



RECOMMENDATIONS FOR EVALUATION METRICS FOR ASTHMA HOME VISITING PROGRAMS

Measuring Environmental Management
& Health Outcomes

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

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EXECUTIVE SUMMARY

Background

Environmental health education, assessment, and remediation of asthma triggers in the home environment is necessary to provide equitable comprehensive asthma care management. Research evidence has shown that home-based, multi-trigger, multicomponent interventions with an environmental component are both economically viable and effective in improving outcomes. The movement to address social determinants of health has led to increased willingness among state Medicaid programs and managed care plans to innovate to pay for services that can be linked to positive health outcomes.

Purpose

Given the importance of controlling asthma triggers in the home environment, which is known to reduce exposure, exacerbations, and episodes of potentially avoidable hospitalizations, there is a need for health care to finance upstream public health interventions to improve health outcomes. While research has shown the health benefits of environmental management services to prevent asthma exacerbations, these home-based services (in-home environmental health education, environmental assessment, and remediation of asthma triggers) are not typically paid for by health insurance plans. To support the reimbursement of in-home environmental health services, there is a need to clearly define the core, supplemental, and emerging health measures for rigorous evaluation of asthma home-visiting programs.

Results

The Environmental Management and Health Outcomes Metrics for Evaluation (EMHOME) Work Group convened a representative group of national stakeholders from different sectors and organizations to offer their input and guidance on which measures to include for recommendation. The goal was to produce a standard set of measures that providers, health systems, managed care organizations, and public health departments can utilize to link health outcomes to program intervention measures for the purpose of obtaining sustainable reimbursement for services.

This publication produces a recommended list of measures that are designated as core, supplemental, and emerging measures that cover the four components of comprehensive asthma care, care coordination, and outcomes – all of which are integral to the evaluation of a home visiting program both in terms of efficacy and cost-effectiveness. This final report of the Work Group presents a set of 28 measures that covers the multiple components of comprehensive asthma care.

CORE METRICS

ASTHMA OUTCOMES	
Domain	Metric
Health Care Utilization	Reduce hospitalizations for asthma; asthma hospitalization rate Reduce emergency department (ED) visits for asthma; asthma emergency department (ED) visits
Quality Improvement	Asthma Medication Ratio (AMR) Medication Management for Asthma (MMA)
ASSESSMENT & MONITORING OF ASTHMA SEVERITY AND CONTROL	
Composite Measures	Asthma Control Asthma Severity
CONTROL OF ENVIRONMENTAL FACTORS AND CO-MORBID CONDITIONS THAT AFFECT ASTHMA	
Tobacco Use	Reduce the proportion of nonsmokers exposed to secondhand smoke Increase the proportion of smoke-free homes
EDUCATION FOR A PARTNERSHIP IN CARE/PATIENT SELF-MANAGEMENT EDUCATION	
Health Care Quality	Increase the proportion of persons with current asthma who receive formal patient education Asthma Action Plan
MEDICATION ADHERENCE	
Medication Utilization	Increase the proportion of persons with current asthma with prescribed inhalers who receive instruction on their use Increase the proportion of persons with current asthma who do not use more than one canister of short-acting inhaled beta agonist per month
Primary Care Connection	Increase the proportion of persons with current asthma who have had at least one routine follow-up visit in the past 12 months Primary Care connection after ED visits for asthma

SUPPLEMENTAL METRICS

ASTHMA OUTCOMES	
Domain	Metric
Health Care Costs	Asthma-specific cost of care Total cost of care
Quality of Life - Productivity Loss	Reduce the proportion of persons with asthma who miss school or work days; missed school/work days due to asthma
Quality of Life - Composite	Quality of Life - Patient Quality of Life - Caregiver
ASSESSMENT & MONITORING OF SEVERITY & CONTROL	
Composite Measures	Optimal Asthma Control
CARE COORDINATION	
Maternal, Infant, and Child Health	Increase in the proportion of children with special health care needs who receive care in family-centered, comprehensive, and coordinated systems

EMERGING METRICS

CONTROL OF ENVIRONMENTAL FACTORS AND CO-MORBID CONDITIONS THAT AFFECT ASTHMA	
Domain	Metric
Environmental Health	Environmental remediation (minor vs. moderate/major) Environmental health assessment Environmental control supplies
Composite Measures	Environmental Scoring System
EDUCATION FOR A PARTNERSHIP IN CARE/PATIENT SELF-MANAGEMENT EDUCATION	
Self-Management Strategies	Environmental health education in the home setting Duration of environmental health education Proportion of home visits completed by type of educator (nurse, respiratory therapist, community health worker, etc.)

