochester, New York, demonstrated that a school-based directly observed therapy program increased symptom-free days, decreased rescue medication use, and improved school attendance.³⁶ Another study of directly observed therapy in Massachusetts found that the intervention was associated with a statistically significant decrease in asthma-related hospitalizations and emergency department visits.³⁷ In a randomized controlled trial in 36 Alabama schools with primarily Black, urban-dwelling participants, children who received directly observed therapy were 1.57 times less likely to experience an asthma exacerbation after enrollment in the intervention compared to baseline, while those children in the control group did not experience an improvement, thus demonstrating effectiveness of the intervention.³⁸ Directly observed therapy has been found to be most cost-effective for children with more severe or less well-controlled asthma, so it may be a particularly important intervention in under-resourced settings.³⁹

A team of Johns Hopkins pediatric clinicians is currently working to implement and evaluate a large-scale school-nurse delivered DOT program at the Rales Health Center (RHC). The RHC serves more than 1,500 students in a large Baltimore public charter elementary/middle school.⁴⁰ This Robert Wood Johnson Foundation-funded initiative, known as Project BREATHE (Baltimore Realizing Equity in Asthma Treatment in Healthcare and Education), takes a multidisciplinary collaborative approach to addressing important systems barriers to asthma management, such as working with insurers to provide a controller inhaler for each child to keep at school in addition to the inhaler kept at home, and working with pharmacies to deliver that second controller directly to the school.

The formal evaluation of Project BREATHE is expected to be completed in late 2020. Based on metrics collected as part of continuous quality improvement efforts, Project BREATHE reports that participants in the RHC program experienced a 70% decline in unscheduled albuterol (rescue inhaler) use during the 2018-2019 school year. In addition, the RHC's School-Based Health Center (SBHC) experienced a 53% decrease in acute asthma visits that year. Evaluation of the program is still ongoing, but the team reports that the decrease is likely attributed to the program. In addition to improving asthma management during the school day, RHC program staff report anecdotally that children enrolled in the program have been less likely to miss inhaler doses outside of school. The program provides children with education about the importance of consistent inhaler use, and about proper use of medications, so that the value of directly observed therapy can extend beyond ensuring doses are administered during the school day. The Project BREATHE team has developed an implementation guide to support other teams developing directly observed therapy initiatives in schools and is working to create a national quality improvement collaborative on school-based DOT.

It is important to acknowledge that comprehensive school health services (SHS) and school-based health centers (SBHCs) each have the potential to improve health and educational outcomes for students, particularly those with asthma, independent of DOT services. Both SHS and SBHCs are underfunded in the city of Baltimore; in fact, most schools in Baltimore City do not have a full-time school nurse.⁴¹ Investing in SHS and SBHCs has the potential to improve not just asthma outcomes but overall health and well-being for Baltimore City children. SHS and SBHCs have consistently demonstrated cost-effectiveness by saving more in hospitalization, emergency department, and other health care utilization dollars than they cost to operate.^{42, 43, 44} In addition, implementing DOT within high-quality SHS and SBHCs, rather than developing DOT as free-standing initiatives, could improve success and sustainability of the DOT programs. Supporting SHS and SBHCs should be prioritized in any comprehensive citywide plan for addressing pediatric health outcomes, including uncontrolled asthma symptoms.

PROMISING APPROACH: Community-based specialist programs

Other approaches to asthma interventions address families' lack of access to health care providers who can help with managing asthma. IMPACT DC Asthma Clinic in Washington, D.C., provides wraparound services to children with asthma, including preventive and urgent care services. Children who visit the emergency department at Children's National Hospital for an asthma-related reason visit the IMPACT DC Asthma Clinic in the weeks following the emergency visit to participate in education and care coordination activities.⁴⁵ The asthma clinic is housed in the emergency department, to make it easier for families to navigate what can otherwise be a fragmented health care system. The model has demonstrated success in engaging children and their families (in one study, 71% of children returned to IMPACT

for a visit in the weeks following an emergent episode), improving use of inhaler medication, and reducing subsequent asthma-related emergency department utilization.⁴⁶

Another approach to increasing access to asthma specialist care is Baltimore's Breathmobile, which provides mobile asthma care to children at school locations, free of charge to families. University of Maryland's Breathmobile is modeled after the flagship Breathmobile in Los Angeles. The Breathmobile's pediatric allergist, pediatric nurse practitioner, and certified nursing assistant provide ongoing comprehensive physical examinations, lung function testing, care planning, medication management, and social service referrals.⁴⁷ After the child's first visit, the parent or guardian does not need to be physically present for visits and can instead communicate with the clinical team by phone to improve access. The Breathmobile rotates among low-income areas in the city of Baltimore to provide care to children with the highest risk for not receiving ongoing medical management of their asthma.

