



2020

# ASTHMA DISPARITIES IN AMERICA

A Roadmap  
to Reducing Burden on  
Racial and Ethnic Minorities



Asthma and Allergy  
Foundation of America

[aafa.org](http://aafa.org)

---

*The Asthma and Allergy Foundation of America is dedicated to saving lives and reducing the burden of disease for people with asthma and allergies through support, advocacy, education and research.*

---



Asthma and Allergy  
Foundation of America

## **Asthma Disparities in America**

### **A Roadmap to Reducing Burden on Racial and Ethnic Minorities**

Available online at [aafa.org/asthmadisparities](https://aafa.org/asthmadisparities)

#### **Suggested Citation**

Asthma and Allergy Foundation of America, (2020). [Asthma Disparities in America: A Roadmap to Reducing Burden on Racial and Ethnic Minorities]. Retrieved from [aafa.org/asthmadisparities](https://aafa.org/asthmadisparities)

**Copyright** © 2020 by the Asthma and Allergy Foundation of America (AAFA). This material may be reproduced unaltered in whole or in part without fees or permission provided that acknowledgment is given to the Asthma and Allergy Foundation of America. Content may not be reprinted, translated, or distributed electronically without prior permission in writing from AAFA. For permission, contact [info@aafa.org](mailto:info@aafa.org).

#### **Media Inquiries**

For media and related inquiries, contact [media@aafa.org](mailto:media@aafa.org).

#### **About the Asthma and Allergy Foundation of America (AAFA)**

Founded in 1953, AAFA is the oldest and largest non-profit patient organization dedicated to saving lives and reducing the burden of disease for people with asthma, allergies, and related conditions through research, education, advocacy, and support. AAFA offers extensive support for individuals and families affected by asthma and allergic diseases, such as food allergies and atopic dermatitis (eczema). Through its online patient support communities, network of local chapters, and affiliated support groups, AAFA empowers patients and their families by providing practical, evidence-based information and community programs and services. AAFA is the only asthma and allergy patient advocacy group that is certified to meet the standards of excellence set by the National Health Council. For more information, visit [aafa.org](https://aafa.org).

#### **About This Report**

AAFA synthesized current data and knowledge related to health disparities—and where available, asthma in particular—and offers recommendations for action. These actions do not constitute AAFA policy or commit AAFA to the activities. This report originated with AAFA's strategic initiative to improve care for underserved populations. During the next phase of this initiative, a workgroup of likeminded organizations and stakeholders will meet to prioritize activities to drastically reduce asthma's burden on at-risk populations.

# ACKNOWLEDGEMENTS

## AUTHORS

**Melanie Carver (Co-Principal Investigator)**  
Chief Mission Officer, AAFA

**Hannah Jaffee, MS**  
Research Analyst, AAFA

**Sanaz Eftekhari (Co-Principal Investigator)**  
Vice President of Research, AAFA

**Mo Mayrides, MBA**  
Managing Partner, Emoluva Partners, LLC

## CONTRIBUTORS

**Kafi Drexel Brown, MS**  
Public Relations Director, AAFA

**Elisa Zizza, MA**  
Manager of Corporate Relations, AAFA

**Jenna Riemenschneider, MS**  
Director of Advocacy, AAFA

## REVIEWERS

*External reviewers provided feedback on select pieces of this report.*

**Kenny Mendez, MBA**  
President and CEO, AAFA

**Alison Galbraith, MD, MPH**  
Center for Healthcare Research in Pediatrics  
Department of Population Health  
Harvard Medical School and  
Harvard Pilgrim Health Care Institute

**Tiana Ottley, MA, EdM**  
Director, Guide Education Consulting

**Naomi Seiler, JD**  
Department of Health Policy and Management  
Milken Institute School of Public Health  
The George Washington University

**Paige Welch**  
Asthma and Community Health Branch  
Division of Environmental Health Science and Practice  
National Center for Environmental Health  
Centers for Disease Control and Prevention

**Kylie Williams**  
Patient Advocate  
AAFA Patient and Family Advisory Council

**Chris Gensch**  
Digital Marketing Manager, AAFA

**Mitchell Grayson, MD**  
Chair, AAFA Medical Scientific Council and  
Director, Division of Allergy and Immunology  
Nationwide Children's Hospital and  
The Ohio State University

**Gary Puckrein, PhD**  
President and CEO  
National Minority Quality Forum

**Mary Stober Murray, MPH**  
Vice President, Collaborative Action Networks  
National Minority Quality Forum

**Ann Chen Wu, MD, MPH**  
Center for Healthcare Research in Pediatrics  
PRecisiOn Medicine Translational Research Center  
Department of Population Health  
Harvard Medical School and  
Harvard Pilgrim Health Care Institute

## DESIGN

**Nicole Gaghan**  
Art Director, AAFA

## FUNDING AND SUPPORT

The authors express gratitude for the ongoing support of AAFA's partners in producing this report. This report is made possible by financial contributions from the following partners:

**AstraZeneca**  
**Genentech, A Member of the Roche Group**  
**Novartis Pharmaceuticals Corporation**  
**Pharmaceutical Research and Manufacturers of America**  
**Sanofi Genzyme and Regeneron Pharmaceuticals**

AAFA thanks the National Minority Quality Forum for in-kind support and data.

**The views and opinions expressed in this report are those of the AAFA authors and do not necessarily reflect the policies or positions of other individuals, organizations, or companies.**



# TABLE OF CONTENTS

<b>Preface</b> . . . . .	<b>8</b>
<b>Executive Summary</b> . . . . .	<b>10</b>
<b>Introduction</b> . . . . .	<b>22</b>
Data Sources . . . . .	24
Asthma: At a Glance . . . . .	29
<b>Chapter 1: Overview of Asthma Disparities in 2020</b> . . . . .	<b>33</b>
Prevalence . . . . .	36
Mortality . . . . .	40
Health Care Utilization . . . . .	42
<b>Spotlight: Asthma Disparities Among Indigenous American Populations</b> . . . . .	<b>45</b>
<b>Chapter 2: Root Causes of Asthma Disparities</b> . . . . .	<b>51</b>
Social and Structural Determinants . . . . .	53
Biological Determinants . . . . .	64
Behavioral Determinants . . . . .	72
<b>Spotlight: Asthma in Older Adults</b> . . . . .	<b>75</b>
<b>Emerging Strategies</b> . . . . .	<b>78</b>
<b>Chapter 3: Addressing Asthma Disparities Through Policy</b> . . . . .	<b>79</b>
A Holistic Approach to Policy Reform . . . . .	81
Health Care . . . . .	82
Economic Stability . . . . .	102
Education . . . . .	111
Physical Environment . . . . .	117
Summary of Public Policy Strategies to Address Asthma Disparities . . . . .	132
<b>Chapter 4: Addressing Asthma Disparities Through Direct Interventions and Programs</b> . . . . .	<b>133</b>
Clinical Interventions . . . . .	136
Educational Interventions . . . . .	145
Environmental Interventions . . . . .	151
Summary of Intervention Strategies to Address Asthma Disparities . . . . .	165
<b>Spotlight: COVID-19 and Asthma</b> . . . . .	<b>166</b>
<b>Chapter 5: Addressing Asthma Disparities Through Science and Research</b> . . . . .	<b>169</b>
Basic Science . . . . .	174
Clinical Research . . . . .	183
Data Collection and Measurement . . . . .	188
Translating Research to Practice . . . . .	193
Implementation and Evaluation . . . . .	194
Health Services Research . . . . .	196
Patient Engagement in Research . . . . .	198
Diversity in Research . . . . .	201
Summary of Research Strategies to Address Asthma Disparities . . . . .	204
<b>Chapter 6: Partnering to Address Asthma Disparities</b> . . . . .	<b>205</b>
Patient/Family Engagement . . . . .	209
Community Engagement . . . . .	212
Summary of Partnership Strategies to Address Asthma Disparities . . . . .	214
<b>Conclusion</b> . . . . .	<b>216</b>
<b>References</b> . . . . .	<b>220</b>
<b>Appendix – Supplemental Tables</b> . . . . .	<b>252</b>

## TABLES

Table 1. U.S. Population by Race and Ethnicity . . . . .	9
Table 2. Summary of Major Federal Datasets Used in This Report . . . . .	24
Table 3. Summary of Trends and Disparities in Current, Lifetime, and Asthma Attack Prevalence . . . . .	36
Table 4. National Prevalence of Current Asthma . . . . .	46
Table 5. Asthma Among American Indian and Alaska Natives in Washington . . . . .	48
Table 6. Poverty Status in the United States . . . . .	49
Table 7. Examples of Structural Determinants of Health . . . . .	54
Table 8. Examples of Socials Determinants of Health . . . . .	60
Table 9. Change in Uninsured Rates by Race and Ethnicity (Age 0-64) . . . . .	83
Table 10. Components of Successful Community-Based Asthma Programs . . . . .	135
Table 11. Inclusion Criteria for Evaluation of Existing Asthma Self-Management Education Packages. . . . .	146
Table 12. NIMHD Research Framework. . . . .	172
Table 13. Comparison of Asthma Subtypes Determined by Cluster Analysis . . . . .	176
Table 14. Biologic Agents Approved for Asthma. . . . .	179
Table 15. Recommended Measures from the Asthma Disparities Workgroup . . . . .	192

## FIGURES

Figure 1. Asthma Rates in the U.S. by Age, Sex, Race, and Poverty Level. . . . .	30
Figure 2. Annual Asthma Costs in the U.S. . . . .	32
Figure 3. Current Asthma Prevalence by Race and Ethnicity (All Ages) . . . . .	37
Figure 4. Current Asthma Prevalence by Race and Ethnicity (Children) . . . . .	37
Figure 5. Current Asthma Prevalence by Race and Ethnicity (Adults) . . . . .	37
Figure 6. Lifetime Asthma Prevalence by Race and Ethnicity (All Ages) . . . . .	38
Figure 7. Lifetime Asthma Prevalence by Race and Ethnicity (Children) . . . . .	38
Figure 8. Lifetime Asthma Prevalence by Race and Ethnicity (Adults) . . . . .	38
Figure 9. Asthma Attack Prevalence by Race and Ethnicity (All Ages) . . . . .	39
Figure 10. Asthma Attack Prevalence by Race and Ethnicity (Children) . . . . .	39
Figure 11. Asthma Attack Prevalence by Race and Ethnicity (Adults) . . . . .	39
Figure 12. Asthma-Related Deaths by Sex, Race, and Ethnicity . . . . .	40
Figure 13. Asthma-Related Deaths by Race, Ethnicity, and of Residents of Puerto Rico . . . . .	41
Figure 14. Asthma-Related Physician Office Visits by Race . . . . .	42
Figure 15. Asthma-Related ED Visits by Race . . . . .	43
Figure 16. Asthma-Related Hospital Inpatient Rates by Race . . . . .	44
Figure 17. AAFA's Framework for Causes of Asthma Disparities . . . . .	52
Figure 18. Ancestry Composition for Hispanic Subgroups . . . . .	66
Figure 19. ER Visits Rate of Asthma Patients on Medicare (Age 65+) . . . . .	76
Figure 20. Health in All Policies Approach . . . . .	81
Figure 21. Uninsured Rates by Race and Ethnicity (Age 0-64). . . . .	83
Figure 22. Impact of the Affordable Care Act on Health Care Access . . . . .	84
Figure 23. Medicaid Coverage Rates (Age 0-64) . . . . .	86
Figure 24. Change in Uninsured Rates by Race, Ethnicity, and State Medicaid Expansion Status . . . . .	87
Figure 25. Percent of Population Without Usual Source of Care by Race and Ethnicity . . . . .	92
Figure 26. Distribution of Usual Source of Care by Race and Ethnicity. . . . .	92
Figure 27. Poverty Status by Race and Ethnicity. . . . .	103
Figure 28. Current Asthma Prevalence by Poverty Level. . . . .	104
Figure 29. Unemployment Rate by Race and Ethnicity. . . . .	106
Figure 30. Median Weekly Earnings by Race and Ethnicity . . . . .	107
Figure 31. High School Graduation Rates by Race and Ethnicity . . . . .	113
Figure 32. Percentage Distribution of Educational Attainment Race and Ethnicity (Age 25+) . . . . .	114
Figure 33. Homeownership Rates by Race . . . . .	118
Figure 34. Housing Inadequacy by Race and Tenure . . . . .	119
Figure 35. Exposure to Rodents, Cockroaches, and Mold by Race and Tenure. . . . .	120
Figure 36. Rent Burden by Race, Ethnicity and Assistance Status. . . . .	124
Figure 37. Pollution Inequity Trends . . . . .	129
Figure 38. Community-Based Interventions to Improve Asthma Outcomes . . . . .	157
Figure 39. COVID-19 Data by State, Race, and Ethnicity . . . . .	167
Figure 40. Organizational Framework for Addressing Asthma Disparities Through Science and Research . . . . .	171
Figure 41. Progress in Asthma Classification . . . . .	175
Figure 42. Participation in Clinical Trials for Approved Therapies by Race and Ethnicity . . . . .	184
Figure 43. Patient Involvement in All Stages of the Research Process . . . . .	199

## PREFACE

In the United States, the burden of asthma falls disproportionately on racial and ethnic minority populations. The Asthma and Allergy Foundation of America (AAFA) in partnership with the National Pharmaceutical Council published a landmark report on asthma disparities in 2005 entitled “Ethnic Disparities in the Burden and Treatment of Asthma.”

The report highlighted inequities among Black and Hispanic populations when compared to white populations. These disparities were particularly evident in mortality and hospitalization rates. Mortality rates among Black and Puerto Rican people with asthma were three times higher than those among white people with asthma, and emergency department (ED) visits and hospitalization rates were two to three times higher. In fact, national averages may have even masked higher rates of disparities in major urban centers where racial and ethnic minority populations were particularly at risk.

The 2005 report was unequivocal. It emphasized that racial and ethnic disparities in asthma were of significant public health concern, and that immediate and widespread action was necessary to reduce disparities. The report encouraged expanding asthma interventions nationwide and described effective models in schools and communities. It also promoted multi-stakeholder approaches as most likely to lead to success. Such approaches would contain multi-agency federal, state, and local collaboration, community-based care, and culturally sensitive outreach as core components.

Some progress occurred in the fifteen years since AAFA published the 2005 asthma disparities report:

- A federal, interagency Asthma Disparities Subcommittee (formerly the Asthma Disparities Working Group) formed in 2010 and published a Coordinated Federal Action Plan to Reduce Racial and Ethnic Asthma Disparities in 2012.
- The Patient Protection and Affordable Care Act (ACA) passed in 2010 and broadened coverage and health care access for millions.
- Our understanding of social risk factors and social determinants of health helped to reframe asthma’s impact regarding structural inequities and is leading to policy changes and interventions that may have been overlooked in the past.
- Measures of asthma control, outcomes, and risk factors are now standardized, while asthma self-management and education (AS-ME) programs have grown in number and sophistication.
- The scientific and clinical understanding of asthma has progressed, with several innovative medicines and more refined approaches to diagnosis and medical management now available.

Despite steps in the right direction throughout the past fifteen years, significant disparities in asthma still exist. The progress made since the 2005 report—and the inequities that persist—are the topic of this document.

## THE COST OF HEALTH DISPARITIES

Health disparities not only have an impact on affected groups but also limit the overall quality of health care for the entire population, leading to avoidable costs to the health care system.

As the U.S. population becomes more racially and ethnically diverse, it becomes increasingly important to address asthma disparities. The U.S. Census Bureau projects that minority populations (all racial and ethnic groups not considered white only) will account for more than half (56%) of the U.S. population by 2060 (Table 1).

Table 1. U.S. Population by Race and Ethnicity

RACE/ETHNICITY	2019 POPULATION	PROJECTED 2060 POPULATION	CHANGE FROM 2019 TO 2060
<b>Black</b>	12.5%	13.6%	1.1
<b>White</b>	60.1%	44.3%	-15.8
<b>American Indian/Alaska Native</b>	0.7%	0.7%	0
<b>Asian</b>	5.8%	8.9%	3.1
<b>Native Hawaiian/Pacific Islander</b>	0.2%	0.2%	0
<b>Two or More Races</b>	2.2%	4.9%	2.7
<b>Hispanic</b>	18.5%	27.5%	9

Source: U.S. Census Bureau, 2019 Population Estimates and 2017 National Population Projections Tables.

Estimates for race categories do not include people of Hispanic Ethnicity.

The W.K. Kellogg Foundation estimates that total health disparities in the U.S. represent \$93 billion in excess medical care costs and \$42 billion in untapped productivity, for a total potential cost of \$135 billion per year.

Eliminating health disparities by 2050 would reduce the need for more than \$150 billion in medical care and reduce lost productivity by \$80 billion, for a total of more than \$230 billion per year. Healthier workers take fewer sick days are more productive on the job and have lower medical care costs. A healthier population saves everyone money on insurance premiums and health-related public spending.

**\$93 BILLION** + **\$42 BILLION** = **\$135 BILLION**  
 Excess medical costs      Untapped productivity      Total potential cost of all health disparities in the U.S.

Source: W.K. Kellogg Foundation, *The Business Case for Racial Equity* (2018)



# EXECUTIVE SUMMARY

The burden of asthma falls disproportionately on Black, Hispanic and American Indian/Alaska Native people.

The existence and causes of asthma disparities related to race and ethnicity have been studied and documented in great detail. Focus in recent years has shifted from describing the problem to addressing it. Although efforts in reducing disparities have been slow, the picture isn't entirely bleak.



---

## EXECUTIVE SUMMARY

In the United States, the burden of asthma falls disproportionately on Black, Hispanic, and American Indian and Alaska Native populations. Decades of extensive research and public health data identified disparities in asthma prevalence, mortality and health care utilization along racial and ethnic lines.

Health care quality generally improved for many people within the last decade. While disparities in health outcomes between various racial populations have begun to narrow, stark inequities in asthma outcomes persist.

The purpose of this report is to describe the current landscape, highlight promising innovations and offer solutions for various stakeholders to evaluate and implement.

This report is cautiously optimistic. Although progress has been slow, recent advances in policy, program development, and research point to the possibility of more significant improvement in the near future.

More importantly, we are encouraged by the widespread and renewed dedication of our many partners to bridge the racial and ethnic gaps in asthma care and outcomes. For many stakeholders—including the Asthma and Allergy Foundation of America (AAFA)—continuing to chip away at the unequal burden of asthma remains a mission-critical priority.

This report represents AAFA's ongoing commitment to drastically reducing the burden of asthma in underserved populations that bear the biggest burden of this disease.

---





## OVERVIEW OF DISPARITIES IN ASTHMA

This report describes asthma disparities in Black and Hispanic populations in detail. Key examples of such disparities at the national level are highlighted below:

### **Puerto Ricans have the highest rate of asthma prevalence compared to any other racial or ethnic group in the U.S.**

Nearly 25 million people in the United States are living with asthma,<sup>1</sup> but prevalence rates differ significantly by race and ethnicity. Puerto Ricans have the highest rate of asthma prevalence. Black Americans are also disproportionately diagnosed with asthma compared to white Americans.

### **Black individuals are nearly three times as likely to die from asthma than white individuals.**

Differences in mortality rates present startling evidence of racial disparities in asthma. Deaths due to asthma—although decreasing overall—are far more frequent in the Black population than in the white population.

### **Asthma-related emergency department (ED) visits are nearly five times as high for Black patients compared to white patients.**

Asthma disparities are perhaps greatest between Black and white populations in terms of ED visits. Increased ED visits are indicative of poor asthma control.

### **Asthma-related data for American Indian (AI) and Alaska Native (AN) populations are limited.**

Data on asthma conditions for AI/AN communities are limited. National datasets do not consistently contain reliable asthma data for AI/AN groups. Some regional data shows AI/AN individuals are twice as likely to experience asthma symptoms every day.



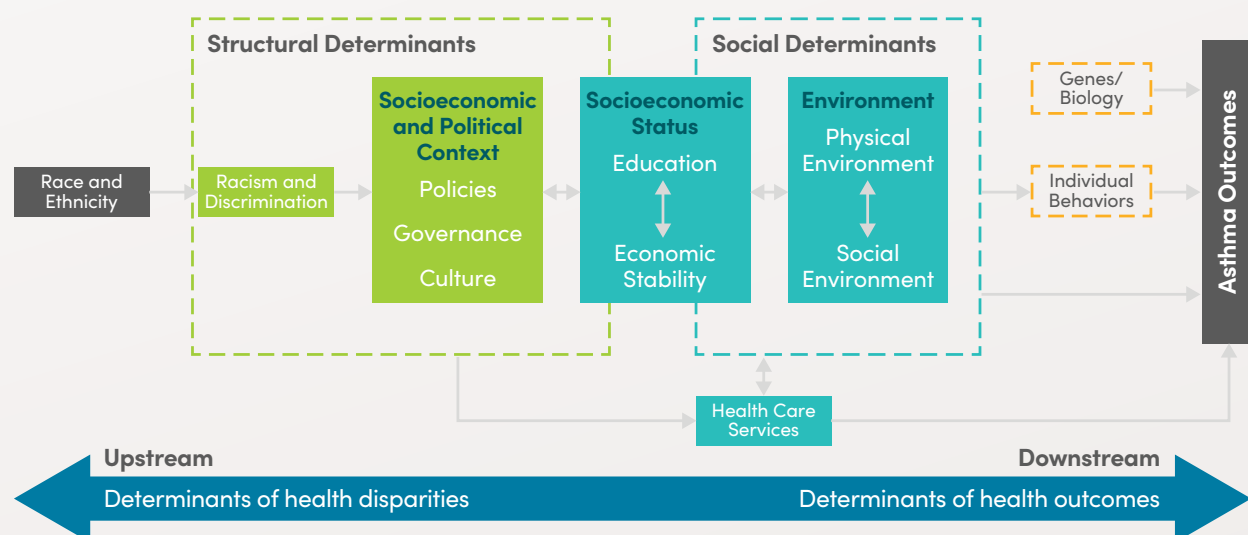


## ROOT CAUSES OF DISPARITIES IN ASTHMA

Racial and ethnic disparities in asthma are the result of complex interactions between varying levels of **social, structural, biological and behavioral** determinants.

AAFA developed the following conceptual framework for root causes of asthma disparities, adapted from several existing models, including the World Health Organization’s Conceptual Framework for Action on the Social Determinants of Health and Healthy People 2020’s “place-based” organizing framework. AAFA’s model specifically highlights the overwhelming role of race and ethnicity in amplifying social, structural, and individual stressors.

### AAFA’s Framework for Root Causes of Asthma Disparities



## SOCIAL AND STRUCTURAL DETERMINANTS

**Social determinants of health** are defined as “the conditions in which people are born, grow, live, work and age.”<sup>2</sup> The social determinants identified in AAFA’s framework are categorized into the following five key domains:

- Economic stability (e.g., poverty, employment)
- Education (e.g., early childhood education, higher education)
- Physical environment (e.g., environmental conditions, quality of housing)
- Social environment (e.g., social class, social cohesion)
- Health care (e.g., access to care, quality of care, health literacy)

**Structural determinants of health** are defined as “the wider set of forces and systems shaping the conditions of daily life.”<sup>2</sup> These forces are deeply ingrained in U.S. policies, governance and culture, and have led to systematic disadvantages of Black and Hispanic Americans. Examples of structural factors that have helped exacerbate racial and ethnic disparities in asthma include:

- Systemic racism and discrimination
- Residential segregation and discriminatory housing policies
- Discriminatory hiring and promotion practices
- Stereotyping and stigmatization
- Explicit and implicit bias
- Environmental injustice



The causal relationship between social advantage and better health is especially well-documented in asthma. Research shows that asthma disparities are highly driven by socioenvironmental and economic conditions, and that structural injustices over time have led to accumulated disadvantage for specific racial and ethnic populations in the U.S.

The concepts of social and structural determinants are intrinsically entangled, complex, and reciprocal in nature. In addition, structural racism—which alone is a significant driver of asthma disparities—is intertwined with and amplifies socioeconomic disadvantages such as poverty, poor housing, and lack of access to health care.

Disparities in asthma are intensified by the cumulative risk from these overlapping determinants.



## BIOLOGICAL DETERMINANTS

Although a large and compelling body of evidence points to social and structural determinants as the dominant causes of asthma disparities, at least some of the differences in asthma outcomes can be attributed to biological factors.

African ancestry shared by Black and Puerto Rican populations has been identified as a potential genetic predictor of asthma.<sup>3</sup> Further understanding of the association between ancestry and asthma continues to be an area of active investigation.

Researchers also seek to explain genetic variations related to asthma. Though the extent to which genes contribute to asthma disparities is not entirely clear, various genes have been found to influence an individual's:

- Susceptibility to asthma (heritability)<sup>4</sup>
- Progression of asthma (severity)<sup>5</sup>
- Response to treatment<sup>6</sup>

Interactions between genetic factors and environmental triggers may also impact asthma susceptibility. Racial and ethnic minority populations in the U.S. are disproportionately burdened by exposure to environmental triggers—such as tobacco smoke and other air pollutants—which have been linked to reduced lung function in people with certain genetic variants.

## BEHAVIORAL DETERMINANTS

An individual's behaviors play a substantial role in determining asthma outcomes. These behaviors are often modifiable through interventions to improve asthma self-management. Individual factors that may contribute to disparities in asthma include:

- Non-adherence to treatment
- Negative beliefs about medication and health care system
- Distrust of the medical establishment
- Misperceptions about illness and asthma severity
- Tobacco use

Such behaviors are often associated with poor asthma control, worse outcomes, and lower quality of life. Adherence to medication, in particular, is a critical self-management strategy for effective asthma control and is highly impacted by personal and cultural attitudes toward medication use. Studies have identified some trends in negative beliefs related to medication among racial and ethnic lines,<sup>7</sup> potentially contributing to disparities in asthma outcomes.

Additionally, historical exploitation of Black bodies in unethical medical experiments—such as the Tuskegee Study—has led to lasting, intergenerational distrust of the medical establishment among Black families.<sup>8</sup>



## ADDRESSING DISPARITIES IN ASTHMA

The existence and causes of asthma disparities related to race and ethnicity have been studied and documented in great detail. Focus in recent years has shifted from describing the problem to *addressing* it. Although efforts in reducing disparities have been slow, the picture isn't entirely bleak. A growing number of strategies and opportunities to address upstream determinants of health have produced notable results in recent years.

The "Asthma Disparities in America" report highlights emerging approaches toward effective, sustainable, and scalable solutions through:

- Public policy reform
- Direct interventions to improve asthma self-management
- Community-based programs
- Advancement in research and science

Although there is no exact prescription for reducing asthma disparities, it is within these areas that some progress has been made and from which new avenues could emerge to drastically decrease the burden on populations disproportionately affected by asthma.

## A ROADMAP TO DRASTICALLY REDUCING ASTHMA DISPARITIES

The mission of the Asthma and Allergy Foundation of America (AAFA) is to save lives and reduce burdens of asthma and allergies through support, research, education and advocacy. The Foundation's current strategic plan calls for improving care for the most vulnerable populations impacted by these diseases.

This report provides an overview of asthma disparities and strategies to improve asthma health in underserved populations. AAFA looks forward to partnering with like-minded individuals and organizations to work together to build sustainable, patient-centered solutions.

## Strategies to Improve Asthma Health in Underserved Populations

CATEGORY	STRATEGIES
<b>Health Care</b>	<ul style="list-style-type: none"> <li>• Expand health insurance coverage for socioeconomically disadvantaged adults and children</li> <li>• Improve coverage of asthma guidelines-based care and treatments by expanding specialist care coverage, lowering copays, expanding eligibility criteria, and removing prior authorization and step therapy barriers</li> <li>• Increase diversity in the primary and specialty health care workforce</li> <li>• Increase the percentage of minority patients with a “usual source of care” by addressing provider shortage areas, removing financial barriers to office-based primary care services, and expanding the primary care infrastructure to integrate better care coordination</li> <li>• Develop sustainable models for care coordination and case management that do not place financial burdens on patients</li> <li>• Encourage and incentivize state and local health departments to adopt comprehensive community asthma programs</li> </ul>
<b>Economic Stability</b>	<ul style="list-style-type: none"> <li>• Increase minimum wage for jobs often held by minority workers</li> <li>• Reduce the racial wage gap in the U.S. labor market</li> <li>• Implement tax policies that help low-income families accumulate more wealth</li> </ul>
<b>Education</b>	<ul style="list-style-type: none"> <li>• Increase access to quality early childhood education and care</li> <li>• Create more equitable school finance systems</li> <li>• Reduce exposure to environmental triggers by improving school building conditions and improving air quality in and around schools</li> <li>• Enact federal and state legislation to put important protections in place for schoolchildren with asthma.</li> </ul>
<b>Physical Environment</b>	<ul style="list-style-type: none"> <li>• Improve housing quality for rental units, including assisted rental units like public housing, through “healthy home” policies and green building practices.</li> <li>• Directly finance or support reimbursement models for programs that align asthma clinical interventions with home assessments, indoor environment improvements and remediations to reduce asthma triggers</li> <li>• Increase access to affordable, quality housing through expanded rental assistance programs, tax credits and inclusionary zoning programs</li> <li>• Desegregate residential neighborhoods through mobility programs and neighborhood revitalization efforts</li> <li>• Encourage smoke-free environments</li> <li>• Combat environmental injustice and reduce exposure to pollution by strengthening clean air policies, reducing transportation-related emissions, restricting zoning of polluting sources and transitioning to a clean energy economy</li> </ul>

**PUBLIC POLICY**



## Strategies to Improve Asthma Health in Underserved Populations

CATEGORY	STRATEGIES
<b>RESEARCH</b>	<b>Basic Science</b> <ul style="list-style-type: none"> <li>• Identify effective biomarkers of asthma and develop tests to measure biomarkers in an easy, rapid, and noninvasive way at the point of care</li> <li>• Increase representation of African-ancestry, Indigenous American-ancestry, and admixed populations in genomics datasets to support genome-wide research in underrepresented populations</li> <li>• Promote and incentivize epigenomic and pharmacogenomic studies of asthma in Black individuals, Indigenous Americans, and Hispanic subgroups</li> <li>• Invest in the development of precision medicine for asthma</li> </ul>
	<b>Clinical and Epidemiological Research</b> <ul style="list-style-type: none"> <li>• Significantly increase participation of Black, Hispanic, and Indigenous Americans in clinical trials</li> <li>• Address cultural stigmas and myths about research among minority populations and build trust in medical establishment and particularly in minority research</li> <li>• Expand research of patterns of asthma risk factors, morbidity, and mortality in underrepresented populations—particularly Black, Hispanic and Indigenous Americans— to inform public health interventions</li> <li>• Improve data collection standards to ensure uniformity in racial and ethnic data collection across agencies</li> <li>• Transform national, state and local surveillance systems to utilize uniform data collocation standards</li> <li>• Improve data collection to monitor disparities experienced by AI/AN populations and Hispanic subgroups</li> <li>• Provide public access to disaggregated data to identify disparities within subgroups of each population</li> </ul>
	<b>Translation, Implementation, and Health Services Research</b> <ul style="list-style-type: none"> <li>• Support research to inform interventions to reduce asthma disparities and collaborate to ensure the translation of research findings to policy and practice</li> <li>• Conduct further research studies and tests among racially and ethnically diverse populations to discover successful strategies that show increased patient adherence to proven asthma management strategies and medicines</li> <li>• Test and scale models for payment systems and program structures that integrate all components of comprehensive, evidence-based asthma care</li> </ul>
	<b>Diversity and Engagement in Research</b> <ul style="list-style-type: none"> <li>• Support patient-centered outcomes research and community-based participatory research in asthma</li> <li>• Align research needs with the needs of patients from underrepresented racial and ethnic groups</li> <li>• Establish policies and practices to support research that engages diverse, multi-sector stakeholders throughout the research process</li> <li>• Increase racial and ethnic diversity among researchers studying asthma</li> <li>• Fund and develop programs to support early-stage investigators devoted to research on minority health</li> <li>• Include physicians and researchers from diverse backgrounds on editorial and review boards</li> </ul>



## Strategies to Improve Asthma Health in Underserved Populations

CATEGORY		STRATEGIES
PARTNERSHIPS	<b>Multi-Stakeholder Collaboration</b>	<ul style="list-style-type: none"> <li>• Strengthen sustainable partnerships between patients/families, health care professionals, researchers, biotech and pharmaceutical companies, educators, schools, community leaders, government agencies, health care systems, health care payers, employers, national and local organizations, advocates, policymakers/legislators and the media to reduce disparities in asthma</li> <li>• Facilitate collaboration between federal, state and local agencies and non-governmental organizations to aid in promoting effective policies/programs to reduce asthma disparities</li> </ul>
	<b>Patient/Family Engagement</b>	<ul style="list-style-type: none"> <li>• Improve trust in health care by engaging diverse patients and families at the onset of program, policy, and research development</li> <li>• Include patient/family advisors in development of educational materials and research protocols, creation of patient portals, and advising on health facility design</li> <li>• Appoint diverse patients to advisory councils, task forces and project committees</li> <li>• Ensure successful patient and family member engagement by establishing transparent processes, identifying mechanisms to act on patient and family input, and properly training health care and research staff on implementing patient and family engagement strategies</li> <li>• Fairly compensate patient and family advisors for their expertise and participation in advisory roles</li> </ul>
	<b>Community Engagement</b>	<ul style="list-style-type: none"> <li>• Include and advance community voice, support, and participation</li> <li>• Include community partners as early as possible when developing asthma care or research programs</li> <li>• Develop provider-community relationships to support people and families with asthma</li> </ul>

AAFA supports the notion of “health in all policies”—a holistic approach to improving health by acknowledging the health implications in all sectors.<sup>9</sup> While policies and interventions that directly relate to health care are essential in reducing asthma disparities, they are not enough. Many social and structural determinants of health fall outside the realm of traditional health care.

Promising solutions will require partnerships across many sectors, including health, education, labor, housing, social services and city planning. Adopting this approach allows for solutions that address the complex and interconnected factors perpetuating health inequity.

## LOOKING FORWARD

Over the past fifteen years, there have been moderate advances in U.S. public policy, health care and research, but gaps in asthma outcomes between Black, Hispanic, Indigenous American populations and white populations have not changed. Minority groups continue to bear disproportionate hardship in managing asthma.

This review of the current state of Asthma Disparities in America serves as a national call-to-action to fix the structural and social inequities that continue to plague vulnerable, at-risk patients and families with asthma.

The Asthma and Allergy Foundation of America remains committed to taking bold actions to facilitate significant improvement and building collaboration with federal, state, and non-governmental entities and individuals who share the similar goal to save lives and reduce the harm and unequal burden of asthma on underserved groups.







# INTRODUCTION

---

Asthma presents significant burdens on individuals, families, communities and health care systems.



## INTRODUCTION

**In the United States, asthma presents significant burdens for approximately 25 million adults and children,<sup>1</sup> as well as their families and caregivers. Annually, asthma costs our society an estimated \$82 billion in direct and indirect expenses, including medical costs related to 14.2 million office visits, 1.8 million emergency visits, and 440,000 hospitalizations.<sup>10</sup> It is estimated that, from 2019 to 2038, the total cost of uncontrolled asthma could exceed \$963 billion in direct and indirect costs.<sup>11</sup> Additionally, asthma is the leading chronic disease among children and the top chronic disease-related reason for missed school days.<sup>12</sup>**

The burden of asthma is disproportionately distributed and largely shouldered by communities of color. Decades of research and public health surveillance data identified disparities in asthma prevalence, mortality, and healthcare utilization along racial and ethnic lines.

Health care quality generally improved for many people during the last decade (2010–2020). Disparities in health outcomes between minority and white populations have begun to decrease, but unacceptable disparities in asthma remain. The complex and multifactorial causes of these disparities are the subject of many studies.

The purpose of this report is to synthesize findings from such studies and propose opportunities for reducing asthma disparities in the U.S. Although it's unrealistic to summarize all published data on this topic—or to provide a single solution to the ongoing problem—we seek to describe the current landscape, highlight promising innovations, and offer solutions for various stakeholders to evaluate and implement.

This report is cautiously optimistic. Recent advances in program development, policy, and research point to the possibility of more significant improvement soon. More importantly, we are encouraged by the widespread and renewed dedication of our many partners. For many stakeholders—including the Asthma and Allergy Foundation of America (AAFA)—continuing to chip away at the unequal burden of asthma remains a mission-critical priority.

This report represents AAFA's renewed commitment to this priority. We hope that the momentum highlighted in this report continues to pave the way for progress on a more significant scale.



# DATA SOURCES

Three key questions guided the research for this report:

- What data exist over the past decade (2010–2020) to support progress in asthma treatment, management and outcomes in the U.S., and specifically, in addressing asthma disparities?
- What are the main factors that have driven success?
- Where are these efforts headed and what should be considered as major priorities moving forward?

## FEDERAL STATISTICAL SYSTEM

AAFA acquired much of the statistical data in this report from federal sources across several departments and agencies. Datasets include surveys (e.g., population surveys, provider surveys), administrative data (e.g., medical records, claims data), vital records, surveillance systems, and disease registries. An overview of major data sources is provided below (Table 2).

All graphs and statistics used in this report are based on U.S. data only. *Detailed data tables are available in the Appendix on page 252.*

**Table 2. Summary of Major Federal Datasets Used in This Report**

DEPARTMENT	Health and Human Services	Commerce
AGENCY	Centers for Disease Control and Prevention (CDC)	U.S. Census Bureau
DATASETS	<ul style="list-style-type: none"> <li>• National Health Interview Survey (NHIS)</li> <li>• National Ambulatory Medical Care Survey (NAMCS)</li> <li>• National Hospital Ambulatory Medical Care Survey (NHAMCS)</li> <li>• National Hospital Discharge Survey (NHDS)</li> <li>• National Vital Statistics System: Mortality (NVSS)</li> </ul>	<ul style="list-style-type: none"> <li>• U.S. Census</li> <li>• American Community Survey (ACS)</li> <li>• American Housing Survey (AHS)</li> </ul>



## U.S. CENTERS FOR DISEASE CONTROL AND PREVENTION - NATIONAL CENTER FOR HEALTH STATISTICS

The Centers for Disease Control and Prevention (CDC) and its National Center for Health Statistics (NCHS) are the gold standard for collecting and maintaining reliable health statistics. Researchers use CDC datasets to unpack important trends that inform their investigations. Importantly, the CDC also centralizes data generated from other government agencies so that most of the latest information can be found in one place.

We used the following data sources from the CDC's NCHS:

### National Health Interview Survey

The National Health Interview Survey (NHIS) is the principal source of information on the health of the civilian noninstitutionalized population in the United States.<sup>13</sup> National statistics on asthma prevalence are made available each year by the NHIS. Asthma data are obtained by face-to-face interviews from a nationally representative sample of households and gathers information on **lifetime asthma** (*Have you ever been diagnosed?*), **current asthma** (*Do you still have asthma?*), and **asthma attacks** (*Have you had one or more attacks in the past 12 months?*). Though current and lifetime asthma data became available in 2001, the NHIS did not begin collecting data on asthma attack prevalence until 2011. NHIS results are weighted to provide national population estimates based on age, sex, race, and ethnicity, including Hispanic subsets, geography, and socioeconomic status. The latest available NHIS data are from 2018.<sup>14</sup>

### National Ambulatory Medical Care Survey

The National Ambulatory Medical Care Survey (NAMCS) collects annual information on physician office visits. It is designed to meet the need for objective, reliable information about the use of ambulatory medical care services in the U.S. Findings are based on a sample of visits to non-federally employed, office-based physicians who are primarily engaged in direct patient care. Starting in 2006, a separate sample of visits to community health centers was added to the survey. NAMCS data from 2010–2016 were used to describe overall patterns for asthma physician office visits where asthma was the primary diagnosis. Starting with 2009 data, NAMCS adopted a model-based single imputation for race and ethnicity data. Race imputation is restricted to three categories (Black, white, and other) with imputed estimates for race categories other than Black and white. Additionally, since 2015, estimates for Black populations regarding asthma-related physician office visits have been suppressed as the relative standard error (RSE) remains greater than 30%, rendering data unreliable.

Asthma is a chronic disease that has no cure. While symptoms may go away (sometimes for many years), a person diagnosed with asthma is always at risk of the symptoms returning at any time. For example, children with asthma may experience a lessening of symptoms during their adolescence and young adulthood, only to have symptoms appear again in later years.



Distinguishing asthma as “lifetime asthma” vs “current asthma” does not fully reflect the natural history of the disease but is a method to capture health care use for treatment and/or current burden of the disease as many people with asthma may currently be in remission.

## DID YOU KNOW?

The National Institute on Minority Health and Health Disparities (NIMHD) is part of the National Institutes of Health (NIH).

Originally called the National Center on Minority Health and Health Disparities, it got re-designated as an Institute in 2010 as part of the Patient Protection and Affordable Care Act.

NIMHD and AAFA are both partners in the NIH's Breathe Better Network, a partnership of organizations around the country working to raise awareness about lung health at the local level.

### **National Hospital Ambulatory Medical Care Survey**

The National Hospital Ambulatory Medical Care Survey (NHAMCS) is designed to collect data on the utilization and provision of ambulatory care services in hospital emergency and outpatient departments, as well as ambulatory surgery locations. Findings are based on a national sample of visits to emergency departments, outpatient departments, and ambulatory surgery locations of noninstitutional general and short-stay hospitals. Survey results provide national population estimates based on age, sex, and race. Starting with 2009 data, NHAMCS adopted race imputation restricted to three categories (Black, white, and other) with imputed estimates for race categories other than Black and white. Health care use data from 2010–2017 were used to describe overall patterns for asthma-related emergency department visits for Black and white individuals. The latest publicly available NHAMCS data are from 2017.

### **National Hospital Discharge Survey**

The National Hospital Discharge Survey (NHDS), which was conducted annually from 1965–2010, was a national probability survey designed to meet the need for information on characteristics of inpatients discharged from non-federal short-stay hospitals in the United States. Data from the NHDS are available annually and are used to examine important topics of interest in public health. Hospital discharge rates from 2001–2009 were used to describe linear patterns of asthma hospital inpatient stays by race. However, NHDS data do not account for ethnicity or Hispanic subgroups. In 2011, the National Hospital Care Survey (NHCS) was initiated, which integrates inpatient data formerly collected by the NHDS with emergency department (ED), outpatient department (OPD), and ambulatory surgery center (ASC) data. However, NHCS data are not publicly available.

### **National Vital Statistics System: Mortality**

The National Vital Statistics System (NVSS) collects and disseminates official vital statistics in the U.S. These data are provided through contracts between NCHS and vital registration systems operated in the various jurisdictions legally responsible for the registration of vital events: births, deaths, marriages, divorces, and fetal deaths. Mortality data from the NVSS are available through the CDC's Wide-ranging ONline Data for Epidemiologic Research (WONDER) database. The WONDER database provides access to a variety of public health information, including data on the underlying cause of death based on death certificates for all U.S. residents from all 50 states and the District of Columbia. Underlying cause of death and demographic descriptors are indicated on the death certificates.



Underlying cause of death data available from 2010–2017 were used to determine asthma-related deaths for Black, Hispanic, and white individuals. The WONDER database does not provide mortality estimates for Hispanic subsets (e.g., Mexican Americans, Puerto Ricans, Cuban Americans and other Latinx identities).

## **U.S. CENSUS BUREAU**

The U.S. Census Bureau (Census Bureau) is a principal agency of the U.S. Federal Statistical System, responsible for producing data about the people and economy in the U.S. The Census Bureau continually conducts more than 130 surveys and programs a year, including population, economic, and government censuses, surveys, and population projections. Data from these statistical programs are available online through datasets, data visualizations, and infographics.

We used the following data sources from the Census Bureau:

### **2010 Census**

The U.S. Census is the decennial population and housing count of all 50 states, the District of Columbia, Puerto Rico, and the Island Areas as required by the Constitution. The results of the census determine the number of seats for each state in the U.S. House of Representatives and are used to map out congressional and state legislative districts. At the time of publishing (2020), the most recent public data available is the 2010 Census. Data from the 2010 Census were used to determine national homeownership rates from 2010–2019, which account for race and ethnicity but not Hispanic subsets.

## American Community Survey

The American Community Survey (ACS) is an ongoing survey that provides vital information on a yearly basis about the U.S. population. Through the ACS, the Census Bureau gathers information about jobs and occupations, educational attainment, veteran status, and other topics. The Census Bureau publishes yearly data files for the ACS on the county, state, and national level, which have the most frequently requested social, economic, housing, and demographic data. ACS data from 2008-2018 were used to identify linear trends in poverty status and insurance status by racial and ethnic background. However, data from the ACS does not account for Hispanic subsets.

## American Housing Survey

The American Housing Survey (AHS) is sponsored by the Department of Housing and Urban Development (HUD) and conducted by the U.S. Census Bureau. The AHS is a longitudinal housing unit survey conducted biennially in odd-numbered years, with samples redrawn in 1985 and 2015. The AHS serves as the most comprehensive national housing survey in the United States since its inception in 1973, and includes questions about the physical condition of homes and neighborhoods, costs of financing and maintaining homes, and the characteristics of people who live in these homes. Data from the AHS provide up-to-date information about the quality and cost of housing in the United States and major metropolitan areas. The U.S. Census Bureau publishes summary tables and public use data files for the AHS, with the most recent published data being from 2017. AHS data from 2017 were used to identify housing inadequacy, exposure to indoor allergens, and rent burden by race, tenure, and assistance status.

## PEER-REVIEWED LITERATURE

To support these statistics, we conducted an extensive review using a series of keywords and phrases related to asthma disparities. The main search engines used included Google Scholar and PubMed Central. Abstracts and introduction sections of potentially useful articles were scanned individually, and relevant publications were downloaded. Lastly, key findings were summarized for each relevant article and formed the basis for this report.





---

## ASTHMA: AT A GLANCE

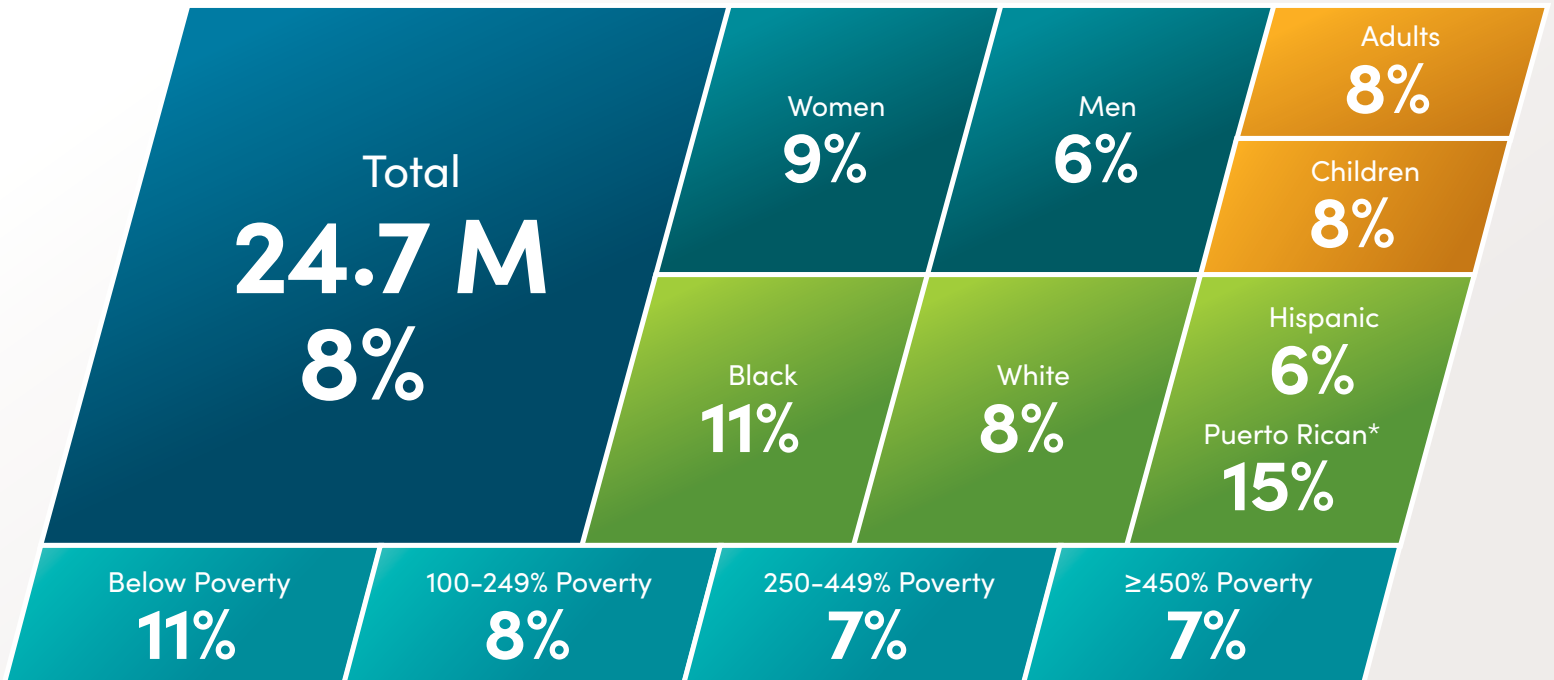
Asthma is a chronic disorder that causes the airways in the lungs to narrow and swell, making it difficult to breathe. People may experience chest tightness or pain, shortness of breath, coughing, wheezing, and other symptoms. Some people only experience mild symptoms, while others can have a more persistent or severe condition. Asthma and allergies often come as a packaged deal. An allergy is an abnormal response to certain substances the immune system registers as harmful. These are known as allergens. Allergic reactions to allergens including cockroaches, dust mites, pet dander, pollen, and mold may also cause asthma symptoms. About 60 - 70% of people with asthma have *allergic asthma* — making it the most common type of asthma.<sup>15</sup> Asthma can also be triggered by outdoor and indoor air pollution, weather and temperature changes, stress, emotions, exercise or physical activity, comorbid conditions, and airway irritants, such as fragrances. Asthma can be fatal. However, a normal and active life with asthma is possible if the condition is well-managed.

Asthma is one of the most common and costly chronic diseases in the U.S. About 19 million adults and 6 million children are currently living with asthma.<sup>1</sup>

---



**FIGURE 1. ASTHMA RATES IN THE U.S. BY AGE, SEX, RACE, AND POVERTY LEVEL**



Source: CDC, National Center for Health Statistics, National Health Interview Survey (2018)

\*as subset of Hispanic

## IMPACT OF ASTHMA

Adults are about five times more likely to die from asthma than children.<sup>1</sup> On average, about ten people die every day from asthma. That’s over 3,600 deaths a year. Most of these deaths are preventable with proper management, access to proper medical care, safe housing, and good air quality.<sup>16</sup> Asthma is also one of the top 20 reasons for emergency department (ED) visits with 1.6 million trips to the ED annually.<sup>17</sup>

While the unnecessary loss of human life is heartbreaking, the financial cost for those living with the disease and the nation as a whole is astronomical. The annual economic cost of asthma is an estimated \$82 billion.<sup>10</sup> Asthma also has substantial effects on daily life between work and school days. Children with severe asthma are more likely to suffer academically. In 2008, children with asthma missed 10.5 million school days.<sup>18</sup> Unplanned emergency room visits, hospital stays, and missed work and school days put the greatest financial burden on people with asthma and their families. Those facing financial difficulties find they must choose between life-saving treatments and basic living expenses, such as rent, mortgage, food, and utilities. Creating a healthier home environment to reduce allergens and asthma triggers adds additional costs for people with asthma and their families.



## ASTHMA TREATMENT AND THERAPIES

There is no cure for asthma, but it can be managed by avoiding exposure to environmental triggers and regular use of asthma-controlling medications. Creating a support system that includes health care providers, family, and friends can help efforts to keep asthma under control. Everyone with asthma should have an Asthma Action Plan. This plan provides information and guidance on how best to manage asthma. It also includes keeping a list of medicines, a checklist for monitoring symptoms, and steps to take in case of an emergency. There are two kinds of medications: quick-relief medications for the immediate relief of symptoms and controller medications for the long-term control of persistent asthma.<sup>19</sup> Many of the medications are inhaled, but some are taken orally. Biologics are a treatment option for people with severe asthma. These are shots or infusions administered every few weeks. They target cell receptors in your body to prevent airway inflammation. However, they can be costly and are usually only prescribed if other medicines have not been effective with asthma control. While expensive, they may be a safer option than oral corticosteroids for people with severe asthma because the side effects are minimal. New therapies are constantly being developed, and it is important for patients to be involved in research to help develop needed treatments.

The 2007 guidelines from the National Asthma Education and Prevention Program (NAEPP) recommended daily long-term control medications for all patients with persistent asthma.<sup>19</sup> The severity of the asthma determined the combinations and dosages of medications used. The NAEPP is set to release updated guidelines on recommended medications for patients with asthma. Similar to the current guidelines from the Global Initiative for Asthma, the new NAEPP guidelines recommend using a control and relief combination medicine for both quick-relief and long-term treatment. The previous guidelines recommended this method for long-term control only.<sup>20</sup>



## FIGURE 2. ANNUAL ASTHMA COSTS IN THE U.S.

Based on data from 2008–2013, CDC researchers estimated the costs of asthma (expressed in 2015 U.S. dollars):

Total annual cost of asthma in the U.S., including medical care, absenteeism, and mortality:

# \$81.9 BILLION

Asthma-related mortality cost:

# \$29 BILLION

per year, representing on average 3,168 deaths.



Missed work and school days combined cost:

# \$3 BILLION

per year, representing 8.7 million workdays and 5.2 million school days lost due to asthma.

Annual medical cost of asthma per person:

# \$3,266

**\$1,830**  
for prescriptions



**\$640**  
for office visits



**\$529**  
for hospitalizations



**\$176**  
for hospital outpatient visits



**\$105**  
for emergency room care



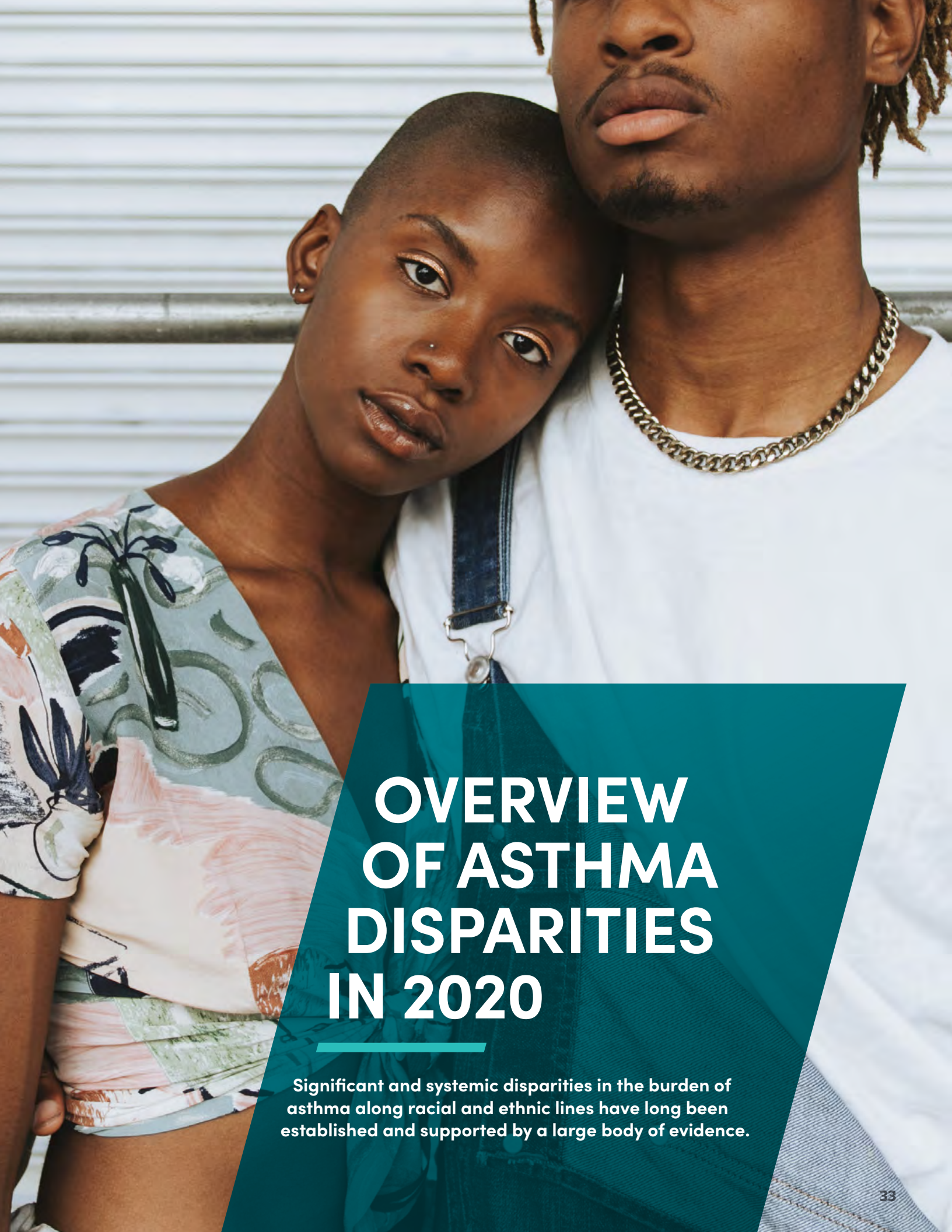
### DIFFERENCES IN ANNUAL MEDICAL COST PER PERSON:

Black: \$3,145  
Hispanic: \$2,905  
White: \$3,323

Poverty: \$3,581  
Near poverty: \$3,274  
Low income: \$3,183  
Middle income: \$3,232  
High income: \$3,204

Medicare: \$3,720  
Medicaid: \$3,454  
Private insurance: \$3,248  
Uninsured: \$2,145





# OVERVIEW OF ASTHMA DISPARITIES IN 2020

Significant and systemic disparities in the burden of asthma along racial and ethnic lines have long been established and supported by a large body of evidence.





This report describes health disparities through the perspective of race and ethnicity. Differences in prevalence and primary outcomes (e.g., asthma attacks, mortality, and healthcare utilization) between various racial and ethnic populations remain the best measures of these health disparities. While these statistics don't tell the whole story, they help paint the picture of the state of asthma disparities in 2020.

We analyzed available data from multiple agency sources (see Data Sources on page 24) to determine national asthma trends beginning in 2010 and, depending on the specific measure, up until the latest year when information was made available publicly. By comparing data points from year-to-year, trend lines provide an approximation of changing disparities.

Overall, the U.S. trends in primary outcomes among people with asthma for the past decade improved. Of course, caution with interpretation is necessary when relying on trend lines, particularly with modest improvements. Although the total observed trends are encouraging, the burden of asthma in the U.S. remains disproportionately distributed based on race and ethnicity.

## A NOTE ON HEALTH DISPARITIES

A “health disparity” refers to preventable differences and disadvantages in the indicators of health among different population groups. This report looks specifically at asthma disparities related to Black race and Hispanic ethnicity, as compared to white race.

However, it's important to acknowledge that disparities also exist among other racial groups, including American Indian/Alaska Native populations (see page 45). Additionally, many non-racial disparities also exist in the U.S. based on factors such as age, geography, language, sex, gender identity, sexual orientation, disability, and citizenship status.

While this report does not discuss all types of health disparities in asthma care, vulnerable populations typically include low-income individuals, women, children, older adults, and individuals in rural and tribal areas. These populations are not mutually exclusive.



## RACE AND ETHNICITY CLASSIFICATIONS

In national data, race is defined as a person’s self-identification with one or more social groups: Asian, Black, American Indian/Alaska Native, Native Hawaiian or Other Pacific Islander, white, or some other race.<sup>21</sup> Increasingly, a larger percentage of individuals identify with more than one race. This inspired numerous federal agencies to include “more than one race” as an option during data collection in recent years.

Ethnicity, often asked separately from race, determines whether a person is of Hispanic origin. In national surveillance data, ethnicity is categorized as either “Hispanic” or “Not Hispanic.” People of Hispanic ethnicity may report as any race.

In some cases, the terms Hispanic and Latinx are (inaccurately) used interchangeably. It is important to note that these terms do not define the same population. Hispanic refers to people who speak Spanish or descend from Spain. Latinx refers to people from Latin America, who may or may not speak Spanish. These populations can overlap in some instances (e.g., Puerto Ricans, who are both Hispanic and Latinx) but not in all instances (e.g., Brazilians, who are Latinx but not Hispanic).

## ASTHMA AMONG HISPANIC SUBPOPULATIONS

National surveys often provide information for the U.S. Hispanic population, and in some cases, also look at ethnic group subsets within that population (including Puerto Ricans). Although bound by a common language, there is considerable heterogeneity among Hispanic groups in the U.S. This is particularly true regarding asthma prevalence.

While asthma rates are relatively low for the Hispanic population in aggregate, wide variations between subgroups are hidden by averages when the Hispanic ethnicity is presented as homogenous. Numerous studies show that the prevalence of asthma is greater among Puerto Ricans than any other Hispanic subgroup—or any other racial or ethnic group in the United States.<sup>22</sup> However, much of the existing asthma outcomes data, including mortality and hospitalizations, do not account for Hispanic subgroups.



**For ease of reference, this report uses the term “Black” to describe “non-Hispanic Black” populations and “white” to describe “non-Hispanic white” populations, unless otherwise noted.**

**This report uses national data on Puerto Rican ethnicity when such data are available but includes the broader Hispanic categorization to highlight overall trends when Puerto Rican data are not available.**

## PREVALENCE

Asthma prevalence is defined as the fraction of the population with asthma. Prevalence data is available in three ways<sup>13</sup>:

- Current asthma (diagnosis of asthma at time of survey)
- Lifetime asthma (diagnosis of asthma at any point in lifetime)
- Asthma attack prevalence (experience with one or more asthma attacks in the previous 12 months)

Refer to the description of the National Health Interview Survey in the Data Sources section on page 25 for explanations on *lifetime* versus *current* asthma.

In this section, current, lifetime, and asthma attack prevalence rates between 2010 and 2018 for Black, Puerto Rican, and white populations in the U.S. are discussed. Linear trend lines are used to visualize whether prevalence among these specific populations is increasing or decreasing. Trend lines are also used to determine whether disparities among specific subgroups when compared to white counterparts are narrowing or widening. These trends are summarized in Table 3 and described in detail on the following pages. *Detailed data tables are available in the Appendix on page 252.*

**Table 3. Summary of Trends and Disparities in Current, Lifetime, and Asthma Attack Prevalence**

	CURRENT ASTHMA		LIFETIME ASTHMA		ASTHMA ATTACK	
	Trend	Disparity with white	Trend	Disparity with white	Trend	Disparity with white
<b>Black (All Ages)</b>	Decreasing	Narrowing	Decreasing	Narrowing	Decreasing	No Disparity
<b>Black (Children)</b>	Decreasing	Narrowing	Decreasing	Narrowing	Decreasing	No Disparity
<b>Black (Adults)</b>	Decreasing	Narrowing	Decreasing	Narrowing	Decreasing	No Disparity
<b>Puerto Rican (All Ages)</b>	Decreasing	Narrowing	Decreasing	Narrowing	Increasing	Widening
<b>Puerto Rican (Children)</b>	Decreasing	Narrowing	Decreasing	Narrowing	Increasing	Widening
<b>Puerto Rican (Adults)</b>	Decreasing	Narrowing	Decreasing	Narrowing	Increasing	Widening
<b>White (All Ages)</b>	Decreasing		Increasing		Decreasing	
<b>White (Children)</b>	Decreasing		Decreasing		Decreasing	
<b>White (Adults)</b>	No Change		Increasing		Decreasing	

Source: CDC, National Center for Health Statistics, National Health Interview Survey (2010–2018)

## CURRENT ASTHMA PREVALENCE

Current asthma prevalence, which is measured by the CDC through self-reported data, is the percent of the population with asthma at the time of the survey. Nearly 25 million people in the United States are living with asthma<sup>1</sup>, but prevalence rates differ significantly by race and ethnicity. Puerto Ricans have the highest rate of asthma prevalence compared to any other racial or ethnic group in the United States. Black Americans are also disproportionately diagnosed with asthma compared to white Americans. The prevalence of current asthma has been trending downward for all populations and the gap (or disparity) between Black and Puerto Rican populations and white populations is narrowing.

Figure 3. Current Asthma Prevalence by Race and Ethnicity (All Ages)

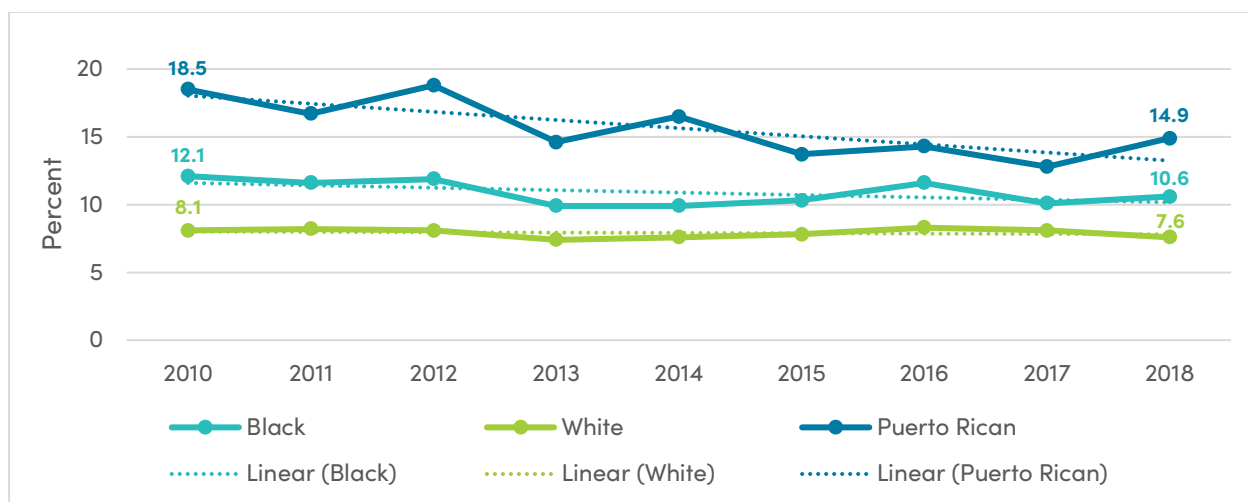


Figure 4. Current Asthma Prevalence by Race and Ethnicity (Children)

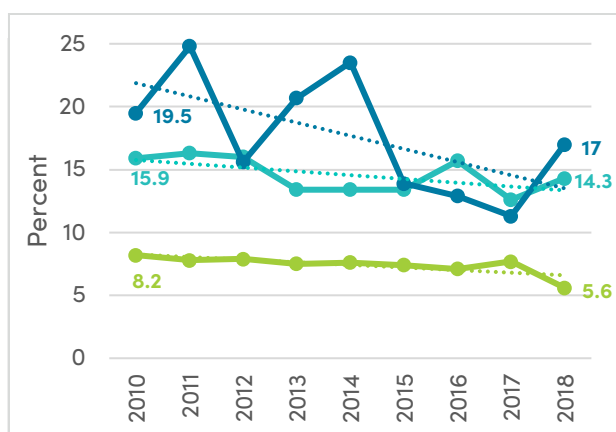
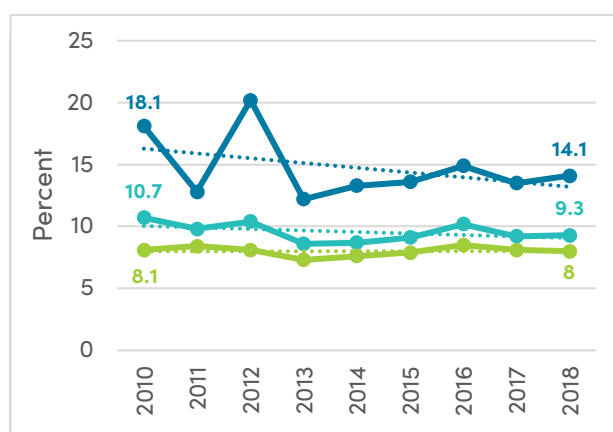


Figure 5. Current Asthma Prevalence by Race and Ethnicity (Adults)



Source: CDC, National Center for Health Statistics, National Health Interview Survey (2010-2018)

Prevalence estimates for Black and white race do not include people of Hispanic ethnicity. Puerto Rican ethnicity is captured as a subset of Hispanic ethnicity in the NHIS.

## LIFETIME ASTHMA PREVALENCE

Lifetime asthma prevalence, which is also measured by the CDC through self-reported data, is the percent of the population who have had asthma at any time in life. Trends in the prevalence of lifetime asthma follow similar trends as current asthma.

Figure 6. Lifetime Asthma Prevalence by Race and Ethnicity (All Ages)

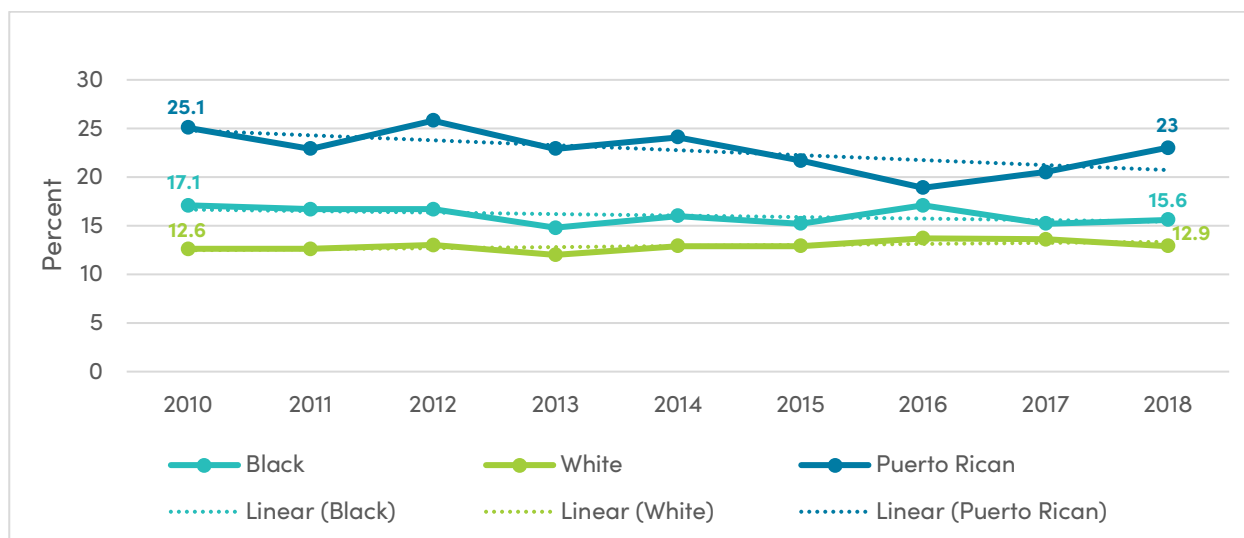


Figure 7. Lifetime Asthma Prevalence by Race and Ethnicity (Children)

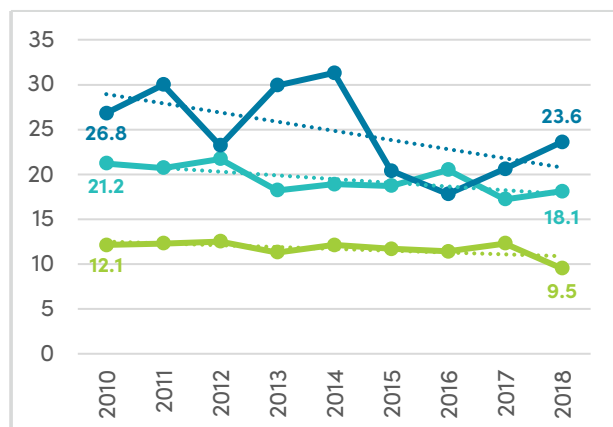
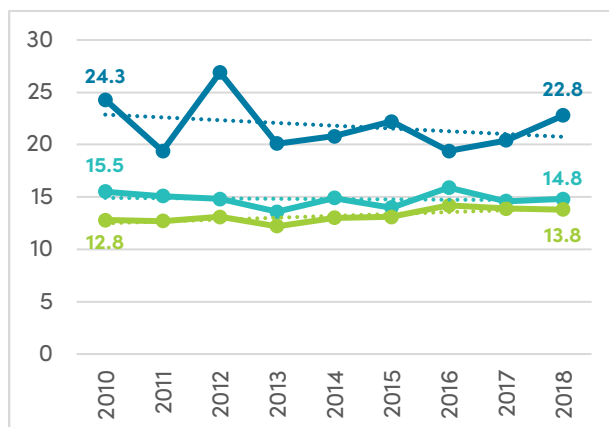


Figure 8. Lifetime Asthma Prevalence by Race and Ethnicity (Adults)



Source: CDC, National Center for Health Statistics, National Health Interview Survey (2010-2018)

Prevalence estimates for Black and white race do not include people of Hispanic ethnicity. Puerto Rican ethnicity is captured as a subset of Hispanic ethnicity in the NHIS.



## ASTHMA ATTACK PREVALENCE

Asthma attack prevalence captures the percent of the population with asthma who has had an asthma attack in the preceding 12 months. Having an asthma attack in the past year is viewed as a surrogate indicator of asthma control. Although current and lifetime asthma data became available in 2001, the CDC did not begin collecting data on asthma attack prevalence until 2011. Between 2011 and 2018, the rate of self-reported asthma attacks decreased for Black and white individuals of all ages but increased for Puerto Ricans of all ages. Black and white Americans reported asthma attack prevalence at similar rates during this timeframe.

Figure 9. Asthma Attack Prevalence by Race and Ethnicity (All Ages)

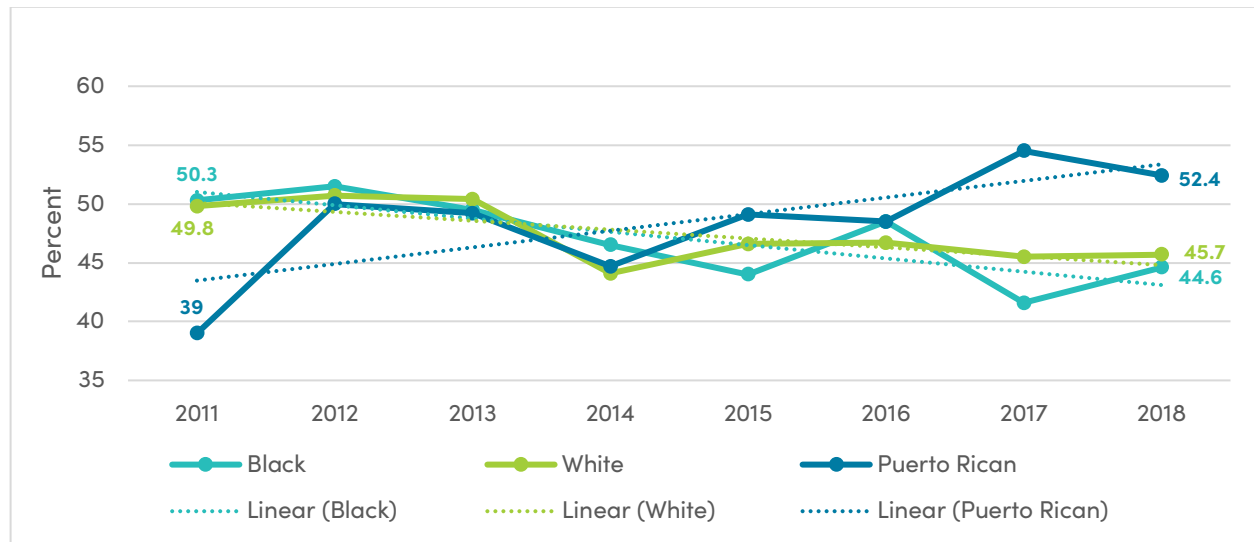


Figure 10. Asthma Attack Prevalence by Race and Ethnicity (Children)

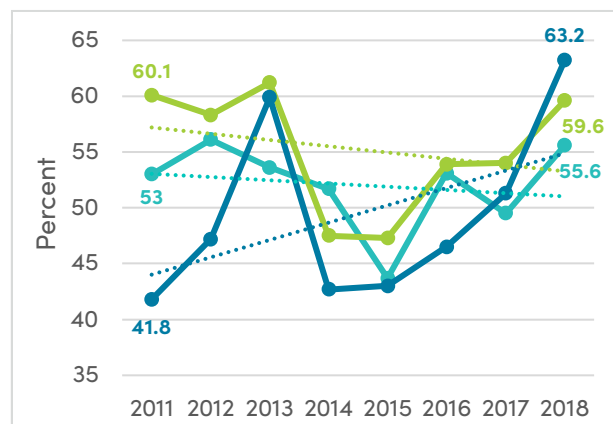
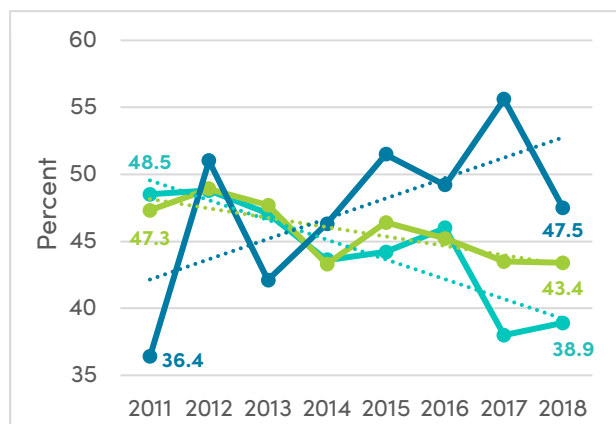


Figure 11. Asthma Attack Prevalence by Race and Ethnicity (Adults)



Source: CDC, National Center for Health Statistics, National Health Interview Survey (2010-2018)

Prevalence estimates for Black and white race do not include people of Hispanic ethnicity. Puerto Rican ethnicity is captured as a subset of Hispanic ethnicity in the NHIS.

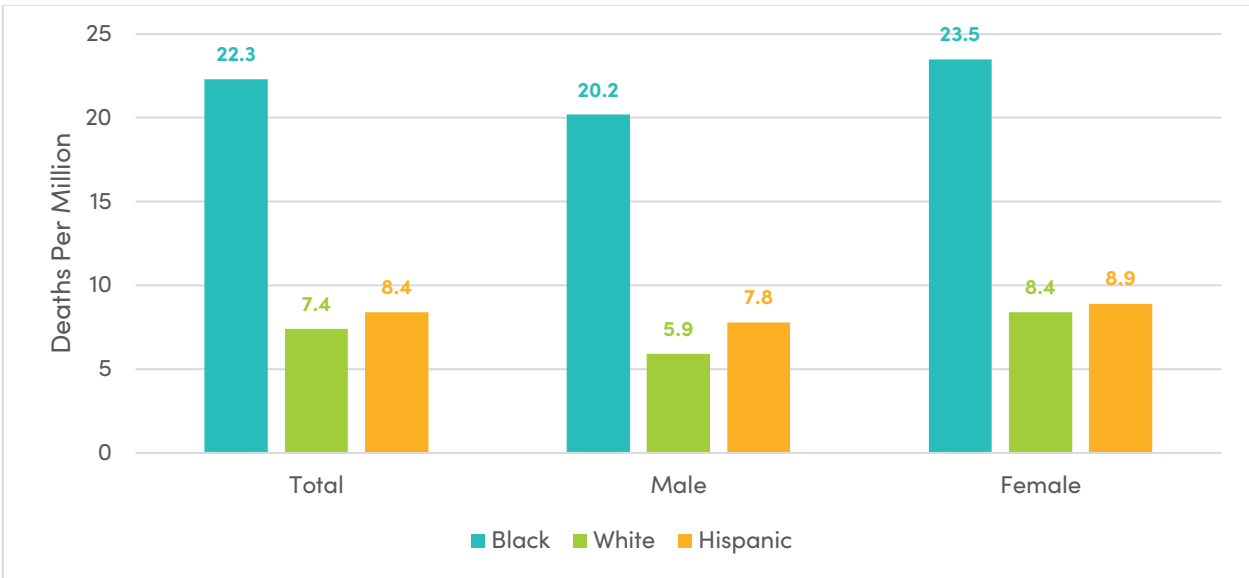
# MORTALITY

Differences in mortality rates among populations in the U.S. present the most startling evidence of racial disparities in asthma. Deaths due to asthma—although decreasing overall— occur more frequently in the Black population.

Black individuals are about three times as likely to die from asthma than Hispanic or white individuals (based on estimated rates of 22.3, 8.4, and 7.4 deaths per million for age-adjusted Black, Hispanic, and white populations, respectively).

When sex is factored in, Black females have the highest rate of fatality due to asthma (23.5 deaths per million). This rate is nearly four times the asthma-related death rate among white males (5.9 deaths per million).

Figure 12. Asthma-Related Deaths by Sex, Race, and Ethnicity

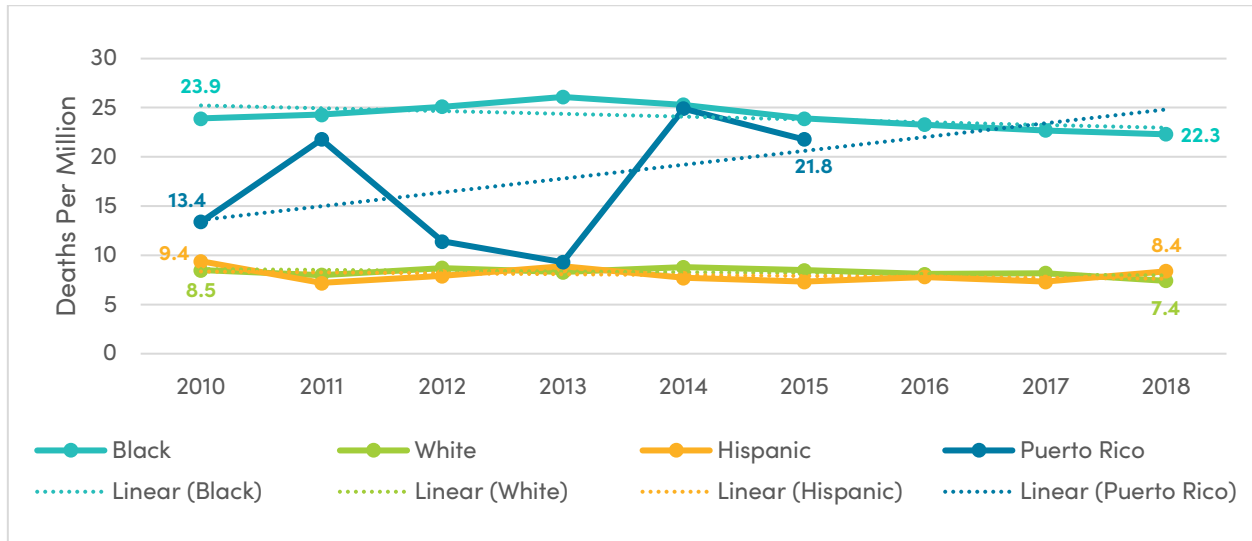


Source: CDC, National Center for Health Statistics, National Vital Statistics System: Mortality (2018)

Mortality estimates for Black and white race do not include people of Hispanic ethnicity. Mortality estimates for Black, white and Hispanic populations show age-adjusted rates.

Throughout the past decade, asthma-related deaths seem to be decreasing for most groups. However, the significantly higher mortality rate among Black populations remains a significant challenge for narrowing asthma disparities. Additionally, the most recent mortality data in Puerto Rico show asthma-related death rates at nearly three times that of the broader Hispanic and white populations in the United States, with an increasing trend from 2010–2015.