CONTENTS

Introduction	01
Asthma Outcomes	04
Overview.....	04
Existing Measures	04
Recommended Reimbursement Measures.....	04
Health Care Utilization Measures.....	04
Health Care Cost Measures.....	06
Quality Improvement Measures.....	06
Quality of Life.....	07
Assessment & Monitoring of Asthma Severity and Control	08
Overview.....	08
Existing Measures	08
Recommended Reimbursement Measures.....	09
Composite Measures.....	09
Control of Environmental Factors & Co-Morbid Conditions That Affect Asthma	12
Overview.....	12
Existing Measures	12
Recommended Reimbursement Measures.....	12
Tobacco Use.....	13
Environmental Health	13
Composite Measures.....	16
Education for a Partnership in Care/Patient Self-Management Education	17
Overview.....	17
Existing Measures	17
Recommended Reimbursement Measures.....	18
Environmental Health	18
Medication Adherence	21
Overview.....	21
Existing Measures	21
Recommended Reimbursement Measures.....	21
Care Coordination	23
Overview.....	23
Existing Measures	23
Recommended Reimbursement Measures.....	23
Conclusion	26
Acknowledgements	27
Appendix	28

INTRODUCTION

Asthma in the United States

More than 26.1 million Americans were estimated to be suffering from asthma in 2018, including 19.9 million adults and 6.2 million children.¹ The negative health impacts of this chronic condition are immense, costing the United States more than \$80 billion per year.² Asthma is a complex, chronic inflammatory disorder of the airways. Its causes are poorly understood and multi-factorial, with risk factors varying in different populations.³ While there is no cure for the disease, symptoms can be effectively controlled with a combination of appropriate medical care, health education, and reduction or elimination of exposure to asthma triggers and respiratory irritants.⁴

A recent analysis by the Centers for Disease Control & Prevention (CDC) suggests that the public health and medical community has made substantial progress in reducing the burden of asthma since 2003. Specifically, from 2003 to 2013, hospitalizations from asthma decreased by half, the overall prevalence of adverse health outcomes and health care use due to asthma decreased significantly, and the prevalence of having an action plan to manage asthma increased.⁵ Some of these improvements are likely attributable to the development and adoption of comprehensive asthma care management programs across the country, many of which were funded through federal research grants (Housing and Urban Development “HUD” Healthy Homes, Center for Medicare & Medicaid Innovation “CMMI”), initiatives (CDC State Asthma Control Program, CDC 6 | 18 Initiative, and Department of Energy’s “DOE” Weatherization Plus Health), and the Affordable Care Act’s Patient-Centered Outcomes Research Institute “PCORI.”

Although the recent CDC national survey analysis found decreasing rates of asthma attacks across all sex, age, and racial/ethnic groups, it shows that asthma still imposes a heavy burden on children, especially low-income, minority children. Findings from this survey indicate that in 2013 and 2016 more than 50% of children with asthma were reported to have had at least one asthma attack and only 71.1% had routine care visits with a primary care physician.⁶ The survey also found 4.7% were hospitalized, 16.7% had emergency department (ED)/urgent care (UC) visit, and 49.0% of school-

age children with asthma missed one or more school days.⁷ Additionally, the CDC found that the percentage of children using asthma control medicine as prescribed declined more than ten percent from 2003 to 2013 (from 65.7% to 54.5%, $p < 0.01$).⁸

Disparities in asthma prevalence and outcomes continue to persist.⁹ Among US children with asthma, black children are twice as likely to be hospitalized or to have an emergency department visit and four times more likely to die due to asthma than white children.¹⁰ Minority children are also less likely than white children to be prescribed medication or take recommended treatments to control their asthma and are less likely to attend outpatient appointments.¹¹ These disparities negatively impact both the persons with asthma and society. The person with asthma experiences poor health, lower quality of life, and decreased productivity at work and school, while society feels the burden of increased health care use and costs from potentially preventable emergency services.