According to the program staff, in 2018, 96% of the Breathmobile's patients were African American and 11% were uninsured. A 2010 effectiveness study demonstrated that children receiving care from the Breathmobile had an increase of 44 symptom-free days per year.⁴⁸ The program also demonstrates an annual cost savings of about \$2,500 per patient per year because of reduced emergency health care utilization.⁴⁹ Patients who received care from the Breathmobile for one year or more experienced four fewer emergency department visits per year on average. The average number of visits decreased from 4.86 visits the year prior to enrollment to less than one per year in the year after enrollment.⁵⁰ While these findings are promising, a 2011 study of the Breathmobile in preschool-aged children found that children who experienced an improvement in symptoms following a Breathmobile intervention did not experience a sustained

improvement past the intervention period.⁵¹ This is likely because asthma requires ongoing management, requiring children to engage in a program like Breathmobile long-term if they do not have access to another regular source of care. Although the Breathmobile is effective for those children who consistently engage in its services, further research is needed to understand how to best target and promote engagement in Breathmobile services.

CHALLENGE: Exposure to environmental triggers exacerbates asthma symptoms.

Some research estimates that household allergens account for 40% of the burden of uncontrolled asthma, yet the vast majority of funding for asthma management is directed toward clinical, health system-based solutions rather than community-based solutions.⁵² Environmental triggers that impact asthma symptoms include mice, cockroaches, dust mites, mold, pollen, and animal dander as well as air pollutants like secondhand smoke, particulate matter, ozone, and nitrogen dioxide.^{53,54,55,56} The link between environmental exposures and asthma symptom burden is clear: Children are more likely to experience asthma exacerbations if they live in areas with high rates of housing code violations or if they are exposed to high levels of allergens or environmental triggers in the home.^{57, 58, 59, 60} Research indicates that more than 84% of homes of children with asthma in Baltimore City contain detectable levels of mouse allergens in bedroom dust and air samples.^{61,62}

PROMISING APPROACH: Individualized in-home environmental remediation

Approaches to mitigating household triggers can range from providing families with cleaning supplies and air purifiers, to conducting pest abatement in the home, to completing major home repairs such as repairing a roof to prevent mold growth in the home. A comprehensive approach to addressing mice, cockroaches, and other



pests is integrative pest management (IPM). This approach includes extermination, implementing improved food and trash storage strategies, fixing and filling holes in the home, and cleaning.⁶³ Trials of environmental interventions—including in Seattle, Boston, and Baltimore—consistently demonstrate effectiveness at mitigating allergen exposure, but demonstrate mixed results at improving health outcomes and reducing asthma-related emergency department visits.^{64, 65, 66, 67, 68} The most promising findings for in-home mitigation efforts have been found for children with high baseline exposures to allergens whose level of allergen exposure is dramatically reduced by an intervention, supporting the case for targeting the highest-risk children for intervention and focusing on significant mitigation efforts for those children.⁶⁹

The Baltimore City Health Department reports that in fiscal year 2019, 80% of children who completed in-home environmental and educational interventions through its Community Asthma Program experienced an

increase in symptom-free days in the 14 days prior to their third visit from the program, compared to the 14 days prior to enrolling in the program. In addition to the city's ongoing asthma program, the state of Maryland is funding in-home environmental assessment and intervention for children with moderate to severe asthma who are Medicaid-eligible. This work, launched in 2018, is funded through a Children's Health Insurance Program Health Services Initiative State Plan Amendment (CHIP HIS SPA) for lead and asthma. This funding mechanism requires the state of Maryland to contribute financially, and each state dollar is matched sevenfold by the federal government.⁷⁰ The work is administered through partnerships with community-based organizations and local health departments, including Baltimore City's.

Another example of local efforts is Baltimore's Green and Healthy Homes Initiative (GHHI), which provides assessment, education, and in-home environmental remediation for families with environmental health concerns, including lead exposure, older adult fall risks, and

asthma. GHHI reports past success in reducing asthma-related health care utilization as well as missed school and work days through in-home environmental approaches.^{71, 72} Amerigroup, a Managed Care Organization (MCO) with beneficiaries in Baltimore, is currently contracting with GHHI to provide integrative pest management for a subset of its beneficiaries.⁷³ Findings from this initiative and the State Plan Amendment work will provide valuable information about the effectiveness of environmental remediation at reducing health care utilization for high-risk children with asthma in Baltimore.

CHALLENGE: Exposure to asthma triggers extends beyond a single apartment unit or house.

One structural limitation to household environmental trigger interventions is that exposure to indoor asthma triggers is linked to housing quality and stability, and poverty—challenges that are beyond the scope of person-level interventions. For example, a landlord or property owner often needs to consent to a housing intervention that involves structural changes to a home. Low-income families often have barriers to contacting their landlords or obtaining landlord agreement. Therefore, these most at-risk families are often excluded from studies or do not benefit from IPM interventions. Also, many low-income families move frequently; an environmental intervention may be delivered in one residence and then need to be repeated each time a child moves homes in order to be effective. Similarly, if a child lives in multiple homes (e.g., children who split time between a parent's house and a grandparent's house, or who live part-time with a second parent in a second home), more than one in-home intervention could be required for an individual child.