**Figure 13. Asthma-Related Deaths by Race, Ethnicity, and of Residents of Puerto Rico**



Source (U.S): CDC, National Center for Health Statistics, National Vital Statistics System: Mortality (2010–2018)  
 Source (PR): Puerto Rico Department of Health, Technical report, Puerto Rico Asthma Project (2010–2015)

Asthma-related deaths were identified as those coded as J45–J46 as the underlying cause of death using the International Code of Diseases 10th revision (ICD-10).  
 Mortality estimates show age-adjusted rates.  
 Mortality estimates for Black and white race do not include people of Hispanic ethnicity.  
 Data for Puerto Rico includes data only from the approximately 3.5 million residents of the Commonwealth of Puerto Rico and does not include the approximately 5 million Puerto Rican Americans living on the U.S. mainland.

## HEALTH CARE UTILIZATION

Health care utilization, which quantifies a population's use of health care services available to them, is illustrated in this section using the following measures:

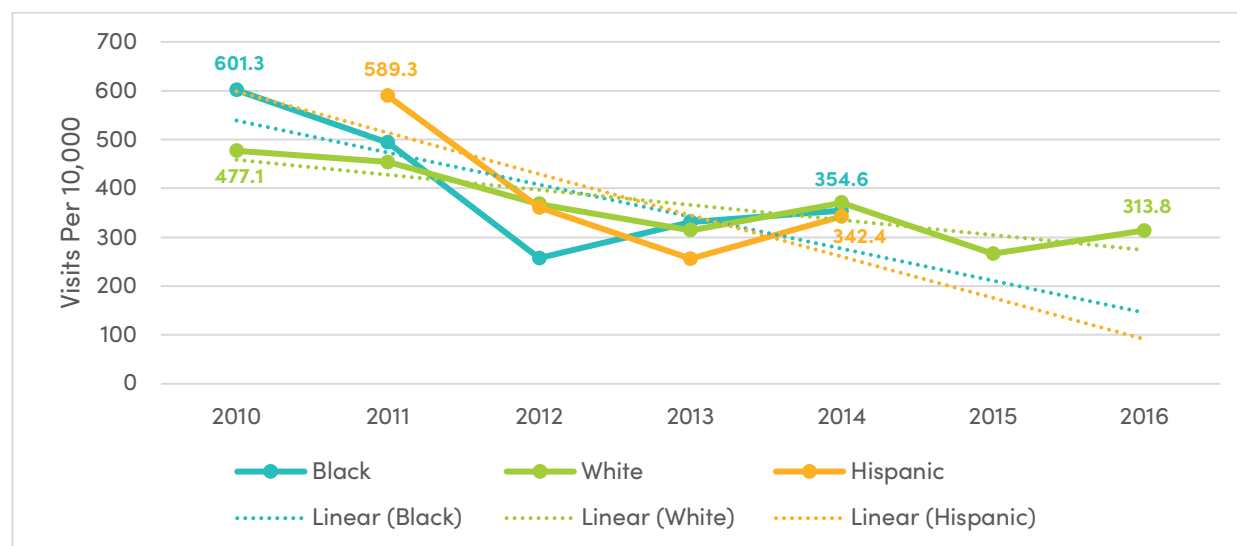
- Asthma-related physician office visits
- Asthma-related emergency department visits
- Asthma-related hospital inpatient visits

The trend line pattern of health care service use for asthma is similar to that for mortality data. National rates for emergency department visits and hospitalizations are two- to threefold higher for Black people than for white people. Health care utilization estimates for Black and white populations include people of Hispanic ethnicity, as information about Hispanic ethnicity is not consistently available in national health care utilization data.

### ASTHMA-RELATED PHYSICIAN OFFICE VISITS

Most asthma management and patient education occurs in primary care settings,<sup>23</sup> making physician office visits an important factor when examining health disparities. For asthma-related physician office visits from 2010–2014, trend lines show a decrease in visits by Black and white adults and children. Starting in 2015, estimates for Black populations have been suppressed due to the relative standard error (RSE) being greater than 30%, rendering the data unreliable.

Figure 14. Asthma-Related Physician Office Visits by Race



Source: CDC, National Center for Health Statistics, National Ambulatory Medical Care Survey (2010–2016)

Estimates for Black and white race include people of Hispanic ethnicity.

Crude rate per 10,000 population

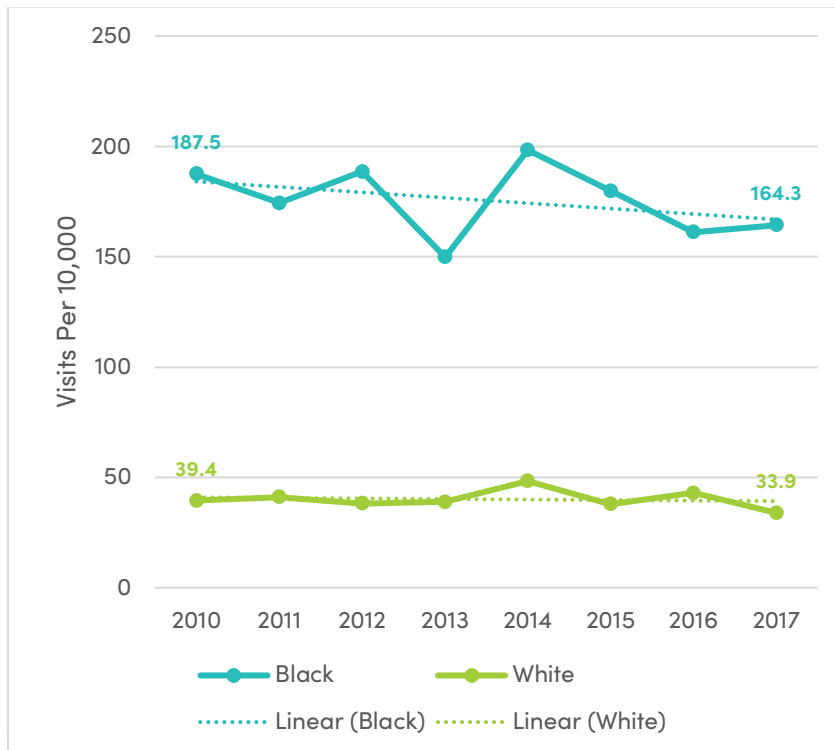


## ASTHMA-RELATED EMERGENCY DEPARTMENT VISITS

Asthma disparities are perhaps greatest between Black and white populations in terms of emergency department (ED) visits. Increased ED visits are indicative of poor asthma control.<sup>24</sup>

Asthma-related ED visits are nearly five times as high for Black patients compared to white patients. However, the trend line for Black individuals shows a slight decline while the trend line for white individuals remains essentially the same. This indicates a slight narrowing in the disparity.

Figure 15. Asthma-Related ED Visits by Race



Source: CDC, National Center for Health Statistics, National Ambulatory Medical Care Survey (2010-2017)

ED estimates for Black and white race include people of Hispanic ethnicity. Crude rate per 10,000 population

## AAFA'S ASTHMA CAPITALS REPORT

AAFA publishes its Asthma Capitals™ report to raise awareness about the nationwide impacts of asthma. It helps people in the most challenging areas of the U.S. who live with asthma to recognize, prevent, and manage symptoms.

The report ranks 100 cities by the most critical health outcomes in asthma prevalence, ED visits due to asthma attacks, and asthma mortality. The report also identifies risk factors that influence health outcomes, including poverty, lack of health insurance, poor air quality, pollen, medication use, smoking laws, and access to specialists.

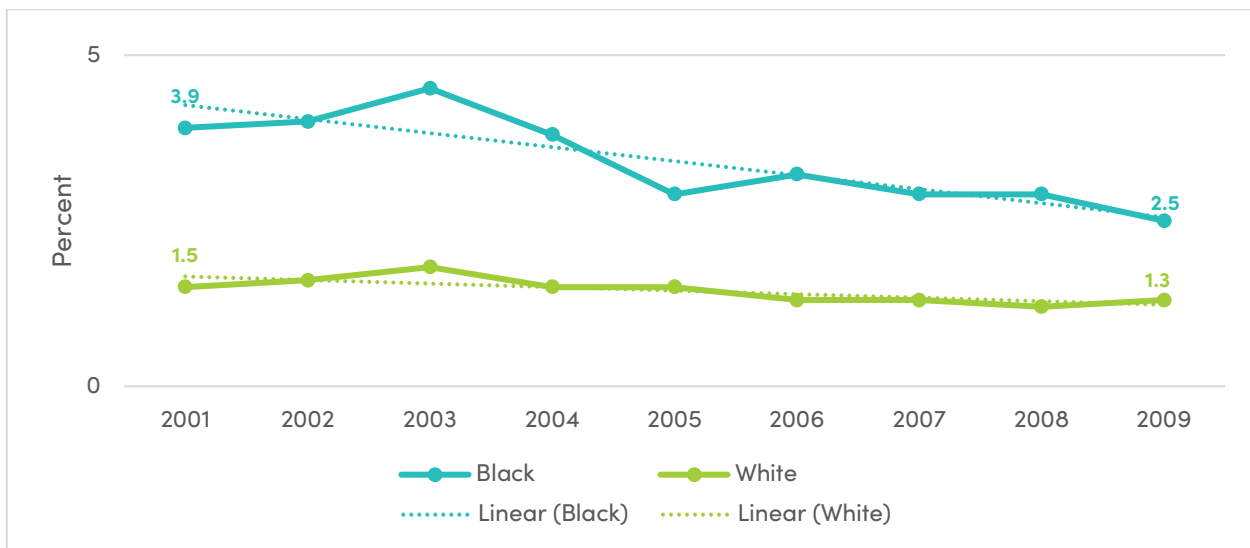
In 2019, Springfield, Massachusetts was ranked as the top asthma capital for the second year in a row. The city had the highest number of asthma-related ED visits in the U.S., as well as a high rate of asthma prevalence overall. AAFA's Asthma Capitals Report is available at [asthmacapitals.org](http://asthmacapitals.org).



## ASTHMA-RELATED HOSPITAL INPATIENT RATES

In addition to ED visits, poor asthma control is associated with increased hospital inpatient admissions.<sup>25</sup> Data for asthma-related hospital inpatient rates related to race and ethnicity is limited as the National Hospital Discharge Survey was discontinued in 2010, and subsequent surveys covering asthma-related inpatient rates lack racial and ethnic data. Nevertheless, in the decade preceding this report, there were stark disparities between Black and white populations in hospital inpatient rates. However, the trend line for Black individuals steadily declined while the trend line for white individuals remained relatively flat, indicating some narrowing in the disparity.


Figure 16. Asthma-Related Hospital Inpatient Rates by Race



Source: CDC, National Center for Health Statistics, National Hospital Discharge Survey (2001–2009)

Estimates for Black and white race include people of Hispanic ethnicity.  
Crude rate per 100 people with asthma





**SPOTLIGHT:**  
**ASTHMA DISPARITIES  
AMONG INDIGENOUS  
AMERICANS**

---

Discrimination, segregation and historical trauma have caused a disproportionate burden of disease on Indigenous peoples.

# ASTHMA DISPARITIES AMONG INDIGENOUS AMERICAN POPULATIONS

The American Indian (AI) and Alaska Native (AN) people have long experienced health disparities when compared to other American people.<sup>26</sup> A disproportionate burden of disease leads to poorer quality of life and lower life expectancies.

Three major mechanisms by which systemic racism influences health equity<sup>27</sup>:

Discrimination (including implicit bias)

Segregation      Historical trauma

The causes of health disparities experienced by AI/AN people are complex. Factors such as lack of available health services or insurance coverage, long distances from health care services, language and communication barriers, lack of diversity in health care workforce, discrimination and racism, high rates of poverty and unhealthy housing conditions, and proximity to high levels of air pollution are just some of the factors contributing to health disparities in AI/AN communities.<sup>28</sup>

Asthma prevalence and risk factors differ between tribal nations given the varied cultures, traditions, lifestyles and environmental exposures that are experienced by AI/AN populations. Data on asthma conditions for AI/AN communities are limited. The CDC's NHIS datasets do not consistently contain reliable asthma data for AI/AN groups (i.e. data with relative standard error below 30%).

According to an analysis of 2016–2018 data from the NHIS, 10.4% of AI/AN individuals have asthma compared to 8.0% of white individuals. The disparity is even greater in children (Table 4).

Table 4. National Prevalence of Current Asthma

	TOTAL	CHILDREN	ADULTS
AI/AN	10.4%	10.2%	10.5%
White	8.0%	6.8%	8.2%

Source: CDC, National Center for Health Statistics, National Health Interview Survey (2016–2018)

Prevalence estimates for AI/AN and white race do not include people of Hispanic ethnicity.





To better evaluate asthma disparities in these populations, we sought information from other sources such as the Indian Health Service (IHS), tribal health organizations and state health departments.

IHS reports that AI/AN people have a 10% higher risk of death from chronic lower respiratory diseases (including asthma).<sup>29</sup> IHS regional rates of asthma hospitalizations declined in all regions except Alaska from 2003–2005 to 2009–2011. The Navajo Nation is the most populous of all Indian Nations and reports the highest rates for asthma hospitalizations among the six IHS regions.<sup>30</sup> Potential risk factors for health disparities in Navajo children with asthma living on reservations include poverty, limited access to specialty care, and environmental challenges, which include high levels of indoor and outdoor air pollution.<sup>31</sup>

Information on potential asthma-relevant environmental determinants remains sparse, but indoor use of wood-burning stoves and tobacco smoke is suspected to be common. Exposure to air pollution (ambient, atmospheric, and indoor) is associated with the development of asthma in young children<sup>33</sup> and increased asthma exacerbations in all populations.<sup>34</sup> Toxic pollutants known to worsen asthma are present in wood smoke including particulate matter, carbon monoxide, nitrogen oxides, and volatile organic compounds. Air pollution from secondhand smoke is a leading risk factor of lung disease and increasing asthma severity.<sup>35</sup> Additional causes of poor air quality in tribal communities include mold, formaldehyde, forest and grass fires, particulates, airborne toxins, and radon.<sup>36</sup>

Comorbidities including high body mass index (obesity) are also linked to increased asthma prevalence in AI/AN populations. Obesity is a risk factor for the development of asthma, worsening asthma symptoms and poor asthma control.<sup>37</sup> The Child Health Measures project studied students in 4th through 12th grades in five reservation communities in Montana and Wyoming. The study found students who were overweight or obese were more likely to self-report current asthma.<sup>38</sup> The Office of Minority Health reports AI/AN adolescents are 30% more likely than non-Hispanic white adolescents to have obesity. AI/AN adults are 50% more likely to have obesity.<sup>39</sup>

“

*The health impacts of air pollution on many American Indian/Alaska Native (AI/AN) communities is magnified by such factors as the inability to receive quality medical care due to issues like cultural barriers and geographic isolation, and spending more time in unhealthy air environments than their non-AI/AN counterparts.*<sup>32</sup>

”

– 2019 Status of Tribal Air Report

Washington state has 29 federally recognized American Indian tribes and has the seventh highest AI/AN population in the United States. In 2012, the Washington State Asthma Program (part of the Washington State Department of Health) conducted a study to assess and address asthma burden on the AI/AN populations living in the state of Washington. Table 5 summarizes the findings of the Asthma Among American Indians and Alaska Natives in Washington report.

**Table 5. Asthma Among American Indian and Alaska Natives in Washington**

The Washington AI/AN population has higher prevalence of other chronic conditions, risk factors, and worse outcomes. The ten-year combined asthma death rate of AI/AN is two times higher than the general population.

AI/AN ADULTS	AI/AN CHILDREN
Higher asthma prevalence than general population in all income levels	Only one in four have received a written asthma action plan from their provider
Nearly twice as likely to experience asthma symptoms every day than other adults with asthma	30% of 12th graders reporting having lifetime asthma (general population reported 20%)
Report more asthma episodes or attacks compared to general population	High school youth with asthma were nearly four times as likely to report having a long-term disability or health problem than youth without asthma
Report waking up more during the night because of asthma related symptoms than other adults with asthma do	Twice as likely to smoke and about 1/3 of high school youth with asthma are exposed to secondhand smoke
More likely to experience poor mental health and emotional issues including stress and depression	Over 1/3 of high school youth with asthma are depressed and one in six has seriously thought about suicide

Source: Washington State Department of Health, *Asthma Among American Indians & Alaska Natives in Washington (2012)*

AI/AN: defined as people who are Non-Hispanic American Indians or Non-Hispanic Alaska Natives.

Centuries of racism and government-sponsored land redistribution have displaced AI/AN communities who continue to experience poverty, housing problems and instability at a higher rate than the average U.S. population.<sup>40</sup>

**Table 6. Poverty Status in the United States**

<b>RACE/ETHNICITY</b>	<b>ESTIMATED PERCENT OF POPULATION BELOW POVERTY LEVEL</b>
White, non-Hispanic	9.5%
<b>Black</b>	<b>22.5%</b>
<b>American Indian / Alaska Native</b>	<b>23.7%</b>
Asian	10.8%
Native Hawaiian and Other Pacific Islander	16.7%
Two or More Races	15.9%
Hispanic or Latino (any race)	18.8%

*Source: U.S. Census Bureau, American Community Survey (2018)*

The Tribal Public and Environmental Health Think Tank, commissioned by the CDC and supported by the American Public Health Association, has focused on five social determinants which have affected tribal health:

1. Unsafe, inadequate housing
2. Barriers to educational achievement
3. Persistent generational poverty
4. Deeply rooted historical trauma
5. Societal and institutional racism and discrimination

The Think Tank is working to advance American Indian and Alaska Native health by addressing environmental factors and social determinants of health that are contributing to poorer health incomes experienced by the AI/AN communities.<sup>41</sup>



*Over multiple generations, American Indian communities have endured a succession of traumatic events that have enduring consequences for community members.<sup>43</sup>*



– Teresa Evans–Campbell

**Historical trauma is another form of structural racism that shapes the health outcomes of certain racial and ethnic groups, including American Indians and Alaska Natives.<sup>42</sup>**

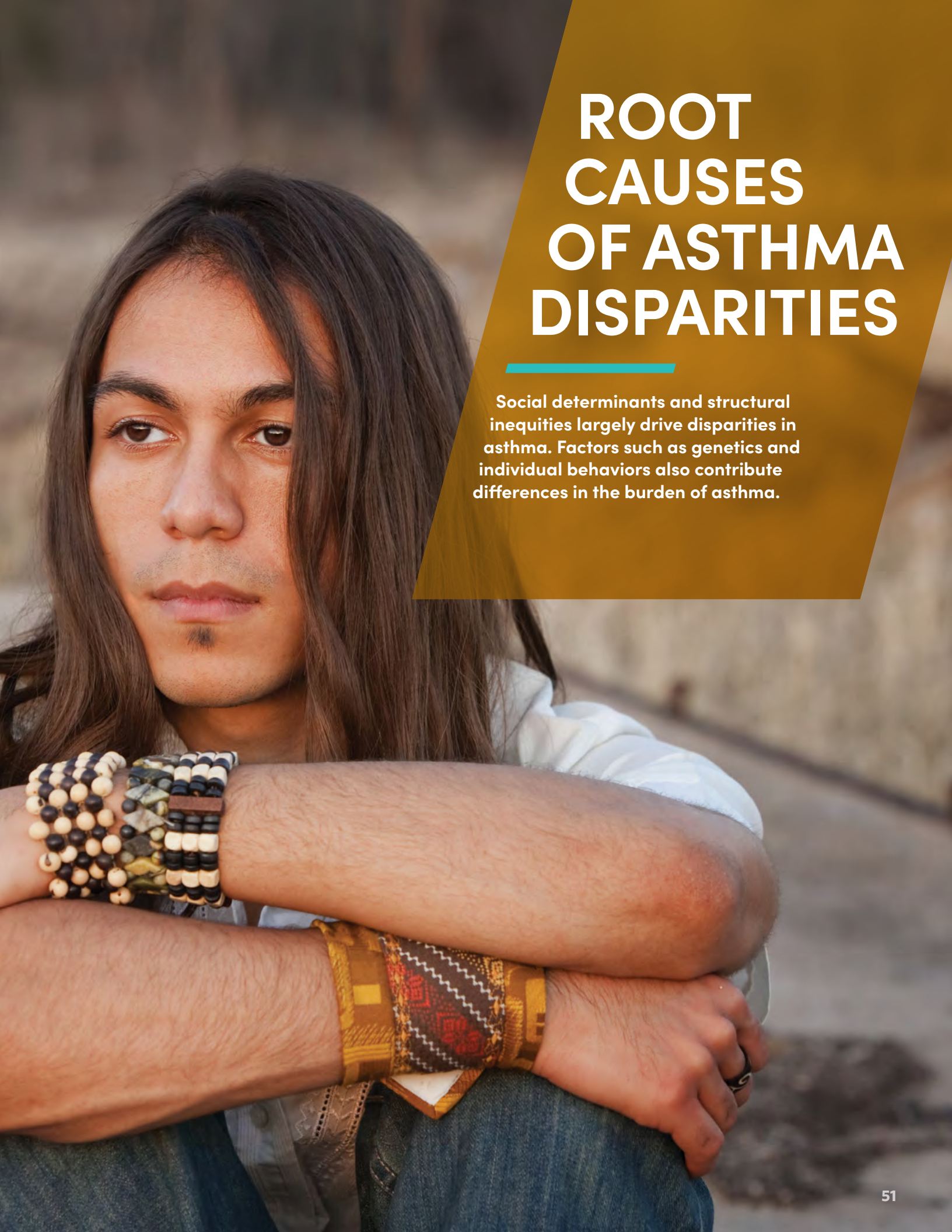
To address asthma health specifically, tested solutions include:

- Providing in-home asthma care, visits, education and assessments<sup>44</sup>
- Using community health workers
- Training providers to offer culturally competent care
- Installing home interventions to reduce asthma triggers in the home (e.g. air quality monitors, chimney thermometers, green cleaning kits, allergy abatement products)<sup>45</sup>

In addition to addressing the structural inequities prioritized by the Tribal Public and Environmental Health Think Tank, the following strategies can improve health outcomes for AI/AN people with asthma:

- Improve data collection to monitor disparities experienced by AI/AN populations
- Expand funding of the CDC's National Asthma Control Program to support tribal health organizations with their efforts to improve asthma care
- Build asthma programs with tribal health leaders and AI/AN patient advisors
- Improved regulations and enforcement of Clean Air Act near tribal communities





# ROOT CAUSES OF ASTHMA DISPARITIES

Social determinants and structural inequities largely drive disparities in asthma. Factors such as genetics and individual behaviors also contribute differences in the burden of asthma.

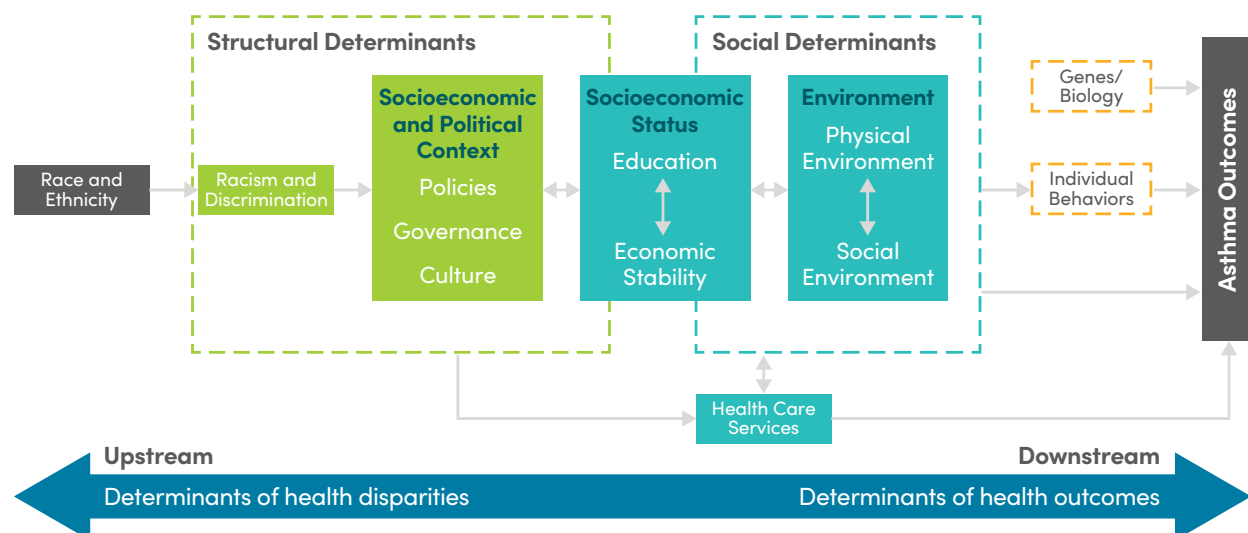


Racial and ethnic disparities described in this report are the result of complex interactions among varying levels of social, structural, genetic, and behavioral factors. While some of the differences between Black, white, and Hispanic (specifically, Puerto Rican) populations may be due to genetic variations, overwhelming evidence suggests that asthma disparities are more significantly rooted in numerous multidimensional social and structural determinants.

Understanding the relative contribution of each of these factors is an area of active research. This chapter provides an overview of the current understanding of social determinants, structural inequities, genetic markers, and individual behaviors responsible for racial and ethnic disparities in asthma.

To depict the relationships between these interdependent factors as organized in this report, we developed a conceptual framework adapted from several existing models, including the World Health Organization’s Conceptual Framework for Action on the Social Determinants of Health<sup>2</sup> and Healthy People 2020’s “place-based” organizing framework<sup>46</sup> (Figure 17). AAFA’s framework reflects the asthma-specific factors of health disparities as outlined in this report. Additionally, while other conceptual models generally incorporate race under larger umbrellas, our framework isolates racism and discrimination to highlight its overwhelming role in amplifying social, structural, and individual stressors.

**Figure 17. AAFA’s Framework for Causes of Asthma Disparities**





## SOCIAL AND STRUCTURAL DETERMINANTS

The causal relationship between social advantage and better health is well-documented in asthma.<sup>47</sup> Research shows that asthma disparities are highly driven by socioenvironmental and economic factors, and that structural injustices over time have led to a situation of accumulated disadvantage for specific racial and ethnic subpopulations in the U.S.

The concepts of social determinants and structural inequities, collectively known as “social determinants of health” (SDOH), are intrinsically entangled, complex, and reciprocal in nature. Disentangling these determinants to evaluate their impacts in isolation is inherently challenging.

Additionally, structural racism, which alone is a significant driver of asthma disparities, amplifies and is intertwined with socioeconomic disadvantages, such as poverty, poor housing conditions, and a lack of access to health care. The cumulative risk from these overlapping social determinants increases asthma disparities.



### SOCIAL DETERMINANTS OF HEALTH: DEFINITIONS AND TERMINOLOGY

The World Health Organization (WHO) defines social determinants of health (SDOH) as “the conditions in which people are born, grow, work, live and age, and the wider set of forces and systems shaping the conditions of daily life.”<sup>2</sup> In this report, we acknowledge the duality within the WHO’s definition and refer to SDOH as the combination of social determinants and structural inequities described below:

**Social determinants** are “the conditions in which people are born, grow, live, work, and age.” These include factors such as socioeconomic status, education, neighborhood and physical environment, employment, social support networks, and access to health care.<sup>2</sup>

**Structural determinants** are “the wider set of forces and systems shaping the conditions of daily life.” These forces, which are deeply embedded in society and have historically influenced policies and governance, lead to systemic disadvantages of a particular social group. Examples include structural racism, discrimination, and segregation.

Strategies and interventions related to SDOH are commonly defined as:

- Downstream: Individual-level health outcomes and behavior
- Midstream: Community-level social, physical, and economic determinants
- Upstream: Population-level institutional and structural inequities

## STRUCTURAL DETERMINANTS OF HEALTH

The unequal distribution of stressors, such as poverty, substandard living environments, and lack of access to quality healthcare, can be attributed in part to systemic injustices and racism deeply ingrained in U.S. policies, governance, and culture.<sup>48</sup> Although structural inequities exist based on sex, gender, age, and other factors, this report examines inequities related to race and ethnicity.

Today's institutional structures have been shaped by the long-lasting and residual impact of slavery, Jim Crow laws, redlining, immigration restrictions and mass deportation, removal of Indigenous Americans, and the fight for civil liberties. Structural inequities from the past remain deeply embedded in the institutions that govern all aspects of non-white or Hispanic communities today, from employment and economic stability to physical environment and social capital.

For more than a century, systemic racism and discrimination have perpetuated the social stratification of minority populations by shaping economic and public policies.<sup>49</sup> This social stratification, which refers to the ranking of people based on factors such as class, race, or income, results in a socioeconomic and political context in which racial and ethnic minorities are routinely disadvantaged in socioeconomic position, physical environment, and health care. Long-term racism and discrimination have incited privilege associated with the white race and disadvantage associated with non-white races and Hispanic ethnicity.

Several complex and often interrelated policies created disadvantages for minority populations and exacerbated racial disparities in health and in asthma, specifically. Examples of structural factors that aided in creating racial and ethnic disparities in asthma are included in Table 7.

**Table 7. Examples of Structural Determinants of Health**

DOMAINS	POLICY AND GOVERNANCE	CULTURE AND SOCIETAL BELIEFS
<b>Key Issues (Determinants)</b>	<ul style="list-style-type: none"> <li>• Systemic Discrimination and Racism</li> <li>• Housing Policies</li> <li>• Immigration Policies</li> <li>• Incarceration Policies</li> <li>• Environmental Policies</li> </ul>	<ul style="list-style-type: none"> <li>• Individual Discrimination and Racism</li> <li>• Stereotyping</li> <li>• Implicit and Explicit Bias</li> <li>• Stigmatization</li> <li>• Discriminatory Hiring and Promotion Practices</li> </ul>
<b>Outcomes</b>	Segregation (e.g., Residential, Occupational, etc.), Racial Wealth Gap, Inequalities in Labor Market and Education System, Unequal Distribution of Resources	
<b>Impact</b>	Economic Stability, Educational Attainment, Social Environment, Physical Environment, Health Care Services	

In the context of asthma disparities, policies that have relegated racial and ethnic minorities to lower socioeconomic positions are profound consequences of structural racism. Such policies contribute to the unequal distribution of wealth and resources, as well as higher rates of poverty, poor housing quality, and low economic and educational opportunities among racial and ethnic populations.



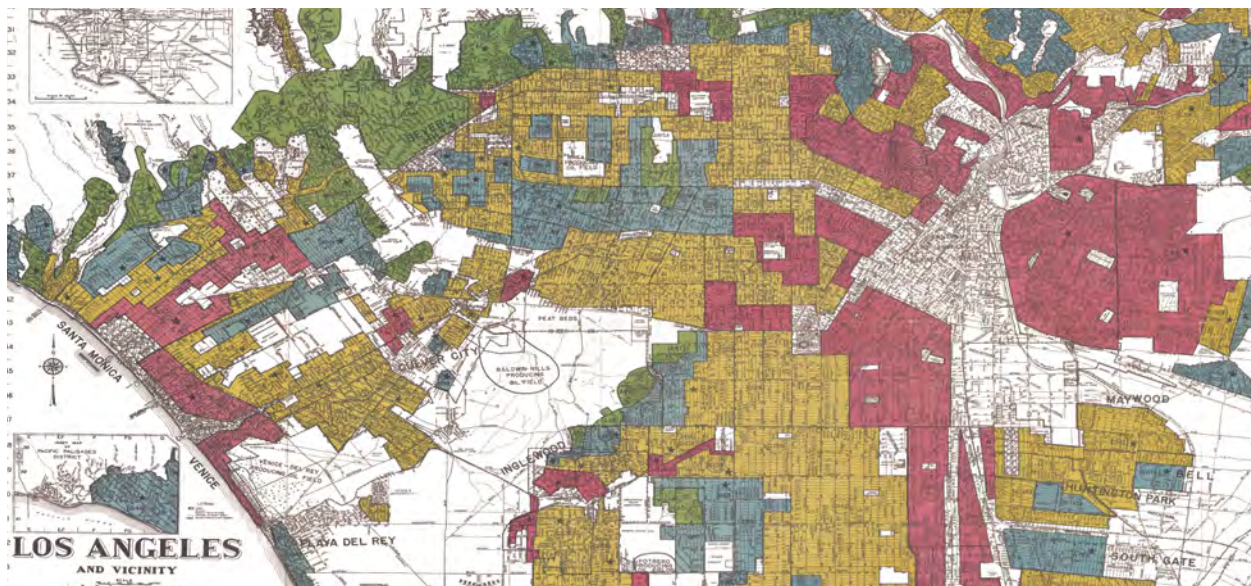
## Racial Segregation

Historical policies that resulted in the racial segregation of neighborhoods, workplaces, schools, and health care facilities continue to exacerbate asthma disparities today.<sup>50, 51</sup> Segregation limits resources and opportunities available to certain populations, affects access to health care, increases risk for exposure to environmental triggers, and increases chronic stress in certain populations.<sup>49</sup>

### *Residential Segregation*

The concentration of racial and ethnic minority populations in low-income neighborhoods is not coincidental. A long history of discriminatory housing policies in the U.S. resulted in current residential segregation, restricting many families of color to undesirable neighborhoods where poverty rates are high, and economic and educational opportunities are low.

Throughout the 20th century, federal housing policies promoted homeownership and wealth generation.<sup>52</sup> However, these policies primarily benefited white populations. The National Housing Act of 1934, which was signed by President Roosevelt in response to the Great Depression, established the Federal Housing Administration (FHA) and its home mortgaging system. To assess lending risk and determine neighborhoods eligible for government-backed mortgages, the FHA relied on maps drawn by the Home Owners' Loan Corporation (HOLC) where "hazardous" neighborhoods were largely based on racial composition.<sup>53</sup> This practice, known as "redlining," denied mortgages based on geographic areas and exacerbated the racial segregation that still exists today.<sup>54</sup>



Source: *Mapping Inequality: Redlining in New Deal America*

Above image represents the map of Los Angeles created by the Home Owners' Loan Corporation (HOLC). In each city, HOLC assigned grades to residential neighborhoods to reflect their "mortgage security" using color-coded maps. Neighborhoods receiving the highest grade of "A" (colored green on the maps) were deemed minimal risks for banks and other mortgage lenders. Areas receiving the lowest grade of "D" (colored red) were considered "hazardous."<sup>55</sup> Scans of historic HOLC maps, many from the National Archives, are available at [dsl.richmond.edu/panorama/redlining](http://dsl.richmond.edu/panorama/redlining).

"Redlining" is only one example of overtly discriminatory housing policies that perpetuated racial segregation. Such policies, which were legal until the Fair Housing Act of 1968, have systematically disadvantaged people of color and continue to do so long after these practices were deemed illegal.



### *Occupational Segregation*

Like residential segregation, stark racial disparities in employment are not coincidental; rather, they are the product of a long history of systemic racism and discrimination. Black individuals face more vulnerability in the labor market than white individuals, and disproportionately experience lower employment rates, wages, access to quality jobs, and job stability.<sup>56</sup>

Following the abolishment of slavery in 1865, many Black workers initially continued to live in the southern U.S., working as sharecroppers. The brutal nature of farm labor, coupled with the disenfranchisement of Jim Crow, incentivized many Black workers to seek industrial occupations in the northern states.<sup>57</sup> However, these Black migrant workers did not enjoy the same employment opportunities as white workers. Black unemployment, workplace discrimination, and racial inequality were the norm through the turn of the century.<sup>58</sup>

In response to the Great Depression in the 1930s, the New Deal launched programs and policies designed to stimulate economic growth by tackling unemployment, increasing wages, and securing job benefits.<sup>59</sup> Similar to housing policies created by the New Deal, these economic and employment policies almost exclusively benefited white workers and perpetuated the systematic discrimination of Black workers in the labor market. The 1.2 million Black veterans who fought in World War II were also excluded from the historically praised G.I. Bill, which were government programs that provided educational, employment and housing benefits, and stimulus.<sup>60</sup> The bill gave deference to Jim Crow laws, buoying prosperity for white Americans and creating a treacherous canyon of racial wealth disparities that generations of Americans are still trying to climb out of today.

To eliminate workplace discrimination and protect the rights of all workers, the Federal Equal Employment Opportunity Commission (EEOC) was created in 1964. Although a major victory in promoting equality and diversity in the workforce, the EEOC was unable to erase or reverse decades of inequality in the labor market.

One of the long-lasting consequences of these discriminatory policies is the occupational segregation still evident in today's workforce. Occupational segregation, which is the concentration of Black Americans in low-quality, undervalued jobs, hinders the ability of Black workers to attain equal opportunities in positions such as management and business.<sup>61</sup>

## Health Care Segregation

Segregation in the U.S. health care system has been described as “one of the most enduring—and least noticed—areas of racial segregation.”<sup>62</sup> The inequalities of the health care system are evident in institutions, policies, and laws that explicitly kept minority groups from receiving the same, often higher quality, care given to white individuals.

Hospitals and other health care settings were also segregated. The 1896 U.S. Supreme Court ruling of *Plessy v. Ferguson* upheld segregation in public institutions, such as hospitals and clinics, as constitutional under the argument of “separate but equal.”<sup>63</sup> Not only did this legitimize “whites only” patient care, segregation also prevented doctors and staff from working in shared environments. That factor mixed with a segregated educational system that included racial barriers to higher learning meant dramatically fewer resources, fewer doctors, and lower quality care overall for communities of color.<sup>64</sup>

These factors led to poor health outcomes that shaped the health of communities of color today. And despite new strides in equal rights protections ushered in by the Civil Rights Act of 1964, generations of geographical segregation left hospitals that served Black patients deeply understaffed and under-resourced.<sup>65</sup>

Laws put in place to protect Civil Rights and eradicate a segregated health care system, continually meet resistance, challenges, and setbacks. In 2001, a U.S. Supreme Court case over the state of Alabama’s policy to administer driver’s license tests in English-only, *Alexander v. Sandoval*, rendered a section of Civil Rights law that protected against health disparities as null.<sup>66</sup> The decision assumes that Title VI of the Civil Rights Act only prohibits intentional discrimination. It also makes private lawsuits based on evidence of disparate impact virtually impossible to prove. Lastly, this decision proved to be a roadblock not only for non-English speaking drivers but for a legal solution to combatting racial and ethnic differences in multiple areas, including health.

Indirectly, the long-lasting impact of residential segregation continues to shape access to health care.<sup>67</sup> Systematic disinvestment in predominantly minority neighborhoods results in a substandard health care infrastructure and scarcity of primary care providers and specialists in underserved communities.





*Overcoming implicit bias is proving to be one of the greatest challenges in health care.*

### **Individual Discrimination and Bias**

Discrimination occurs on the macro level (e.g., the segregation described in the previous sections), as well as on the personal level (e.g., individual racism, biases, or stereotyping). On the individual level, discrimination, biases, and stereotyping fuel racial disparities in health in various ways.

Implicit biases are associated with negative stereotypes and unconscious judgments or attitudes directed toward people based on social and physical categories, including race, income, employment status, age, size, ability, sex, gender, or sexual orientation.<sup>68</sup> This is also known as intrinsic bias or subconscious racism bias. These are learned behaviors picked up from societal cues or prejudice most people do not even realize they are absorbing. But this has a major impact on the way we respond to circumstances, situations, and other people with often damaging ramifications.

Unconscious and learned behaviors that reinforce stereotypes and prompt a rush to judgement can be particularly dangerous in health care settings.<sup>69</sup> Regardless of age, sex, gender, race, sexual orientation, or political leaning everyone holds implicit biases. Studies show most Americans subconsciously develop negative bias toward Black people and more positive feelings toward white people. The Institute of Medicine's 2003 Report, "Unequal Treatment: Confronting Racial and Ethnic Disparities in Health Care," found that even when factors like insurance coverage and household income were controlled, racial and ethnic minority groups still received subpar care compared to white patients for many diseases and health conditions, including asthma.<sup>70</sup>

Challenges with implicit bias are divided both ways between health care providers and patients. Researchers have found that this can be a detrimental mix leading to poor interactions and more negative outcomes. This is especially the case when doctors have higher levels of implicit bias and patients have greater mistrust in the health care system and report experiencing past discrimination.<sup>71</sup> Overcoming implicit bias is proving to be one of the greatest challenges in health care. Unconscious racism is also considered to be a key driver of health disparities. Dedicated researchers and public health experts are calling for legal solutions and new strategies to help doctors, physicians-in-training, and all health care workers and providers acknowledge any bias and to see patients as individuals rather than preconceived ideas.<sup>72</sup>

Social disparities can shape health outcomes for future generations. Racism, whether implicit or explicit, can have a cumulative effect across generations.



---

## AAFA'S COMMITMENT TO RACIAL JUSTICE

In 2020, the deaths of Ahmaud Arbery, Breonna Taylor, George Floyd, and many others occurred during a global pandemic that was already showing signs of racism and disparities in health care. COVID-19 disproportionately infected and killed people in Black, Indigenous American, and Hispanic communities.

*“ Disparities in health care are something we know about all too well as an organization, and we are actively working to change this. The disproportionate harm from the health care systems on minority populations are both rooted in the same thing: deep, systemic racism. Our systems have historically failed Black Americans and other marginalized groups. AAFA is an organization that has always been dedicated toward striving for justice with our work to reduce disparities in care for underserved groups. We are working hard to keep these issues at the forefront until we eradicate these differences. ”*

**- Kenneth Mendez, President and CEO, Asthma and Allergy Foundation of America**

---

## SOCIAL DETERMINANTS OF HEALTH

The social determinants identified in AAFA’s framework (Figure 17, page 52) are adapted from Healthy People 2020’s organizing framework for social determinants of health (SDOH). The Healthy People approach includes five key domains, each with several key issues that affect an individual’s health (Table 8).

The burden of asthma is shaped by determinants within all five domains. Arguably, the three domains and corresponding issues most influential to racial and ethnic disparities in asthma are economic stability (e.g., employment, poverty), physical environment (e.g., poor housing and environmental conditions), and health care (e.g., access to health care, quality of care, and health literacy).

**Table 8. Examples of Socials Determinants of Health**

KEY DOMAINS	ECONOMIC STABILITY	EDUCATIONAL ATTAINMENT	SOCIAL ENVIRONMENT	PHYSICAL ENVIRONMENT	HEALTH CARE
<b>Key Issues</b>	<ul style="list-style-type: none"> <li>• Poverty</li> <li>• Employment</li> <li>• Income</li> <li>• Job Quality</li> <li>• Food Insecurity</li> <li>• Housing Instability</li> </ul>	<ul style="list-style-type: none"> <li>• Early Childhood Education and Development</li> <li>• Higher Education</li> <li>• High School Graduation</li> <li>• Language and Literacy</li> </ul>	<ul style="list-style-type: none"> <li>• Social Class</li> <li>• Civic Participation</li> <li>• Incarceration</li> <li>• Social Cohesion</li> </ul>	<ul style="list-style-type: none"> <li>• Access to Foods</li> <li>• Crime and Violence</li> <li>• Indoor Air Quality</li> <li>• Outdoor Air Quality</li> <li>• Quality of Housing</li> <li>• Transportation</li> </ul>	<ul style="list-style-type: none"> <li>• Access to Health Care</li> <li>• Access to Primary Care</li> <li>• Health Literacy</li> <li>• Quality of Care</li> </ul>
<b>Influence</b>	Mortality, Morbidity, Life Expectancy, Health Care Expenditures, Health Status, Functional Limitations				

*Source: modified from Healthy People 2020’s organizing framework for Social Determinants of Health (2010)*

## SOCIOECONOMIC STATUS

Socioeconomic status (SES), sometimes referred to as socioeconomic position, is defined in various ways. In general, SES spans across the SDOH domains of economic stability, education, and social environment, and encompasses determinants, such as income, employment, educational attainment, and social class. SES is one of the strongest predictors of health, which is especially true with asthma.

Several studies confirmed that when various social determinants, including socioeconomic factors, are statistically balanced, disparities in asthma burden between Black and white populations are reduced significantly. Such research supports the notion that social determinants are more significant causes of disparities, as opposed to biology or genes.

Researchers at Cincinnati Children’s Hospital Medical Center used this type of statistical technique to compare hospital readmission risk for Black children ages 1-16 compared to white children of the same age. They estimated the extent in which racial disparities would exist should Black and white children experience similar, balanced social and physical environments. At baseline, Black children had worse outcomes and were over two times more likely than white children to be readmitted to the hospital. After adjusting for socioeconomic variables, 53% of the disparity in hospital readmissions disappeared. When additional factors were adjusted, including environmental and biological factors (including age, sex, and sensitization to certain allergens), as well as access to care and disease management, these variables accounted for 80% of the disparity in hospital readmissions.<sup>73</sup>



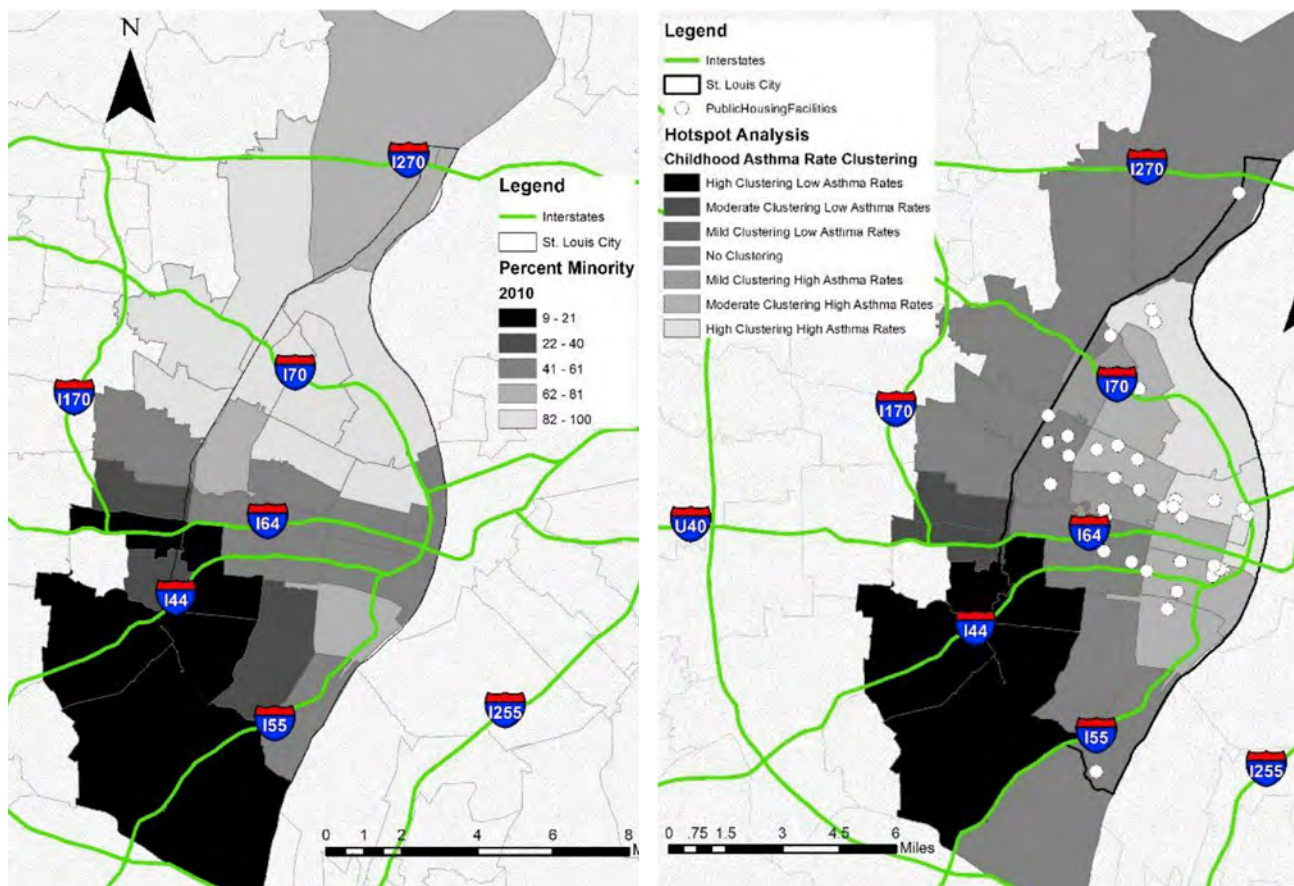
The National Heart, Lung, and Blood Institute’s (NHLBI) Severe Asthma Research Program (SARP) used a similar technique when comparing a one-year risk rate for an asthma-related ED visit among Black and white patients age 6 and up with severe asthma. At baseline, Black patients were determined to have a two-fold risk of an ED visit compared to white patients, but this disparity disappeared after statistical adjustments of socioeconomic and environmental variables.<sup>74</sup>

In another study, researchers analyzed data collected between 2001-2004 from Black and white children with severe asthma ages 6-11 at 283 clinical sites across the U.S. The data showed that although Black children used more systemic and inhaled corticosteroids than white children, they had higher rates of poorly controlled asthma, higher Immunoglobulin E (IgE) levels, worse lung function and quality of life, and greater limitations on activity and school participation. Using statistical rebalancing, the researchers found that socioeconomic variables were responsible for 40% of observed disparities in a composite measure of asthma exacerbation and 12% of the disparities observed in asthma control.<sup>75</sup>

## Mapping Social Determinants

Throughout the past 10–15 years, a deeper understanding of the complexities involved in identifying, measuring, and disentangling SDOH from one another has played a key role in the emergence of innovative tools aimed at better identifying disparities. One such tool is the use of geographic information system (GIS) mapping to detect trends and compare variables across neighborhoods. GIS mapping allows researchers to capture data at the neighborhood level to determine where disparities are clustered and to analyze interrelated SDOH factors in specific geographic areas.

A case study from St. Louis, Missouri demonstrated how GIS was used to identify significant concentrations, or “hotspots,” of higher asthma prevalence in certain zip codes overlapping with GIS maps of concentrated public housing, older housing and condemned properties, high levels of violence, and lower levels of school achievement and car ownership, among other variables. The overlapping maps showed that these variables were associated with higher asthma rates in zip codes where 80% of school-age children are Black and 84% of families rely on Medicaid.<sup>76</sup> According to the authors, the scale of environmental injustice or place-based inequality among neighborhoods in the same city is staggering.



Source: *Mapping Inequality: Childhood asthma and environmental injustice, a case study of St. Louis, Missouri*<sup>76</sup>

Above images represent maps of St. Louis, Missouri using Geographic Information Systems (GIS) to identify the percentage of minority residents per zip code (left) and public housing facilities located in asthma hotspots (right). The study identified asthma hotspots as the statistically significant spatial clustering of high or low levels of childhood asthma. Comparison of the two maps point to associations between race and ethnicity, public housing facilities, and asthma prevalence.





In another study, researchers used GIS to map 350 mostly Black or Hispanic children with asthma in inner-city Boston, Massachusetts. Mapping showed that 60% were living or going to school within 100 meters of a major roadway, which was shown to be associated with increased asthma symptoms, greater health care utilization, and higher rates of poorly controlled asthma. The authors added that an estimated 3.2 million students in the U.S. attend schools that are located less than 100 meters (328 feet) from major roadways.<sup>77</sup>

In Houston, Texas, researchers studying childhood asthma separated the diverse city's neighborhoods into three classes of relative advantage based on several demographic, economic, and environmental indicators. Using data from medical records and GIS, disparities among children with diagnosed asthma were determined to be driven more by the inability to access care and resources than by neighborhood composition.<sup>78</sup>

Researchers in Cincinnati, Ohio performed a similar mapping exercise with childhood asthma hospitalizations and ED visits matched to over 200 census tracts in surrounding Hamilton County. Data from the Child Opportunity Index (COI) was utilized to categorize each census tract based on a scale of relative "opportunity" for children in education, health-environmental, social, and economic domains. Higher rates of asthma hospitalizations and ED visits were observed for each successive lower neighborhood opportunity score.<sup>79</sup>

“

*Residents of these high asthma hotspots experience greater environmental risk, and significant disparities in health and education outcomes, physical and financial healthcare resources, and overall well-being.*<sup>76</sup>

”

- Kelly M. Harris  
Washington University



## BIOLOGICAL DETERMINANTS

Asthma is a highly heterogeneous disease that results from complex interactions between genetic and environmental factors. Although a large and compelling body of evidence points to social and structural determinants as the dominant causes of asthma disparities, at least some of the differences in asthma outcomes can be attributed to biological factors.

As highlighted in AAFA's 2005 report "Ethnic Disparities in the Burden and Treatment of Asthma,"<sup>80</sup> African ancestry shared by Black and Puerto Rican populations has been identified as a potential genetic predictor of asthma.<sup>3</sup> In the years since the publication of the 2005 report, the association between ancestry and asthma continues to be an area of active investigation.

Researchers also seek to explain genetic variations related to asthma. Although the extent to which asthma is dictated by genetics is not entirely clear, various genes were found to influence an individual's:

- Susceptibility to asthma (heritability)<sup>4</sup>
- Progression of asthma (severity)<sup>5</sup>
- Response to treatment<sup>6</sup>

The specific genes implicated in asthma remain under investigation, though several gene variants, namely single nucleotide polymorphisms (SNPs), have been associated with asthma susceptibility and severity.<sup>81</sup>

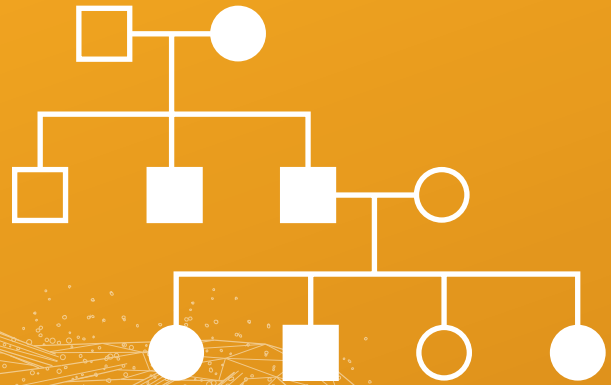
In fact, studies identified over a hundred different genes that are associated with asthma susceptibility.<sup>81</sup> To date, only a few asthma-associated genes have been identified and replicated in more than one study.<sup>82</sup>

Approaches used to discover genes related to asthma evolved in the past few decades. Researchers initially used linkage analyses and candidate-gene association studies, which led to the emergence of genome-wide association studies (GWAS) that have dominated the field of genomics research in recent years.

# EVOLUTION OF GENOMICS RESEARCH

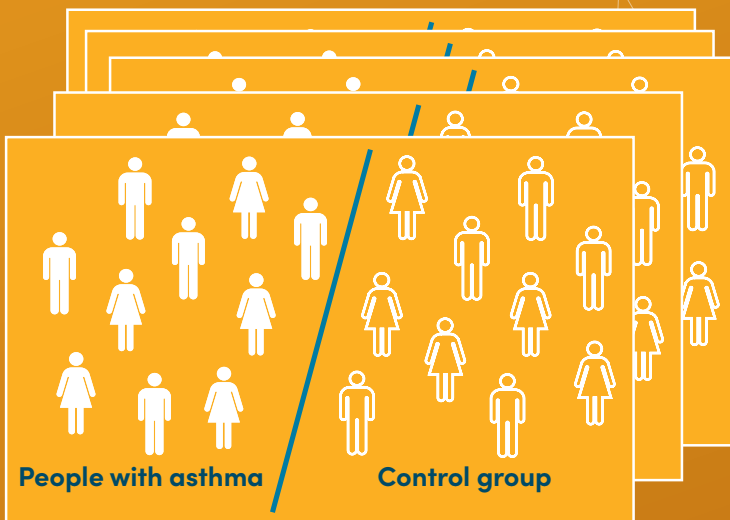
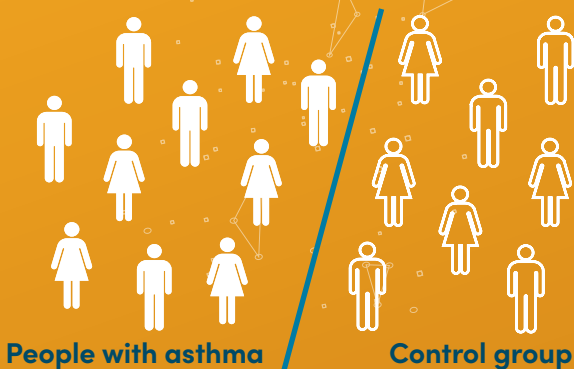
## FAMILY LINKAGE STUDIES

Linkage analyses are often conducted among multigenerational family members affected by asthma and help identify large regions of the genome where susceptibility genes are more likely to reside. These studies are useful in determining the inheritance/heritability of asthma.



## CANDIDATE-GENE ASSOCIATION STUDIES

Candidate-gene association studies are used to confirm specific genes that are believed to play a role in susceptibility to asthma.



## GENOME-WIDE ASSOCIATION STUDIES

Genome-wide association studies (GWAS) are used to quickly scan multiple genomes to identify single nucleotide polymorphisms (or single genetic code variations) associated with specific diseases. GWAS have become the most effective approach to study the genetics of asthma.

## ASTHMA HERITABILITY

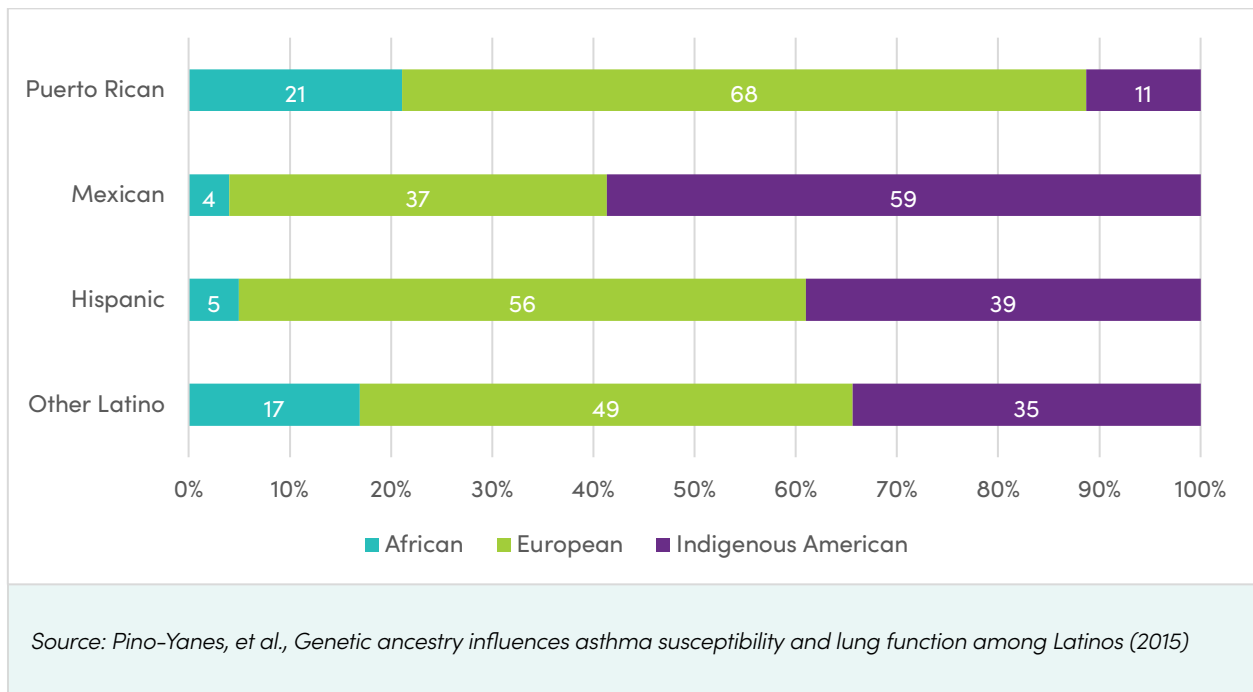
Evidence points to a family history of asthma as a leading risk factor for developing asthma. Maternal asthma serves as a stronger risk factor for asthma in children, compared to paternal asthma.<sup>83</sup>

Early studies of twins and families of people with asthma support the idea of genetic heritability in asthma, with heritability estimates ranging from 35–95%.<sup>84</sup> Such findings indicate that certain components of asthma are hereditary, although the exact likelihood of inheriting asthma is unknown.

A study based on genomic data on 1,211 children enrolled in two asthma clinical research programs demonstrated that for every increase of 10 percent in African ancestry, the odds of allergic asthma were 1.5 times higher and the odds of positive skin prick test (SPT) 6.3 times higher.<sup>85</sup>

Researchers hypothesize that African ancestry may partially explain the disproportionate burden of asthma in Puerto Ricans compared to other Hispanic subgroups.<sup>86</sup> Puerto Ricans can be of any race and have variable proportions of African, European, and Indigenous American ancestry. Studies have found that Puerto Ricans have about 18–25% African ancestry, 60–70% European ancestry, and 12–15% Indigenous American ancestry.<sup>87</sup> Composition of Hispanic subgroups studied in one cohort showed that Mexicans, on the other hand, have much lower proportions of African genes (Figure 18).

Figure 18. Ancestry Composition for Hispanic Subgroups

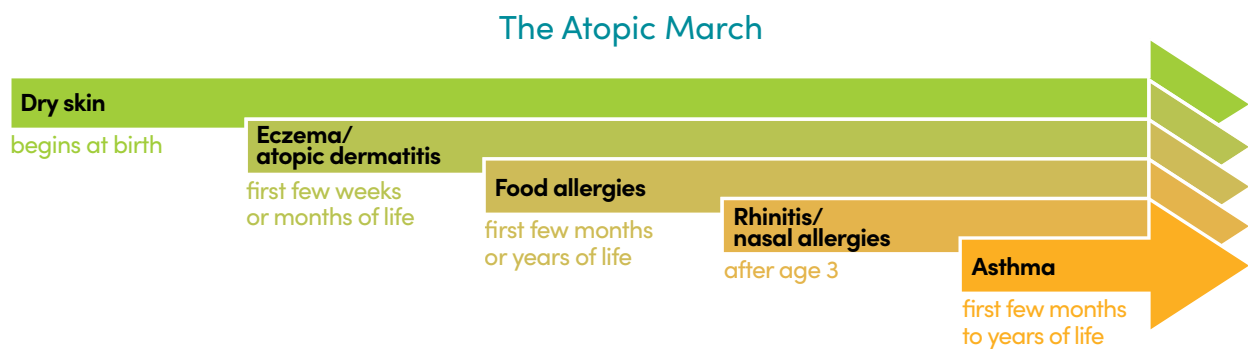






Asthma belongs to a group of atopic (allergic) conditions that tends to run strong in families, including food allergy, atopic dermatitis (eczema) and allergic rhinitis (nasal allergy). Atopic diseases share common characteristics such as Type 2 immune response, suggesting similarities in the underlying mechanisms of disease. Family history of atopy in one or more immediate relatives is a strong and reliable predictor of atopic conditions.<sup>88,89</sup> On an individual level, the presence of atopy increases predisposition to more than one atopic disease.

The natural history of allergic diseases is known as the “atopic march” or the “allergic march.”<sup>90</sup> This refers to the progression of a disease process in an individual over time, in the absence of treatment. In asthma and allergies, the natural history tends to begin with dry skin and follow this course:



## GENE-ENVIRONMENT INTERACTIONS

Although linkage, candidate-gene, and genome-wide studies have added critical knowledge to our understanding of asthma, these studies do not adequately explain genetic predisposition to asthma.

Rather, understanding the genetic contribution to asthma susceptibility and progression requires studying interactions between genes and environmental influences. The clinical patterns in asthma reflect the combined effect of an individual’s biological markers and exposure to environmental factors. Exposure to various non-biological influences, such as air pollution and medication, have been observed to alter gene expression and play a role in asthma development and severity.

### Exposure to Air Pollutants

In the context of asthma disparities, gene–environment interactions are critical because racial and ethnic minority populations in the U.S. are disproportionately burdened by exposure to environmental pollutants, such as traffic pollution, tobacco smoke, and other air pollutants, which are linked to chronic respiratory diseases and reduced lung function.<sup>91</sup>

Gene–environment interactions have been found to occur even in utero. Several studies suggest that prenatal exposure to air pollutants, such as fine particulate matter (PM<sub>2.5</sub>) or nitrogen oxides (NO<sub>x</sub>), influences the risk of developing asthma.<sup>92</sup> These findings also suggest that pollution may affect lung development in the fetus and predispose children to lung diseases, such as asthma.

The connection between in utero exposure to air pollution and vulnerability in the developing respiratory system seems to be especially evident in boys. An analysis of exposure to PM2.5 among pregnant women in Boston showed that increased exposure to air pollutants, particularly during the second trimester, was significantly associated with early childhood development of asthma in urban children, but only in boys by age 6.<sup>93</sup> However, researchers understand that environmental exposures rarely happen in isolation. In fact, exposures are often compounded by social factors. In a later study, the researchers looked at the cumulative impact of prenatal air pollution and maternal stress on asthma development.<sup>94</sup> They found that elevated stress in pregnancy and higher exposure to fine particulate matter during the second trimester significantly increased the child's likelihood of developing post-natal asthma.



High exposure to nitrogen dioxide (NO<sub>2</sub>) in pregnant women, which is a marker for traffic-related air pollution, also increases the risk of asthma in children. A large study conducted in Toronto, Canada found that exposures to NO<sub>2</sub> and PM<sub>2.5</sub> during the second trimester were associated with increased risks of developing early childhood asthma (before the age of 6).<sup>95</sup> In addition, children born to mothers who were themselves diagnosed with asthma and experienced high prenatal exposure to NO<sub>2</sub> during the second trimester were at even greater risk of developing asthma before 6 years of age.

As a result, the likelihood of asthma development in children may be influenced by exposure to environmental pollutants often experienced disproportionately by mothers near environmental pollutants. These mothers are overwhelmingly urban residents and people of color.

Genetic studies in asthma have largely focused on the genetic implications of disease susceptibility. However, the interactions between genes and environmental exposures are also responsible for asthma expression and progression (i.e., the severity of disease). Specific genes were found to influence lung function, which is an indicator of asthma severity.<sup>96</sup>

## Epigenetics and Asthma

Epigenetics is the study of genetic modification of a disease that is not caused by changes to the DNA code itself. Epigenetic mechanisms are thought to explain genomic adaptation to various environmental influences. Such gene-environment interactions are an important component in understanding asthma development. Several studies now focus on understanding how epigenetic modifications regulate gene expression and may affect disease susceptibility and severity.

Recently emerging genome-wide interaction studies (GWIS) are considered a powerful approach to identify novel disease loci that interact with environmental factors. Disease loci are the specific physical locations of a gene or other DNA sequence on a chromosome.

Interaction studies also help understand the impact of environmental exposures on asthma exacerbations and may guide asthma interventions in the future.

## TOBACCO SMOKE EXPOSURE AND ASTHMA



Secondhand smoke (SHS) is linked to negative outcomes in people with asthma. Exposure to SHS is associated with increased need for inhaled corticosteroids in children with asthma,<sup>97</sup> higher odds of asthma exacerbations, and poor asthma control among Black and Hispanic children.<sup>98</sup>

Numerous epigenetics studies identified associations between environmental exposure to tobacco smoke and the development of asthma. In particular, multiple studies identified associations with maternal smoking during pregnancy and asthma development:

- In-utero smoke exposure has been shown to reduce age-related improvements in airway responsiveness among asthmatic children.<sup>99</sup>
- The epigenetic effects on gene expression related to maternal smoking during pregnancy can persist into adulthood.<sup>100</sup>
- Maternal smoking during pregnancy is associated with poor asthma control in Black and Hispanic children ages 8-17.<sup>101</sup>
- American Indians/Alaska Natives are more at risk for asthma-related morbidity and mortality and have a higher prevalence of maternal smoking during pregnancy compared to the rate for the entire U.S. population.<sup>102</sup>

Tobacco smoke can trigger epigenetic modifications in certain genes that correlate with the development of childhood asthma, which can persist into adulthood. Researchers and public health officials agree there is no safe level of exposure to environmental or secondhand tobacco smoke.

## Response to Treatment

Another form of gene-environment interaction that influences asthma severity is the role of genetic variation in an individual's response to asthma treatment, where exposure to the medicine is considered the "environment."

Pharmacogenetics, which is the study of biological responses to medicines, is an area of active investigation in asthma, particularly regarding differences in response to common treatments such as beta-agonists and inhaled corticosteroids (ICS).

Genetic variants, possibly related to shared African ancestry in Black and Puerto Rican populations, may contribute to treatment resistance or reduced responsiveness in these populations. Pharmacogenetic studies also demonstrate that genetic heterogeneity within Hispanic subgroups may explain observed ethnic disparities in asthma, particularly between Puerto Rican and Mexican populations.

## TYPES OF ASTHMA MEDICINES

1

**BRONCHODILATORS (open the airways by relaxing the muscles around the airways)**

- Short acting beta agonists (e.g. albuterol)
- Long acting beta agonists
- Anticholinergics

2

**ANTI-INFLAMMATORIES (treat or prevent airway inflammation/swelling)**

- Corticosteroids (inhaled or systemic/oral)
- Biologics
- Leukotriene modifiers

3

**COMBINATION MEDICATIONS (combined into one inhaler)**

- Contain both inhaled corticosteroids and long acting beta agonists or anticholinergics

Researchers documented differences in the therapeutic response to albuterol (a common quick-relief medication and bronchodilator) along racial and ethnic lines. One study that compared bronchodilator response (BDR) among Black, Puerto Rican, and Mexican American patients found that Black and Puerto Rican individuals with moderate-to-severe asthma demonstrated the lowest responsiveness.<sup>103</sup>

Compared to Mexican individuals, Puerto Ricans are significantly less responsive to albuterol. In a longitudinal study of children with asthma, Puerto Rican children with asthma had significantly higher odds of "decreasing" or "poor" adherence compared to Mexican children.<sup>104</sup> Similar patterns of treatment adherence continue to be supported by later studies.





Pharmacological studies also examine variations in treatment response in people receiving multiple types of asthma medications. In a study of Black, Puerto Rican, and Mexican American children with persistent asthma, participants were given both ICS and albuterol to evaluate whether the use of controller medicine was associated with increased BDR.<sup>105</sup> Statistically, only Mexican American children showed adequate BDR when combined with ICS use. Such studies reinforce the importance of evaluating pharmacological responses in different races and ethnicities.

Understanding the racial and ethnic differences in treatment response supports the movement toward personalized care and individualized approaches to asthma management (See Precision Medicine on page 181). Efforts to ensure more effective asthma treatment in minority populations have the potential to reduce disparities in disproportionately affected populations.

“

*Most pharmacogenetics studies in asthma have focused on white individuals, even though Black, Hispanic, and Indigenous populations are more likely to have asthma and experience a disproportionate share of the asthma burden. Addressing the role of race and ethnicity in pharmacogenetic response to asthma medications is critical to improving asthma management for diverse populations.*

”

- Ann Chen Wu, MD, MPH  
Harvard Medical School  
and Harvard Pilgrim  
Health Care Institute



## BEHAVIORAL DETERMINANTS

An individual's behaviors play a substantial role in determining asthma outcomes. These behaviors can be modified through interventions to improve asthma self-management. Individual factors that may contribute to disparities in asthma include:

- Negative beliefs about medication and the health care system
- Non-adherence to treatment
- Distrust in the medical establishment
- Misperceptions about illness and asthma severity
- Tobacco use

Such behaviors are often associated with poor asthma control, worse outcomes, and lower quality of life. Adherence to medication is a critical self-management strategy for effective asthma control and is highly impacted by personal attitudes toward medication use. Studies have identified some trends in negative beliefs related to medication among racial and ethnic lines, potentially contributing to disparities in asthma outcomes.

Additionally, historical exploitation of Black bodies in unethical medical experiments, such as the Tuskegee Study, has led to lasting intergenerational distrust of the medical establishment among Black families.

## HEALTH BELIEFS AND IMPACT ON ADHERENCE TO TREATMENT

Beliefs about disease, self-management approaches, and medications can be influenced by a variety of factors, including culture, family experiences, and individual preferences. In some cases, these factors can influence behaviors more than guidance from a health care provider.<sup>106</sup> Personal beliefs may affect timing of medication use (e.g., beginning with natural remedies before progressing to prescribed medications), as well as whether parents choose to fill prescription medications at all.<sup>107</sup> Research shows that individual beliefs about the necessity of a medication and the level of concern about taking daily medications differ among cultural groups, making medication beliefs an important point to consider when addressing health disparities.<sup>106</sup>

Attitudes toward medication use are important to understand when addressing asthma disparities. Controller medications, such as ICS, are recommended for persistent asthma and quick-relief medications are recommended for all patients with asthma. Research on patient and caregiver perspectives regarding the use of asthma controller medications point to common concerns about potential long-term complications, fear of dependence, and concerns about side effects.<sup>108, 109</sup> Research also shows that these beliefs and their impact on medication use may differ by racial and ethnic background.<sup>110</sup> A 2007 study on parents of children with asthma indicated that relative to white parents, Black and Hispanic parents' concerns about medication more frequently outweighed belief in the necessity of medication, which was associated with lower self-reported medication adherence.<sup>111</sup> In another study of adult asthma patients, negative medication beliefs and minority status were associated with nonadherence to inhaled corticosteroids.<sup>112</sup>



Regarding research on commonly held views about asthma medicines, there are relatively few studies documenting what those beliefs are and how they might contribute to suboptimal adherence rates. In a study of more than 150 Black adults in the Kansas City, Missouri metro area, researchers found that while knowledge about asthma symptoms, triggers, and management was at a medium-to-high level, more than half and almost half agreed or were not sure about whether ICS were dangerous to use. Importantly, the sampled group included Black residents from diverse socioeconomic backgrounds, and the survey instrument the researchers used was developed locally using input from leaders and advocates in the Black community.<sup>113</sup>

In a focus group study documenting the concerns of Black caregivers, researchers found that many fear administering asthma medicines to their children may cause dangerous side effects and so they rely on the emergency department (ED) for medicine administration. Many also reported going to the ED to receive or refill a child's prescription more easily.<sup>114</sup> In a broader review of 56 studies on how patients and health care providers view asthma self-management, challenges with asthma medicines was a topic for 70% of those publications. In several of these studies, it was reported that fear and mistrust about ICS can drive patients and/or their caregivers to frequently take a trial-and-error approach with asthma medicines, only sometimes with the treating physician's knowledge. Patients/caregivers and physicians seem to recognize the need for, and the value of, a better working relationship between them.<sup>115</sup>

Skepticism or fear surrounding use of conventional medicine, such as ICS, may drive patients and caregivers to use alternative medicines and home remedies, which may also affect asthma outcomes. Using home remedies to treat asthma has been reported frequently among Hispanic/Latino and Black patients and caregivers.<sup>107</sup> This may delay treatment and lead to more severe symptoms.



## DISTRUST IN THE MEDICAL ESTABLISHMENT

Historical failures and experiences with unfair treatment have led many Black Americans and other people of color to believe the health care system cannot be relied upon. This lack of trust is based not only on experiences but statistics, which often demonstrate negative and disproportionate health outcomes for people of color compared to white people. It also comes from a general sense of unease in health care settings, particularly when it comes to experiencing or reacting to implicit and explicit bias in care. For example, this can shape some negative beliefs about medication and treatment plans, prompting patients to be less adherent to recommended treatment plans.



Source: CDC

*This historic photograph was created during the Tuskegee Syphilis Study, and depicts Eunice Rivers, RN (second from left) with two colleagues, while visiting a patient (far right) in Macon County, Alabama. Nurse Rivers was assigned to the study in 1932, and was the only staff member who remained through the study's 40-year period.*

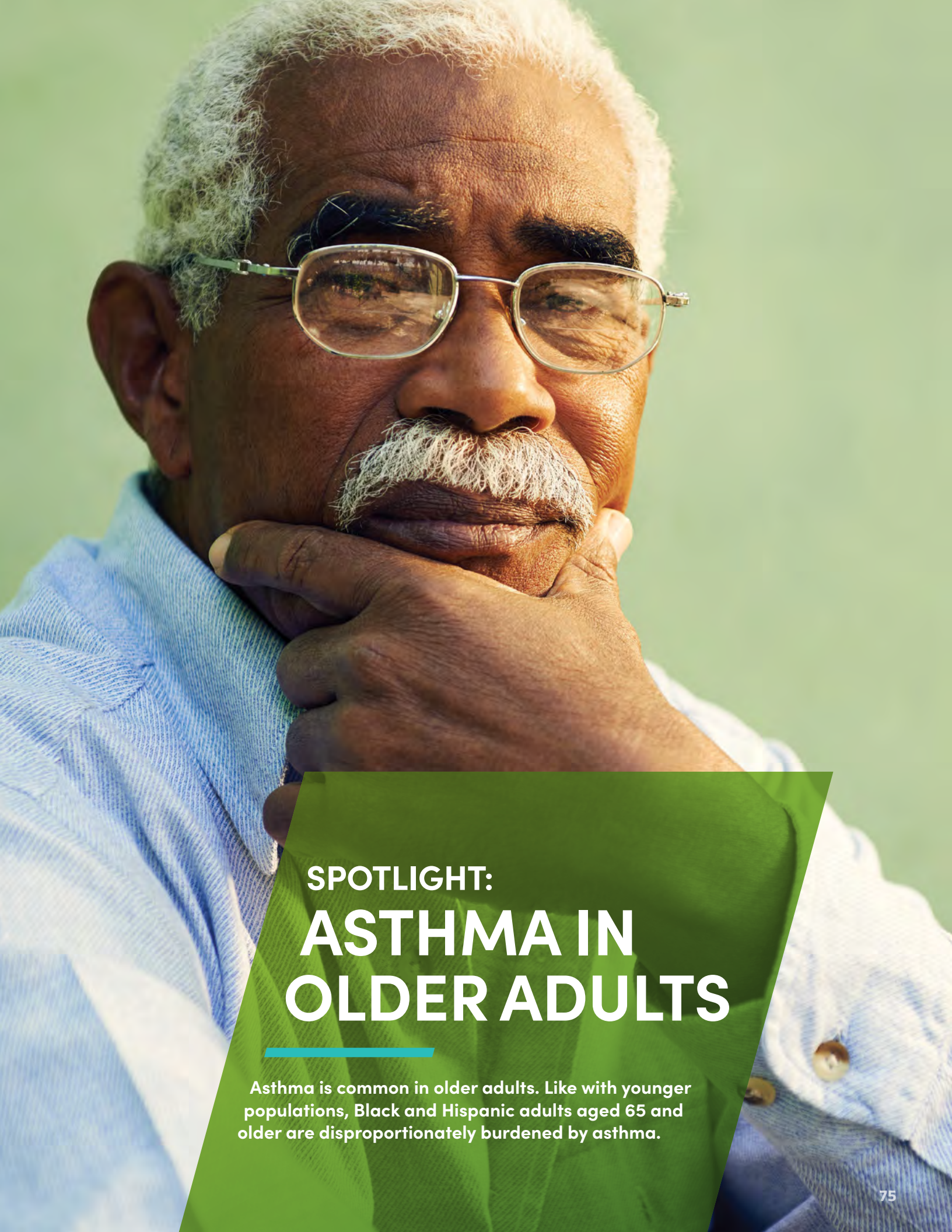
A painful legacy of medical abuse, health care neglect, and being historically exploited and used are critical factors in the distrust of the medical establishment. One example includes the 30-year Tuskegee Study, which was made notorious for unethical experimentation on Black men in the Southern U.S. who were left untreated for syphilis.<sup>116</sup> Scientists like James Marion Sims also gained fame at the expense of Black lives. Sims was long revered as the “father of modern gynecology.” However, the often dangerous and unethical medical practices he performed on enslaved Black

women have left him a controversial figure in the history books. The U.S. government also has a history of mandating dangerous inoculation campaigns, inhumane drug experimentation, and intrusive medical inspections on Black Americans and other minority groups, including Chinese and Mexican immigrants.

Historical distrust and mistrust from present-day experiences have combined. According to a 2017 study conducted in partnership with NPR, the Robert Wood Johnson Foundation, and Harvard's T.H. Chan School of Public Health, at least one third of Black Americans say they have experienced racial bias in health care settings, and one in five avoid medical care due to discrimination concerns.<sup>117</sup>

During the COVID-19 pandemic, a lawsuit was brought against the CDC to release racial and ethnic data to get the most reliable picture of how U.S. populations of color were affected.<sup>118</sup> When the CDC released federal data on race, the information was incomplete,<sup>118</sup> which may further reinforce distrust among people of color regarding the medical establishment.





**SPOTLIGHT:**  
**ASTHMA IN  
OLDER ADULTS**

---

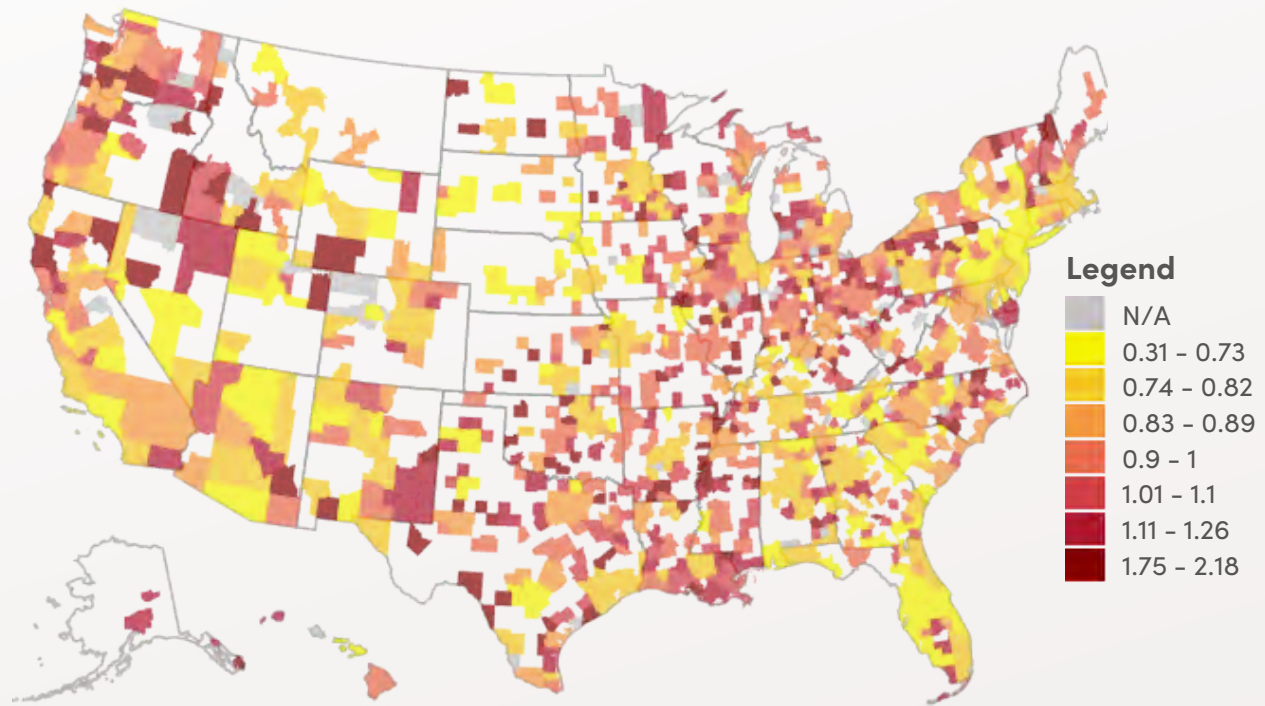
Asthma is common in older adults. Like with younger populations, Black and Hispanic adults aged 65 and older are disproportionately burdened by asthma.