Reimbursement for Comprehensive Asthma Interventions

Reversing the trends of poor asthma outcomes requires transforming the health system and closing gaps in health care coverage by providing a continuum of guidelines-based disease management care and preventive services to those that need it most.¹² The *National Asthma Education and Prevention Program Expert Panel Report 3 (NAEPP EPR-3): Guidelines for the Diagnosis and Management of Asthma* recommends that multifaceted allergen education and control interventions delivered in the home setting are effective in reducing indoor allergens and establishes that effective asthma care must include four key components:

1. Assessing and monitoring asthma severity and asthma control;
2. Education for a partnership in care;
3. Control of environmental factors and comorbid conditions that affect asthma;
4. Medications.¹³

Research evidence from the *Community Guide Systematic Review* (“Task Force”) has concluded that home-based,

multi-trigger, multicomponent interventions with an environmental component (“Comprehensive Asthma Intervention”) are effective in reducing acute care visits, lowering costs, and improving overall quality of life and productivity in children and adolescents with asthma. The Task Force found insufficient evidence for adults with asthma due to the small number of quality studies identified and the mixed results across outcomes. However, since the systematic review was completed in 2008, several additional randomized controlled trials in adults have been completed and found that multicomponent environmental interventions have a significant effect on improving asthma control and quality of life in adults.^{14,15} Other evidence from economic evaluations of guidelines-based interventions in adults are more limited, but many have established improved health outcomes and cost-effectiveness, including greater returns on investment.^{16,17,18,19}

NAEPP EPR-3 guidelines-based care and the Task Force findings represent the medical and scientific consensus, yet not all four components of the Comprehensive Asthma Intervention are uniformly covered or reimbursed. Home-based asthma interventions that provide self-management education (component 2) and control of environmental factors (component 3) receive the least amount of coverage from health care despite findings that Comprehensive Asthma Interventions are economically viable, with a return on investment of \$5.30-\$14.00 for every dollar spent.²⁰

Medicaid, one of the largest payers for health care in the United States, provides health coverage to low income people, many of whom experience health disparities related to asthma prevalence and outcomes. As part of the movement in the health care system to address social determinants of health,²¹ many Medicaid programs have utilized waivers, demonstration projects, and service

delivery reforms to allow for the reimbursement of non-traditional services to improve population health. The National Quality Forum (NQF), in collaboration with Centers for Medicare & Medicaid Services (CMS), has developed a framework that positions Medicaid programs at the “hub” and emphasizes “the importance of collaboration and partnerships between health and non-health sectors and the utility of social determinants of health (SDOH) data in health care delivery.”²²

In part, the scarcity of payments for the control of environmental factors and self-management education are linked to the lack of standard measures for evaluating these home-based components of Comprehensive Asthma Interventions. Without standard measures, the outcomes of a Comprehensive Asthma Intervention cannot be evaluated, making it difficult to make the case to health care for reimbursement. In fact, despite the national movement to address social determinants of health, most home-based asthma interventions are not being reimbursed. According to the American Lung Association’s Asthma Care Coverage project, three state Medicaid programs (Nevada, Missouri, North Carolina) provide coverage for home-based asthma interventions, but only one state Medicaid program (Connecticut) provides coverage without barriers for home-based asthma interventions.²³

Medicaid populations experience the burden of health inequities related to asthma due to both a greater concentration of pre-existing risk factors related to social determinants of health and a systemic failure to reimburse for guidelines-based preventative care throughout the health system. For these reasons, many states are now considering strategies to advance reimbursement of asthma self-management education services (component 2) (MO, OR, and DSRIP in NY) or expand the types of providers that can deliver such services (e.g. community health workers in IN). Despite some progress for self-management education services (component 2), there are only a few states reimbursing for the control of environmental factors (component 3) through environmental health education, environmental assessment, and environmental remediation – MD, MO and OR.

The movement to address social determinants of health has led to increased willingness among CMS, state Medicaid programs, and managed care organizations to



develop pathways to finance the delivery of home-based services that can be linked to positive health outcomes. Given the importance of managing asthma triggers in the home to controlling asthma exacerbations and preventing avoidable acute care visits, there is a need for health care to finance upstream public health interventions to improve health outcomes. For this to become a reality, there must be standardized measures by which to show the efficacy of the home-based components of the Comprehensive Asthma Intervention.