Additionally, IPM is only effective long-term if families are able to maintain the allergen or trigger reduction.^{74, 75} For example, if food is left out in the home, pests are likely to return

soon after the intervention, rendering it ineffective days or weeks after implementation. In addition, many risk factors for pests are not within a family's control. The Associated Press reports that Maryland's public housing is the worst performing of any state's in health and safety scores.⁷⁶ If a family's apartment building is not properly maintained, or if neighbors do not properly store food or dispose of trash, it may be nearly impossible to eliminate and keep pests from the home. Similarly, children may be exposed to secondhand smoke entering the home from external sources, even if parents and other household members do not smoke.⁷⁷ In addition, children are exposed to allergens in locations outside the home, including at school. Studies demonstrate that mouse allergen levels in schools may be higher than in homes and may have an effect on symptoms, independent of in-home allergen levels.^{78, 79}

PROMISING APPROACH: Public building remediation

Efforts made to improve the environmental health of Baltimore City public housing buildings and schools would not only make other interventions more effective for children with moderate to severe asthma, but also benefit entire communities. Baltimore City housing officials report that, in 2019, they began working with Public Works officials to coordinate internal and external extermination efforts in and around public buildings.⁸⁰ By prioritizing funding for structural repairs, mold remediation, and pest management in public housing and in schools, the Housing Authority of Baltimore City and Baltimore City Public Schools could help prevent unnecessary spending on asthma-related health care utilization.

Poor environmental conditions in schools are associated with increased absenteeism and poorer performance.⁸¹ Researchers are currently conducting an analysis of the effects of school renovations in Baltimore. Scientists

Recommendations for Future Research on Asthma Interventions

Asthma interventions have been widely studied. However, inconsistencies in research methods across studies make it difficult to compare the effectiveness of different interventions.

Use of control groups: Asthma symptoms tend to improve in children as they age.ⁱ This means that an asthma intervention may appear to be effective when really the child's increasing age is partially or fully responsible for improved health status over time. This is not to say that pre-test/post-test designs are useless in the study of asthma, but their results should be interpreted with caution and, when possible, a waitlist or attention control group of children matched on important characteristics should be utilized.

Uniformity in outcome measures: Some asthma intervention studies report only on short-term outcomes (e.g., symptom-free days at 30 days post-intervention) while others report on long-term outcomes. Some studies focus on medication use, such as number of times that a rescue inhaler is used, whereas other studies focus on health care service utilization, such as emergency department visits.^{ii iii} Recently, the Green and Healthy Homes Initiative launched a workgroup of national experts to develop a standard set of metrics to be used in community-based studies of pediatric asthma interventions. Widespread uptake of standard measures could make it easier to determine the relative effectiveness of asthma programs.^{iv}

Clinical significance and statistical significance: Most academic literature reports the statistical significance of study findings. Statistical significance is the likelihood that a difference between groups or a difference from one point in time to another is due to something other than chance alone. While this is standard and important information in the scientific literature, it does not always indicate findings of importance to clinicians or patients. For example, a statistically significant decrease in symptoms may or may not be large enough to result in a difference in that child's use of health care services.^v When appropriate, future studies should provide results in terms of both statistical and clinical significance.

i Cabana M, Kunselman S, Nyenhuis S, Wechsler M. Researching asthma across the ages: Insights from the NHLBI asthma network. *J Allergy Clin Immunol*. 2014; 133(1): 27-33. [https://www.jacionline.org/article/S0091-6749\(13\)01639-4/fulltext](https://www.jacionline.org/article/S0091-6749(13)01639-4/fulltext)

ii Gold DR, Medical H, Adamkiewicz G, et al. NIAID, NIEHS, NHLBI, MCAN Workshop Report: The Indoor Environment and Childhood Asthma: Implications for Home Environmental Intervention in Asthma Prevention and Management. *J Allergy Clin Immunol*. 2018; 140(4): 933-949.

iii van Wonderen K, van der Mark L, Mohrs J, Bindels P, van Aalderen W, Riet G. Different definitions in childhood asthma: How dependable is the dependent variable? *Eur Respir J*. 2010; 36: 48-56. <https://erj.ersjournals.com/content/36/1/48>.

iv Wu TD, Perzanowski M, Peng RD, et al. Validation of the maximum symptom day among children with asthma. *J Allergy Clin Immunol*. 2019; 143(2): 803-805.e10. [https://www.jacionline.org/article/S0091-6749\(18\)31447-7/fulltext](https://www.jacionline.org/article/S0091-6749(18)31447-7/fulltext)

v Stempel D, Fuhlbrigge A. Defining the responder in asthma therapy. *J Allergy Clin Immunol*. 2005; 115(3). <https://doi.org/10.1016/j.jaci.2004.12.1113>

monitored school air quality, including mouse and cockroach allergen concentration, both before and after improvements to 30 schools through the 21st Century School Buildings Program.⁸² Initial findings suggest that the school renovations may have had positive impacts for children in the schools, both in terms of academic performance and absenteeism.⁸³ The team is now evaluating the relationship between school conditions and health outcomes, using Medicaid data.

PROMISING APPROACH: Housing mobility programs

Children living with asthma in under-resourced neighborhoods may be disproportionately exposed to allergens and environmental triggers, and this exposure may be difficult or impossible to mitigate in that child's existing environment. Some children may benefit from having the opportunity to relocate to neighborhoods with less exposure to environmental asthma triggers. The Baltimore Regional Housing Partnership, a housing mobility program, offers housing vouchers and intensive counseling to families to assist them in accessing housing and navigating resources in low-poverty, high-opportunity areas throughout the Baltimore region. According to the Baltimore Regional Housing Partnership, many of the families it serves report improved pediatric asthma symptoms after moving.⁸⁴ A team funded by the National Institute of Environmental Health Sciences is currently testing the effectiveness and feasibility of housing mobility programs like Baltimore's at reducing asthma symptoms and improving overall health.⁸⁵

CHALLENGE: Families may need support to manage asthma.