Asthma in older adults is common, affecting 7.8% of individuals aged 65 and over in the United States.<sup>1</sup> Though asthma prevalence is equivalent to that of the general population, asthma in older adults is associated with higher morbidity and mortality than asthma in younger patients.<sup>119, 120, 121</sup> Additionally, older patients with asthma are more likely to be underdiagnosed, undertreated, and hospitalized than younger patients.<sup>120</sup>

Among the older population, asthma also disproportionately affects Black, Hispanic, and low-income communities. Older adults in these groups have the greatest risk for frequent hospitalizations.<sup>121</sup> Additionally, among adults aged 65 and older who are on Medicare, Black, and Hispanic individuals have an emergency room (ER) visitation rate of more than 1.5 times that of white patients (1.22 and .79, respectively).<sup>122</sup>

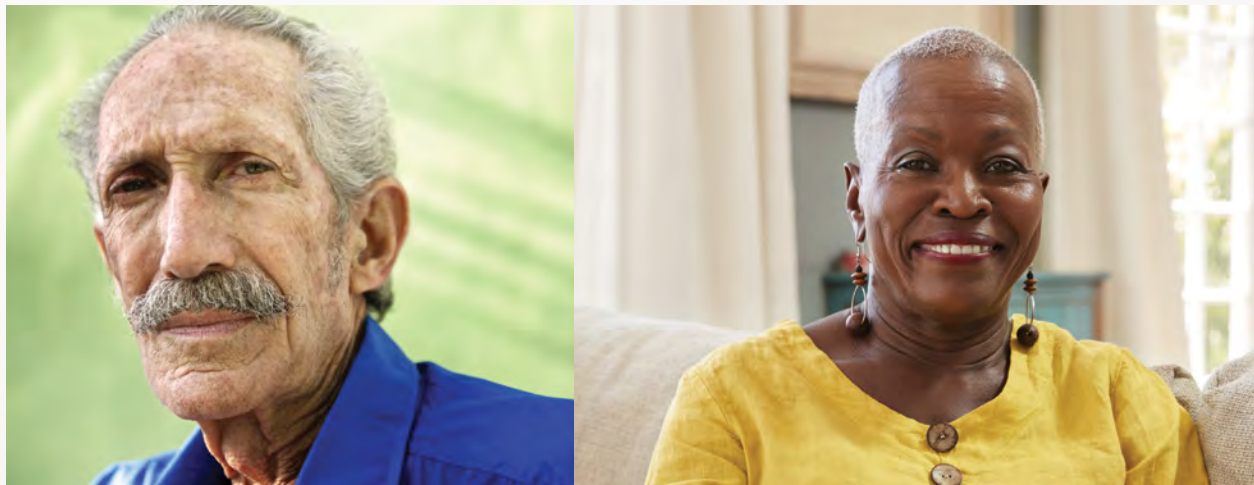
**Figure 19. ER Visits Rate of Asthma Patients on Medicare (Age 65+)**



Source: National Minority Quality Forum, Asthma Index (2017)

An analysis of data from the 2015 Behavioral Risk Factor Surveillance Survey and Asthma Call-Back Survey also highlights disproportionate health care utilization by Black and Hispanic adults with asthma.<sup>123</sup> The analysis, which looked at 4,700 adults aged 55 and older with asthma, found that Black and Hispanic respondents were twice as likely as white respondents to have at least one asthma-related emergency department visit during the previous 12 months. Additionally, Black and Hispanic respondents were more likely to report gaps in health insurance coverage and impaired access to health care due to cost. These disparities remained even when researchers used statistical methods to control for social determinants such as education and income.<sup>123</sup>

Though asthma in the older population often has similar clinical and physiologic consequences as those in younger populations, the presence of more and different comorbid illnesses might affect the diagnosis, presentation, and treatment of asthma in older populations.<sup>119, 120</sup> Asthma is often confused with other common diseases for this group, such as chronic obstructive pulmonary disease (COPD), congestive heart failure, paroxysmal arrhythmias, pulmonary emboli, recurrent aspiration, and gastroesophageal reflux disease (GERD), which have led to the development of a more severe asthma phenotype compared to younger patients.<sup>119, 120</sup> Additionally, the physiological and psychosocial effects of aging may further impact effective diagnosis and management. Structural changes in aging lungs, combined with structural changes due to asthma itself, can worsen the disease and lung function.<sup>124</sup> Impaired cognition and motor skills, psychosocial effects of aging, and age-related adverse effects of medications may also affect asthma diagnosis and treatment.<sup>124</sup>



With these challenges in mind, there is an apparent need for further clinical research and guidelines regarding asthma in older adults. However, older people have been excluded from participating in asthma clinical trials and often are not covered by treatment guidelines.<sup>119, 120</sup> Clinical trials for asthma also typically utilize lung function testing to measure outcomes, though this type of testing has limitations in certain cohorts as it is difficult to define predicted values at an advanced age. Additionally, many patients with physical or cognitive impairment cannot reliably perform these tests.<sup>120</sup> The use of objective measures of asthma diagnosis and control can be especially important because many older adults with asthma consider their respiratory symptoms to be normal and a consequence of aging, and they often delay seeking medical consultations for their symptoms.<sup>119, 120</sup> These individuals may also have additional fears and misconceptions about their treatment.<sup>119</sup>

Most older adults with asthma can lead active productive lives if their asthma is appropriately managed. In fact, when older adults with severe or difficult-to-treat asthma are identified by a physician's assessment, they appear to manage their asthma better than younger patients.<sup>120</sup> Additionally, research shows that with effective care, older adults with asthma can have lower rates of unscheduled office visits, emergency department visits, and corticosteroid bursts.<sup>125</sup> However, this requires care tailored to the population, as many older patients with asthma need continuous treatment programs to control their disease and may require complicated and frequent dosing with multiple expensive drugs due to significant rates of non-adherence.

A thorough understanding of asthma in adults aged 65 and older is required to determine effective management plans, and future efforts to address asthma in this population must include age-specific considerations for diagnosis, characterization, monitoring, and treatment.

---

## EMERGING STRATEGIES

The existence and causes of asthma disparities related to race and ethnicity have been studied and documented in great detail. Focus in recent years has shifted from describing the problem to addressing it. Although efforts in reducing disparities have been slow, the picture is not entirely bleak. A growing number of strategies and opportunities to address upstream determinants of health have produced notable results in recent years.

This report highlights emerging approaches toward effective, sustainable and scalable solutions:

- Public policy reform
- Direct interventions to improve asthma self-management
- Community-based programs
- Advancement in research and science

Although there is no exact prescription for reducing asthma disparities, it is within these areas that some progress has been made and from which new avenues to drastically decrease the burden could emerge.

The following chapters highlight strategies that various stakeholders may implement to address asthma disparities. Because this report supports a holistic approach, some strategies aim to address health disparities overall and are not specific to asthma. Similarly, some strategies aim to improve asthma care overall and are not specific to racial disparities.





# ADDRESSING ASTHMA DISPARITIES THROUGH POLICY

Unfair laws and policies are largely responsible for asthma disparities. We examine strategies for enacting local, county, state, regional, and federal policies to improve asthma outcomes.





Achieving health equity in a widespread and sustainable way requires systemic changes to the structural inequities that continue to perpetuate health disparities. Despite increasing evidence that structural determinants contribute to poor health in racial and ethnic minority populations, the majority of interventions ignore the socioeconomic and political context in which health disparities exist. Solutions that focus only on individual-level determinants are limited in scale, sustainability, and ability to affect population-level change.

Structural interventions, such as reforming public policies, attempt to shift social structures by combatting the ongoing effects of systemic racism and discrimination. These interventions aim to advance health equity by changing the “the wider set of forces and systems shaping the conditions of daily life.”<sup>2</sup> Promising solutions should influence multiple domains of social determinants and include diverse stakeholders from multiple sectors.

Policy reform and resource redistribution can mitigate health disparities among disadvantaged groups in many ways. Progressive policies at the local, state, and national levels have played an important role in advancing asthma care and management in the U.S. and reducing the disproportionate burden of asthma on minority populations. Advocates for better asthma outcomes have long understood that reaching vulnerable patients requires systemic and institutional policy changes, both small and large.

## A HOLISTIC APPROACH TO POLICY REFORM

This report embraces “health in all policies”—a holistic approach to improving health by acknowledging the health implications of policy decisions in all sectors.<sup>9</sup> While policies that directly relate to health care are essential in reducing asthma disparities, they are not enough.

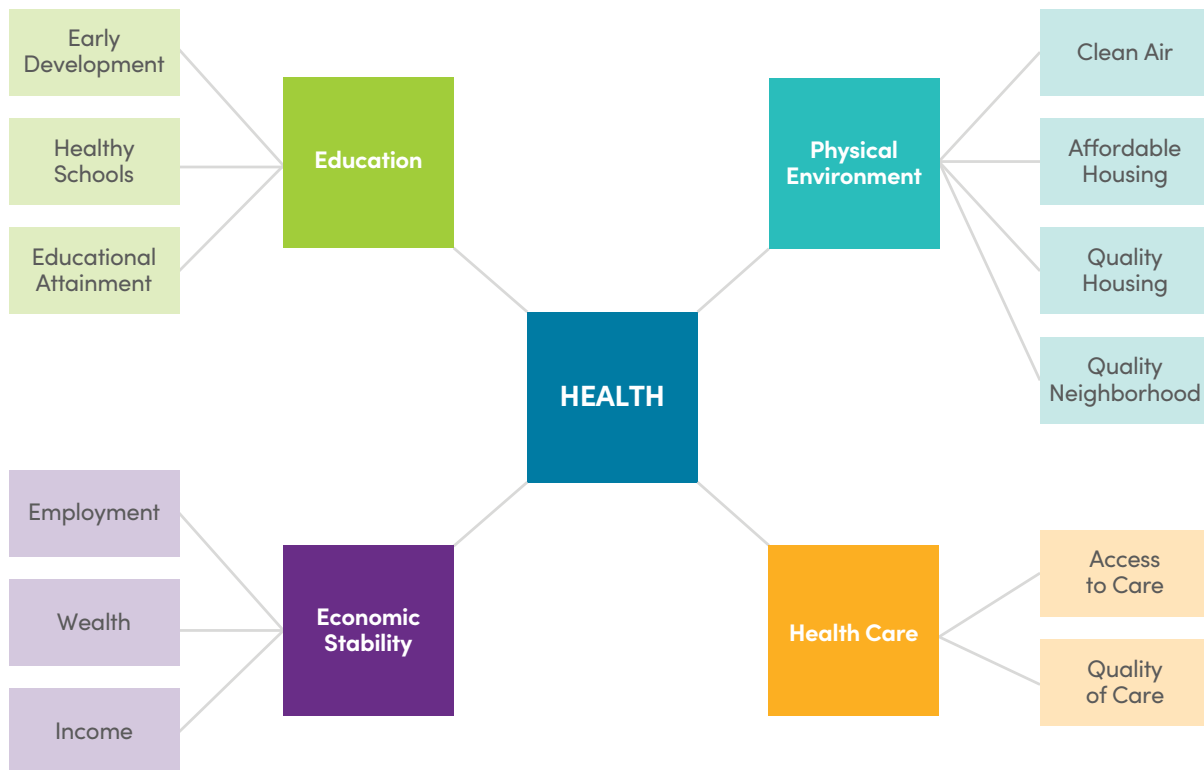
Many social and structural determinants of health fall outside traditional health care. Promising policy solutions require partnerships across many sectors, including health, education, labor, housing, social services, and city planning. Adopting this approach allows for solutions that address the complex and interconnected factors perpetuating health inequity.

This chapter explores how select factors affect health disparities and the related policy reforms that can promote improved health and health equity. Specifically, it will focus on policies shaping:

- Health care
- Economic stability
- Education
- Physical environment

Throughout this chapter, we discuss recent policy actions and highlight strategies for reducing disparities that are supported by existing data and literature.

Figure 20. Health in All Policies Approach





## HEALTH CARE

Inadequate access to high-quality health care is an important and modifiable contributor to ongoing asthma disparities. Lack of health insurance, limited availability of health care resources, unreliable access to primary and preventative care, unreliable transportation, language barriers, and an inability to take time off work, among others, can all limit access to health care and lead to poor asthma control. Barriers are often magnified by overlapping determinants, such as racism and poverty.

In the domain of health care services, inequities in three main areas reinforce racial and ethnic disparities in asthma:

- Access to health care
- Access to primary care
- Quality of health care

Expanding access to high-quality health care that is affordable, comprehensive, and available to all is critical to reducing disparities in asthma. On a macro level, equity in health care access and quality must be achieved through public policy.

### ACCESS TO HEALTH CARE

Access to health care plays an important role in managing asthma symptoms, preventing exacerbations and promoting better quality of life. Yet, inadequate health insurance coverage, one of the most profound barriers to quality health care, remains unequally distributed along racial and ethnic lines. While most adults under the age of 65<sup>†</sup> receive health insurance as a job benefit, many individuals lack access to employer-based healthcare and cannot afford coverage on their own. Minority populations disproportionately experience barriers to health insurance, contributing to racial and ethnic disparities in health care.<sup>126</sup>

<sup>†</sup>Nearly all senior adults in the U.S. are insured by Medicare, so uninsured populations are almost entirely under the age of 65.

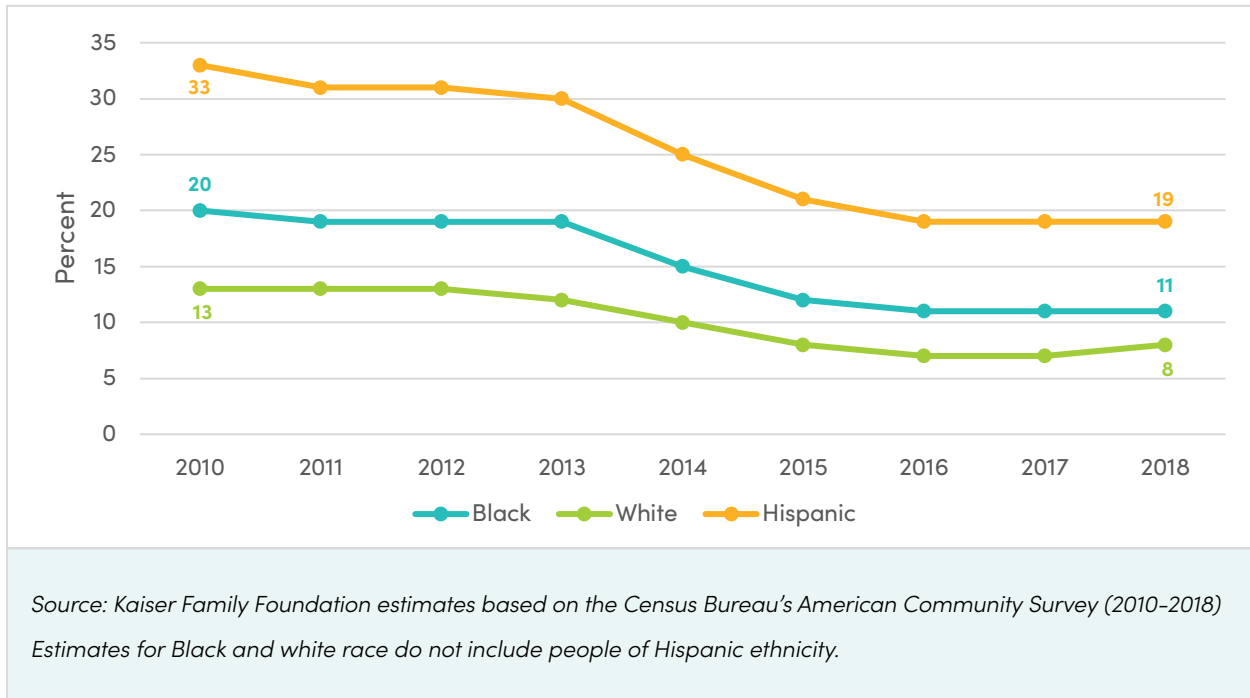
Since the publication of AAFA's 2005 report on asthma disparities,<sup>80</sup> the greatest expansion of health insurance resulted from the passage of the Patient Protection and Affordable Care Act (ACA) in 2010. The ACA aimed to reduce access barriers by facilitating health insurance options for all Americans, particularly underserved populations.

The ACA laid the foundation for major improvements in health insurance disparities by funding a broad expansion of public and private insurance and enacting broader market reforms to protect consumers. As a result, the ACA expanded the health insurance market to cover millions of Americans with asthma and other diseases who previously could not access health insurance.



Since the passage of the ACA, the rate of those without insurance in the U.S. dropped from 18% in 2010 to 10% in 2018. While the landmark law increased health insurance coverage for all racial and ethnic groups, health care coverage among Black and Hispanic Americans under age 65 improved most dramatically. The uninsured rate for Black Americans fell from 20% to 11% between 2010 and 2018, and the uninsured rate for Hispanic Americans fell from 33% to 19% during the same timeframe, significantly narrowing the disparity in health insurance coverage between minority and white populations (Figure 21, Table 9).

**Figure 21. Uninsured Rates by Race and Ethnicity (Age 0-64)**



**Table 9. Change in Uninsured Rates by Race and Ethnicity (Age 0-64)**

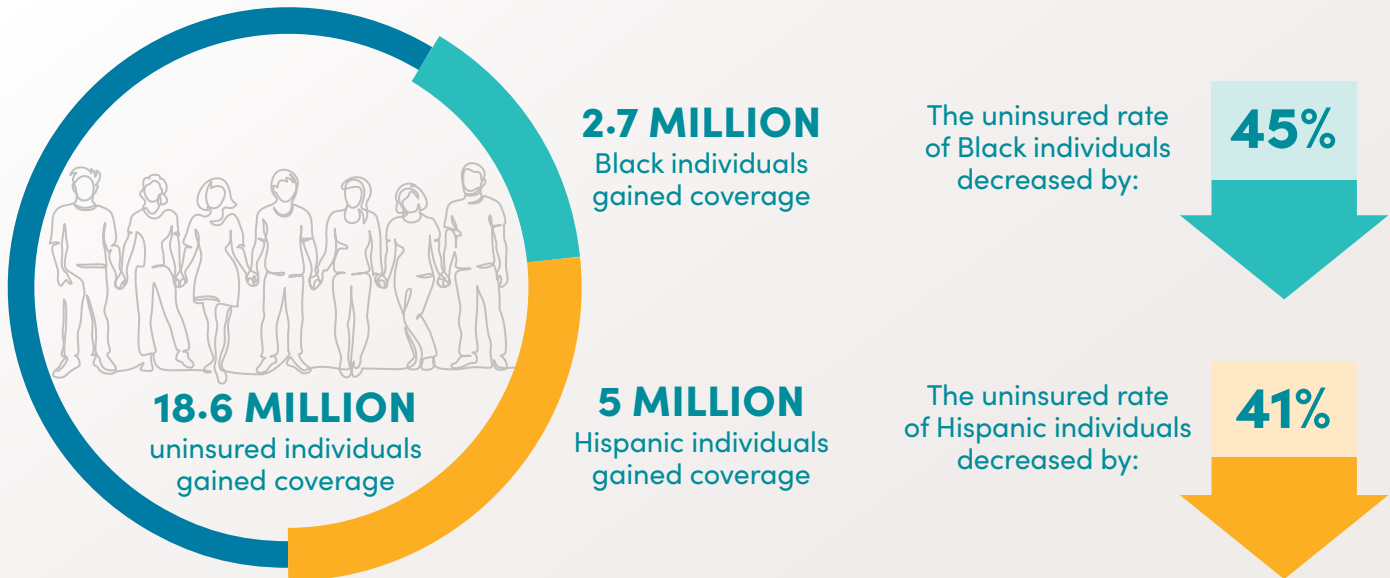
	Uninsured Rate		Change	Disparity with White	
	2010	2018	2010 TO 2018	2010	2018
<b>Overall U.S. Population</b>	18%	10%	-8	5	2
<b>Black</b>	20%	11%	-9	7	3
<b>White</b>	13%	8%	-5	—	—
<b>Hispanic</b>	33%	19%	-14	20	11

Source: Kaiser Family Foundation estimates based on the Census Bureau's American Community Survey, (2010-2018). Estimates for Black and white race do not include people of Hispanic ethnicity.

## FIGURE 22. IMPACT OF THE AFFORDABLE CARE ACT ON HEALTH CARE ACCESS

### THE AFFORDABLE CARE ACT (ACA) IMPROVED HEALTH CARE COVERAGE FOR MILLIONS OF PEOPLE IN THE UNITED STATES

Between 2010 and 2018:



Source: U.S. Census Bureau, American Community Survey (2010–2018)

### THE AFFORDABLE CARE ACT (ACA) ALSO IMPROVED ACCESS TO CARE

Between 2010 and 2018:



Disparities in having at least one personal care provider decreased:

**1.4** percentage points for Black adults compared to white adults

**2.3** percentage points for Hispanic adults compared to white adults

Source: Centers for Disease Control and Prevention, Behavioral Risk Factor Surveillance System (2010–2018)

While increased insurance coverage is not enough to eliminate all health inequalities afflicting racial and ethnic minority populations and low-income communities, health care coverage plays a critical role in narrowing these disparities by reducing financial barriers to access health care.

---

### **Strategy: Expand health insurance coverage for socioeconomically disadvantaged adults and children.**

---

The ACA expanded access to health insurance through three main routes: Medicaid expansion, subsidized coverage for individuals and small businesses, and market-wide reforms to protect consumers.

#### **Medicaid Expansion**

Medicaid has long been a crucial source of coverage for Americans with asthma. Even before the enactment of the ACA, Medicaid was a major payer of asthma care. According to the Agency for Healthcare Research and Quality, Medicaid was the largest source of primary coverage for hospital stays for children and adults with asthma in 2010.<sup>127</sup>

The ACA provides enhanced federal funding for states to expand their Medicaid programs to cover all low-income adults under the age of 65, up to 138% of the federal poverty level. As of July 2020, 36 states and the District of Columbia have expanded Medicaid under the ACA.<sup>128</sup>

Though adults are the primary beneficiaries of Medicaid expansion, the ACA also expanded Medicaid as a primary source of coverage for children. States that expand Medicaid see increases in insurance enrollment rates not only among newly eligible adults but also among previously eligible adults and children who had not yet enrolled.<sup>129</sup> Overall, states that expand Medicaid have seen significant declines in people without insurance, increased access to health care, and better health status.

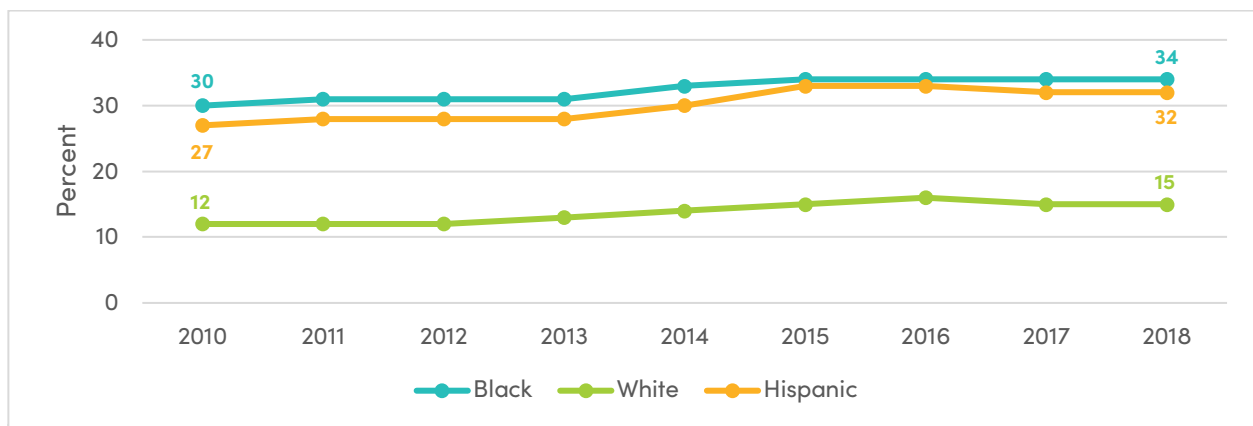
Medicaid continues to be a dominant insurer for asthma care, particularly for children. In 2018, Medicaid or other public insurance covered 46% of children with asthma, compared to 33% of children without asthma.<sup>130</sup> In the same year, 20% of adults with asthma were covered by Medicaid, compared to 14% of adults without asthma.





Medicaid enrollment rates overall increased for Black, Hispanic, and white Americans since passage of the ACA, which reduced disparities in access to health insurance. Between 2010 and 2018, the Medicaid enrollment rate for white Americans increased from 12% to 15%, whereas the enrollment rate for Black and Hispanic Americans increased from 30% to 34% and 27% to 32% respectively during the same period (Figure 23).

Figure 23. Medicaid Coverage Rates (Age 0-64)

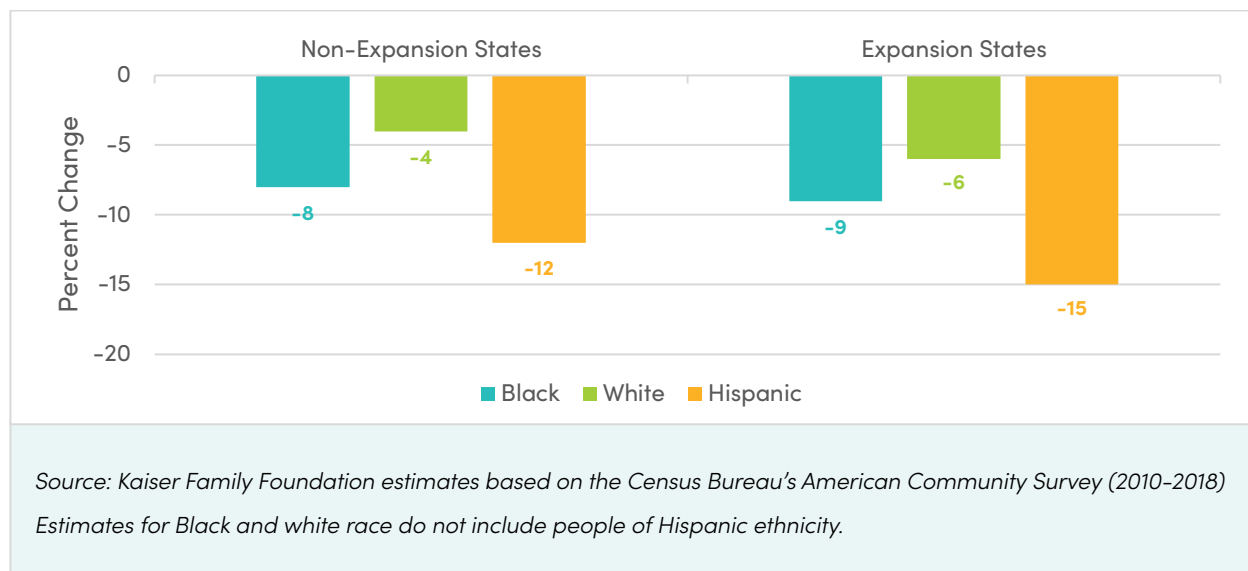


Source: Kaiser Family Foundation estimates based on the Census Bureau's American Community Survey (2010-2018)  
Estimates for Black and white race do not include people of Hispanic ethnicity.



Declines in the number of people without insurance are more evident in states with expanded Medicaid coverage than those without it. A comparison of people without insurance in expansion and non-expansion states shows increased coverage rates across racial and ethnic groups. Although expansion states began with lower uninsured rates prior to the ACA, states that implemented Medicaid expansion had more significant coverage gains for white, Hispanic, and Black populations than states that have not expanded Medicaid (Figure 24).

**Figure 24. Change in Uninsured Rates by Race, Ethnicity, and State Medicaid Expansion Status**



Medicaid expansion reduces barriers to health care, which contributes to better health outcomes. In one 2017 study, researchers used National Health Interview Survey data on over 60,000 adults ages 19–64 with incomes below 138% of the federal poverty level to compare various outcomes in 2014–2015 and between 2010–2013 in Medicaid expansion versus non-expansion states. Rates of health care insurance coverage, health care use, access to care, and the overall health status of the adults in those states that expanded Medicaid were generally better, especially in the second year after expansion. Adults in Medicaid expansion states also reported fewer occasions of needing care but not seeking it or of deciding to take less medicine due to affordability.<sup>131</sup>

In a literature review of 324 studies published since the ACA took effect and through June 2019, researchers at the Kaiser Family Foundation found the impact of state Medicaid expansion to be mostly positive for health care coverage, access, utilization, outcomes, quality of care, and affordability, while individual financial security and the economies of expansion states also benefited.<sup>132</sup> Such evidence of an increase in the affordability of care or improvements in financial security for low-income adult populations are likely to affect asthma disparities, as are the findings of less reliance on emergency room visits for regular care and earlier diagnosis, more consistent care for chronic conditions, and more access to tobacco cessation services through Medicaid. Evidence of state-level budget savings in expansion states could also translate into a greater willingness to explore new or different reimbursement models for asthma services.



*Strategies such as coverage expansions and value-based insurance designs can reduce the cost burden of insurance and asthma care and help address disparities in access to quality asthma care for families with asthma.*



- Alison Galbraith, MD, MPH  
Harvard Medical School  
and Harvard Pilgrim Health  
Care Institute

While Medicaid expansion has been important in those states that have adopted it, challenges persist. In a study of children with asthma using data from 2012–2014, publicly insured children, which are children on Medicaid or the Children’s Health Insurance Program (CHIP), a program for children at slightly higher income levels, faced out-of-pocket cost barriers to seeing a physician more often than privately insured children.<sup>133</sup> Researchers cite less expendable family income combined with Medicaid or CHIP premiums, enrollment fees, and/or mandated cost-sharing as potential causes. Also, insured Black children were more likely to face cost barriers than insured white children regarding seeing a physician of any kind.<sup>133</sup>

Medicaid reimbursement rates, which have been historically lower than Medicare or private insurance rates, were implicated as another potential driver of lower asthma standards of care for the publicly insured in certain medical practice settings. Some studies documented difficulties for the Medicaid-insured in accessing outpatient physician care and then filling a prescription at a pharmacy, which creates an incentive for low-income families with insurance to rely instead on emergency rooms and/or hospitalization for their asthma care.<sup>134–136</sup> Patients with asthma who rely on the emergency room for asthma management may miss out on the long-term benefits of having a usual source of care (see Access to Primary Care on page 92).<sup>137</sup>

To gain a deeper understanding of how Medicaid covers asthma care, the American Lung Association (ALA) initiated a Guideline-Based Care Coverage Project with funding from the CDC to describe the scope of state Medicaid program coverage for asthma care. The analysis was based on recommendations in the National Asthma Education and Prevention Program (NAEPP) Guidelines.<sup>138</sup> The project helped identify important access and treatment gaps in 2019 across all 50 states, the District of Columbia, and Puerto Rico. Copayment requirements, treatment quantity limits, and prior authorization requirements were among the key barriers identified in Medicaid programs. Additionally, widespread variation in Medicaid fee-for-service and managed care organization plans can result in confusion by providers and patients about treatment coverage options.

---

**Strategy: Improve coverage of asthma guidelines-based care and treatments by expanding specialist care coverage, lowering copays, expanding eligibility criteria, and removing prior authorization and step therapy barriers.**

---

In separate research, America's Health Insurance Plans (AHIP) also identified gaps in achieving "next-generation" guidelines-based asthma care by surveying their Medicaid and commercial health insurance plan members in 2016. While all Medicaid plan members surveyed agreed their patients would benefit from comprehensive asthma education and 93% agreed better environmental management can reduce health care utilization, only 57% provided any kind of home-based education, 61% provided home-based environmental assessments, and 39% provided environmental remediation services.<sup>139</sup> Because Medicaid disproportionately insures Black and Hispanic individuals, it's important to make sure that Medicaid coverage and quality are equitable compared to commercial insurance.

In recent years, the CDC acted to address the gaps between asthma guideline-based care and reality. The CDC's 6|18 initiative, launched with several partner stakeholders in 2016, addresses asthma and five other high-burden, high-cost conditions with a total of 18 evidence-based interventions.<sup>140</sup> For asthma, these proven interventions include following the NAEPP guidelines and strategies for access and use of asthma medicines and devices. They also include intensive asthma education and home-based visits for those whose asthma is not well controlled and who would benefit from home-based education and strategies to reduce home triggers.<sup>141</sup> Now in its fourth year and currently assisting 16 states and three U.S. territories<sup>142</sup>, the 6|18 initiative demonstrated the importance of linking state health departments with Medicaid programs so that these asthma services are covered and utilized more broadly.<sup>143</sup>

The 6|18 initiative publishes successful efforts in enhancing reimbursement as a resource for programs considering options for implementing or redesigning reimbursement mechanisms that increase access to evidence-based asthma management.<sup>144</sup> Additionally, the Childhood Asthma Leadership Coalition (CALC) published a guide to help advocates navigate specific pathways for asthma reimbursement in Medicaid.<sup>145</sup>

Nearly all asthma-related policy and coverage initiatives emphasize the importance of generating economic evidence to support increasing investments in coverage and reimbursement. These evaluation and return-on-investment calculations have become an important part of asthma public health policy and advocacy. In a narrative review of return on investment (ROI) results reported in asthma self-management education (AS-ME) and home visit programs, researchers found that eight out of nine intensive asthma education programs and 14 out of 17 home-visit programs resulted in a positive ROI within one to three years after implementation.<sup>146</sup> More recently, researchers used Medicaid data in Illinois from 2014–2017 to compare 6,245 children and young adults with a chronic disease, most of them with asthma, to see if a comprehensive care program led by community health workers (compared to usual care for half of the children) would affect Medicaid costs. Although overall Medicaid costs were not reduced, Medicaid costs related to hospital stays and ED visits were reduced in the first year of the program's implementation.<sup>147</sup>

## Subsidized Coverage for Individuals and Small Businesses

In addition to expanding Medicaid, the ACA creates more opportunities for health insurance access by making subsidized coverage available through state-level marketplaces. Prior to the ACA, individual health insurance was often costly, offered sparse benefits and in most states could, exclude individuals based on preexisting conditions. Under the ACA, individuals and families can access qualified health plans (QHPs) that cover 10 categories of “essential benefits.”

The 10 “Essential Benefits” health insurance plans must cover under the ACA are:

1. Prescription Drug
2. Pediatric Services
3. Preventive and Wellness Services and Chronic Disease Management
4. Emergency Services
5. Hospitalization
6. Mental Health and Addiction Services
7. Pregnancy, Maternity, and Newborn Care
8. Ambulatory Patient Services
9. Laboratory Services
10. Rehabilitative and Habilitative Services and Devices

In an effort to make health insurance more affordable for individuals and families, the ACA provides government subsidies to help people cover health insurance costs. People in households between 100–400% of the federal poverty level (FPL) are eligible for assistance in paying premiums whereas those in households between 100–250% of the FPL are also eligible for assistance with cost sharing. Further, ACA marketplaces are also available to small businesses, which often faced prohibitive costs to insure their employees prior to the ACA.

Despite measures to make health care more affordable for consumers with private insurance, families must balance the cost of asthma in the context of other medical expenses and basic needs such as food and housing. A study conducted by the Harvard Pilgrim Health Care Institute and Harvard Medical School, in partnership with AAFA, explored the health care decision making and tradeoffs families make when faced with the costs of asthma care. Participants of the Asthma in Families Facing Out-of-Pocket Requirements with Deductibles (AFFORD) study expressed willingness to prioritize asthma care, even if it meant going into debt or sustaining financial loss.<sup>148</sup> However, they were sometimes forced to make sacrifices in asthma care to pay for food, housing, or other essentials.

One parent enrolled in the study, when discussing the burden of asthma care costs, expressed that “you have to rob Peter to pay Paul so your kid can breathe.”<sup>148</sup> When faced with such difficult financial choices, families have to make tradeoffs that could result in suboptimal asthma care or increased asthma exacerbations. For low-income communities who are already disproportionately burdened by asthma, these types of decisions are especially worrisome. Health care providers and policymakers should be aware of the financial burdens of chronic conditions and take steps to ensure all families are able to access affordable guidelines-based asthma care.



## Market Reforms to Protect Consumers

The ACA includes a set of market reforms that make private insurance more available and affordable for consumers inside and outside the ACA marketplaces. Key reforms include:

- **Guaranteed issue and renewability of coverage:** Individual policies, both inside and outside marketplaces, must offer coverage to anyone, regardless of health status. For people with asthma, this means that the condition no longer disqualifies them from coverage.
- **Preexisting conditions:** In addition to being required to cover any applicant regardless of health status, individual plans may not charge more based on preexisting conditions, such as asthma, or exclude preexisting conditions from the terms of coverage. Premiums can only differ based on geography, age, smoking status, and the number of family members enrolled.
- **Preventive services:** All private plans, individual, small group, and large group plans, must cover a set of preventive services recommended by the U.S. Preventive Services Task Force as well as immunizations recommended by the CDC's Advisory Committee on Immunization Practices. These include some important services for people with asthma, such as influenza immunizations.
- **The elimination of lifetime or annual limits on coverage:** All private plans, individual, small group, and large group plans, are prohibited from applying annual or lifetime limits on coverage for any services considered to fall within the ten categories of essential health benefits.
- **Out of pocket maximums:** Annual out of pocket spending is capped for enrollees in individual and small group plans.
- **Dependent Coverage Extension (DCE):** This benefit seeks to reduce the high rate of uninsured young adults by allowing those up to age 26 to stay on their parents' private health insurance policy. This has had a positive impact for people with asthma. Using CDC data, researchers found that more adults ages 19-25 with current asthma had health insurance and reported fewer barriers to access medical care between 2011-2016 compared to adults ages 26-32.<sup>149</sup> When researchers looked at those age groups from 2006-2009, the reverse was true, meaning that the DCE likely played a role in expanding health insurance and reducing access barriers for young adults with asthma.

Though these market reforms may have a positive impact for all people with asthma, there is limited evidence about the effect on racial and ethnic disparities. Additional studies are needed to assess whether reform policies benefit subpopulations differently and whether these policies could help reduce disparities in asthma.



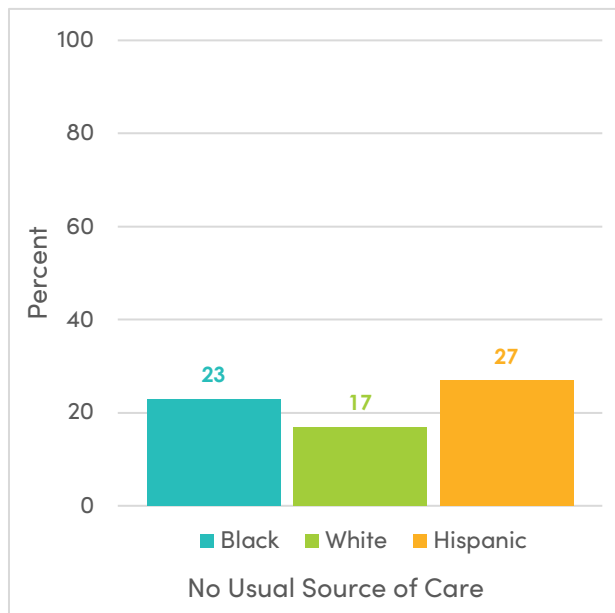
## ACCESS TO PRIMARY CARE

In addition to having health insurance, access to timely primary care services is important for maintaining health, especially for people managing chronic conditions like asthma. On the patient level, regular visits with primary care providers (PCPs) can strengthen patient-provider relationships, improve long-term quality care, and reduce the frequency of acute episodes and hospitalizations. Conversely, overreliance on urgent and emergency care for general disease management takes an unnecessary economic toll on the health care system. On a societal level, reforming the use of primary care would reduce the financial burden on the U.S. health care system.

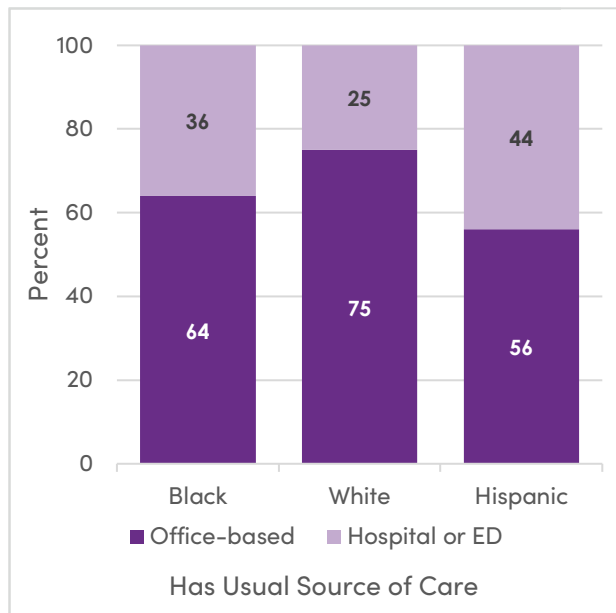
One indicator of access to primary care is whether an individual reports access to a usual source of care. In 2017, 23% of Black individuals and 27% of Hispanic individuals reported that they have no consistent source of health care, compared to 17% of white individuals (Figure 25).

Racial trends in utilization of the emergency department (ED) or hospital as sources of regular care have long been observed. In the same 2017 study, among those who reported having a usual source of primary care, more Black and Hispanic patients relied on the hospital or ED compared to white patients (36% and 44%, compared to 25%) (Figure 26).

**Figure 25. Percent of Population Without Usual Source of Care by Race and Ethnicity**



**Figure 26. Distribution of Usual Source of Care by Race and Ethnicity**



Source: Agency for Healthcare Research and Quality, Medical Expenditure Panel Survey (2017)

Estimates for Black and white race include people of Hispanic ethnicity.  
Figure 26 shows data for people who reported having a usual source of care.

Even with the insurance coverage gains of the ACA, many Americans still face geographic, financial, cultural, linguistic, or psychosocial barriers in primary care. One significant factor is the shortage of PCPs in the U.S. The Health Resources and Services Administration (HRSA) estimates that about 80 million Americans live in Health Professional Shortage Areas (HPSAs).<sup>150</sup> This is particularly true in low-income urban and rural communities, which may face challenges in recruiting qualified medical professionals who are willing and trained to serve racially, ethnically, and culturally diverse Medicaid beneficiaries and uninsured patients.

In addition to provider shortages, other barriers to regular use of primary care exist for racial and ethnic minority populations. Affordability remains an issue, particularly for people with high-deductible health plans.<sup>151</sup> Low-income individuals must weigh the direct cost of care as well as potential indirect costs of seeking primary care in office settings.<sup>152</sup> For example, people lacking job benefits, such as paid sick leave, may be unwilling to seek primary care during normal business hours for fear of lost hours or reprimand by an employer.<sup>153</sup> Since emergency departments (ED) are open nights and weekends, the decision to rely on the ED may be based on logistics. For non-English speakers, the inability to find providers to accommodate their language and cultural needs may pose an issue.<sup>154</sup> Individual beliefs, such as mistrust of the medical establishment and experience with discrimination, may discourage people from seeking regular care.<sup>155</sup>

## DIVERSITY IN THE HEALTH CARE WORKFORCE

There is a growing need to increase diversity within the health care workforce, including in primary care. Racial, ethnic, cultural, and socioeconomic diversity among health care providers can also better ensure care that is culturally and linguistically appropriate for minority populations and increase access to care in rural and underserved areas.<sup>156</sup>

Minority physicians are often best suited to gain the trust of and serve minority communities, but racial and ethnic minorities remain significantly underrepresented in medical and scientific communities. In 2018, Black and Hispanic physicians represented only 5% and 5.8% of active physicians in the U.S. respectively, although they represented 13.4% and 18.3% of the total U.S. population.<sup>157</sup>

The distribution of racial and ethnic minority professionals in the health care workforce has not kept up with the changing demographics of the general U.S. population, which potentially creates even greater disparities in health care delivery and outcomes.<sup>158</sup> In addition to primary care, racially diverse allergist, immunologists, pulmonologists, respiratory therapists, health educators, and nurses are needed to specialize in asthma care.

---

### **Strategy: Increase diversity in the primary and specialty health care workforce.**

---

Although there is widespread agreement about the need to improve health care workforce diversity, achieving this goal is often difficult, as it requires continuous effort by academia, communities, health care institutions, and government and legislative groups.<sup>159</sup> Additionally, racial and ethnic minorities in health professions may experience personal setbacks in their career trajectories, such as cost of education, inadequate preparation to meet admissions requirements for doctoral programs, lack of mentors, limited exposure to health careers, and poor advising.<sup>160</sup>



Policy changes that strengthen the primary care infrastructure and expand access to comprehensive, culturally competent primary care services could help reduce disparities and lead to better health outcomes for medically disenfranchised communities. The federal government has taken some steps to combat barriers to regular access of primary care services.

Since 1965, the Department of Health and Human Services (HHS) has funded community health centers through its Bureau of Primary Health Care. These health centers often operate in underserved communities and provide access to primary and preventive health care for people who face financial barriers to accessing care. The network of federally funded health centers has expanded in the past fifty years. Today, about 1,400 centers provide affordable health care to 29 million Americans. Federal and state support for community clinics is critical to meeting the needs of medically underserved populations who rely on these health centers.

The ACA expanded funding for community health centers and aimed to address financial barriers in several other ways as well, such as requiring plans to cover preventative services. Notably, the ACA sparked discussions about value-based care models and payment reform, creating the Center for Medicare and Medicaid Innovation (the CMS Innovation Center) under the Center for Medicare and Medicare Services (CMS) to solicit ideas for innovative public and private payment reforms. In 2012, CMS launched the four-year Comprehensive Primary Care (CPC) Initiative to evaluate multi-payer payment models in seven regions nationwide. In 2017, CMS launched the Comprehensive Primary Care Plus (CPC+) initiative, a five-year primary care medical home model. CPC+ integrates many lessons learned from CPC and aims to strengthen primary care through regionally based multi-payer payment reform and care delivery transformation.



Although there has been progress in expanding primary care for underserved populations, around 20% of the population does not have a usual source of care.<sup>161</sup> The primary care system remains underfunded and access to regular care remains inequitable for racial and ethnic minority populations.<sup>162</sup> Sustained change and the advancement of primary care services must be achieved through further legislative and economic actions.

---

**Strategy: Increase the percentage of minority patients with a usual source of care by addressing provider shortage areas, removing financial barriers to office-based primary care services, and expanding the primary care infrastructure to integrate better care coordination.**

---

Ensuring minority patients have access to usual care requires incentivizing PCPs to practice in medically underserved communities. Studies have found that financial incentives contribute to a physician's choice of practice setting and should be honed to encourage practice in underserved communities.<sup>163</sup> States use various incentive programs to recruit PCPs to provider shortage areas, but loan repayment and direct financial benefits have been shown to be the most effective programs.<sup>164</sup> States should consider the overall cost saving potential of improving access to usual care in underserved communities when creating effective incentive programs.

Financial barriers remain an obstacle for patients seeking primary care. Fee-for-service, still the most dominant reimbursement model, can disincentivize outcomes-based care and lead to increased costs to the patient.<sup>165</sup> Payers should test models that support team-based care and explore possibilities like providing flexibility to pay traditionally non-billable professionals, such as community health workers (CHWs) and peer supports. A multi-payer model that aligns incentives with quality measures like positive health outcomes and hospital readmission reductions is another mechanism that can reduce financial barriers to accessing care.

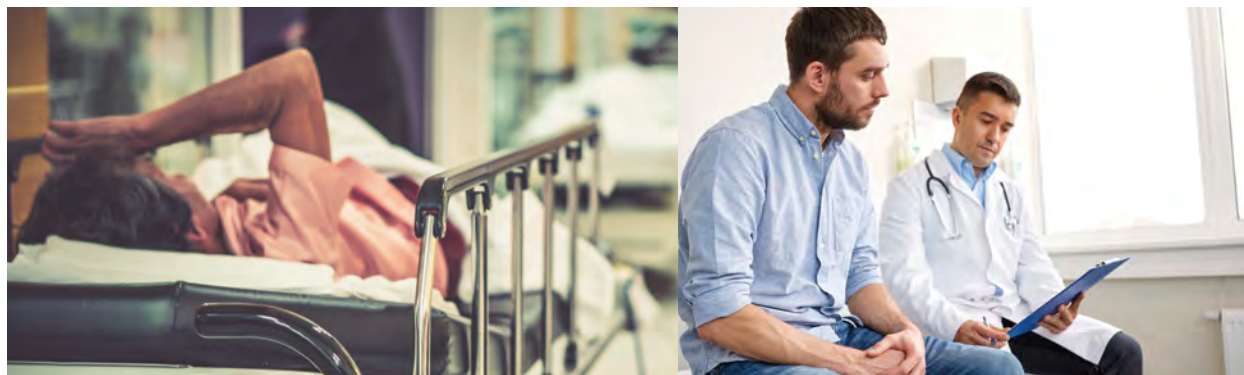
Expanding the primary care infrastructure to integrate better care coordination with social services is also critical to increasing access. Primary care systems must be restructured and reimagined to care for the whole patient, including nonmedical needs. The health care system is increasingly complex, and PCPs have an important role in helping patients navigate it. PCPs must be prepared to meet the challenges and demands of a changing health system while maintaining their role as the central providers of continuous, comprehensive relationship-based care. To do this, payers should promote and incentivize the ability of PCPs to screen patients for socioeconomic needs and refer them to the appropriate services. Policy options to promote comprehensive care teams of CHWs, social workers, and peer support counselors must also be pursued to achieve holistic patient primary care.

A successful primary care system will be achieved when patients are able to access comprehensive, high quality, and culturally competent primary care services in their community, regardless of race, ethnicity, or income.

## QUALITY OF CARE

Quality of health care, defined as the extent to which health care services improve desired health outcomes, has improved over the last decade (2010–2020) in the United States.<sup>166</sup> However, these improvements have not equally benefited racial and ethnic minority patients.

In the National Healthcare Quality and Disparities Report, published annually by the Agency for Healthcare Research and Quality (AHRQ), quality measures are grouped by priority areas, including person-centered care, patient safety, healthy living, effective treatment, care coordination, and affordable care. Health care quality spans a range of services, such as prevention, treatment and management, and settings, including clinics, hospitals, and home health.



Care coordination is one of the most essential components of quality care in asthma and poor coordination of care is often a hindrance to quality care. The U.S. healthcare system is highly fragmented, especially when it comes to receiving continued care for chronic conditions.

In addition to primary care, individuals with asthma might need to be in the care of a specialist, such as a pulmonologist, allergist, or immunologist, who may have more experience treating patients with severe asthma or allergic asthma than a primary care physician (see Case Management and Care Coordination on page 142). Communication among the care team members as well as communication with the patient or caregiver is necessary to ensure efficiency and quality care.

One reason for the lack of alignment in the health care system is the complexity of payment structures and reporting requirements. Care coordination often involves information exchange among personnel (e.g., HCPs, community partners, case managers) and other resources (e.g., insurance, medical history, test results) to provide high-quality and high-value care that meets patients' specific needs. Patients are often caught in the middle of multiple providers who may not be communicating with each other.<sup>167</sup> Instead, providers are often spending time trying to manage the necessary policies and paperwork for various payers.

This lack of communication and alignment impedes the system's ability to provide comprehensive, patient-centered care. Additionally, the complex nature of care coordination may place financial burdens on patients, particularly on those who are underinsured or uninsured.

---

**Strategy: Develop sustainable models for care coordination and case management that do not place financial burdens on patients.**

---

## Innovation of Health Care Models at a Federal Level

The ACA tries to address the need for better integrated and coordinated care in part by creating Medicaid “health homes.” In general, a medical home is a provider or care team that coordinates comprehensive, high quality, evidence-based, and patient-centered care.<sup>168</sup> The ACA created a model for Medicaid health homes for people with, or at risk of, two or more chronic conditions, such as asthma. The federal government provides enhanced federal funding for certain care coordination services that Medicaid medical homes must offer their enrollees. Entities eligible to serve as Medicaid health homes include community health centers, which also received expanded national grant funding under the ACA.<sup>169</sup>

In order to find ways to improve the quality and reduce the cost of health care, the ACA authorized the new Center for Medicare and Medicaid Innovation (The CMS Innovation Center) and provided funding over a 10-year period for the Innovation Center to design and test innovative health care reforms. If reform ideas are deemed successful that they improve quality or reduce costs, or both, the ACA allows for the officials responsible for Medicare and Medicaid programs to enact them as policies without the usual process of congressional approval prior to implementation.<sup>170</sup>

Pediatric asthma was one of the early targets of Innovation Center funding provided to three projects in July 2012 as part of the first round of its Health Care Innovation Awards (HCIA) program.<sup>171</sup> As detailed below, all three interventions served primarily Black or Hispanic populations, 83% Black participants in Le Bonheur, 69% Black participants in Nemours, and 58% Hispanic participants in Health Resources in Action (HRiA):

- Le Bonheur Community Health and Well Being implemented a Changing High-Risk Asthma in Memphis through Partnership (CHAMP) program affiliated with one hospital in Memphis, Tennessee and surrounding Shelby County, Tennessee. CHAMP provided asthma action plans, certified education, home visits by community health workers (CHWs) and outreach to schools to reduce health care use and save costs.

The greatest challenge for this program was long-term sustainability, as well as limits on the time clinical specialists had for adequate follow-up sessions with patients. At the time, Le Bonheur reported there was a need to integrate primary care providers in the area surrounding the hospital to better manage the workload for the entire community. Despite this, the program resulted in fewer emergency department (ED) visits—but not hospitalizations—for children and also produced some evidence of cost savings. Researchers of the intervention advocated for the reimbursement of CHW services by Medicaid and private payers in Tennessee.<sup>171</sup>

- The Nemours Foundation was funded at three clinical sites in Delaware to test a medical home model and community-based education program to reduce unnecessary asthma health care use. Home visits and environmental assessments were conducted by CHWs who were also integrated into the operations of each clinical practice where they coordinated care and helped manage the asthma patient workload. At the interim stage, the program resulted in fewer ED visits but was not found to significantly reduce either asthma-related hospitalizations or overall costs.

Among the challenges encountered in the Nemours program were violence in the community, the need to address non-medical social determinants of the families in the intervention, and long-term sustainability since integrating CHWs into clinics was not reimbursed by third-party payers in Delaware.<sup>171</sup>

- Health Resources in Action (HRiA) implemented a home-visit program led by CHWs and certified asthma educators (AE-Cs) to reduce preventable asthma health care use and costs. At the time of reporting, the program was in nine sites across four New England states and had reached over 1,000 patients with home education visits, environmental assessments, and provision of cleaning supplies when needed.<sup>172</sup> In a sub-group analysis of the program, HRiA estimated that pre-intervention rates of health care use were highest among Black participants, but that this group also saw the steepest decline in asthma-related hospitalizations, ED visits, and urgent care visits post-intervention.

Evidence from the program is being used to advance Medicaid reimbursement for CHW-led home-based interventions. Flexibility for sites to adapt the model as needed and good levels of communication between the AE-Cs and CHWs were judged to be driving factors for success across all project sites. However, costs were not yet measured in the interim evaluation due to difficulties in securing Medicaid claims data. In fact, working with state Medicaid agencies was highlighted as one of the more difficult challenges in project implementation.<sup>172</sup>

In reporting about these three programs, the CMS Innovation Center identified common challenges and factors for success. Evidence from all three shows that CHW-led care coordination, education, and home visits have a lasting impact on the confidence of caregivers to better handle asthma in the home, especially with regard to managing asthma medications and reducing potential environmental triggers.<sup>171</sup> Delivering these services with cultural awareness and appropriate choice of language for the HRiA program was also important, as was reaching additional family members (and not always the same caregiver) to reinforce the messaging. All three programs also benefited from a concerted effort to personalize asthma action plans, to actively use them in home and clinic visits, and to update the plans as patient situations changed.

Finally, two other aspects proved noteworthy. Firstly, program implementers found caregivers to be much more open to an asthma education session in the clinic or at home immediately following an asthma ED visit or hospitalization. At any other time, caregivers were much more likely to believe their child's asthma was under control and not consent to further CHW outreach. Secondly, the ability of CHWs to address non-medical social determinants of health depended highly on program location. Larger cities typically have more social resources and organizations for referral, and CHWs in those larger cities may have more experience with where those resources are located and how to best contact them. In terms of challenges, it seems all three projects had to be modified to continue forward due to the lack of reimbursement from public or private payers for the work of CHWs.

Innovative care coordination models and payment structures may be important mechanisms for reducing health disparities.<sup>173</sup> Additional studies are needed to evaluate the impact of these structural interventions on racial and ethnic disparities in asthma.



## **Innovation of Health Care Models at a State Level**

In the past 10 years, concurrent with—and in many respects driven by—ACA health care reform, state-level public policy beyond Medicaid programs also advanced considerably to meet the challenge of asthma care in the U.S. A 2015 briefing by the National Governors Association (NGA) encouraged state leaders across the country to expand and increase the quality of asthma care by broadening the list of providers qualified to serve asthma patients, coordinating local initiatives across stakeholder groups, and encouraging health insurers to cover and pay for asthma education, in-home visits, and targeted environmental remediation. The NGA shared examples of several statewide asthma initiatives that were evaluated and judged to have generated a positive return on investment and specified that such positive returns are likely available by expanding asthma services in their respective Medicaid programs.<sup>174</sup>

## **Innovative Collaborations Between Federal, State, Territory and Municipality Levels**

The success of the National Asthma Control Program (NACP) has proven to be an impactful partnership between the federal government and states in addressing asthma quality care. Administered by the Centers for Disease Control and Prevention (CDC), the NACP awards competitive grants/cooperative agreements to states, territories, and municipalities to address the burden of asthma. By working with state health departments on community-based care models, the NACP has been highly effective in its aim to reduce the number of deaths, hospitalizations, emergency department (ED) visits, missed school and workdays, and other activity limitations due to asthma since its founding in 1999.<sup>175</sup>

In February 2020, the CDC published “Moving the Needle on Asthma Control: Examining Context, Promising Practices, and Innovation.”<sup>176</sup> The report highlights the progress state grantees made since a five-year cycle of grants ended in the summer of 2019. Grantee states reported decreases in ED visits, urgent care visits, and asthma-related hospitalizations. Grantees also made progress in addressing the persistent racial and ethnic disparities in prevalence and health outcomes. Approaches to address disparities varied by state, but common practices included developing targeted infrastructure to focus on specific communities, working with trusted community health workers (CHWs), and focusing on partner schools in the lowest-income

“

*It is possible to live well with asthma. Effective, evidence-based strategies in both the health care and public health sectors are available. Yet the burden of asthma remains high, and disturbing disparities persist in asthma prevalence, asthma control, emergency department visits, and hospitalizations.*<sup>176</sup>

”

- Centers for Disease Control and Prevention, Moving the Needle on Asthma Control: Examining Context, Promising Practices, and Innovation

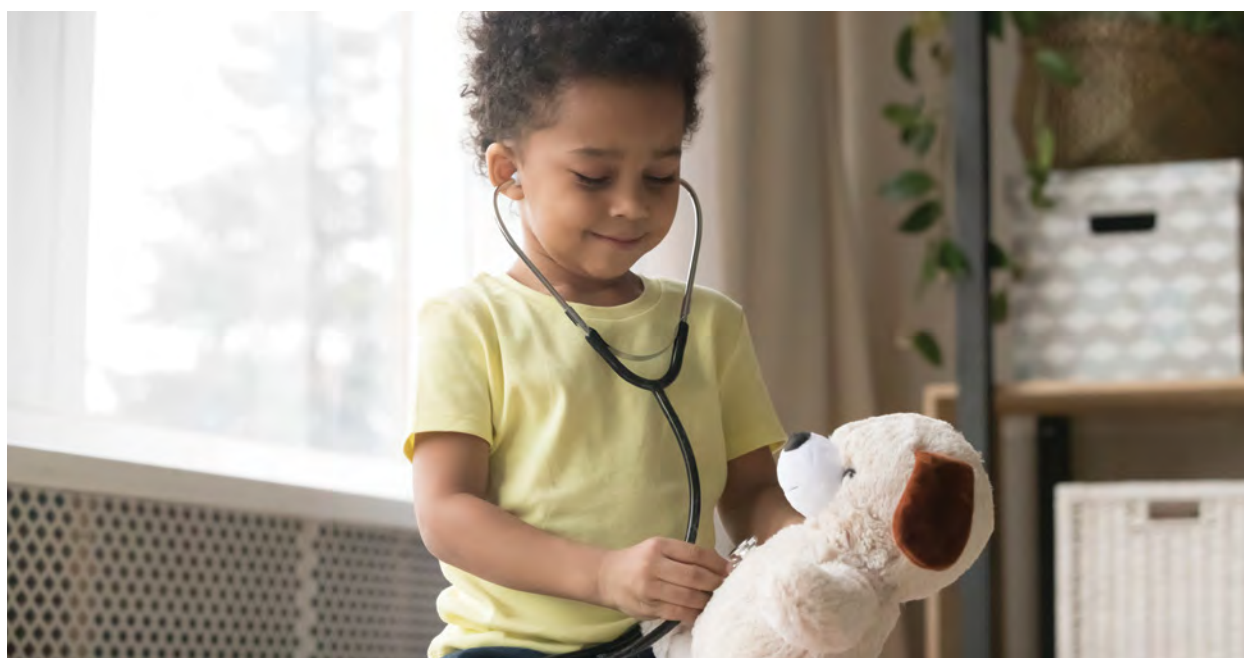
communities.<sup>176</sup> The report also highlighted several specific activities at the state level to pursue health equity:

- California is incorporating SDOH and environmental health factors through the Healthy Places Index to target its asthma self-management education.
- Massachusetts reframed its state asthma plan to focus on health inequities, which includes racial equity awareness training.
- Vermont worked with pharmacy interns on trainings to address SDOH and the development of culturally appropriate materials.
- Ohio worked with stakeholders to develop a Health Equity Action Plan.

The most recent five-year NACP cooperative agreements were announced in 2019 to provide funding for community-based asthma interventions in 22 states, Puerto Rico, and the City of Houston, Texas. In 2020, NACP funded one additional state. The grantees will continue to build on the NACP's six **EXHALE** strategies<sup>177</sup> published in 2018:

- **E**ducation on asthma self-management
- **X**-tinguishing smoking and exposure to second-hand smoke
- **H**ome visits for trigger reduction and asthma self-management education (AS-ME)
- **A**chievement of guidelines-based medical management
- **L**inkages and coordination of care across settings
- **E**nvironmental policies to reduce asthma triggers from indoor, outdoor, and occupational sources

Grantees will also work to achieve the CDC's new goal of Controlling Childhood Asthma and Reducing Emergencies (CCARE), which aims to prevent 500,000 ED visits and hospitalizations due to asthma by August 31, 2024.<sup>178</sup> Unfortunately, as of fiscal year 2020, the NACP is only funded at \$30 million annually.<sup>179</sup> In the most recent funding cycle, almost ten states, cities, and other entities were approved but not funded for the next five-year cycle, including previous grantees Hawaii, Mississippi, and Oregon. Funding for additional states is critical to making progress towards the goal set forth by CCARE and in reducing asthma health disparities.



## FEDERAL INITIATIVES TO REDUCE RACIAL AND ETHNIC HEALTH DISPARITIES

At the federal level, agencies within the Department of Health and Human Services (HHS) launched several cooperative, multi-stakeholder initiatives targeting health disparities and, in some cases, asthma disparities specifically. Federal programs are critical to reducing asthma disparities because federal agency representatives have access to a multitude of resources and numerous stakeholders in various locations across the U.S. Therefore, they can use their vast experience and extensive resources to provide guidance and resources to make an impact at the local level.

Each decade, “Healthy People,” an initiative led by the Office of Disease Prevention and Health Promotion (ODPHP) at HHS, provides a new set of science-based national objectives to improve the health of all Americans. The initiative began in 1979 with ambitious objectives to promote health and prevent disease within the U.S. by 1990. Following the original report, Healthy People has produced new editions each decade. One of the four overarching goals of the Healthy People 2020 initiative is “to achieve health equity, eliminate disparities and improve the health of all groups.” Healthy People 2020 assesses health disparities in the U.S. population by tracking rates of death, chronic and acute diseases, injuries, and other health-related behaviors for subpopulations defined by race, ethnicity, gender identity, sexual orientation, disability status or special health care needs, and geographic location. Healthy People frameworks are developed with input from public health and prevention experts, a wide range of federal, state, and local government officials, a consortium of more than 2,000 organizations, and the public.<sup>180</sup>

The Racial and Ethnic Approaches to Community Health (REACH) program, administered by the CDC since 1999, funds local and culturally appropriate programs aimed at reducing health disparities among racial and ethnic populations. The CDC currently funds 40 communities to implement best practices to reduce health disparities.<sup>181</sup>

The “National Healthcare Quality and Disparities Report” is an annual report by the Agency for Healthcare Research and Quality (AHRQ) that evaluates the quality of health care in the United States. It also measures disparities that different racial and socioeconomic groups experience related to health and health care. This report has been published annually since 2003 in collaboration with other agencies at HHS, other federal departments, and the private sector.<sup>182</sup>

The HHS Action Plan to Reduce Racial and Ethnic Health Disparities evaluates the impact of HHS policies and programs on disparities and is used by HHS to promote integrated, evidence-based programs to reduce disparities. This report, developed in collaboration with several federal agencies, complements the 2011 National Stakeholder Strategy for Achieving Health Equity, a product of the National Partnership for Action. It also builds on Healthy People 2020.<sup>183</sup>

The 2012 Coordinated Federal Action Plan to Reduce Racial and Ethnic Asthma Disparities provides a framework for federal agencies to work together to review and build upon past work to reduce asthma disparities. This initiative is co-chaired by HHS, the Environmental Protection Agency (EPA), and the U.S. Department of Housing and Urban Development (HUD). The working group functions under the President’s Task Force on Environmental Health Risks and Safety Risks to Children and aligns with other federal programs aimed at reducing health disparities.<sup>184</sup>





## ECONOMIC STABILITY

Economic instability is one of the strongest risk factors for asthma. Financial hardship, combined with interrelated factors such as poverty, employment, and income, contributes to socioeconomic disadvantage. Low socioeconomic status has been shown to increase an individual's exposure to asthma triggers and decrease the ability to seek effective health care.

Various indicators of economic stability impact health:

- Poverty status
- Employment
- Income

In the U.S., the lasting impacts of discriminatory practices and policies created the racial wealth gap still evident today. Elimination of disparities in asthma requires intentional efforts to even the inequitable distribution of wealth and eliminate the economic disadvantage carried disproportionately by racial and ethnic minority populations.

## POVERTY STATUS

Numerous studies have explored and confirmed the link between poverty and poor asthma outcomes. For example, living in poverty directly affects several well-known intermediary determinants of asthma, including:

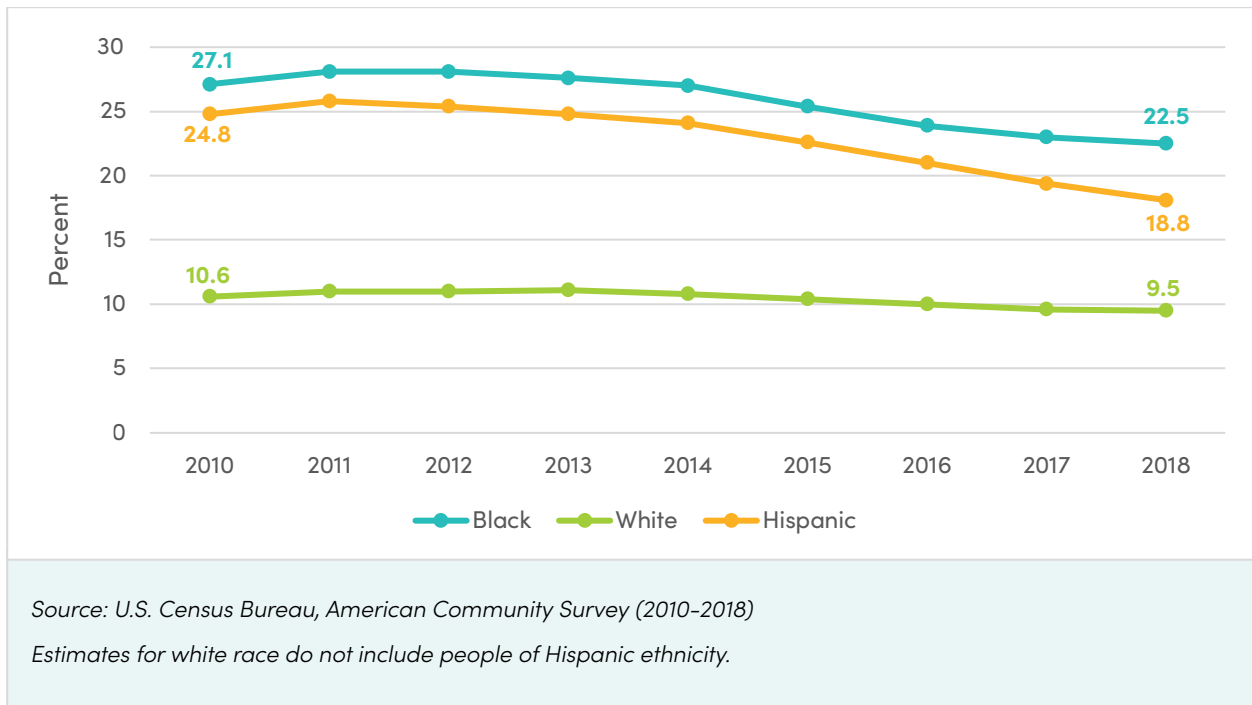
- Poor housing quality and increased exposure to indoor asthma triggers
- Poor air quality and increased exposure to outdoor asthma triggers
- Inability to pay for asthma care due to pressure of paying for basic needs
- Lack of access to quality asthma care due to suboptimal healthcare coverage.

Although many factors contribute to an individual's risk of living in poverty, including education, income, employment, geographic location, migrant status, disability status, and social class, the unequal distribution of poverty among racial and ethnic lines is particularly staggering.



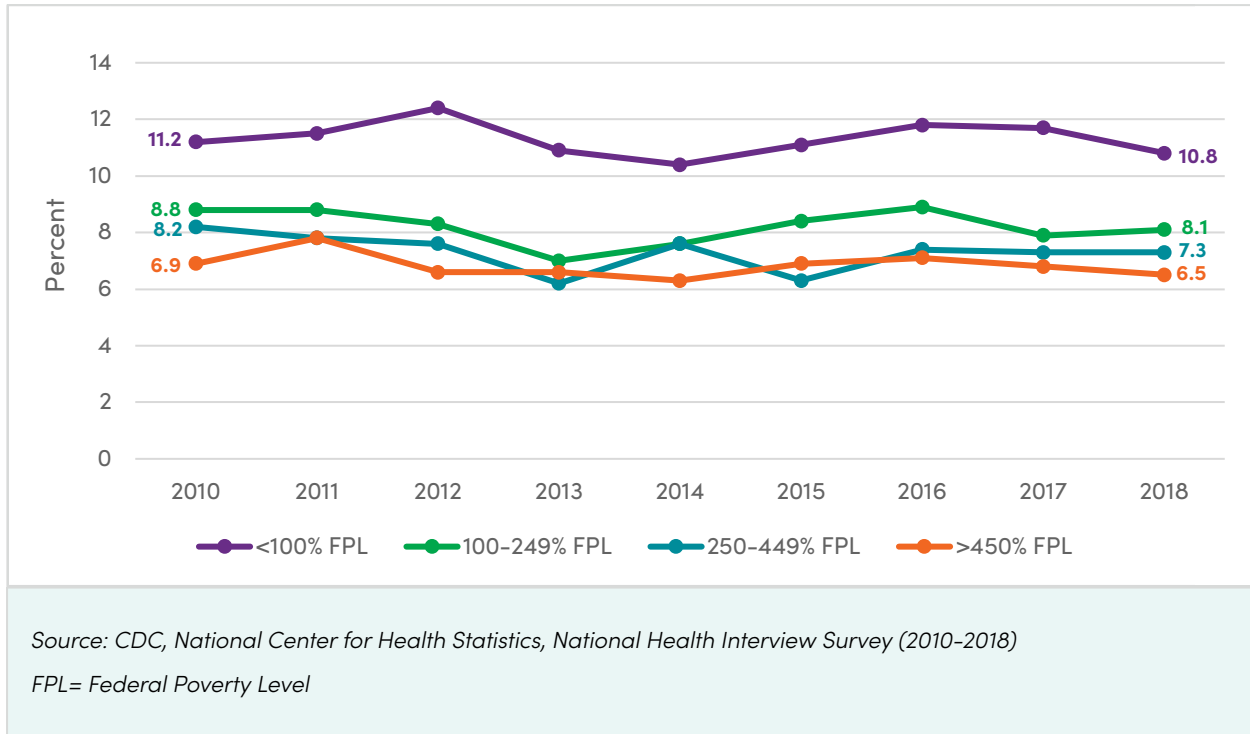
In 2018, 38.1 million people in the U.S. were living under the poverty threshold, which was \$12,784 annually for an individual or \$25,701 annually for a family of four. The overall poverty rate in 2018 was 11.8%, but Black and Hispanic populations were living at a higher rate of poverty (22.5% and 18.1%, respectively) when compared to the white population (9.5%) (Figure 27). In the past decade, poverty rates among Black and Hispanic populations appear to be declining while the rate among white population remains relatively stable. This variation in population trend lines points to a slow but promising narrowing of racial and ethnic disparities in the distribution of poverty.

Figure 27. Poverty Status by Race and Ethnicity



Asthma prevalence among people in low-income households is significantly higher than among people in economically stable households. In 2018, of people with household incomes (HHI) below the Federal Poverty Level (FPL), 10.8% had asthma, compared to 8.1% of people with HHI between 100–249% of the FPL, 7.3% of people with HHI between 250–449% of the FPL, and 6.5% people with HHI 450% or more of the FPL (Figure 28).

Figure 28. Current Asthma Prevalence by Poverty Level



Poverty and the labor market are closely connected. Access to full time employment as well as stable, livable wages can keep many people out of poverty. Additionally, stable, full-time employment leads to benefits, such as health insurance and paid sick leave. High wage earners may also be better able to afford any necessary treatments. These benefits can help manage chronic conditions, such as asthma, and lead to improved health outcomes. These disparities are evident when comparing indicators of employment opportunity (unemployment rates) and job quality (wages). Detailed data tables are available in the Appendix on page 252.

## EMPLOYMENT

Employment may be a key factor that affects individual and community health. The Bureau of Labor Statistics (BLS) defines the labor force as including individuals who are either employed or unemployed.<sup>185</sup> Employment is defined by those who are working for pay or profit, and unemployed is defined by those who are jobless but are available to work and have actively worked in the previous four weeks.<sup>186</sup> People who are neither employed nor unemployed are not part of the labor force.



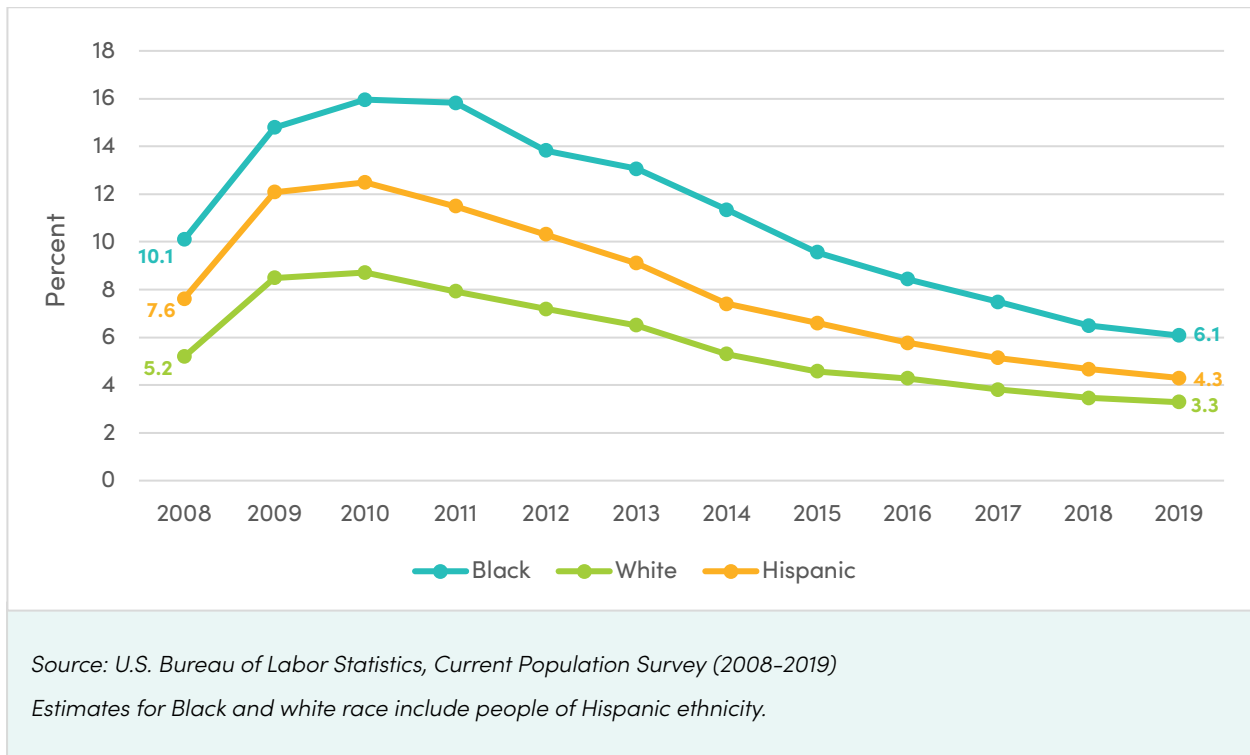
Multiple aspects of employment, including job security, work environment, financial compensation, and job demands, may affect health. Employees may be especially prone to injury and illness if their job includes risks, such as high physical demand, and long-term exposure to harmful chemicals, such as lead, pesticides, aerosols, and asbestos, and a stressful working environment.<sup>187</sup> People in highly stressful jobs may also exhibit unhealthy coping skills, such as smoking or alcohol abuse.<sup>186</sup> Additionally, experiences, such as perceived job insecurity, downsizing, or workplace closure, and underemployment also have implications for physical and mental health.

Employment also determines access to job benefits, such as health insurance, paid sick leave, and parental leave. In 2017, 70% of civilian workers and 67% of private industry workers had access to health insurance, while 89% of state and local government employees had access.<sup>188</sup> Access to health insurance offers two main benefits to individuals: affordable medical care and financial protection from unexpected health care costs.<sup>189</sup> Added benefits, such as paid sick leave, also allow employees to seek medical care for themselves or dependent family members without losing wages.<sup>190</sup> Finally, though frequently unpaid, some employers offer maternity leave after the birth of a child, which is associated with positive health outcomes for women and children.<sup>191</sup>

Black individuals regularly face more vulnerability in the labor market than white individuals, and disproportionately experience lower employment rates, wages, access to quality jobs and job stability. These disparities in employment are the product of a long history of systemic racism and discriminatory policies, such as the New Deal economic and employment policies. Historically imposed policies that hinder employment opportunity for minority groups continue to fuel racial disparities in the workforce.

The Black unemployment rate in the U.S. has consistently been around twice the white unemployment rate for at least fifty years.<sup>192</sup> In 2010, following the Great Recession of 2008, the Black unemployment rate was 16%, and the Hispanic unemployment rate was 12%, compared to 9% unemployment in the white population (Figure 29). By 2019, unemployment dropped across the board, but the rate among the Black population (6%) was still twice that of the white population (3%).

**Figure 29. Unemployment Rate by Race and Ethnicity**



Unfortunately, employment discrimination still exists today. In addition to the unchanged racial gap in unemployment, researchers recently uncovered that levels of racial discrimination during the hiring process also remained unchanged in the past 25 years.<sup>193</sup>



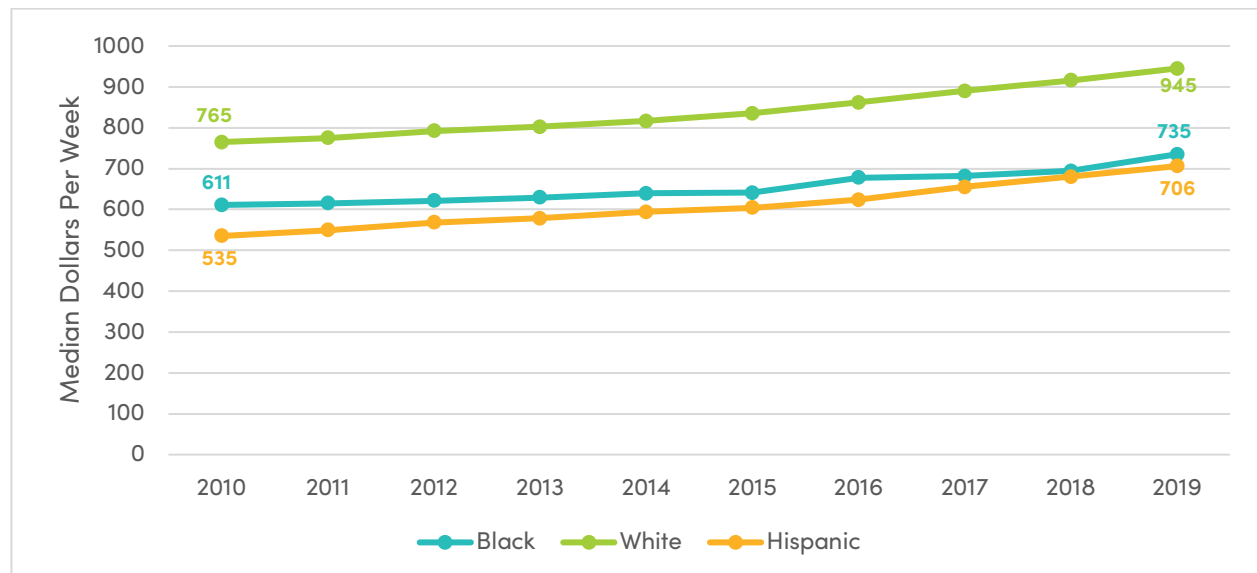
Addressing employment in public policy may benefit those facing health disparities. Research shows the establishment of civil rights policies, including equal access to employment, resulted in employment and income gains that led to increases in life expectancy between the mid-1960s and the mid-1970s.<sup>194</sup> These gains were proven to be larger for Black than white individuals and greater for Black women than Black men, indicating these policies might have played a role in reducing health disparities faced by Black communities. Additionally, research suggests employment interventions could be effective in reducing health disparities experienced by specific vulnerable groups, such as low-socioeconomic status women and people living with severe mental illness.<sup>195, 196</sup>

Employment can have positive and negative impacts on physical and mental health, but there is limited population-level research examining the health impacts of employment interventions. Therefore, additional research is needed to understand the relationship between employment and health. Such research can be used to promote interventions that effectively address health disparities associated with employment status and facilitate public health efforts to address employment as a social determinant of health. When considering employment, significant attention should be given to the type of occupation and income generated by public policies, acknowledging the deeply rooted structural and societal inequalities that minority communities face.

## INCOME AND JOB QUALITY

Related to employment, income is broadly regarded as an important social determinant of health.<sup>197</sup> Black and Hispanic workers consistently earn less than white workers. In 2019, the median weekly earnings for full-time Hispanic employees was \$706 and \$735 for Black employees, compared to \$945 for white employees (Figure 30).

Figure 30. Median Weekly Earnings by Race and Ethnicity



Source: U.S. Bureau of Labor Statistics, Current Population Survey (2010-2019)

Estimates for Black and white race include people of Hispanic ethnicity.

Additionally, Black individuals more commonly enter occupations that increase their exposure to environmental risk factors than their white counterparts.<sup>198</sup> In many cases, these are minimum wage, repetitive jobs that increase their risk for poor mental health, substance abuse, and health problems.<sup>199</sup>

Disparities in income are intricately linked to health disparities, as the relationship between income and health exists outside of other socioeconomic variables. Research has demonstrated that with each unit increase in income, there is the same increase in life expectancy for Black and white populations.<sup>200</sup> Additionally, research suggests that income redistribution can predict physical and mental well-being.<sup>201</sup> In that regard, existing literature points to a promising pathway for reducing health disparities by way of wage and income policy.