National Initiative for Asthma Reimbursement

The National Initiative for Asthma Reimbursement was formed by the Green & Healthy Homes Initiative (GHHI) with support from the Environmental Protection Agency's (EPA) Indoor Environments Division in the Office of Radiation and Indoor Air (ORIA) and the JPB Foundation. One of the three goals of the initiative was to form and convene an Environmental Management and Health Outcomes Metrics for Evaluation (EMHOME) Work Group ("Work Group").

Purpose and Scope of Project

While research has shown the health benefits of environmental management services to prevent asthma exacerbations, these home-based asthma services (self-management education and control of environmental factors) are not typically paid for by health insurance plans. To support the reimbursement of these services, there is a need to clearly define the set of measures that are necessary for rigorous evaluation of the home-based components of the Comprehensive Asthma Intervention. The goal of the Work Group is identifying a standard set of existing measures in use which are recommended for evaluating the efficacy and return on investment of Comprehensive Asthma Interventions.

The convening of the Work Group brought together a diverse and representative group of stakeholders from across sectors and issue areas who are dedicated to creating a system of standard measurement to enable further innovations in financing and service delivery of Comprehensive Asthma Interventions. The intention is identifying and recommending a standard set of metrics that providers (clinical, educational, and environmental), health systems, managed care organizations, public health departments, and community-based organizations can implement and thereby catalyze reimbursement of these services across the country.

This final report of the Work Group presents all the widely known used existing measures for Comprehensive Asthma Interventions and recommends which measures programs should track to increase the likelihood of health care reimbursement. These measures are presented in six categories:

1. asthma outcomes;
2. assessment & monitoring of asthma severity and control;
3. control of environmental factors and co-morbid conditions that affect asthma;
4. education for a partnership in care/patient self-management education;
5. medication adherence; and
6. coordination of care.

The measures selected for inclusion in each category were then classified according to use, validation, and standardization of the methodology, as follows:

Core measures: A set of measures that are validated and standardized and should be included for purposes of evaluation.

Supplemental measures: A set of measures that are validated and standardized, optional for inclusion.

Emerging measures: A set of measures with potential to expand or improve certain aspects of disease monitoring that are not yet standardized, require further validation, optional for inclusion.

All of the measures in the paper were selected from existing efforts at metric standardization, specifically Healthy People 2020, the Asthma Outcomes workshop (2012), the Standards Subcommittee of the Asthma Disparities Workgroup (2016),²⁴ A Roadmap for Promoting Health Equity and Eliminating Disparities: The Four I's for Health Equity,²⁵ and CDC's EXHALE: A Technical Package to Control Asthma.²⁶ The majority of the existing measures that we recommend were created and are maintained by the collaborative efforts of National Institute of Health institutes, the Standards Subcommittee of the Asthma Disparities Workgroup (formerly Asthma Disparities Working Group), the National Center for Health Statistics (NCHS), and other federal agencies.

ASTHMA OUTCOMES

Overview

The asthma outcomes measures identified, including the nine recommended, are all standardized existing measures that are categorized into four domains: health care utilization, health care costs, quality improvement and quality of life. Evaluation of asthma outcomes is critical to measure the impact of Comprehensive Asthma Interventions and often used as the primary method to determine the efficacy and cost-effectiveness.²⁷ Evaluating the impact from the societal perspective is most equitable and the best practice for determining the cost-effectiveness of home-based asthma interventions.²⁸ Therefore, the measures recommended represent and value multiple perspectives – quality of life for persons with asthma, quality improvement and health care use for clinicians and other service providers, and health care costs for the payer. A balanced evaluation would also attempt to report on outcomes from across the four domains.

Health care utilization and health costs measures are important primary outcomes to track but need to be complemented with measures to ensure the quality of care is valued. Quality measures are used to monitor or quantify the performance of asthma interventions in terms of outcomes, health care processes, patient experience or caregiver perception, organizational structure, and systems.²⁹ Such measures are important for reimbursement since they are being used to directly link intervention performance to payments. In fact, over 90% of health plans are reporting Health Care Effectiveness Data and Information Set (HEDIS) measures which are used by CMS and state Medicaid programs to incentivize payments and alternative payment models based on quality improvement outcomes.³⁰ Measure specifications and methods of analysis vary depending on the type of quality measure and the data source. Quality measures can be based on self-report surveys, or on claims data, such as HEDIS measures, whereas others rely on electronic health records from clinical data, such as electronic clinical quality measures (eCQM). Currently, such quality measures based on claims data or electronic health records are favored by the health care system because they are considered the most valid and reliable method.