All children and adults are sensitized to tobacco smoke, and exposure to tobacco can be a significant contributor to asthma exacerbations. Therefore, children exposed to tobacco smoke at home may not benefit from interventions that do not include efforts

to reduce their exposure to tobacco.^{86, 87}

A parent's smoking status is an important variable that can significantly impact a child's symptom burden.^{88, 89} If a child is not exposed to tobacco smoke and an asthma intervention significantly reduces an allergen to which the child is sensitized, that intervention may be effective in improving the child's symptom burden. However, the same intervention for the same child will not be as influential if the child is exposed to tobacco smoke. Unfortunately, many studies exclude children exposed to tobacco smoke or fail to include smoking cessation as an intervention element.

But tobacco smoke exposure is just one factor of pediatric asthma symptom management that is heavily influenced by family caregivers. As a chronic illness, successful management of asthma requires that children and their families engage in resource navigation, lifestyle changes, and routine health care services. A parent or guardian may need to manage a child's medication schedule, ensure that the child has medication and is able to self-administer the medication when away from home, schedule and bring the child to frequent health care appointments, make environmental changes to reduce allergen and environmental trigger exposure, and so on. Research demonstrates that a family caregiver's level of stress, depression, and self-esteem all have a relationship with a child's symptom burden and level of asthma symptom control, making family involvement an important element of asthma interventions.^{90, 91, 92}

For low-income families, asthma may be particularly challenging to manage due to disproportionate exposure to environmental triggers, limited flexibility during the workday to access medical appointments, financial strain and lack of access to transportation, and other resource limitations.

PROMISING APPROACH: Community health worker-facilitated education and support

Some research suggests that family education and behavioral approaches have the most potential to influence sustainable improvements in the health of children with asthma.^{93, 94} Family education and support may also be a particularly cost-effective solution, as short-term family education could have a long-term benefit.⁹⁵ Programs that deploy community health workers to provide in-home education and care coordination support to families of children with asthma have demonstrated both health benefits and cost-effectiveness.^{96, 97, 98, 99} A study of a community health worker program for low-income urban children in Boston found the intervention to be cost-effective due to decreased hospitalizations and emergency department visits.¹⁰⁰ In that program, community health workers helped families to identify and mitigate allergens and environmental triggers in the home, provided education on asthma symptom management,

and helped families to develop strategies for improving medication adherence.¹⁰¹ The program specifically targeted children with severe asthma or high social/environmental needs. The intervention broke even at two years, and the return on investment was 1.91 over five years, meaning that the intervention saved \$1.91 in health care utilization for every \$1 spent on the program.¹⁰²

Studies of smoking cessation support for parents of children with asthma that includes motivational interviewing demonstrate successful parent cessation and improved symptom burden for children.^{103, 104, 105} A family member may interact with a child's asthma provider, or a registered nurse or community health worker who is part of a child's asthma intervention, more consistently than with his or her own health care team. Clinicians and program staff focused on pediatric health can and should consider family smoking cessation support as part of a child's care plan as appropriate.



Smoking cessation is also an important component to improving the effectiveness of other types of intervention in a multimodal approach to asthma management. In Rochester, New York, researchers tested a combined directly observed therapy and nurse-led smoking cessation program. While many studies demonstrate that an asthma intervention is more effective—or only effective—for children not exposed to secondhand smoke at home, this combined DOT-smoking cessation intervention resulted in reduced symptom burden both for children exposed and not exposed to secondhand smoke at home.¹⁰⁶ This is one example of the potential in combining clinical and educational/behavioral interventions to achieve widespread success.

PART II: Policy and Payment Challenges to Asthma Interventions

In addition to the programmatic challenges of implementing and sustaining successful asthma interventions, families, clinicians, and community-based organizations face health policy and financing issues that create barriers to scaling innovative and effective care for children with asthma. In this section, we provide a brief overview of asthma care financing challenges. In Part III of this report, we propose suggested steps that MCOs, health systems, and the state and city government should take to begin to coordinate an effort to address these systemic financing challenges.

CHALLENGE: Social impact pilots in Medicaid lack flexibility.

It is currently difficult for a single Medicaid Managed Care Organization (MCO) to engage in a social impact funding pilot with a hospital, health system, or community-based organization. In a social impact funding program, an “impact-driven investor” such as a foundation provides start-up funding that an MCO, along with its clinical and

community-based partners, could use to develop comprehensive, cross-sector asthma interventions.¹⁰⁷ However, the current financing structure in Maryland creates adverse incentives for MCOs to repay investors. The rate that each MCO is paid to manage care for its enrollees is determined based on all MCO spending data from previous years and each MCO’s market share, irrespective of the MCO’s success in a social impact funding pilot or its obligation to repay an investor for a social impact pilot investment.

CHALLENGE: The global budget structure in Maryland needs to be matched by delivery system innovation to deliver on its promise of enhanced prevention across the state.