In the U.S., the most important law regulating wage and hours conditions is the Federal Labor Standard Act (FLSA), which was designed as a regulatory response to dangerous working conditions in industrial settings.<sup>202</sup> Under FLSA, employers are required to pay covered nonexempt workers at or above the federal minimum wage and not less than 1.5 times their regular rates of pay for hours worked over 40 in a workweek.

---

### **Strategy: Increase minimum wage for jobs often held by minority workers.**

---

The federal minimum wage has been \$7.25 per hour since July 2009, though 17 states have established higher minimum wages.<sup>203</sup> Wage and salary disparities continue to exist among sex, age, and racial lines. According to the Bureau of Labor Statistics (BLS), 4.36 million workers (67% of whom were female) were paid hourly wage rates below or at the minimum wage in 2010. Workers under age 25 represented only one-fifth of hourly paid workers but made up half of those paid the federal minimum wage or less. The BLS data also indicated that 7% of Black American workers earned hourly wages at or below the minimum wage compared to 5.9% of white workers.<sup>204</sup> Additionally, a survey of 4,387 low-wage workers in Los Angeles, Chicago, and New York found that 30% of women experienced minimum wage violations, compared to 20% of the men. Foreign-born Hispanic workers had the highest minimum wage violation rate (31%), while Black workers (30.2%) had triple the rate of white workers (10.1%).<sup>205</sup>

---

### **Strategy: Reduce the racial wage gap in the U.S. labor market.**

---

Though more research is needed about policy effects on health disparities, the close relationship between income and health suggest policies that effectively address the racial income gap can play a role in reducing health disparities over time.

Income supplements are another factor that might help reduce the effects of health disparities. In the U.S., examples of income enhancements and supplements include the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), the Earned Income Tax Credit (EITC) for low-income families, and Social Security income (Old Age and Survivors Insurance) for the elderly. Social Security benefits may also be available for some children<sup>206</sup> and adults<sup>207</sup> with asthma severe enough to qualify as a disability, or if it renders an adult otherwise unable to work.

Research shows that income supplements are associated with various health benefits. For example, WIC and EITC are associated with reduced rates of low birthweights.<sup>208</sup> With WIC, these effects appear stronger for women with lower versus higher education levels, and with EITC, these effects appear greater for Black women than for white women.<sup>209</sup> Additionally, the SSI program has been associated with decreased mortality for the elderly and larger declines in mortality over time with increased benefits.<sup>210</sup>

Conditional cash transfers offer another form of supplemental income to effectively improve health outcomes. Conditional cash transfers provide eligible beneficiaries with a cash benefit contingent upon certain behaviors. Conditional cash transfers are less studied in high-income countries, but research in low- and middle-income countries suggests that they might be effective in increasing the use of preventive care and improving nutrition, health behaviors, and birth outcomes.<sup>211</sup> For example, a trial conducted by the Johns Hopkins Center for Population Health and Health Disparities found that among Black Americans with controlled hypertension, pairing conditional cash transfers for use on groceries with nutritional counseling is associated with increased fruit and vegetable consumption and improved dietary patterns.<sup>212</sup> Additionally, a North Carolina study examined the impact of income supplements to American Indians resulting from casino revenue. The study found supplements were associated with improved mental health outcomes in adolescence that persisted through early adulthood, increased education, and reduced criminal offenses among American Indian youth.<sup>213</sup> Moreover, the supplements supported the elimination of the racial disparity on both outcomes. Policies providing these types of temporary financial incentives may also have a role in addressing the needs of people in deep poverty.<sup>214</sup>

Additional research is needed on the effects of income supplements and health as they relate to health disparities. However, existing literature suggests income supplements can be used as a tool for individuals to prioritize and address health disparities in communities that might not have the resources otherwise. To effectively reduce disparities, policy needs to address the existing inequities among other social determinants of health. For example, the amount of cash transfer can increase based on beneficiaries' level of economic disadvantage such that the poorest receive the largest cash amount. Additionally, other conditions might require unconditional income supplements depending on the population and health condition being addressed.<sup>215</sup> Considering the close relationship between income and health, public support of income supplement programs could prove to be beneficial for individual wellbeing and community health.

## ASTHMA DISABILITY BENEFITS

Asthma is a common cause of missed workdays. According to the Americans With Disabilities Act (ADA), a person with a disability is someone who has a physical or mental impairment that seriously limits one or more major life activities (like breathing). Asthma is usually considered a disability under the ADA and warrants reasonable accommodations.

The Social Security Administration (SSA) offers help for some people who are unable to work due to severe asthma. To qualify for Social Security Disability Insurance (SSDI) benefits, a patient must meet the FEV1 criteria (a lung function measurement of forced expiratory volume in one second) set by SSA and have a record of exacerbations or complications requiring three hospitalizations within a 12-month period and at least 30 days apart. Each hospitalization must last at least 48 hours, including hours in a hospital emergency department immediately before the hospitalization.<sup>207</sup>

More information about disability assistance is available at [ssa.gov](http://ssa.gov) and [aafa.org](http://aafa.org).

In a 2017 survey conducted by the Asthma and Allergy Foundation of America, adults with asthma reported the most common reasons for not using prescribed asthma treatments were all related to cost:

*“I could not afford it”*

*“It was too expensive”*

*“It was not covered by my insurance plan”*

Source: Asthma and Allergy Foundation of America, My Life With Asthma Survey Report (2017) [aafa.org/asthmalife](http://aafa.org/asthmalife)

## TAX POLICIES

At the federal, state, and local levels, tax policies can perpetuate or mitigate economic inequality. To the extent disparities in asthma outcomes and healthcare access are driven by economic disparities, policymakers should support tax policies that support low-income children and families.

---

### **Strategy: Implement tax policies that help low-income families accumulate more wealth.**

---

At the federal level, the Earned Income Tax Credit (EITC) and the Child Tax Credit help provide income support for low-income tax filers. However, these credits primarily help households with children and workers. The lowest-income households, which are not required to file taxes, are less likely to benefit from tax credits. These tax credits could be expanded to further raise households out of poverty.

Progressive taxes could also bolster low-income families. States can increase tax levels on the highest income households to fund programs that support all citizens, particularly those at the lowest income levels. States can also consider other taxes on high income entities, including estate taxes and a range of corporate taxes.

About a third of states and some localities still impose sales taxes on groceries, imposing a disproportionate tax burden on low-income households. These state and local taxes should be modified to reduce the burden for low-income families, who pay a larger proportion of their income on groceries.







## EDUCATION

Early childhood development and education have significant impacts on the long-term health of a child. Factors, such as early life stress, socioeconomic status, familial relationships, and access to early education programs affect a child's school readiness and educational achievement. Additionally, the impact of education on health is intergenerational: parental educational attainment can influence the health of their children.

Educational attainment is a key indicator of socioeconomic status, a strong risk factor affecting asthma outcomes. Disparities in asthma and socioeconomic status reflect the same racial disparities seen in education. Education impacts health in the following areas:

- Early childhood development
- Educational attainment
- Healthy schools

Racial and ethnic inequality in education today is rooted in the country's history of systemic racism and racial segregation. Some progress has been made since the 1954 ruling in *Brown v. Board of Education* which established racial segregation of public schools as unconstitutional. However, progress in closing the racial education gap created by our country's history has been slow and incomplete.

Policies and practices to reduce the racial education gap, increase achievement and opportunities for minority children, and ensure healthy environments in schools have the potential to reduce to health disparities, especially for children with asthma.

## EARLY CHILDHOOD DEVELOPMENT

Disparities in health are influenced by stressors in the first eight years of a child's life. Early childhood is a vulnerable time when the societal toxins and stress related to upstream inequities can result in life-long challenges in health and wellbeing primarily for persons of color in low-resource communities.<sup>216</sup> Positive and negative experiences in early childhood can have lifelong impacts on developmental outcomes. Children from low-income families, who are more likely to be racial and ethnic minorities, have lower access to high-quality early childhood programs.<sup>217</sup>

Early childhood interventions have the potential to improve educational and health outcomes. Life course perspectives, which focus on understanding the impacts of early life experience on lifetime and intergenerational health, are gaining popularity among experts, yielding promising approaches to address health disparities.<sup>218</sup> Investment in high-quality early learning and care programs can yield significant economic returns in the long term, help children toward the path for lifelong success, improve outcomes for families, and reduce socioeconomic disadvantages over time.

This concept is demonstrated by the success of the Perry Preschool Project, a high-quality preschool program for Black children (ages 3–4) living in poverty. The program was designed to provide a strong preschool curriculum to at-risk children to promote long-term educational attainment, employment opportunities, and earning potential. While the program was conducted from 1962–1967, a long running longitudinal study continues to follow participants of the program. The study shows that by age 40, participants of the Perry Preschool Project were more likely to have graduated high school, hold a job, have higher earnings, and own their own home and car than non-participants.<sup>219</sup> A cost-benefit analysis found that the program’s economic return to society was \$16.14 per dollar invested.

Another early childhood initiative, the Abecedarian Project, provided low-income and mostly Black children in North Carolina with quality, comprehensive early childhood education during the 1970s. In a longitudinal study, the children who participated in the program reported better educational, vocational, and health outcomes in their 20s and 30s when compared to the control group. The program delivered an estimated 13% return on investment per year.<sup>220</sup>



The federally funded Head Start program, founded in 1965 and continuing today, aims to address health outcomes and close the gap in school readiness rooted in socioeconomic disadvantage. The program provides grants to more than 1,600 agencies nationwide to administer services to children ages 3–5 and their families in the areas of early learning, health, and family well-being. During the 1994 reauthorization of Head Start, the Early Head Start program was established to provide child development services to low-income infants and toddlers under age 3. Nearly 1,400 Early Head Start centers provide services that benefit children and their families and help lay the foundation for childhood learning and development.

Participation in Head Start and Early Head Start programs produced positive outcomes for children and their families. Children enrolled in these programs demonstrate higher school readiness, greater cognitive development, increased academic success, and higher likelihood of becoming high school graduates.<sup>221</sup> Additionally, family participation in these programs increases parenting skills and parent engagement in their children’s learning.

Aligned with efforts to expand access to quality health care, addressing adverse childhood experiences through a wide range of cognitive and social services will lead to more equitable health.<sup>222</sup>

## Strategy: Increase access to quality early childhood education and care.

Access to early childhood programs is limited, as Head Start is only able to enroll one third of eligible children, and Early Head Start can only enroll 7% of eligible infants and toddlers in its program. Investment in programs like Head Start and Early Head Start will help close the racial education gap by providing access to high-quality early learning, child development, and family engagement for families of young children.

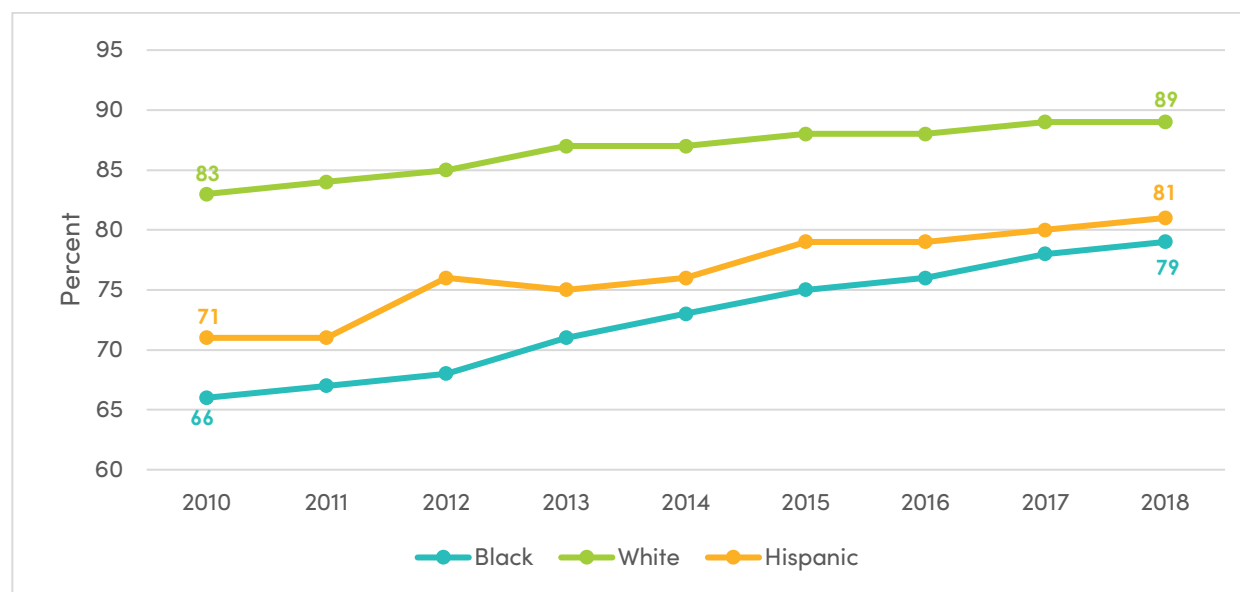
## EDUCATIONAL ATTAINMENT

Educational attainment affects health behaviors by increasing health knowledge and literacy. Longer-term education shapes employment opportunities and related benefits, such as income, job quality, and access to employer-based health insurance.

Although legal segregation ended in the 20th century, racial and ethnic minority students continue to face unequal opportunities in early childhood development and education. The racial education gap continues to impact disparities in health today.

The achievement gaps for Black and Hispanic students that begin in early childhood also persist throughout primary and secondary school. Proficiencies in reading and math and high school graduation rates remain disparate, though the gap has been narrowing in recent years.<sup>223</sup> Four-year high school graduation rates in 2018 were 79% among Black students, 80% among Hispanic students, and 89% among white students (Figure 31).

Figure 31. High School Graduation Rates by Race and Ethnicity

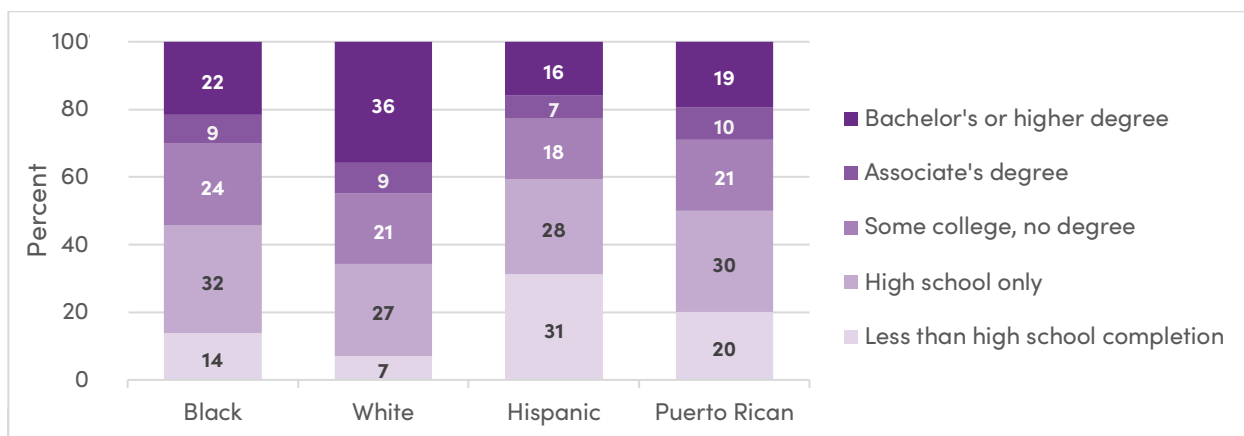


Source: U.S. Department of Education, Office of Elementary and Secondary Education, Consolidated State Performance Report (2010-2018)

Graduation rates reflect adjusted cohort graduation rate, the percentage of public high school freshmen who graduate with a regular diploma within 4 years of starting 9th grade. Estimates for Black and white race do not include people of Hispanic ethnicity.

Future employment opportunities are heavily dependent on high school attainment, and increasingly dependent on post-secondary training. As of 2017, Black adults age 25 and older were twice as likely to not have completed high school than white adults. This disparity is higher for Hispanic adults, who are over four times as likely to have not completed high school than white adults. Additionally, while nearly half (45%) of white adults obtained a post-secondary degree, only 31% of Black adults and 23% of Hispanic adults (including 29% of Puerto Rican adults) did the same (Figure 32).

**Figure 32. Percent Distribution of Educational Attainment by Race and Ethnicity (Age 25+)**



Source: National Center for Education Statistics, *Digest of Education Statistics (2017)*

Estimates for Black and white race do not include people of Hispanic ethnicity. Puerto Rican ethnicity is captured as a subset of Hispanic ethnicity.

The government acted in support of more equitable educational achievement through federal legislation. The Every Student Succeeds Act (ESSA), which passed in 2015, encourages schools to increase educational achievement through “whole child” strategies. The law calls for the use of evidence-based interventions in schools, mandates implementation of evidence-based improvement plans, and provides schools the opportunity to better define educational achievement and opportunity by embracing health and wellness.

Educational attainment is highly influenced by neighborhood. Residential segregation by race, ethnicity, and poverty leave many communities without access to high-quality schools.<sup>224</sup> Most school funding comes from local property taxes tying school quality to community wealth. While efforts to reform this practice are underway in many states, resource disparities remain bleak.

**Strategy: Create more equitable school finance systems.**

Currently, the wealthiest school districts receive an average of \$1,200 more per student than the districts with the highest poverty rates and an average of \$2,000 more per student than the districts serving the highest number of Black students.<sup>225</sup> Overall, there is a \$23 billion funding gap between majority white and majority minority schools.



Policies that promote more equitable funding of schools can help address the educational gaps that contribute to poor health outcomes. Increased resource allocation at a federal and state level to schools that serve low-income and minority students is imperative to improving educational attainment and the associated health outcomes.

## HEALTHY SCHOOLS

Inequitable financial resources contribute not only to inequitable academic resources such as teachers, counselors, instructional materials, and technology, but also to poor school facilities and critical infrastructure that directly affect student health. In 2017, the American Society of Civil Engineers (ASCE) gave U.S. public schools a D+ on its Infrastructure Report Card. Annual funding to maintain school buildings falls about \$38 billion short. The report card notes that 53% of the nearly 100,000 public school buildings need repairs, renovations, and modernizations to be considered in “good” condition, and school districts with more low-income, racial and ethnic minority children are more likely to report their school buildings as being in “poor” or “fair” condition.<sup>226</sup>

Aging infrastructure is one of the root causes of poor indoor air quality (IAQ) in schools, which is critically important for children’s health and academic performance.<sup>227</sup> According to the Environmental Protection Agency (EPA), indoor levels of pollutants are often higher than outdoor levels and there is substantial evidence that poor IAQ increases risks of severe asthma attacks and allergic reactions.<sup>228</sup> Some of the most common allergens in schools, such as dust mites, pests, and mold, are known asthma triggers.

---

**Strategy: Reduce exposure to environmental triggers by improving school building conditions and improving air quality in and around schools.**

---

Outdoor air quality and placement of schools near pollutant sources also negatively affect health and educational outcomes, especially for low-income, minority populations. Only 4% of schools serving predominantly white students sit near a major road, whereas 15% of schools serving mostly students of color are near major roads.<sup>229</sup> Poor air quality and exposure to particulate matter are significant risks for developing asthma and for those who already have asthma. Asthma remains a leading health-related cause of school absenteeism, and academic performance decreases with absences.<sup>230</sup>



*Schools are the workplaces for children. Schools have the responsibility for establishing systems where a safe and nurturing learning environment can be maintained for all students, teachers, and support staff.*



- Mary Ellen Conley BSN,  
RN, NCSN,  
Community Relations  
Subcommittee Chair,  
Asthma and Allergy  
Foundation of America

There are existing state policies that address asthma's impact in schools that can help decrease negative health and academic outcomes. AAFA published its 2019 State Honor Roll of Asthma and Allergy Policies for schools, which ranks states with the best public policies for people with asthma, food allergies, anaphylaxis, and related allergic diseases in U.S. elementary, middle, and high schools.

The report, available at [StateHonorRoll.org](http://StateHonorRoll.org), highlights 23 core policy standards that focus on medication and treatment, awareness, and the school environment (see page 155). It is critical that students with asthma have access to their life-saving medications and that emergency protocols are in place. States and schools should also have IAQ management policies, periodic inspections of heating, ventilation, and air conditioning (HVAC) systems, and an integrated pest management system in place. As of 2019, only the District of Columbia and Connecticut meet all 23 core policy standards.

## THE SCHOOL-BASED ALLERGIES AND ASTHMA MANAGEMENT PROGRAM ACT (H.R. 2468)

The School-Based Allergies and Asthma Management Program act (H.R. 2468) is a bipartisan bill that would create a preference in the CDC's National Asthma Control Program (NACP) for states with a comprehensive school-based allergies and asthma management program that:

- identifies all students with asthma or allergies
- establishes individual action plans
- educates school staff
- reduces environmental triggers of allergies and asthma
- coordinates management of allergies and asthma with families and primary care providers

To receive the preference, states would need to require all public elementary and secondary schools to have a nurse or other trained individual who can administer asthma or allergy medication onsite during operating hours. This preference would be put in place alongside an existing preference for states that require stocks of epinephrine to address allergic reactions.

H.R. 2468 would address several policy gaps to promote the health and learning of all children with asthma. For example, given the low number of states that set school nurse standards, it is important for states to require that someone—whether a nurse or other trained individual—be available during all operating hours to administer asthma medication. Similarly, H.R. 2468 would help fill gaps in state requirements related to emergency protocols, indoor air quality, and other preparedness factors in schools.

Parents want to send their kids to school knowing that they will be safe, healthy, and ready to learn. H.R. 2468 would help ensure this is a reality for more children and families managing asthma and allergies.



## PHYSICAL ENVIRONMENT

Indoor and outdoor physical environments greatly influence an individual's health and wellbeing, particularly for people with asthma. Exposure to indoor and outdoor allergens and triggers strongly contribute to poor asthma control and exacerbations.

Substandard housing conditions often lead to greater exposure to common indoor triggers—including cockroach, dust mite, pets, moisture and molds, tobacco smoke, and rodents—known to exacerbate asthma symptoms. Similarly, poor environmental conditions lead to greater exposure of air pollution—including gases, smoke from fires, volcanic ash, and dust particles.

The connection between physical environment and asthma is multi-dimensional. The following components of an individual's environment impact health:

- Housing quality and tenure
- Housing stability and affordability
- Neighborhood characteristics
- Air quality

Like many social determinants of health, housing disadvantage is disproportionately experienced by racial and ethnic minorities. Poor housing conditions often intersect with other forms of economic hardship, contributing to an accumulation of socioeconomic risk factors known to exacerbate asthma.

Addressing housing quality, affordability, stability, and neighborhood characteristics on a large scale will be achieved by implementing multi-component housing policies and practices.

## HOUSING QUALITY AND TENURE

Poor indoor environments—and housing characteristics in particular—are strongly associated with asthma morbidity. Most Americans spend about 90% of their time indoors, leading to exposure from indoor allergens and irritants which are major asthma triggers.<sup>231</sup> Due to poor housing quality and increased exposure to triggers, racial and ethnic minority and low-income families disproportionately suffer from poor asthma control.

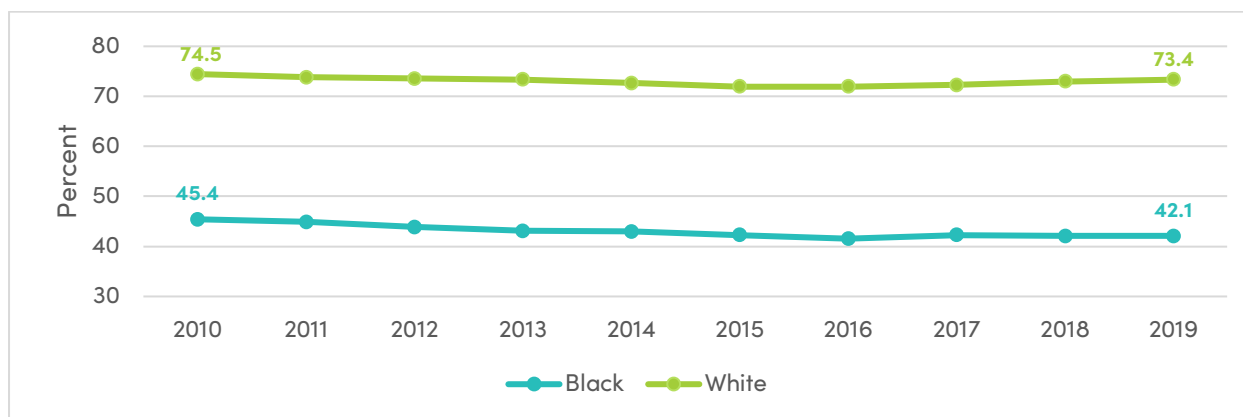
Studies found that housing quality is affected by an individual's housing tenure (i.e., whether their home is owned or rented). Home ownership is strongly associated with better quality of housing and decreased rates of asthma-related ED visits.<sup>232</sup> This may be because homeowners are likely to have more control over the physical environment in the home and a better ability to reduce exposure to indoor triggers.

On average, housing conditions in rental units are found to be worse.<sup>233</sup> This is especially important for chronic health conditions exacerbated by environmental triggers.

Decades-long inequities in home ownership continue to reinforce racial and ethnic disparities in asthma. Throughout the 20th century, federal housing policies were implemented to promote homeownership and wealth generation.<sup>52</sup> However, these policies primarily benefited white populations. Although overt discrimination in housing policy is forbidden today, the effects of prior legalized discrimination in housing policy and lending practices remain. A long history of systemic injustices made homeownership difficult to obtain for racial and ethnic minority populations in the U.S.

In 2019, homeownership rates among Black populations in the U.S. was only 42%, compared to 73% among white populations. In fact, the trend remains almost stagnant when comparing Black and white homeownership rates in the past decade (Figure 33).

Figure 33. Homeownership Rates by Race



Source: U.S. Census Bureau, Current Population Survey/Housing Vacancy Survey (2010-2019)

Estimates for white race do not include people of Hispanic ethnicity.



Living in rental housing can present challenges for families managing asthma. Rental units are more likely to have deficiencies or inadequacies and fewer means to address problems that increase exposure to asthma triggers. Renters lack the control (and often, the financial means) to make physical improvements to the property to remediate asthma triggers or to relocate to safe, quality housing.

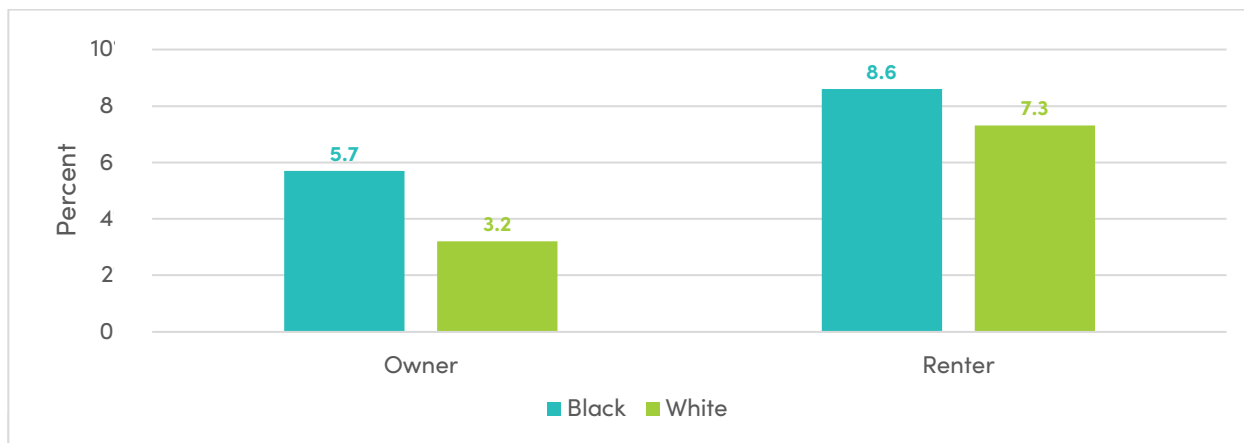
The Department of Housing and Urban Development (HUD) classifies housing quality based on three categories<sup>†</sup>:

- “Severely inadequate” units meet one of several criteria, including: lack of piped water or bathroom, major electric problems or lack of electricity, major water leaks, structural issues, or holes in the floors, walls, or ceilings.
- “Moderately inadequate” units meet similar but less severe deficiencies in plumbing, electrical, structural, or upkeep.
- “Adequate” units are those that do not meet the definitions of severely inadequate or moderately inadequate.

<sup>†</sup>The detailed definitions of housing adequacy classifications can be found on HUD’s website at [hud.gov](http://hud.gov).

Housing adequacy is distributed disproportionately based on race and tenure. In 2017, 8.6% of Black renters lived in housing deemed “severely” or “moderately” inadequate, compared to 7.3 % of white renters (Figure 34). Black owners also lived in inadequately housing at a higher rate (5.7%) compared to white owners (3.2%).

**Figure 34. Housing Inadequacy by Race and Tenure**



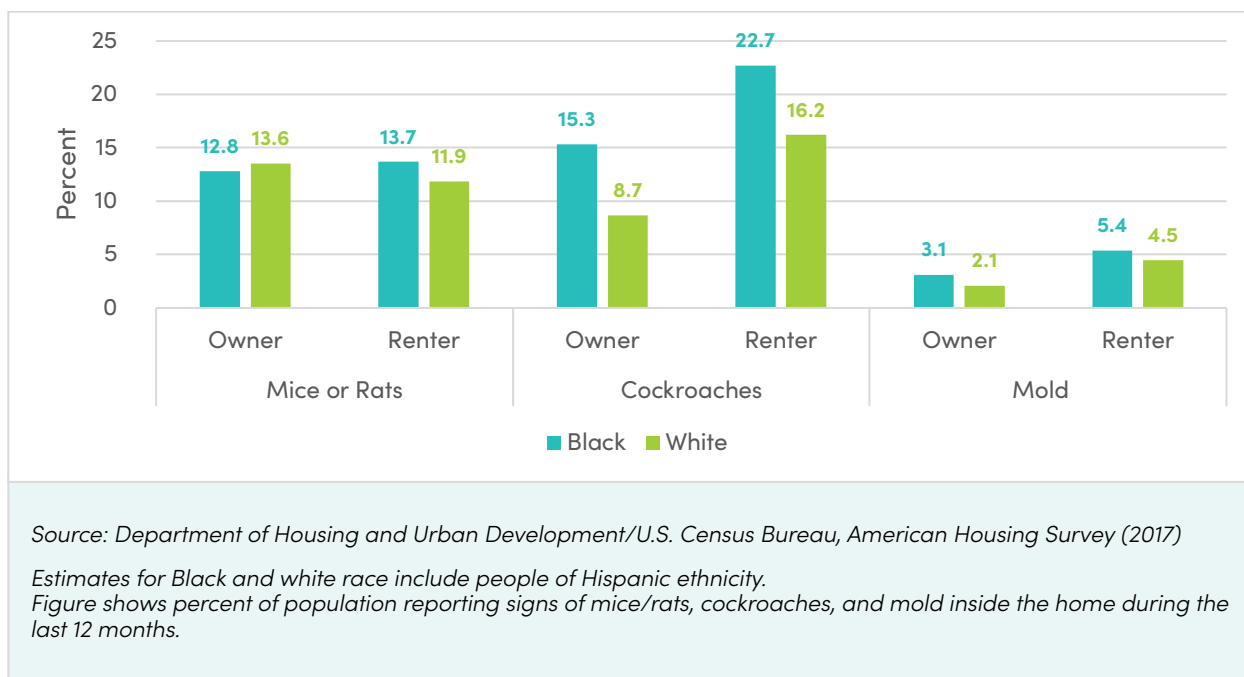
Source: Department of Housing and Urban Development/U.S. Census Bureau, American Housing Survey (2017)

Estimates for Black and white race include people of Hispanic ethnicity.

Figure shows percent of population living in “severely inadequate” or “moderately inadequate” housing.

Similar inequities related to race and housing tenure exist when evaluating differences in exposure to common indoor asthma triggers linked to poor housing quality. In nearly all categories, Black renters reported significantly more deficiencies in housing than white owners when asked about signs of rats/mice, cockroaches, or mold in the home in the last 12 months (Figure 35).

**Figure 35. Exposure to Rodents, Cockroaches, and Mold by Race and Tenure**



Among renters, low-income residents receiving housing assistance through federal programs face the greatest challenges in housing conditions. For example, the quality of public housing units is substandard in many cities nationwide. Assisted renters often have greater exposure to indoor triggers like tobacco smoke and mold than other low-income renters not receiving government rental assistance. Studies also suggest that there is a higher prevalence of asthma among assisted renters than the general population, potentially due to substandard housing quality in units qualified for rental assistance.<sup>234</sup>

Housing code violations for asthma-related triggers (e.g., exposure to cockroaches or mold) are associated with poor asthma outcomes.<sup>235</sup> In Cincinnati, Ohio, increased density of housing code violations was significantly correlated with increased asthma morbidity and ED visits. Children who were hospitalized for asthma and lived in the highest quartile of housing violation census tracts were nearly twice as likely (1.84 odds) to revisit the emergency department or require a rehospitalization within twelve months.<sup>235</sup>

Support for “healthy homes” policies and green building practices increased significantly in recent years. These interventions promote safe, adequate, and sanitary housing as a means to reduce exposure to common asthma triggers, particularly for low-income renters who may be most vulnerable.

---

**Strategy: Improve housing quality for rental units, including assisted rental units like public housing, through “healthy home” policies and green building practices.**

---

There were successful federal and local efforts to pass legislation to improve the conditions of rental housing to improve health outcomes. Notably, the U.S. Department of Housing and Urban Development (HUD) issued a mandate requiring Public Housing Agencies administering low-income, conventional public housing to maintain a smoke free policy.<sup>236</sup> This rule, which took effect in 2017, is an important ruling for people with asthma living in public housing and is likely to have positive health impacts among this vulnerable population.

At the local level, New York City took bold action in passing the Asthma-Free Housing Act in December 2017. Under this law, property owners are responsible for identifying and remediating indoor allergens in the homes of residents with asthma, chronic obstructive pulmonary disease (COPD), or lung cancer.

Nonprofit leaders, researchers, and other stakeholder are also raising awareness about the connection between rental housing quality and health, which could help foster systemic change in housing policy. The National Center for Healthy Housing (NCHH) and the American Public Health Association (APHA) created a National Healthy Housing Standard, a health-focused property management policy that stakeholders can use to improve community health. Additionally, the NCHH and the APHA recently published case studies featuring two cities with integrated healthy home provisions in their city code—Tukwila, Washington, and Dallas, Texas. Similar reforms in other municipalities nationwide could help improve the quality of rental housing and reduce asthma disparities.<sup>237</sup>

## NATIONAL HEALTHY HOUSING STANDARD

The *National Healthy Housing Standard* is a resource for property owners, elected officials, code agency staff, and healthy housing advocates. It sets minimum performance standards for a safe and healthy home.

To reduce asthma exacerbations, the Standard<sup>237</sup> sets guidelines for:

- indoor moisture reduction to prevent mold growth
- pest management to control cockroaches and rodents
- smoke free policies to limit secondhand and thirdhand smoke exposure
- restricted use of manufactured building materials that contain harmful levels of toxic substances such as formaldehyde and volatile organic compounds

More information about the *National Healthy Housing Standard* is available at [nchh.org](http://nchh.org) and [apha.org](http://apha.org).

Green building practices, well-known for their positive environmental effects due to their use of eco-friendly materials and energy-saving techniques, are increasingly associated with improved health and wellbeing.<sup>238</sup> Substantial evidence shows that healthy housing practices are essential for asthma control. There are several green and healthy housing initiatives that align clinical asthma treatment with home-based environmental hazard remediation.<sup>239</sup> These initiatives are often developed through partnerships with healthcare providers, environmental health service providers, payers, and policymakers. Many nonprofit organizations are leading these initiatives.

## ORGANIZATIONS IN ACTION

**The Green & Healthy Homes Initiative (GHHI)** provides evidence-based direct services in Maryland and technical assistance to public- and private-sector partners to develop, implement, and finance healthy home programs nationwide. GHHI received the 2015 EPA National Environmental Leadership Award in Asthma Management in recognition of its innovative, community-based approach that addressed asthma.

GHHI uses coordinated intake measures, comprehensive assessments, and integrated interventions to provide a variety of financial and programmatic resources needed to make improvements for health, safety, and energy usage in the home. These integrated interventions reduce costs by 20–25% by reducing travel time, site preparation, effort duplication, and other inefficiencies that drive up costs when multiple contractors are used to perform multiple interventions in a single home.

In recent years, GHHI has been developing projects with health plans, healthcare providers, environmental health service providers, and policymakers to allow for Medicaid funds to pay for home-based programs that provide comprehensive environmental health services. These interventions dramatically reduce the incidence of medical utilization related to asthma, including hospitalizations, emergency room visits, and doctor visits, and further 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.

**The Pierce County Healthy Homes (PCHH) Partnership** used Weatherization Plus Health (Wx+H) program funding to develop and implement a pilot program that promoted improved health outcomes. It combined energy and cost-saving weatherization enhancements with disease management education and trigger reduction strategies to improve the home environment for families managing asthma. The pilot showed some promising results. Eighty-six percent of households with follow-up home assessments reported taking two or more actions to reduce environmental triggers or improve medical management. Sixty-five percent of clients reported improved asthma control, and 70% of asthma patients reported improved quality of life.<sup>240</sup>

Various literature exists that describes how the physical, social, and economic features of a person's neighborhood affects health outcomes and quality of life.<sup>241</sup>





Throughout the past decade (2010–2020), several healthy housing initiatives emerged that align clinical asthma treatment with home-based environmental hazard remediation through partnerships with payers, healthcare providers, environmental health service providers, and policymakers. Investing in these programs is an important strategy for reducing disparities in asthma.

---

**Strategy: Directly finance or support reimbursement models for programs that align asthma clinical interventions with home assessments, indoor environment improvements, and remediations to reduce asthma triggers.**

---

Various innovative financing strategies exist to support healthier homes:

- Federal Housing and Health Grant Programs: HUD Lead and Healthy Homes grants, Community Development Block Grants (CDBG), Community Services Block Grant (CSBG), and other community development programs
- Foundations: There are several foundations committed to providing support to programs that implement upstream solutions for promoting health equity. At the national level, the Robert Wood Johnson Foundation and the Kresge Foundation are key examples. Others at the state and local level may share an interest in this area of work.
- Payers: There is a movement to change Medicaid guidelines to allow for funds to pay for home intervention programs that decrease medical utilization related to asthma and address health inequities related to asthma.
- Pay for Success (PFS) is a financing model in which an initial investor provides funding to a service provider who uses the funds to deliver evidence-based services to a defined population for measuring outcomes and cost savings for a backend payer, who then repays the investors.

With adequate financing, healthier housing initiatives have the potential to affect upstream social determinants of health and promote health and health equity.

## HOUSING STABILITY AND AFFORDABILITY

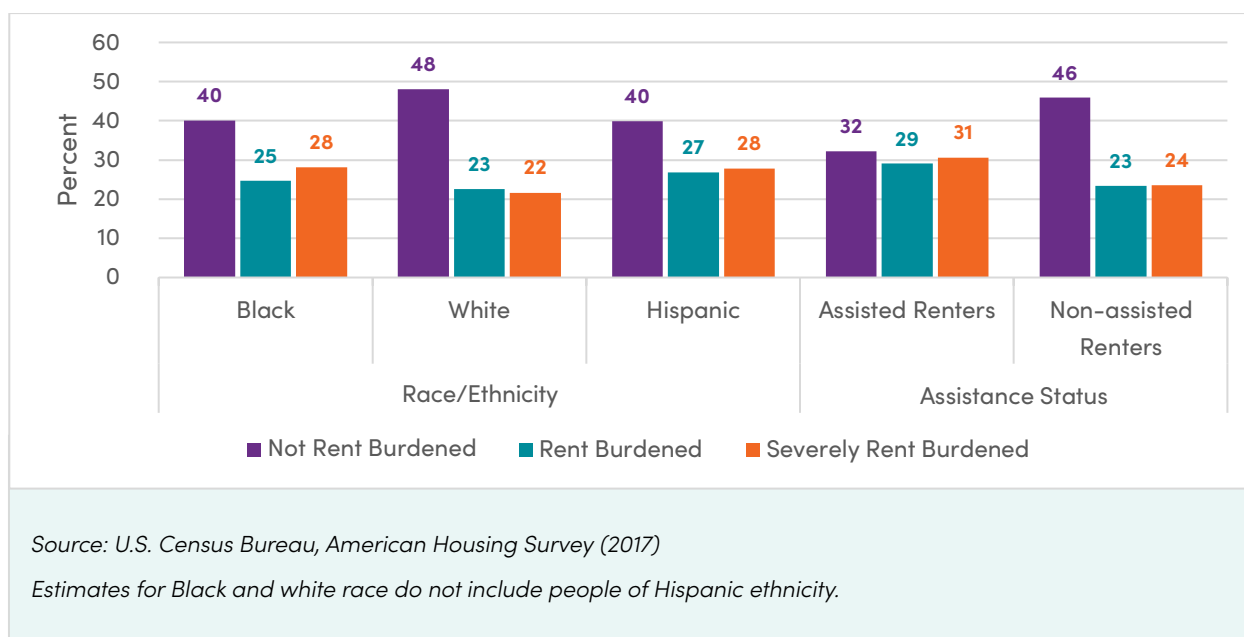
The quality of an individual's physical environment often correlates with their economic stability. Housing affordability and stability have become a significant policy concern in the context of health disparities. Families experiencing housing instability, such as trouble paying rent, frequent moving, overcrowding, homelessness, and high rents, are at a greater risk for asthma-related hospitalizations and other negative health outcomes.<sup>242</sup>

The unacceptable prevalence of housing insecurity in the U.S. is due to a shortage in affordable rental housing. The demand for low-rent units continues to exceed the supply available in the limited rental market. Many low-income individuals and families are forced to rent substandard housing with increased exposure to indoor asthma triggers.

Rent burden is higher among Black and Hispanic renters compared to white renters, and higher among renters using federal housing assistance. Households are considered to be rent burdened if more than 30% of the household income is used for housing and are considered severely rent burdened if housing costs are greater than 50% of monthly income. In 2017, 53% of all Black renters and 55% of Hispanic renters in the U.S. were rent burdened or severely rent burdened, compared to 45% of white renters. Among renters living in HUD-assisted rental units, 60% were burdened compared to 47% of renters not in assisted housing programs (Figure 36).

Families with asthma who experience high rent burden have little money to spend on asthma care and management, significantly increasing the risk of poor asthma control and negative outcomes, such as ED visits.

Figure 36. Rent Burden by Race, Ethnicity and Assistance Status



To support affordable housing and attempt to lessen the crisis, the federal government implements various housing programs and tax policies. These programs and policies are critical in providing safe, stable housing for the most vulnerable populations, including low-income families living with asthma. But it is not enough. An increased and unified commitment to supporting these programs is necessary for reducing disparities in asthma.

---

## Strategy: Increase access to affordable, quality housing through expanded rental assistance programs, tax credits, and inclusionary zoning programs.

---

Federal rental assistance programs, funded through the U.S. Department of Housing and Urban Development (HUD) and often administered by local housing agencies, enable low-income households to better afford decent homes and promote housing stability among socioeconomically vulnerable populations. HUD offers three main programs for low-income families:

- Housing Choice Voucher Program: This program enables families to rent their choice of privately-owned, affordable quality housing. This support not only increases low-income families' access to economic opportunity and safer neighborhoods but also demonstrated the potential to promote health equity.<sup>243</sup>
- Project-Based Rental Assistance programs: These programs enable low-income households to afford modest apartments in specific privately-owned units that have contracted with the agency.
- Public housing: These units are owned and operated by local housing agencies nationwide and offer more affordable options for eligible renters.

## HOUSING CHALLENGES

Federal housing programs have an important role in ensuring safe, affordable housing for vulnerable populations. However, rental assistance programs face many challenges in promoting true housing and health equity:

- Inadequate funding
- Long waiting lists
- Insufficient resources to ensure safe living conditions
- HUD's "fair market rent" calculations for metro areas include suburbs thus reducing assistance and options available
- Programs often concentrate families in high-poverty areas and limit mobility to higher-opportunity areas which contributes to intergenerational poverty
- Mobility programs do not always provide information and assistance to support successful moves for families
- Tight market conditions, housing shortages, and landlord discrimination may prevent families who receive assistance from finding eligible housing
- Families may be hesitant to report unsafe or unhealthy conditions because of how hard it is to find an affordable place to live

Addressing the barriers to safe, affordable housing is critical to ensure better asthma management and higher quality of life for low-income families managing asthma.

The government encourages the development of affordable housing through various incentives. Inclusionary zoning programs, for example, use local land use regulations to require or incentivize the production of affordable housing as part of market rate housing development. In other words, a percentage of new housing developments must be reserved for low- or moderate-income housing, which promotes diversity and inclusion within the neighborhood and reduces disparities.<sup>244</sup>

Similarly, the Low-Income Housing Tax Credit (LIHTC) contributes to the expansion of affordable housing by encouraging the construction and preservation of millions of rental units. However, the LIHTC is not enough to fully meet the needs of the low-income housing market on its own. Other initiatives are implemented simultaneously to further create affordable housing for low-income households. The Home Investments Partnership Program (HOME) is a federal block grant that provides grants to states and localities to respond to affordable housing challenges by building, buying, or rehabilitating affordable housing. However, federal funding for the HOME program decreased in recent years, leaving gaps in resources and financing for affordable housing.

## NEIGHBORHOOD CHARACTERISTICS

A large body of literature describes how the physical, social, and economic features of an individual's neighborhood affect health outcomes and quality of life.<sup>245</sup> Segregated neighborhoods limit access to health care services and tend to be urban areas with limited greenspace. Racial and ethnic minority and low-income families disproportionately suffer from poor asthma control due to poor housing conditions and living in less healthy locations.<sup>246</sup>

Asthma in low-income, urban environments (“inner-city asthma”) has been the subject of many studies over the past two decades (2000–2020). A Johns Hopkins University study of 1.5 million children ages 5–17 enrolled in Medicaid across 18 states in 2009–2010 found that inner-city urban residence—defined to be where at least 20% of households live below the federal poverty line—resulted in an estimated 40% higher risk of asthma-related emergency department visits and a 62% higher risk of asthma hospitalization. The study concluded that 30% of the risk of asthma hospitalization was attributable to Black race, urban residence, and living in poverty.<sup>247</sup> In fact, the factors associated with asthma and low-income, urban environments have been extensively described: disease severity, quality of care, indoor and outdoor allergens and irritants, housing, environmental tobacco smoke, outdoor pollution, obesity, prematurity, and psychosocial factors.<sup>248</sup>

**30%** of risk of asthma hospitalization is attributable to Black race, urban residence, and living in poverty

*Source: Keet, et al., Urban residence, neighborhood poverty, race/ethnicity, and asthma morbidity among children on Medicaid (2017)*





A long history of discriminatory housing policies in the U.S. resulted in current residential segregation, constraining many families of color to undesirable neighborhoods where poverty rates are high and economic and educational opportunities are low.

One of the ways residential segregation disadvantages minority patients is by concentrating health care resources and facilities in predominantly white, higher-income communities. Segregated communities of low-income, minority populations tend to have more safety net and community health clinics and less private and specialty medical clinics.<sup>249</sup>

Improving conditions in current communities is an important strategy to reduce the impact of housing inequities and to expand opportunity for low-to moderate-income families. Various public and private programs exist that aim to foster comprehensive community and economic development so that families can thrive. There are federal and state programs and funding opportunities that support collaborations between the corporate sector and government and community leaders to work together to serve distressed areas. Further, several private funders support local community development efforts for revitalizing underfunded neighborhoods.<sup>250</sup>

In addition to initiatives that expand affordable housing access, various policies and programs exist that have the potential to diversify neighborhoods, desegregate housing, and reduce health disparities.

One way to improve health and reduce disparities is to promote access to green spaces. “Green space” can be used to describe any undeveloped space.<sup>251</sup> However, when used wisely, such as for community gardens that produce healthy and fresh foods, or for parks that offer a safe space for recreation, green spaces have the potential to improve environmental quality and community health.

---

**Strategy: Desegregate residential neighborhoods through mobility programs and neighborhood revitalization efforts.**

---

Ozone is one of the most widespread air pollutants and is the main component of smog or “haze.” Increased ozone concentration is directly related to asthma attacks and can reduce lung function. It is most found in cities with more cars and on high heat days. In 2018, EPA scientists conducted a report called “Assessing Human Health PM2.5 and Ozone Impacts from U.S. Oil and Natural Gas Sector Emissions in 2025.” Without intervention, the report estimates that ozone-related health effects from the oil and natural gas industry alone in 2025 will contribute to 1,970 premature deaths, 39,000 individuals with upper and lower respiratory issues, 3,600 emergency department visits, and 1.1 million asthma attacks.<sup>254</sup>

Particle pollution is also a significant risk factor for asthma. Airborne particles pass through the nose or mouth directly into the lungs. Fine particle pollution comes from many sources, including agricultural and wildfire smoke, as well as the burning of fossil fuels in factories, power plants, and vehicles. Particle pollution diminishes lung function and can worsen asthma. Increased short-term particle pollution exposure also leads to increased hospitalizations and severity of asthma attacks in children.<sup>255</sup>

The Department of Housing and Urban Development (HUD) funded a ten-year demonstration project called The Moving to Opportunity (MTO) for Fair Housing. The program supported a set of low-income families in using housing vouchers for rentals in communities with very low levels of poverty.<sup>252</sup> Researchers found that children whose families moved to low-poverty neighborhoods when they were young (below age 13) experienced higher college attendance rates and earnings compared to a control group.<sup>253</sup> However, the effect was reversed for children whose families moved when the child was 13 or older, demonstrating the complexity of how and when neighborhood factors affect children’s long-term outcomes.

By implementing policies and practices that invest in affordable housing, better geographically distribute affordable housing, and expand mobility programs for low-income Americans, we can work toward residential desegregation across the U.S. Reducing disparities in housing remains an important step in addressing disparities in asthma.

## AIR QUALITY

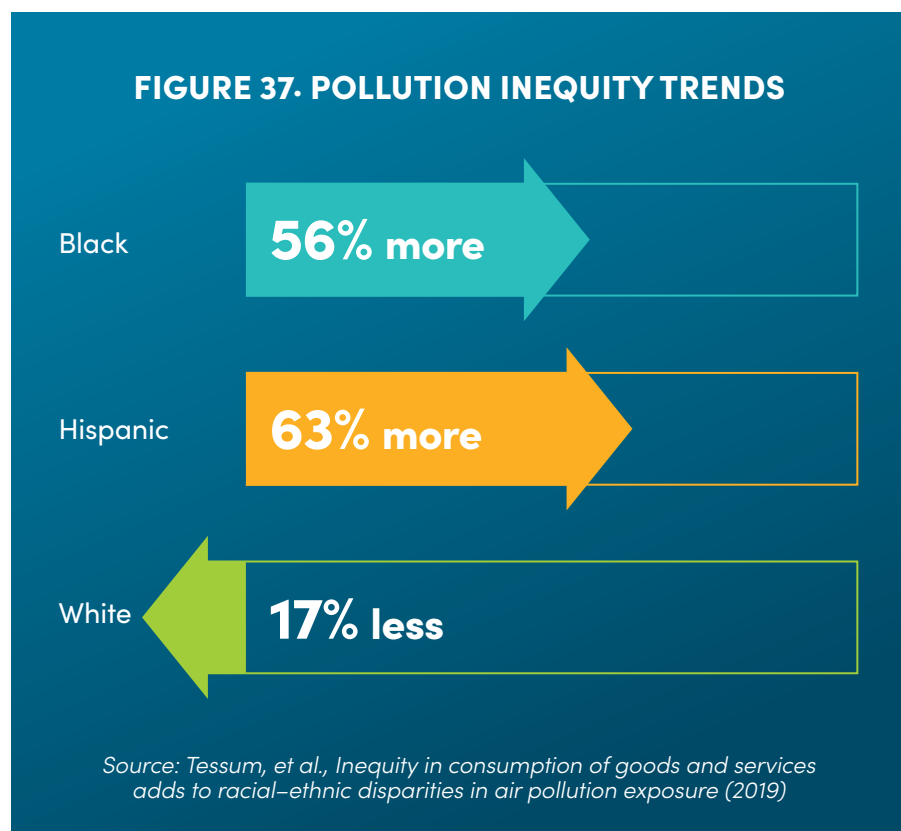
Poor environmental conditions can bring about greater exposure to air pollution—including tobacco smoke, ozone pollution, and particulate pollution—that contributes to poor asthma outcomes.

Environmental tobacco smoke (ETS) is a mixture of pollutants caused by the burning of tobacco products and the smoke exhaled by smokers. ETS is a major contributor to indoor air pollution, particularly in homes, apartment buildings, and vehicles. ETS also worsens outdoor air quality in highly trafficked pedestrian areas like entrances to multifamily housing units and shopping areas.

Gases like ozone and nitrogen dioxide, small particulate matter, and biological molecules contribute to outdoor air pollution, also known as atmospheric or ambient air pollution.

As with many determinants of health, the burden of air pollution falls disproportionately on racial and ethnic minorities. Residential segregation resulted in large percentages of racial and ethnic minority populations living near sources of outdoor pollution, such as industrial centers, major roadways, oil and gas refineries, and distribution hubs. In urban areas, traffic-related pollution is often the primary polluting source. Individuals living in these areas are also predominantly low-income and at risk for poor asthma due to economic factors. Proximity to sources of pollution, amplified by socioeconomic stressors like poverty, leads to poor asthma outcomes.

A 2019 analysis of links between human activities and air pollution found that exposure to pollutants, specifically, fine particulate matter (PM<sub>2.5</sub>), was disproportionately experienced by Black and Hispanic populations, but that emissions were disproportionately caused by white populations. The study highlighted the role of race and ethnicity in driving this pollution inequity, defined as the “fractional difference between a racial-ethnic group’s exposure to PM<sub>2.5</sub> caused by all groups and that group’s population-adjusted contribution to the overall PM<sub>2.5</sub> exposure of all groups”. “Pollution burden” was high among Black populations (56% inequity) and Hispanic populations (63% inequity), while white populations experienced a “pollution advantage” (17% equity), on average (Figure 37).<sup>256</sup>



“*Fine particulate matter (PM<sub>2.5</sub>) exposure is a major health risk factor in the United States, responsible for 63% of deaths from environmental causes and 3% of deaths from all causes.*<sup>256</sup>”

- Tessum, et al.

Nearly half of the U.S. population live in areas with unhealthy levels of ozone or particle pollution, and this number has increased in recent years.<sup>257</sup> Climate change—a public health emergency—is one of the most critical explanations for this increase in pollution.<sup>258</sup>

Though some political action and regulation has been put in place, the actions underway now will not be enough to combat climate change and protect people with asthma. The Clean Air Act of 1970 was passed to combat a variety of air pollution problems through evidence- and science-based programs and achieved dramatic reductions in air pollution since its passing.



*Secondhand  
smoke  
[environmental  
tobacco smoke]  
causes numerous  
health problems  
in infants  
and children,  
including  
more frequent  
and severe  
asthma attacks,  
respiratory  
infections, ear  
infections, and  
sudden infant  
death syndrome.*



- U.S. Environmental  
Protection Agency

As part of its mission to protect the health of individuals and the environment, the EPA maintains civil and criminal enforcement efforts to ensure that the requirements of major federal environmental laws, such as the Clean Air Act, are met. Unfortunately, recent trends include a decline in the number of enforcement cases initiated, a reduction in enforcement staff, and an overreliance on state enforcement programs.<sup>259, 260</sup>

A 2019 report by the Environmental Data and Governance Initiative (EDGI) examined environmental enforcement at the EPA from 2017–2019.<sup>261</sup> Its main finding was that the EPA lost significant capability to fulfill its mission to ensure enforcement of federal environmental laws. Individual states cannot make up for weak federal environmental inspections and a poor federal enforcement system. Budget cuts at many state agencies are also driving declines in state-level inspection and enforcement.<sup>262</sup>

In addition to decreasing enforcement actions, the EPA endeavored to weaken many important standards that unnecessarily increase levels of carbon and other pollution and negatively affect human health. EPA is the cornerstone of the environmental public health infrastructure in the United States and its mission to protect the public's health and the environment is critical to the wellbeing of our country. Strong environmental laws and enforcement of these laws are needed to ensure EPA's mission is achieved, and the communities disproportionately affected by air pollution are protected.

Robust policy reform is needed to reduce the disproportionate impact of air pollution on racial and ethnic minorities and its associated poor asthma outcomes. To achieve a more equitable outdoor environment, policymakers must take decisive and immediate action.

---

**Strategy: Combat environmental injustice and reduce exposure to pollution by strengthening clean air policies, reducing transportation-related emissions, restricting zoning of polluting sources, and transitioning to a clean energy economy.**

---

Strengthening the Clean Air Act and opposing attempts to weaken it are critical to ensuring access to clean air for all Americans. The adoption and enforcement of strong standards is necessary to reduce the emission of harmful air pollutants that affect climate change and perpetuate environmental injustice.



Measures to increase fuel efficiency and reduce vehicle emissions, such as carbon dioxide, hydrocarbons, nitrogen oxide, particulate matter, and mobile source air toxins<sup>263</sup>, can address the burden of air pollution on two fronts. Populations near highways will benefit from reduced pollution in their immediate outdoor environments, while other communities will benefit from upstream pollution reductions associated with the extraction, transportation, and refinement of petroleum products.



In addition to addressing traffic pollution, policymakers must ensure other pollutant sources are not placed in low-income and minority residential communities. There are two main hypotheses that account for the disproportionate exposure of low-income, largely racial and ethnic minority populations to pollutant sources. One is that the communities have limited political power and influence to prevent construction near pollutant sources, and alternatively, that the presence of a pollutant source causes a decline in values to the adjacent properties, making them more accessible to low-income populations.<sup>264</sup> Strict regulations that would prevent dangerous, pollutant sources from being zoned near residential communities could address both theories and diminish the burden of air pollution on marginalized communities.

Promoting a clean energy economy is critical to addressing the disproportionate burden of asthma. Moving away from a fossil fuel-based economy to a clean, renewable energy-based economy will not only reduce harmful emissions from polluting sources but also reduce the impact of climate change. Climate change is directly linked to increased ozone and particulate pollution as well as longer and more intense allergy seasons, which is prolonging and expanding exposure to common asthma triggers. Extreme weather patterns such as heat and severe storms, and wildfires and wildfire smoke are destabilizing communities and reducing access to health care. Policies that incentivize an equitable transition to a clean energy economy will be vital for promoting long-term health equity.

## Summary of Public Policy Strategies to Address Asthma Disparities

CATEGORY	STRATEGIES
<b>Health Care</b>	<ul style="list-style-type: none"> <li>• Expand health insurance coverage for socioeconomically disadvantaged adults and children</li> <li>• Improve coverage of asthma guidelines-based care and treatments by expanding specialist care coverage, lowering copays, expanding eligibility criteria, and removing prior authorization and step therapy barriers</li> <li>• Increase diversity in the primary and specialty health care workforce</li> <li>• Increase the percentage of minority patients with a “usual source of care” by addressing provider shortage areas, removing financial barriers to office-based primary care services, and expanding the primary care infrastructure to integrate better care coordination</li> <li>• Develop sustainable models for care coordination and case management that do not place financial burdens on patients</li> <li>• Encourage and incentivize state and local health departments to adopt comprehensive community asthma programs</li> </ul>
<b>Economic Stability</b>	<ul style="list-style-type: none"> <li>• Increase minimum wage for jobs often held by minority workers</li> <li>• Reduce the racial wage gap in the U.S. labor market</li> <li>• Implement tax policies that help low-income families accumulate more wealth</li> </ul>
<b>Education</b>	<ul style="list-style-type: none"> <li>• Increase access to quality early childhood education and care</li> <li>• Create more equitable school finance systems</li> <li>• Reduce exposure to environmental triggers by improving school building conditions and improving air quality in and around schools</li> <li>• Enact federal and state legislation to put important protections in place for schoolchildren with asthma.</li> </ul>
<b>Physical Environment</b>	<ul style="list-style-type: none"> <li>• Improve housing quality for rental units, including assisted rental units like public housing, through “healthy home” policies and green building practices.</li> <li>• Directly finance or support reimbursement models for programs that align asthma clinical interventions with home assessments, indoor environment improvements and remediations to reduce asthma triggers</li> <li>• Increase access to affordable, quality housing through expanded rental assistance programs, tax credits and inclusionary zoning programs</li> <li>• Desegregate residential neighborhoods through mobility programs and neighborhood revitalization efforts</li> <li>• Encourage smoke-free environments</li> <li>• Combat environmental injustice and reduce exposure to pollution by strengthening clean air policies, reducing transportation-related emissions, restricting zoning of polluting sources and transitioning to a clean energy economy</li> </ul>

PUBLIC POLICY



# ADDRESSING ASTHMA DISPARITIES THROUGH DIRECT INTERVENTIONS AND PROGRAMS

---

Clinical, educational and environmental interventions can improve asthma outcomes in diverse, racial and ethnic minority populations.





Poor outcomes in asthma among racial and ethnic minorities and low-income individuals can be attributed to factors that can be modified, such as triggers in the physical environment, lack of access to quality health care, and behavior regarding treatment adherence. Asthma education and management programs tailored to diverse, racial and ethnic minority populations can address many of these factors. Various such programs have been tested with demonstrable success in many low-income or “underserved” communities. The widespread adoption of such programs could potentially alleviate a large portion of the burden of asthma on underserved populations.

The essential components of successful asthma programs vary by community. However, upon reviewing existing programs, which are diverse in scale and scope, many common themes appear. To be successful, programs must:

- Comprehensively target behavioral and social drivers of disparities, often through integrated medical, educational, and environmental interventions
- Be tailored for diverse populations and cultures
- Be scalable and sustainable
- Address all four components of the National Heart Lung and Blood Institute’s (NHLBI) National Asthma Education Prevention Program’s (NAEPP) clinical guidelines for asthma<sup>19</sup>:
  1. Assessment and monitoring of asthma control
  2. Self-management and education
  3. Pharmacological treatment
  4. Reduction of environmental triggers

Initial approaches to asthma management focused only on medical intervention models targeting downstream behavioral factors. Current approaches feature comprehensive, multidimensional programs targeting more upstream social factors. There has also been a shift from single-setting (e.g., clinic, home, and school) interventions to integrated, multilevel programs that incorporate clinic-based, home-based, and school-based elements. Siloed approaches limited to a single setting are unlikely to produce long-term success and sustainability.



Table 10 summarizes the clinical, educational and, environmental components of successful community-based asthma programs discussed on the following pages.

**Table 10. Components of Successful Community-Based Asthma Programs**

<b>COMPONENT</b>	<b>Clinical Intervention</b>	<b>Social (Educational) Intervention</b>	<b>Environmental Intervention</b>
<b>COMMON SETTING(S) FOR DELIVERY</b>	<ul style="list-style-type: none"> <li>• Clinic</li> </ul>	<ul style="list-style-type: none"> <li>• Home</li> <li>• Clinic</li> <li>• School</li> <li>• Digital</li> </ul>	<ul style="list-style-type: none"> <li>• Home</li> <li>• School</li> <li>• Community</li> </ul>
<b>COMMON ELEMENTS</b>	<ul style="list-style-type: none"> <li>• Assessment of asthma severity and ongoing monitoring of control</li> <li>• Education on the basic anatomy and physiology of asthma</li> <li>• Medical prescription and adherence</li> <li>• Action plan completion</li> <li>• Case management and care coordination</li> </ul>	<ul style="list-style-type: none"> <li>• Self-management education about symptoms and triggers</li> <li>• Management strategies</li> <li>• Medication adherence and technique</li> <li>• Education around trigger assessment and reduction</li> </ul>	<ul style="list-style-type: none"> <li>• Home assessment</li> <li>• Trigger remediation</li> <li>• Provision of products like encasements, vacuums, and cleaning supplies</li> <li>• Resources and referrals (e.g., pest management, cleaning services, mold removal, and legal/housing assistance)</li> <li>• Pest management education and tools</li> <li>• Encouragement of smoke-free environments</li> </ul>
<b>COMMON CARE TEAM</b>	<ul style="list-style-type: none"> <li>• Physician</li> <li>• Nurse</li> <li>• Case manager</li> <li>• Respiratory therapist (RT)</li> <li>• Pharmacist</li> </ul>	<ul style="list-style-type: none"> <li>• Community Health Worker (CHW)</li> <li>• Certified Asthma Educator (AE-C)</li> <li>• RT</li> </ul>	<ul style="list-style-type: none"> <li>• CHW</li> <li>• AE-C</li> <li>• RT</li> <li>• Social worker</li> <li>• Legal/Housing expert</li> <li>• School nurse</li> </ul>
<b>COMPONENT OF ASTHMA CARE FROM EPR3 NAEPP GUIDELINES</b>	<ul style="list-style-type: none"> <li>• Assessment and monitoring of asthma control</li> <li>• Pharmacological treatment</li> </ul>	<ul style="list-style-type: none"> <li>• Education to improve self-management skills of patients and their families</li> </ul>	<ul style="list-style-type: none"> <li>• Reduction of environmental triggers that worsen asthma</li> </ul>

## CLINICAL INTERVENTIONS

Effective asthma management relies on proper assessment and treatment. Many interventions for improving asthma outcomes begin by addressing modifiable behaviors regarding disease management and treatment adherence at the individual and family levels. Often, the clinic serves as the medical home for the patient. Elements of clinic-based approaches include:

- Assessment of asthma severity and ongoing monitoring of control
- Education on the basic anatomy and physiology of asthma
- Provision of medicine prescriptions and encouragement for treatment adherence
- Action plan completion
- Case management and care coordination

The goal of the medical intervention is to decrease hospitalizations, reduce overreliance on quick-relief or systemic corticosteroid medications, and increase adoption of asthma action plans and appropriate use of control (preventative) medications.

## CLINICAL ASSESSMENTS

The quality of a medical provider visit is critical for asthma management. Patients should be asked about specific symptoms or activity limitations and the extent of their quick-relief (short-acting beta agonist) inhaler use. Patients should be taught how to recognize symptoms, handle asthma exacerbations, use their inhalers, and monitor their asthma control. Asthma action plans are also critical, as these tie together education, self-monitoring, and medication use for the patient in between regular physician visits.

Shared decision-making (SDM) between physicians and patients emerged as an important area of investigation in the last decade (2010–2020). The idea is that with greater mutual respect and better bidirectional communication, managing asthma could be more effective. In a study using six focus groups of Black adults with persistent asthma at two Federally Qualified Health Centers (FQHC) in Philadelphia, Pennsylvania, patients felt their treating physicians did not respect a patient's autonomy to make their own decisions.<sup>265</sup>

---

**Strategy: Integrate principles of shared-decision making into practice. Equip providers and patients with tools to improve communications on diagnosis and treatment options.**

---

## PROVIDER-PATIENT COMMUNICATIONS

An important target for reducing asthma disparities is to address knowledge and communication gaps that arise between clinicians and patients during, in between, and after scheduled visits. These gaps between provider and patient can create significant barriers to achieving and maintaining asthma control. One approach is to use “patient advocates” or “navigators” trained to communicate with patients and providers to identify specific problem areas and bridge communication gaps. This approach may have potential regarding the greater understanding of medication adherence barriers and as a communication channel for physicians when a patient has additional needs related to SDOH that could potentially be addressed outside of the clinic.<sup>266</sup>

---

**Strategy: Bridge communication gaps to improve shared decision-making between health care providers and patients by training “patient advocates/navigators” to identify and remedy specific problem areas in patient-provider communication.**

---



Training and enabling nurses to better screen for and help patients with asthma address their social determinants of health-related issues is also of current interest for improving asthma care for the most vulnerable populations. The Clinton Global Initiative has a program called Transition to Success (TTS), where care clinics can screen patients regarding social determinants of health as a billable health service and then coordinate with nurses or other care coordinators to match patients with available community-based resources.<sup>267</sup> As a billable service, professionals are reimbursed for their training and expertise, while the usefulness of these interventions can be tracked over time using claims software.<sup>267</sup>

---

**Strategy: Develop and implement training programs for health care professionals to identify asthma patients with social determinants of health-related issues and build community partnerships to match patients with local resources. To make this health service sustainable, it needs to be funded or reimbursable.**

---

## MEDICINE PRESCRIPTIONS AND TREATMENT ADHERENCE

Medicine use is an important factor in asthma disparities. The increased rates of emergency department (ED) visits and hospitalizations among poor and minority populations are due in part to non-adherence or barriers to proven asthma management strategies, including appropriate access to and use of medicines for long-term asthma control. Reasons for suboptimal adherence factors have been categorized as:<sup>268</sup>

- Medication-related: medicine costs, their side effects, proper use/technique, complex dosing regimens, and the need for multiple inhalers
- Intentional factors: overestimating one's control of asthma, skipping or not taking medicine, and not using asthma medicines due to a cultural or religious objection
- Unintentional factors: comorbidities that make it difficult to properly use an inhaler or that affect the response to medicine, lower health literacy, forgetfulness, and communication barriers between health care professionals and patients

Testing new approaches to improve asthma management and medicine adherence in different settings is needed. In fact, few randomized control clinical trials have been performed to assess approaches to increasing asthma control medication adherence rates in primarily minority populations. In one recent literature review, only five studies on adherence that included sufficient numbers of Black adults were identified. None of the approaches in those studies resulted in improved adherence.<sup>269</sup> The different approaches studied included problem-solving classes, a patient-advocate led program, training delivered by computer, clinic-based education sessions combined with home visits, and a pharmacist-led counseling session. Authors of the review point out that cultural adaptation of the intervention, stakeholder engagement to get input on setting up the experiment, and using a behavior theory approach for targeting specific barriers, and facilitators to adherence could all be important factors in ensuring future studies show increased adherence rates among Black adults.

### Changing Asthma Treatment Guidelines

Asthma guidelines-based medicine recommendations for asthma are undergoing significant revision in the U.S. with important implications for treatment adherence. Experts suspected that "as-needed" combination medicines of ICS and long-acting  $\beta$ 2-agonists (LABA) in mild to moderate persistent asthma, taken only when symptoms appear, work as well as daily maintenance doses of ICS and work better than only prescribing an as-needed short-acting beta-agonist (SABA).<sup>270</sup> Long-awaited evidence seems to confirm some of this. In large clinical trials, when compared to as-needed SABA, as-needed ICS/LABA does better at preventing attacks and results in better control for patients 12 years and older. When compared to daily maintenance ICS, as-needed ICS/LABA works just as well in preventing asthma attacks but not as well for asthma control, quality of life, or measures of lung function.<sup>271</sup>



The implications of these findings are numerous. Firstly, the estimate is that 75% of asthma is diagnosed as mild, but that an estimated 30–40% of asthma attacks in mild cases result in emergency department (ED) visits. Secondly, as-needed ICS/LABA compared to daily ICS drastically reduces the amount of ICS exposure by a cumulative 83% in one trial and by 75% in the other. This has the double benefit of a potential shift in beliefs and attitudes about ICS (less concern about side effects) and a reduction in asthma health care costs, since daily ICS is more expensive than when taken only as-needed.<sup>19</sup> Thirdly, these research results might help address long-held concerns in the asthma community about over-reliance on SABA quick-relief/rescue inhalers. Patients may feel better with a quick-relief/rescue dose of medicine and as a result stop taking their preventive controller medicine. Also, using ICS/LABA as-needed reduces the number of inhaler types needed for these patients while also reducing patient confusion about which inhaler to take and when. Of course, patients with mild asthma on as-needed ICS/LABA regimens would have to accept the likely appearance of symptoms in exchange for less exposure to ICS.<sup>19</sup> Experts also advised that this research was conducted with a specific ICS/LABA combination of ICS-formoterol, where the results may not apply to other LABA medicines used in combination with ICS.

---

**Strategy: Educate nurses, health educators, community health workers, and promotoras to provide guidelines-based asthma care and patient education on new treatments, including an as-needed ICS/LABA combination to control asthma.**

---

As asthma treatment recommendations shift to use as-needed combination medicine (ICS/LABA) therapy, health care providers and asthma education programs need to address any concerns of Black patients related to the safe use of these medicines. Based on a 2003 study called the “Salmeterol Multicenter Asthma Research Trial (SMART),” which reported a small increase in the risk of death and hospitalization in people with asthma, particularly Black patients, who used LABA therapy,<sup>272</sup> the FDA added a Boxed Warning, sometimes referred to as “black box,” on all medications containing salmeterol, including Advair, an ICS/LABA combination medicine. Upon later review, the study was found to have been poorly designed.

The FDA required drug companies that market LABAs to conduct new studies to assess potential dangers in using LABAs in combination with ICS. In 2016, the AUSTRI trial evaluated the safety of salmeterol (a LABA) and fluticasone (an ICS) combination in 12,000 people with asthma. The researchers ensured that 15% of the trial participants were Black Americans to assess if adverse events were related to race and ethnicity. The AUSTRI trial found that the risk of asthma attacks or adverse events was no greater for people taking the combination than taking the fluticasone ICS alone.<sup>273</sup> Additional studies confirmed the same result: ICS/LABA combination medicines were more effective in decreasing asthma attacks and decreased the need for oral corticosteroids. As a result, the FDA removed the Boxed Warning on medicines containing salmeterol.

Health care providers and asthma education programs may need to provide additional information about the benefits and risks of using ICS/LABA therapy to reassure any Black adults with asthma who remember the previous the *Boxed Warning*.<sup>274</sup>



### **Filling Prescriptions**

It seems increasingly important that patients and/or caregivers be asked on a regular basis if their prescribed asthma medicines are actually available at home. Using structured surveys in urban homes, researchers studied 335 kids with persistent asthma who were prescribed daily controller medicine from 2014–2016. When asked to present any types of asthma medicines currently available at home, only 45% could produce any type of asthma medicine. Furthermore, limiting the analysis to only children who were known via medical records to have filled a prescription in the past year, only 15% could show that the medicine was currently available in the home. In many of those cases, researchers determined medicines were shared among family members and that any kind of health insurance lapse in the previous year led to higher rates of unavailable medicines in the home.<sup>275</sup>

---

**Strategy: Reduce financial barriers to filling prescriptions, expand patient assistance programs, and integrate pharmacy care into medical practice by filling prescriptions during physician/ED visits so patients return home with appropriate medicines.**

---

Socioeconomic circumstances also overlap. When CDC NHIS data on 4,262 children with asthma ages 2–17 were matched to Medicaid claims data between 1999 and 2008, researchers showed that 63% discontinued their asthma controller medicine less than 90 days after the first prescription. Rates of discontinuation were higher for racial and ethnic minority populations and in single-parent households with three or more children and with caregiver education levels below grade 12.<sup>276</sup>

---

**Strategy: Expand pharmacy access by providing a three-month supply of asthma medicines and add an educational component to care so patients understand the importance of using their asthma medicines.**

---

## Asthma Action Plans

Personalized asthma action plans are also an important topic regarding adherence since asthma action plans are recommended for patients, especially when a patient is prescribed a controller medicine. Management of persistent asthma requires two types of medication: control or preventative medicine and quick-relief medicine. An asthma action plan helps people with asthma know when to use their medicines.

Research using CDC NHIS data determined action plans were in greater use by 2013 compared to 2003, but that in 2013, only around one-half of children with asthma were ever provided with one.<sup>277</sup> Moreover, it was shown that a greater percentage of Black children than white children received asthma action plans in 2013, although there is uncertainty as to whether this was due to more severe asthma or worse outcomes that made it more likely for Black children to receive an action plan. In addition, researchers found that action plans are used more frequently when patients have private insurance, which was not a surprise given that action plans require more time with a physician, which is shorter when paid for with public insurance.<sup>275</sup>

Personalized, culture-specific asthma action plans may help improve adherence and outcomes in racial and ethnic minority populations.<sup>278</sup> Culture-specific means asthma education is adapted to a specific culture, reflecting that culture's values, beliefs, language, and/or education which is provided by people from that culture. Using culturally appropriate education, language, and terminology can increase understanding between the health care provider and patient or caregiver. For example, patients might identify their inhalers by color, shape, common name, brand name, or nickname (e.g., "puffer," "puff," "pump"), which may not match the language provided on a standardized asthma action plan.

---

**Strategy: Ensure primary care and specialty providers offer personalized, culturally-appropriate asthma action plans using the patient's and caregivers' language and wording.**

---



A systematic review of seven available comparative studies that included 837 patients found that tailored educational programs reduce asthma attacks that require hospitalization, improve asthma control scores, and result in better quality of life measures for children. In adults, only the asthma quality of life scores were higher when using a culture-specific asthma educational program. Researchers concluded that culture-specific asthma education was likely effective and worthwhile but also noted that such programs are probably more expensive given the time and effort to adapt asthma messaging to a specific local context.<sup>279</sup>

People who live in an area where there are fewer asthma specialists wait longer for appointments, travel longer distances for care, and bear a heavier burden on personal finances and time.



AAFA's Asthma Capitals report highlights the ten cities in the U.S. with the fewest asthma specialists per patient:

1. Riverside, CA
2. Virginia Beach, VA
3. Ogden, UT
4. Modesto, CA
5. Bakersfield, CA
6. Dallas, TX
7. Atlanta, GA
8. New York, NY
9. Charlotte, NC
10. Greensboro, NC

Source: Asthma and Allergy Foundation of America, *Asthma Capitals (2019)*  
[asthmacapitals.org](http://asthmacapitals.org)

## CASE MANAGEMENT AND CARE COORDINATION

Working with a health care team to create a personalized plan to keep asthma under control is crucial when managing asthma. In addition to a primary care doctor, individuals with asthma might need specialist care, such as a pulmonologist, allergist, or immunologist who may have more experience treating patients with severe asthma or allergic asthma than a primary care physician. However, access to appropriate medical care depends on different factors, including socioeconomic status, insurance status, and availability of specialists in nearby locations. A 2017 review of asthma management in the U.S., found that based on NAEPP guidelines, the majority of asthma patients were uncontrolled and only 22% of patients visited a specialist regarding their asthma care.<sup>280</sup> Additionally, in a review of a pediatric asthma population, only 44% visited an asthma specialist within 12 months of an initial emergency department (ED) visit, contrary to guideline recommendations.<sup>280</sup> For those without access, the lack of availability of nearby asthma specialists may be associated with poor asthma outcomes.

In addition to potentially having more experience treating patients with varying asthma severity, specialists may also have more experience treating patients with asthma in conjunction with common comorbidities. Asthma is frequently associated with exacerbating comorbidities, such as allergic rhinitis, rhinosinusitis, gastroesophageal reflux disease (GERD), and obesity.<sup>281</sup> These comorbidities may further influence the asthma phenotype and may act as confounding factors in the diagnosis or assessment of asthma control.<sup>281</sup> Additionally, the presence of comorbidities can make it harder for individuals to control asthma. Therefore, optimal management often relies on confirming an asthma diagnosis, as well as identifying comorbidities that may contribute to persisting symptoms.<sup>282</sup>

---

**Strategy: Expand access to specialist care by increasing referrals from primary to specialty care, expanding specialist care coverage, and recruiting more specialists for areas with fewer available specialists.**

---

Specialized asthma management that addresses comorbidities often requires care coordination and case management, as research shows patients are less likely to follow-up on treatment if they are not offered assistance to connect them with qualified health care providers.<sup>283</sup> Though there is no consensus on the definition of care coordination, it is broadly defined as "the deliberate organization of patient care activities between two or more participants, including the patient, involved in



a patient's care to facilitate the appropriate delivery of health care services.<sup>284</sup> Care coordination often involves information exchange among personnel (e.g., HCPs, community partners, case managers) and other resources (e.g., insurance, medical history, test results) to provide high-quality and high-value care that meets patients' specific needs. Due to its complex nature, care coordination may place financial burdens on patients, particularly on those who are underinsured or uninsured.

Considering the potential financial burden, there have been a number of care coordination and case management efforts in recent years that have successfully targeted underserved populations in a variety of settings (e.g., homes, schools, virtual). Several studies show individuals in underserved communities who receive case management have significantly fewer hospitalizations, emergency department visits, clinic visits, and hospital days than those who do not receive case management.<sup>285, 286, 287</sup> Patients and families also demonstrate increased knowledge about asthma, including symptom identification, and experience significant cost savings.<sup>285, 286</sup> In school settings, case management can be particularly effective in identifying and managing pediatric asthma. A pilot study found that a combination of school nurse screening, case management, and collaboration with a medical provider resulted in early identification and subsequent treatment of students at risk for asthma.<sup>288</sup> In addition to its effects on asthma health outcomes, school nurse case management was associated with improved academic performance and reduced absences due to illness, so much so that testing scores of children with asthma who received school nurse case management nearly mirrored those of children without asthma.<sup>288</sup>

---

**Strategy: Expand case management to school settings by including school nurses as partners in a child's care team.**





Care coordination is highly specialized. However, existing literature has identified some successful pathways for care coordination beyond clinical settings. Within care coordination, dedicated case managers can educate patients, families, and school faculty (e.g., teachers, nurses) about asthma triggers and symptoms. In school settings, successful case management studies established school nurses as case managers who explain asthma screening findings to families, determine whether students currently receive asthma care, and if not, discuss options for care and refer the family to a selected provider.<sup>288</sup> School nurses can also help set up appointments with the private provider and provide follow-up to ensure that students have asthma action plans and the necessary medication and equipment available at school.<sup>288</sup> Community-based case managers can also work with landlords, property managers, and the public housing authority on housing code violations such as pests and mold, refer patients to inspectional services, legal services, food pantries, and smoking cessation resources, and assess eligibility and assistance obtaining benefits and services, including food stamps, Medicaid, shelter or day care placement, and tutoring.<sup>287</sup>

Though there is no “one size fits all” model for effective care coordination, research suggests multidisciplinary teams of case managers can be particularly effective in managing asthma outcomes.<sup>281, 289</sup> Additionally, beyond addressing medical needs, effective care coordination and case management should address social needs. Research shows that social support can be a mediating factor in the effect of case management on asthma control and treatment adherence, particularly in low-income and racial and ethnic minority communities. Community-based asthma case management can provide additional cultural and linguistic competency, which can further decrease asthma-related hospitalizations and ED visits.<sup>287, 290</sup> To improve patient outcomes for asthma, especially in underserved populations, care coordination with community-based organizations is key. In diversifying care coordination partners, health care providers are better equipped to effectively address social determinants of health, and in turn, asthma management is more effectively facilitated so that patients receive the care they need.

---

**Strategy: Develop multidisciplinary teams of case managers who also provide social support for effective asthma management among patients**

---

## EDUCATIONAL INTERVENTIONS

One of the main drivers of success in asthma care during the past two decades is the growth in number and diversity of asthma self-management education (AS-ME) programs. Evidence-based clinical guidelines in asthma recognized the importance of self-management education since at least 2007 given the complex interplay of managing medicines, avoiding triggers, and understanding how asthma works in the body.<sup>291</sup> AS-ME programs are designed to educate patients on self-care and cover:

- Medication adherence and inhaler technique
- Symptom management
- Trigger assessment and reduction

AS-ME programs come in many varieties and are designed for use in homes, schools, community sites, clinics, and other health care facilities.

### A REVIEW OF ASTHMA SELF-MANAGEMENT EDUCATION PROGRAMS

In a 2017 global meta-analysis of 270 different controlled trials, researchers found consistent evidence that AS-ME programs reduce asthma hospitalizations, ED visits, and unscheduled clinic visits, while improving symptom control and patient/caregiver quality of life. Furthermore, successful AS-ME programs were those that considered the "lived experience of asthma," addressing the everyday concerns of patients and caregivers, while also integrating asthma case management into clinic-based care.<sup>292</sup>

Perhaps the greatest evolution in terms of AS-ME and its potential for reducing asthma disparities is the shift from proven interventions in the clinic, home, or at school to connecting AS-ME efforts in each setting with one another. In bridging AS-ME efforts, today's programs recognize that the needs of patients and caregivers in the same community are diverse. As such, the approach of supported self-management in asthma should be more flexible within the broad parameters of holistic case-management.