However, there is a growing demand for “measures based on patient-reported outcomes, patient involvement in the decision-making process regarding their care, and the quality of home and community-based services.”³¹ The quality measures recommended also include patient-reported outcome measures (PROMs) that attempt to include the perspective of the person with asthma and caregivers – while still being based on clinical guidelines, evidence-based, and relevant to patients.³² Such measures are necessary to report on the outcomes that matter most to patients and their families, such as improvements in productivity and quality of life and thereby establish more equity in the measurement of high-quality care.

Existing Measures

Many organizations have contributed to the literature on asthma outcomes measures. Table 1 lists the existing asthma outcomes measures that have been identified.

Recommended Reimbursement Measures

Of the full list of existing asthma outcomes measures, the Work Group recommends that Comprehensive Asthma Interventions track and report on the following measures to increase the potential of reimbursement from health care.

Health Care Utilization Measures

Asthma hospitalization rate: This measure has been defined by Healthy People 2020 and stratified into three age groups. The goal is to reduce asthma hospitalization rates to 18.2 hospitalizations per 10,000 for children under age 5, 8.7 per 10,000 for people aged 5 to 64, and 20.1 per 10,000 adults aged 65 years and over. Hospitalization rates from asthma programs can be compared to rates of the city or region in which the intervention is taking place, or, alternatively, state or national numbers if city- or county-specific numbers cannot be identified. EPR-3 guidelines suggest keeping records of hospitalizations for monitoring the risk domain and asthma progression in order to determine the level of asthma control and whether treatment should be stepped up or down.³³ Hospitalizations are important to measure as they are avoidable, costly, and “potentially sensitive to the quality of ambulatory care and patient compliance with care” and are a predictor of “those at highest risk for asthma-specific

Table 1

Domain	Type	Measure	Source
Health Care Utilization	Core	Current Asthma Prevalence	Standards Subcommittee (2016)
	Core	Asthma Attack Prevalence	Standards Subcommittee (2016)
	Core	Asthma Exacerbations	Akinbami et al. (2012)
	Core	Reduce asthma deaths; Asthma death rate	Healthy People 2020 RD-1; Standards Subcommittee (2016)
	Core	Reduce hospitalizations for asthma; Asthma hospitalization rate	Healthy People 2020 RD-2; Standards Subcommittee (2016)
	Core	Reduce emergency department (ED) visits for asthma; Asthma emergency department (ED) visit rate	Healthy People 2020 RD-3; Standards Subcommittee (2016)
	Core	Asthma-specific outpatient visits	Reddel et al. (2009) Wildfire et al. (2012)
	Core	Asthma-specific medication use	CMS Quality ID #398
	Supplemental	Reduce asthma-related unplanned readmissions within 30 days of discharge from the index admission	Akinbami et al. (2012)
	Supplemental	Health care utilization by social and behavioral risk factors	Akinbami et al. (2012)
Health Care Costs	Supplemental	Asthma-specific cost of care	CMS Quality ID #356
	Supplemental	Total cost of care	National Quality Forum (2017)
Quality Improvement	Core	Asthma Medication Ratio (AMR)	Akinbami et al (2012)
	Core	Medication Management for Asthma (MMA)	NQF #1799
Quality of Life - Productivity Loss	Supplemental	Missed school/work days due to asthma	Healthy People 2020; Standards Subcommittee (2016)
Quality of Life - Composite	Supplemental	Quality of Life - Patient	Giese et al (2018)
	Supplemental	Quality of Life - Caregiver	Giese et al (2018)

morbidity and mortality.”³⁴ Accordingly, Akinbami et al. describes the need to track outcomes that “achieve a more complete and standardized accounting of resource use,” which includes tracking significant medical events, such as hospitalizations.³⁵