Maryland is the first state in the country to fund its hospitals through an all-payer global budgeting system. This means that hospitals are provided a set amount of money each year to provide care for their designated patient population.¹⁰⁸ Traditional “fee for service” models create a financial incentive for hospitals to see as many patients for as many urgent and emergent visits as possible. The purpose of global budgets is to shift away from fee-for-service payments by incentivizing hospitals to engage in prevention efforts and keep people healthy in the community and out of the hospital.^{109, 110}

Under a global budget model, hospitals keep some of the dollars they do not spend on patient care, a reward for helping to keep their community healthy and reducing utilization of the health care system. Some hospitals have used these incentives to enhance prevention activities for asthma. But many have not, illustrating the fact that in our complex health system, transformation depends on more than just top-level financial incentives.

For example, for financial incentives to have the greatest impact, they should apply at the level of the department. A pediatric asthma department might develop an innovative program focused on reducing asthma-

related hospital admissions and emergency department visits. If the pediatric asthma department is successful, the hospital as a whole will benefit financially under a global budget. However, without a clear mechanism for returning those dollars to the departments initiating the prevention work, the department will be penalized financially for its innovation. In fact, the department's budget could be reduced in the coming quarter or year due to reduced utilization of the department, making it difficult or impossible for the department to afford to continue its prevention efforts. Similarly, if a hospital funds a community-based program, the savings will be spread across local health systems, not just within the hospital that funded the program. This fragmentation creates barriers to funding innovative and effective interventions.

CHALLENGE: Insurers frequently change their medication formularies.

One policy-driven barrier to medication use is that Maryland's nine Medicaid Managed Care Organizations (MCOs) do not all cover the same asthma medications, and each MCO can change its covered medication formulary as often as multiple times per year. The MCOs make regular changes to their formularies in order to reduce their expenses based on ongoing pharmaceutical company price changes and negotiations.¹¹¹ The result is that clinicians and families are often unsure of which medication a child can be prescribed under the child's insurance plan.¹¹² A family member may arrive at the pharmacy to pick up a medication and be asked to pay the full out-of-pocket cost for the prescription because it is no longer covered by the child's plan. If a child is switched to a new type of inhaler as a result of formulary changes, the child may not have timely access to support in learning how to use the new device. If the child uses the new inhaler improperly, he or she may not receive therapeutic benefit from the medication and, as a result, may stop using it. Formulary changes are challenging, particularly for

low-income children whose families are often managing multiple stressors and who are therefore already at risk for missed medication doses. Pediatricians report that formulary flux is an influential driver of missed doses of asthma medication.

PART III: Recommendations

In Parts I and II of this report, we outlined some of the most salient contributors to the burden of uncontrolled pediatric asthma symptoms in Baltimore City, and provided examples of promising programmatic approaches to supporting children with asthma and their families. In this section, we outline key recommendations for developing a multimodal, public health response to improve equity for Baltimore's children living with asthma.

RECOMMENDATION ONE: Develop a population health goal for pediatric asthma in Baltimore City.

Poorly controlled asthma symptoms are a serious public health concern, spending issue, and contributor to health disparities in Baltimore City, but much of this inequitable burden of asthma is preventable. If Baltimore City's low-income minority children experienced the same levels of symptom control as their most socioeconomically advantaged peers, we could expect asthma spending to decrease by eightfold along with immeasurable gains in equity. Understanding that some contributors to uncontrolled asthma symptoms may require long-term, structural intervention, the city should aim to reduce pediatric asthma-related emergency department visits and hospitalizations by at least 30% within five years. We recommend that the city's leadership identify and publicly declare a specific population health goal for pediatric asthma to drive a collaborative response.

RECOMMENDATION TWO: Develop a citywide, cross-sector approach to pediatric asthma management based on a developed goal.

As there are multiple risk factors for asthma symptom exacerbation, a multimodal response is necessary. Many approaches have been piloted and demonstrate promise for mitigating Baltimore's pediatric asthma symptom burden. To truly address asthma disparities in Baltimore and significantly impact health utilization and spending, the city needs a coordinated population-level approach that capitalizes on the most promising evidence from environmental, housing, medical, and educational approaches. In partnership with the state of Maryland and city-serving health care systems and MCOs, Baltimore City should develop an approach that addresses the most important contributors to asthma outcomes, including:

- A. Reducing Missed Doses of Asthma Medication:** directly observed therapy and asthma specialist care for children at highest risk for uncontrolled symptoms; and
- B. Mitigating Exposure to Environmental Triggers and Supporting Families:** individually tailored in-home allergen and environmental trigger mitigation, family education, and smoking cessation support delivered by community health workers.

Below, we provide estimated costs of scaling existing promising approaches in Baltimore City.

Scaling Up Directly Observed Therapy Services in Schools

Cost estimates for scaling up directly observed therapy in Baltimore City Schools are based on proposed implementation in five targeted large schools (those with at least 300 students) with high asthma prevalence (at least 20%

of students have asthma). When possible, DOT services should build on existing school health services rather than being implemented in parallel to those existing structures, and should be tailored to the existing and preferred staffing models of individual schools (e.g., scaling up funding for existing nursing assistants may make sense for a particular school rather than hiring new staff). An example of a robust approach to DOT in Baltimore City would be to increase registered nurse staffing in targeted schools from the current one nurse per three schools to one nurse per target school. The registered nurses would lead development and implementation of the DOT program, and would promote integration of DOT into existing school-based health services, allowing for health promotion activities beyond medication administration. Funds would also be required for supplies including inhaler storage and educational materials. These staffing and supply costs are estimated at \$65,000 per school.