---

#### **Strategy: Expand adoption of comprehensive asthma education programs for high-risk populations.**

---

The success of AS-ME in the U.S. comes from constant evolution. Approaches have been tested repeatedly in a variety of settings and for different population groups over time with results and lessons learned broadly shared. The CDC and the Agency for Healthcare Research and Quality (AHRQ) are among the agencies leading efforts to identify the optimal design and implementation of AS-ME programs.<sup>293, 294</sup>

AHRQ released a technical brief on the "Characteristics of Existing Asthma Self-Management Education (AS-ME) Packages" in April 2020. The purpose of the review was to "identify components of AS-ME packages, and examine, compare, and organize key characteristics and available research to improve understanding of current practice and future needs."<sup>295</sup>

AHRQ reviewed 14 AS-ME packages, seven systematic reviews, and 33 primary studies on AS-ME programs published since 2007. Table 11 outlines AHRQ’s inclusion/exclusion criteria, in the form of PICOTS: populations, interventions, comparators, outcomes, timing, and settings.

**Table 11. Inclusion Criteria for Evaluation of Existing Asthma Self-Management Education Packages**

PICOTS	CRITERIA
<b>Population</b>	<ul style="list-style-type: none"> <li>• Asthma</li> <li>• Any age</li> <li>• ≥50% U.S. patients</li> </ul>
<b>Intervention</b>	<p>AS-ME packages with:</p> <ul style="list-style-type: none"> <li>• Interactive component</li> <li>• Description of methodology for use or implementation</li> <li>• Available in the U.S.</li> </ul>
<b>Comparator</b>	<ul style="list-style-type: none"> <li>• No intervention</li> <li>• Control</li> <li>• Standard of care</li> <li>• Other AS-ME package(s)</li> </ul>
<b>Outcomes</b>	<p>Reports at least one outcome of interest listed under Guiding Question 3 (<i>What is the current evidence addressing AS-ME packages?</i>):</p> <ul style="list-style-type: none"> <li>• Asthma control</li> <li>• Asthma-related healthcare utilization</li> <li>• Asthma-related medication adherence</li> <li>• Asthma-related quality of life</li> <li>• Ease of use</li> <li>• Acceptability</li> <li>• Patient/family/instructor satisfaction</li> <li>• Feasibility</li> <li>• Adoption</li> <li>• Fidelity</li> <li>• Applicability</li> </ul>
<b>Timing</b>	Any
<b>Setting</b>	Any

Source: Agency for Healthcare Research and Quality. Technical Brief, Characteristics of Existing Asthma Self-Management Education Packages (2020)



The AHRQ evaluation results found AS-ME packages were “generally associated with improved asthma control, reduced symptom frequency, increased asthma knowledge and fewer school absences.”<sup>295</sup>

The characteristics of AS-ME packages evaluated by ARHQ included:

- Education designed to teach patients or their families directly or training health care professionals (e.g., health educators, school nurses, clinicians)
- Designed to teach self-management skills to patients of all ages
- Some AS-ME programs target specific patient populations (e.g., women, people in low-income communities, Hispanic/Latino communities, severity of disease).
- Various AS-ME programs can be delivered in different settings (homes, schools, health care facilities, community sites).
- All programs were designed in English. Spanish versions are available for many (but not all).
- Literacy levels were available for the AS-ME programs developed by the Asthma and Allergy Foundation of America (AAFA), but other packages reviewed by ARHQ did not self-identify literacy levels of potential users.
- Nearly all packages include a face-to-face educational element and are facilitated by a nurse, respiratory therapist, or nonclinical professional trained in asthma (community health worker or other health educator).
- AAFA’s “ASTHMA Care for Adults” program was the only program with a web-based component.
- All programs use paper-based materials, and some offered audio-visual components.
- Many AS-ME packages are available for free.

The educational content of AS-ME programs varied. AHRQ’s evaluation found most of the programs’ content was generally homogenous, with variations to reflect different audiences and settings. The topic areas include:

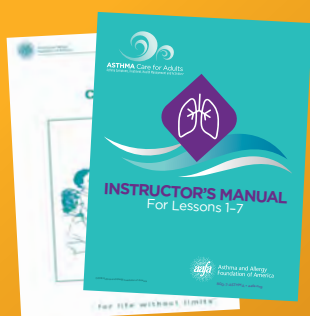
- Lung physiology with emphasis on asthma-related inflammation
- Medications and devices with emphasis on discussing controller and quick-relief medicines
- Symptom management covering monitoring, prevention, and treatment with emphasis on the use of asthma action plans
- Asthma triggers
- Additional content that addresses the cognitive, psychological, or emotional challenges experienced with asthma

---

**Strategy: Increase CDC and NHLBI funding to sustain and scale successful Asthma Self-Management Education (AS-ME) programs.**

---

Successful implementation of AS-ME programs depends on sustained funding, facilitator training, and the adaptability of the programs to be tailored to specific local settings, populations, or individuals. The ARHQ review found nine out of 14 AS-ME packages were developed with funding from the CDC and one was developed and funded by NHLBI. The Asthma and Allergy Foundation of America and the American Lung Association offer programs that provide educator training. NHLBI’s “A Breath of Life” program offers curriculum for promotoras, the Spanish term for community health workers. The review found little funding is available for AS-ME training. When an asthma program, educator, nurse, asthma educator, or clinic implements an AS-ME program, they need to evaluate if the curriculum is useful for their target audience and how much adaptation may be required to make the education relevant and useful for their intended audience.



The Agency for Healthcare Research and Quality reviewed five AS-ME programs developed by AAFA. The agency found that “AAFA’s ASTHMA Care for Adults” and “You Can Control Asthma” programs offered the highest number of recommended content topics (nine out of 11) for comprehensive AS-ME packages. AAFA’s programs develop content that is appropriate for multicultural, racial and ethnic minority, and low-income communities. Released in 2018, “ASTHMA Care for Adults” is distinguished for offering the most robust content features, including handouts, asthma action plan, symptom log, medication list, trigger checklist, participant assessment, certification of participation. “You Can Control Asthma,” a staple pediatric AS-ME program since 2005, is written at a third-grade level for students, with its parent materials written at a sixth-grade level. “You Can Control Asthma” is available in English and Spanish.

AAFA’s “You Can Control Asthma” program and NHLBI’s “A Breath of Life” program are the only two programs reviewed that included content to help families and patients implement strategies to improve treatment adherence.

## ADDRESSING MEDICATION ADHERENCE THROUGH EDUCATIONAL INTERVENTIONS

AS-ME programs conducted outside of clinics can supplement and reinforce information from clinicians on the role of asthma medicines, identifying asthma medicines, knowing how and when to use certain medicines, and reviewing asthma action plans.

The Severe Asthma Clinic at Rady Children’s hospital in San Diego, California uses a multidisciplinary team of physicians, nurses, respiratory therapists, pharmacists, and community health workers to improve outcomes for people (mostly children) with uncontrolled asthma. At each provider touchpoint with patients and caregivers, the team reviews the patient’s medicines and asks the patient-caregiver team to teach back what they know about their asthma medicines. The repetitive review of asthma medicines and inhaler technique prepares the patient for better self-management of asthma.

## INHALER TECHNIQUE

Teaching children and their caregivers proper inhaler technique continues to be a pillar of asthma self-management education. However, under direct observation, researchers found that children and caregivers can highly overestimate their ability to correctly use asthma medicines. In a year-long observational study in 2016–2017 of 65 children at four schools in Chicago, Illinois, 97% of whom were Black and 82% were low-income, researchers identified only one child able to use their metered-dose inhaler correctly, despite 71% of kids and 92% of parents being confident in inhaler technique.<sup>296</sup> Researchers discuss the importance of physicians having enough time



during clinical encounters to do hands-on demonstrations, and to review inhaler technique during follow-up visits. Inhaler technique was also studied in 113 children and caregivers admitted to a hospital for asthma. Researchers found that 42% missed a critical step in using their inhalers and that more errors were observed when using a spacer with a mouthpiece than when using a mask. Authors of the study note that inhaler technique education in the hospital inpatient setting is an opportunity to reach vulnerable patients, and that special attention to older children and adolescents is important given their transition from caregiver help to self-administration.<sup>297</sup>

---

**Strategy: Review inhaler technique at every care touchpoint, including home visits, ED and urgent care visits, and at schools when school nurses administer medicines.**

---

## SYMPTOM MANAGEMENT

The comprehensive education AS–ME programs provide can improve identification and management of asthma symptoms. Research shows individuals who complete a comprehensive asthma education program are more likely to engage in better self-management practices.<sup>298, 299</sup> Additionally, AS–ME programs promote self-efficacy and goal-setting for asthma patients, which contribute to more sustainable self-management practices.<sup>300</sup> For example, research suggests Black and Hispanic patients may perceive access to healthcare as an issue and may have a lesser understanding of their medications compared to white patients, but comprehensive action plan education can increase confidence in these populations, leading to better symptom management.<sup>301</sup> However, a 2015 study found that less than 20% of Black adolescents completed a comprehensive asthma education program.<sup>298</sup>

In addition to this lack of access, research points to clinically significant differences in the asthma symptoms reported between Black and white populations, with Black individuals less likely to experience nighttime awakenings, shortness of breath, and chest pain.<sup>302</sup> More common symptoms include chest tightness and wheezing, indicating a need for AS-ME programs that include these symptoms in order to effectively address self-management of asthma symptoms in Black populations.<sup>303</sup> Additionally, research suggests wheezing may be a more common symptom in Hispanic populations, and differences in asthma beliefs among Hispanic subpopulations may result in poorer self-management.<sup>304</sup> These findings support the importance of facilitating access to and reinforcing asthma education that is tailored to the needs, beliefs, and practices of each patient. Researchers recommend that clinicians working with diverse populations provide access to culturally and developmentally appropriate asthma education programs, and for this education to be reinforced at all points of care (e.g., clinics, schools, pharmacies, etc.).<sup>298</sup>



## TRIGGER REDUCTION

In home, school, and community settings, AS-ME programs can be particularly effective in reducing triggers and in improving asthma management. Research shows home-based education programs that target multiple triggers are effective in improving overall quality of life and productivity in children and adolescents with asthma.<sup>305</sup> As such, the NAEP EPR-3 recommends individually tailored, multi-faceted home-based interventions as a means to provide AS-ME and/or reduce environmental asthma triggers for specific populations.<sup>306</sup> However, within these interventions, it is important to tailor programs to the needs of the targeted population, which vary by age group, culture, language, and ethnicity.<sup>299</sup> Research shows AS-ME programs that take these needs into consideration improve the continued use of asthma action plans, which help patients better identify and manage triggers.<sup>299</sup> In addition to cultural considerations, location is an important factor in building and maintaining effective AS-ME programs, as trigger reduction in urban housing will differ from trigger reduction methods in rural Indigenous communities.<sup>307</sup> For these home-based intervention programs, research suggests AS-ME programs should incorporate environmental education, supplies, and services to reduce environmental asthma triggers.<sup>146</sup>



## ENVIRONMENTAL INTERVENTIONS

An individual's environment is especially influential in the context of asthma.<sup>308</sup> Reducing exposure to allergens and triggers is a cornerstone of successful asthma management and control. Indoor environments like homes, workplaces, and schools can expose people with asthma to numerous asthma triggers including mold, dust mites, volatile organic compounds, animal dander (including rodents), smoke, and other air pollution. An individual's outdoor environment may also lead to exposure to high pollen counts and air pollution, such as ground level ozone and traffic emissions. Outdoor pollutants can also infiltrate indoors. Some communities adopted strategies and programs to address asthma management in homes or developed community-wide strategies to reduce asthma's impact on high-risk populations in low-income, Black, or Hispanic communities. These programs may offer asthma education paired with environmental remediations or may only address particular facets of the local environment's impact on asthma.

## HOME-BASED INTERVENTIONS

Home visit programs that include multi-component asthma interventions are proven effective at improving quality of life, reducing asthma symptoms, and reducing missed school days.<sup>309</sup> Although varied in scope and scale, home-based environmental interventions generally include:

- A home assessment
- Trigger education and remediation
- Provision of trigger-abatement products, such as bedding encasements, vacuums, and cleaning supplies
- Referral to resources, such as cleaning services, mold removal, legal/housing assistance
- Pest management education and tools
- Encouragement of smoke-free environments

---

**Strategy: Reduce exposure to triggers in the home by providing trigger-abatement products and offering referrals to resources such as cleaning services, mold removal, pest management, and legal/housing assistance.**

---

Professionals conducting the assessment and education in the home, often called "home visitors," include community health workers (CHW), social workers, nurses, respiratory therapists (RT), or certified asthma educators (AE-C).

“

*The Community Health Worker is often the unsung hero in the frontline effort to intervene in the disproportionate burden of asthma on disadvantaged communities. These highly trained lay health educators are effective in working together with families to increase self-management skills and to remove asthma triggers as well as provide care coordination services. CHW's are often the glue that connects caregivers to the healthcare system, community resources and social support systems and a key driver in community efforts to reduce asthma disparities.<sup>311</sup>*

”

- Dr. Tyra Bryant-Stephens  
Community Asthma  
Prevention Program,  
Children's Hospital  
of Philadelphia

Home-based interventions usually begin with an assessment of the home environment during the initial visit. The home visitor also educates patients and families about environmental triggers and works with them to reduce exposure. Home visitors sometimes provide additional services, such as pest and dust management and control, or products, such as air purifiers and allergy-friendly bedding or encasements. For more extensive needs, such as severe pest infestations and structural repairs, home visitors often provide referrals to qualified professionals.<sup>310</sup>

---

**Strategy: Support and expand programs for community health workers, promotoras, nurses, social workers and certified asthma educators to conduct home-based assessments and interventions.**

---

The Healthy Homes project by the King County Asthma Program in Seattle, Washington evaluated and compared outcomes between education provided by in-clinic nurses and home-based visits by community health workers (CHWs). The home visits included home environmental assessments, asthma education, support, and resources. The study included 309 children aged 3 to 13 years with asthma living in low-income households. The results showed that the addition of the home-based visits by CHWs increased symptom-free days and improved quality of life for caregivers.<sup>312</sup>

Lack of reimbursement is a major obstacle to providing home-based interventions. A study evaluated the return on investment (ROI) for the King County Healthy Homes project and concluded it yielded an ROI of 190%, making it an economically viable option that reduced urgent health care utilization and costs while improving outcomes.<sup>313</sup>

## **SCHOOL-BASED INTERVENTIONS**

In the U.S., more than 53 million children and six million adults spend a large part of their days in more than 120,000 public and private schools. Asthma is the leading cause of missed school days.

To improve asthma care and reduce disparities, school-based asthma initiatives are necessary because that is where children spend most of their time when away from home and as a result, asthma-related absences remain stubbornly high. In fact, the NHLBI and the CDC offer comprehensive guidance for schools on asthma<sup>314</sup> and school-based asthma awareness programs, environmental remediation guidance, and training for school professionals to administer asthma medicines, among other topics, have long been a staple of asthma programming nationwide. A greater focus on schools as a setting for asthma self-management education (AS-ME) as an additional opportunity to lessen asthma morbidity in at-risk communities surfaced from these efforts. A meta-analysis of 55 studies published in 2019 showed evidence that school-based asthma management programs reduce hospitalizations and ED visits while increasing asthma control scores and quality of life.<sup>315</sup>

## Case Management by School Nurses

More recently, the goal has been to identify and remove barriers so that school-based asthma management efforts are more integrated with clinic-based care and asthma interventions in the home. In this way, school nurses are increasingly recognized not only as a first line of defense when a child suffers from an asthma exacerbation at school but also as core team members in a case management approach to pediatric asthma.

---

### Strategy: Increase number of school nurses nationwide.

---

To begin standardizing asthma management in schools, the Chicago Public Schools system recently surveyed 120 of their school nurses to prioritize challenges in appropriately addressing asthma in schools. Difficulty in communicating with a child's physician and the lack of access to up-to-date asthma action plans, or missing key data within those plans, were often cited as key barriers.<sup>316</sup>

The "Building Bridges for Asthma Care" Program implemented in Denver, Colorado and Hartford, Connecticut schools was modeled to address these challenges. School nurses were provided with cases of children with poorly controlled asthma and asked to manage their care via individual educational sessions with them and with their parents/caregivers, to help secure physician care and health insurance if necessary, and to facilitate communication between families and health care providers by ensuring school asthma care plans and asthma action plans were updated and aligned. When researchers compared asthma outcomes after two years, students participating in the program were able to reduce school absenteeism and reliance on short-acting quick-relief ("rescue") medicines while improving asthma control scores.<sup>317</sup>

School-Based Asthma Management Program (SAMPRO™) is a school-based asthma management program developed by The American Academy of Allergy, Asthma & Immunology (AAAAI) and several national partners. It emphasizes the important role of school nurses in asthma case management. The initiative is designed for schools in communities where integrated asthma management across clinics, homes, and schools has not yet been implemented. SAMPRO calls for harmonizing student asthma action plans initiated by physicians and asthma emergency plans kept by the school, so that school nurses are more empowered to reinforce and complement the goals of clinic- or home-based asthma management in the school setting. SAMPRO also



*The school nurse is more important than ever before. We help students grow and thrive. A professional school nurse is needed for every school because school nursing is the foundation for student physical and mental health.*



- Laurie Combe, MN, RN,  
NCSN, President of National  
Association of School Nurses

validates the role of school nurses (or school-based health centers, Breathmobile programs, or CHW-led school health models) in empowering school staff on asthma education and ensuring the school itself is not a source for environmental asthma triggers.<sup>318</sup>

---

**Strategy: Remove barriers for implementing comprehensive school-based asthma management programs through increased funding, awareness, and training.**

---

### **School Policies Addressing Asthma Management and the School Environment**

The School-Based Allergies and Asthma Management Program Act (H.R. 2468) introduced in the 116th Congress (2019–2020) would further provide support for the implementation of SAMPRO. The bill is a top policy priority for the Asthma and Allergy Foundation of America (AAFA). If passed, it would put important protections in place for children with asthma and allergies by encouraging states to put into place:

- A method to identify all students with allergies and/or asthma
- Individual student action plans
- Allergy and asthma education for school staff responsible for these students
- A school nurse or other trained staff on site during operating hours
- Efforts to reduce environmental triggers
- A system to support students

Comprehensive policies to address asthma in the school setting must also address reducing exposures to asthma triggers in the school environment. AAFA developed a list of 23 core policies necessary to protect the health of students and staff in school settings. As of 2019, only 15 states enacted a minimum of 18 of these core policies, and no states have added indoor air quality policies since 2014.<sup>319</sup>

Indoor air quality (IAQ) in schools can affect a children’s health and how well they perform in school. According to the Environmental Protection Agency (EPA), indoor air is more polluted than outside air. Evidence shows that poor IAQ increases risks of severe asthma attacks and allergic reactions.<sup>320</sup> The aging infrastructure of our public school system is one of the top causes of poor IAQ in schools.

In 2017, the American Society of Civil Engineers (ASCE) gave U.S. public schools a D+ on its Infrastructure Report Card. Annual funding to keep up school buildings falls about \$38 billion short. The report card notes that 53% of the nearly 100,000 public school buildings need repairs, renovations, and modernizations just to be considered in “good” condition.<sup>321</sup> School districts with more low-income and minority children are more likely to report their school buildings as being in “poor” or “fair” condition.<sup>322</sup>



# AAFA'S RECOMMENDED CORE POLICIES FOR PROTECTING STUDENTS' ASTHMA AND ALLERGY HEALTH

The State Honor Roll of Asthma and Allergy Policies for Schools ranks the states with the best public policies for people with asthma and allergies in U.S. elementary, middle and high schools. AAFA developed a list of **23 core policies** and **13 extra credit indicators**—in the areas of medication and treatment, awareness, and school environment—that are necessary to protect the health of students and staff in school settings.

## MEDICATION AND TREATMENT

1. State requires physician's written instructions to be on file to dispense prescription medication to students.
2. State policy ensures students' right to self-carry and self-administer prescribed asthma medication.
3. State policy ensures students' right to self-carry and self-administer prescribed anaphylaxis medication.
4. State policies or procedures shield school personnel from liability for unintended injuries.
5. State requires local school districts to create asthma and anaphylaxis medication policy and provide resources, guidelines and parameters.
6. State policy mandates schools to identify and maintain records for students with chronic conditions including asthma and anaphylaxis.
7. State requires a procedure updating health records periodically.
8. State requires that schools maintain asthma/allergy incident reports for reactions, attacks and medications administered.
9. State requires a student health history form that includes asthma/allergy information to be maintained for each student.
10. State requires schools to have emergency protocols for asthma.
11. State requires schools to have emergency protocols for anaphylaxis.
12. Nurse-to-student ratio is 1:750 or better.

### Extra credit:

- A. State requires anaphylaxis medicine – epinephrine – stocking and authority to administer in schools.
- B. State allows and/or requires asthma quick-relief medicine – albuterol – stocking and authority to administer in schools.
- C. State has or is preparing an explicit asthma program with policies, procedures and resources for schools to manage students with asthma.
- D. State has or is preparing an explicit anaphylaxis program with policies, procedures and resources for schools to manage students with allergies.
- E. State has adopted policy that each school will have one full-time nurse.
- F. State has adopted policy stating that school districts provide case management for students with chronic health conditions such as asthma.

*continued on next page*

## AWARENESS

13. State recognizes problem of asthma in schools and has begun to address it.
14. State recognizes problem of allergy in schools and has begun to address it.

Extra credit:

- G. State sponsors or provides funding for staff training in asthma awareness covering school asthma program/policy and procedures.
- H. State sponsors or provides funding for staff training in food allergies.

## SCHOOL ENVIRONMENT

15. State has mandated that all schools must have indoor air quality (IAQ) management policies.
16. State has adopted a policy requiring that districts and schools conduct periodic inspections of heating, ventilation and air conditioning (HVAC) system and other items important in asthma/allergy management.
17. State has IAQ policies that include specific components important in asthma/allergy management – HVAC, HEPA (high efficiency particulate air) filters, carpeting, and pesticide use.
18. State recommends/requires that districts or schools use Integrated Pest Management (IPM) techniques OR ban use of pesticides inside school.
19. State requires schools to notify parents of upcoming pesticide applications.
20. State limits school bus idling time and establishes proximity restrictions.
21. All smoking is prohibited in school buildings and on school grounds.
22. All smoking is prohibited on school buses and at school-related functions.
23. Tobacco-use prevention is required in health education curriculum.

Extra credit:

- I. State makes funding or resources available for technical IAQ assistance to schools.
- J. State recommends standards and programs to promote environmentally preferable materials for school construction, maintenance and cleaning.
- K. State requires school facility design standards that include low emission construction materials, pollutant source controls, durable and easy to clean surfaces and floors, moisture/mold controls.
- L. State has implemented or actively promotes diesel school bus engine retrofitting program.
- M. State requires districts or schools to provide tobacco-use-cessation services to students.

---

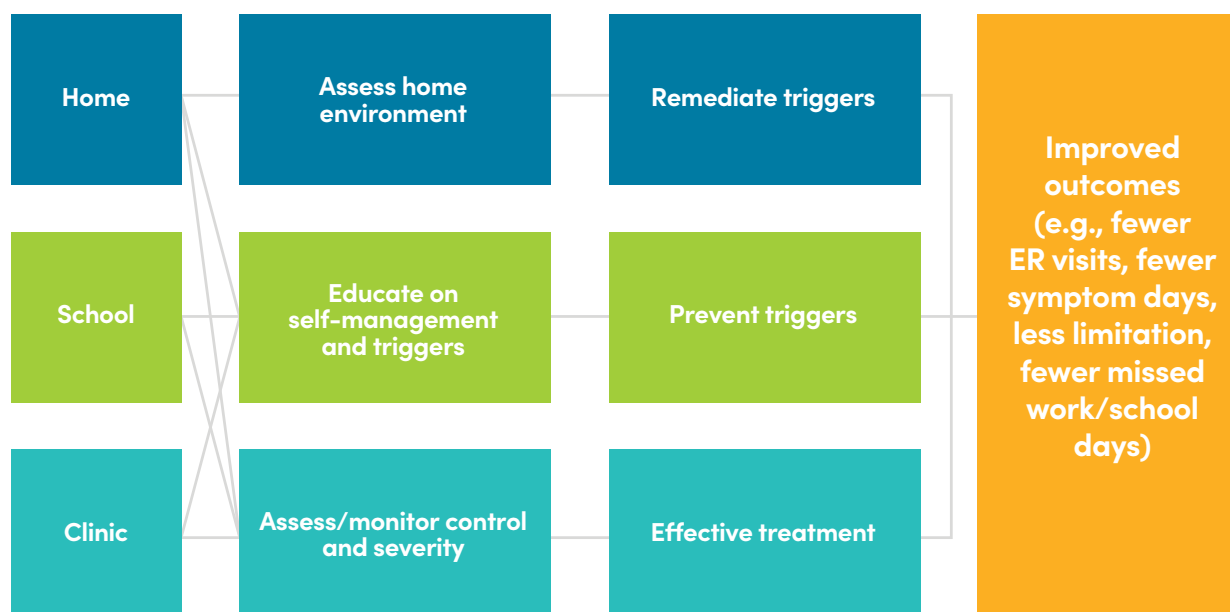
**Strategy: Enact and adopt statewide policies that support students with asthma. In particular, continue efforts to stock undesignated quick-relief asthma medicine in schools, ensure schools are equipped to obtain asthma medicines, and train appropriate staff to administer medicines.**

---

## COMMUNITY-BASED INTERVENTIONS

A growing number of health systems, organizations, and agencies successfully implemented robust asthma programs by bridging clinical, educational, and environmental elements while targeting low-income and racial and ethnic minority communities where uncontrolled asthma in children was identified as an ongoing issue and priority. Many of these models include built-in evaluation goals and processes to demonstrate programmatic value and cost savings to stakeholders, payers, and policy decision makers.

Figure 38. Community-Based Interventions to Improve Asthma Outcomes



*Adapted from: Department of Housing and Urban Development, Guide to Sustaining Effective Asthma Home Intervention Programs (2018)*

### Community Coalitions

One of the early pioneers in community-based asthma interventions for vulnerable, low-income neighborhoods was the Allies Against Asthma (AAA) initiative funded by the Robert Wood Johnson Foundation and implemented by the University of Michigan from 2000 to 2008.<sup>323</sup> This national initiative encompassed the work of seven community coalitions. It was driven by the idea that for complex health problems, broad-based community partnerships harness the collective wisdom of local stakeholders for tailored solutions and increase the likelihood of programmatic success due to high levels of buy-in and sustainability over time.<sup>324</sup> The AAA coalitions were some of the first to recognize the need to bridge clinic-based asthma care with interventions in homes, at schools, and with additional community resources. The initiative heralded two other aspects that came to define current asthma programming: the importance of more rigorous evaluation of asthma outcomes tied to community programs and the idea that such outcomes are not immediate but take several years to show up in medical claims data. Over a five-year period, AAA coalition efforts were shown to reduce asthma hospitalizations and lessen the reliance on emergency departments or urgent care centers, with the strongest evidence appearing in the final two years of programming.<sup>325</sup> Finally, AAA also pioneered the analysis of potential policy changes to improve the local infrastructure necessary for reaching vulnerable patients, which heralded later efforts of advocates to press for expanding Medicaid reimbursement for community-based asthma services.<sup>325</sup>

Another program pioneer for multi-faceted, community-based asthma interventions was the Merck Children's Asthma Network (MCAN) with operations supporting diverse sites from 2005-2015 to improve asthma care for at-risk communities.<sup>326</sup> In Phase II of the program from 2010-2015, MCAN funded evidence-based pediatric asthma care coordination services in Chicago, Illinois, Los Angeles, California, Philadelphia, Pennsylvania, and San Juan, Puerto Rico. In total, more than 1,200 children with asthma participated in these programs, with 92% of them either Black or Hispanic and 90% of them Medicaid-insured.<sup>327</sup> The approach was similar at each MCAN site. Trained nurses, health educators, or community health workers worked one-on-one with asthma parents and caregivers at their homes and in the clinic to provide asthma self-management education, to assess the home environment and provide remediation supplies for common household triggers, and to facilitate communication between patients/caregivers and treating physicians. Over a one- and then two-year period of data collection, program beneficiaries self-reported fewer daytime and nighttime symptoms, as well as fewer ED visits and asthma hospitalizations. MCAN was unique in allowing each site to choose their own setting for program implementation depending on what made sense locally at the time. Thus, Los Angeles chose to work within its large school system and Chicago chose a specific neighborhood, while care coordination in Philadelphia and in San Juan was tied to specific clinical care centers. Interestingly, the approach implemented in MCAN dates back to work in the late 1990s and early 2000s with the "Yes We Can" children's asthma program, which was one of the first programs to pilot test the chronic care model where health workers were sent out into the community to work directly with patients and their families.<sup>328</sup>



In fact, when it comes to multi-component, community-based asthma interventions led by trained community health workers, one can draw almost a direct line from the early years of the "Yes We Can" program to the later AAA and MCAN initiatives, and then from these successful programs, to current work supported by the NIH's National Heart, Lung, and Blood Institute (NHLBI). The NHLBI's Asthma Empowerment Collaborations to Reduce Childhood Asthma Disparities is a national research funding initiative that grew from the May 2012 Coordinated Federal Action Plan to Reduce Racial and Ethnic Asthma Disparities. The NHLBI initiative supports the local community-based design of Asthma Care Implementation Plans (ACIPs) and then the follow-up evaluation studies required to measure the impact of those plans as they are implemented over several years.<sup>329</sup>



By scaling up the programmatic experience of earlier initiatives, the NHLBI empowerment program helps cement current consensus among experts that local multi-stakeholder design and buy-in, the use of community health workers, multi-component outreach and care that connects the clinic with the home, with schools, and to additional community resources, and the importance of measuring impacts are all essential elements in reducing asthma disparities in at-risk communities. As data from these efforts continue to become available, application of these approaches in diverse neighborhoods should increase. Best practices will also continue to be refined for maximum impact.

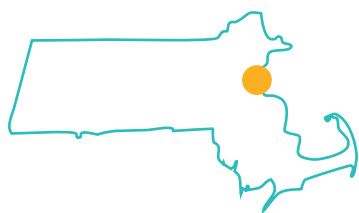
---

**Strategy: Build broad-based community partnerships with local stakeholders to tailor solutions and increase buy-in and sustainability.**

---

### Hospital-Centered Asthma Interventions

In more recent years, four programs in Boston, Philadelphia, Washington, D.C., and San Diego offer hospital-centered comprehensive asthma interventions for low-income and predominantly minority, pediatric populations. While the programs vary in scope, infrastructure, reach, and outcomes, they each embody a shared commitment to supplement quality clinical care with educational and environmental interventions in the home, at school, and in the community.



Boston Children's Hospital launched their Community Asthma Initiative (CAI) in 2005 to improve outcomes for high risk children with asthma. Its pilot program

initially targeted low-income, primarily Medicaid-insured families living in four ZIP codes near Boston Children's Hospital and a related community health center. The target population had some of the highest rates of asthma among Black and Latino residents. CAI's model identifies patients who are frequently hospitalized for asthma to augment clinical care by providing home-based education and environmental remediation. CAI uses an extensive community needs assessment before implementing an asthma case management and home visit program led by nurses and CHWs. The CAI received funding

## AAFA AROUND AMERICA

The Asthma and Allergy Foundation of America has four regional chapters that work with volunteers, health care providers, government agencies and local leaders in their community.

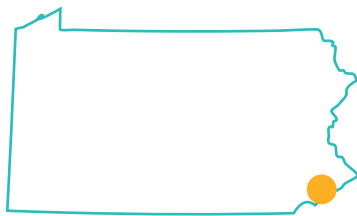
The **AAFA Alaska Chapter** serves Alaskan residents of all ages and provides resources and education for health care professionals, caregivers, educators, and childcare providers. Learn more at [AAFAAlaska.com](http://AAFAAlaska.com).

The **AAFA Michigan Chapter** serves Michigan residents of all ages, including more than 200,000 children with asthma, by providing education, training and community support. Learn more at [AAFAMich.org](http://AAFAMich.org).

The **AAFA New England Chapter** serves Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island and Vermont residents of all ages by offering public education, training programs, personal assistance, and support. Learn more at [AsthmaAndAllergies.org](http://AsthmaAndAllergies.org).

The **AAFA St. Louis Chapter** serves the Greater St. Louis region by providing children with asthma and allergies life-saving medications, equipment, education, and support. Learn more at [AAFASTL.org](http://AAFASTL.org).

from the CDC's Racial and Ethnic Approaches to Community Health (REACH) program from 2007–2012 with the goal of reducing asthma disparities in part by addressing social determinants of health. CAI relies heavily on outreach to local stakeholder organizations, such as the YMCA, city and state agencies, the public-school system, Head Start, and after school programs. The program is also innovative in its case management approach where, in addition to asthma education, a family's social determinants of health are assessed and referrals are provided when necessary for legal services, food banks, navigating social safety net programs, day care, tutoring, and smoking cessation, among others. Environmental remediation is also a central focus of the program with CHWs trained to assess housing conditions and provide supplies or referral services as needed to reduce common allergens and asthma triggers in the home. An evaluation of the program comparing outcomes in the four targeted zip codes to nearby zip codes not included in the program showed a decrease in asthma hospitalizations, with less success in lowering the number of ED visits, although baseline asthma morbidity was much higher in the intervention neighborhoods.<sup>330</sup>



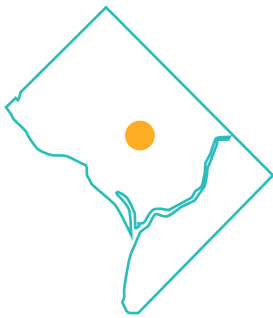
The Community Asthma Prevention Program (CAPP) at the Children's Hospital of Philadelphia (CHOP) offers a comprehensive and sustainable community-driven asthma management program for predominantly Black, low-income families. CAPP's program implements asthma self-management education in the child's home, community, school, and health care environments. Since its inception in 1997, the program conducted 20,000 home visits for more than

4,000 families, serving about 30% of the asthma population in West Philadelphia. Between 2010 and 2014, the program decreased ED visits by 62% and asthma-related hospitalizations by 70%. In 2018, CHOP launched the Community Asthma Prevention Program Plus (CAPP+) Home Repairs Program, developed to further reduce pediatric asthma hospitalizations in Philadelphia by offering enhanced home remediation for the most vulnerable families.



*CAPP and AAFA visit five-year-old Ausada and her mother.*

In 2018, the Asthma and Allergy Foundation of America provided CAPP with donations of **CERTIFIED asthma & allergy friendly®** products to improve the indoor air quality for 30 high-risk families living in predominantly Black neighborhoods located near fuel and gas refineries.



In Washington, D.C., Children's National Hospital's comprehensive pediatric asthma program, "Improving Pediatric Asthma Care (IMPACT DC)," aims to reduce asthma-related emergency room visits and hospitalizations through clinical care and education. Enrollment in IMPACT's asthma clinic is triggered by recent emergency room visits and hospitalizations among children with poorly controlled asthma. The program offers individualized asthma education and facilitates care coordination among patients, primary care physicians, specialists, case managers, and school personnel. IMPACT also refers patients to home visitor programs, prescription assistance programs, financial counseling, Medicaid enrollment, legal services, tobacco cessation, and other social programs. The asthma clinic serves an average 40 to 50 new families each month. The program has been successful in increasing the use of controller medication, decreasing the number of subsequent emergency department visits, and improving the quality of life for the children it serves.



*Abria hugs her mother, LaJoy, during a visit from Breathe DC and AAFA.*

In 2019, the Asthma and Allergy Foundation of America provided IMPACT DC and its partner home visiting program, Breathe DC, with donations of **CERTIFIED asthma & allergy friendly®** products to help up to 50 high-risk families in predominantly Black neighborhoods address allergen triggers in their homes.



In San Diego, Rady Children's Hospital offers a multidisciplinary severe asthma clinic for children (and some adults) with severe persistent, uncontrolled asthma. A clinical team of pediatric allergist/immunologists, pulmonologists, pharmacists, social workers, respiratory therapists, and registered nurses evaluate each patient and work together to ensure complete care and self-management education is provided from each team member. Children who are seen in the severe asthma clinic can take part in Rady's Community Approach to Severe Asthma (CASA) program. This program connects high-risk, low-income children and their families with trained community health workers (CHWs). Over half

of the children in the program are insured by Medi-Cal (California's Medicaid program). CHWs help families find and reduce asthma triggers in the home. They also provide free resources and allergen-control products to help reduce these triggers. Rady Children's location near the U.S.-Mexico border positions it to serve a large Hispanic population.



*Asthma and Allergy Foundation of America staff meet with members of the Rady Children's severe asthma clinic team.*

In 2020, AAFA (with support from Sanofi Genzyme and Regeneron) provided Rady Children's severe asthma clinic a \$200,000 grant to help expand the program to:

- Develop in-clinic, interactive digital tools to teach families about asthma self-management
- Track and analyze outcomes data
- Expand support for the CASA program with training of additional CHWs and provide additional allergen control products

One advantage of asthma program success in Boston, Philadelphia, Washington, D.C., and San Diego is the expertise and capacity with leading children's hospitals and related community clinics. But at-risk communities are everywhere, and the suburbanization of poverty means there will be more pockets of asthma.

### **State Health Departments**

One important possibility now more than ever is the adoption of comprehensive community asthma programs by state and local health departments, which would allow for these initiatives to be implemented in many more areas, especially where there is not ready access to research staff and other program coordinators. From 2014-2016, the Georgia State Department of Health undertook a multi-component asthma intervention for children with asthma covered by the state



Medicaid program. Although the study population was small—only 23 kids finished the program of asthma education combined with home visits—most of these children reduced the number of school absences, ED visits, and hospitalizations while also increasing asthma control scores.<sup>331</sup>

The Centers Medicare & Medicaid Services (CMS) now offers a Learning Collaborative to support state Medicaid and Children’s Health Insurance Program (CHIP) agencies improve asthma outcomes. The Learning Collaborative offers a series of webinars demonstrating state-based case studies of successful asthma models of care. Starting in March 2020, state agencies, including departments of health, can join an affinity group that will support states as they identify, implement, and scale asthma initiatives.<sup>332</sup>

### **Environmental Justice Advocacy Groups**

Asthma and allergies are related to environmental conditions. Airborne allergens and respiratory tract irritants found indoors, especially in substandard housing, and atmospheric pollutants contribute to asthma. High levels of ozone contribute heavily to atmospheric pollution, and pollutants, such as nitrogen oxides, acidic aerosols, and airborne particulate matter, are associated with asthma exacerbations.<sup>333, 334</sup> Moreover, disparities exist in the way these environmental conditions affect asthma. Air pollution from transportation emissions and fuel and gas refineries disproportionately affect communities of color and low-income populations, as do indoor allergens, such as dust mites, and tobacco smoke.<sup>335, 336</sup> The effects of climate change also exacerbate asthma while also disproportionately affecting communities of color and low-income populations.<sup>337, 338</sup>

In recent years, there has been some progress in addressing environmental justice related to asthma disparities. Environmental justice organizations have been instrumental in bringing these issues of inequality to the attention of local, state, and national leaders. One such organization is WE ACT in New York City, whose mission is to build healthy communities by ensuring that people of color and/or low income residents participate meaningfully in the creation of sound and fair



## DID YOU KNOW?

AAFA is a member of the WE ACT's Coalition for Asthma Free Homes, the Climate & Respiratory Health Workgroup led by CSTE, and serves on the steering committee for the National Safe and Healthy Housing Coalition.

environmental health and protection policies and practices.<sup>339</sup> In 2016, WE ACT and members of the Coalition for Asthma Free Homes created the Asthma Free Housing Act, which prioritizes prevention measures in those living with asthma by:

- requiring landlords to inspect for indoor allergens and correct them and their causes using approved methods when identified
- requiring the NYC Housing and Preservation Department (HPD) to inspect for indoor allergens and their causes, as well as issue appropriate violations
- requiring HPD to correct violations where landlords fail to do so promptly
- creating a system for patients with asthma to receive physician referrals for housing inspections by the City
- codifying safe and effective work practices for remediation of mold hazards<sup>340</sup>

The Asthma Free Housing Act was passed in January 2018, giving New York City residents legal rights to better living conditions and enforcing correct remediation compliance by landlords.<sup>341</sup>

On a national level, the Council for State and Territorial Epidemiologists (CSTE) works to promote effective use of epidemiologic data to guide public health practice and improve health in all localities, states, and territories in the United States. In 2004, CSTE established the State Environmental Health Indicators Collaborative (SEHIC), which focused on creating environmental public health indicators for surveillance that is more inclusive of environmental factors.<sup>342</sup> CSTE has also established a Climate & Respiratory Health Workgroup, which focuses on surveillance of environmental allergens and their relationship to respiratory conditions in the U.S. and developed position statements on the need for national pollen surveillance.<sup>343</sup> To cover broader climate and respiratory health topics, the Climate & Respiratory Health Workgroup also developed three subgroups focused on aeroallergens, urban air and heat, and wildfires. In addition to CSTE, the National Center for Healthy Housing established the National Safe and Healthy Housing Coalition in 2009, which promotes policies for safe and healthy housing in the U.S., with special emphasis on those who are disproportionately affected. The coalition works to improve housing conditions nationwide through education and outreach to key national stakeholders and decision makers. In the 10 years since its inception, it successfully established policies and programs that improve the lives of individuals living with asthma nationwide.<sup>344</sup> As climate change continues, environmental justice organizations and efforts such as these are needed to further mitigate the disproportionate environmental impacts that are affecting communities of color and low-income communities.







SPOTLIGHT:  
**COVID-19  
DISPARITIES**

---

Black, Hispanic, and Indigenous Americans are also experiencing disparities in COVID-19 cases and deaths.



## SPOTLIGHT: COVID-19 AND ASTHMA

In March 2020, the World Health Organization (WHO) declared COVID-19 a pandemic. It is an infectious disease caused by a new coronavirus (SARS-CoV-2). Coronaviruses are a group of viruses that can cause infections, such as the common cold, severe acute respiratory syndrome (SARS), and Middle East respiratory syndrome (MERS). While it is important for people living with asthma to take precautions when any type of respiratory illness is spreading, emerging data suggests asthma patients with COVID-19 do not appear to have a higher rate of hospitalizations or death compared with other patients.<sup>345-347</sup> However, like asthma, startling health disparities in race have proven to play a significant role.

Severe cases of COVID-19 have disproportionately affected Black, Hispanic, and Indigenous American populations. According to data collected as of June 2020 by The COVID Racial Data Tracker – a collaboration between *The Atlantic's* COVID Tracking Project and the Antiracist Research and Policy Center – Black individuals make up 13% of the U.S. population yet account for 21.3% of deaths where race is known.<sup>348</sup> This means the COVID-19 mortality rate for Black Americans is over 1.5 times higher than their share of the population.

Indigenous Americans (American Indians and Native Alaskans) are also contracting and dying from the disease at disproportionate rates. In May 2020, the Navajo Nation, which spans parts of Arizona, New Mexico, and Utah, reported the highest infection rate in the U.S.<sup>349</sup> And according to analysis conducted by American Public Media, mortality rates for Indigenous Americans also skyrocketed compared to white populations. While state reporting provided minimal data, Indigenous Americans are dying at rates above their population share by 4% in Mississippi, 16% in Arizona, and 51% in New Mexico. Based on that same analysis, while Indigenous Americans make up only 9% of New Mexico's population, they accounted for 60% of COVID-19 deaths in that state.<sup>350</sup> The dramatic swing in these statistics is most likely due to underfunded health programs for Indigenous Americans and other entrenched inequities, including limited access to medical care and higher rates of preexisting conditions (which are also rooted in disparities caused by social determinants of health).

### FIGURE 39. COVID-19 DATA BY STATE, RACE, AND ETHNICITY



#### LOUISIANA

reported race data for 75% of cases and 96% of deaths:

Although **Black Americans** make up 32% of the population, they represent **44% of the COVID-19 cases** and **50% of the deaths** in Louisiana.

#### NEBRASKA

reported ethnicity data for 75% of cases and 88% of deaths:

Although **Hispanic Americans** make up 11% of the population, they represent **48% of the COVID-19 cases** and **26% of the deaths** in Nebraska.



#### NEW MEXICO

reported race data for 93% of cases and 60% of deaths:

Although **American Indians** make up 9% of the population, they represent **38% of the COVID-19 cases** and **59% of the deaths** in New Mexico.

Source: *The Atlantic, The Covid Tracking Project (August 2020)*

---

**“** *Research is most effective when the study participants are reflective of the diversity within our communities. Studying genetic risk factors, patient perspectives and issues relating to the social determinants of health are critical to tailoring effective intervention strategies designed to improve asthma outcomes.* **”**

**- James P. Kiley, MS, PhD  
Director, Division of Lung Diseases  
NHLBI, National Institutes of Health**

---



A photograph of a man and a young boy hugging outdoors. The man is on the left, smiling with his eyes closed, wearing a blue and white plaid shirt. The boy is on the right, wearing a blue denim jacket over a grey hoodie, with his eyes closed and resting his head on the man's shoulder. The background is a soft-focus green landscape.

# ADDRESSING ASTHMA DISPARITIES THROUGH SCIENCE AND RESEARCH

---

Advances in science and research lead to more equitable outcomes and personalized care for people with chronic conditions. Health disparities researchers study the causes of disparities and develop interventions to mediate inequalities in vulnerable populations.





Recent advancements in the scientific knowledge of asthma and an increased understanding of driving forces of health disparities have shaped efforts to address racial and ethnic disparities in asthma. There is a clear need for continued research to evaluate disparities, inform policy, guide evidence-based interventions, and lay the foundation in the fight for equity.

Experts have embraced the relatively new and growing discipline of “health disparities research,” a multidisciplinary field of study that includes biomedical, social, behavioral, and applied and translational research.<sup>351</sup> Health disparities research encompasses two main purposes: to investigate the causes of disparities in specific populations and to identify solutions for eradicating those disparities.<sup>352</sup>

Researchers study health disparities in several ways:

- Investigate biological mechanisms influencing health outcomes in diverse populations
- Integrate studies of environmental and biological factors
- Explore social and structural determinants shaping health disparities
- Identify and document patterns of risk factors, morbidity, and mortality in subpopulations
- Test and evaluate interventions tailored to individuals based on their unique experiences and cultures
- Examine the role of the health care system in health disparities

Continued efforts in research will promote the knowledge base about the biological, behavioral, social, and structural determinants of asthma disparities and the necessary interventions to achieve health equity.

Disparities studies should “promote research from a comprehensive perspective of the individual, the community, and systems over the life span.”<sup>353</sup> The design and implementation of creative health disparities research will need to be integrative, collaborative, and transdisciplinary. For example, scientific findings must be effectively translated from clinical settings to community-based social and behavioral interventions and programs.

Several federal agencies and organizations offer plans and recommendations for addressing health disparities through research (see Federal Initiatives on page 172). This report does not duplicate the efforts of the National Institutes of Health (NIH), the Centers for Disease Control and



Prevention (CDC), or other agencies. Additionally, this report does not offer an exhaustive list of strategies for implementing research to combat disparities. Rather, it focuses on select opportunities in biomedical, social science, and health systems research that show promise in asthma.

Ideas presented in this chapter will not be novel. In fact, many research opportunities have been explored and promoted, though considerable knowledge gaps exist.

The strategies presented in this chapter are organized using an adapted version of the National Heart, Lung, and Blood Institute's (NHLBI) Research Spectrum<sup>354</sup> and the translational research framework.<sup>355</sup>

## FIGURE 40. ORGANIZATIONAL FRAMEWORK FOR ADDRESSING ASTHMA DISPARITIES THROUGH SCIENCE AND RESEARCH

### BASIC SCIENCE

Studies of biological, cellular, and molecular mechanisms of disease. Includes genomics and the study of disease pathophysiology.

### CLINICAL AND EPIDEMIOLOGICAL RESEARCH

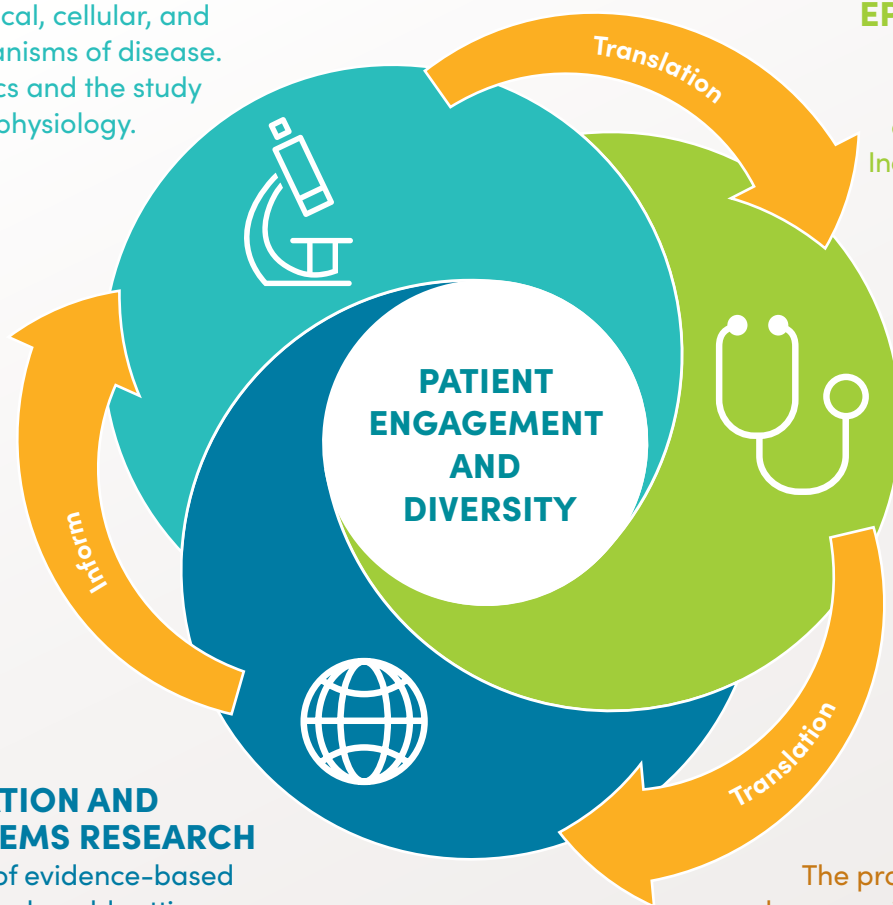
Studies of health and illness in humans. Includes development of effective interventions and study of disease patterns.

### IMPLEMENTATION AND HEALTH SYSTEMS RESEARCH

Implementation of evidence-based interventions in real world settings and study of social, financial, and structural factors influencing health services.

### TRANSLATIONAL RESEARCH

The process of integrating all research areas with the long-term goal of improving public health. Translational research serves as a bridge and includes movement from lab → humans → clinical setting → real world setting



Adapted from: National Heart, Lung, and Blood Institute (NHLBI), Research Spectrum

## FEDERAL INITIATIVES TO ADDRESS HEALTH DISPARITIES THROUGH RESEARCH

The National Institutes of Health (NIH), through its National Institute of Minority Health and Health Disparities (NIMHD), is developing the 2020–2024 NIH Minority Health and Health Disparities Strategic Plan,<sup>356</sup> an update to the previous plan published for 2009–2013.<sup>357</sup> The new strategic plan, which is part of the NIH’s charge to lead scientific research to improve minority health and reduce disparities, will center around the thematic areas of scientific research, research-sustaining activities, and outreach, collaboration, and dissemination.<sup>358</sup> As part of the process, the NIMHD recently published the Minority Health and Health Disparities Research Framework<sup>359</sup> (Table 12) to organize various domains and levels of influence in disparities research.

Table 12. NIMHD Research Framework

		LEVELS OF INFLUENCE			
		Individual	Interpersonal	Community	Societal
DOMAINS OF INFLUENCE (over the lifecourse)	Biological	<ul style="list-style-type: none"> <li>• Biological Vulnerability and Mechanisms</li> </ul>	<ul style="list-style-type: none"> <li>• Caregiver-Child Interaction</li> <li>• Family Microbiome</li> </ul>	<ul style="list-style-type: none"> <li>• Community Illness</li> <li>• Exposure</li> <li>• Herd Immunity</li> </ul>	<ul style="list-style-type: none"> <li>• Sanitation</li> <li>• Immunization</li> <li>• Pathogen Exposure</li> </ul>
	Behavioral	<ul style="list-style-type: none"> <li>• Health Behaviors</li> <li>• Coping Strategies</li> </ul>	<ul style="list-style-type: none"> <li>• Family Functioning</li> <li>• School/Work Functioning</li> </ul>	<ul style="list-style-type: none"> <li>• Community Functioning</li> </ul>	<ul style="list-style-type: none"> <li>• Policies and Laws</li> </ul>
	Physical/ Built Environment	<ul style="list-style-type: none"> <li>• Personal Environment</li> </ul>	<ul style="list-style-type: none"> <li>• Household Environment</li> <li>• School/Work Environment</li> </ul>	<ul style="list-style-type: none"> <li>• Community Environment</li> <li>• Community Resources</li> </ul>	<ul style="list-style-type: none"> <li>• Societal Structure</li> </ul>
	Sociocultural Environment	<ul style="list-style-type: none"> <li>• Sociodemographics</li> <li>• Limited English</li> <li>• Cultural Identity</li> <li>• Response to Discrimination</li> </ul>	<ul style="list-style-type: none"> <li>• Social Networks</li> <li>• Family/Peer Norms</li> <li>• Interpersonal Discrimination</li> </ul>	<ul style="list-style-type: none"> <li>• Community Norms</li> <li>• Local Structural Discrimination</li> </ul>	<ul style="list-style-type: none"> <li>• Social Norms</li> <li>• Societal Structural Discrimination</li> </ul>
	Health Care System	<ul style="list-style-type: none"> <li>• Insurance Coverage</li> <li>• Health Literacy</li> <li>• Treatment Preferences</li> </ul>	<ul style="list-style-type: none"> <li>• Patient-Clinician Relationship</li> <li>• Medical Decision-Making</li> </ul>	<ul style="list-style-type: none"> <li>• Availability of Services</li> <li>• Safety Net Services</li> </ul>	<ul style="list-style-type: none"> <li>• Quality of Care</li> <li>• Health Care Policies</li> </ul>
Health Outcomes		Individual Health	Family/ Organizational Health	Community Health	Population Health

Source: NIH, National Institute on Minority Health and Health Disparities (2017)

In 2012, federal agencies partnered to release the Coordinated Federal Action Plan to Reduce Racial and Ethnic Asthma Disparities (the Action Plan).<sup>184</sup> The effort is an outcome of the Asthma Disparities Subcommittee, co-chaired by the U.S. Department of Health and Human Services (HHS), the U.S. Environmental Protection Agency (EPA), and the U.S. Department of Housing and Urban Development (HUD). The Action Plan outlined four strategies to coordinate a series of Priority Actions to reduce the disproportionately high burden of asthma on minority children.

The Action Plan incorporates several research and data priorities<sup>184</sup>:

- Conduct research to evaluate models of partnerships that empower communities to identify and target disparate populations and provide comprehensive, integrated care at the community level
- Examine the relative contribution and cost effectiveness of different components of a systemwide partnership program
- Investigate the added value of emerging technologies to enhance the identification of target populations and risk factors
- Standardize definitions, measures, outcomes, and data/information collection methods, as well as maximize the availability and use of collected data across federal asthma programs
- Promote the use of standard definitions, measures, outcomes, and information/data collection methods in state, local, and community settings.
- Establish priorities and collaborations for research across federal agencies to test interventions that may prevent the onset of asthma and reduce disparities in the incidence of asthma
- Coordinate asthma research programs across federal agencies that support observational follow up of birth cohorts

In 2015, the Asthma Disparities Subcommittee reported that progress was made in all four strategies<sup>360</sup> and identified the following as a remaining priority area for the group: “Expand research coordination to leverage resources to address asthma disparities across federal agencies.”

“Achieving federal coordination and harmonization of definitions of asthma measures and outcomes, as well as data collection and reporting methodologies, will equip us to better identify subpopulations in need. Results of these efforts will be used to guide resource allocation decisions, target outreach efforts, assess program outcomes, and inform public health policy and program enhancement decisions.”<sup>184</sup>”

- Coordinated Federal Action Plan to Reduce Racial and Ethnic Asthma Disparities



*Ensuring that diverse populations are adequately included in scientific research is imperative not only in terms of scientific integrity and fiduciary responsibility but also as a matter of social justice.*<sup>362</sup>



- Oh, et al.

## **BASIC SCIENCE**

Scientific research is foundational to our understanding of asthma and the elimination of racial and ethnic disparities in asthma outcomes. Recent discoveries allow for the shift from a “one-size-fits-all” solution to personalized asthma care.<sup>361</sup>

Basic science research refers to the study of underlying mechanisms of biology and disease.<sup>354</sup> These scientific discoveries help experts better understand the inner workings of the human body, organs, tissues, and cells. Many medical innovations and asthma treatments exist because of discoveries in the lab that were applied to human health and studied in patients with asthma.

Scientific discoveries have been slow to address disparities in asthma, but steady progress in understanding the cellular, molecular, and genetic mechanisms of asthma holds promise for translating scientific findings to the real world. It is hoped that an era of precision medicine and personalized care can narrow asthma disparities by treating individuals based on genetic and biological factors.

Racial and ethnic minority populations are consistently understudied and underrepresented in research cohorts. Because researchers are largely informed by data extrapolated from white populations, science may not benefit underserved patients equally. Scientific discoveries in asthma lead to equitable outcomes only if institutions, individuals, and communities work together to dramatically increase representation of diverse subjects in basic research.

## **CLASSIFICATION OF ASTHMA**

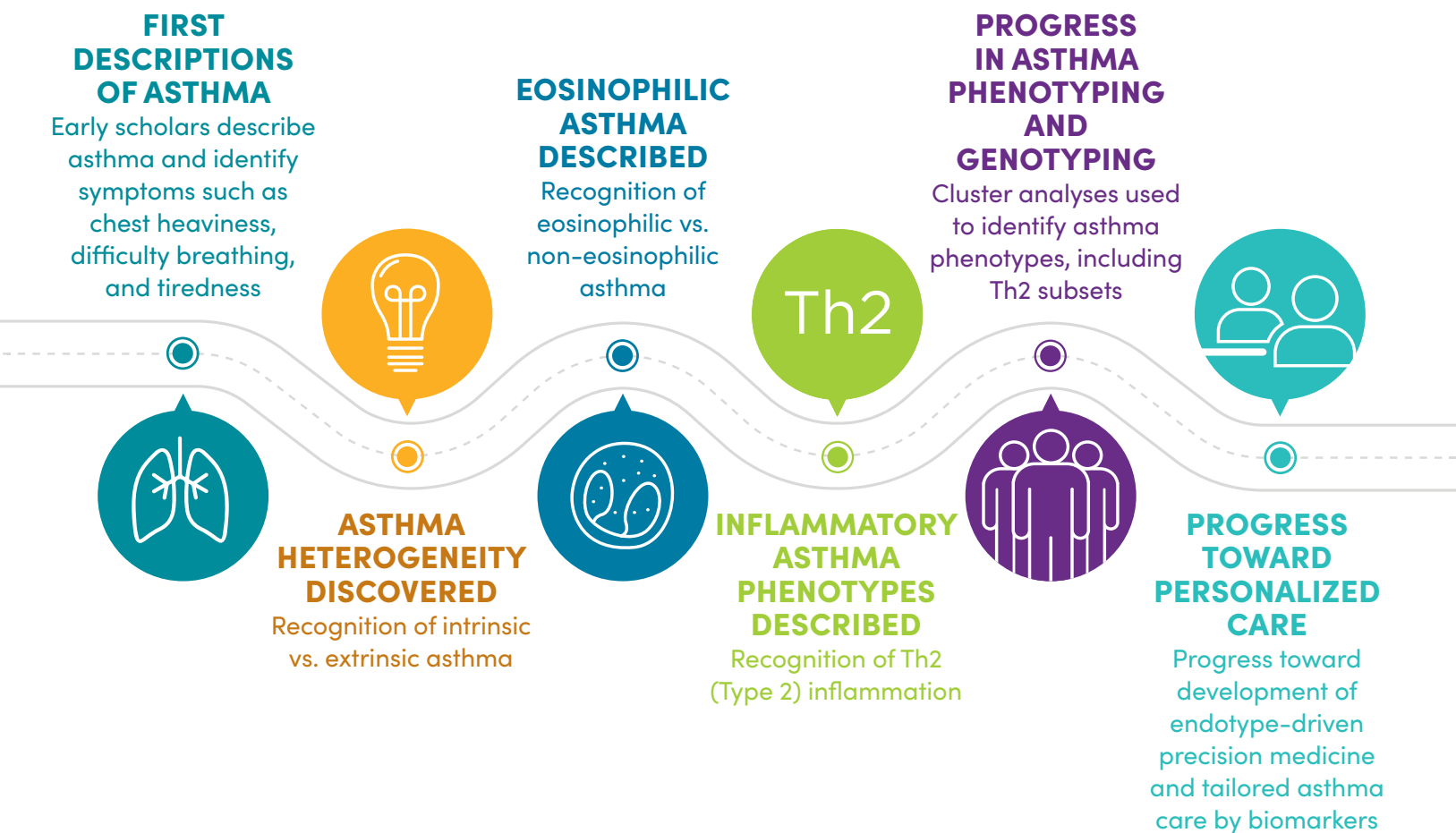
Asthma is increasingly recognized as a condition with considerable heterogeneity, rather than a single uniform disease. This evolving knowledge promotes new approaches to asthma care that are more patient-centered and individualized than ever before.<sup>363</sup>

Asthma can look different from one person to another. Identifying asthma subtypes helps achieve better outcomes by recognizing the diversity of asthma profiles encountered in clinical practice.<sup>364</sup> Asthma can be classified by observable characteristics (“phenotypes”) based on differences in clinical presentation, physiological processes, or response to treatment.<sup>365, 366</sup>



The study of asthma phenotypes is an evolving field. Early concepts of asthma subtypes focused on the dichotomous classification into broad categories of extrinsic (allergic) and intrinsic (non-allergic).<sup>366</sup> More recently, interest in the role of eosinophils led to increased research on inflammatory markers to classify asthma. Researchers recognized the significant heterogeneity even within the categories of eosinophilic and non-eosinophilic asthma, leading to the search for more distinct phenotypes based on measurable biomarkers.<sup>367</sup> Figure 41 describes the progress toward using the knowledge of asthma heterogeneity to inform personalized care.<sup>365-368</sup>

Figure 41. Progress in Asthma Classification



Scientists continue to dissect the heterogeneity of asthma<sup>365</sup> and identify phenotypes of asthma with greater specificity. To date, experts have not reached consensus on specific asthma phenotypes. Several phenotypes (some with overlapping characteristics) have been proposed, including:

- allergic asthma
- eosinophilic asthma
- neutrophilic asthma
- exercise-induced asthma (EIA)
- obesity-related asthma
- smoking-related asthma
- aspirin exacerbated respiratory disease (AERD)

Cluster analysis is used as a data mining technique to identify groups of people with asthma who share specific clinical characteristics. The Severe Asthma Research Program (SARP), established by the National Heart, Lung, and Blood Institute (NHLBI) in 2001<sup>369</sup>, used cluster analysis to identify five phenotypes of severe asthma in adults<sup>370</sup> and four clusters in children.<sup>371</sup> SARP distinguished clusters based on several variables, including age of onset, atopy and lung function (Table 13).

A separate cluster analysis of the Airways Disease Endotyping for Personalized Therapeutics (ADEPT) cohort identified four phenotypes, which were validated in the UBIO-PRED (Unbiased Biomarkers for the Prediction of Respiratory Disease Outcome Consortium) cohort.<sup>372</sup>

**Table 13. Comparison of Asthma Subtypes Determined by Cluster Analysis**

<b>SARP CLUSTERS (ADULTS)<sup>370</sup></b>	<b>SARP CLUSTERS (CHILDREN)<sup>371</sup></b>	<b>ADEPT CLUSTERS<sup>372</sup></b>
Childhood-onset, mild, atopic, eosinophilic	Late-onset symptomatic asthma with normal lung function	Mild, normal lung function, early onset, low inflammation
Childhood-onset, moderate, atopic, eosinophilic	Early-onset atopic asthma with normal lung function	Moderate, atopic, mild reversible obstruction, hyperresponsive, eosinophilic
Adult-onset, nonatopic, eosinophilic, female, obese	Early-onset atopic asthma with mild airflow limitation	Mixed severity, mild reversible obstruction, neutrophilic
Childhood-onset, severe, atopic, reversible obstruction, eosinophilic	Early-onset atopic asthma with advanced airflow limitation	Severe uncontrolled, severe reversible obstruction
Adult-onset, long duration, severe, fixed airflow obstruction		

Severe asthma is defined as “asthma that requires treatment with high dose inhaled corticosteroids [...] plus a second controller (and/or systemic corticosteroids) to prevent it from becoming ‘uncontrolled’ or which remains ‘uncontrolled’ despite this therapy”.<sup>373</sup> To properly diagnose severe asthma, other comorbidities that may mimic asthma must be addressed and excluded.<sup>374</sup> Severe asthma is heterogeneous and spans across multiple phenotypes. Severe asthma affects about 5-10% of people with asthma.<sup>373</sup>

### Partnering to Address OCS Overexposure

Some people with severe asthma may depend on chronic use of oral corticosteroids (OCS) as a long-term treatment. OCS are important medicines that are often used to treat asthma flares by reducing inflammation and swelling in the airways quickly but can have significant side effects and risks with prolonged use.<sup>375</sup> Because of low cost and easy access, socioeconomically disadvantaged communities may use OCS more often than recommended by asthma treatment guidelines.

Beginning in 2018, AAFA partnered with other patient advocacy groups, medical professionals, and industry stakeholders to raise awareness of OCS use in asthma treatment. The collaborative launched “OCS Overexposed: Thinking Beyond the Burst”<sup>376</sup> in 2019. Resources for patients, providers, and policymakers are available at [OCSoverexposed.com](http://OCSoverexposed.com).

Despite progress in specifying asthma phenotypes, health care providers face challenges applying this knowledge to clinical practice. Additional efforts are needed to understand how phenotypes relate to underlying disease mechanisms and therapeutic responses.<sup>377</sup> Because of the clinical limitations of phenotyping, personalized therapy based on asthma phenotype is not available.

To address limitations of phenotyping in tailoring treatment, researchers explored the underlying molecular mechanisms and pathophysiology of asthma. The term “endotype” was introduced to describe subtypes of asthma based on distinct biological mechanisms.<sup>378</sup> Unlike phenotypes based on clinical characteristics that may change over time or in response to treatment, endotypes are defined by distinct genetic or molecular characteristics that remain stable.<sup>379</sup> Stratifying asthma by endotypes allows for easier translation of this research to everyday practice, particular in designating precise therapeutic targets for individual patients.<sup>380</sup>

## ASTHMA CLASSIFICATION: DEFINITIONS AND TERMINOLOGY

Asthma is recognized as a collection of diseases with distinct pathways and observable characteristics that determine disease progression, treatment response, and health outcomes in a complex interplay of genetic and environmental factors.

**Phenotypes** are “the visible characteristics of an organism resulting from the interaction between its genetic makeup and the environment.”<sup>381</sup> Classification of phenotypes is based on observable clinical, physiological, and demographic variations without consideration of underlying pathology. Phenotypes are defined using variables such as age of onset, lung function, presence of atopy, and medication use. Examples of phenotypes include childhood-onset allergic asthma and adult-onset eosinophilic asthma.

**Endotypes** are “the specific biological pathways that explain the observable properties of a phenotype.”<sup>385</sup> Defining endotypes may help predict response to therapy, optimize use of currently available treatments, and guide development of personalized medicine in the future. Two inflammatory endotypes, T-helper type 2 (Th2)-high and Th2-low, are well recognized in asthma.<sup>382</sup>

**Biomarkers** are measurable indicators used to help identify subtypes of asthma, target distinct pathways, and predict therapeutic response.<sup>383</sup> Examples of biomarkers of asthma are eosinophils, immunoglobulin-E (IgE), and fractional exhaled nitric oxide (FeNO).<sup>383</sup>

Asthma is categorized by at least two distinct endotypes, T helper 2 (Th2)-high and Th2-low, based on the degree of airway inflammation.<sup>384</sup> Th2-high asthma, which is the more common of the two endotypes, encompasses a range of eosinophilic and allergic phenotypes and is driven by type 2 inflammatory response.<sup>385</sup>

Type 2 inflammation is an important mechanism of asthma in many patients.<sup>385</sup> Following exposure to an asthma trigger, type 2 immune response is initiated by cytokines, such as interleukin-25 (IL-25), IL-33, and thymic stromal lymphopoietin (TSLP).<sup>379</sup> These “alarmins” lead to activation of cells that produce cytokines IL-4, IL-5, and IL-13 to mediate inflammation.<sup>379</sup>

Type 2 inflammation contributes to multiple comorbid conditions, including allergic rhinitis, atopic dermatitis (eczema), food allergy, nasal polyps, and eosinophilic esophagitis.<sup>379</sup>

Greater understanding of the pathophysiology of asthma, particularly related to type 2 inflammation, has led to the development of new biologic agents. These novel therapies are critical for targeted treatment of persistent airway inflammation that is refractory (resistant) to maximum doses of inhaled steroids.<sup>386</sup>

Five biologic therapies (Table 14) are currently available for people with moderate-to-severe asthma characterized by type 2 inflammation. The advent of biologics has renewed interest in the pathophysiological mechanisms of asthma and ability to translate scientific discoveries into tailored treatments. For such endotype-driven approaches to personalized treatment to be successful, measurable indicators (“biomarkers”) will be needed to match individuals with therapeutic agents.

Several non-invasive biomarkers exist for detecting type 2 inflammation, including eosinophils, immunoglobulin-E (IgE), and fractional exhaled nitric oxide (FeNO).<sup>383</sup> Additional research is needed to identify the most effective biomarkers to guide asthma treatment.

---

**Strategy: Identify effective biomarkers of asthma and develop tests to measure biomarkers in an easy, rapid, and noninvasive way at the point of care.**

---

Biomarkers can be used to guide treatment in several ways.<sup>379</sup>

- Identify specific disease pathways in an individual
- Predict response to specific treatments
- Monitor success of specific treatments
- Assess risk of disease progression





Table 14. Biologic Agents Approved for Asthma

	OMALIZUMAB (XOLAIR)	MEPOLIZUMAB (NUCALA)	BENRALIZUMAB (FASENRA)	RESLIZUMAB (CINQAIR)	DUPILUMAB (DUPIXENT)
<b>Pathway</b>	IgE	IL-5	IL-5	IL-5	IL-4 and IL-13
<b>Target</b>	Anti-IgE monoclonal antibody	Anti-IL-5 monoclonal antibody	Anti-IL-5 monoclonal antibody	Anti-IL-5 alpha monoclonal antibody	Anti-IL-4R alpha monoclonal antibody
<b>Age of Patient</b>	6+	6+	12+	18+	12+
<b>Asthma Indication</b>	Moderate-to-severe persistent asthma in patients with a positive skin test or in vitro reactivity to a perennial aeroallergen and symptoms that are inadequately controlled with ICS	Severe eosinophilic asthma	Severe eosinophilic asthma	Severe eosinophilic asthma	Moderate-to-severe asthma with an eosinophilic phenotype or with OCS dependent asthma
<b>Mode of Administration</b>	Subcutaneous injection	Subcutaneous injection	Subcutaneous injection	Intravenous infusion	Subcutaneous injection
<b>Setting of Administration</b>	Clinic	Clinic or home	Clinic or home	Clinic	Clinic or home
<b>Dosing Interval</b>	Every two to four weeks	Every four to eight weeks	Every four weeks	Every four weeks	Every two weeks

Abbreviations used: immunoglobulin-E (IgE), inhaled corticosteroids (ICS), interleukin (IL), oral corticosteroids (OCS)

Asthma is a complex disease with variable features, severity, and therapeutic response. Approaching asthma management as “one-size-fits-all,” regardless of an individual’s specific circumstances, may contribute to racial and ethnic disparities in asthma outcomes. Considering the heterogeneity of people with asthma is essential to improving and personalizing asthma care.

## GENOMICS RESEARCH

Genomics is an emerging area of research. By studying large databases of genomic data over the past few decades, researchers advanced the understanding of asthma biology. Specific genes are implicated in asthma development or its progression, while other genetic variations were found to influence therapeutic response.

Although genomics research in asthma has not made the same strides as other conditions, we are still able to analyze and address asthma disparities at the molecular level. Such research in genomics may help us address disparities in the future by preventing asthma development in individuals who are genetically predisposed.

The ability of genomics to benefit disparities efforts depends on significantly and immediately increasing the representation of diverse ancestral populations in future studies. Until recently, most genome-wide research was almost exclusively conducted among cohorts with predominantly European ancestry. Genetic studies in diverse populations have suggested that differences in associations across racial and ethnic groups exist, and these differences could be attributed to unique biological pathways involved in asthma susceptibility in these populations.<sup>387</sup> However, investigation of differences in asthma development or progression in disproportionately affected populations, such as Black and Puerto Rican individuals with asthma, has been limited.

Future genomics studies will need to account for the genetic diversity of populations with non-European ancestry, including populations with African genes, Indigenous American genes, and mixed ancestry.

---

**Strategy: Increase representation of African-ancestry, Indigenous American-ancestry, and admixed populations in genomics datasets to support genome-wide research in underrepresented populations.**

---

To address the lack of diversity, the National Institutes of Health (NIH) National Heart, Lung, and Blood Institute (NHLBI) funded the Consortium on Asthma among African-ancestry Populations in the Americas (CAAPA).<sup>388</sup> Charged with prioritizing and investigating the genetics of asthma in diverse cohorts, CAAPA researchers sequenced the genomes of 642 individuals of African ancestry from North and South American, Caribbean, and West African populations in their flagship paper.<sup>389</sup> In a later study, researchers partnered with Illumina Inc. to develop the African Diaspora Power Chip (ADPC) for improved tagging and coverage of African ancestry genetic variation. Using the ADPC, researchers were able to perform a large genome-wide study of asthma in individuals of African ancestry, including 7,009 individuals with asthma and 7,645 controls.<sup>390</sup>

As part of their mission to catalog genetic diversity in populations of African descent, CAAPA investigators publicly released the whole genome sequence data on approximately 1,000 individuals of African ancestry.<sup>388</sup> These data serve as an important resource for facilitating gene discovery for asthma among highly-burdened populations.

The NHLBI also funded a birth cohort study called the Puerto Rican Infant Metagenomic and Epidemiologic study of Respiratory Outcomes (PRIMERO), which was designed to address the root causes of asthma by following thousands of Puerto Rican children from birth through early childhood.<sup>391</sup> In studying the respiratory health of these individuals, PRIMERO researchers from the University of California, San Francisco, National Jewish Health, and Centro de Neumología Pediátrica aim to recognize early-life origins of asthma (birth to age 5) and identify the biological drivers of disease in Puerto Rican children.

Genomic data on Hispanic subsets (e.g., Puerto Rican, Mexican, etc.) and Indigenous Americans are scarce. When minorities are categorized into large groups, such as “Hispanic,” the homogeneity of subgroups is masked.<sup>392</sup> Additionally, aggregation of these groups masks differences in ancestral compositions. For example, Puerto Rican individuals have larger percentages of African genes, while Mexican individuals have larger percentages of Indigenous American genes.<sup>87</sup>

The advent of innovative and tailored approaches to asthma management and treatment depends on the populations studied. Without a dramatic increase in inclusion and representation, the genomics revolution will fail to benefit the most vulnerable populations.<sup>393</sup>

Increasing the diversity of samples in genomic datasets is only part of the battle. Researchers and funders must also invest in studying the genetics of asthma in minority populations. In particular, epigenomic studies of gene–environment interactions and pharmacogenomic studies of treatment response are areas of opportunity in asthma research.<sup>394</sup>

---

**Strategy: Promote and incentivize epigenomic and pharmacogenomic studies of asthma in Black individuals, Indigenous Americans, and Hispanic subgroups.**

---

Genomics research has significant untapped potential in asthma studies. Epigenomic studies can be used to reduce asthma’s impact on underserved populations by explaining the influence of environmental exposure on asthma development and progression. Knowledge of the intergenerational effects of gene–environment interactions can help develop interventions for at-risk individuals in the future. In the short term, pharmacogenomic research could help identify patients who would benefit from existing treatments. In the longer term, these studies are critical to the development of genetic profiles necessary for precision medicine.

## **PRECISION MEDICINE**

Precision medicine is defined as “an approach to disease treatment and prevention that seeks to maximize effectiveness by taking into account individual variability in genes, environment, and lifestyle.”<sup>395</sup> The goal of precision medicine is to provide the right treatment to the right patient at the right time.

Precision medicine may help eliminate asthma disparities by addressing the genetic factors that influence therapeutic response in diverse populations. Novel therapies that are

*“We are in the midst of a biomedical revolution. With the emergence of genomic science, precision medicine, health information technologies and other research advances, biomedical and behavioral research hold greater promise today than ever before to improve our nation’s health.”*

– National Institute on Minority Health and Health Disparities



*Precision medicine seeks to redefine our understanding of disease onset and progression, treatment response, and health outcomes through the more precise measurement of molecular, environmental, and behavioral factors that contribute to health and disease. This understanding will lead to more accurate diagnoses, more rational disease prevention strategies, better treatment selection, and the development of novel therapies.*<sup>396</sup>



- Precision Medicine Initiative Working Group

personalized based on genetics may help predict which patients will experience the best response to treatment.

Precision medicine is becoming a reality for some diseases, though the potential in asthma has not been fully realized. However, progress in understanding the biological mechanisms of disease, as well as genetic discoveries through “-omics research” (e.g., genomics, epigenomics, pharmacogenomics), hold promise for bringing precision medicine approaches to asthma.

---

### **Strategy: Invest in the development of precision medicine for asthma.**

---

Applying basic science discoveries to the development of precision medicine will require a large scale and coordinated effort. In his 2015 State of the Union Address, President Obama shared his vision for the Precision Medicine Initiative (PMI).<sup>395</sup> The effort, launched in 2016 with a \$215 million investment, aims to accelerate biomedical discoveries and promote innovative approaches to personalized disease management.

A key element of the PMI is the creation of a voluntary national research cohort of one million Americans, led by the NIH, in collaboration with other agencies and stakeholders. PMI seeks to engage Americans to contribute health data to “improve health outcomes, fuel the development of new treatments, and catalyze a new era of data-based and more precise medical treatment.”<sup>395</sup> The NIH formed the Precision Medicine Initiative Working Group to develop a plan for creating and managing the national research cohort. In 2015, the group published a detailed report that provided a framework for creating the All of Us Research Program.<sup>396</sup>

As part of the PMI, the NHLBI launched the Trans-Omics for Precision Medicine (TOPMed) program in 2014. TOPMed is designed to improve the scientific understanding of and advance precision medicine for heart, lung, blood, and sleep disorders. To achieve its goals, TOPMed researchers collect whole-genome sequencing and other “-omics” data and integrate them with molecular, behavioral, imaging, environmental, and clinical data to improve prevention and treatment of targeted disorders.<sup>397</sup> As of February 2020, TOPMed consists of over 150,000 participants from more than 80 different HLBS studies, with considerable diversity in disease phenotype, participant ancestry, and ethnicity, with approximately 60% of current participants having substantial non-European ancestry. Such diversity enables expanding genetic variation knowledge to provide tailored and individualized disease treatment.<sup>398</sup>



## CLINICAL RESEARCH

Clinical research is the study of health and illness in people. Clinical trials, a type of clinical research, translate discoveries from the lab to humans and test new ways to prevent, detect, or treat diseases.<sup>354</sup>

The alarming lack of racial and ethnic diversity in clinical trials is well recognized. Long and rigorous studies to ensure the safety and efficacy of a potential new treatment are conducted in populations that do not reflect the U.S. population.

By excluding segments of the population that disproportionately shoulder the burden of chronic disease of asthma, clinical trials overlook potential differences in treatment response or resistance in various individuals. Research conducted on white patients may not necessarily be accurately generalized to the general population.

In an emerging era of precision medicine tailored to individuals, clinical trials must include a diverse pool of participants to ensure that potential treatments are effective for people likely to use them. It is particularly important for certain populations to be included in clinical trials when they are more at risk for a certain disease, such as asthma. However, Black, Hispanic, and Indigenous Americans are less likely than their white counterparts to be included in asthma trials.

The need for minority representation in clinical research was addressed by the 1993 National Institutes of Health (NIH) Revitalization Act, where a key objective was to ensure inclusion of minorities in NIH-funded studies. However, from 1993–2013, inclusion of racial or ethnic minorities was reported in less than 5% of all NIH-funded published studies of respiratory diseases.<sup>385</sup> There are likely multiple reasons for this underrepresentation and exclusion of minorities from NIH-funded studies. For example, clinical researchers may have insufficient education and training on the design and implementation of population-based studies of minorities. Researchers may also encounter significant challenges in recruitment and retention of minority participants that they determine to be too difficult to overcome. Additionally, there is an underrepresentation of minorities in medical and scientific communities, and a lack of successful partnerships between academic medical centers and underrepresented communities.<sup>115</sup>

---

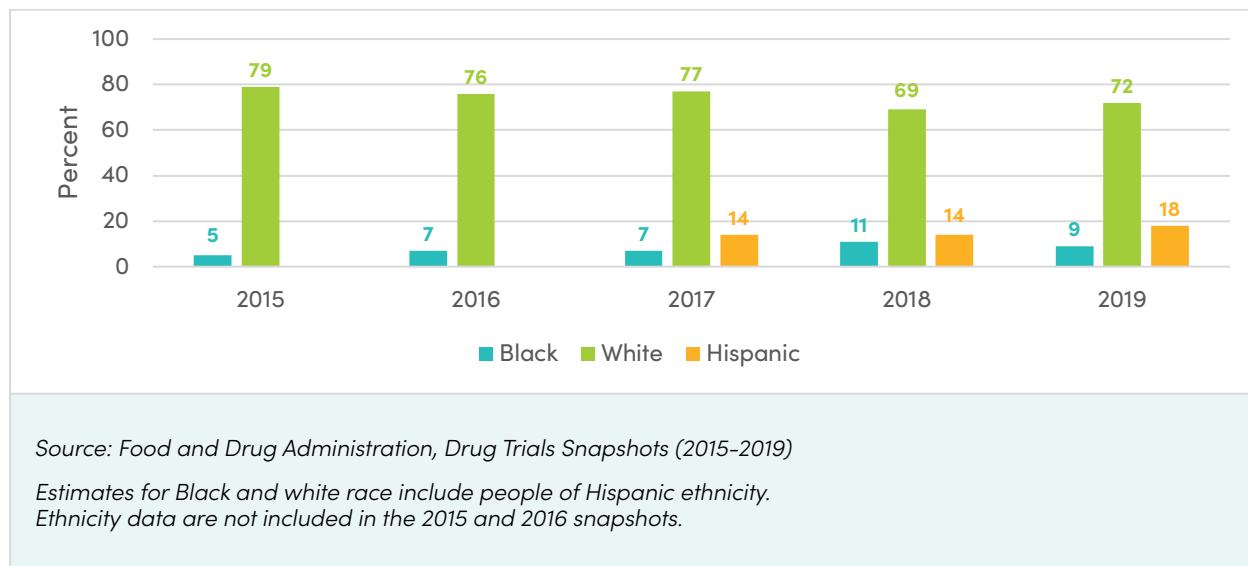
### **Strategy: Significantly increase participation of Black, Hispanic, and Indigenous Americans in clinical trials.**

---

Additional reasons that few studies have included indigenous people and individuals of African and Hispanic ancestry include that “researchers have avoided the increased difficulty of identifying true from spurious associations when ancestral differences among cases and controls may differ, which happens more often in admixed populations; logistical issues have led researchers to make use of large datasets established by large medical centers, some of which are not accessible to minority individuals; and minority individuals elect not to participate in research studies for cultural or historical reasons.”<sup>399</sup>

Since 2015, the Food and Drug Administration (FDA) has published an annual “Drug Trials Snapshot” to share information on the diversity of participants in clinical trials of novel drugs.<sup>400</sup> The reports show participation only for pivotal clinical trials used to approve drugs that are a New Molecular Entity (NME) or original biologic product. Black and Hispanic individuals consistently represent a significantly smaller portion of clinical trial participants, compared to white individuals (Figure 42).