Asthma emergency department (ED) visit rate: This measure has been defined by Healthy People 2020 and stratified into three age groups. The goal is to reduce asthma ED visits to 95.7 per 10,000 among children

under age 5, 49.6 per 10,000 for people aged 5 to 64 years, and 13.7 for adults aged 65 years and over. ED visit rates from asthma programs can be compared to rates of the city or region in which the intervention is taking place, or, alternatively, state or national numbers if city- or county-specific numbers cannot be identified. According to EPR-3 guidelines, ED visits are risk factors for asthma-related morbidity and death and by keeping count of ED visits, patients can be classified as high-risk and provided with specialized care, “particularly intensive education,

monitoring, and care.”³⁶ ED visits are important to measure as they can occur when “there are high barriers to high quality ambulatory care.”³⁷ Again Akinbami et al. describes the need to track outcomes that “achieve a more complete and standardized accounting of resource use,” which includes tracking significant medical events, such as ED visits.³⁸

Health Care Cost Measures

Asthma-specific cost of care measures the costs accrued to the health care system for any asthma-related encounters, including hospitalizations, emergency department visits, urgent care visits, medications, and other events. This measure is important because it can be used to understand the financial impact of asthma-related health care encounters and the potential return on investment for interventions that reduce utilization. Programs that can impact this measure are beneficial to the patient, the provider, and the plan.

Total cost of care “describes dollars spent by health care purchasers for health care services and includes payment for the comprehensive basket of health care services utilized by a patient or population.”³⁹ As many health plans and providers establish cost benchmarks for patients that are not specific to any diagnosis, impact on total cost of care is important for programs to measure. Shared savings payments to providers, value-based payments, and alternative payment models are also commonly based on the total cost of care rather than costs associated with a specific diagnosis. An example of such a measure is the total cost of care population-based per member per month (PMPM) index (NQF #16), which calculates the total cost of care of a commercial population compared to a peer group average. This is an example of a methodology that could be adopted to evaluate other asthma populations outside of commercial health plans.⁴⁰ In general, a total cost of care that measures all of the costs accrued to the health care system for all health care encounters for patients with asthma is necessary to determine the cost-effectiveness of services to a health plan.

Both asthma-specific cost of care and total cost of care can be measured using state-level administrative claims, specific health plan data, hospital discharge data, or publicly available health cost data. The Work Group recognizes that not all programs have access to this data and may not be able to track these outcomes.

Quality Improvement Measures

Quality improvement measures are “used to monitor and report performance across health plans, providers, and health systems and are a foundational element of value-based payment” and improvement efforts by health care entities.⁴¹ The inclusion of standardized quality measures allows programs to demonstrate impact on measures that are familiar and important to the health care system.

Asthma Medication Ratio (AMR) measures the ratio of controller medication to total asthma medications to better understand compliance with preventive medications. Centers for Medicare and Medicaid Services divides the AMR into two measures: one for children ages 5-18 and one for adults ages 19-64.^{42,43}

Medication Management for People with Asthma (MMA) assesses the percentage of persons, 5-64 years of age, with asthma that were dispensed appropriate controller medications and that remained on them for their treatment period. MMA has two rates that are reported: 1) the number of members who achieved proportion of days covered (PDC) of at least 50% and those who achieved PDC of at least 75% during the treatment period.⁴⁴

“The Asthma Medication Ratio measure (NQF #1800) replaces the Medication Management for People with Asthma measure (not NQF endorsed), which was included in the 2013–2017 Child Core Sets but has been taken out subsequently.”⁴⁵ However, at this time many states are still requiring health plans to report either one or both MMA and AMR, and there are many financial incentives tied to MMA performance in states, so we are including MMA in the recommendations.

Improvements in both AMR and MMA can signal better asthma control and help programs understand the impact their intervention is having on medication adherence. AMR and MMA are also used to evaluate health plan and provider performance and are often tied to financial incentives. Programs that can demonstrate improvement of those measures can make a better case for sustained health care reimbursement for intervention services.

AMR and MMA have limitations as proxy measures of asthma control, as they only measure one component of asthma care management and therefore need to be combined with other outcome and process measures to provide a holistic evaluation of program

performance. Home-based asthma interventions that include environmental control commonly include self-management education for patients and their families, which often incorporates review of prescribed asthma medications and their proper use. This education can lead to effective behavior change and quality improvements in medication adherence outcomes.⁴⁶ Many clinicians and payers may not understand the benefits of home-based asthma self-management education and its direct impact on medication adherence so some education may be required.