In addition to the per-school cost, scaling up DOT services in Baltimore City would require planning and program-wide coordination efforts. The Johns Hopkins BREATHE DOT team estimates those costs at \$170,000 during the planning year (year one), \$130,000 during the first year of implementation (year two), and \$90,000/year during the second year of implementation (year three) and beyond. This would include a full-time DOT program administrator based in the city's health department; part-time epidemiologist support; and planning, evaluation, and technical assistance provided by a team with DOT implementation experience.

In summary, to support five Baltimore City Schools whose children are at highest risk for uncontrolled asthma symptoms, we estimate that DOT staffing and supplies would cost \$415,000/year with an additional cost of \$300,000 to support planning and start-up in years one and two.

Scaling Up Specialty Services

The city should consider investing in mobile or clinic-based specialty services in areas of the city that do not have access to School-Based Health Centers (SBHCs), and making additional investments where SBHCs do exist, to ensure their ability to support children with asthma. Prior to investing in a citywide, multimodal approach to asthma, the city should conduct an analysis to understand where SBHCs exist and where mobile services may be of greatest support. In addition, the analysis should include a cost-benefit assessment of other approaches to specialty services, such as the IMPACT DC Asthma Clinic model. Here, we provide an estimate of the costs that may be required to scale up access to specialty care, using figures provided by Baltimore's Breathmobile.

The Breathmobile estimates that each new mobile unit would cost \$325,000. Each unit can manage care for approximately 500 children. To reach the 1,500 children who the Breathmobile leadership estimates are most in need of mobile specialty services for asthma (e.g., those without reliable transportation to office visits or with other social barriers to care) would require a total of three mobile units, including the one current unit. The total upfront cost for purchasing the two new units would be \$650,000. In addition, the annual budget for each unit is estimated at \$360,000 per year (supplies, full-time nurse practitioner, full-time nursing assistant, a shared medical director, hourly rate for driver). To support 1,500 children at highest risk for uncontrolled asthma symptoms, we estimate a scaled-up citywide mobile specialty program would cost \$1,080,000 per year, with an additional upfront cost of \$650,000.

Scaling Up Community Health Worker Programs

Community health worker programs that provide support, education, and resource navigation demonstrate considerable promise

for improving health and reducing health care expenses of children with asthma. The "glue" of Baltimore's multimodal approach to asthma should be a scale-up of existing community health worker services to support children with asthma and their families. Community health workers can support families with sustaining environmental and medication management techniques initiated by other partners and ensure that families are connected to appropriate resources. In a scaled-up Community Asthma Program, community health workers would provide not only in-home environmental mitigation, but also family education and smoking cessation support services to families.

Baltimore City's Community Asthma Program estimates that, in a scaled-up two-team program, it could serve up to 1,200 children each year through home visits, and an additional 600 each year through community-based group education. Each community asthma team would consist of a nurse supervisor, a referral coordinator, and five community health workers. This model estimates three to six home visits per child to support an individualized, multicomponent, multi-trigger in-home intervention for all children at highest risk for uncontrolled asthma symptoms. Funding estimates for this model include environmental supplies and community health worker staffing to facilitate in-home mitigation efforts, in addition to community health worker staffing to facilitate family education and smoking cessation programs. Funding estimates also support an asthma program coordinator who would coordinate citywide strategies and lead outreach and referral management.

The total cost per year of the scaled-up Community Asthma Program is estimated at \$1.5 million, including staffing, supplies, travel expenses, and staff development. Although we do not provide cost estimates for a housing voucher prescription approach or public building mitigation, we believe that

these strategies should be further evaluated for cost-effectiveness. They may be important components of a citywide approach to pediatric asthma, in order to address environmental concerns that are beyond the scope of community health worker interventions.

RECOMMENDATION THREE: Develop a centralized infrastructure for data monitoring and case management to track health care utilization and coordinate services for pediatric asthma.

A citywide approach targeting “hot spots” for uncontrolled symptoms will produce the greatest return on the important investment outlined in Recommendation Two. The program described in Recommendation Two should be supported by a citywide pediatric asthma data monitoring and case management infrastructure, housed in the Baltimore City Health Department. The infrastructure should include:

1. A publicly accessible, real-time aggregate data dashboard with citywide metrics on asthma-related health care utilization at the zip-code level (with data contributed by all local health systems), and
2. A case management system, accessible to Baltimore City case managers, indicating which services a particular child has been referred to and enrolled in. This infrastructure would ensure the following:
 - a. All stakeholders have access to real-time aggregate citywide metrics on asthma-related health care utilization, at the zip-code level, enabling partners from across sectors to align efforts with the citywide population health goal for asthma. Communities at highest risk for asthma disparities can be prioritized for outreach from program staff across sectors.
 - b. Children and families can be seamlessly connected to all appropriate resources, rather than families having to navigate multiple disconnected programs.