**Figure 42. Participation in Clinical Trials for Approved Therapies by Race and Ethnicity**



In 2019, the FDA issued a draft guidance on how the drug industry could increase diversity in clinical trials through expanded eligibility criteria, improved trial design, and inclusive recruitment and enrollment practices.<sup>401</sup>

## INDUSTRY DEDICATION TO DIVERSITY IN CLINICAL TRIALS

Many clinical trials are undertaken by the pharmaceutical and biotechnology industries, who rely on clinical trials to research novel therapies and gain FDA approval for clinical use. As sponsors of clinical research, industry partners are increasingly aware of the need for diversity in clinical trials in order to better serve people of all races and ethnicities. In recent years, some of the largest sponsors of asthma clinical trials have expressed commitment to inclusivity and diversity in clinical trial participation. Proposed actions include:

- Reexamine study site selection to improve access for underrepresented populations
- Conduct pilot studies to understand best practices in screening and recruitment of diverse participants
- Train investigators on the importance of diversity in clinical trials
- Build roadmaps for engaging diverse populations in all phases of clinical research
- Collaborate with strategic partners to establish new standards for inclusive research
- Develop new approaches to support and protect vulnerable populations
- Leverage clinical outcomes with preexisting data to gain more complete information
- Identify new approaches to support underrepresented populations to maintain diversity in clinical trials

Along with initiatives from the FDA and NIH, these industry efforts are needed to improve the recruitment and retention of diverse participants in clinical trials. With enhanced support from industry partners, ensuring diversity in clinical trials can provide more accurate information on historically underrepresented populations and accelerate personalized treatments to eliminate disparities.

## BARRIERS TO ACHIEVING DIVERSITY IN CLINICAL TRIALS

Despite widespread recognition to include diverse participants in clinical research, significant challenges exist. Barriers to participation in drug trials are complex. Many Black, Hispanic, and Indigenous populations have limited access to specialty care centers that can refer them to clinical studies.<sup>402</sup> Other barriers include financial constraints, scheduling conflicts, lack of access to information and comprehension about research, unique cultural and linguistic differences, fears of unintended outcomes, stigmatization, and health care discrimination.<sup>403</sup>

### Common Barriers to Clinical Trial Participation



Research shows that individuals in minority groups may be as willing to participate in health research as white individuals,<sup>404</sup> but addressing participation challenges among minority populations requires buy-in from all stakeholders, including funders, academic institutions, investigators, and potential research participants.<sup>405</sup> Challenges in minority inclusion can be addressed through short-, medium-, and long-term strategies. Short-term barriers such as loss of wages and challenges in transportation and childcare can be addressed by offering compensation, travel support, flexible recruitment hours, and study sites in areas with diverse residents.<sup>362</sup> Researchers can also adapt recruitment materials to the language and reading level requirements of target groups by ensuring to describe how collected data will be used, ensuring transparency, and easing fears stemming from lack of information.<sup>405</sup> Researchers can also partner with community health care providers to compensate for the limited access to specialty care centers that typically refer participants to clinical studies.

## DIGITAL TRANSFORMATION

As health care becomes increasingly patient-centered, emerging technologies present new opportunities to engage and empower patients, optimize health care, and facilitate research.

In practice, “smart” inhalers and sensors offer new ways to gather real-world data and empower people with asthma to practice better self-management. Telehealth and telemedicine allow people with asthma to visit a provider virtually. Mobile apps and wearable devices make it possible to track and analyze health data.

Digital health is also positioned to transform clinical trials. Technology-driven approaches have the potential to increase patient engagement, accelerate clinical research, and reduce costs. Digital health tools can engage large cohorts over time by providing participants with wearable technology that collects and integrates data with little effort. Additionally, the use of digital health solutions might help increase clinical trial participation and diversity by providing technologies to participants who otherwise would be unable to participate due to cost, access, time constraints, or location.

More long-term strategies include developing the careers of minority scientists and facilitating and valuing research on minorities by investigators of all backgrounds. However, given the length of time required to accomplish these steps, researchers can employ research staff who share their same culture as their target population(s) and with whom participants can communicate in their own language, as potential participants are more likely to partake when recruited by research staff they personally know or with whom they identify.<sup>403, 406</sup> Funding agencies, such as the NIH, can also implement solutions to promote population-based studies of racial and ethnic minorities, including providing funding for studies exclusively focused on cohorts of racial or ethnic minorities and increasing the number of requests for applications for these types of studies.<sup>407</sup>

Addressing these challenges in research diversity is imperative. Existing health disparities could worsen if minority populations continue to be excluded from research cohorts. Racial and ethnic minority populations may respond differently to different medical products. Additionally, information about these differences can be included in product labeling to help doctors and patients make treatment decisions. Diversity in clinical trials ensures medical products are safe and effective for everyone who will use them, which can have a major impact on eradicating respiratory health disparities.

Efforts to increase diversity in clinical trials require thoughtful, targeted initiatives from stakeholders. Significant barriers to racial and ethnic minority participation in clinical trials still exist, with recurring themes of trust in medical establishment, costs, and access or knowledge of the clinical trial process presenting the most significant challenges. To ensure that medical discoveries, new treatments, and interventions are applicable to all populations for whom they are intended, physicians and researchers need to address these key barriers through culturally competent recruitment and retention efforts.

---

**Strategy: Address cultural stigmas and myths about research among minority populations and build trust in medical establishment and particularly in minority research.**

---

Hiring research staff who are from the same community as study participants can build trust in medical establishment and clinical research. Being from the same community as participants, community research staff can serve as trusted points of contact who can answer questions and explain the importance of participation in clinical trials. Community research staff can also mentor and advocate for participants, as they are more familiar with and can speak to the lived experiences of the community. Additionally, community research staff can serve as culturally-competent motivators to improve retention and monitor future participant interaction.

Hiring community-based research staff may help improve diversity in clinical trials. Best practices for thoughtful execution include:

- Provide staff with an overview of clinical trials research, as well as potential benefits, risks, and outcomes of current research prior to study start
- Ensure that staff meet with health care providers prior to recruitment to explain the study, address concerns, and gain a commitment to assist with research protocols
- Empower staff in their roles as trusted points of contact for participants in clinical trial research
- Continue staff training and education during and after the study, reinforcing the value of community research staff in clinical trials
- Leverage relationships between staff and participants to strengthen community partnerships following the conclusion of the study



## NATIONAL MINORITY QUALITY FORUM: DEDICATION TO REPRESENTING MINORITY POPULATIONS IN RESEARCH

The National Minority Quality Forum (NMQF) is a non-profit Washington, D.C.-based, health care research and education organization whose mission is to reduce patient risk by assuring optimal care for all.<sup>408</sup>

NMQF integrates data and expertise in support of initiatives to eliminate health disparities by assisting health care providers, professionals, administrators, researchers, policy makers, and community-based organizations in delivering appropriate health care to minority communities.

As part of its mission, NMQF advocates for the need for minority representation throughout the health care ecosystem. NMQF hosts a Health Disparities Summit, bringing together nearly 1000 attendees annually from professions as health care providers, administrators, researchers, policy makers, and community organizations. The Summit aims to educate and foster collaboration among health care leaders to deliver holistic approaches for quality care to diverse populations.<sup>409</sup>

NMQF's annual "40 Under 40" program recognizes outstanding young health care industry professionals for their achievements in bringing health equity to their institutions and communities.

The organization also maintains a National Health Index, which provides demographic intelligence about chronic disease prevalence, costs, outcomes, and associated trends, including for asthma. The Index allows users to access more than 5 billion patient records to power collaborative learning communities through claims and related medical data analytics for academic research, patient outcomes, advocacy, and clinical and commercial operational applications. This data becomes the foundation for peer-reviewed social and clinical research, quality improvement and education initiatives to reduce disparities in clinical practice, clinical trial diversity efforts and local and national advocacy initiatives.<sup>410</sup>

NMQF applies its data to the conduct of clinical and social research, recognizing that a lack of representation in research results in science that is inadequate to support health care treatment and policy recommendations related to racial and ethnic minorities. Powering clinical trials and other research with sufficient minority participants may be the greatest challenge in determining what constitutes effective and safe care.

NMQF efforts are critical. As such, future NMQF efforts are important in addressing the significant challenge to include representative participants in research and ensuring the future of safe and effective care for all populations.

“

*Reflecting the diversity of the patients in research will enable the healthcare system to stimulate investment in healthcare quality in a manner that fundamentally reduces patient risk and builds a more efficient system that is powered to sustain a more diverse America in the 21st century... and beyond.* ”

- Gary Puckrein, PhD  
President and CEO  
National Minority  
Quality Forum

## DATA COLLECTION AND MEASUREMENT

The U.S. has a long history in conducting research to identify and understand patterns of asthma risk factors, incidence, morbidity, and mortality. Population-based studies are critical in the development of public health initiatives intended to improve asthma outcomes. However, data from some populations are scarce or unreliable, leading to the inequitable application of epidemiological data.

---

**Strategy: Expand research of patterns of asthma risk factors, morbidity, and mortality in underrepresented populations—particularly Black, Hispanic and Indigenous Americans—to inform public health interventions.**

---

A significant challenge in efforts to gather data is the absence of data collection and measurement standards for population subgroups. Reliable and valid measurement is critical in efforts to eliminate health disparities, and the lack of such standards has inhibited uniform reporting and tracking of health disparities data.<sup>411</sup>

Researchers have recommended standardizing the collection of subgroup population data to better understand health barriers related to race and ethnicity, language, disability status, and sex, as well as identify strategies to overcome them.<sup>412</sup> Key components in standardizing and expanding data collection and measurement include:

- Uniformity in race and ethnicity terminology
- Uniformity across reporting agencies
- Investment in additional data from underrepresented populations
- Availability of disaggregated data to public
- Improvement of asthma monitoring and measurement terminology

### UNIFORMITY IN RACE AND ETHNICITY TERMINOLOGY

To better identify, understand, and address disparities, consistent data collection and reporting methods regarding race and ethnicity are needed. Race and ethnicity data are collected by various agencies at local, state, and national levels, and consistency in the collection and measurement of this data can allow for more useful comparisons between populations at every level. Additionally, increasing diversity in the U.S. population, including rising diversity within existing categories of racial and ethnic minority populations, requires improved and standardized measures of race and ethnicity that more accurately identify the health needs of diverse populations.<sup>411</sup>

---

**Strategy: Improve data collection standards to ensure uniformity in racial and ethnic data collection across agencies.**

---

Throughout the past decade, there have been federal efforts to improve and standardize the collection of this data. In 2009, at the request of the Agency for Healthcare Research and Quality, the Institute of Medicine (IOM) formed the Subcommittee on Standardized Collection of Race/Ethnicity Data for Healthcare Quality to examine approaches to the standardization of data on race, ethnicity, and language. In a subsequent report entitled “Race, Ethnicity, and Language

Data: Standardization for Health Care Quality Improvement,” the Subcommittee emphasized that the lack of standardized data on race, ethnicity, and language prevented the identification of effective actions that could be used to reduce health disparities.<sup>413</sup> The report further recommended that data collection standards should expand beyond the Office of Management and Budget’s (OMB) race and Hispanic ethnicity categories established in 1997 to include collection of data on a more granular ethnicity, which are based on one’s ancestry and language.<sup>413</sup>

In 2011, the Department of Health and Human Services (HHS) published the Action Plan to Reduce Racial and Ethnic Health Disparities, which included a key strategy to increase the availability and quality of the data that are collected and reported. To achieve this goal, the plan outlines several related action items, including establishing data standards and ensuring federally conducted or supported health programs, activities, or surveys collect and report data on race, ethnicity, sex, primary language, and disability status as authorized in the Affordable Care Act.<sup>414</sup> Since the publication of the Action Plan, HHS adopted new standards for the collection of data by race, ethnicity, language, sex, and disability status, provided additional granularity for the Asian race category and Hispanic ethnicity, and distinguished Native Hawaiian from Pacific Islander race categories in major self-reported population health surveys.<sup>415</sup>

As the primary source used to monitor the nation’s health, the adoption of these standards by the HHS is significant in addressing issues related to current data collection processes. HHS collects data through a family of related surveys conducted by its various agencies, including AHRQ, CDC, CMS, and NIH. Data from these surveys are used to provide national, and often subnational, estimates of measures, such as insurance coverage, preventive care, access to and quality of care, mental health services utilization, and medical expenditures. Prior to the establishment of these standards by the Affordable Care Act, HHS agencies neither collected data on race and ethnicity at comparable levels of specificity nor used consistent collection methods for data on primary language.<sup>413</sup> By standardizing the collection of demographic data across agencies, new data collection standards will allow for more accurate comparisons across health care measures by demographic data.

## UNIFORMITY ACROSS REPORTING AGENCIES

Beyond HHS, there is a need for uniformity in data collection and measurement across local, state, and national agencies to better understand and address health disparities. Comprehensive health care surveillance involves public and private data collection systems, including health surveys, administrative enrollment and billing records, and medical records. These data are used by entities such as hospitals, community health centers (CHCs), physicians, and health plans, all of which collect data on race, ethnicity, and language to some extent.<sup>416</sup> No single entity has the ability to gather data on race, ethnicity, and language for the entire population of patients, nor does any single entity currently collect all health data on individual patients.

Moreover, entities that collect data on race and ethnicity may not have established standards for doing so and may not use the data to effectively monitor health outcomes for patient populations. A 2006 review of data collection in hospitals showed that while most hospitals collected data on race and ethnicity, only about one in five had formal policies regarding collection of race and ethnicity data. Even fewer hospitals had specific policies that addressed the categories or methods that should be used for data collection.<sup>417</sup> The review also found that less than one in five hospitals that collect race and ethnicity data used it to assess and compare quality of care, utilization of health services, health outcomes, or patient satisfaction across different patient populations.<sup>417</sup> Nevertheless, race and ethnicity data collected by hospitals is believed to be relatively accurate and could be used with other data sources to identify and monitor

health disparities. To get the most use out of health surveillance data, the National Research Council suggests integrating data from multiple sources to gain more comprehensive insights.<sup>418</sup> Therefore, in addition to establishing uniform data collection standards for race, ethnicity, and language data across entities, data integration is needed for accurate comparison and to better inform disparities reduction efforts.

---

**Strategy: Transform national, state and local surveillance systems to utilize uniform data collocation standards.**

---

## **INVESTMENT IN ADDITIONAL DATA FROM UNDERREPRESENTED POPULATIONS**

Another significant challenge facing entities tracking disparities is the lack of reliable estimates for racial and ethnic subgroups due to small sample size. To address these problems, many national surveys oversample Black and Hispanic populations, and in doing so, are able to support national estimates for these groups, as well as some stratified analyses (e.g., analysis by sex, age, income).<sup>419</sup> However, small samples of other populations such as American Indigenous/American Native (AI/AN), Asian, and Native Hawaiians and Other Pacific Islanders (NHOPI) populations persist, limiting the availability of statistically reliable estimates for these groups.<sup>419</sup> Issues with small sample sizes are exacerbated when attempting to examine racial disparities within subpopulations (e.g., Hispanic subpopulations) or by other factors (e.g., sex, age).<sup>419</sup> Considering the heterogeneity in asthma within populations, oversampling smaller populations and population subgroups is needed to provide more reliable estimates regarding health disparities.

---

**Strategy: Improve data collection to monitor disparities experienced by AI/AN populations and Hispanic subgroups.**

---

In instances where oversampling is not possible, agencies may take other approaches to provide reliable estimates for specific populations. One such approach is to aggregate data across years to yield more statistically reliable national estimates. However, this approach is only possible when a survey is conducted yearly or on an otherwise regular basis, and when data collection instruments remain consistent over time.<sup>417</sup> Additionally, depending on the number of years that must be combined to produce reliable estimates, this approach may limit the ability to track short-term effects of policy changes.<sup>420</sup> In its Action Plan to Reduce Racial and Ethnic Health Disparities, HHS outlines this pooling technique as a method to capture low-density population estimates when oversampling is not fiscally feasible.<sup>414</sup> HHS also promotes the development and implementation of targeted special population studies, both internally and through research grant funding and contracts.<sup>414</sup> This integrative approach can be particularly effective in addressing subpopulation disparities missed by standard HHS data collection activities. With effective targeting, sampling, and integration of data across sources, more reliable populations estimates can be made available that accurately reflect the health needs of diverse groups.



## PUBLIC ACCESS TO DISAGGREGATED DATA

Another key element to addressing disparities is making population data publicly available. Though data from national HHS surveys are often made available to the public, data at the state and local levels are often more difficult to obtain.<sup>421</sup> Since many decisions regarding coverage and access to care are made at the state and local levels, the availability of this data could provide key insights into existing health disparities within local populations. Additionally, available public data are often presented in ways that aggregate racial and ethnic subgroups into broader categorizations.<sup>421</sup> Though aggregate data can provide insight into overarching disparities, public access to disaggregated data can further inform efforts to reduce disparities. Public disaggregated data can be particularly useful to inform efforts targeting greater disparities experienced by specific subpopulations, such as asthma-related health outcomes of the Puerto Rican population within Hispanic ethnicity.

---

**Strategy: Provide public access to disaggregated data to identify disparities within subgroups of each population.**

---

As part of their initiative to implement a multifaceted data collection strategy around health disparities, HHS implemented strategies for improving public access to more comprehensive racial and ethnic data.<sup>421</sup> Specifically, HHS aims to ensure public access to data that is appropriately disaggregated and de-identified to promote further disparities research.<sup>421</sup> Additionally, HHS aims to ensure that data on race and ethnicity in federally supported programs, activities, or surveys is routinely reported in a format that is available for external analysis.<sup>421</sup> In doing so, HHS made a commitment to publish estimates of health outcomes for racial and ethnic minority populations and subpopulations on a regular, pre-determined schedule.<sup>421</sup> At the local, state, and national levels, implementing actions to collect and publish reliable estimates of detailed racial and ethnic data can improve the quality and use of such data in efforts to improve health outcomes for populations facing disparities.

## IMPROVEMENT OF ASTHMA MONITORING AND MEASUREMENT TERMINOLOGY

To effectively address asthma disparities, there is an additional need for improved terminology around asthma monitoring and measurement.<sup>422</sup> In 2012, federal agencies partnered to release the Coordinated Federal Action Plan to Reduce Racial and Ethnic Asthma Disparities (the Action Plan).<sup>184</sup> As part of the strategy to improve capacity to identify children most affected by asthma disparities, the Action Plan includes priority actions to standardize definitions, measures, outcomes, and data collection methods. Efforts to standardize these factors include developing greater depth, increasing validity, and optimizing collection methods in surveillance, research, evaluation, and health care initiatives.<sup>184</sup>

In April 2016, the Asthma Disparities Subcommittee, consisting of representatives from the Centers for Disease Control and Prevention (CDC), state health departments, the National Institutes of Health (NIH), and the Health Resources and Services Agency (HRSA), developed a list of suggested measures typically used in asthma surveillance for children but are generally applicable to adults as well.<sup>423</sup> The subcommittee organized asthma measures based on well-known primary outcomes and specified principal measures for asthma control and asthma management (Table 15).

Table 15. Recommended Measures from the Asthma Disparities Workgroup

<p><b>Prevalence and Outcome Measures</b></p>	<ul style="list-style-type: none"> <li>• Current asthma prevalence</li> <li>• Asthma attack prevalence</li> <li>• Asthma emergency department visits</li> <li>• Asthma hospitalization rate</li> <li>• Asthma death rate</li> <li>• Missed school/workdays due to asthma</li> </ul>
<p><b>Risk Factors</b></p>	<ul style="list-style-type: none"> <li>• Race/ethnicity</li> <li>• Poverty status</li> <li>• Parental educational attainment</li> <li>• Exposure to environmental factors inside homes</li> <li>• Weight status</li> <li>• Lack of health insurance coverage</li> <li>• Type of health insurance coverage</li> <li>• No usual source of health care</li> <li>• Unable to pay medical bills</li> <li>• Personal doctor</li> </ul>
<p><b>Management</b></p>	<ul style="list-style-type: none"> <li>• Asthma action plan</li> <li>• Taught how to recognize early symptoms</li> <li>• Taught how to use inhaler</li> <li>• Taught how to respond to episodes of asthma</li> <li>• Taught how to monitor peak flow for daily therapy</li> <li>• Advised to change home/school/work environment</li> <li>• Asked about symptom frequency</li> <li>• Asked about relief inhaler frequency</li> <li>• Asked about activity limitation</li> <li>• Flu vaccination</li> <li>• Routine asthma visits in past year</li> <li>• Any preventive medication use</li> <li>• Regular use of prevention medication</li> <li>• Short-acting beta agonist overuse</li> <li>• Action taken to address environmental risks</li> </ul>
<p><b>Control</b></p>	<ul style="list-style-type: none"> <li>• General health status</li> <li>• Daytime symptoms</li> <li>• Nighttime awakenings</li> <li>• Activity limitation due to asthma</li> <li>• Frequent use of short-acting beta-agonists</li> </ul>

Source: Centers for Disease Control and Prevention, Asthma Disparities Subcommittee Recommendations (2016)

## TRANSLATING RESEARCH TO PRACTICE

Although there have been important clinical advances in the care of individuals with asthma, delivering those interventions at the community level has been less successful, particularly for the racial and ethnic minorities who experience a disproportionate burden of the illness. There remains a clear need to better integrate clinical asthma care and community health.

Translation is the process of turning observations in the laboratory, clinic, and community into interventions that improve the health of individuals, communities, and populations.<sup>354</sup>

Translational research “promotes the multidirectional and multidisciplinary integration of basic research, patient-oriented research, and population-based research”<sup>424</sup> necessary to inform evidence-based interventions to eliminate health disparities.

The translational research pathway includes multiple stages. Early-stage translation focuses on translating basic science from the lab to people.<sup>425</sup> Late-stage translation converts clinical findings to inform the development of evidence-based approaches.

Translational research strategies are used to<sup>426</sup>:

- Develop new approaches, technologies, resources, and models
- Demonstrate effectiveness and usefulness of interventions
- Disseminate intervention data, analysis, and methodologies to the community

Using these methods, researchers design science-based programs to improve outcomes in people with asthma.<sup>427</sup>

As new discoveries emerge, researchers will continue translating science to policy and practice.

---

**Strategy: Support research to inform interventions to reduce asthma disparities and collaborate to ensure the translation of research findings to policy and practice.**

---

Following the translation of scientific finding into evidence-based interventions, researchers often turn to implementation and evaluation methods that ensure programs and policies are appropriate for the populations who need them most.

Federal agencies, including the CDC and the NIH, recognize the need for translation. Through the Controlling Asthma in American Cities Project (CAACP), the CDC provided funding to seven inner-city sites to support the translation of scientific knowledge into innovative, comprehensive approaches for urban children in underserved communities.<sup>428</sup> CAACP funded the development of successful community- and household-level interventions in underserved communities with a high asthma burden.

The NIH established the National Center for Advancing Translational Sciences (NCATS) in 2012 to transform the translational science process so that new treatments and cures for disease could be delivered to patients faster. NCATS strives to develop innovations in translational research to accelerate the delivery of new drugs, diagnostics, and medical devices.

In 2015, the NIH’s National Heart, Lung, and Blood Institute established its Center for Translation Research and Implementation Science (CTRIS) to ensure successful integration of evidence-based interventions within clinical and public health settings. CTRIS’ mission builds on successes in fundamental discovery science and early- and late-stage translational research.



*We spend billions on health innovations, but very little on how best to apply them in real-world settings. Without implementation research, we are at best committing valuable resources in the hope that things will work out.*<sup>431</sup>



- David Peters, Nhan Tran,  
Taghreed Adam (World  
Health Organization)

## IMPLEMENTATION AND EVALUATION

Multi-level interventions that are tailored to individual needs, that work in various settings (e.g., clinic, home, school, and community), and that address all components of asthma care (e.g., assessment and monitoring, self-management and education, treatment, and environmental triggers) show promise for reducing disparities in asthma. In recent years, many innovative programs were developed and proven to be effective (see Addressing Asthma Disparities Through Direct Interventions and Programs on page 133).

Despite this evidence, comprehensive asthma interventions remain inaccessible for many communities experiencing a disproportionate burden of asthma.<sup>139</sup>

Reducing asthma disparities on a large scale requires efforts that focus not only on developing interventions but also on what, why, and how interventions work in the “real world.”<sup>429</sup> Research efforts are needed to identify the best methods for implementing evidence-based programs in diverse communities.

Implementation science describes the process of translating research from a clinical setting to a real-world setting.<sup>354</sup> Implementation strategies aim to deliver evidence-based interventions in health care settings, homes, schools, and communities. This includes integrating, scaling up, and sustaining proven-effective interventions, as well as identifying unproven or outdated clinical practices.<sup>430</sup>

Implementation outcomes can be studied through evaluation methods. Incorporating routine evaluation for asthma interventions can help inform policies and practices, justify program costs, and establish program value. Implementation research helps tackle disparities in asthma by ensuring proven interventions are applied to populations who need them most.

Implementation research strategies are used to<sup>432</sup>:

- Evaluate performance
- Inform efforts to scale-up interventions
- Support quality improvement efforts
- Identify models for sustainability
- Determine replicability
- Address issues of access to interventions
- Understand barriers to fidelity
- Examine feasibility and cost
- Identify methods for adoption in diverse populations



The path from tightly controlled trials to real-world settings often faces challenges. Implementation research allows experts to test and fine-tune interventions that are successful in controlled settings but have not been proven in community settings (e.g., worksites, communities, health systems/practitioners, or schools). When successful, implementation of asthma interventions in the real world has important implications for future policy and payment decisions that improve the care and outcomes of children with asthma.

In the 1990s, the National Institute of Allergy and Infectious Diseases (NIAID) formed an inner-city asthma consortium of investigators to explore the causes of asthma and design interventions to reduce asthma morbidity in underserved communities. Interventions were tested in two randomized controlled trials (RCTs): National Cooperative Inner-City Asthma Study (NCICAS) and Inner-City Asthma Study (ICAS).<sup>433</sup> NCICAS was designed to identify and address each child's unique risks. ICAS was designed to integrate environmental risk management based on each participant's unique environmental risks.

Both interventions were successful in their controlled settings. Researchers later integrated both interventions into primary care practices in community health centers (CHCs) to determine that interventions were also successful in the real world.<sup>433</sup>

## **ADAPTING AND IMPLEMENTING INTERVENTIONS FOR UNIQUE POPULATIONS**

One of the most important considerations in the development of evidence-based interventions is ensuring programs are appropriate for demographically, socioeconomically, and culturally unique populations.<sup>278</sup> This is especially critical because the lack of diversity in basic science research and clinical research means that many interventions are informed by research extrapolated from a largely white population.

Successful interventions must adapt proven methods to the individual needs, beliefs, and characteristics of diverse populations and local environments.<sup>296</sup> Some researchers across the U.S. tested asthma interventions in racial and ethnic minority populations.

A study of 590 children with asthma living in high-risk, low income communities in Arizona, Michigan, and Puerto Rico found that evidence-based interventions were successful when tailored for application in diverse community health centers (CHCs).<sup>434</sup> Researchers noted clinically significant reductions in symptom days, oral corticosteroid usage, and urgent care visits in children who received the tailored intervention than the control group.

In Louisiana, investigators used implementation strategies to adapt an evidence-based asthma counseling intervention to meet the needs of 182 children with moderate-to-severe persistent asthma in a post-hurricane and resource-poor environment.<sup>435</sup> The study found that by adapting to the needs of the study population and setting, investigators successfully implemented a counseling intervention that improved treatment adherence and clinical outcomes.

Researchers in Baltimore targeted over 200 school-aged children with persistent asthma for a home-based intervention.<sup>436</sup> The study modeled the intervention on the successful Seattle King County Asthma Program and included six Baltimore-specific adaptations. The intervention included an initial home assessment, asthma education, six home visits, and a final home assessment after one year. For 102 children who completed the program, data showed statistically significant reduction in asthma symptoms and asthma-related emergency room visits.

Additional implementation studies are needed to adapt evidence-based interventions to unique populations. Although many evidence-based interventions exist for asthma, there is a need for more studies about adapting those programs to racial and ethnic minority populations.<sup>437</sup>

---

**Strategy: Conduct further research studies and tests among racially and ethnically diverse populations to discover successful strategies that show increased patient adherence to proven asthma management strategies and medicines.**

---



## HEALTH SERVICES RESEARCH

Health care factors, such as coverage, access, and quality of care, contribute to health disparities. In recent years, several payment reform systems, legislative changes, and quality improvement initiatives aimed to address these factors. However, few research studies were conducted to determine the long-term impact of these initiatives.<sup>438</sup> In order to properly monitor and address the impact of health care systems on disparities, health services research is needed.

Health services research focuses on policies, organizations, and programs to examine factors that include quality improvement, payment reform systems, patient-clinician interaction, and clinical decision-making.<sup>438, 439</sup> While health services research examines government funded health facilities, it also accounts for public health laws and regulations, financing mechanisms, such as social health insurance and user fee schemes, household and community health initiatives, and the private health sector comprised of formal and informal providers.<sup>439</sup>

Health services research benefits from a multidisciplinary approach, breaking down barriers between areas such as finance, epidemiology, and behavioral and social science.<sup>440</sup> In using this approach, health services research focuses on how the system as a whole achieves desired

outcomes by evaluating the long-term impacts of quality improvement initiatives, legislative changes on access and quality, payer-based changes, implementation of evidence-based and guideline-driven care, and patterns of health care underuse or overuse.<sup>440</sup> In this process, health services research may identify services and interventions that cause disparities in care and outcomes across population groups, which can be used to inform future interventions, policies, and systems that better promote health equity and reduce disparities.<sup>440</sup>

For health equity to be achieved, health care systems must provide access, remove barriers to care, and provide equally effective treatment to all individuals.<sup>438</sup> Research efforts are needed to evaluate whether system-level changes achieve these goals and have significant effects on reducing health care disparities. Understanding the systemic factors that contribute to health care disparities, as well as how they contribute to population-level health disparities, is essential so that more effective equity-promoting interventions can be implemented.<sup>438</sup> To do so, payers, systems, and communities must work together with clinicians and patients to identify the causes of disparities in health care. Additionally, to effectively promote health equity and reduce health disparities, health systems should commit to tracking equity measures, implementing quality improvement initiatives, building culturally competent health care services, and fostering relationships between clinicians and patients.

---

**Strategy: Test and scale models for payment systems and program structures that integrate all components of comprehensive, evidence-based asthma care.**

---

In 2015, the Brookings Institute and AAFA convened a diverse group of stakeholders to explore opportunities that improve the care of pediatric asthma patients through enhanced coordination of clinical services, community organizations, and public health entities.

Experts from the federal government, health and social agencies, successful community-based asthma programs, physicians, patients, school nurses, pharmacists, and payers met to discuss<sup>441</sup>:

- Opportunities to improve care through community interventions
- Improved access and efficiency of community interventions
- The relationship among payment reform, health system transformation, and sustainability of community interventions.

A paper published following the meeting reviews the evidence on opportunities for improving outcomes and lowering costs by better addressing the social determinants of asthma. It also describes a broadened care delivery model that can be implemented through practical and incremental reforms.



*Coincident with advancing the science of medicine is a changing culture of medical practice and medical research that engages individuals as active partners – not just as patients or research subjects. We believe the combination of a highly engaged population and rich biological, health, behavioral, and environmental data will usher in a new and more effective era of American healthcare.*<sup>396</sup>



– Precision Medicine Initiative Working Group

## PATIENT ENGAGEMENT IN RESEARCH

Engaging patients and other stakeholders is an important element in the design and conduct of health research during the last 15 years.<sup>442</sup> Particularly with the inception of the Patient-Centered Outcomes Research Institute (PCORI) through the Patient Protection and Affordable Care Act (Affordable Care Act 2010), stakeholder engagement received national attention in the United States. PCORI is an independent, nonprofit, nongovernmental funding organization whose main initiative is to improve the quality and relevance of evidence available to help patients, caregivers, clinicians, employers, insurers, and policymakers make informed health decisions.<sup>443</sup>

Notably, PCORI requires researchers to include a detailed engagement plan as part of all proposals, which encourages research informed by participatory action. Without being prescriptive to the approach, every application must describe a process to involve patients, caregivers, clinicians, and other healthcare stakeholders meaningfully throughout the research process.<sup>444</sup> In turn, PCORI-funded research utilizes stakeholder engagement to enhance research effectiveness and relevance in populations affected by disparities.<sup>444</sup>

---

### **Strategy: Support patient-centered outcomes research and community-based participatory research in asthma.**

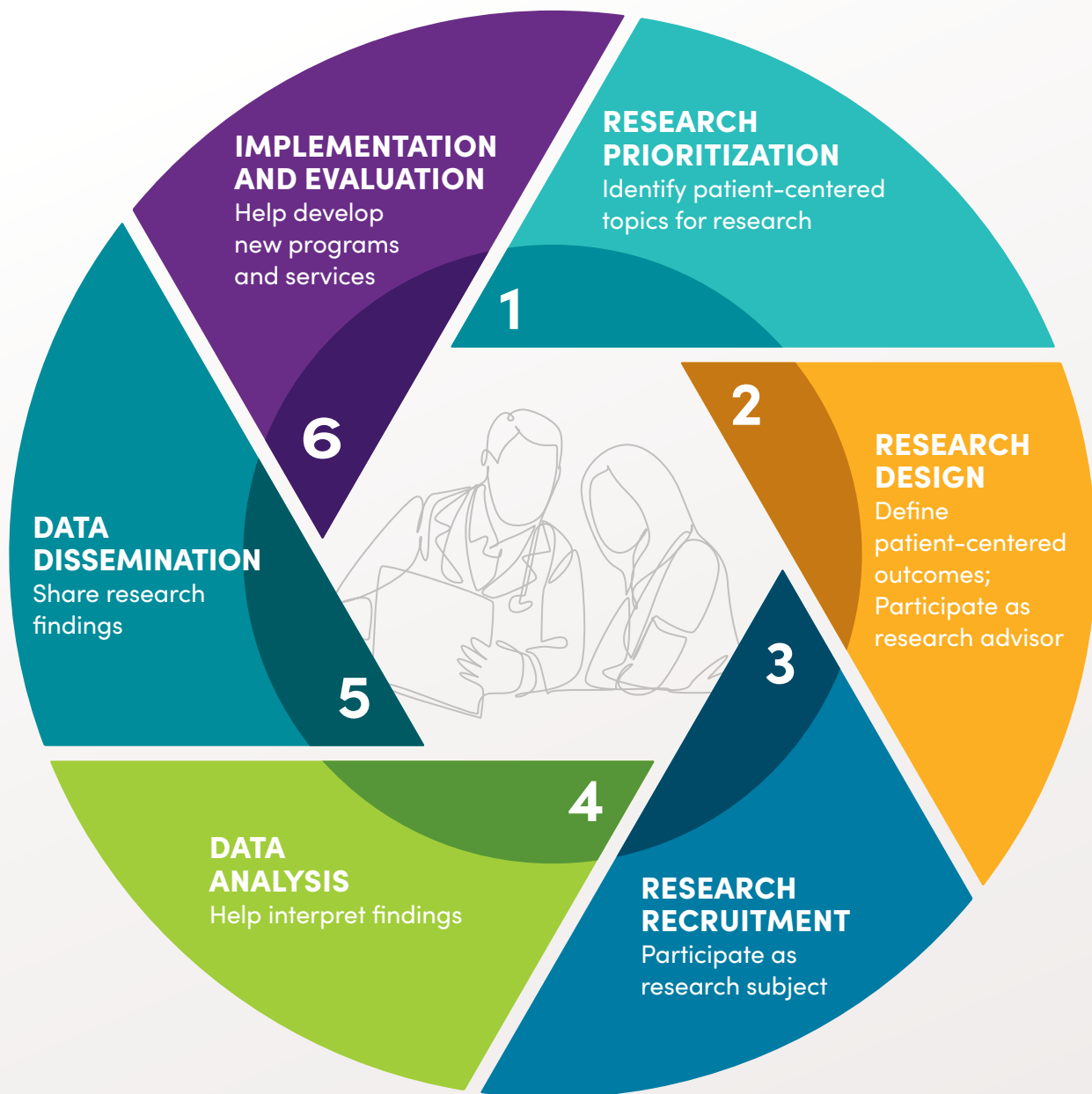
---

The PCORI Methodology Report states that patient engagement can include defining topics and formulating study questions, identifying a study population and choosing interventions, comparators and outcomes, developing optimal strategies for recruitment and retention of study participants, conducting a study and analyzing results and disseminating research findings into clinical practice.<sup>445</sup> Patient and family engagement can be mutually beneficial, as engaging patients in the research process can challenge researchers' assumptions, align research with patient needs, increase transparency and patients' trust in research, and lead to research that improves patient care.<sup>446</sup> Additionally, by honoring patient priorities and preferences, research that engages patients and families is more likely to produce sustainable improvement in health outcomes.<sup>447</sup>



Researchers, institutions and funders increasingly recognize the importance of patient involvement in research. Though patients historically were seen as research participants as subjects only, many stakeholders now support and encourage patient involvement in all stages of the research process (Figure 43).

## FIGURE 43. PATIENT INVOLVEMENT IN ALL STAGES OF THE RESEARCH PROCESS



Community groups and national patient advocacy organizations often engage patients in their program planning and evaluation. For example, AAFA maintains a Patient and Family Advisory Council (PFAC) with over 100 dedicated and trained volunteers. This group provides valuable feedback to AAFA staff and leadership as well as its partners on the development and implementation of new research initiatives and programs. Because these individuals also manage asthma and allergies for themselves or a family member, they are aware of community needs and provide invaluable feedback.

---

**Strategy: Align research needs with the needs of patients from underrepresented racial and ethnic groups.**

---

This type of participatory research recognizes the strengths that each stakeholder brings, which is important for disparities research. Researchers acknowledge that models driven solely by researchers have not addressed the variety of persisting health disparities, and that there is a need for integrated approaches that create actionable results for practitioners while also providing valuable, relevant information to the most affected populations.<sup>448</sup> By engaging stakeholders throughout the process, researchers ensure the results have the highest potential impact and benefit for the community.

Though stakeholder engagement has the potential to effectively address health disparities, there are patient and system level barriers to effective engagement. As a relatively new venture, patient-centered outcomes research (PCOR) has few well-established methods for engaging patients and other stakeholders with teams of academics or clinicians to meaningfully incorporate their input.<sup>449</sup> Additionally, individual characteristics (e.g., age, self-efficacy, and literacy), disease characteristics (e.g., perception, stigma/taboo, comorbidities, and treatment demands), setting characteristics (e.g., type of provider, data driven care, incentives, and information availability), and cultural/contextual norms create additional challenges in maintaining stakeholder engagement.<sup>449</sup> Nevertheless, the potential benefits to engaging multiple stakeholders are apparent.

---

**Strategy: Establish policies and practices to support research that engages diverse, multi-sector stakeholders throughout the research process.**

---

Research suggests that engagement contributes to research that is better aligned with patients' and clinicians' needs, and provides valuable contributions to research feasibility, acceptability, rigor, and relevance, despite trade-offs in engagement.<sup>450</sup> Additionally, participatory research methods were proposed to reduce disparities and enhance trust in health research.<sup>451</sup> Successful engagement provides researchers and stakeholders with an opportunity to share in collaboration, empathy, trust, and shared values, as well as provide researchers with a new perspective on the importance of the work.<sup>450</sup>

As engagement practices continue to gain traction, it is important for researchers to understand the critical elements of engagement best-practices, as well as the challenges to implementing effective engagement. Additionally, research shows it is critical to recognize characteristics of engaged partners beyond their stakeholder "group" (e.g., patient, researcher, community leader) to understand how diverse representation affects engagement contributions.<sup>450</sup> With multiple stakeholders involved, this knowledge informs best practices, policies, and resource allocation to address challenges with engagement and research relevance.



## DIVERSITY IN RESEARCH

Diversity in research and medicine ensures safe and effective care for racial and ethnic minority populations. This report previously addressed the need for diverse representation among health care providers (see Diversity in the Health Care Workforce on page 93), diversity of samples in genomic datasets (see Genomics Research on 180), and diversity of patients in clinical trials (see Clinical Research on page 183), but there is also an increasing need for diversity among researchers. Diversity in medical and scientific communities increases minority participation in clinical research, produces research that can better serve racial and ethnic minority communities, and supports care that is culturally and linguistically appropriate for racial and ethnic minority populations.<sup>452</sup>

Diversity and inclusion programs at medical schools are a critical first step in promoting diversity in research. In 2018, Hispanic and Black individuals made up only 8% and 5% of Ph.D. recipients in biological and biomedical sciences, respectively.<sup>453</sup> However, the enrollment of minority students in U.S. medical schools is on the rise: from the 2018–2019 academic year to 2019–2020, the number of Black students enrolled in U.S. medical schools rose by 4.7%, and the number of Hispanic enrollees increased by 5.5%.<sup>454</sup> These increases are not coincidental, as U.S. medical schools are making concerted efforts to increase enrollment of minority students.<sup>455</sup> In 2009, the Liaison Committee on Medical Education (LCME) strengthened diversity requirements for accreditation, insisting that medical schools must have policies and practices in place that achieve appropriate diversity among students.<sup>455</sup> The new requirements went beyond previous suggestions that medical schools “should have policies and practices ensuring the gender, racial, cultural, and economic diversity of its students.”<sup>455</sup> Following the establishment of these new requirements, previous declining trends of declining nonwhite student enrollment reversed.<sup>456</sup>

Nevertheless, increasing racial and ethnic diversity among researchers requires more institutional reform. Beyond enrollment, many minority students experience racial discrimination, prejudice, and feelings of isolation in medical school.<sup>457</sup> Additionally, minority students may feel pushed into a “one-size-fits-all” approach in medical programs that are built by predominantly white individuals, where racial, ethnic, and cultural differences are stigmatized rather than celebrated.<sup>458</sup> For diversity and inclusion efforts to be effective, institutions will need to support minority students throughout their medical school tenure. Programs and initiatives that are tailored to recognize and support the needs of minority students can assist in recruitment and retention of diverse researchers interested in studying asthma.

---

**Strategy: Increase racial and ethnic diversity among researchers studying asthma.**

---

Beyond medical school, there is an apparent need for medical and research institutions to support programs that promote diversity in research. A 2013 study found that senior faculty at academic medical centers are less likely to be engaged or to mentor junior faculty in research studies involving minorities.<sup>459</sup> With a lack of engagement, early-stage investigators, who may also come from disadvantaged backgrounds, are more likely to abandon a career in research in favor of more secure or lucrative teaching or clinical positions.<sup>459</sup> Therefore, funding and career development programs for early-stage and mid-career investigators devoted to research on minority health is imperative for racial and ethnic minority retention in research.

At the federal level, the NIH supported many efforts on the mentorship and development of racial and ethnic minority researchers, including minority-focused research fellowship programs, international research training grants, biomedical research support programs, student development initiatives, and high school student research programs.<sup>362</sup> Several NIH-funded programs supporting mentorship and career development of minority researchers report success, particularly in faculty mentors' competence in addressing diversity and promoting professional development.<sup>460-462</sup> The success of programs that focus on relevant issues to underrepresented groups indicate a proactive and essential approach to improve recruitment and retention of investigators from diverse backgrounds.

---

### **Strategy: Fund and develop programs to support early-stage investigators devoted to research on minority health**

---

Disparities are self-perpetuating, and it can be difficult to break a cycle of undervaluing the importance of diversity in research. However, there are solutions that can help bridge the gaps in building a diverse medical and scientific workforce. As of 2014, the NIH funded multiple investigations to understand and eliminate discrepancies for minority investigators in the peer review process.<sup>362</sup> The same year, the NIH awarded two prizes to initiatives focused on increasing the fairness and impartiality of the scientific review process and for novel methods of identifying bias.<sup>362</sup> These efforts are part of a larger campaign to identify and eliminate unconscious bias in peer review.<sup>362</sup> They are critical in supporting racial and ethnic minority researchers.

Additionally, prioritizing diversity in research helps support research focused on minority health. In the grant application process, health disparities studies, which are often conducted by principal investigators belonging to a racial or ethnic minority group, can be reviewed by study sections comprising researchers who are familiar with and value racial and ethnic minority research.<sup>362</sup> Similarly, grant applications should be regarded more favorably for studying minority populations.<sup>362</sup>

Further, including physicians and researchers of diverse backgrounds in editorial and review boards while placing value on minority research increases the representation of racial and ethnic minorities in publications.<sup>362</sup> In turn, with increased representation in publications, minority researchers and physicians can further advance in career development, which diversifies the workforce and reduces disparities in racial and ethnic minority research and health care.

---

### **Strategy: Include physicians and researchers from diverse backgrounds on editorial and review boards**

---



## RESEARCH FUNDING

Research funding is critical to fighting asthma disparities. AAFA supports maximizing funding for basic, clinical, preventive, and health services research. This includes supporting increased funding for agencies that conduct and support asthma research.

- **National Institutes of Health (NIH):** Scientists at the NIH continue to work to prevent and treat asthma. Three institutes lead asthma research: the National Institute of Environmental Health Sciences (NIEHS), the National Heart, Lung, and Blood Institute (NHLBI), and the National Institute of Allergy and Infectious Diseases (NIAID).
- **Centers for Disease Control and Prevention (CDC):** The CDC uses several surveys to conduct and analyze data related to asthma, including the National Health Interview Survey (NHIS) and Behavioral Risk Factor Surveillance System (BRFSS). Additionally, the CDC's National Asthma Control Program provided critical support to states working to improve the quality of asthma treatment and management. The program must receive continued funding to decrease the number of emergency department visits, hospitalizations, and deaths caused by asthma each year. AAFA supports increased funding for NACP to sufficient levels that would allow all 50 states to have effective asthma control programs. As part of the program, the CDC encourages sound evaluation and measurement practices.
- **Environmental Protection Agency (EPA):** The EPA oversees several programs that promote energy efficiency, environmental stewardship, sustainable growth, air quality, and pollution prevention. The EPA maintains a coordinated approach to addressing environmental asthma and allergy triggers through research, education, and community-focused outreach.
- **Patient Centered Outcomes Research Institute (PCORI):** PCORI is an independent nonprofit, nongovernmental organization authorized by Congress in 2010 as part of the Affordable Care Act (ACA). PCORI's mission is to improve healthcare delivery and outcomes by producing and promoting evidence-based information from stakeholder-guided research. In May 2019, AAFA and other members of the Friends of PCORI Reauthorization coalition submitted a letter to the Senate Finance Committee urging their reauthorization of PCORI funding, which was set to expire in September 2019.<sup>463</sup> In December 2019, Congress reauthorized PCORI's funding for an additional 10 years.

## Summary of Research Strategies to Address Asthma Disparities

CATEGORY	STRATEGIES
<b>RESEARCH</b>	<b>Basic Science</b> <ul style="list-style-type: none"> <li>• Identify effective biomarkers of asthma and develop tests to measure biomarkers in an easy, rapid, and noninvasive way at the point of care</li> <li>• Increase representation of African-ancestry, Indigenous American-ancestry, and admixed populations in genomics datasets to support genome-wide research in underrepresented populations</li> <li>• Promote and incentivize epigenomic and pharmacogenomic studies of asthma in Black individuals, Indigenous Americans, and Hispanic subgroups</li> <li>• Invest in the development of precision medicine for asthma</li> </ul>
	<b>Clinical and Epidemiological Research</b> <ul style="list-style-type: none"> <li>• Significantly increase participation of Black, Hispanic, and Indigenous Americans in clinical trials</li> <li>• Address cultural stigmas and myths about research among minority populations and build trust in medical establishment and particularly in minority research</li> <li>• Expand research of patterns of asthma risk factors, morbidity, and mortality in underrepresented populations—particularly Black, Hispanic and Indigenous Americans— to inform public health interventions</li> <li>• Improve data collection standards to ensure uniformity in racial and ethnic data collection across agencies</li> <li>• Transform national, state and local surveillance systems to utilize uniform data collocation standards</li> <li>• Improve data collection to monitor disparities experienced by AI/AN populations and Hispanic subgroups</li> <li>• Provide public access to disaggregated data to identify disparities within subgroups of each population</li> </ul>
	<b>Translation, Implementation, and Health Services Research</b> <ul style="list-style-type: none"> <li>• Support research to inform interventions to reduce asthma disparities and collaborate to ensure the translation of research findings to policy and practice</li> <li>• Conduct further research studies and tests among racially and ethnically diverse populations to discover successful strategies that show increased patient adherence to proven asthma management strategies and medicines</li> <li>• Test and scale models for payment systems and program structures that integrate all components of comprehensive, evidence-based asthma care</li> </ul>
	<b>Diversity and Engagement in Research</b> <ul style="list-style-type: none"> <li>• Support patient-centered outcomes research and community-based participatory research in asthma</li> <li>• Align research needs with the needs of patients from underrepresented racial and ethnic groups</li> <li>• Establish policies and practices to support research that engages diverse, multi-sector stakeholders throughout the research process</li> <li>• Increase racial and ethnic diversity among researchers studying asthma</li> <li>• Fund and develop programs to support early-stage investigators devoted to research on minority health</li> <li>• Include physicians and researchers from diverse backgrounds on editorial and review boards</li> </ul>



A group of diverse children and an adult woman are holding hands in a circle on a playground. The woman, on the left, has curly hair and is wearing a maroon long-sleeved top. The children include a girl in a white long-sleeved shirt and a denim skirt with a colorful patterned hem, a boy in a pink checkered shirt and blue pants, and a girl in a yellow long-sleeved shirt. They are standing on a green and brown rubber playground mat. The background shows a paved area with white lines and scattered leaves.

# PARTNERING TO ADDRESS ASTHMA DISPARITIES

Patient, family, and community partnerships are the key to successful and inclusive programs, policies, and research to reduce asthma disparities.





Complicated and interconnected biological, environmental, social, and behavioral factors exist that lead to asthma disparities, particularly among minority populations. As discussed throughout this report, programs that address several determinants of health successfully reduce the burden of asthma on racial and ethnic minorities. While these programs show positive results among their target population within specific locations, there are systemic limitations that block widespread health equity.

A mid-course review of the 1,054 measurable objectives for health disparities for the Healthy People 2020 initiative found that only 21.1% of measurable objectives met or exceeded their 2020 targets, 27.3% demonstrated little or no detectable change, and 11.1% of measurable objectives were getting worse.<sup>464</sup> There are several factors that potentially explain these roadblocks in reducing health disparities, including:

- Lack of community voice, support, and participation, which are necessary for sustainable long-term results.
- Separation from other significant community-development strategies that can influence the known determinants of health disparities (e.g., housing, safety, education, and civic engagement).
- Platforms that ignore governance, management, and adequate stable financing, as these elements ensure consistency in prevention, early detection, treatment, and evaluation.

These data suggest that multi-sectoral approaches to addressing asthma disparities are needed in order to improve health outcomes and promote health equity. Partners across disciplines, institutions, and sectors must work together to achieve that goal.

The medical and scientific communities cannot address the factors that contribute to poorer health outcomes for minority populations alone. Rather, reducing health disparities requires deliberate and collaborative actions between the medical and scientific communities as well as stakeholders across multiple sectors, such as health, education, labor, housing, social services, and city planning.



Each stakeholder group brings a unique perspective on the various challenges underserved communities face to successfully achieve asthma control. Together, these stakeholders can inform comprehensive programs/interventions, research, and policies that address the complex and interconnected factors aimed at reducing asthma disparities.

**Strategy: Strengthen sustainable partnerships between patients/families, health care professionals, researchers, biotech and pharmaceutical companies, educators, schools, community leaders, government agencies, health care systems, health care payers, employers, national and local associations, advocates, policymakers/legislators and the media to reduce disparities in asthma.**

### Key Partners Addressing Disparities



Since AAFA's 2005 asthma disparities report,<sup>80</sup> significant gains in engaging stakeholders occurred across multiple sectors to address health disparities. In 2007, the Office of Minority Health and US Department of Health and Human Services (HHS) developed the National Partnership for Action to End Health Disparities (NPA), whose main goal is to build leadership capacity across sectors and organizational levels to address health disparities through public policy and advocacy.<sup>465</sup>

Over the following five years, the NPA established a Federal Interagency Health Equity Team (FIHET), which consists of representatives from 12 federal departments and agencies who identify opportunities for federal collaboration and action on policies, practices, and initiatives related to health disparities. The NPA also established 10 Regional Health Equity Councils (RHECs) comprising individuals from the public, nonprofit, and private sectors. Members of the RHECs represent communities experiencing health disparities and drive action for their geographic areas across multiple sectors (e.g., government, environmental justice, housing, transportation, education).<sup>466</sup>

*We don't want a 2030 review on asthma disparities to find that there hasn't been meaningful improvement in the health and well-being of Black, Indigenous and Hispanic Americans with asthma. We need to listen to the voices that have been unheard and address together the immoral, disproportionate hardships placed on non-white or Hispanic communities.*

- Melanie Carver,  
Chief Mission Officer,  
Asthma and Allergy  
Foundation of America

A 2016 review concluded the NPA and its subgroups have been relatively successful in achieving its goals, as its actions led to a gradual increase in action and activity that address health disparities and promote health equity.<sup>465</sup>

National leadership can be effective because it focuses on a comprehensive, community-driven approach by enabling collaboration among federal departments, agencies, offices, and nonfederal partners to aid in promoting effective policies and programs that address health disparities.<sup>467</sup> Local, statewide, and regional advocacy initiatives are crucial for putting systems in place that could address local determinants of health. For example, changes to zoning regulations can improve indoor and outdoor air quality, which can lead to improved asthma outcomes. Engaging multiple stakeholders through federal agencies and local communities offers great promise in producing research, health care, and policies that are more relevant to patients' needs and promote health equity.

---

**Strategy: Facilitate collaboration between federal, state and local agencies and non-governmental organizations to aid in promoting effective policies/programs to reduce asthma disparities.**

---

Grantmakers play an important role in promoting cross-sector collaborations by supporting research initiatives, programs, and interventions that improve asthma outcomes among low-income and minority populations. For example, as of June 2020, PCORI funded 97 comparative clinical effectiveness research studies and related projects to help patients at risk for health disparities make better-informed decisions regarding options to improve their health. Private foundations of all sizes have also embraced programs with a "health in all policies"<sup>9</sup> approach to promoting health equity. For example, the BUILD Health Challenge, which is funded by 11 partners, supports partnerships between community-based organizations, health departments, and hospitals/health systems working to address important health issues in their respective communities. With established funding, these comprehensive, collaborative programs are better equipped to deliver needed asthma care to local communities experiencing asthma disparities.

## PATIENT/FAMILY ENGAGEMENT

Including patient and family advisors in research, program development, and public policy is another key element in engaging multiple stakeholders to address health disparities. Trust in health care and research is limited in many communities, particularly minority communities, due to histories of abuse.<sup>116</sup> By engaging diverse patients and families at the onset, physicians and researchers can build trust in minority communities through active partnership, and tailor interventions based on their input to reduce health disparities.

---

**Strategy: Improve trust in health care by engaging diverse patients and families at the onset of program, policy, and research development.**

---

Patient engagement strategies vary, from consultation to collaboration to shared leadership, with patients and families often engaging in health care and research through advisory councils, task forces, and project committees. When implemented thoughtfully, engaging patient and family advisors can be beneficial for all stakeholders involved.

---

**Strategy: Include patient/family advisors in development of educational materials and research protocols, creation of patient portals, and advising on health facility design.**

---

In health care settings, patient and family partnerships can go beyond shared decision-making practices to include collaborative clinical visits, co-leading quality improvement (QI) committees, and developing new policies and programs with patients and families.<sup>468</sup> In these cases, patient and family advisors share their insights and experiences to collaborate on tasks such as redesigning educational materials, creating patient portals, or advising on health facility design.<sup>468</sup>

Patient and family partnerships benefit patients directly by encouraging deeper communication with providers and motivating further improvement and management of personal health.<sup>469</sup> On a broader level, patient and family engagement offers a more promising solution toward better-quality health care and increased patient safety, more efficient and cost-effective care, and improved population health.<sup>468</sup>

Achieving these goals through diverse patient and family advisory groups is essential, as minority populations tend to be less engaged with health care, and physician communication with minority patients is less patient-centered.<sup>470</sup> Therefore, engaging and understanding care experiences of patients and families from minority racial and ethnic groups is key to making health care more equitable.

---

**Strategy: Appoint diverse patients to advisory councils, task forces and project committees.**

---

In research, much of the improvements in patient engagement are fueled in part by the creation of PCORI, which is committed to producing and promoting high-integrity comparative effectiveness research (CER) that is “guided by patients, caregivers, and the broader healthcare community”<sup>471</sup> (see Patient Engagement in Research on page 198).

The patient voice is also essential to ensure that drug developments meet patient needs. To that end, the FDA created the Patient Focus Drug Development (PFDD) meeting program, which provides an opportunity to connect patients and families directly with the FDA, which elevates the patient voice in disease-related research and treatment development. The FDA states: “Patient-focused drug development is a systematic approach to help ensure patients’ experiences, perspectives, needs, and priorities are captured and meaningfully incorporated into drug development and evaluation. As experts in what it is like to live with their condition, patients are uniquely positioned to inform the understanding of the therapeutic context for drug development and evaluation.”<sup>472</sup>

In 2019, a collaborative of five patient organizations—the Asthma and Allergy Foundation of America, Allergy & Asthma Network, Global Parents for Eczema Research, National Eczema Association, and International Topical Steroid Awareness Network—hosted the “More Than Skin Deep” patient-focused drug development (PFDD) meeting for eczema. This collaborative research initiative sought to understand and share the lived experiences of patients and caregivers affected by eczema. Testimonials from 160 in-person participants and thousands of virtual attendees, as well as data from a companion survey, were summarized into a “Voice of the Patient” report, which will be used to inform program development at each of the five host organizations and influence new eczema therapy developments.<sup>473</sup> The FDA will add the report to its resources for regulators, life science companies, researchers, the patient community, and the public.

In 2021, AAFA and partners in the food allergy community plan to host a PFDD meeting to highlight experiences of people and families living with food allergies. In addition, AAFA is working with partners in the asthma community to host a PFDD meeting to discuss childhood asthma.

Patient and family perspectives on the challenges preventing them from achieving asthma control are crucial in influencing programs, interventions, and public policy decisions that could be most impactful in achieving health outcomes.

Though the benefits are evident, creating effective patient and family partnerships for health care improvement is not yet routine, and many challenges remain to achieve successful patient and family partnerships. On an organizational level, challenges involve lack of staff training, time, and resources, uncertainty about how to work with patients, concerns about burdening patients, and uncertainty about the benefits of patient partnership.<sup>470</sup> Additionally, organizations may encounter challenges ensuring accurate representation in patient and family advisors, making it more difficult to consider diverse perspectives that address health disparities.



Complex, competing organizational demands add to these challenges, causing organizations to not consider patient partnerships or to perceive partnerships as work that cannot be accommodated due to lack of resources.<sup>468</sup> On the patient level, barriers include lack of interest, time, training, and comfort with participating. Patients may also be uncomfortable speaking on behalf of others or be uncertain about their role as an advisor. Particularly for racial and ethnic minority communities, language barriers as well as cultural differences and distrust in the medical system present significant challenges.<sup>470</sup> Health care providers and researchers should develop strategies to address these barriers.

Known strategies exist for securing successful patient and family engagement. In many cases, successful patient and family partnerships depend on process transparency, mechanisms for acting on patient/family input, and proper training for health care and research staff.<sup>470</sup>

---

**Strategy: Ensure successful patient and family member engagement by establishing transparent processes, identifying mechanisms to act on patient and family input, and properly training health care and research staff on implementing patient and family engagement strategies.**

---

Additionally, patient and family advisors should be fairly compensated for their time and contributions. While health care professionals are regularly compensated for their contributions as research advisors, patient involvement has historically been a volunteer effort.<sup>474</sup> However, patient and family advisors should be similarly compensated for their input. Through their lived experiences, patients and caregivers are true experts on the disease and offer unique insights to health initiatives.<sup>474</sup> In 2015, PCORI's Advisory Panel on Patient Engagement created the Framework on Compensation to provide compensation guidelines to PCORI researchers.<sup>475</sup> The framework does not provide specific direction on payment amounts or payment methods but rather recognizes patients and families as true research partners while emphasizing the need to compensate partners based on their circumstances and contributions.<sup>475</sup> The framework further emphasizes that fair compensation should extend beyond patients' out-of-pocket expenses and should reflect their role, skills, and capabilities related to the project.<sup>475</sup> Fair compensation that considers these factors ensures patient and family advisors are valued and can help mitigate existing challenges related to advisory role participation, such as time, costs, and mistrust in the medical establishment.<sup>474</sup>

## PATIENT-CENTERED DRUG DEVELOPMENT

AAFA strongly supports patient and caregiver involvement in the drug development process. Patients can be involved in the drug process in many ways, such as informing product strategy, reviewing clinical trial protocols, recruiting for clinical trials, developing patient-centered outcomes, and disseminating findings. Companies that proactively and routinely seek patient input are better equipped to:

- Identify true unmet needs and opportunities
- Design research protocols that are likely to succeed
- Communicate effectively with consumers
- Understand individual experiences of people with asthma

The patient voice has become increasingly valued by drug makers, and regulating agencies emphasize the need for patient-focused drug development, placing additional pressure on pharmaceutical companies to involve patients in the entire drug development lifecycle. Innovative and collaborative efforts are needed to bring the patient voice to drug development. Patient advocacy organizations like AAFA can support these efforts by serving as a bridge between patients and industry.

---

**Strategy: Fairly compensate patient and family advisors for their expertise and participation in advisory roles.**

---

When utilizing patient and family advisors to address disparities, medical and research organizations should encourage patient engagement by demonstrating that patients' participation and leadership are central to achieving improvement goals.<sup>476</sup> Organizations can partner with community organizations that advocate for populations experiencing health disparities and develop mechanisms to ensure patient-family advisors represent the diverse populations they serve.<sup>477</sup> Upon securing diverse patient and family advisors, organizations should then develop processes that maximize input from patients and families while minimizing burdens of time, language barriers, and cultural barriers that are often the most significant challenges to patient and family engagement in minority communities.<sup>477</sup> By effectively engaging patient and family advisors, medical and research organizations can utilize partnerships to provide research and care that is better suited to meet the needs of racial and ethnic minority communities.



## COMMUNITY ENGAGEMENT

Community engagement is another instrumental factor in successful multistakeholder collaboration. By securing community engagement, programs and interventions have the potential to pursue evidence-based strategies while effectively meeting community needs. For example, current programs designed by academic medical centers and health systems exist that heavily emphasize clinical interventions.<sup>478</sup> Yet, these programs may be missing environmental and social components that can effectively complement and enhance the health outcomes of these clinical interventions. On the other hand, some non-clinical programs emphasize the need to address social and environmental factors of community development and health. Though highly engaged with the community, these initiatives might not be on the radar of disparities

researchers, and often lack the investment and resources needed to have an impact on community health.<sup>478</sup> The National Academy of Medicine asserts that effectively addressing health disparities lies in improved understanding, design, and implementation of “hybrid” approaches, which combine clinical, community, and other sources to empower and mobilize community resources and residents to implement systematic, sustainable, and clinically sound approaches to improving health outcomes.<sup>478</sup> With systems in place to bridge community and clinical interventions, these programs could lead to better health outcomes.

---

**Strategy: Include and advance community voice, support, and participation.**

---

Several community engagement strategies exist that emphasize partnerships between health care providers and community groups. Identifying and establishing partners such as community health workers, social workers, and community leaders, can provide key insight into community assets and challenges, as well as effective community outreach. Though developing provider-community relationships is time consuming at first, these relationships have the potential to last indefinitely and allow for creativity in developing networks, resources, sustainability, and buy-in.<sup>479</sup>

It is important to include community partners as early as possible, including providing input into recruitment and dissemination strategies. Mistrust of academic institutions may be prevalent in Black, Hispanic, and Indigenous American communities, stemming from many sources including sustained racial disparities in health care, limited health care access, lack of cultural competency among health care providers and researchers, and racism among health care providers.<sup>480</sup> Including community partners in early program and research development processes ensures the presented information is relevant and culturally sensitive to the local community, and also ensures that the health message is not perceived as judgmental.<sup>481</sup>

---

**Strategy: Include community partners as early as possible when developing asthma care or research programs.**

---

Community partners can also be trained to deliver health education and care in clinical, social, and environmental interventions, further fostering community trust and cultural competency. Through shared resources, shared decision-making, and empowerment of community partners, effective partnerships allow interventions to reach a larger group by facilitating participant recruitment, ensuring feasibility, and promoting community acceptance. In turn, researchers and physicians are more likely to improve not only the research outcomes but also the health outcomes of the community. In communities with high asthma prevalence, strong community-provider relationships are needed to bridge the gap between community and care for patients experiencing asthma disparities.

---

**Strategy: Develop provider-community relationships to support people and families with asthma.**

---

## Summary of Partnership Strategies to Address Asthma Disparities

CATEGORY		STRATEGIES
PARTNERSHIPS	<b>Multi-Stakeholder Collaboration</b>	<ul style="list-style-type: none"> <li>• Strengthen sustainable partnerships between patients/families, health care professionals, researchers, biotech and pharmaceutical companies, educators, schools, community leaders, government agencies, health care systems, health care payers, employers, national and local organizations, advocates, policymakers/legislators and the media to reduce disparities in asthma</li> <li>• Facilitate collaboration between federal, state and local agencies and non-governmental organizations to aid in promoting effective policies/programs to reduce asthma disparities</li> </ul>
	<b>Patient/Family Engagement</b>	<ul style="list-style-type: none"> <li>• Improve trust in health care by engaging diverse patients and families at the onset of program, policy, and research development</li> <li>• Include patient/family advisors in development of educational materials and research protocols, creation of patient portals, and advising on health facility design</li> <li>• Appoint diverse patients to advisory councils, task forces and project committees</li> <li>• Ensure successful patient and family member engagement by establishing transparent processes, identifying mechanisms to act on patient and family input, and properly training health care and research staff on implementing patient and family engagement strategies</li> <li>• Fairly compensate patient and family advisors for their expertise and participation in advisory roles</li> </ul>
	<b>Community Engagement</b>	<ul style="list-style-type: none"> <li>• Include and advance community voice, support, and participation</li> <li>• Include community partners as early as possible when developing asthma care or research programs</li> <li>• Develop provider-community relationships to support people and families with asthma</li> </ul>



---

**“** *The findings in our Asthma Disparities in America report aren't surprising. Causes of disparities in asthma have been documented for decades and effective interventions have been successfully implemented in various populations. Despite this, disparities persist. Why? It boils down to two reasons: insufficient funding and lack of political will. Achieving equity in asthma is completely possible if all stakeholders agree to prioritize this work and invest the resources needed to make real change.* **”**

**- Sanaz Eftekhari, Vice President of Research,  
Asthma and Allergy Foundation of America**

---



## CONCLUSION

**Asthma disparities are complex. Despite exciting breakthroughs in science, medicine, and health care driven by innovations in the past decade, it's not immediately apparent that asthma has improved from previous generations for Black, brown, or poor people with asthma in America. Upstream injustices borne of racism and discrimination result in downstream medical and non-medical factors, increasing risks for worse asthma control and quality of life. Racial and ethnic minorities are still more at risk of severe, difficult-to-control asthma that affects all parts of their lives, more at risk of needing emergency room visits and hospital admissions, and more at risk of dying from asthma. Some portion of asthma may have links to a distant genetic past well beyond one's control. It's also still true that too many racial and ethnic minority children with asthma from disadvantaged backgrounds miss days of school and lack the benefit of a usual source of primary care that is the backbone for the continuous care needed to live healthy lives and feel better.**

Asthma disparities in the U.S.—the disproportionate burden of asthma on minority populations—have long bedeviled public health experts, physicians, and advocates ever since these disturbing trends were first measured two decades ago. And while experts identified disparities-related measures, outcomes, and contributing factors, a composite yardstick of progress is elusive. After all, trends in one direction can head in a different direction based on what is measured, when, and how. Nevertheless, especially in these times with differing visions for the future of U.S. health care, we believe it's critical to celebrate what's possible.

The overall U.S. response to asthma has been tremendous. Specifically, we believe some important progress has been made in asthma disparities, with advances to likely demonstrate even more of an impact near- and mid-term. We wanted to highlight this progress to celebrate these advances, but also because it is important for all stakeholders to continue the fight against disparities. While we have not reached the target—this report shows that asthma disparities in the U.S. are at least well surrounded.

A major advancement in the fight to narrow asthma disparities in the U.S. was the 2012 launch of the multi-agency Coordinated Federal Action Plan to Reduce Racial and Ethnic Asthma

Disparities<sup>184</sup>. From establishing consensus on standard measures to widespread research funding and boosting community programs with an emphasis on measuring results, the plan helped channel existing energy and created a new level of intensity in the field. Not to be outdone, the plan coincided with passage and implementation of the Patient Protection and Affordable Care Act (ACA), which introduced several innovations that push the limits on coverage, access, and quality. Regarding these large initiatives, one can add the momentum gained in this decade by a deeper understanding and acceptance of the impact of social determinants of health, as well as the parallel effort to make health care more patient-centric. These advancements encouraged the possibilities for a less transactional health system, one that is more focused on the lived experiences of all its beneficiaries. Finally, the noteworthy conclusions above have slowly had an important impact on Medicaid, which is where the benefits conferred by policy, programs, and medical innovations are realized in the daily lives of lower income racial and ethnic minority asthma patients.

The asthma disparities plan, the ACA, and Medicaid reform may be the largest representations of where advances have taken asthma care and management in the U.S. throughout the past 10 years. But significant achievements in many narrow research topics have clearly paved the way to these larger successes. Understanding asthma as much more than one disease, demystifying underlying disease pathways, using this knowledge to bring new treatment options forward, and continually questioning and refining guidelines-based care are all tremendous advancements in asthma care, management, and outcomes.

There is a focus and intensity to asthma programs utilizing community health workers to meet the medical and non-medical needs of our most vulnerable populations. These programs benefit from the wealth of knowledge gained from education and outreach experiments implemented in the decades prior, most of which heralded the importance of linking the clinic with the home and with schools. Many of the questions around public housing policy and environmental mitigation were addressed, even if there is still a policy gap to support proven interventions. Systems of primary care seem to be moving towards evidence-driven, community-based care.

Meanwhile, geo-mapping technology is driving unparalleled accuracy of where the unmet needs are greatest, even as the demographics of poverty and vulnerability shift. In addition, we have much more context for the value of asthma interventions in terms of health care investments and savings. This helped spur interest in and leadership of asthma programming by many more state health departments. Today, asthma is a higher priority within the broader public health mandate to comprehensively address chronic disease, which experts have long understood is most effectively done at the local level.

A consensus-driven focus on asthma disparities by stakeholders and experts alike has resulted in new knowledge, tools, and approaches to tackling asthma in the United States. The lesson is critical: based on a shared vision of the “intensified vulnerability of nonwhite communities warranting special care,” the asthma community continues to break down what is a complex problem so that different disciplines can affect positive change in racial, ethnic, and socioeconomic disparities. By doing so piece-by-piece, these improvements have benefited everyone.

Of course, these exciting times are also times of deep uncertainty for the future. Research leadership and direction relies heavily on continued federal investment. State Medicaid directives are subject to the push-and-pull of current events. Asthma community programs can become unattractive or deemed not sustainable. While advances in asthma throughout the past decade shine an important light on what’s possible when disparities are the focus, none of this is inevitable. In the end, this report is a call to action. We have asthma disparities surrounded, and we must work together to close in on this important public health target.

---

To get involved in improving the health of Black, Hispanic/Latinx, American Indian and Alaska Native adults and children with asthma, join AAFA's online community at **[aafa.org/join](https://aafa.org/join)**

By bridging the gaps in asthma care and outcomes for underserved communities, we advance care and management for everyone with asthma. As an AAFA community member, you will receive updated asthma information, action alerts for important policies, and invitations to participate in patient-centered research.

Together, we will save lives and reduce the burden of asthma.