By developing a centralized data monitoring and case management infrastructure for pediatric asthma, Baltimore can identify children at highest risk for uncontrolled symptoms, who therefore also contribute most significantly to preventable health care utilization and spending. The central data monitoring system can be used to prioritize environmental mitigation for the most at-risk children whose in-home exposures are likely to be highest, to prioritize schools for DOT whose students are most in need of support, and to prioritize areas of the city for specialty care and public health messaging (e.g., health department and health system billboards, mailers, and social media campaigns) that are most under-resourced and where asthma health disparities are most pronounced. Currently, this type of targeting is not possible due to the lack of available, real-time data. The centralized data monitoring and case management infrastructure will be a crucial step toward improving equity in asthma symptom burden and reducing the financial burden of uncontrolled asthma symptoms on Baltimore City.

A centralized data monitoring and case management infrastructure is not a new idea for Baltimore: B'More for Healthy Babies, in coordination with HealthCare Access Maryland, supports data monitoring and case management to support pregnant women and their new babies, through resource and referral management. We estimate the cost of a centralized data monitoring and case management infrastructure specific to pediatric asthma at \$500,000/year. This is based on an estimated need to support approximately 5,000 children and their families per year with case management, referral and

tracking with a specific emphasis on referral management for highest risk children, and additional costs to support IT infrastructure and epidemiologist support. The total five-year costs are estimated at \$2.5 million.

The total costs estimated to support Recommendations Two and Three are \$17.92 million over five years, including start-up costs. Of that spending, \$12.37 million would go toward new or expanded services and the remainder would sustain funding for existing effective services. Hospitalization and emergency department visits for pediatric asthma total more than \$7 million per year in Baltimore City, or \$35 million over five years. If the proposed program successfully reduces those costs by 30%, the savings in hospitalization and emergency department visits alone would cover almost 60% of annual program costs after start-up costs. This does not account for the health care spending that

is prevented by existing effective services or other anticipated health care savings such as reduced pharmaceutical spending and urgent care visits. Most importantly, this estimate does not account for invaluable improvements in quality of life and school attendance. Because these savings will benefit state and city taxpayers, MCOs, and health care systems in the city, this program should be supported through strategic and sustainable financial investment from all of those parties.

RECOMMENDATION FOUR: The Maryland Department of Health and Baltimore City Health Department should convene an Asthma Policy and Payment Summit to determine a path forward for addressing financing barriers and cross-organization coordination challenges.

Research on asthma calls for a cross-sector approach to addressing the disease at the population level. However, logistical

Estimated budget for a scaled-up city-wide asthma program

	Y1	Y2	Y3	Y4	Y5	Total
Directly Observed Therapy	\$170,000	\$455,000	\$415,000	\$415,000	\$415,000	\$1,870,000
Mobile Specialty Care	\$1,730,000	\$1,080,000	\$1,080,000	\$1,080,000	\$1,080,000	\$6,050,000
Community Health Workers Program	\$1,500,000	\$1,500,000	\$1,500,000	\$1,500,000	\$1,500,000	\$7,500,000
Data Infrastructure	\$500,000	\$500,000	\$500,000	\$500,000	\$500,000	\$2,500,000
Total	\$3,900,000	\$3,535,000	\$3,495,000	\$3,495,000	\$3,495,000	\$17,920,000

The Value of Citywide Data Infrastructure for Helping Baltimore Support Children at Highest Risk for Uncontrolled Asthma Symptoms

Research suggests that some interventions may not demonstrate impact on asthma symptoms or health care utilization because the intervention's benefit may be limited to children at highest risk for uncontrolled symptoms, for whom an intervention can most substantially change their level of exposure or support. For example, a very large reduction in allergen and environmental trigger exposure may be required for an environmental trigger mitigation intervention to achieve a clinical impact.^{i, ii} In a Baltimore and Boston-based randomized controlled trial comparing a combined integrative pest management and family education program to family education alone, there were no overall significant differences in clinical outcomes between groups.ⁱⁱⁱ However, children whose exposure to mouse allergens was reduced by very large amounts (90%) as a result of the intervention did experience significantly improved clinical symptoms.^{iv}

Experts estimate that a 50% or greater reduction in household allergens may be required for an environmental program to impact a child's asthma symptoms or health care utilization. These findings suggest that benefit of remediation interventions may be limited to children who are highly exposed to allergens at baseline and to interventions that dramatically reduce exposures. Central data monitoring and case management infrastructure as part of a population-level intervention in Baltimore will make this type of targeted, tailored approach possible.

i Matsui E, Perzanowski M, Peng R, et al. Effect of an integrated pest management intervention on asthma symptoms among mouse-sensitized children and adolescents with asthma: A randomized clinical trial. *JAMA*. 2017; 317(10): 1027-1036. <https://jamanetwork.com/journals/jama/fullarticle/2607513>

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iii Matsui E, Perzanowski M, Peng R, et al.: 1027-1036.

iv Ibid.

barriers exist to paying for prevention and to developing large-scale partnerships between insurers, health care providers, and community-based organizations. Maryland has many health system strengths, including the nation's first all-payer global budgeting model for hospitals, and some of the most prestigious academic medical centers in the world. There are opportunities to build on these strengths to develop and sustain a large-scale multimodal asthma plan for the city of Baltimore. The state and city should partner to convene an Asthma Policy and Payment Summit focused on addressing financial and logistical barriers to implementing a citywide approach and centralized data monitoring and case management infrastructure as proposed in Recommendations Two and Three.

The convened Summit should be comprised of experts appointed by the state and city health commissioners, including a leadership panel of no more than three people tasked with translating summit ideas into an actionable plan to address these issues. Experts should include state Medicaid and MCO personnel, pharmacists, pediatric asthma specialists, pediatric primary care providers, public health and community organization leaders, and family caregivers of children with asthma.

Potential Strategies for Asthma Policy and Payment Summit Considerations

STRATEGY 1: Summit leaders should consider strategies such as increasing state funding for the Maryland State Plan Amendment for community-based asthma intervention. Maryland's CHIP Health Services Initiative amendment for lead and asthma services capitalizes on a significant public health financing opportunity available to states: The federal government matches in multifold each dollar contributed to the program by the state. Maryland contributes \$860,000 to the program and receives \$6,306,667 from the federal government in matching funds.¹¹³ The state could propose to increase its contributions and

thereby potentially increase federal funding for in-home environmental intervention for Maryland children by a relative sevenfold.

Currently, Maryland State Plan Amendment supports funding for education and assessment of environmental triggers as well as abatement supplies for families. However, it does not include funds for significant in-home remediation efforts or meaningful partnership with clinical programs that promote symptom self-management. The state should consider proposing to increase its contributions, and thereby the federal government's, to enable funding for a multimodal intervention. This could be a sustainable solution to funding meaningful cross-sector asthma intervention.

STRATEGY 2: In addition to increasing funding for the Maryland State Plan Amendment, Summit leaders should propose changes to payer quality metrics and funding models related to pediatric asthma care, to ensure alignment between organizations toward the identified population health goal. For example, the Summit leaders could propose that MCOs serving Baltimore's children tie at least 50% of a health care system's value metrics to the citywide pediatric asthma goal. Summit leaders should prioritize making two-sided risk-bearing models available to health systems that are willing to be paid according to their contribution toward population health goals.

Under Maryland's global budget model for health care financing, each hospital negotiates a budget that is based on population served as opposed to number of services provided. This is meant to encourage hospitals to engage in prevention efforts because as hospital admissions and emergency department visits are avoided, the hospital does not lose that portion of its budget. However, budget surpluses achieved by one department do not necessarily return to that department. Summit leaders should propose subcapitated agreements or global budgets at the department level to encourage individual

health system departments or programs (such as a children's hospital or a pediatrics department that is part of a larger system) to develop and engage in programs that may have population health benefits for that department's subpopulation, such as pediatric asthma patients.

Nationwide Children's Hospital in Columbus, Ohio, offers a model for this kind of subcapitation agreement. Nationwide is part of Partners for Kids, a pediatric accountable care organization (ACO), which carries full financial risk for hundreds of thousands of area children who are insured by any of five Medicaid MCOs. The ACO pays Nationwide Children's Hospital based on a global budget, allowing the hospital and its partners to benefit from savings that they contribute to through reduced hospital admissions and emergency department visits.¹¹⁴ These kind of subcapitated payment models may be especially effective in paying for the care of patients with asthma whose needs are often highly individualized and often require support from multiple sectors.

STRATEGY 3: In addition to addressing financing barriers, the Summit leaders should develop a strategy for addressing logistical barriers to providing high-quality care to children with asthma. For example, clinicians and their patients struggle with the complications of navigating insurer formularies to determine which medications are approved for payment under insurance plans. The Summit leaders could propose legislative solutions, such as restricting the number of allowed formulary changes or coordinating formulary changes across MCOs. In addition, the Summit leaders could identify and propose a path forward for addressing key logistical challenges such as lack of uniformity of forms or the need for a more seamless referral process across organizations.

Conclusion

The state of Maryland, and Baltimore in particular, has many assets that can be further leveraged to achieve improved outcomes in children with asthma. Currently, most approaches are single-modal and operate within a single organization such as a single health care system or a single nonprofit. Effectively addressing asthma at a population level will require partnership across traditionally siloed partners, flexible payment and design methods that allow for integration of nonmedical interventions with clinical approaches, tailoring to individual needs, and an overall increase in resources. By developing a coordinated cross-sector approach to asthma and ensuring that payment structures incentivize achievement of the goals of that approach, Baltimore can expect to narrow the outcome gaps in quality of life, education, and health for children living with asthma whose communities have experienced historical disinvestment.

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**The Unequal Burden of Pediatric Asthma: A Call
for an Equity-Driven, Multimodal, Public Health
Approach to Asthma in Baltimore**

By Sarah LaFave, MPH, RN, PhD Candidate

About the Abell Foundation

The Abell Foundation is dedicated to the enhancement of the quality of life in Maryland, with a particular focus on Baltimore. The Foundation places a strong emphasis on opening the doors of opportunity to the disenfranchised, believing that no community can thrive if those who live on the margins of it are not included.

Inherent in the working philosophy of the Abell Foundation is the strong belief that a community faced with complicated, seemingly intractable challenges is well-served by thought-provoking, research-based information. To that end, the Foundation publishes background studies of selected issues on the public agenda for the benefit of government officials; leaders in business, industry and academia; and the general public.

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