---



---

**“** *Dismantling the driving forces that fuel health disparities and racial injustice has been a painstakingly slow journey. We’ve charted a roadmap to rebuild and create new systems that promote racial equality in asthma care. Roadmaps give us the direction to move forward. Working together, it’s our hope that we’ll finally reach our destination.* **”**

**- Kenneth Mendez, President and CEO,  
Asthma and Allergy Foundation of America**

---



# REFERENCES

- <sup>1</sup>Centers for Disease Control and Prevention. (2019). *Most recent national asthma data*. U.S. Department of Health and Human Services. [https://www.cdc.gov/asthma/most\\_recent\\_national\\_asthma\\_data.htm](https://www.cdc.gov/asthma/most_recent_national_asthma_data.htm)
- <sup>2</sup>World Health Organization. (2010). *A conceptual framework for action on the social determinants of health*. [https://www.who.int/sdhconference/resources/ConceptualframeworkforactiononSDH\\_eng.pdf](https://www.who.int/sdhconference/resources/ConceptualframeworkforactiononSDH_eng.pdf)
- <sup>3</sup>Rumpel, J. A., Ahmedani, B. K., Peterson, E. L., Wells, K. E., Yang, M., Levin, A. M., Yang, J. J., Kumar, R., Burchard, E. G., & Williams, L. K. (2012). Genetic ancestry and its association with asthma exacerbations among African American subjects with asthma. *The Journal of Allergy and Clinical Immunology*, *130*(6), 1302–1306. <https://doi.org/10.1016/j.jaci.2012.09.001>
- <sup>4</sup>Duffy, D. L., Martin, N. G., Battistutta, D., Hopper, J. L., & Mathews, J. D. (1990). Genetics of asthma and hay fever in Australian twins. *American Review of Respiratory Disease*, *142*(6\_pt\_1), 1351–1358. [https://doi.org/10.1164/ajrccm/142.6\\_pt\\_1.1351](https://doi.org/10.1164/ajrccm/142.6_pt_1.1351)
- <sup>5</sup>Slager, R. E., Hawkins, G. A., Li, X., Postma, D. S., Meyers, D. A., & Bleeker, E. R. (2012). Genetics of asthma susceptibility and severity. *Clinics in Chest Medicine*, *33*(3), 431–443. <https://doi.org/10.1016/j.ccm.2012.05.005>
- <sup>6</sup>Vijverberg, S. J. H., Farzan, N., Slob, E. M. A., Neerincx, A. H., & Maitland-van der Zee, A. H. (2017). Treatment response heterogeneity in asthma: the role of genetic variation. *Expert Review of Respiratory Medicine*, *12*(1), 55–65. <https://doi.org/10.1080/17476348.2018.1403318>
- <sup>7</sup>George, M., Topaz, M., Rand, C., Sommers, M. (Lynn) S., Glanz, K., Pantalon, M. V., Mao, J. J., & Shea, J. A. (2014). Inhaled corticosteroid beliefs, complementary and alternative medicine, and uncontrolled asthma in urban minority adults. *Journal of Allergy and Clinical Immunology*, *134*(6), 1252–1259. <https://doi.org/10.1016/j.jaci.2014.07.044>
- <sup>8</sup>Brandon, D. T., Isaac, L. A., & LaVeist, T. A. (2005). The legacy of Tuskegee and trust in medical care: Is Tuskegee responsible for race differences in mistrust of medical care? *Journal of the National Medical Association*, *97*(7), 951–956. <https://pubmed.ncbi.nlm.nih.gov/16080664/>
- <sup>9</sup>World Health Organization. (2014). *Health in All Policies: Framework for country action*. [https://www.who.int/cardiovascular\\_diseases/140120HPRHiAPFramework.pdf](https://www.who.int/cardiovascular_diseases/140120HPRHiAPFramework.pdf)
- <sup>10</sup>Nurmagambetov, T., Kuwahara, R., & Garbe, P. (2018). The economic burden of asthma in the United States, 2008–2013. *Annals of the American Thoracic Society*, *15*(3), 348–356. <https://doi.org/10.1513/AnnalsATS.201703-259OC>
- <sup>11</sup>Yaghoubi, M., Adibi, A., Safari, A., FitzGerald, J. M., & Sadatsafavi, M. (2019). The projected economic and health burden of uncontrolled asthma in the United States. *American Journal of Respiratory and Critical Care Medicine*, *200*(9), 1102–1112. <https://doi.org/10.1164/rccm.201901-0016oc>
- <sup>12</sup>Akinbami, L. J., Moorman, J. E., & Liu, X. (2011). Asthma prevalence, health care use, and mortality: United States, 2005–2009. *National Health Statistics Reports*, (32), 1–14.
- <sup>13</sup>National Center for Health Statistics. (n.d.). *National Health Interview Survey*. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention. <https://www.cdc.gov/nchs/nhis/index.htm>
- <sup>14</sup>Centers for Disease Control and Prevention. (2019). *2018 National Health Interview Survey data*. U.S. Department of Health & Human Services. <https://www.cdc.gov/asthma/nhis/2018/data.htm>
- <sup>15</sup>Genetics Home Reference. (2011). *Allergic asthma*. U.S. Department of Health & Human Services, National Institutes of Health. <https://ghr.nlm.nih.gov/condition/allergic-asthma>
- <sup>16</sup>Asthma and Allergy Foundation of America. (2019). *Asthma capitals 2019: The most challenging places to live with asthma*. <https://www.aafa.org/media/2426/aafa-2019-asthma-capitals-report.pdf>

- <sup>17</sup> National Center for Health Statistics. (2017). *National Hospital Ambulatory Medical Care Survey: 2017 emergency department summary tables*. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention. [https://www.cdc.gov/nchs/data/nhamcs/web\\_tables/2017\\_ed\\_web\\_tables-508.pdf](https://www.cdc.gov/nchs/data/nhamcs/web_tables/2017_ed_web_tables-508.pdf)
- <sup>18</sup> Akinbami, L.J., Mooreman, J.E., Bailey, C., Zahran, H., King, M., Johnson, C., & Liu, X. (2012, May) *Trends in asthma prevalence, health care use, and mortality in the United States, 2001–2010*. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics. <http://www.cdc.gov/nchs/data/databriefs/db94.pdf>
- <sup>19</sup> National Heart, Lung, and Blood Institute. (2007). *Expert Panel Report 3: Guidelines for the diagnosis and management of asthma*. U.S. Department of Health & Human Services, National Institutes of Health. <https://www.ncbi.nlm.nih.gov/books/NBK7232/>
- <sup>20</sup> Sobieraj, D.M., Baker, W.L., Weeda, E.R., Nguyen, E., Coleman, C.I., White, C.M., Lazarus, S.C., Blake, K.V., & Lang, J.E. (2018, March 19). *Intermittent inhaled corticosteroids and long-acting muscarinic antagonists for asthma*. Agency for Healthcare Research and Quality. <https://effectivehealthcare.ahrq.gov/products/asthma-pharmacologic-treatment/research-2017/>
- <sup>21</sup> U.S. Census Bureau. (2017, March 6). *Research to improve data on race and ethnicity*. U.S. Department of Commerce. <https://www.census.gov/about/our-research/race-ethnicity.html>
- <sup>22</sup> Szentpetery, S. E., Forno, E., Canino, G., & Celedón, J. C. (2016). Asthma in Puerto Ricans: Lessons from a high-risk population. *Journal of Allergy and Clinical Immunology*, 138(6), 1556–1558. <https://doi.org/10.1016/j.jaci.2016.08.047>
- <sup>23</sup> Wechsler, M. E. (2009). Managing asthma in primary care: Putting new guideline recommendations into context. *Mayo Clinic Proceedings*, 84(8), 707–717. <https://doi.org/10.4065/84.8.707>
- <sup>24</sup> Ahmed, A. E., AL-Jahdali, H., AL-Harbi, A., Khan, M., Ali, Y., Al Shimemeri, A., AL-Muhsen, S., & Halwani, R. (2014). Factors associated with poor asthma control among asthmatic patient visiting emergency department. *The Clinical Respiratory Journal*, 8(4), 431–436. <https://doi.org/10.1111/crj.12090>
- <sup>25</sup> Sullivan, S. D., Wenzel, S. E., Bresnahan, B. W., Zheng, B., Lee, J. H., Pritchard, M., Kamath, T. V., & Weiss, S. T. (2007). Association of control and risk of severe asthma-related events in severe or difficult-to-treat asthma patients. *Allergy*, 62(6), 655–660. <https://doi.org/10.1111/j.1398-9995.2007.01383.x>
- <sup>26</sup> Sarche, M., & Spicer, P. (2008). Poverty and health disparities for American Indian and Alaska Native children. *Annals of the New York Academy of Sciences*, 1136(1), 126–136. <https://doi.org/10.1196/annals.1425.017>
- <sup>27</sup> National Academies of Sciences, Engineering, and Medicine, Health and Medicine Division, Board on Population Health and Public Health Practice. (2017). The root causes of health inequity. In A. Baciu., Y. Negussie, A. Geller, & J.N. Weinstein (Eds.), *Communities in action: Pathways to health equity* (pp. 99–185). National Academies Press (US); <https://www.ncbi.nlm.nih.gov/books/NBK425845/>
- <sup>28</sup> Jones, D. S. (2006). The persistence of American Indian Health disparities. *American Journal of Public Health*, 96(12), 2122–2134. <https://doi.org/10.2105/ajph.2004.054262>
- <sup>29</sup> Indian Health Service (2019). *Indian health disparities*. U.S. Department of Health and Human Services. [https://www.ihs.gov/sites/newsroom/themes/responsive2017/display\\_objects/documents/factsheets/Disparities.pdf](https://www.ihs.gov/sites/newsroom/themes/responsive2017/display_objects/documents/factsheets/Disparities.pdf)
- <sup>30</sup> Mehal, J. M., Holman, R. C., Steiner, C. A., Bartholomew, M. L., & Singleton, R. J. (2014). Epidemiology of asthma hospitalizations among American Indian and Alaska Native people and the general United States population. *Chest*, 146(3), 624–632. <https://doi.org/10.1378/chest.14-0183>
- <sup>31</sup> Lowe, A. A., Bender, B., Liu, A. H., Solomon, T., Kobernick, A., Morgan, W., & Gerald, L. B. (2018). Environmental concerns for children with asthma on the Navajo Nation. *Annals of the American Thoracic Society*, 15(6), 745–753. <https://doi.org/10.1513/AnnalsATS.201708-674PS>

- <sup>32</sup> National Tribal Air Association. (2019). *Status of Tribal air report*. U.S. Environmental Protection Agency, Office of Air & Radiation. <https://www.ntatribalair.org/wp-content/uploads/2019/12/2019-NTAA-Status-of-Tribal-Air-Report.pdf>
- <sup>33</sup> U.S. Environmental Protection Agency. (2018, October 22). *The links between air pollution and childhood asthma*. <https://www.epa.gov/sciencematters/links-between-air-pollution-and-childhood-asthma>
- <sup>34</sup> U.S. Environmental Protection Agency. (2014, August 18). *Asthma Triggers: Gain Control*. US EPA. <https://www.epa.gov/asthma/asthma-triggers-gain-control>
- <sup>35</sup> Office on Smoking and Health. (2006). *The health consequences of involuntary exposure to tobacco smoke: A report of the Surgeon General*. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention. <https://www.ncbi.nlm.nih.gov/books/NBK44324/>
- <sup>36</sup> Tribal Public and Environmental Health Think Tank. (2018). *Priorities in Tribal public health*. American Public Health Association. [https://www.apha.org/-/media/files/pdf/topics/environment/partners/tpeh/priorities\\_tribal\\_health\\_2018.ashx?la=en&hash=C06951A62A5E215BE6C99442A9E1E9DDD060B7C6](https://www.apha.org/-/media/files/pdf/topics/environment/partners/tpeh/priorities_tribal_health_2018.ashx?la=en&hash=C06951A62A5E215BE6C99442A9E1E9DDD060B7C6)
- <sup>37</sup> Centers for Disease Control and Prevention. (2013) *Asthma and obesity*. U.S. Department of Health and Human Services. [https://www.cdc.gov/asthma/asthma\\_stats/asthma\\_obesity.htm](https://www.cdc.gov/asthma/asthma_stats/asthma_obesity.htm)
- <sup>38</sup> Noonan, C. W., Brown, B. D., Bentley, B., Conway, K., Corcoran, M., FourStar, K., Freide, P., Hemlock, B., Wagner, S., & Wilson, T. (2010). Variability in childhood asthma and body mass index across Northern Plains American Indian communities. *Journal of Asthma*, 47(5), 496–500. <https://doi.org/10.3109/02770901003759436>
- <sup>39</sup> Office of Minority Health. (2020). *Obesity and American Indians/Alaska Natives*. U.S. Department of Health and Human Services. <https://minorityhealth.hhs.gov/omh/browse.aspx?lvl=4&lvlid=40>
- <sup>40</sup> Solomon, D., Maxwell, C., & Castro, A. (2019, August 7). *Systemic inequality: Displacement, exclusion, and segregation*. Center for American Progress. <https://www.americanprogress.org/issues/race/reports/2019/08/07/472617/systemic-inequality-displacement-exclusion-segregation/>
- <sup>41</sup> Tribal Public and Environmental Health Think Tank. (2018). *Priorities in Tribal public and environmental health fact sheet*. American Public Health Association. [https://apha.org/-/media/files/pdf/topics/environment/partners/tpeh/priorities\\_handout.ashx?la=en&hash=8F50383B89686D68D738BC097DC2B11FDF85592](https://apha.org/-/media/files/pdf/topics/environment/partners/tpeh/priorities_handout.ashx?la=en&hash=8F50383B89686D68D738BC097DC2B11FDF85592)
- <sup>42</sup> Walters, K. L., Mohammed, S. A., Evans-Campbell, T., Beltrán, R. E., Chae, D. H., & Duran, B. (2011). Bodies don't just tell stories, they tell histories. *Du Bois Review: Social Science Research on Race*, 8(1), 179–189. <https://doi.org/10.1017/s1742058x1100018x>
- <sup>43</sup> Evans-Campbell, T. (2008). Historical trauma in American Indian/Native Alaska communities: A multilevel framework for exploring impacts on individuals, families, and communities. *Journal of Interpersonal Violence*, 23(3), 316–338. <https://doi.org/10.1177/0886260507312290>.
- <sup>44</sup> Asthma Community Network. (2019, July 23). *Opportunities for in-home asthma care in Native communities: A Northwest initiative and Tribal pilot project* [Webinar]. U.S. Environmental Protection Agency. [https://www.asthmacommunitynetwork.org/system/files/webinar/pdf/ACN%20Webinar%20R10%20Tribal%20Asthma\\_FINAL.pdf](https://www.asthmacommunitynetwork.org/system/files/webinar/pdf/ACN%20Webinar%20R10%20Tribal%20Asthma_FINAL.pdf)
- <sup>45</sup> Nelson, M.A. (2018, July 21). *Asthma in Tribal communities: Indoor air quality in Tribal communities* [Presentation]. Northern Arizona University, Institute for Tribal Environmental Professionals. <https://www.asthmaeducators.org/resources/Documents/2-ITEP%20Asthma.pdf>
- <sup>46</sup> Healthy People 2020. (2011). *Social determinants of health*. U.S. Department of Health and Human Services, Office of Disease Prevention and Health Promotion. <https://www.healthypeople.gov/2020/topics-objectives/topic/social-determinants-of-health>



- <sup>47</sup> Sullivan, K., & Thakur, N. (2020). Structural and social determinants of health in asthma in developed economies: A scoping review of literature published between 2014 and 2019. *Current Allergy and Asthma Reports*, 20(2), 5. <https://doi.org/10.1007/s11882-020-0899-6>
- <sup>48</sup> Bailey, Z. D., Krieger, N., Agénor, M., Graves, J., Linos, N., & Bassett, M. T. (2017). Structural racism and health inequities in the USA: Evidence and interventions. *The Lancet*, 389(10077), 1453–1463. [https://doi.org/10.1016/s0140-6736\(17\)30569-x](https://doi.org/10.1016/s0140-6736(17)30569-x)
- <sup>49</sup> Rothstein, R. (2017). *The color of law: A forgotten history of how our government segregated America*. Liveright Publishing Corporation, A Division of W.W. Norton & Company.
- <sup>50</sup> Nardone, A., Casey, J. A., Morello-Frosch, R., Mujahid, M., Balmes, J. R., & Thakur, N. (2020). Associations between historical residential redlining and current age-adjusted rates of emergency department visits due to asthma across eight cities in California: An ecological study. *The Lancet Planetary Health*, 4(1), e24–e31. [https://doi.org/10.1016/s2542-5196\(19\)30241-4](https://doi.org/10.1016/s2542-5196(19)30241-4)
- <sup>51</sup> Williams, D. R., & Collins, C. (2001). Racial residential segregation: a fundamental cause of racial disparities in health. *Public Health Reports*, 116(5), 404–416. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1497358/>
- <sup>52</sup> Martinez, S. C. (2000). The Housing Act of 1949: Its place in the realization of the American dream of homeownership. *Housing Policy Debate*, 11(2), 467–487. <https://doi.org/10.1080/10511482.2000.9521374>
- <sup>53</sup> Mitchell, B., & Franco, J. (2018, March 20). *HOLC “redlining” maps: The persistent structure of segregation and economic inequality*. National Community Reinvestment Coalition. <https://ncrc.org/holc/>
- <sup>54</sup> Aaronson, D., Hartley, D. A., & Mazumder, B. (2017, September 19). *The effects of the 1930s HOLC “redlining” maps*. Federal Reserve Bank of Chicago. [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=3038733](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3038733)
- <sup>55</sup> Nelson, R.K., Winling, L., Marciano, M., Connolly, N. et al. (2019). Mapping inequality: Redlining in New Deal America. In Nelson, R.K. and Ayers, E.L. (Eds.), *American Panorama: An atlas of United States history*. Accessed August 4, 2020. <https://s3.amazonaws.com/holc/tiles/CA/LosAngeles1/1939/holc-scan.jpg>
- <sup>56</sup> Hanks, A., Solomon, D., & Weller, C.E. (2018, February 21). *Systematic inequality: How America’s structural racism helped create the Black-white wealth gap*. Center for American Progress. <https://www.americanprogress.org/issues/race/reports/2018/02/21/447051/systematic-inequality/>
- <sup>57</sup> Tolnay, S. E. (2003). The African American “Great Migration” and beyond. *Annual Review of Sociology*, 29(1), 209–232. <https://doi.org/10.1146/annurev.soc.29.010202.100009>
- <sup>58</sup> Fairlie, R. W., & Sundstrom, W. A. (1997). The Racial unemployment gap in long-run perspective. *The American Economic Review*, 87(2), 306–310. <https://www.jstor.org/stable/2950936?seq=1>
- <sup>59</sup> Fishback, P. V. (2016, January 1). *How successful was the New Deal? The microeconomic impact of New Deal spending and lending policies in the 1930s*. National Bureau of Economic Research. <https://www.nber.org/papers/w21925>
- <sup>60</sup> Blakemore, E. (2019, June 21). *How the GI Bill’s promise was denied to a million Black WWII veterans*. History.com. <https://www.history.com/amp/news/gi-bill-black-wwii-veterans-benefits>
- <sup>61</sup> Browne, I., Hewitt, C., Tigges, L., & Green, G. (2001). Why does job segregation lead to wage inequality among African Americans? Person, place, sector, or skills? *Social Science Research*, 30(3), 473–495. <https://doi.org/10.1006/ssre.2001.0708>
- <sup>62</sup> Newkirk, V.R., Jr. (2016, May 18). America’s health segregation problem: Has the country done enough to overcome its Jim Crow health care history? *The Atlantic*. <https://www.theatlantic.com/politics/archive/2016/05/americas-health-segregation-problem/483219/>
- <sup>63</sup> Carnegie, M. E. (1999). Honoring the past, treasuring the present, and anticipating the future of nursing and health care for Black Americans. *The ABNF Journal: Official Journal of the Association of Black Nursing Faculty in Higher Education, Inc*, 10(6), 126–130. <https://pubmed.ncbi.nlm.nih.gov/10855084/>

- <sup>64</sup> Dayna Bowen Matthew. (2018). *Just medicine: a cure for racial inequality in American health care*. New York University Press.
- <sup>65</sup> Ko, M., Needleman, J., Derose, K. P., Laugesen, M. J., & Ponce, N. A. (2013). Residential segregation and the survival of U.S. urban public hospitals. *Medical Care Research and Review*, 71(3), 243–260. <https://doi.org/10.1177/1077558713515079>
- <sup>66</sup> Gross, M. K. (2004). *Invisible shackles: Alexander V. Sandoval and the compromise to the medical civil rights movement*. Race, Racism and the Law. <https://racism.org/articles/basic-needs/health-and-health-care/health-status/health-disparities/2443-invisible-shackles-alexander>
- <sup>67</sup> White, K., Haas, J. S., & Williams, D. R. (2012). Elucidating the role of place in health care disparities: The example of racial/ethnic residential segregation. *Health Services Research*, 47(3pt2), 1278–1299. <https://doi.org/10.1111/j.1475-6773.2012.01410.x>
- <sup>68</sup> Chapman, E. N., Kaatz, A., & Carnes, M. (2013). Physicians and implicit bias: How doctors may unwittingly perpetuate health care disparities. *Journal of General Internal Medicine*, 28(11), 1504–1510. <https://doi.org/10.1007/s11606-013-2441-1>
- <sup>69</sup> Paradies, Y., Truong, M., & Priest, N. (2013). A systematic review of the extent and measurement of healthcare provider racism. *Journal of General Internal Medicine*, 29(2), 364–387. <https://doi.org/10.1007/s11606-013-2583-1>
- <sup>70</sup> Institute of Medicine. (2003). *Unequal Treatment: Confronting racial and ethnic disparities in health care*. The National Academies Press. <https://doi.org/10.17226/12875>.
- <sup>71</sup> Penner, L.A., Dovidio, J.F., Manning, M.A., Albrecht, T.L., & van Ryn, M. (2019). Doing harm to some: Patient and provider attitudes and healthcare disparities. In D. Albarracin & B.T. Johnson (Eds.), *The Handbook of Attitudes, Vol. 2—Applications* (2<sup>nd</sup> ed., pp. 152–197). Routledge.
- <sup>72</sup> Penner, L. A., Gaertner, S., Dovidio, J. F., Hagiwara, N., Porcerelli, J., Markova, T., & Albrecht, T. L. (2013). A social psychological approach to improving the outcomes of racially discordant medical interactions. *Journal of General Internal Medicine*, 28(9), 1143–1149. <https://doi.org/10.1007/s11606-013-2339-y>
- <sup>73</sup> Beck, A. F., Huang, B., Auger, K. A., Ryan, P. H., Chen, C., & Kahn, R. S. (2016). Explaining racial disparities in child asthma readmission using a causal inference approach. *JAMA Pediatrics*, 170(7), 695–703. <https://doi.org/10.1001/jamapediatrics.2016.0269>
- <sup>74</sup> Fitzpatrick, A. M., Gillespie, S. E., Mauger, D. T., Phillips, B. R., Bleecker, E. R., Israel, E., Meyers, D. A., Moore, W. C., Sorkness, R. L., Wenzel, S. E., Bacharier, L. B., Castro, M., Denlinger, L. C., Erzurum, S. C., Fahy, J. V., Gaston, B. M., Jarjour, N. N., Larkin, A., Levy, B. D., ... Teague, W. G. (2019). Racial disparities in asthma-related health care use in the National Heart, Lung, and Blood Institute’s Severe Asthma Research Program. *The Journal of Allergy and Clinical Immunology*, 143(6), 2052–2061. <https://doi.org/10.1016/j.jaci.2018.11.022>
- <sup>75</sup> Guilbert, T., Zeiger, R. S., Haselkorn, T., Iqbal, A., Alvarez, C., Mink, D. R., Chipps, B. E., & Szeffler, S. J. (2019). Racial disparities in asthma-related health outcomes in children with severe/difficult-to-treat asthma. *The Journal of Allergy and Clinical Immunology. In Practice*, 7(2), 568–577. <https://doi.org/10.1016/j.jaip.2018.07.050>
- <sup>76</sup> Reprinted from *Social Science & Medicine*, 230, Harris, K.M., Mapping inequality: Childhood asthma and environmental injustice, a case study of St. Louis, Missouri., 91–110, Copyright (2019), with permission from Elsevier. <https://doi.org/10.1016/j.socscimed.2019.03.040>
- <sup>77</sup> Hauptman, M., Gaffin, J. M., Petty, C. R., Sheehan, W. J., Lai, P. S., Coull, B., Gold, D. R., & Phipatanakul, W. (2020). Proximity to major roadways and asthma symptoms in the School Inner-City Asthma Study. *Journal of Allergy and Clinical Immunology*, 145(1), 119–126.e4. <https://doi.org/10.1016/j.jaci.2019.08.038>
- <sup>78</sup> Kranjac, A. W., Kimbro, R. T., Denney, J. T., Osiecki, K. M., Moffett, B. S., & Lopez, K. N. (2017). Comprehensive neighborhood portraits and child asthma disparities. *Maternal and Child Health Journal*, 21(7), 1552–1562. <https://doi.org/10.1007/s10995-017-2286-z>

- <sup>79</sup> Beck, A. F., Huang, B., Wheeler, K., Lawson, N. R., Kahn, R. S., & Riley, C. L. (2017). The Child Opportunity Index and disparities in pediatric asthma hospitalizations across one Ohio metropolitan area, 2011–2013. *The Journal of Pediatrics*, *190*, 200–206.e1. <https://doi.org/10.1016/j.jpeds.2017.08.007>
- <sup>80</sup> Asthma and Allergy Foundation and the National Pharmaceutical Council. (2005). Ethnic Disparities in the Burden and Treatment of Asthma. <https://www.aafa.org/burden-of-asthma-on-minorities>
- <sup>81</sup> Bossé, Y., & Hudson, T. J. (2007). Toward a comprehensive set of asthma susceptibility genes. *Annual Review of Medicine*, *58*, 171–184. <https://doi.org/10.1146/annurev.med.58.071105.111738>
- <sup>82</sup> Wan, Y. I., Shrine, N. R. G., Artigas, M. S., Wain, L. V., Blakey, J. D., Moffatt, M. F., Bush, A., Chung, K. F., Cookson, W. O. C. M., Strachan, D. P., Heaney, L., Al-Momani, B. a. H., Mansur, A. H., Manney, S., Thomson, N. C., Chaudhuri, R., Brightling, C. E., Bafadhel, M., Singapuri, A., ... Hall, I. P. (2012). Genome-wide association study to identify genetic determinants of severe asthma. *Thorax*, *67*(9), 762–768. <https://doi.org/10.1136/thoraxjnl-2011-201262>
- <sup>83</sup> Lim, R. H., Kobzik, L., & Dahl, M. (2010). Risk for asthma in offspring of asthmatic mothers versus fathers: a meta-analysis. *PloS one*, *5*(4), e10134. <https://doi.org/10.1371/journal.pone.0010134>
- <sup>84</sup> Ober, C., & Yao, T. C. (2011). The genetics of asthma and allergic disease: a 21st century perspective. *Immunological Reviews*, *242*(1), 10–30. <https://doi.org/10.1111/j.1600-065X.2011.01029.x>
- <sup>85</sup> Ding, L., Li, D., Wathen, M., Altaye, M., & Mersha, T. B. (2018). African ancestry is associated with cluster-based childhood asthma subphenotypes. *BMC medical genomics*, *11*(1), 51. <https://doi.org/10.1186/s12920-018-0367-5>
- <sup>86</sup> Choudhry, S., Burchard, E. G., Borrell, L. N., Tang, H., Gomez, I., Naqvi, M., Nazario, S., Torres, A., Casal, J., Martinez-Cruzado, J. C., Ziv, E., Avila, P. C., Rodriguez-Cintron, W., & Risch, N. J. (2006). Ancestry–environment interactions and asthma risk among Puerto Ricans. *American Journal of Respiratory and Critical Care Medicine*, *174*(10), 1088–1093. <https://doi.org/10.1164/rccm.200605-596oc>
- <sup>87</sup> Pino-Yanes, M., Thakur, N., Gignoux, C. R., Galanter, J. M., Roth, L. A., Eng, C., Nishimura, K. K., Oh, S. S., Vora, H., Huntsman, S., Nguyen, E. A., Hu, D., Drake, K. A., Conti, D. V., Moreno-Estrada, A., Sandoval, K., Winkler, C. A., Borrell, L. N., Lurmann, F., Islam, T. S., ... Burchard, E. G. (2015). Genetic ancestry influences asthma susceptibility and lung function among Latinos. *The Journal of allergy and clinical immunology*, *135*(1), 228–235. <https://doi.org/10.1016/j.jaci.2014.07.053>
- <sup>88</sup> Ortiz, R. A., & Barnes, K. C. (2015). Genetics of allergic diseases. *Immunology and allergy clinics of North America*, *35*(1), 19–44. <https://doi.org/10.1016/j.iac.2014.09.014>
- <sup>89</sup> Dold, S., Wjst, M., von Mutius, E., Reitmeir, P., & Stiepel, E. (1992). Genetic risk for asthma, allergic rhinitis, and atopic dermatitis. *Archives of disease in childhood*, *67*(8), 1018–1022. <https://doi.org/10.1136/ad.67.8.1018>
- <sup>90</sup> Bantz, S. K., Zhu, Z., & Zheng, T. (2014). The atopic march: Progression from atopic dermatitis to allergic rhinitis and asthma. *Journal of clinical & cellular immunology*, *5*(2), 202. <https://doi.org/10.4172/2155-9899.1000202>
- <sup>91</sup> Gilmour, M. I., Jaakkola, M. S., London, S. J., Nel, A. E., & Rogers, C. A. (2006). How exposure to environmental tobacco smoke, outdoor air pollutants, and increased pollen burdens influences the incidence of asthma. *Environmental Health Perspectives*, *114*(4), 627–633. <https://doi.org/10.1289/ehp.8380>
- <sup>92</sup> Vieira, S. (2015). The health burden of pollution: the impact of prenatal exposure to air pollutants. *International Journal of Chronic Obstructive Pulmonary Disease*, 1111. <https://doi.org/10.2147/copd.s40214>
- <sup>93</sup> Hsu, H.-H. L., Chiu, Y.-H. M., Coull, B. A., Kloog, I., Schwartz, J., Lee, A., Wright, R. O., & Wright, R. J. (2015). Prenatal particulate air pollution and asthma onset in urban children: Identifying sensitive windows and sex differences. *American Journal of Respiratory and Critical Care Medicine*, *192*(9), 1052–1059. <https://doi.org/10.1164/rccm.201504-0658OC>

- <sup>94</sup> Lee, A., Hsu, H.-H. L., Chiu, Y.-H. M., Bose, S., Rosa, M. J., Kloog, I., Wilson, A., Schwartz, J., Cohen, S., Coull, B. A., Wright, R. O., & Wright, R. J. (2018). Prenatal fine particulate exposure and early childhood asthma: effect of maternal stress and fetal gender. *The Journal of Allergy and Clinical Immunology*, *141*(5), 1880–1886. <https://doi.org/10.1016/j.jaci.2017.07.017>
- <sup>95</sup> Lavigne, É., Bélair, M.-A., Rodriguez Duque, D., Do, M. T., Stieb, D. M., Hystad, P., van Donkelaar, A., Martin, R. V., Crouse, D. L., Crighton, E., Chen, H., Burnett, R. T., Weichenthal, S., Villeneuve, P. J., To, T., Brook, J. R., Johnson, M., Cakmak, S., Yasseen, A. S., & Walker, M. (2018). Effect modification of perinatal exposure to air pollution and childhood asthma incidence. *The European Respiratory Journal*, *51*(3). <https://doi.org/10.1183/13993003.01884-2017>
- <sup>96</sup> Yang, I. A., & Holloway, J. W. (2007). Asthma: advancing gene-environment studies. *Clinical & Experimental Allergy*, *37*(9), 1264–1266. <https://doi.org/10.1111/j.1365-2222.2007.02798.x>
- <sup>97</sup> Podlecka, D., Malewska-Kaczmarek, K., Jerzyńska, J., Stelmach, W., & Stelmach, I. (2018). Secondhand smoke exposure increased the need for inhaled corticosteroids in children with asthma. *Annals of Allergy, Asthma & Immunology*, *121*(1), 119–121. <https://doi.org/10.1016/j.anai.2018.04.021>
- <sup>98</sup> Neophytou, A. M., Oh, S. S., White, M. J., Mak, A. C. Y., Hu, D., Huntsman, S., Eng, C., Serebrisky, D., Borrell, L. N., Farber, H. J., Meade, K., Davis, A., Avila, P. C., Thyne, S. M., Rodríguez-Cintrón, W., Rodríguez-Santana, J. R., Kumar, R., Brigino-Buenaventura, E., Sen, S., ... Burchard, E. G. (2018). Secondhand smoke exposure and asthma outcomes among African-American and Latino children with asthma. *Thorax*, *73*(11), 1041–1048. <https://doi.org/10.1136/thoraxjnl-2017-211383>
- <sup>99</sup> Cohen, R. T., Raby, B. A., Van Steen, K., Fuhlbrigge, A. L., Celedón, J. C., Rosner, B. A., Strunk, R. C., Zeiger, R. S., & Weiss, S. T. (2010). In utero smoke exposure and impaired response to inhaled corticosteroids in children with asthma. *The Journal of Allergy and Clinical Immunology*, *126*(3), 491–497. <https://doi.org/10.1016/j.jaci.2010.06.016>
- <sup>100</sup> Richmond, R. C., Suderman, M., Langdon, R., Relton, C. L., & Davey Smith, G. (2018). DNA methylation as a marker for prenatal smoke exposure in adults. *International Journal of Epidemiology*, *47*(4), 1120–1130. <https://doi.org/10.1093/ije/dyy091>
- <sup>101</sup> Oh, S. S., Tcheurekdjian, H., Roth, L. A., Nguyen, E. A., Sen, S., Galanter, J. M., Davis, A., Farber, H. J., Gilliland, F. D., Kumar, R., Avila, P. C., Brigino-Buenaventura, E., Chapela, R., Ford, J. G., LeNoir, M. A., Lurmann, F., Meade, K., Serebrisky, D., Thyne, S., ... Burchard, E. G. (2012). Effect of secondhand smoke on asthma control among Black and Latino children. *The Journal of Allergy and Clinical Immunology*, *129*(6), 1478–1483.e7. <https://doi.org/10.1016/j.jaci.2012.03.017>
- <sup>102</sup> Drake, P., Driscoll, A.K., & Mathews, T.J. (2018). *Cigarette smoking during pregnancy: United States, 2016*. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics. [https://www.cdc.gov/nchs/products/databriefs/db305.htm#:~:text=Among%20the%20three%20largest%20race,and%20Hispanic%20women%20\(1.8%25\)](https://www.cdc.gov/nchs/products/databriefs/db305.htm#:~:text=Among%20the%20three%20largest%20race,and%20Hispanic%20women%20(1.8%25)).
- <sup>103</sup> Naqvi, M., Thyne, S., Choudhry, S., Tsai, H. J., Navarro, D., Castro, R. A., Nazario, S., Rodriguez-Santana, J. R., Casal, J., Torres, A., Chapela, R., Watson, H. G., Meade, K., LeNoir, M., Avila, P. C., Rodriguez-Cintrón, W., & Burchard, E. G. (2007). Ethnic-specific differences in bronchodilator responsiveness among African Americans, Puerto Ricans, and Mexicans with asthma. *The Journal of Asthma: Official Journal of the Association for the Care of Asthma*, *44*(8), 639–648. <https://doi.org/10.1080/02770900701554441>
- <sup>104</sup> Arcoleo, K. J., McGovern, C., Kaur, K., Halterman, J. S., Mammen, J., Crean, H., Rastogi, D., & Feldman, J. M. (2019). Longitudinal patterns of Mexican and Puerto Rican children's asthma controller medication adherence and acute healthcare use. *Annals of the American Thoracic Society*, *16*(6), 715–723. <https://doi.org/10.1513/AnnalsATS.201807-462OC>
- <sup>105</sup> Samedy-Bates, L.-A., Oh, S. S., Nuckton, T. J., Elhawary, J. R., White, M., Elliot, T., Zeiger, A. M., Eng, C., Salazar, S., LeNoir, M. A., Meade, K., Farber, H. J., Serebrisky, D., Brigino-Buenaventura, E., Rodriguez-Cintrón, W., Bibbins-Domingo, K., Kumar, R., Thyne, S., Borrell, L. N., ... Burchard, E. G. (2019). Racial/ethnic-specific differences in the effects of inhaled corticosteroid use on bronchodilator response in patients with asthma. *Clinical Pharmacology and Therapeutics*, *106*(5), 1133–1140. <https://doi.org/10.1002/cpt.1555>



- <sup>106</sup> McQuaid, E. L., & Landier, W. (2017). Cultural issues in medication adherence: Disparities and directions. *Journal of General Internal Medicine*, 33(2), 200–206. <https://doi.org/10.1007/s11606-017-4199-3>
- <sup>107</sup> McQuaid, E. L., Vasquez, J., Canino, G., Fritz, G. K., Ortega, A. N., Colon, A., Klein, R. B., Kopel, S. J., Koinis-Mitchell, D., Esteban, C. A., & Seifer, R. (2009). Beliefs and barriers to medication use in parents of Latino children with asthma. *Pediatric Pulmonology*, 44(9), 892–898. <https://doi.org/10.1002/ppul.21074>
- <sup>108</sup> Bender, B. G., & Bender, S. E. (2005). Patient-identified barriers to asthma treatment adherence: responses to interviews, focus groups, and questionnaires. *Immunology and Allergy Clinics of North America*, 25(1), 107–130. <https://doi.org/10.1016/j.iac.2004.09.005>
- <sup>109</sup> Peterson-Sweeney, K., McMullen, A., Yoos, H. L., & Kitzman, H. (2003). Parental perceptions of their child's asthma: management and medication use. *Journal of Pediatric Health Care: Official Publication of National Association of Pediatric Nurse Associates & Practitioners*, 17(3), 118–125. <https://doi.org/10.1067/mp.2003.31>
- <sup>110</sup> Canino, G., McQuaid, E. L., & Rand, C. S. (2009). Addressing asthma health disparities: A multilevel challenge. *Journal of Allergy and Clinical Immunology*, 123(6), 1209–1217. <https://doi.org/10.1016/j.jaci.2009.02.043>
- <sup>111</sup> Conn, K. M., Halterman, J. S., Lynch, K., & Cabana, M. D. (2007). The impact of parents' medication beliefs on asthma management. *Pediatrics*, 120(3), e521–e526. <https://doi.org/10.1542/peds.2006-3023>
- <sup>112</sup> Le, T. T., Bilderback, A., Bender, B., Wamboldt, F. S., Turner, C. F., Rand, C. S., & Bartlett, S. J. (2008). Do asthma medication beliefs mediate the relationship between minority status and adherence to therapy? *The Journal of Asthma: Official Journal of the Association for the Care of Asthma*, 45(1), 33–37. <https://doi.org/10.1080/02770900701815552>
- <sup>113</sup> Tam-Williams, J. B., & Jones, B. L. (2018). Closing the gap: Understanding African American asthma knowledge and beliefs. *Annals of Allergy, Asthma & Immunology: Official Publication of The American College of Allergy, Asthma, & Immunology*, 121(4), 458–463.
- <sup>114</sup> Bellin, M. H., Land, C., Newsome, A., Kub, J., Mudd, S. S., Bollinger, M. E., & Butz, A. M. (2016). Caregiver perception of asthma management of children in the context of poverty. *The Journal of Asthma: Official Journal of the Association for the Care of Asthma*, 54(2), 162–172. <https://doi.org/10.1080/02770903.2016.1198375>
- <sup>115</sup> Miles, C., Arden-Close, E., Thomas, M., Bruton, A., Yardley, L., Hankins, M., & Kirby, S. E. (2017). Barriers and facilitators of effective self-management in asthma: systematic review and thematic synthesis of patient and healthcare professional views. *NPJ Primary Care Respiratory Medicine*, 27(1). <https://doi.org/10.1038/s41533-017-0056-4>
- <sup>116</sup> Yearby, R. (2017). Exploitation in medical research: The enduring legacy of the Tuskegee Syphilis Study, 67 *Case W. Res. L. Rev.*, 67, 1171.
- <sup>117</sup> Harvard T.H. Chan School of Public Health, Robert Wood Johnson Foundation, and National Public Radio (NPR). (2017). *Discrimination in America: experiences and views of African Americans*. <https://media.npr.org/assets/img/2017/10/23/discriminationpoll-african-americans.pdf>
- <sup>118</sup> Oppel, R.A. Jr., Gebeloff, R., Lai, K. K. R., Wright, W., & Smith, M. (2020, July 5). The fullest look yet at the racial inequity of coronavirus. *The New York Times*. <https://www.nytimes.com/interactive/2020/07/05/us/coronavirus-latinos-african-americans-cdc-data.html>
- <sup>119</sup> Boulet, L.-P. (2016). Asthma in the elderly patient. *Asthma Research and Practice*, 2(1). <https://doi.org/10.1186/s40733-015-0015-1>
- <sup>120</sup> Hanania, N. A., King, M. J., Braman, S. S., Saltoun, C., Wise, R. A., Enright, P., Falsey, A. R., Mathur, S. K., Ramsdell, J. W., Rogers, L., Stempel, D. A., Lima, J. J., Fish, J. E., Wilson, S. R., Boyd, C., Patel, K. V., Irvin, C. G., Yawn, B. P., Halm, E. A., ... Ledford, D. K. (2011). Asthma in the elderly: Current understanding and future research needs—a report of a National Institute on Aging (NIA) workshop. *The Journal of Allergy and Clinical Immunology*, 128(3), S4–S24. <https://doi.org/10.1016/j.jaci.2011.06.048>

- <sup>121</sup> Dunn, R. M., Busse, P. J., & Wechsler, M. E. (2018). Asthma in the elderly and late-onset adult asthma. *Allergy, 73*(2), 284–294. <https://doi.org/10.1111/all.13258>
- <sup>122</sup> National Minority Quality Forum. (2019). National Minority Quality Forum asthma index. SHC Holdings LLC. Retrieved August 4, 2020 from <https://asthma.nmqf.us/>
- <sup>123</sup> Cremer, N. M., & Baptist, A. P. (2020). Race and Asthma Outcomes in Older Adults: Results from the National Asthma Survey. *The Journal of Allergy and Clinical Immunology: In Practice, 8*(4), 1294–1301.e7. <https://doi.org/10.1016/j.jaip.2019.12.014>
- <sup>124</sup> Skloot, G. S., Busse, P. J., Braman, S. S., Kovacs, E. J., Dixon, A. E., Vaz Fragoso, C. A., Scichilone, N., Prakash, Y. S., Pabelick, C. M., Mathur, S. K., Hanania, N. A., Moore, W. C., Gibson, P. G., Ziemann, S., & Ragless, B. B. (2016). An official American Thoracic Society workshop report: Evaluation and management of asthma in the elderly. *Annals of the American Thoracic Society, 13*(11), 2064–2077. <https://doi.org/10.1513/annalsats.201608-658st>
- <sup>125</sup> Slavin, R. G., Haselkorn, T., Lee, J. H., Zheng, B., Deniz, Y., & Wenzel, S. E. (2006). Asthma in older adults: observations from the Epidemiology and Natural History of Asthma: Outcomes and Treatment Regimens (TENOR) study. *Annals of Allergy, Asthma & Immunology, 96*(3), 406–414. [https://doi.org/10.1016/s1081-1206\(10\)60907-6](https://doi.org/10.1016/s1081-1206(10)60907-6)
- <sup>126</sup> Brown, E., Ojeda, V., Wyn, R., & Levan, R. (2000). *Racial and ethnic disparities in access to health insurance and health care*. The Henry J. Kaiser Family Foundation. <https://escholarship.org/content/qt4sf0p1st/qt4sf0p1st.pdf>
- <sup>127</sup> Barrett, M. L., Wier, L. M., & Washington, R. (2014). *Trends in pediatric and adult hospital stays for asthma, 2000–2010: Statistical brief #169*. Agency for Healthcare Research and Quality, Health Care Utilization Project. <https://www.ncbi.nlm.nih.gov/books/NBK189849/>
- <sup>128</sup> The Henry J. Kaiser Family Foundation. (2020, January 10). *Status of state action on the Medicaid expansion decision*. <https://www.kff.org/health-reform/state-indicator/state-activity-around-expanding-medicaid-under-the-affordable-care-act/?currentTimeframe=0&sortModel=%7B%22collid%22:%22Location%22>
- <sup>129</sup> Miller, S., & Wherry, L. R. (2019). Four years later: Insurance coverage and access to care continue to diverge between ACA Medicaid expansion and non-expansion states. *AEA Papers and Proceedings, 109*, 327–333. <https://doi.org/10.1257/pandp.20191046>
- <sup>130</sup> National Center for Health Statistics (2019). *National Health Interview Survey: Tables of summary health statistics*. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention. <https://www.cdc.gov/nchs/nhis/shs/tables.htm>
- <sup>131</sup> Miller, S., & Wherry, L. R. (2017). Health and access to care during the first 2 years of the ACA Medicaid Expansions. *The New England Journal of Medicine, 376*(10), 947–956. <https://doi.org/10.1056/NEJMsa1612890>
- <sup>132</sup> Guth, M., Garfield, R. & Rudowitz, R. (2020, March 17). *The effects of Medicaid expansion under the ACA: Updated findings from a literature review*. The Henry J. Kaiser Family Foundation. <https://www.kff.org/medicaid/report/the-effects-of-medicaid-expansion-under-the-aca-updated-findings-from-a-literature-review/>
- <sup>133</sup> Pate, C. A., Qin, X., Bailey, C. M., & Zahran, H. S. (2019). Cost barriers to asthma care by health insurance type among children with asthma. *Journal of Asthma, 1*–7. <https://doi.org/10.1080/02770903.2019.1640730>
- <sup>134</sup> Finkelstein, J. A., Barton, M. B., Donahue, J. G., Algatt-Bergstrom, P., Markson, L. E., & Platt, R. (2000). Comparing asthma care for Medicaid and Non-Medicaid children in a health maintenance organization. *Archives of Pediatrics & Adolescent Medicine, 154*(6), 563–568. <https://doi.org/10.1001/archpedi.154.6.563>

- <sup>135</sup> Piecoro, L. T., Potoski, M., Talbert, J. C., & Doherty, D. E. (2001). Asthma prevalence, cost, and adherence with expert guidelines on the utilization of health care services and costs in a state Medicaid population. *Health Services Research, 36*(2), 357–371. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1089228/?page=12>
- <sup>136</sup> Ferris, T. G., Blumenthal, D., Woodruff, P. G., Clark, S., & Camargo, C. A. (2002). Insurance and quality of care for adults with acute asthma. *Journal of General Internal Medicine, 17*(12), 905–913. <https://doi.org/10.1046/j.1525-1497.2002.20230.x>
- <sup>137</sup> Blewett, L. A., Johnson, P. J., Lee, B., & Scal, P. B. (2008). When a usual source of care and usual provider matter: adult prevention and screening services. *Journal of General Internal Medicine, 23*(9), 1354–1360. <https://doi.org/10.1007/s11606-008-0659-0>
- <sup>138</sup> American Lung Association. (2020, April 28). *Asthma guidelines-based care coverage project materials*. <https://www.lung.org/policy-advocacy/healthcare-lung-disease/asthma-policy/asthma-care-coverage/asthma-care-coverage-materials>
- <sup>139</sup> America's Health Insurance Plans. (2016, November 16). *Next generation asthma care: Integrating clinical and environmental strategies to improve asthma outcomes*. <https://www.ahip.org/next-generation-asthma-care-integrating-clinical-and-environmental-strategies-to-improve-asthma-outcomes/>
- <sup>140</sup> Center for Health Care Strategies, Inc. (n.d.). *What is CDC's 6/18 Initiative?* <https://www.618resources.chcs.org/what-is-the-cdcs-618-initiative/>
- <sup>141</sup> Centers for Disease Control and Prevention. (2019, October 22). *CDC's 6/18 Initiative: Control asthma*. U.S. Department of Health and Human Services. <https://www.cdc.gov/sixteen/asthma/index.htm>
- <sup>142</sup> Center for Health Care Strategies. (2017, March 29). *Advancing implementation of the CDC's 6/18 Initiative*. <https://www.chcs.org/project/advancing-public-commercial-payers-implementation-cdcs-618-initiative/>
- <sup>143</sup> Seeff, L. C., McGinnis, T., & Heishman, H. (2018). CDC's 6/18 Initiative: A cross-sector approach to translating evidence into practice. *Journal of Public Health Management and Practice, 1*. <https://doi.org/10.1097/phh.0000000000000782>
- <sup>144</sup> National Asthma Control Program. (2013). *Asthma self-management education and environmental management: Approaches to enhancing reimbursement*. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention. [https://www.cdc.gov/asthma/pdfs/Asthma\\_Reimbursement\\_Report.pdf](https://www.cdc.gov/asthma/pdfs/Asthma_Reimbursement_Report.pdf)
- <sup>145</sup> Childhood Asthma Leadership Coalition. (2016, May 27). *Pathways to Medicaid reimbursement for pediatric asthma services*. <http://asthmaregionalcouncil.org/wp-content/uploads/2016/10/Medicaid-Pathways-to-Asthma-Reimbursement-CALC-Sept-2016.pdf>
- <sup>146</sup> Hsu, J., Wilhelm, N., Lewis, L., & Herman, E. (2016). Economic evidence for US asthma self-management education and home-based interventions. *The Journal of Allergy and Clinical Immunology: In Practice, 4*(6), 1123–1134.e27. <https://doi.org/10.1016/j.jaip.2016.05.012>
- <sup>147</sup> Caskey, R., Moran, K., Touchette, D., Martin, M., Munoz, G., Kanabar, P., & Van Voorhees, B. (2019). Effect of comprehensive care coordination on Medicaid expenditures compared with usual care among children and youth with chronic disease. *JAMA Network Open, 2*(10), e1912604. <https://doi.org/10.1001/jamanetworkopen.2019.12604>
- <sup>148</sup> Galbraith, A., Faugno, E., Cripps, L. A., Przywara, K. M., Wu, A. C., & Gilkey, M. B. (2020, May). "You Have to Rob Peter to Pay Paul so Your Kid Can Breathe:" How Families Make Trade-Offs When Faced with Burdensome Asthma Care Costs. C14. American Thoracic Society International Conference, 2020. [https://doi.org/10.1164/ajrccm-conference.2020.201.1\\_meetingabstracts.a4478](https://doi.org/10.1164/ajrccm-conference.2020.201.1_meetingabstracts.a4478)
- <sup>149</sup> Hsu, J., Qin, X., & Mirabelli, M. C. (2019). Asthma-related impact of extending US parents' health insurance coverage to young adults. *The Journal of Allergy and Clinical Immunology: In Practice, 7*(3), 1091–1093.e1. <https://doi.org/10.1016/j.jaip.2018.08.031>

- <sup>150</sup> Health Resources and Services Administration. (2020). *Shortage areas*. U.S. Department of Health and Human Services. <https://data.hrsa.gov/topics/health-workforce/shortage-areas>
- <sup>151</sup> Galbraith, A. A., Soumerai, S. B., Ross-Degnan, D., Rosenthal, M. B., Gay, C., & Lieu, T. A. (2012). Delayed and forgone care for families with chronic conditions in high-deductible health plans. *Journal of General Internal Medicine*, 27(9), 1105–1111. <https://doi.org/10.1007/s11606-011-1970-8>
- <sup>152</sup> Patel, M. R., Brown, R. W., & Clark, N. M. (2012). Perceived parent financial burden and asthma outcomes in low-income, urban children. *Journal of Urban Health*, 90(2), 329–342. <https://doi.org/10.1007/s11524-012-9774-7>
- <sup>153</sup> McLellan, R. K. (2017). Work, health, and worker well-being: Roles and opportunities for employers. *Health Affairs*, 36(2), 206–213. <https://doi.org/10.1377/hlthaff.2016.1150>
- <sup>154</sup> Taira, D. A. (1999). Improving the health and health care of non-English-speaking patients. *Journal of General Internal Medicine*, 14(5), 322–323. <https://doi.org/10.1046/j.1525-1497.1999.00345.x>
- <sup>155</sup> LaVeist, T. A., Isaac, L. A., & Williams, K. P. (2009). Mistrust of health care organizations is associated with underutilization of health services. *Health Services Research*, 44(6), 2093–2105. <https://doi.org/10.1111/j.1475-6773.2009.01017.x>
- <sup>156</sup> Office of Minority Health. (2013, April 13). *National standards for CLAS in health and health care: A blueprint for advancing and sustaining CLAS policy and practice*. U.S. Department of Health and Human Services. <https://thinkculturalhealth.hhs.gov/assets/pdfs/EnhancedCLASStandardsBlueprint.pdf>
- <sup>157</sup> Association of American Medical Colleges. (2019). *Diversity in medicine: Facts and figures 2019*. <https://www.aamc.org/system/files/2019-12/19-222-Executive%20Summary-FINAL-120919.pdf>
- <sup>158</sup> Nikaj, S., Roychowdhury, D., Lund, P. K., Matthews, M., & Pearson, K. (2018). Examining trends in the diversity of the U.S. National Institutes of Health participating and funded workforce. *FASEB Journal: Official Publication of the Federation of American Societies for Experimental Biology*, fj201800639. <https://doi.org/10.1096/fj.201800639>
- <sup>159</sup> Sullivan Commission on diversity in the healthcare workforce: U.S. healthcare professions separate and unequal. (2004, September 20). BioSpace. <https://www.biospace.com/article/releases/-b-sullivan-commission-on-diversity-in-the-healthcare-workforce-b-release-u-s-healthcare-professions-separate-and-unequal/>
- <sup>160</sup> Toretsky, C., Mutha, S., & Coffman, J. (2018). *Breaking barriers for underrepresented minorities in the health professions*. Healthforce Center at UCSF. <https://healthforce.ucsf.edu/sites/healthforce.ucsf.edu/files/publication-pdf/Breaking%20Barriers%20for%20Underrepresented%20Minorities%20in%20the%20Health%20Professions%20.pdf>
- <sup>161</sup> Viera, A. J., Pathman, D. E., & Garrett, J. M. (2006). Adults' lack of a usual source of care: A matter of preference? *Annals of Family Medicine*, 4(4), 359–365. <https://doi.org/10.1370/afm.557>
- <sup>162</sup> Bodenheimer, T., & Pham, H. H. (2010). Primary care: Current problems and proposed solutions. *Health Affairs*, 29(5), 799–805. <https://doi.org/10.1377/hlthaff.2010.0026>
- <sup>163</sup> Pathman, D. E., Konrad, T. R., King, T. S., Taylor, D. H., & Koch, G. G. (2004). Outcomes of states' scholarship, loan repayment, and related programs for physicians. *Medical Care*, 42(6), 560–568. <https://doi.org/10.1097/01.mlr.0000128003.81622.ef>
- <sup>164</sup> Goodfellow, A., Ulloa, J. G., Dowling, P. T., Talamantes, E., Chheda, S., Bone, C., & Moreno, G. (2016). Predictors of primary care physician practice location in underserved urban or rural areas in the United States: A Systematic literature review. *Academic Medicine: Journal of the Association of American Medical Colleges*, 91(9), 1313–1321. <https://doi.org/10.1097/ACM.0000000000001203>
- <sup>165</sup> The National Commission on Physician Payment Reform. (2013). *Report of the National Commission on Physician Payment Reform*. Robert Wood Johnson Foundation. [https://www.sgim.org/File%20Library/SGIM/Communities/Advocacy/physician\\_payment\\_report-resave2.pdf](https://www.sgim.org/File%20Library/SGIM/Communities/Advocacy/physician_payment_report-resave2.pdf)



- <sup>166</sup> Agency for Healthcare Research and Quality. (2018). *National healthcare quality & disparities report*. U.S. Department of Health and Human Services. <https://www.ahrq.gov/sites/default/files/wysiwyg/research/findings/nhqdr/2018qdr-final.pdf>
- <sup>167</sup> Clarke, J. L., Bourn, S., Skoufalos, A., Beck, E. H., & Castillo, D. J. (2017). An innovative approach to health care delivery for patients with chronic conditions. *Population Health Management, 20*(1), 23–30. <https://doi.org/10.1089/pop.2016.0076>
- <sup>168</sup> Jackson, G. L., Powers, B. J., Chatterjee, R., Prvu Bettger, J., Kemper, A. R., Hasselblad, V., Dolor, R. J., Irvine, R. J., Heidenfelder, B. L., Kendrick, A. S., Gray, R., & Williams, J. W. (2013). The patient-centered medical home. *Annals of Internal Medicine, 158*(3), 169. <https://doi.org/10.7326/0003-4819-158-3-201302050-00579>
- <sup>169</sup> Lyon, M., Markus, A.R., & Rosenbaum, S. (2010, December 2). *The Affordable Care Act, medical homes, and childhood asthma: A key opportunity for progress*. Merck Childhood Asthma Network. [https://publichealth.gwu.edu/departments/healthpolicy/DHP\\_Publications/pub\\_uploads/dhpPublication\\_67550887-5056-9D20-3DD02730276FFC88.pdf](https://publichealth.gwu.edu/departments/healthpolicy/DHP_Publications/pub_uploads/dhpPublication_67550887-5056-9D20-3DD02730276FFC88.pdf)
- <sup>170</sup> Blumenthal, D., & Abrams, M. (2020). The Affordable Care Act at 10 years — Payment and delivery system reforms. *New England Journal of Medicine, 382*(11), 1057–1063. <https://doi.org/10.1056/nejmhpr1916092>
- <sup>171</sup> NORC at the University of Chicago (2016). *HCIA disease-specific evaluation*. <https://downloads.cms.gov/files/cmami/hcia-diseasespecific-thirdannualrpt.pdf>
- <sup>172</sup> NORC at the University of Chicago (2016). *HCIA disease-specific evaluation: Health Resources in Action*. <https://downloads.cms.gov/files/cmami/hcia-diseasespecific-thirdannualrpt.pdf>
- <sup>173</sup> Chin, M. H. (2016). Creating the Business Case for Achieving Health Equity. *Journal of General Internal Medicine, 31*(7), 792–796. <https://doi.org/10.1007/s11606-016-3604-7>
- <sup>174</sup> National Governors Association. (2015, April 16). *Health investments that pay off: Strategies for addressing asthma in children*. <https://www.nga.org/center/publications/strategies-addressing-asthma-children/>
- <sup>175</sup> Centers for Disease Control and Prevention. (n.d.). *CDC's National Asthma Control Program*. U.S. Department of Health and Human Services. <https://www.cdc.gov/asthma/nacp.htm>
- <sup>176</sup> Centers for Disease Control and Prevention. *Moving the needle on asthma control: Examining context, promising practices, and innovation*. U.S. Department of Health and Human Services, National Center for Environmental Health. [https://www.cdc.gov/asthma/pdfs/Moving\\_the\\_Needle\\_Asthma\\_Control-508.pdf](https://www.cdc.gov/asthma/pdfs/Moving_the_Needle_Asthma_Control-508.pdf)
- <sup>177</sup> Hsu, J., Sircar, K., Herman, E., & Garbe, P. (2018). *EXHALE: A technical package to control asthma*. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Environmental Health. [https://www.cdc.gov/asthma/pdfs/EXHALE\\_technical\\_package-508.pdf](https://www.cdc.gov/asthma/pdfs/EXHALE_technical_package-508.pdf)
- <sup>178</sup> Centers for Disease Control and Prevention. (n.d.). *Controlling Childhood Asthma and Reducing Emergencies (CCARE)*. U.S. Department of Health and Human Services. <https://www.cdc.gov/asthma/ccare.htm>
- <sup>179</sup> Centers for Disease Control and Prevention. (2020). *Justification of estimates for appropriation committees*. U.S. Department of Health and Human Services. <https://www.cdc.gov/budget/documents/fy2021/FY-2021-CDC-congressional-justification.pdf?fbclid=IwAR0CWEcg-jf-v2k2qg41VZNtrDB-W4mD9Sw4bzw7hN-8jTajBjWM7Z1fC-M>
- <sup>180</sup> Office of Disease Prevention and Health Promotion. *Healthy People 2020*. U.S. Department of Health and Human Services. Retrieved June 23, 2020 from <https://health.gov/healthypeople>.
- <sup>181</sup> Division of Nutrition, Physical Activity, and Obesity. (2019). *Racial and ethnic approaches to community health*. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention. <https://www.cdc.gov/nccdphp/dnpao/state-local-programs/reach/index.htm>

- <sup>182</sup> Agency for Healthcare Research and Quality. (2018). *2018 National healthcare quality & disparities report: Introduction and methods*. U.S. Department of Health and Human Services. <https://www.ahrq.gov/research/findings/nhqdr/nhqdr18/index.html>
- <sup>183</sup> U.S. Department of Health and Human Services. (2011). *HHS action plan to reduce racial and ethnic health disparities: A nation free of disparities in health and health care*. [https://minorityhealth.hhs.gov/assets/pdf/hhs/HHS\\_Plan\\_complete.pdf](https://minorityhealth.hhs.gov/assets/pdf/hhs/HHS_Plan_complete.pdf)
- <sup>184</sup> U.S. Environmental Protection Agency. (2012). *Coordinated federal action plan to reduce racial and ethnic asthma disparities*. <https://www.epa.gov/asthma/coordinated-federal-action-plan-reduce-racial-and-ethnic-asthma-disparities>
- <sup>185</sup> Bureau of Labor Statistics. (2017). *The employment situation – October 2017*. U.S. Department of Labor. [https://www.bls.gov/news.release/archives/empst\\_11032017.pdf](https://www.bls.gov/news.release/archives/empst_11032017.pdf)
- <sup>186</sup> Bureau of Labor Statistics. (2015). *Labor force statistics from the current population survey: How the government measures unemployment*. U.S. Department of Labor. [http://www.bls.gov/cps/cps\\_htgm.htm](http://www.bls.gov/cps/cps_htgm.htm)
- <sup>187</sup> Popovich, D. (2008). *Work matters for health issue brief 4: Work and health*. Robert Wood Johnson Foundation. <http://www.commissiononhealth.org/PDF/0e8ca13d-6fb8-451d-bac8-7d15343aacff/Issue%20Brief%204%20Dec%2008%20-%20Work%20and%20Health.pdf>
- <sup>188</sup> Bureau of Labor Statistics. (2017). *Employee benefits in the United States: March 2017*. U.S. Department of Labor. [https://www.bls.gov/news.release/archives/ebs2\\_07212017.pdf](https://www.bls.gov/news.release/archives/ebs2_07212017.pdf)
- <sup>189</sup> Sommers, B. D., Gawande, A. A., & Baicker, K. (2017). Health insurance coverage and health – what the recent evidence tells us. *New England Journal of Medicine*, 377(6), 586–593. <https://doi.org/10.1056/nejmsb1706645>
- <sup>190</sup> DeRigne, L., Stoddard-Dare, P., & Quinn, L. (2016). Workers without paid sick leave less likely to take time off for illness or injury compared to those with paid sick leave. *Health Affairs*, 35(3), 520–527. <https://doi.org/10.1377/hlthaff.2015.0965>
- <sup>191</sup> Burtle, A., & Bezruchka, S. (2016). Population health and paid parental leave: What the United States can learn from two decades of research. *Healthcare*, 4(2), 30. <https://doi.org/10.3390/healthcare4020030>
- <sup>192</sup> DeSilver, D. (2013, August 21). *Black unemployment rate is consistently twice that of whites*. Pew Research Center. <https://www.pewresearch.org/fact-tank/2013/08/21/through-good-times-and-bad-black-unemployment-is-consistently-double-that-of-whites/>
- <sup>193</sup> Quillian, L., Pager, D., Hexel, O., & Midtbøen, A. H. (2017). Meta-analysis of field experiments shows no change in racial discrimination in hiring over time. *Proceedings of the National Academy of Sciences*, 114(41), 10870–10875. <https://doi.org/10.1073/pnas.1706255114>
- <sup>194</sup> Kaplan, G.A., Ranjit, N., & Burgard, S.A. (2008). Lifting gates, lengthening lives: Did civil rights policies improve the health of African American woman in the 1960s and 1970s? In: R.F. Schoeni, J.S. House, G.A. Kaplan, & H. Pollack (Eds.), *Making Americans healthier: Social and economic policy as health policy*. (pp. 145–169). Russell Sage Foundation.
- <sup>195</sup> Kneipp, S. M., Kairalla, J. A., & Sheely, A. L. (2013). A randomized controlled trial to improve health among women receiving welfare in the US: the relationship between employment outcomes and the economic recession. *Social Science & Medicine* (1982), 80, 130–140. <https://doi.org/10.1016/j.socscimed.2012.08.011>
- <sup>196</sup> Mueser, K. T., Bond, G. R., Essock, S. M., Clark, R. E., Carpenter-Song, E., Drake, R. E., & Wolfe, R. (2014). The effects of supported employment in Latino consumers with severe mental illness. *Psychiatric Rehabilitation Journal*, 37(2), 113–122. <https://doi.org/10.1037/prj0000062>
- <sup>197</sup> Braveman, P., Egerter, S., & Williams, D. R. (2011). The social determinants of health: Coming of age. *Annual Review of Public Health*, 32(1), 381–398. <https://doi.org/10.1146/annurev-publhealth-031210-101218>

- <sup>198</sup> Bureau of Labor Statistics. (2011). *Occupational employment by race and ethnicity*. U.S. Department of Labor. [https://www.bls.gov/opub/ted/2012/ted\\_20121026.htm](https://www.bls.gov/opub/ted/2012/ted_20121026.htm)
- <sup>199</sup> O'Campo, P., & Rojas-Smith, L. (1998). Welfare reform and women's health: review of the literature and implications for state policy. *Journal of Public Health Policy*, 19(4), 420–446. <https://pubmed.ncbi.nlm.nih.gov/9922619/>
- <sup>200</sup> Assari, S., & Lankarani, M. M. (2016). Race and urbanity alter the protective effect of education but not income on mortality. *Frontiers in Public Health*, 4. <https://doi.org/10.3389/fpubh.2016.00100>
- <sup>201</sup> Cheung, F. (2018). Income redistribution predicts greater life satisfaction across individual, national, and cultural characteristics. *Journal of Personality and Social Psychology*, 115(5), 867–882. <https://doi.org/10.1037/pspp0000164>
- <sup>202</sup> United States Congress. (1938). Fair Labor Standards Act (FLSA). <https://www.dol.gov/agencies/whd/flsa>
- <sup>203</sup> Siqueira, C. E., Gaydos, M., Monforton, C., Slatin, C., Borkowski, L., Dooley, P., Liebman, A., Rosenberg, E., Shor, G., & Keifer, M. (2014). Effects of social, economic, and labor policies on occupational health disparities. *American Journal of Industrial Medicine*, 57(5), 557–572. <https://doi.org/10.1002/ajim.22186>
- <sup>204</sup> Bureau of Labor Statistics. (2016). *Labor force statistics from the current population survey: Characteristics of minimum wage workers, 2010*. US Department of Labor. <https://www.bls.gov/cps/minwage2010.htm>
- <sup>205</sup> Martelle, S. (2009). *Confronting the gloves-off economy: America's broken labor standards and how to fix them* (A. Bernhardt, H. Boushey, L. Dresser, & C. Tilley (eds.)). Labor and Employment Relations Association. [https://cepr.net/documents/publications/gloves\\_off\\_final.pdf](https://cepr.net/documents/publications/gloves_off_final.pdf)
- <sup>206</sup> U.S. Social Security Administration. (n.d.). *Disability evaluation under Social Security: 103.00 respiratory diseases – childhood*. <https://www.ssa.gov/disability/professionals/bluebook/103.00-Respiratory-Childhood.htm>
- <sup>207</sup> U.S. Social Security Administration. (n.d.). *Disability evaluation under Social Security: 3.00 respiratory diseases – adult*. [https://www.ssa.gov/disability/professionals/bluebook/3.00-Respiratory-Adult.htm#3\\_03](https://www.ssa.gov/disability/professionals/bluebook/3.00-Respiratory-Adult.htm#3_03)
- <sup>208</sup> Hoynes, H., Page, M., & Stevens, A. H. (2011). Can targeted transfers improve birth outcomes? *Journal of Public Economics*, 95(7–8), 813–827. <https://doi.org/10.1016/j.jpubeco.2010.12.006>
- <sup>209</sup> Hamad, R., & Rehkopf, D. H. (2015). Poverty, pregnancy, and birth outcomes: A study of the Earned Income Tax Credit. *Paediatric and Perinatal Epidemiology*, 29(5), 444–452. <https://doi.org/10.1111/ppe.12211>
- <sup>210</sup> Arno, P. S., House, J. S., Viola, D., & Schechter, C. (2011). Social security and mortality: The role of income support policies and population health in the United States. *Journal of Public Health Policy*, 32(2), 234–250. <https://doi.org/10.1057/jphp.2011.2>
- <sup>211</sup> Ranganathan, M., & Lagarde, M. (2012). Promoting healthy behaviours and improving health outcomes in low and middle income countries: A review of the impact of conditional cash transfer programmes. *Preventive Medicine*, 55, S95–S105. <https://doi.org/10.1016/j.ypmed.2011.11.015>
- <sup>212</sup> Miller, E. R., Cooper, L. A., Carson, K. A., Wang, N.-Y., Appel, L. J., Gayles, D., Charleston, J., White, K., You, N., Weng, Y., Martin-Daniels, M., Bates-Hopkins, B., Robb, I., Franz, W. K., Brown, E. L., Halbert, J. P., Albert, M. C., Dalcin, A. T., & Yeh, H.-C. (2016). A dietary intervention in urban African Americans: Results of the “Five Plus Nuts and Beans” randomized trial. *American Journal of Preventive Medicine*, 50(1), 87–95. <https://doi.org/10.1016/j.amepre.2015.06.010>
- <sup>213</sup> Costello, E. J. (2010). Association of family income supplements in adolescence with development of psychiatric and substance use disorders in adulthood among an American Indian population. *JAMA*, 303(19), 1954. <https://doi.org/10.1001/jama.2010.621>
- <sup>214</sup> Bitler, M., & Hoynes, H. (2016). *Strengthening temporary assistance for needy families*. The Hamilton Project. [https://www.hamiltonproject.org/assets/files/bitler\\_hoynes\\_strengthening\\_tanf.pdf](https://www.hamiltonproject.org/assets/files/bitler_hoynes_strengthening_tanf.pdf)

- <sup>215</sup> Brownell, M., Nickel, N. C., Chartier, M., Enns, J. E., Chateau, D., Sarkar, J., Burland, E., Jutte, D. P., Taylor, C., & Katz, A. (2018). An unconditional prenatal income supplement reduces population inequities in birth outcomes. *Health Affairs (Project Hope)*, *37*(3), 447–455. <https://doi.org/10.1377/hlthaff.2017.1290>
- <sup>216</sup> Hillemeier, M. M., Lanza, S. T., Landale, N. S., & Oropesa, R. S. (2013). Measuring early childhood health and health disparities: A new approach. *Maternal and Child Health Journal*, *17*(10). <https://doi.org/10.1007/s10995-012-1205-6>
- <sup>217</sup> Thornton, R. L. J., Glover, C. M., Cené, C. W., Glik, D. C., Henderson, J. A., & Williams, D. R. (2016). Evaluating strategies for reducing health disparities by addressing the social determinants of health. *Health Affairs*, *35*(8), 1416–1423. <https://doi.org/10.1377/hlthaff.2015.1357>
- <sup>218</sup> Jones, N. L., Gilman, S. E., Cheng, T. L., Drury, S. S., Hill, C. V., & Geronimus, A. T. (2019). Life course approaches to the causes of health disparities. *American Journal of Public Health*, *109*(S1), S48–S55. <https://doi.org/10.2105/ajph.2018.304738>
- <sup>219</sup> Schweinhart, L.J., Montie, J., Xiang, Z., Barnett, W.S., Belfield, C.R., & Nores, M. (2014). *The High/Scope Perry Preschool Study through age 40: Summary, conclusions, and frequently asked questions*. High Scope Press. [http://nieer.org/wp-content/uploads/2014/09/specialsummary\\_rev2011\\_02\\_2.pdf](http://nieer.org/wp-content/uploads/2014/09/specialsummary_rev2011_02_2.pdf)
- <sup>220</sup> García, J. L., Heckman, J., Leaf, D. E., & Prados, M. J. (2016). The life-cycle benefits of an influential early childhood program. *National Bureau of Economic Research*. <https://doi.org/10.3386/w22993>
- <sup>221</sup> Bauer, L., & Schanzenbach, D. (2016). *The long-term impact of the Head Start Program*. The Hamilton Project. [https://www.hamiltonproject.org/assets/files/long\\_term\\_impact\\_of\\_head\\_start\\_program.pdf](https://www.hamiltonproject.org/assets/files/long_term_impact_of_head_start_program.pdf)
- <sup>222</sup> Health Equity Action for System Transformation. (2019). *Helping our children grow and thrive: Leveraging the health care system to prevent and mitigate adverse childhood experiences and advance equity in childhood*. Families USA. [https://familiesusa.org/wp-content/uploads/2019/08/FamiliesUSA\\_Help-Our-Children-Grow-And-Thrive\\_Report.pdf](https://familiesusa.org/wp-content/uploads/2019/08/FamiliesUSA_Help-Our-Children-Grow-And-Thrive_Report.pdf)
- <sup>223</sup> National Center for Education Statistics. (2020). *Public high school graduation rates*. Institute of Education Sciences. [https://nces.ed.gov/programs/coe/indicator\\_coi.asp#info](https://nces.ed.gov/programs/coe/indicator_coi.asp#info)
- <sup>224</sup> Quillian, L. (2014). Does segregation create winners and losers? Residential segregation and inequality in educational attainment. *Social Problems*, *61*(3), 402–426. <https://doi.org/10.1525/sp.2014.12193>
- <sup>225</sup> U.S. Commission on Civil Rights. (2018). *Public education funding inequity in an era of increasing concentration of poverty and resegregation*. <https://www.usccr.gov/pubs/2018/2018-01-10-Education-Inequity.pdf>
- <sup>226</sup> [Re]Build America's School Infrastructure Coalition (BASIC). (2018). *Education equity requires modern school facilities: The case for federal funding for school infrastructure*. <https://static1.squarespace.com/static/5a6ca11af9a61e2c7be7423e/t/5ba23b3688251b659c2f9eff/1537358671343/Education+Equity+Requires+Modern+School+Facilities.pdf>
- <sup>227</sup> U.S. Environmental Protection Agency. (2014, October 20). *Evidence from scientific literature about improved academic performance*. <https://www.epa.gov/iaq-schools/evidence-scientific-literature-about-improved-academic-performance>
- <sup>228</sup> U.S. Environmental Protection Agency. (2015, October 27). *Why indoor air quality is important to schools*. <https://www.epa.gov/iaq-schools/why-indoor-air-quality-important-schools>
- <sup>229</sup> Hopkins, J.S. (2017, February 17). *The invisible hazard afflicting thousands of schools*. Center for Public Integrity. <https://publicintegrity.org/environment/the-invisible-hazard-afflicting-thousands-of-schools/>
- <sup>230</sup> Hsu, J., Qin, X., Beavers, S. F., & Mirabelli, M. C. (2016). Asthma-Related School Absenteeism, Morbidity, and Modifiable Factors. *American Journal of Preventive Medicine*, *51*(1), 23–32. <https://doi.org/10.1016/j.amepre.2015.12.012>



- <sup>231</sup> U.S. Environmental Protection Agency. (n.d.). *The inside story: A guide to indoor air quality*. <https://www.epa.gov/indoor-air-quality-iaq/inside-story-guide-indoor-air-quality>
- <sup>232</sup> Hughes, H. K., Matsui, E. C., Tschudy, M. M., Pollack, C. E., & Keet, C. A. (2017). Pediatric asthma health disparities: Race, hardship, housing, and asthma in a national survey. *Academic Pediatrics, 17*(2), 127–134. <https://doi.org/10.1016/j.acap.2016.11.011>
- <sup>233</sup> Gibson, M., Petticrew, M., Bambra, C., Sowden, A. J., Wright, K. E., & Whitehead, M. (2011). Housing and health inequalities: A synthesis of systematic reviews of interventions aimed at different pathways linking housing and health. *Health & Place, 17*(1), 175–184. <https://doi.org/10.1016/j.healthplace.2010.09.011>
- <sup>234</sup> Ganesh, B., Payton Scally, C., Skopec, L., & Zhu, J. (2017). *The relationship between housing and asthma among school-age children: Analysis of the 2015 American Housing Survey*. The Urban Institute. <http://www.nchph.org/wp-content/uploads/2017/10/UI-2017-Housing-and-Asthma-among-School-Age-Children-AHS-2015-1.pdf>
- <sup>235</sup> Beck, A. F., Huang, B., Chundur, R., & Kahn, R. S. (2014). Housing code violation density associated with emergency department and hospital use by children with asthma. *Health affairs (Project Hope), 33*(11), 1993–2002. <https://doi.org/10.1377/hlthaff.2014.0496>
- <sup>236</sup> U.S. Department of Housing and Urban Development. (2017). *Implementing HUD's smoke-free policy in public housing*. [https://www.hud.gov/sites/documents/SMOKEFREE\\_GUIDEBK.PDF](https://www.hud.gov/sites/documents/SMOKEFREE_GUIDEBK.PDF).
- <sup>237</sup> American Public Health Association. (n.d.). *Healthy homes*. <https://www.apha.org/topics-and-issues/environmental-health/healthy-community-design/healthy-homes>
- <sup>238</sup> Ewing, R., & Kreutzer, R. (2006). *Understanding the relationship between public health and the built environment: A report prepared for the LEED-ND Core Committee*. Lawrence Frank and Company, Inc. <https://www.usgbc.org/sites/default/files/public-health-built-environment.pdf>
- <sup>239</sup> Krieger, J. (2010). Home is where the triggers are: Increasing asthma control by improving the home environment. *Pediatric Allergy, Immunology, and Pulmonology, 23*(2), 139–145. <https://doi.org/10.1089/ped.2010.0022>
- <sup>240</sup> Washington State Weatherization Plus Health Program Pilot. (2019). *Pierce County Healthy Homes case study*. Washington State University Energy Program. <http://www.commerce.wa.gov/wp-content/uploads/2019/01/Pierce-County-Healthy-Homes-Case-Study-Jan-22-2019.pdf>
- <sup>241</sup> Diez Roux, A. V., & Mair, C. (2010). Neighborhoods and health. *Annals of the New York Academy of Sciences, 1186*(1), 125–145. <https://doi.org/10.1111/j.1749-6632.2009.05333.x>
- <sup>242</sup> Corburn, J. (2005). Urban planning and health disparities: Implications for research and practice. *Planning Practice and Research, 20*(2), 111–126. <https://doi.org/10.1080/02697450500414652>
- <sup>243</sup> U.S. Department of Housing and Urban Development. (n.d.). *Housing choice voucher fact sheet*. [https://www.hud.gov/program\\_offices/public\\_indian\\_housing/programs/hcv/about/fact\\_sheet](https://www.hud.gov/program_offices/public_indian_housing/programs/hcv/about/fact_sheet)
- <sup>244</sup> Stromberg, B., & Sturtevant, L. (2016). *What makes inclusionary zoning happen?* National Housing Conference. <http://landuselaw.wustl.edu/Articles/Inclusionary%20Zoning%20Rept%202016.pdf>
- <sup>245</sup> Commission to Build a Healthier America. (2008). *Where we live matters for our health: Neighborhoods and health*. Robert Wood Johnson Foundation. <http://www.commissiononhealth.org/PDF/888f4a18-eb90-45be-a2f8-159e84a55a4c/Issue%20Brief%203%20Sept%2008%20-%20Neighborhoods%20and%20Health.pdf>
- <sup>246</sup> Northridge, J., Ramirez, O. F., Stingone, J. A., & Claudio, L. (2010). The role of housing type and housing quality in urban children with asthma. *Journal of Urban Health, 87*(2), 211–224. <https://doi.org/10.1007/s11524-009-9404-1>
- <sup>247</sup> Keet, C. A., Matsui, E. C., McCormack, M. C., & Peng, R. D. (2017). Urban residence, neighborhood poverty, race/ethnicity, and asthma morbidity among children on Medicaid. *The Journal of Allergy and Clinical Immunology, 140*(3), 822–827. <https://doi.org/10.1016/j.jaci.2017.01.036>

- <sup>248</sup> Gergen, P. J., & Togias, A. (2015). Inner city asthma. *Immunology and Allergy Clinics of North America*, 35(1), 101–114. <https://doi.org/10.1016/j.iac.2014.09.006>
- <sup>249</sup> Gaskin, D. J., Dinwiddie, G. Y., Chan, K. S., & McCleary, R. (2012). Residential segregation and disparities in healthcare services utilization. *Medical Care Research and Review*, 69(2), 158–175. <https://doi.org/10.1177/1077558711420263>
- <sup>250</sup> Levine, J. R. (2016). The privatization of political representation: Community based organizations as nonelected neighborhood representatives. *American Sociological Review*, 81(6), 1251–1275. <https://doi.org/10.1177/0003122416670655>
- <sup>251</sup> U.S. Environmental Protection Agency. (2017). *What is open space/green space?* <https://www3.epa.gov/region1/eco/uep/openspace.html>
- <sup>252</sup> U.S. Department of Housing and Urban Development. (n.d.). *Moving to Opportunity for Fair Housing*. [https://www.hud.gov/programdescription/mto#:~:text=Moving%20to%20Opportunity%20for%20Fair%20Housing%20\(MTO\)%20is%20a%2010,areas%20to%20low%2Dpoverty%20neighborhoods.](https://www.hud.gov/programdescription/mto#:~:text=Moving%20to%20Opportunity%20for%20Fair%20Housing%20(MTO)%20is%20a%2010,areas%20to%20low%2Dpoverty%20neighborhoods.)
- <sup>253</sup> Chetty, R., Hendren, N., & Katz, L. (2016). The effects of exposure to better neighborhoods on children: New evidence from the moving to opportunity project. *American Economic Review*, 106(4). <https://scholar.harvard.edu/hendren/publications/effects-exposure-better-neighborhoods-children-new-evidence-moving-opportunity>
- <sup>254</sup> Fann, N., Baker, K. R., Chan, E. A. W., Eyth, A., Macpherson, A., Miller, E., & Snyder, J. (2018). Assessing human health PM<sub>2.5</sub> and ozone impacts from U.S. oil and natural gas sector emissions in 2025. *Environmental Science & Technology*, 52(15), 8095–8103. <https://doi.org/10.1021/acs.est.8b02050>
- <sup>255</sup> U.S. Environmental Protection Agency. (2015, February 19). *Integrated Science Assessment (ISA) for particulate matter*. <https://www.epa.gov/isa/integrated-science-assessment-isa-particulate-matter>
- <sup>256</sup> Tessum, C. W., Apte, J. S., Goodkind, A. L., Muller, N. Z., Mullins, K. A., Paoletta, D. A., Polasky, S., Springer, N. P., Thakrar, S. K., Marshall, J. D., & Hill, J. D. (2019). Inequity in consumption of goods and services adds to racial–ethnic disparities in air pollution exposure. *Proceedings of the National Academy of Sciences*, 116(13), 6001–6006. <https://doi.org/10.1073/pnas.1818859116>
- <sup>257</sup> American Lung Association. (2020). *State of the air 2020*. <http://www.stateoftheair.org/assets/SOTA-2020.pdf>
- <sup>258</sup> American Lung Association. (2019). *A declaration on climate change and health*. <https://www.lung.org/getmedia/414c4b5e-7961-47e2-bb35-00f8fec24309/health-medical-groups.pdf.pdf>
- <sup>259</sup> Public Employees for Environmental Responsibility. (2019, January 14). *Criminal enforcement collapse at EPA*. <https://www.peer.org/criminal-enforcement-collapse-at-epa>
- <sup>260</sup> U.S. Environmental Protection Agency. (2019, January 10). *Fiat Chrysler Automobiles Clean Air Act civil settlement information sheet*. <https://www.epa.gov/enforcement/fiat-chrysler-automobiles-clean-air-act-civil-settlement-information-sheet>
- <sup>261</sup> Fredrickson, L., Sullivan, M., Sellers, C., Ohayon, J., Kohl, E., Lamdan, S., Cordner, A., Hu, A., Kaczowka, K., Navas, N., & Wicks, L. (2018). *A sheep in the closet: The erosion of enforcement at the EPA*. <https://envirodatagov.org/wp-content/uploads/2018/11/Sheep-in-the-Closet.pdf>
- <sup>262</sup> Pelton, T. (2019, February 26). *EPA enforcement at record low in 2018*. Environmental Integrity Project. <https://environmentalintegrity.org/news/new-report-epa-enforcement-at-record-low-in-2018/>
- <sup>263</sup> Health Effects Institute. (2010, January 12). *Traffic-related air pollution: A critical review of the literature on emissions, exposure, and health effects*. <https://www.healtheffects.org/publication/traffic-related-air-pollution-critical-review-literature-emissions-exposure-and-health>
- <sup>264</sup> Hajat, A., Hsia, C., & O'Neill, M. S. (2015). Socioeconomic disparities and air pollution exposure: A global review. *Current Environmental Health Reports*, 2(4), 440–450. <https://doi.org/10.1007/s40572-015-0069-5>

- <sup>265</sup> George, M., Arcia, A., Chung, A., Coleman, D., & Bruzzese, J.-M. (2019). African Americans want a focus on shared decision-making in asthma adherence interventions. *The Patient - Patient-Centered Outcomes Research*, 13(1), 71–81. <https://doi.org/10.1007/s40271-019-00382-x>
- <sup>266</sup> Localio, A. M., Black, H. L., Park, H., Perez, L., Ndicu, G., Klusaritz, H., Rogers, M., Han, X., & Apter, A. J. (2018). Filling the patient-provider knowledge gap: a patient advocate to address asthma care and self-management barriers. *Journal of Asthma*, 56(10), 1027–1036. <https://doi.org/10.1080/02770903.2018.1520864>
- <sup>267</sup> Francis, L., DePriest, K., Wilson, M., & Gross, D. (2018). Child poverty, toxic stress, and social determinants of health: Screening and care coordination. *Online Journal of Issues in Nursing*, 23(3), 2. <https://pubmed.ncbi.nlm.nih.gov/31427855/>
- <sup>268</sup> George, M., & Bender, B. (2019). New insights to improve treatment adherence in asthma and COPD. *Patient Preference and Adherence*, 13, 1325–1334. <https://doi.org/10.2147/ppa.s209532>
- <sup>269</sup> Riley, I. L., Murphy, B., Razouki, Z., Krishnan, J. A., Apter, A., Okelo, S., Kraft, M., Feltner, C., Que, L. G., & Boulware, L. E. (2019). A systematic review of patient- and family-level inhaled corticosteroid adherence interventions in Black/African Americans. *The Journal of Allergy and Clinical Immunology. In Practice*, 7(4), 1184–1193.e3. <https://doi.org/10.1016/j.jaip.2018.10.036>
- <sup>270</sup> O'Byrne, P. M., FitzGerald, J. M., Bateman, E. D., Barnes, P. J., Zhong, N., Keen, C., Jorup, C., Lamarca, R., Ivanov, S., & Reddel, H. K. (2018). Inhaled combined budesonide-formoterol as needed in mild asthma. *New England Journal of Medicine*, 378(20), 1865–1876. <https://doi.org/10.1056/nejmoa1715274>
- <sup>271</sup> Lazarus, S. C. (2018). On-demand versus maintenance inhaled treatment in mild asthma. *New England Journal of Medicine*, 378(20), 1940–1942. <https://doi.org/10.1056/nejme1802680>
- <sup>272</sup> Nelson, H. S., Weiss, S. T., Bleecker, E. R., Yancey, S. W., & Dorinsky, P. M. (2006). The salmeterol multicenter asthma research trial: A comparison of usual pharmacotherapy for asthma or usual pharmacotherapy plus salmeterol. *Chest*, 129(1), 15–26. <https://doi.org/10.1378/chest.129.1.15>
- <sup>273</sup> Stempel, D. A., Raphiou, I. H., Kral, K. M., Yeakey, A. M., Emmett, A. H., Prazma, C. M., Buaron, K. S., & Pascoe, S. J. (2016). Serious asthma events with fluticasone plus salmeterol versus fluticasone alone. *New England Journal of Medicine*, 374(19), 1822–1830. <https://doi.org/10.1056/nejmoa1511049>
- <sup>274</sup> Center for Drug Evaluation and Research. (2019). *FDA drug safety communication: FDA review finds no significant increase in risk of serious asthma outcomes with long-acting beta agonists (LABAs) used in combination with inhaled corticosteroids (ICS)*. U.S. Food and Drug Administration. <https://www.fda.gov/drugs/drug-safety-and-availability/fda-drug-safety-communication-fda-review-finds-no-significant-increase-risk-serious-asthma-outcomes>
- <sup>275</sup> Caveney, B., Fagnano, M., Halterman, J. S., & Frey, S. M. (2019). Identifying which children with persistent asthma have preventive medications available at home. *The Journal of Asthma: Official Journal of The Association for the Care of Asthma*, 1–7. Advance online publication. <https://doi.org/10.1080/02770903.2019.1640734>
- <sup>276</sup> Capo-Ramos, D. E., Duran, C., Simon, A. E., Akinbami, L. J., & Schoendorf, K. C. (2014). Preventive asthma medication discontinuation among children enrolled in fee-for-service Medicaid. *The Journal of Asthma: Official Journal Of The Association For The Care Of Asthma*, 51(6), 618–626. <https://doi.org/10.3109/02770903.2014.895010>
- <sup>277</sup> Simon, A. E., & Akinbami, L. J. (2016). Asthma action plan receipt among children with asthma 2–17 years of age, United States, 2002–2013. *The Journal of Pediatrics*, 171, 283–289.e1. <https://doi.org/10.1016/j.jpeds.2016.01.004>
- <sup>278</sup> Press, V. G., Pappalardo, A. A., Conwell, W. D., Pincavage, A. T., Prochaska, M. H., & Arora, V. M. (2012). Interventions to improve outcomes for minority adults with asthma: A systematic review. *Journal of General Internal Medicine*, 27(8), 1001–1015. <https://doi.org/10.1007/s11606-012-2058-9>

- <sup>279</sup> McCallum, G. B., Morris, P. S., Brown, N., & Chang, A. B. (2017). Culture-specific programs for children and adults from minority groups who have asthma. *Cochrane Database of Systematic Reviews*. <https://doi.org/10.1002/14651858.cd006580.pub5>
- <sup>280</sup> Price, D., Bjermer, L., Bergin, D., & Martinez, R. (2017). Asthma referrals: A key component of asthma management that needs to be addressed. *Journal of Asthma and Allergy, Volume10*, 209–223. <https://doi.org/10.2147/jaa.s134300>
- <sup>281</sup> Burke, H., Davis, J., Evans, S., Flower, L., Tan, A., & Kurukulaaratchy, R. J. (2016). A multidisciplinary team case management approach reduces the burden of frequent asthma admissions. *ERJ Open Research, 2*(3), 00039–02016. <https://doi.org/10.1183/23120541.00039-2016>
- <sup>282</sup> Robinson, D. S., Campbell, D. A., Durham, S. R., Pfeffer, J., Barnes, P. J., & Chung, K. F. (2003). Systematic assessment of difficult-to-treat asthma. *European Respiratory Journal, 22*(3), 478–483. <https://doi.org/10.1183/09031936.03.00017003>
- <sup>283</sup> Gerald, L. B., Sockrider, M. M., Grad, R., Bender, B. G., Boss, L. P., Galant, S. P., Gerritsen, J., Joseph, C. L. M., Kaplan, R. M., Madden, J. A., Mangan, J. M., Redding, G. J., Schmidt, D. K., Schwindt, C. D., Taggart, V. S., Wheeler, L. S., Van Hook, K. N., Williams, P. V., Yawn, B. P., & Yuksel, B. (2007). An official ATS workshop report: Issues in screening for asthma in children. *Proceedings of the American Thoracic Society, 4*(2), 133–141. <https://www.atsjournals.org/doi/pdf/10.1513/pats.200604-103ST>
- <sup>284</sup> Agency for Healthcare Research and Quality. (2010). *What is care coordination?* U.S. Department of Health and Human Services. <https://www.ahrq.gov/ncepcr/care/coordination/atlas/chapter2.html>
- <sup>285</sup> Karnick, P., Margellos-Anast, H., Seals, G., Whitman, S., Aljadeff, G., & Johnson, D. (2007). The pediatric asthma intervention: A comprehensive cost-effective approach to asthma management in a disadvantaged inner-city community. *Journal of Asthma, 44*(1), 39–44. <https://doi.org/10.1080/02770900601125391>
- <sup>286</sup> Levy, M., Heffner, B., Stewart, T., & Beeman, G. (2006). The efficacy of asthma case management in an urban school district in reducing school absences and hospitalizations for asthma. *Journal of School Health, 76*(6), 320–324. <https://doi.org/10.1111/j.1746-1561.2006.00120.x>
- <sup>287</sup> Woods, E. R., Bhaumik, U., Sommer, S. J., Chan, E., Tsopelas, L., Fleegler, E. W., Lorenzi, M., Klements, E. M., Dickerson, D. U., Nethersole, S., & Dulin, R. (2016). Community asthma initiative to improve health outcomes and reduce disparities among children with asthma. *MMWR Supplements, 65*(1), 11–20. <https://doi.org/10.15585/mmwr.su6501a4>
- <sup>288</sup> Moricca, M. L., Grasska, M. A., BMarthaler, M., Morphew, T., Weismuller, P. C., & Galant, S. P. (2012). School asthma screening and case management: Attendance and learning outcomes. *The Journal of School Nursing, 29*(2), 104–112. <https://doi.org/10.1177/1059840512452668>
- <sup>289</sup> Bhaumik, U., Norris, K., Charron, G., Walker, S. P., Sommer, S. J., Chan, E., Dickerson, D. U., Nethersole, S., & Woods, E. R. (2013). A cost analysis for a community-based case management intervention program for pediatric asthma. *Journal of Asthma, 50*(3), 310–317. <https://doi.org/10.3109/02770903.2013.765447>
- <sup>290</sup> Gustafson, D., Wise, M., Bhattacharya, A., Pulvermacher, A., Shanovich, K., Phillips, B., Lehman, E., Chinchilli, V., Hawkins, R., & Kim, J.-S. (2012). The effects of combining web-based eHealth with telephone nurse case management for pediatric asthma control: A randomized controlled trial. *Journal of Medical Internet Research, 14*(4), e101. <https://doi.org/10.2196/jmir.1964>
- <sup>291</sup> National Asthma Education and Prevention Program. (2012). *Guidelines for the diagnosis and management of asthma (EPR-3)*. National Institutes of Health, National Heart, Lung, and Blood Institute. <https://www.nhlbi.nih.gov/health-topics/guidelines-for-diagnosis-management-of-asthma>
- <sup>292</sup> Pinnock, H., Parke, H. L., Panagioti, M., Daines, L., Pearce, G., Epiphaniou, E., Bower, P., Sheikh, A., Griffiths, C. J., & Taylor, S. J. C. (2017). Systematic meta-review of supported self-management for asthma: a healthcare perspective. *BMC Medicine, 15*(1). <https://doi.org/10.1186/s12916-017-0823-7>



- <sup>293</sup> Centers for Disease Control and Prevention. (2018). *Self-management education programs: Managing asthma*. U.S. Department of Health and Human Services. <https://www.cdc.gov/learnmorefeelbetter/programs/asthma.htm>
- <sup>294</sup> Agency for Healthcare Research and Quality. (2019, April 16). *Characteristics of existing asthma self-management education packages: Research protocol*. U.S. Department of Health and Human Services. <https://effectivehealthcare.ahrq.gov/products/asthma-education/protocol>
- <sup>295</sup> Agency for Healthcare Research and Quality. (2020, April 27). *Technical brief no. 35, Characteristics of existing asthma self-management education packages: Research protocol*. U.S. Department of Health and Human Services. <https://effectivehealthcare.ahrq.gov/sites/default/files/asthma-self-mgmt-summary.pdf>
- <sup>296</sup> Brewster, C. (2019, May 6). *Asthma patients continue to misuse inhaler therapy, despite guidelines*. HCP Live; MD Magazine. <https://www.mdmag.com/medical-news/asthma-patients-misuse-inhaler-therapy-guidelines>
- <sup>297</sup> Samady, W., Rodriguez, V. A., Gupta, R., Palac, H., Karamanis, M., & Press, V. G. (2019). Critical errors in inhaler technique among children hospitalized with asthma. *Journal of Hospital Medicine, 14*(6), 361–365. <https://doi.org/10.12788/jhm.3195>
- <sup>298</sup> Crowder, S. J., Hanna, K. M., Carpenter, J. S., & Broome, M. E. (2015). Factors associated with asthma self-management in African American Adolescents. *Journal of Pediatric Nursing, 30*(6), e35–e43. <https://doi.org/10.1016/j.pedn.2015.03.005>
- <sup>299</sup> Mammen, J., & Rhee, H. (2012). Adolescent asthma self-management: A concept analysis and operational definition. *Pediatric Allergy, Immunology, and Pulmonology, 25*(4), 180–189. <https://doi.org/10.1089/ped.2012.0150>
- <sup>300</sup> Liao, Y., Gao, G., & Peng, Y. (2019). The effect of goal setting in asthma self-management education: A systematic review. *International Journal of Nursing Sciences, 6*(3), 334–342. <https://doi.org/10.1016/j.ijnss.2019.04.003>
- <sup>301</sup> Fox, P., Porter, P. G., Lob, S. H., Boer, J. H., Rocha, D. A., & Adelson, J. W. (2007). Improving Asthma-Related Health Outcomes Among Low-Income, Multiethnic, School-aged Children: Results of a Demonstration Project That Combined Continuous Quality Improvement and Community Health Worker Strategies. *Pediatrics, 120*(4), e902–e911. <https://doi.org/10.1542/peds.2006-1805>
- <sup>302</sup> Trochtenberg, D. S., BeLue, R., Piphus, S., & Washington, N. (2008). Differing reports of asthma symptoms in African Americans and Caucasians. *The Journal of Asthma, 45*(2), 165–170. <https://doi.org/10.1080/02770900701847076>
- <sup>303</sup> Trochtenberg, D. S., & BeLue, R. (2007). Descriptors and perception of dyspnea in African-American asthmatics. *The Journal of Asthma, 44*(10), 811–815. <https://doi.org/10.1080/02770900701645769>
- <sup>304</sup> Hunninghake, G. M., Weiss, S. T., & Celedón, J. C. (2006). Asthma in Hispanics. *American Journal of Respiratory and Critical Care Medicine, 173*(2), 143–163. <https://doi.org/10.1164/rccm.200508-1232so>
- <sup>305</sup> Crocker, D. D., Kinyota, S., Dumitru, G. G., Ligon, C. B., Herman, E. J., Ferdinands, J. M., Hopkins, D. P., Lawrence, B. M., & Sipe, T. A. (2011). Effectiveness of home-based, multi-trigger, multicomponent interventions with an environmental focus for reducing asthma morbidity: a community guide systematic review. In *Database of Abstracts of Reviews of Effects (DARE): Quality-assessed Reviews*. Centre for Reviews and Dissemination. <https://www.ncbi.nlm.nih.gov/books/NBK81131/>
- <sup>306</sup> National Asthma Education and Prevention Program. (2007). Expert Panel Report 3 (EPR-3): Guidelines for the Diagnosis and Management of Asthma-Summary Report 2007. *The Journal of Allergy and Clinical Immunology, 120*(5 Suppl), S94–138. <https://doi.org/10.1016/j.jaci.2007.09.043>
- <sup>307</sup> Estrada, R. D., & Ownby, D. R. (2017). Rural asthma: Current understanding of prevalence, patterns, and interventions for children and adolescents. *Current Allergy and Asthma Reports, 17*(6). <https://doi.org/10.1007/s11882-017-0704-3>

- <sup>308</sup> Dick, S., Doust, E., Cowie, H., Ayres, J. G., & Turner, S. (2014). Associations between environmental exposures and asthma control and exacerbations in young children: a systematic review. *BMJ Open*, 4(2), e003827. <https://doi.org/10.1136/bmjopen-2013-003827>
- <sup>309</sup> U.S. Environmental Protection Agency. (2014). *Asthma home visit programs*. <https://www.epa.gov/asthma/asthma-home-visit-programs>
- <sup>310</sup> Bryant-Stephens, T. (2012, July 5). *Reducing asthma disparities*. The White House: President Barack Obama. <https://obamawhitehouse.archives.gov/blog/2012/07/05/reducing-asthma-disparities>
- <sup>311</sup> Office of Lead Hazard Control and Healthy Homes. (2018). *Guide to sustaining effective asthma home intervention programs*. U.S. Department of Housing and Urban Development. [https://www.hud.gov/sites/dfiles/HH/documents/HUD%20Asthma%20Guide%20Document\\_Final\\_7\\_18.pdf](https://www.hud.gov/sites/dfiles/HH/documents/HUD%20Asthma%20Guide%20Document_Final_7_18.pdf)
- <sup>312</sup> Krieger, J., Takaro, T. K., Song, L., Beaudet, N., & Edwards, K. (2009). A randomized controlled trial of asthma self-management support comparing clinic-based nurses and in-home community health workers. *Archives of Pediatrics & Adolescent Medicine*, 163(2), 141. <https://doi.org/10.1001/archpediatrics.2008.532>
- <sup>313</sup> Campbell, J. D., Brooks, M., Hosokawa, P., Robinson, J., Song, L., & Krieger, J. (2015). Community health worker home visits for Medicaid-enrolled children with asthma: Effects on asthma outcomes and costs. *American Journal of Public Health*, 105(11), 2366–2372. <https://doi.org/10.2105/ajph.2015.302685>
- <sup>314</sup> CDC Healthy Schools. (2018, December 12). *Strategies for addressing asthma within a coordinated school health program*. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention. <https://www.cdc.gov/healthyschools/asthma/strategies/asthmacsh.htm>
- <sup>315</sup> Harris, K., Kneale, D., Lasserson, T. J., McDonald, V. M., Grigg, J., & Thomas, J. (2019). School-based self-management interventions for asthma in children and adolescents: a mixed methods systematic review. *Cochrane Database of Systematic Reviews*. <https://doi.org/10.1002/14651858.cd011651.pub2>
- <sup>316</sup> Pappalardo, A. A., Paulson, A., Bruscatto, R., Thomas, L., Minier, M., & Martin, M. A. (2018). Chicago public school nurses examine barriers to school asthma care coordination. *Public Health Nursing*, 36(1), 36–44. <https://doi.org/10.1111/phn.12574>
- <sup>317</sup> Cicutto, L., Gleason, M., Haas-Howard, C., White, M., Hollenbach, J. P., Williams, S., McGinn, M., Villarreal, M., Mitchell, H., Cloutier, M. M., Vinick, C., Langton, C., Shocks, D. J., Stempel, D. A., & Szeffler, S. J. (2018). Building Bridges for Asthma Care Program: A school-centered program connecting schools, families, and community health-care providers. *The Journal of School Nursing*, 36(3), 168–180. <https://doi.org/10.1177/1059840518805824>
- <sup>318</sup> Lemanske, R. F., Kakumanu, S., Shanovich, K., Antos, N., Cloutier, M. M., Mazyck, D., Phipatanakul, W., Schantz, S., Szeffler, S., Vandlik, R., & Williams, P. (2016). Creation and implementation of SAMPRO™: A school-based asthma management program. *The Journal of Allergy and Clinical Immunology*, 138(3), 711–723. <https://doi.org/10.1016/j.jaci.2016.06.015>
- <sup>319</sup> Asthma and Allergy Foundation of America (2019). *2019 State honor roll of asthma and allergy policies for schools*. [www.statehonorroll.org](http://www.statehonorroll.org)
- <sup>320</sup> U.S. Environmental Protection Agency (2015). *Why indoor air quality is important to schools*. <https://www.epa.gov/iaq-schools/why-indoor-air-quality-important-schools>
- <sup>321</sup> American Society of Civil Engineers. (2017). *2017 Infrastructure report card: A comprehensive assessment of America's infrastructure*. <https://www.infrastructurereportcard.org/wp-content/uploads/2019/02/Full-2017-Report-Card-FINAL.pdf>
- <sup>322</sup> Majd, E., McCormack, M., Davis, M., Curriero, F., Berman, J., Connolly, F., Leaf, P., Rule, A., Green, T., Clemons-Erby, D., Gummerson, C., & Koehler, K. (2019). Indoor air quality in inner-city schools and its associations with building characteristics and environmental factors. *Environmental Research*, 170, 83–91. <https://doi.org/10.1016/j.envres.2018.12.012>

- <sup>323</sup> Allies Against Asthma. (2008). *Allies Against Asthma: Promoting asthma care for children*. University of Michigan. Retrieved June 9, 2020, from <http://www.asthma.umich.edu/>
- <sup>324</sup> Friedman, A. R., & Wicklund, K. (2006). Allies Against Asthma: A midstream comment on sustainability. *Health Promotion Practice, 7*(2\_suppl), 140S-148S. <https://doi.org/10.1177/1524839906287058>
- <sup>325</sup> Clark, N. M., L. Lachance, L., Benedict, M. B., Doctor, L. J., Gilmore, L., Kelly, C. S., Krieger, J., Lara, M., Meurer, J., Milanovich, A. F., Nicholas, E., Song, P. X. K., Rosenthal, M., Stoll, S. C., Awad, D. F., & Wilkin, M. (2013). Improvements in health care use associated with community coalitions: Long-term results of the Allies Against Asthma initiative. *American Journal of Public Health, 103*(6), 1124-1127. <https://doi.org/10.2105/AJPH.2012.300983>
- <sup>326</sup> Merck Childhood Asthma Network. (2015). *Translating evidence into practice: Merck Childhood Asthma Network impact report*. [https://www.asthmacommunitynetwork.org/sites/default/files/resource\\_files/mcan-short-report-109.pdf](https://www.asthmacommunitynetwork.org/sites/default/files/resource_files/mcan-short-report-109.pdf)
- <sup>327</sup> Merck Childhood Asthma Network. (2015). *Merck Childhood Asthma Network Care Coordination Initiative program sites*. [http://www.asthmacommunitynetwork.org/system/files/CareCoordsite\\_summaries.pdf](http://www.asthmacommunitynetwork.org/system/files/CareCoordsite_summaries.pdf)
- <sup>328</sup> Centers for Disease Control and Prevention. (2019, February 12). *YES WE CAN Children's Asthma Program - design and development*. U.S. Department of Health and Human Services. [https://www.cdc.gov/asthma/interventions/yes\\_we\\_can\\_design.htm](https://www.cdc.gov/asthma/interventions/yes_we_can_design.htm)
- <sup>329</sup> National Heart, Lung, and Blood Institute (NHLBI). (2015). *Asthma empowerment collaborations to reduce childhood asthma disparities*. U.S. Department of Health and Human Services, National Institutes of Health.. Retrieved June 9, 2020, from <https://grants.nih.gov/grants/guide/rfa-files/RFA-HL-17-001.html>
- <sup>330</sup> Woods, E. R., Bhaumik, U., Sommer, S. J., Chan, E., Tsopelas, L., Fleegler, E. W., Lorenzi, M., Klements, E. M., Dickerson, D. U., Nethersole, S., & Dulin, R. (2016). Community Asthma Initiative to improve health outcomes and reduce disparities among children with asthma. *MMWR Supplements, 65*(1), 11-20. <https://doi.org/10.15585/mmwr.su6501a4>
- <sup>331</sup> Ebell, M. H. (2019). A multicomponent, multi-trigger intervention to enhance asthma control in high-risk African American children. *Preventing Chronic Disease, 16*. <https://doi.org/10.5888/pcd16.180387>
- <sup>332</sup> Reese-Mclaughlin, N. (2019, December 19). *Models of asthma care: Successful state case studies*. Centers for Medicare & Medicaid Services. <https://www.medicaid.gov/medicaid/quality-of-care/downloads/asthma-studies-webinar.pdf>
- <sup>333</sup> American Public Health Association. (2019). *Creating the healthiest nation: Environmental justice for all*. [https://www.apha.org/-/media/files/pdf/factsheets/environmental\\_justice.ashx?la=en&hash=BF2694E6A2FC6707C373F1E1DC60243BF333CACE](https://www.apha.org/-/media/files/pdf/factsheets/environmental_justice.ashx?la=en&hash=BF2694E6A2FC6707C373F1E1DC60243BF333CACE)
- <sup>334</sup> Guarnieri, M., & Balmes, J. R. (2014). Outdoor air pollution and asthma. *The Lancet, 383*(9928), 1581-1592. [https://doi.org/10.1016/s0140-6736\(14\)60617-6](https://doi.org/10.1016/s0140-6736(14)60617-6)
- <sup>335</sup> Wright, R. J., & Subramanian, S. V. (2007). Advancing a multilevel framework for epidemiologic research on asthma disparities. *Chest, 132*(5), 757S-769S. <https://doi.org/10.1378/chest.07-1904>
- <sup>336</sup> Nardone, A., Neophytou, A. M., Balmes, J., & Thakur, N. (2018). Ambient air pollution and asthma-related outcomes in children of color of the United States: a scoping review of literature published between 2013 and 2017. *Current Allergy and Asthma Reports, 18*(5), 29. <https://doi.org/10.1007/s11882-018-0782-x>
- <sup>337</sup> D'Amato, G., Pawankar, R., Vitale, C., Lanza, M., Molino, A., Stanziola, A., Sanduzzi, A., Vatrella, A., & D'Amato, M. (2016). Climate change and air pollution: Effects on respiratory allergy. *Allergy, Asthma & Immunology Research, 8*(5), 391. <https://doi.org/10.4168/air.2016.8.5.391>
- <sup>338</sup> Thomas, K., Hardy, R. D., Lazrus, H., Mendez, M., Orlove, B., Rivera-Collazo, I., Roberts, J. T., Rockman, M., Warner, B. P., & Winthrop, R. (2018). Explaining differential vulnerability to climate change: A social science review. *Wiley Interdisciplinary Reviews: Climate Change, 10*(2). <https://doi.org/10.1002/wcc.565>
- <sup>339</sup> WE ACT for Environmental Justice. (n.d.). *Our story*. Retrieved July 28, 2020, from <https://www.weact.org/howeare/ourstory/>

- <sup>340</sup> WE ACT for Environmental Justice. (n.d.). *Coalition for Asthma Free Homes*. <https://www.weact.org/campaigns/cafh/>
- <sup>341</sup> Asthma and Allergy Foundation of America. (2018, January 25). *New York City passes bill to protect renters with asthma*. <https://community.aafa.org/blog/new-york-city-passes-bill-to-protect-renters-with-asthma>
- <sup>342</sup> CSTE. (n.d.). *Environmental health: Climate, health & equity subcommittee*. Retrieved July 28, 2020, from <https://www.cste.org/members/group.aspx?id=87587>
- <sup>343</sup> CSTE. (n.d.). *Climate & respiratory health workgroup*. Retrieved July 28, 2020, from <https://www.cste.org/page/ClimateResp>
- <sup>344</sup> Goodwin, S., & Plankey, A. (2019, November 11). *Ten years of the National Safe and Healthy Housing Coalition: Who we are now*. National Center for Healthy Housing. [https://nchh.org/2019/11/nshhc-at-10\\_3/](https://nchh.org/2019/11/nshhc-at-10_3/)
- <sup>345</sup> Chhiba, K. D., Patel, G. B., Vu, T. H. T., Chen, M. M., Guo, A., Kudlaty, E., Mai, Q., Yeh, C., Muhammad, L. N., Harris, K. E., Bochner, B. S., Grammer, L. C., Greenberger, P. A., Kalhan, R., Kuang, F. L., Saltoun, C. A., Schleimer, R. P., Stevens, W. W., & Peters, A. T. (2020). Prevalence and characterization of asthma in hospitalized and non-hospitalized patients with COVID-19. *Journal of Allergy and Clinical Immunology*. <https://doi.org/10.1016/j.jaci.2020.06.010>
- <sup>346</sup> Butler, M. W., O'Reilly, A., Dunican, E. M., Mallon, P., Feeney, E. R., Keane, M. P., & McCarthy, C. (2020). Prevalence of comorbid asthma in COVID-19 patients. *The Journal of Allergy and Clinical Immunology*. <https://doi.org/10.1016/j.jaci.2020.04.061>
- <sup>347</sup> Lieberman-Cribbin, W., Rapp, J., Alpert, N., Tuminello, S., & Taioli, E. (2020). The impact of asthma on mortality in patients with COVID-19. *Chest*. <https://doi.org/10.1016/j.chest.2020.05.575>
- <sup>348</sup> The COVID Tracking Project. (2020). *The COVID racial data tracker*. The Atlantic Monthly Group. <https://covidtracking.com/race>
- <sup>349</sup> Srikanth, A. (2020, May 19). *Navajo Nation under strict lockdown with highest coronavirus infection rate in the country*. TheHill. <https://thehill.com/changing-america/respect/diversity-inclusion/498517-navajo-nation-under-strict-lockdown-with-highest>
- <sup>350</sup> APM Research Lab. (2020, July 22). *COVID-19 deaths analyzed by race and ethnicity*. American Public Media. Retrieved August 3, 2020, from <https://www.apmresearchlab.org/covid/deaths-by-race#indigenous>
- <sup>351</sup> Duran, D. G., & Pérez-Stable, E. J. (2019). Novel Approaches to Advance Minority Health and Health Disparities Research. *American Journal of Public Health, 109*(S1), S8–S10. <https://doi.org/10.2105/ajph.2018.304931>
- <sup>352</sup> Kilbourne, A. M., Switzer, G., Hyman, K., Crowley-Matoka, M., & Fine, M. J. (2006). Advancing health disparities research within the health care system: a conceptual framework. *American journal of public health, 96*(12), 2113–2121. <https://doi.org/10.2105/AJPH.2005.077628>
- <sup>353</sup> Dye, B. A., Duran, D. G., Murray, D. M., Creswell, J. W., Richard, P., Farhat, T., Breen, N., & Engelgau, M. M. (2019). The importance of evaluating health disparities research. *American Journal of Public Health, 109*(S1), S34–S40. <https://doi.org/10.2105/AJPH.2018.304808>
- <sup>354</sup> National Heart, Lung, and Blood Institute. (n.d.) *Research Spectrum*. U.S. Department of Health and Human Services, National Institutes of Health. <https://www.nhlbi.nih.gov/science/research-spectrum>
- <sup>355</sup> National Institute of Environmental Health Sciences. (n.d.). *Translational research framework*. U.S. Department of Health and Human Services, National Institutes of Health. <https://www.niehs.nih.gov/research/programs/translational/framework-details/index.cfm>
- <sup>356</sup> National Institute on Minority Health and Health Disparities. (2019). *The 2020–2024 NIH minority health and health disparities strategic plan*. U.S. Department of Health and Human Services, National Institutes of Health. <https://www.nimhd.nih.gov/about/overview/strategic-plan.html>



- <sup>357</sup> National Institutes of Health. *NIH health disparities strategic plan and budget fiscal years 2009–2013*. U.S. Department of Health and Human Services. [https://www.nimhd.nih.gov/docs/2009-2013nih\\_health\\_disparities\\_strategic\\_plan\\_and\\_budget.pdf](https://www.nimhd.nih.gov/docs/2009-2013nih_health_disparities_strategic_plan_and_budget.pdf)
- <sup>358</sup> National Institute on Minority Health and Health Disparities. (2018). *Listening sessions report for the NIH-wide minority health and health disparities strategic plan*. U.S. Department of Health and Human Services, National Institutes of Health. <https://www.nimhd.nih.gov/docs/strategic-plan/community-report.pdf>
- <sup>359</sup> National Institute on Minority Health and Health Disparities. (n.d.). *NIMHD minority health and health disparities research framework*. U.S. Department of Health and Human Services, National Institutes of Health. <https://www.nimhd.nih.gov/about/overview/research-framework/>
- <sup>360</sup> President’s Task Force on Environmental Health Risks and Safety Risks to Children. (n.d.). *Asthma disparities*. U.S. Department of Health and Human Services, National Institutes of Health, National Institute of Environmental Health Sciences. <https://ptfceh.niehs.nih.gov/activities/asthma/index.htm>
- <sup>361</sup> Thibaut F. (2016). From basic research to personalized medicine. *Dialogues in clinical neuroscience*, 18(3), 231–232.
- <sup>362</sup> Oh, S. S., Galanter, J., Thakur, N., Pino-Yanes, M., Barcelo, N. E., White, M. J., de Bruin, D. M., Greenblatt, R. M., Bibbins-Domingo, K., Wu, A. H., Borrell, L. N., Gunter, C., Powe, N. R., & Burchard, E. G. (2015). Diversity in clinical and biomedical research: A promise yet to be fulfilled. *PLoS Medicine*, 12(12), e1001918. <https://doi.org/10.1371/journal.pmed.1001918>
- <sup>363</sup> Corren, J. (2013). Asthma phenotypes and endotypes: An evolving paradigm for classification. *Discovery Medicine*, 15(83), 243–249. <https://www.discoverymedicine.com/Jonathan-Corren/2013/04/26/asthma-phenotypes-and-endotypes-an-evolving-paradigm-for-classification/>
- <sup>364</sup> Hamilton, D., & Lehman, H. (2019). Asthma phenotypes as a guide for current and future biologic therapies. *Clinical Reviews in Allergy & Immunology*, 10.1007/s12016-019-08760-x. Advance online publication. <https://doi.org/10.1007/s12016-019-08760-x>
- <sup>365</sup> Desai, M., & Oppenheimer, J. (2016). Elucidating asthma phenotypes and endotypes: progress towards personalized medicine. *Annals of Allergy, Asthma & Immunology*, 116(5), 394–401. <https://doi.org/10.1016/j.anai.2015.12.024>
- <sup>366</sup> Wenzel, S. E. (2012). Asthma phenotypes: the evolution from clinical to molecular approaches. *Nature Medicine*, 18(5), 715–725. <https://doi.org/10.1038/nm.2678>
- <sup>367</sup> Wenzel, S. E., Schwartz, L. B., Langmack, E. L., Halliday, J. L., Trudeau, J. B., Gibbs, R. L., & Chu, H. W. (1999). Evidence that severe asthma can be divided pathologically into two inflammatory subtypes with distinct physiologic and clinical characteristics. *American Journal of Respiratory and Critical Care Medicine*, 160(3), 1001–1008. <https://doi.org/10.1164/ajrccm.160.3.9812110>
- <sup>368</sup> Gauthier, M., Ray, A., & Wenzel, S. E. (2015). Evolving concepts of asthma. *American Journal of Respiratory and Critical Care Medicine*, 192(6), 660–668. <https://doi.org/10.1164/rccm.201504-0763pp>
- <sup>369</sup> Wenzel, S. E., & Busse, W. W. (2007). Severe asthma: Lessons from the Severe Asthma Research Program. *Journal of Allergy and Clinical Immunology*, 119(1), 14–21. <https://doi.org/10.1016/j.jaci.2006.10.025>
- <sup>370</sup> Moore, W. C., Meyers, D. A., Wenzel, S. E., Teague, W. G., Li, H., Li, X., D’Agostino, R., Castro, M., Curran-Everett, D., Fitzpatrick, A. M., Gaston, B., Jarjour, N. N., Sorkness, R., Calhoun, W. J., Chung, K. F., Comhair, S. A. A., Dweik, R. A., Israel, E., Peters, S. P., ... Bleeker, E. R. (2010). Identification of asthma phenotypes using cluster analysis in the Severe Asthma Research Program. *American Journal of Respiratory and Critical Care Medicine*, 181(4), 315–323. <https://doi.org/10.1164/rccm.200906-0896oc>
- <sup>371</sup> Fitzpatrick, A. M., Teague, W. G., Meyers, D. A., Peters, S. P., Li, X., Li, H., Wenzel, S. E., Aujla, S., Castro, M., & Bacharier, L. B. (2011). Heterogeneity of severe asthma in childhood: Confirmation by cluster analysis of children in the National Institutes of Health/National Heart, Lung, and Blood Institute Severe Asthma Research Program. *Journal of Allergy and Clinical Immunology*, 127(2), 382–389.e13. <https://doi.org/10.1016/j.jaci.2010.11.015>

- <sup>372</sup> Loza, M. J., Adcock, I., Auffray, C., Chung, K. F., Djukanovic, R., Sterk, P. J., Susulic, V. S., Barnathan, E. S., Baribaud, F., Silkoff, P. E., & ADEPT and U-BIOPRED Investigators (2016). Longitudinally Stable, Clinically Defined Clusters of Patients with Asthma Independently Identified in the ADEPT and U-BIOPRED Asthma Studies. *Annals of the American Thoracic Society*, *13 Suppl 1*, S102–S103. <https://pubmed.ncbi.nlm.nih.gov/27027940/>
- <sup>373</sup> Chung, K. F., Wenzel, S. E., Brozek, J. L., Bush, A., Castro, M., Sterk, P. J., Adcock, I. M., Bateman, E. D., Bel, E. H., Bleecker, E. R., Boulet, L.-P., Brightling, C., Chanez, P., Dahlen, S.-E., Djukanovic, R., Frey, U., Gaga, M., Gibson, P., Hamid, Q., ... Teague, W. G. (2013). International ERS/ATS guidelines on definition, evaluation and treatment of severe asthma. *European Respiratory Journal*, *43*(2), 343–373. <https://doi.org/10.1183/09031936.00202013>
- <sup>374</sup> Holguin, F., Cardet, J. C., Chung, K. F., Diver, S., Ferreira, D. S., Fitzpatrick, A., Gaga, M., Kellermeyer, L., Khurana, S., Knight, S., McDonald, V. M., Morgan, R. L., Ortega, V. E., Rigau, D., Subbarao, P., Tonia, T., Adcock, I. M., Bleecker, E. R., Brightling, C., ... Bush, A. (2019). Management of severe asthma: a European Respiratory Society/American Thoracic Society guideline. *European Respiratory Journal*, *55*(1), 1900588. <https://doi.org/10.1183/13993003.00588-2019>
- <sup>375</sup> Bleecker, E. R., Menzies-Gow, A. N., Price, D. B., Bourdin, A., Sweet, S., Martin, A. L., Alacqua, M., & Tran, T. N. (2020). Systematic literature review of systemic corticosteroid use for asthma management. *American Journal of Respiratory and Critical Care Medicine*, *201*(3), 276–293. <https://doi.org/10.1164/rccm.201904-0903SO>
- <sup>376</sup> Allergy & Asthma Network. (2019). *OCS overexposed: Thinking beyond the burst*. <https://www.ocsoverexposed.com/>
- <sup>377</sup> Fitzpatrick, A. M., & Moore, W. C. (2017). Severe asthma phenotypes – how should they guide evaluation and treatment?. *The Journal of Allergy and Clinical Immunology: In Practice*, *5*(4), 901–908. <https://doi.org/10.1016/j.jaip.2017.05.015>
- <sup>378</sup> Wenzel, S. (2012). Severe asthma: from characteristics to phenotypes to endotypes. *Clinical & Experimental Allergy*, *42*(5), 650–658. <https://doi.org/10.1111/j.1365-2222.2011.03929.x>
- <sup>379</sup> Robinson, D., Humbert, M., Buhl, R., Cruz, A. A., Inoue, H., Korom, S., Hanania, N. A., & Nair, P. (2017). Revisiting Type 2-high and Type 2-low airway inflammation in asthma: current knowledge and therapeutic implications. *Clinical & Experimental Allergy*, *47*(2), 161–175. <https://doi.org/10.1111/cea.12880>
- <sup>380</sup> Svenningsen, S., & Nair, P. (2017). Asthma endotypes and an overview of targeted therapy for asthma. *Frontiers in Medicine*, *4*. <https://doi.org/10.3389/fmed.2017.00158>
- <sup>381</sup> Wenzel, S. E. (2006). Asthma: defining of the persistent adult phenotypes. *The Lancet*, *368*(9537), 804–813. [https://doi.org/10.1016/s0140-6736\(06\)69290-8](https://doi.org/10.1016/s0140-6736(06)69290-8)
- <sup>382</sup> Kuruvilla, M. E., Lee, F. E.-H., & Lee, G. B. (2018). Understanding Asthma Phenotypes, Endotypes, and Mechanisms of Disease. *Clinical Reviews in Allergy & Immunology*, *56*(2), 219–233. <https://doi.org/10.1007/s12016-018-8712-1>
- <sup>383</sup> Piuvezam, M. R., Ferreira, L. K. D. P., Monteiro, T. M., Vieira, G. C., & Roberto Bezerra-Santos, C. (2018). Severe Asthma: Updated Therapy Approach Based on Phenotype and Biomarker. *Asthma Diagnosis and Management - Approach Based on Phenotype and Endotype*. <https://doi.org/10.5772/intechopen.74775>
- <sup>384</sup> Stokes, J. R., & Casale, T. B. (2016). Characterization of asthma endotypes: implications for therapy. *Annals of Allergy, Asthma & Immunology*, *117*(2), 121–125. <https://doi.org/10.1016/j.anai.2016.05.016>
- <sup>385</sup> Fahy J. V. (2015). Type 2 inflammation in asthma--present in most, absent in many. *Nature reviews. Immunology*, *15*(1), 57–65. <https://doi.org/10.1038/nri3786>

- <sup>386</sup> Peters, M. C., Kerr, S., Dunican, E. M., Woodruff, P. G., Fajt, M. L., Levy, B. D., Israel, E., Phillips, B. R., Mauger, D. T., Comhair, S. A., Erzurum, S. C., Johansson, M. W., Jarjour, N. N., Coverstone, A. M., Castro, M., Hastie, A. T., Bleecker, E. R., Wenzel, S. E., & Fahy, J. V. (2019). Refractory airway type 2 inflammation in a large subgroup of asthmatic patients treated with inhaled corticosteroids. *Journal of Allergy and Clinical Immunology*, *143*(1), 104–113.e14. <https://doi.org/10.1016/j.jaci.2017.12.1009>
- <sup>387</sup> Dahlin, A., Sordillo, J. E., Ziniti, J., Iribarren, C., Lu, M., Weiss, S. T., Tantisira, K. G., Lu, Q., Kan, M., Himes, B. E., Jorgenson, E., & Wu, A. C. (2019). Large-scale, multiethnic genome-wide association study identifies novel loci contributing to asthma susceptibility in adults. *The Journal of Allergy and Clinical Immunology*, *143*(4), 1633–1635. <https://doi.org/10.1016/j.jaci.2018.11.037>
- <sup>388</sup> Consortium on Asthma Among African-Ancestry Populations in the Americas (CAAPA). (2012). National Institutes of Health, National Heart, Lung, and Blood Institute. <https://www.caapa-project.org/>
- <sup>389</sup> Mathias, R. A., Taub, M. A., Gignoux, C. R., Fu, W., Musharoff, S., O'Connor, T. D., Vergara, C., Torgerson, D. G., Pino-Yanes, M., Shringarpure, S. S., Huang, L., Rafaels, N., Boorgula, M. P., Johnston, H. R., Ortega, V. E., Levin, A. M., Song, W., Torres, R., Padhukasahasram, B., ... Barnes, K. C. (2016). A continuum of admixture in the Western Hemisphere revealed by the African Diaspora genome. *Nature Communications*, *7*(1). <https://doi.org/10.1038/ncomms12522>
- <sup>390</sup> Daya, M., Rafaels, N., Brunetti, T. M., Chavan, S., Levin, A. M., Shetty, A., Gignoux, C. R., Boorgula, M. P., Wojcik, G., Campbell, M., Vergara, C., Torgerson, D. G., Ortega, V. E., Doumatey, A., Johnston, H. R., Acevedo, N., Araujo, M. I., Avila, P. C., Belbin, G., ... Barnes, K. C. (2019). Association study in African-admixed populations across the Americas recapitulates asthma risk loci in non-African populations. *Nature Communications*, *10*(1). <https://doi.org/10.1038/s41467-019-08469-7>
- <sup>391</sup> PRIMERO Research. (n.d.). *About PRIMERO*. <https://www.primerobirthcohort.com/about-primero>
- <sup>392</sup> Borrell, L. N. (2005). Racial identity among Hispanics: Implications for health and well-being. *American Journal of Public Health*, *95*(3), 379–381. <https://doi.org/10.2105/ajph.2004.058172>
- <sup>393</sup> Bentley, A. R., Callier, S., & Rotimi, C. N. (2017). Diversity and inclusion in genomic research: why the uneven progress?. *Journal of community genetics*, *8*(4), 255–266. <https://doi.org/10.1007/s12687-017-0316-6>
- <sup>394</sup> Kabesch, M., & Tost, J. (2020). Recent findings in the genetics and epigenetics of asthma and allergy. *Seminars in immunopathology*, *42*(1), 43–60. <https://doi.org/10.1007/s00281-019-00777-w>
- <sup>395</sup> White House Office of the Press Secretary. (2015, January 30). *Fact sheet: President Obama's Precision Medicine Initiative*. The White House: President Barack Obama. <https://obamawhitehouse.archives.gov/the-press-office/2015/01/30/fact-sheet-president-obama-s-precision-medicine-initiative>
- <sup>396</sup> Precision Medicine Initiative Working Group. (2015, September 17). *The precision medicine initiative cohort program—building a research foundation for 21st century medicine*. U.S. Department of Health and Human Services, National Institutes of Health. <https://www.nih.gov/sites/default/files/research-training/initiatives/pmi/pmi-working-group-report-20150917-2.pdf>.
- <sup>397</sup> National Heart, Lung, and Blood Institute. (2014). *Trans-Omics for Precision Medicine (TOPMed) Program*. U.S. Department of Health and Human Services, National Institutes of Health. <https://www.nhlbi.nih.gov/science/trans-omics-precision-medicine-topmed-program>
- <sup>398</sup> NHLBI Tans-Omics for Precision Medicine (2020, August 10). *About TOPMed*. U.S. Department of Health and Human Services, National Institutes of Health, National Heart, Lung, and Blood Institute. <https://www.nhlbiwgs.org/>
- <sup>399</sup> Wu, A. C., Kiley, J. P., Noel, P. J., Amur, S., Burchard, E. G., Clancy, J. P., Galanter, J., Inada, M., Jones, T. K., Kropski, J. A., Loyd, J. E., Nogee, L. M., Raby, B. A., Rogers, A. J., Schwartz, D. A., Sin, D. D., Spira, A., Weiss, S. T., Young, L. R., & Himes, B. E. (2018). Current Status and Future Opportunities in Lung Precision Medicine Research with a Focus on Biomarkers. An American Thoracic Society/National Heart, Lung, and Blood Institute Research Statement. *American journal of respiratory and critical care medicine*, *198*(12), e116–e136. <https://doi.org/10.1164/rccm.201810-1895ST>

- <sup>400</sup> U.S. Food and Drug Administration. (2020). *Drug trial snapshots*. U.S. Department of Health and Human Services. <https://www.fda.gov/drugs/drug-approvals-and-databases/drug-trials-snapshots>
- <sup>401</sup> U.S. Food and Drug Administration. (2020). *Enhancing the diversity of clinical trial populations – eligibility criteria, enrollment practices, and trial designs guidance for industry*. U.S. Department of Health and Human Services. <https://www.fda.gov/regulatory-information/search-fda-guidance-documents/enhancing-diversity-clinical-trial-populations-eligibility-criteria-enrollment-practices-and-trial>
- <sup>402</sup> Durant, R. W., Wenzel, J. A., Scarinci, I. C., Paterniti, D. A., Fouad, M. N., Hurd, T. C., & Martin, M. Y. (2014). Perspectives on barriers and facilitators to minority recruitment for clinical trials among cancer center leaders, investigators, research staff, and referring clinicians: Enhancing minority participation in clinical trials (EMPaCT). *Cancer*, *120*, 1097–1105. <https://doi.org/10.1002/cncr.28574>
- <sup>403</sup> George, S., Duran, N., & Norris, K. (2014). A systematic review of barriers and facilitators to minority research participation among African Americans, Latinos, Asian Americans, and Pacific Islanders. *American Journal of Public Health*, *104*(2), e16–e31. <https://doi.org/10.2105/ajph.2013.301706>
- <sup>404</sup> Wendler, D., Kington, R., Madans, J., Wye, G. V., Christ-Schmidt, H., Pratt, L. A., Brawley, O. W., Gross, C. P., & Emanuel, E. (2005). Are racial and ethnic minorities less willing to participate in health research? *PLoS Medicine*, *3*(2), e19. <https://doi.org/10.1371/journal.pmed.0030019>
- <sup>405</sup> Powe, N.R., & Gary, T.L. (2004) Clinical trials. In: B.M. Beech & M. Goodman (Eds.), *Race & research: Perspectives on minority participation in health studies*. (pp. 61–78). American Public Health Association Press.
- <sup>406</sup> Johnson, V. A., Edwards, K. A., Sherman, S. L., Stephens, L. D., Williams, W., Adair, A., & Deer-Smith, M. H. (2009). Decisions to participate in fragile X and other genomics-related research: Native American and African American voices. *Journal of Cultural Diversity*, *16*(3), 127–135. <https://pubmed.ncbi.nlm.nih.gov/19824292/>
- <sup>407</sup> Office of Minority Health. (2016, October 26). *Collection of race and ethnicity data in clinical trials: Guidance for industry and Food and Drug Administration Staff*. U.S. Department of Health and Human Services. <https://www.fda.gov/media/75453/download>
- <sup>408</sup> National Minority Quality Forum. (2019). *About the forum*. <https://www.nmqf.org/about>
- <sup>409</sup> National Minority Quality Forum. (2020). *NMQF Leadership Summit on Health Disparities and Health Braintrust*. <https://www.nmqf.org/nmqf-events/2020annualsummit>
- <sup>410</sup> National Minority Quality Forum. (2019). *The National Health Index*. <https://www.nmqf.org/nmqf-indexes/cardiovascular-disease-index-bwbd3>
- <sup>411</sup> Truman, B.I., Smith, C.K., Roy, K., Chen, Z., Moonesinghe, R., Zhu, J., Gotway Crawford, C., & Zaza, S. (2011). *Rationale for regular reporting on health disparities and inequalities – United States*. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention. <https://www.cdc.gov/mmWR/preview/mmwrhtml/su6001a2.htm>
- <sup>412</sup> Dorsey, R., Graham, G., Glied, S., Meyers, D., Clancy, C., & Koh, H. (2014). Implementing health reform: Improved data collection and the monitoring of health disparities. *Annual Review of Public Health*, *35*(1), 123–138. <https://doi.org/10.1146/annurev-publhealth-032013-182423>
- <sup>413</sup> Subcommittee on Standardized Collection of Race/Ethnicity Data for Healthcare Quality Improvement. (2009). *Race, ethnicity, and language data: Standardization for health care quality improvement*. Institute of Medicine. <https://www.ahrq.gov/sites/default/files/publications/files/iomracereport.pdf>
- <sup>414</sup> Dorsey, R. (2016). The Department of Health and Human Services Action Plan to Reduce Racial and Ethnic Health Disparities: A Commentary on data needs to monitor progress toward health equity. *Health Systems and Policy Research*, *03*(04). <https://doi.org/10.21767/2254-9137.100053>



- <sup>415</sup> Office of Minority Health. (2015). *HHS Action Plan to Reduce Racial and Ethnic Health Disparities: Implementation progress report 2011–2014*. U.S. Department of Health and Human Services. <https://aspe.hhs.gov/system/files/pdf/206166/DisparitiesActionPlan.pdf>
- <sup>416</sup> Agency for Healthcare Research and Quality. (2012). *Improving data collection across the health care system*. U.S. Department of Health and Human Services. <https://www.ahrq.gov/research/findings/final-reports/iomracereport/reldata5.html>
- <sup>417</sup> Regenstein, M., & Sickler, D. (2006). *Race, ethnicity, and language of patients: hospital practices regarding collection of information to address disparities in health care*. National Public Health and Hospital Institute. [https://hsrc.himmelfarb.gwu.edu/cgi/viewcontent.cgi?referer=https://scholar.google.com/&httpsredir=1&article=1203&context=sphhs\\_policy\\_facpubs](https://hsrc.himmelfarb.gwu.edu/cgi/viewcontent.cgi?referer=https://scholar.google.com/&httpsredir=1&article=1203&context=sphhs_policy_facpubs)
- <sup>418</sup> National Research Council. (2009). *Principles and practices for a federal statistical agency: Fourth edition*. Edited by C. F. Citro, M. E. Martin and M. L. Straf. Washington, DC: The National Academics Press.
- <sup>419</sup> Moy, E., Arispe, I. E., Holmes, J. S., & Andrews, R. M. (2005). Preparing the National Healthcare Disparities Report: Gaps in data for assessing racial, ethnic, and socioeconomic disparities in health care. *Medical Care*, 43(3), 19–116. [https://www.jstor.org/stable/3768233?seq=7#metadata\\_info\\_tab\\_contents](https://www.jstor.org/stable/3768233?seq=7#metadata_info_tab_contents)
- <sup>420</sup> Bilheimer, L. T., & Klein, R. J. (2010). Data and measurement issues in the analysis of health disparities. *Health Services Research*, 45(5p2), 1489–1507. <https://doi.org/10.1111/j.1475-6773.2010.01143.x>
- <sup>421</sup> Johnson, P. J., Blewett, L. A., & Davern, M. (2010). Disparities in public use data availability for race, ethnic, and immigrant groups. *Medical Care*, 48(12), 1122–1127. <https://doi.org/10.1097/mlr.0b013e3181ef984e>
- <sup>422</sup> Busse, W. W., Morgan, W. J., Taggart, V., & Togias, A. (2012). Asthma outcomes workshop: overview. *The Journal of Allergy and Clinical Immunology*, 129(3 Suppl), S1–S8. <https://doi.org/10.1016/j.jaci.2011.12.985>
- <sup>423</sup> Standards Subcommittee of the Asthma Disparities Workgroup. (2016). *Measures to identify and track racial disparities in childhood asthma: Asthma Disparities Workgroup Subcommittee recommendations*. National Institutes of Health, National Institute of Environmental Health Sciences. [https://www.cdc.gov/asthma/pdfs/Racial\\_Disparities\\_in\\_Childhood\\_Asthma.pdf](https://www.cdc.gov/asthma/pdfs/Racial_Disparities_in_Childhood_Asthma.pdf)
- <sup>424</sup> Rubio, D. M., Schoenbaum, E. E., Lee, L. S., Scheingart, D. E., Marantz, P. R., Anderson, K. E., Platt, L. D., Baez, A., & Esposito, K. (2010). Defining translational research: implications for training. *Academic Medicine*, 85(3), 470–475. <https://doi.org/10.1097/ACM.0b013e3181ccd618>
- <sup>425</sup> Apiou-Sbirlea, G., Tearney, G.J., Birngruber, R., Hasan, T., & Rox Anderson, R. (2015). Anatomy and physiology of translation: the academic research imperative. *Clinical Investigation*, 5(10). [https://www.bmo.uni-luebeck.de/fileadmin/files/publications/Translation\\_Apiou-Sbirlea\\_2015\\_03.pdf](https://www.bmo.uni-luebeck.de/fileadmin/files/publications/Translation_Apiou-Sbirlea_2015_03.pdf)
- <sup>426</sup> Woolf, S. H. (2008). The meaning of translational research and why it matters. *JAMA*, 299(2). <https://doi.org/10.1001/jama.2007.26>
- <sup>427</sup> Levy, B. D., Noel, P. J., Freemer, M. M., Cloutier, M. M., Georas, S. N., Jarjour, N. N., Ober, C., Woodruff, P. G., Barnes, K. C., Bender, B. G., Camargo, C. A., Chupp, G. L., Denlinger, L. C., Fahy, J. V., Fitzpatrick, A. M., Fuhlbrigge, A., Gaston, B. M., Hartert, T. V., Kolls, J. K., ... Erzurum, S. C. (2015). Future research directions in asthma: An NHLBI working group report. *American Journal of Respiratory and Critical Care Medicine*, 192(11), 1366–1372. <https://doi.org/10.1164/rccm.201505-0963WS>
- <sup>428</sup> Herman, E. J., Garbe, P. L., & McGeehin, M. A. (2011). Assessing Community-Based Approaches to Asthma Control: The Controlling Asthma in American Cities Project. *Journal of Urban Health*, 88(S1), 1–6. <https://doi.org/10.1007/s11524-010-9480-2>

- <sup>429</sup> Bender, B. G., Krishnan, J. A., Chambers, D. A., Cloutier, M. M., Riekert, K. A., Rand, C. S., Schatz, M., Thomson, C. C., Wilson, S. R., Apter, A., Carson, S. S., George, M., Gerald, J. K., Gerald, L., Goss, C. H., Okelo, S. O., Mularski, R. A., Nguyen, H. Q., Patel, M. R., ... Freemer, M. (2015). American Thoracic Society and National Heart, Lung, and Blood Institute Implementation Research Workshop Report. *Annals of the American Thoracic Society*, 12(12), S213–S221. <https://doi.org/10.1513/annalsats.201506-367ot>
- <sup>430</sup> Gillissen, A. (2004). Managing asthma in the real world. *International Journal of Clinical Practice*, 58(6), 592–603. <https://doi.org/10.1111/j.1368-5031.2004.00182.x>
- <sup>431</sup> Peters, D.H., Tran, N/T., & Adam, T. (2013). *Implementation research in health: a practical guide*. Alliance for Health Policy and Systems Research, World Health Organization. [https://www.who.int/alliance-hpsr/alliancehpsr\\_irpguide.pdf?ua=1](https://www.who.int/alliance-hpsr/alliancehpsr_irpguide.pdf?ua=1)
- <sup>432</sup> Proctor, E., Silmere, H., Raghavan, R., Hovmand, P., Aarons, G., Bunger, A., Griffey, R., & Hensley, M. (2010). Outcomes for Implementation Research: Conceptual Distinctions, Measurement Challenges, and Research Agenda. *Administration and Policy in Mental Health and Mental Health Services Research*, 38(2), 65–76. <https://doi.org/10.1007/s10488-010-0319-7>
- <sup>433</sup> Busse, W. W. (2010). The National Institutes of Allergy and Infectious Diseases Networks on asthma in inner city children: An approach to improved care. *The Journal of Allergy and Clinical Immunology*, 125(3), 529–539. <https://doi.org/10.1016/j.jaci.2010.01.036>
- <sup>434</sup> Kennedy, S., Bailey, R., Jaffee, K., Markus, A., Gerstein, M., Stevens, D. M., Lesch, J. K., Malveaux, F. J., & Mitchell, H. (2017). Effectiveness of evidence-based asthma interventions. *Pediatrics*, 139(6), e20164221. <https://doi.org/10.1542/peds.2016-4221>
- <sup>435</sup> Chulada, P. C., Kennedy, S., Mvula, M. M., Jaffee, K., Wildfire, J., Thornton, E., Cohn, R. D., Grimsley, L. F., Mitchell, H., El-Dahr, J., Sterling, Y., Martin, W. J., White, L., Stephens, K. U., & Lichtveld, M. (2012). The Head-off Environmental Asthma in Louisiana (HEAL) study--methods and study population. *Environmental health perspectives*, 120(11), 1592–1599. <https://doi.org/10.1289/ehp.1104239>
- <sup>436</sup> Baltimore City Health Department (2013). *Clinical innovations: Reducing Asthma Disparities (RAD)*. Maryland Department of Health. <https://health.maryland.gov/innovations/Pages/reducingasthmadisparities.aspx>
- <sup>437</sup> Brown, A. F., Ma, G. X., Miranda, J., Eng, E., Castille, D., Brockie, T., Jones, P., Airhihenbuwa, C. O., Farhat, T., Zhu, L., & Trinh-Shevrin, C. (2019). Structural interventions to reduce and eliminate health disparities. *American Journal of Public Health*, 109(S1), S72–S78. <https://doi.org/10.2105/AJPH.2018.304844>
- <sup>438</sup> Wasserman, J., Palmer, R. C., Gomez, M. M., Berzon, R., Ibrahim, S. A., & Ayanian, J. Z. (2019). Advancing health services research to eliminate health care disparities. *American journal of public health*, 109(S1), S64–S69. <https://doi.org/10.2105/AJPH.2018.304922>
- <sup>439</sup> Alliance for Health Policy and Systems Research. (2007). *What is health policy and systems research and why does it matter?* World Health Organization. <https://www.who.int/alliance-hpsr/resources/Alliance%20HPSR%20-%20Briefing%20Note%201.pdf?ua=1>
- <sup>440</sup> Graham, G. (2007). Improving the system: The role of public health systems research in improving the health of all Americans. *Journal of Public Health Management and Practice*, 13(2), 95–96. [https://journals.lww.com/jphmp/Fulltext/2007/03000/Improving\\_the\\_System\\_\\_The\\_Role\\_of\\_Public\\_Health.3.aspx](https://journals.lww.com/jphmp/Fulltext/2007/03000/Improving_the_System__The_Role_of_Public_Health.3.aspx)
- <sup>441</sup> Farmer, S., McStay, F., George, M., McClellan, M., & Sennett, C. (2015). *Community based approaches for optimal asthma outcomes and accountable population health*. Center for Health Policy at Brookings and the Asthma and Allergy Foundation of America. <https://www.aafa.org/media/1535/aafa-brookings-report-2015.pdf>
- <sup>442</sup> Wallerstein N & Duran B. (2003). The conceptual, historical, and practice roots of community based participatory arch and related participatory traditions. In M. Minkler & N. Wallerstein, *Community-based participatory research for health*, (pp.27-52). Jossey-Bass.

- <sup>443</sup> Patient-Centered Outcomes Research Institute. (2019, June 27). *Our vision & mission*. <https://www.pcori.org/about-us/our-vision-mission>
- <sup>444</sup> Patient-Centered Outcomes Research Institute. (2014). *Engagement rubric for applicants*. <https://www.pcori.org/sites/default/files/Engagement-Rubric.pdf>
- <sup>445</sup> Patient-Centered Outcomes Research Institute (PCORI) Methodology Committee. (2019). *PCORI methodology report*. Patient-Centered Outcomes Research Institute. <https://www.pcori.org/sites/default/files/PCORI-Methodology-Report.pdf>
- <sup>446</sup> Duffett, L. (2017). Patient engagement: What partnering with patient in research is all about. *Thrombosis Research, 150*, 113–120. <https://doi.org/10.1016/j.thromres.2016.10.029>
- <sup>447</sup> Shelef, D. Q., Rand, C., Streisand, R., Horn, I. B., Yadav, K., Stewart, L., Fousheé, N., Waters, D., & Teach, S. J. (2016). Using stakeholder engagement to develop a patient-centered pediatric asthma intervention. *The Journal of Allergy and Clinical Immunology, 138*(6), 1512–1517. <https://doi.org/10.1016/j.jaci.2016.10.001>
- <sup>448</sup> Cukor, D., Cohen, L. M., Cope, E. L., Ghahramani, N., Hedayati, S. S., Hynes, D. M., Shah, V. O., Tentori, F., Unruh, M., Bobelu, J., Cohen, S., Dember, L. M., Faber, T., Fischer, M. J., Gallardo, R., Germain, M. J., Ghahate, D., Grote, N., Hartwell, L., ... Mehrotra, R. (2016). Patient and other stakeholder engagement in Patient-Centered Outcomes Research Institute funded studies of patients with kidney diseases. *Clinical Journal of the American Society of Nephrology, 11*(9), 1703–1712. <https://doi.org/10.2215/CJN.09780915>
- <sup>449</sup> Wennerstrom, A., Springgate, B. F., Jones, F., Meyers, D., Henderson, N., Brown, A., Niyogi, A., Martin, D., Smith, J., Kirkland, A. L., Jones, L., & Norris, K. C. (2018). Lessons on patient and stakeholder engagement strategies for pipeline to proposal awards. *Ethnicity & Disease, 28*(Suppl 2), 303–310. <https://doi.org/10.18865/ed.28.S2.303>
- <sup>450</sup> Forsythe, L. P., Carman, K. L., Szydowski, V., Fayish, L., Davidson, L., Hickam, D. H., Hall, C., Bhat, G., Neu, D., Stewart, L., Jalowsky, M., Aronson, N., & Anyanwu, C. U. (2019). Patient engagement in research: Early findings from the Patient-Centered Outcomes Research Institute. *Health Affairs, 38*(3), 359–367. <https://doi.org/10.1377/hlthaff.2018.05067>
- <sup>451</sup> Agency for Healthcare Research and Quality (AHRQ). (2016). *2015 National Healthcare Quality and Disparities Report and 5th anniversary update on the National Quality Strategy*. U.S. Department of Health and Human Services. <https://www.ahrq.gov/sites/default/files/wysiwyg/research/findings/nhqdr/nhqdr15/2015nhqdr.pdf>
- <sup>452</sup> Cohen, J. J., Gabriel, B. A., & Terrell, C. (2002). The Case For Diversity In The Health Care Workforce. *Health Affairs, 21*(5), 90–102. <https://doi.org/10.1377/hlthaff.21.5.90>
- <sup>453</sup> Kang, K. (2019). *Survey of earned doctorates*. National Center for Science and Engineering Statistics, National Science Foundation. <https://nces.nsf.gov/pubs/nsf20301/data-tables/>
- <sup>454</sup> Association of American Medical Colleges. (2019). *Total U.S. medical school enrollment by race/ethnicity (alone) and sex, 2015–2016 through 2019–2020*. [https://www.aamc.org/system/files/2019-11/2019\\_FACTS\\_Table\\_B-3.pdf](https://www.aamc.org/system/files/2019-11/2019_FACTS_Table_B-3.pdf)
- <sup>455</sup> Samuel, L. (2019, June 17). *As medical schools diversify, they're learning hard lessons along the way*. STAT. <https://www.statnews.com/2019/06/17/medical-schools-diversity-hard-lessons/>
- <sup>456</sup> Boatright, D. H., Samuels, E. A., Cramer, L., Cross, J., Desai, M., Latimore, D., & Gross, C. P. (2018). Association between the Liaison Committee on Medical Education's diversity standards and changes in percentage of medical student sex, race, and ethnicity. *JAMA, 320*(21), 2267–2269. <https://doi.org/10.1001/jama.2018.13705>
- <sup>457</sup> Dyrbye, L. N., Thomas, M. R., Eacker, A., Harper, W., Massie, F. S., Power, D. V., Huschka, M., Novotny, P. J., Sloan, J. A., & Shanafelt, T. D. (2007). Race, ethnicity, and medical student well-being in the United States. *Archives of Internal Medicine, 167*(19), 2103–2109. <https://doi.org/10.1001/archinte.167.19.2103>

- <sup>458</sup> Tsai, J. (2018, July 12). *Diversity and inclusion in medical schools: The reality*. Scientific American Blog Network. <https://blogs.scientificamerican.com/voices/diversity-and-inclusion-in-medical-schools-the-reality/>
- <sup>459</sup> Beech, B. M., Calles-Escandon, J., Hairston, K. G., Langdon, S. E., Latham-Sadler, B. A., & Bell, R. A. (2013). Mentoring programs for underrepresented minority faculty in academic medical centers. *Academic Medicine, 88*(4), 541–549. <https://doi.org/10.1097/acm.0b013e31828589e3>
- <sup>460</sup> Johnson, M. O., & Gandhi, M. (2014). A mentor training program improves mentoring competency for researchers working with early-career investigators from underrepresented backgrounds. *Advances in Health Sciences Education, 20*(3), 683–689. <https://doi.org/10.1007/s10459-014-9555-z>
- <sup>461</sup> Valentine, H. A., Lund, P. K., & Gammie, A. E. (2016). From the NIH: A systems approach to increasing the diversity of the biomedical research workforce. *CBE—Life Sciences Education, 15*(3), fe4. <https://doi.org/10.1187/cbe.16-03-0138>
- <sup>462</sup> Fabris, F., Rice, T., Jeffe, D. B., Czajkowski, S., Boyington, J., & Boutjdir, M. (2016). Career development of junior faculty through a NHLBI program to increase diversity in cardiovascular health-related research. *Journal of the American College of Cardiology, 67*(19), 2312–2313. <https://doi.org/10.1016/j.jacc.2016.01.087>
- <sup>463</sup> Friends of PCORI Reauthorization. (2019, May 13). *Letter of support*. <https://www.aafa.org/media/2430/aafa-sign-on-letters-pcori-reauthorization-senate-house.pdf>
- <sup>464</sup> Healthy People 2020. (2017). *Overview of midcourse progress and health disparities contents*. Centers for Disease Control and Prevention. <https://www.cdc.gov/nchs/data/hpdata2020/HP2020MCR-B03-Overview.pdf>
- <sup>465</sup> Espinosa, O., Coffee-Borden, B., Bakos, A., & Nweke, O. (2017). Implementation of the National Partnership for Action to End Health Disparities: A Three-Year Retrospective. *Journal of Health Disparities Research and Practice, 9*(6). <https://digitalscholarship.unlv.edu/jhdrp/vol9/iss6/3/>
- <sup>466</sup> National Prevention Council. (2011). *National Prevention Strategy*. <https://www.hhs.gov/sites/default/files/disease-prevention-wellness-report.pdf>
- <sup>467</sup> U.S. Department of Health and Human Services. (2015). *HHS Action Plan to Reduce Racial and Ethnic Health Disparities: Implementation progress report 2011–2014*. <https://aspe.hhs.gov/system/files/pdf/206166/DisparitiesActionPlan.pdf>
- <sup>468</sup> Conway, J., Johnson, B., Edgman-Levitan, S., Schlucter, J., Ford, D., Sodomka, P., & Simmons, L. (2006). *Partnering with patients and families to design a patient- and family-centered health care system: A roadmap for the future*. Institute for Family-Centered Care and Institute for Healthcare Improvement. <http://www.ihc.org/resources/Pages/Publications/PartneringwithPatientsandFamilies.aspx>
- <sup>469</sup> Renedo, A., Marston, C. A., Spyridonidis, D., & Barlow, J. (2014). Patient and public involvement in healthcare quality improvement: How organizations can help patients and professionals to collaborate. *Public Management Review, 17*(1), 17–34. <https://doi.org/10.1080/14719037.2014.881535>
- <sup>470</sup> Johnson, R. L., Roter, D., Powe, N. R., & Cooper, L. A. (2004). Patient race/ethnicity and quality of patient-physician communication during medical visits. *American Journal of Public Health, 94*(12), 2084–2090. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1448596/>
- <sup>471</sup> Selby, J. V., Beal, A. C., & Frank, L. (2012). The Patient-Centered Outcomes Research Institute (PCORI) national priorities for research and initial research agenda. *JAMA, 307*(15), 1583–1584. <https://doi.org/10.1001/jama.2012.500>



- <sup>472</sup> Center for Drug Evaluation and Research. (2019). *Externally-led Patient-Focused Drug Development meetings*. U.S. Food and Drug Administration. <https://www.fda.gov/industry/prescription-drug-user-fee-amendments/externally-led-patient-focused-drug-development-meetings>
- <sup>473</sup> More Than Skin Deep Initiative. (2020). *Understanding the lived experience of eczema: The “voice of the patient” report on the eczema patient-focused drug development meeting*. [http://www.morethanskindeep-eczema.org/uploads/1/2/5/3/125377765/mtsd\\_report\\_-\\_digital\\_file.pdf](http://www.morethanskindeep-eczema.org/uploads/1/2/5/3/125377765/mtsd_report_-_digital_file.pdf)
- <sup>474</sup> Richards, D. P., Jordan, I., Strain, K., & Press, Z. (2018). Patient partner compensation in research and health care: the patient perspective on why and how. *Patient Experience Journal*, 5(3), 6–12. <https://doi.org/10.35680/2372-0247.1334>
- <sup>475</sup> Patient-Centered Outcomes Research Institute. (2015, June 10). *Financial compensation of patients, caregivers, and patient/caregiver organizations engaged in PCORI-funded research as engaged research partners*. <https://www.pcori.org/sites/default/files/PCORI-Compensation-Framework-for-Engaged-Research-Partners.pdf>
- <sup>476</sup> Johnson, B., Abraham, M., Conway, J., Simmons, L., Edgman-Levitan, S., Sodomka, P., Schlucter, J., & Ford, D. (2008). *Partnering with patients and families to design a patient- and family-centered health care system: Recommendations and promising practices*. Institute for Family-Centered Care and Institute for Healthcare Improvement. <http://www.ihc.org/resources/Pages/Publications/PartneringwithPatientsandFamiliesRecommendationsPromisingPractices.aspx>
- <sup>477</sup> Sokol-Hessner, L., Folcarelli, P. H., Annas, C. L., Brown, S. M., Fernandez, L., Roche, S. D., Sarnoff Lee, B., Sands, K. E., Atlas, T., Benoit, D. D., Burke, G. F., Butler, T. P., Federico, F., Gandhi, T., Geller, G., Hickson, G. B., Hoying, C., Lee, T. H., Reynolds, M. E., ... Turner, K. (2018). A road map for advancing the practice of respect in health care: The results of an interdisciplinary modified delphi consensus study. *The Joint Commission Journal on Quality and Patient Safety*, 44(8), 463–476. <https://doi.org/10.1016/j.jcjq.2018.02.003>
- <sup>478</sup> Institute of Medicine Roundtable on Health Disparities. (2008). *Challenges and successes in reducing health disparities: Workshop summary*. National Academies Press. <https://www.ncbi.nlm.nih.gov/books/NBK215371/>
- <sup>479</sup> Ochoa, E. R., & Nash, C. (2009). Community engagement and its impact on child health disparities: Building Blocks, examples, and resources. *Pediatrics*, 124(Supplement 3), S237–S245. <https://doi.org/10.1542/peds.2009-1100L>
- <sup>480</sup> Scharff, D. P., Mathews, K. J., Jackson, P., Hoffsuemmer, J., Martin, E., & Edwards, D. (2010). More than Tuskegee: understanding mistrust about research participation. *Journal of health care for the poor and underserved*, 21(3), 879–897. <https://doi.org/10.1353/hpu.0.0323>
- <sup>481</sup> Chen, P. G., Diaz, N., Lucas, G., & Rosenthal, M. S. (2010). Dissemination of results in community-based participatory research. *American Journal of Preventive Medicine*, 39(4), 372–378. <https://doi.org/10.1016/j.amepre.2010.05.021>
- <sup>482</sup> Newman, M.S. (2019, May 20). *Why racial disparities in asthma are an urban planning issue*. Next City. <https://nextcity.org/features/view/why-racial-disparities-in-asthma-are-an-urban-planning-issue>



# APPENDIX – SUPPLEMENTAL TABLES

## SUPPLEMENTAL TABLES

Table S1. Current Asthma Prevalence . . . . .	254
Table S2. Lifetime Asthma Prevalence . . . . .	255
Table S3. Asthma Attack Prevalence . . . . .	256
Table S4. Asthma-Related Deaths . . . . .	257
Table S5. Asthma-Related Physician Office Visits . . . . .	257
Table S6. Asthma-Related Emergency Departments Visits . . . . .	258
Table S7. Asthma-Related Hospital Inpatient Rates . . . . .	258
Table S8. Uninsured Rates (Age 0-64) . . . . .	259
Table S9. Medicaid Coverage Rates (Age 0-64) . . . . .	260
Table S10. Poverty Status . . . . .	261
Table S11. Unemployment Rates . . . . .	261
Table S12. Median Weekly Earnings . . . . .	262
Table S13. High School Graduation Rates . . . . .	263
Table S14. Homeownership Rates . . . . .	263

Table S1. Current Asthma Prevalence by Race, Ethnicity, and Poverty Level

	2010	2011	2012	2013	2014	2015	2016	2017	2018
	Percent of Population								
<b>Total</b>	8.5	8.5	8.3	7.3	7.7	7.8	8.3	7.9	7.7
<b>Black (all ages)</b>	12.1	11.6	11.9	9.9	9.9	10.3	11.6	10.1	10.6
<b>Black (children)</b>	15.9	16.3	16	13.4	13.4	13.4	15.7	12.6	14.3
<b>Black (adults)</b>	10.7	9.8	10.4	8.6	8.7	9.1	10.2	9.2	9.3
<b>Puerto Rican (all ages)</b>	18.5	16.7	18.8	14.6	16.5	13.7	14.3	12.8	14.9
<b>Puerto Rican (children)</b>	19.5	24.8	15.6	20.7	23.5	13.9	12.9	11.3	17
<b>Puerto Rican (adults)</b>	18.1	12.8	20.2	12.2	13.3	13.6	14.9	13.5	14.1
<b>White (all ages)</b>	8.1	8.2	8.1	7.4	7.6	7.8	8.3	8.1	7.6
<b>White (children)</b>	8.2	7.8	7.9	7.5	7.6	7.4	7.1	7.7	5.6
<b>White (adults)</b>	8.1	8.4	8.1	7.3	7.6	7.9	8.5	8.1	8
<b>AI/AN (children)</b>	—	—	—	*4.9	10.2	11.4	15.1	**	**
<b>AI/AN (adults)</b>	—	—	—	7.7	11.2	10.5	9.5	7.7	9.9
<b>&lt;100% FPL</b>	11.2	11.5	12.4	10.9	10.4	11.1	11.8	11.7	10.8
<b>100–249% FPL</b>	8.8	8.8	8.3	7	7.6	8.4	8.9	7.9	8.1
<b>250–449% FPL</b>	8.2	7.8	7.6	6.2	7.6	6.3	7.4	7.3	7.3
<b>&gt;450% FPL</b>	6.9	7.2	6.6	6.6	6.3	6.9	7.1	6.8	6.5

Source: CDC, National Center for Health Statistics, National Health Interview Survey (2010–2018)

AI/AN=American Indian or Alaska Native

FPL=Federal Poverty Level

Prevalence estimates for Black and white race do not include people of Hispanic ethnicity.

Puerto Rican ethnicity is captured as a subset of Hispanic ethnicity in the NHIS.

\*Estimates are considered unreliable. Data preceded by an asterisk have a relative standard error (RSE) greater than 30% and less than or equal to 50% and should be used with caution.

\*\*Estimates are considered unreliable. Data have a relative standard error (RSE) greater than 50% and are not shown.



Table S2. Lifetime Asthma Prevalence by Race, Ethnicity, Age, and Poverty Level

	2010	2011	2012	2013	2014	2015	2016	2017	2018
	Percent of Population								
<b>Total</b>	12.9	12.9	13.0	12.0	12.9	12.7	13.6	13.3	13.0
<b>Black (all ages)</b>	17.1	16.7	16.7	14.8	16.0	15.2	17.1	15.2	15.6
<b>Black (children)</b>	21.2	20.7	21.7	18.2	18.9	18.7	20.5	17.2	18.1
<b>Black (adults)</b>	15.5	15.1	14.8	13.6	14.9	14.0	15.9	14.6	14.8
<b>Puerto Rican (all ages)</b>	25.1	22.9	25.8	22.9	24.1	21.7	18.9	20.5	23.0
<b>Puerto Rican (children)</b>	26.8	30.0	23.2	29.9	31.3	20.4	17.8	20.6	23.6
<b>Puerto Rican (adults)</b>	24.3	19.4	26.9	20.1	20.8	22.2	19.4	20.4	22.8
<b>White (all ages)</b>	12.6	12.6	13.0	12.0	12.9	12.9	13.7	13.6	12.9
<b>White (children)</b>	12.1	12.3	12.5	11.3	12.1	11.7	11.4	12.3	9.5
<b>White (adults)</b>	12.8	12.7	13.1	12.2	13.0	13.1	14.2	13.9	13.8
<b>AI/AN (children)</b>	—	—	—	*8.1	15.3	12.4	17.5	12.5	18.0
<b>AI/AN (adults)</b>	—	—	—	13.7	15.0	17.9	16.9	10.2	15.7
<b>&lt;100% FPL</b>	15.6	16.2	17.1	15.9	15.8	15.5	16.6	17.3	16.0
<b>100–249% FPL</b>	13.1	13.4	12.6	11.6	12.9	13.4	13.6	13.2	13.3
<b>250–449% FPL</b>	12.7	12.1	12.5	11.0	12.4	11.2	12.7	12.6	12.7
<b>&gt;450% FPL</b>	11.4	11.4	11.4	11.3	11.8	12.0	13.0	12.5	11.9

Source: CDC, National Center for Health Statistics, National Health Interview Survey (2010–2018)

AI/AN=American Indian or Alaska Native

FPL=Federal Poverty Level

Prevalence estimates for Black and white race do not include people of Hispanic ethnicity.

Puerto Rican ethnicity is captured as a subset of Hispanic ethnicity in the NHIS.

\*Estimates are considered unreliable. Data preceded by an asterisk have a relative standard error (RSE) greater than 30% and less than or equal to 50% and should be used with caution.

Table S3. Asthma Attack Prevalence by Race, Ethnicity, Age, and Poverty Level

	2011	2012	2013	2014	2015	2016	2017	2018
	Percent of Population							
<b>Total</b>	49.1	50.7	49.9	44.7	46.9	46.9	45.6	45.4
<b>Black (all ages)</b>	50.3	51.5	49.5	46.5	44.0	48.5	41.6	44.6
<b>Black (children)</b>	53.0	56.1	53.6	51.7	43.7	53.1	49.5	55.6
<b>Black (adults)</b>	48.5	48.8	47.1	43.6	44.2	46.0	38.0	38.9
<b>Puerto Rican (all ages)</b>	39.0	50.0	49.2	44.7	49.1	48.5	47.9	52.4
<b>Puerto Rican (children)</b>	41.8	47.2	59.9	42.7	43.0	46.5	33.9	63.2
<b>Puerto Rican (adults)</b>	36.4	51.0	42.1	46.3	51.5	49.2	53.4	47.5
<b>White (all ages)</b>	49.8	50.7	50.4	44.1	46.6	46.7	45.5	45.7
<b>White (children)</b>	60.1	58.3	61.2	47.5	47.3	53.9	54.0	59.6
<b>White (adults)</b>	47.3	48.9	47.7	43.3	46.4	45.2	43.5	43.4
<b>&lt;100% FPL</b>	52.9	53.5	56.0	52.2	50.6	50.4	49.6	50.1
<b>100-249% FPL</b>	49.1	49.6	50.1	42.6	47.9	48.0	45.7	50.1
<b>250-449% FPL</b>	47.1	50.5	47.6	44.9	46.0	45.4	42.8	38.9
<b>&gt;450% FPL</b>	47.8	49.2	46.4	40.4	43.6	44.6	45.0	43.4

Source: CDC, National Center for Health Statistics, National Health Interview Survey (2011-2018)

FPL=Federal Poverty Level

Prevalence estimates for Black and white race do not include people of Hispanic ethnicity.

Puerto Rican ethnicity is captured as a subset of Hispanic ethnicity in the NHIS.

Table S4. Asthma-Related Deaths by Race, Ethnicity, and Residents of Puerto Rico

	2010	2011	2012	2013	2014	2015	2016	2017	2018
	<b>Age-Adjusted Rate Per 1,000,000 Population</b>								
<b>Total</b>	10.6	10.2	10.7	10.7	10.8	10.5	10.2	10.1	9.4
<b>AI/AN</b>	11.1	8.4	15.4	15.2	16.1	15.9	14.1	9.5	12.7
<b>Black</b>	23.9	24.2	24.9	26.1	25.4	23.9	23.3	22.7	22.3
<b>White</b>	8.5	8.1	8.6	8.3	8.8	8.4	8.2	8.1	7.4
<b>Hispanic or Latinx</b>	9.4	7.5	8.0	9.1	7.9	7.6	8.0	7.2	8.4
<b>Puerto Rican</b>	13.4	21.8	11.4	9.3	23.9	21.8	—	—	—

Source (U.S): CDC, National Center for Health Statistics, National Vital Statistics System: Mortality (2010-2018)  
 Source (PR): Puerto Rico Department of Health, Technical report, Puerto Rico Asthma Project (2010-2015)

AI/AN=American Indian or Alaska Native

Asthma-related deaths were identified as those coded as J45-J46 as the underlying cause of death using the International Code of Diseases 10th revision (ICD-10).

Mortality estimates for Black and white race do not include people of Hispanic ethnicity.

Data for Puerto Rico includes data only from the approximately 3.5 million residents of the Commonwealth of Puerto Rico and does not include the approximately 5 million Puerto Rican Americans living on the U.S. mainland.

Table S5. Asthma-Related Physician Office Visits by Race and Ethnicity

	2010	2011	2012	2013	2014	2015	2016
	<b>Crude Rate Per 10,000 Population</b>						
<b>Total</b>	468.7	454.0	341.1	304.2	351.6	304.4	307.8
<b>Black</b>	601.3	494.0	257.4	331.7	354.6	—	—
<b>White</b>	477.1	453.9	368.1	314.2	370.4	266.3	313.8
<b>Hispanic or Latinx</b>	—	589.3	361.0	256.1	342.4	—	—

Source: CDC, National Center for Health Statistics, National Ambulatory Medical Care Survey (2010-2016)

Estimates for Black and white race include people of Hispanic ethnicity.

Table S6. Asthma-Related Emergency Departments Visits by Race

	2010	2011	2012	2013	2014	2015	2016	2017
	<b>Crude Rate Per 10,000 Population</b>							
<b>Total</b>	57.8	58.1	54.9	52.5	64.5	55.0	55.9	49.1
<b>Black</b>	187.5	174.4	188.6	149.8	198.3	179.9	161.1	164.3
<b>White</b>	39.4	41.1	38.1	38.9	48.3	37.9	42.9	33.9
<b>Hispanic or Latinx</b>	56.7	78.8	99.6	56.9	77.6	70.4	79.6	—

Source: CDC, National Center for Health Statistics, National Ambulatory Medical Care Survey (2010-2017)

ED estimates for Black and white race include people of Hispanic ethnicity.

Table S7. Asthma-Related Hospital Inpatient Rates by Race

	2001	2002	2003	2004	2005	2006	2007	2008	2009
	<b>Percent of Population with Asthma</b>								
<b>Total</b>	2.2	2.4	2.9	2.4	2.2	1.9	2.0	1.9	2.0
<b>Black</b>	3.9	4.0	4.5	3.8	2.9	3.2	2.9	2.9	2.5
<b>White</b>	1.5	1.6	1.8	1.5	1.5	1.3	1.3	1.2	1.3
<b>Other Races</b>	1.3	1.2	3	3.1	1.9	0.8	1.3	1.5	1.9

Source: CDC, National Center for Health Statistics, National Hospital Discharge Survey (2001-2009)

Inpatient estimates for Black and white race include people of Hispanic ethnicity.



Table S8. Uninsured Rates by Race, Ethnicity, and Poverty Level (Age 0–64)

	2010	2011	2012	2013	2014	2015	2016	2017	2018
	<b>Percent of Population</b>								
<b>Total</b>	18	17	17	17	14	11	10	10	10
<b>AI/AN</b>	32	30	30	30	26	23	22	22	22
<b>Black</b>	20	19	19	19	15	12	11	11	11
<b>White</b>	13	13	13	12	10	8	7	7	8
<b>Hispanic or Latinx</b>	33	31	31	30	25	21	19	19	19
<b>&lt;100% FPL</b>	30	30	28	28	23	19	17	18	17
<b>100–199% FPL</b>	30	29	29	28	23	18	17	17	17
<b>200–399% FPL</b>	17	17	17	16	13	11	11	11	12
<b>&gt;400% FPL</b>	6	6	6	6	5	4	4	4	4

Source: Kaiser Family Foundation estimates based on the Census Bureau’s American Community Survey (2010–2018)

AI/AN=American Indian or Alaska Native

FPL=Federal Poverty Level

Uninsured estimates include those without health insurance and those who have coverage under the Indian Health Service only at the time of the survey.

Estimates for Black and white race do not include people of Hispanic ethnicity.

Table S9. Medicaid Coverage Rates by Race, Ethnicity, and Poverty Level (Age 0-64)

	2010	2011	2012	2013	2014	2015	2016	2017	2018
	Percent of Population								
<b>Total</b>	17	18	18	18	20	22	22	22	22
<b>AI/AN</b>	28	30	30	30	33	34	36	36	36
<b>Black</b>	30	31	31	31	33	34	34	34	34
<b>White</b>	12	12	12	13	14	15	16	15	15
<b>Hispanic or Latinx</b>	27	28	28	28	30	33	33	32	32
<b>&lt;100% FPL</b>	49	50	51	51	54	57	58	59	59
<b>100-199% FPL</b>	30	30	31	31	35	39	41	41	41
<b>200-399% FPL</b>	10	10	10	10	12	14	16	16	16
<b>&gt;400% FPL</b>	3	3	3	3	3	4	4	4	5

Source: Kaiser Family Foundation estimates based on the Census Bureau's American Community Survey (2010-2018)

AI/AN=American Indian or Alaska Native

FPL=Federal Poverty Level

Medicaid coverage estimates for Medicaid coverage include those covered by Medicaid, Medical Assistance, Children's Health Insurance Plan (CHIP) or any kind of government-assistance plan for those with low incomes or a disability. Estimates also include those who have both Medicaid and another type of coverage, such as dual eligibles who are also covered by Medicare. Estimates for Black and white race do not include people of Hispanic ethnicity.

Table S10. Poverty Status by Race and Ethnicity

	2010	2011	2012	2013	2014	2015	2016	2017	2018
<b>Percent of Population</b>									
<b>Total</b>	15.3	15.9	15.9	15.8	15.5	14.7	14.0	13.4	13.1
<b>AI/AN</b>	28.4	29.5	29.1	28.9	28.3	26.6	26.2	25.4	23.7
<b>Black</b>	27.1	28.1	28.1	27.6	27.0	25.4	23.9	23.0	22.5
<b>White</b>	10.6	11.0	11.0	11.1	10.8	10.4	10.0	9.6	9.5
<b>Hispanic or Latinx</b>	24.8	25.8	25.4	24.8	24.1	22.6	21.0	19.4	18.8

U.S. Census Bureau, American Community Survey (2010–2018)

AI/AN=American Indian or Alaska Native

Poverty estimates show those below the federal poverty level in the past 12 months.

Poverty estimates for white race do not include people of Hispanic ethnicity.

Table S11. Unemployment Rates by Race and Ethnicity

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
<b>Percent of Population in Labor Force</b>												
<b>Total</b>	5.8	9.3	9.6	8.9	8.1	7.4	6.2	5.3	4.9	4.4	3.9	3.7
<b>Black</b>	10.1	14.8	16.0	15.8	13.8	13.1	11.3	9.6	8.4	7.5	6.5	6.1
<b>White</b>	5.2	8.5	8.7	7.9	7.2	6.5	5.3	4.6	4.3	3.8	3.5	3.3
<b>Hispanic or Latinx</b>	7.6	12.1	12.5	11.5	10.3	9.1	7.4	6.6	5.8	5.1	4.7	4.3
<b>Puerto Rican</b>	—	—	15.4	14.1	12.4	13.6	10.6	8.9	6.9	6.0	5.7	5.0

Source: U.S. Bureau of Labor Statistics, Current Population Survey (2008–2019)

Persons are classified as unemployed if they do not have a job, have actively looked for work in the prior 4 weeks, and are currently available for work at the time of the survey.

Unemployment estimates for Black and white race include people of Hispanic ethnicity.

Puerto Rican ethnicity is captured as a subset of Hispanic ethnicity in the CPS.

Table S12. Median Weekly Earnings by Race, Ethnicity, and Sex

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
	U.S. Dollars									
<b>Total</b>	747	756	768	776	791	809	832	860	866	917
<b>Black (all)</b>	611	615	621	629	639	641	678	682	694	735
<b>Black Men</b>	633	653	665	664	680	680	718	710	735	769
<b>Black Women</b>	592	595	599	606	611	615	641	657	654	704
<b>White (all)</b>	765	775	792	802	816	835	862	890	916	945
<b>White Men</b>	850	856	879	884	897	920	942	971	1,002	1,036
<b>White Women</b>	684	703	710	722	734	743	766	795	817	840
<b>Hispanic or Latinx (all)</b>	535	549	568	578	594	604	624	655	680	706
<b>Hispanic or Latinx Men</b>	560	571	592	594	616	631	663	690	720	747
<b>Hispanic or Latinx Women</b>	508	518	521	541	548	566	586	603	617	642

Source: U.S. Bureau of Labor Statistics, Current Population Survey (2010–2019)

Estimates reflect median weekly earnings of full-time wage and salary workers.  
Median earnings estimates for Black and white race include people of Hispanic ethnicity.



Table S13. High School Graduation Rates by Race and Ethnicity

	2010	2011	2012	2013	2014	2015	2016	2017	2018
<b>Adjusted Cohort Graduation Rate (ACGR)</b>									
<b>Total</b>	78	79	81	81	82	83	84	85	85
<b>Black</b>	66	67	68	71	73	75	76	78	79
<b>White</b>	83	84	85	87	87	88	88	89	89
<b>Hispanic or Latinx</b>	71	71	76	75	76	78	79	80	81

Source: U.S. Department of Education, Office of Elementary and Secondary Education, Consolidated State Performance Report (2010-2018)

Graduation rates reflect adjusted cohort graduation rate, the percentage of public high school freshmen who graduate with a regular diploma within 4 years of starting 9th grade.

Graduation estimates for Black and white race do not include people of Hispanic ethnicity.

Table S14. Homeownership Rates by Race and Ethnicity

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
<b>Percent of Population</b>										
<b>Total</b>	66.9	66.2	65.5	65.1	64.5	63.7	63.4	63.9	64.4	64.6
<b>Black</b>	45.4	44.9	43.9	43.1	43.0	42.3	41.6	42.3	42.1	42.1
<b>White</b>	74.5	73.8	73.6	73.4	72.7	71.9	71.9	72.3	73.0	73.4
<b>Hispanic or Latinx</b>	47.5	46.9	46.1	46.1	45.4	45.6	45.9	46.2	47.1	47.5

Source: U.S. Census Bureau, Current Population Survey/Housing Vacancy Survey (2010-2019)

Homeownership rates reflect the percentage of U.S. homes that are owner-occupied compared to the total number of occupied households.

Homeownership estimates for white race do not include people of Hispanic ethnicity.



Asthma and Allergy  
Foundation of America

1235 South Clark Street • Suite 305 • Arlington, VA 22202  
800-7-ASTHMA • [aafa.org](http://aafa.org)

---