Quality of Life

Missed school/work days due to asthma: This measure has been defined by Healthy People 2020 and stratified into two age groups. The goal is to reduce the proportion of children (ages 5-17) who miss school days to 48.8%, and the proportion of adults (ages 18 to 64) who miss workdays to 26.7%. The proportions of missed school or workdays from asthma programs can be compared to rates of the city or region in which the intervention is taking place, or, alternatively, state or national numbers if city- or county-specific numbers cannot be identified. To estimate these measures a program can use administrative data from a school system or employer, administer self-reported surveys, or employ both methods to ensure accuracy of results reported. These societal benefits can be included if evaluating the broader impact, especially since they are the results valued by the persons with asthma and their families.

Quality of life: Clinicians who take patients' quality of life goals into account and show their willingness to address these goals "may enhance patients' willingness to take medications and thus, improve both their asthma control and their quality of life."⁴⁷ Questionnaires that assess health care-related quality of life help identify gaps in patient understanding and overall patient needs, as well as the ability to track progress over time. These types of patient reported outcome measures (PROMs) need to be included to measure the impact from the perspective of the person with asthma. For purposes of reimbursement these quality of life measures are best collected using validated instruments which provide quantifiable scores that are easily tracked over time and are tailored for specific populations to improve accuracy of reporting.



The Asthma Quality of Life Questionnaire (AQLQ) measures the quality of life for adults with asthma by assessing symptoms, activity limitation, emotional function, and environmental stimuli. The goal of the questionnaire is to measure the physical and mental components most important to adults with asthma while being reproducible when health is stable and maintaining accuracy with subtle changes.⁴⁸ While the AQLQ is designed for clinical studies and provides greater precision for adults, the Mini Asthma Quality of Life Questionnaire (MiniAQLQ) is used in instances where there is a need to cost-effectively monitor a very large number of adults or where efficiency is required, but precise measurements are not.⁴⁹ Although the AQLQ is accurate for assessing quality of life as it pertains to adults with asthma, children and caregivers of children with asthma require a tailored questionnaire to ensure it measures the components most important to them.

The Pediatric Asthma Quality of Life Questionnaire (PAQLQ) measures the quality of life related to children (ages 7 to 17) with asthma by assessing symptoms, activity limitations, and emotional function. The Pediatric Asthma Caregiver Quality of Life Questionnaire (PACQLQ) measures the quality of life for the caregiver of a child with asthma by measuring limitations and emotional function.⁵⁰

ASSESSMENT & MONITORING OF ASTHMA SEVERITY AND CONTROL

Overview

Asthma control is defined as “the extent to which the various manifestations of asthma have been reduced or removed by treatment”⁵² and asthma severity as the difficulty in controlling asthma with treatment. The routine assessment and monitoring of asthma control and severity within a Comprehensive Asthma Intervention has a set of well-established best practices in the clinical setting, many of which can also be performed in the home setting. The goal of asthma care management is two-fold: the reduction of impairment and the reduction of risk, both of which are related to asthma control and severity. Reduction of impairment focuses on preventing chronic symptoms, requiring “infrequent use (< 2 days a week) of inhaled short acting beta2-agonist (SABA) for quick relief of symptoms,” “maintaining near normal pulmonary function,” and maintaining “normal activity levels.”⁵³ The reduction of risk focuses on “preventing recurrent exacerbations of asthma and minimizing the need for emergency department (ED) visits or hospitalizations; preventing loss of lung function; for children, preventing reduced lung growth; and providing optimal pharmacotherapy with minimal or no adverse effects of therapy.”⁵⁴

Previously, asthma severity was classified as intermittent, persistent-mild, persistent-moderate, or persistent-

“Assessment and monitoring of asthma are tied to the concepts of severity, control and responsiveness and the domains of impairment and risk.”⁵¹

severe, but this is now only recommended for research studies.⁵⁵ After exclusion of modifiable factors such as poor adherence, smoking, and comorbidities, severity largely reflects the required level of treatment and the activity of the underlying disease state during treatment, which may vary depending on the underlying phenotype, environmental factors, and comorbidities.⁵⁶ Since asthma severity may change over time, and depends not only on the severity of the underlying disease but also its responsiveness to treatment, there has been a paradigm shift which recommends a classification based on asthma control.⁵⁷ Asthma control can be classified as controlled, partly controlled, or not controlled as described in Figure 1.⁵⁸

Existing Measures

Many organizations have contributed to the literature on assessment and monitoring of asthma severity and control measures. Table 2 lists the existing measures that have been identified.

Table 2

Domain	Type	Measure	Source
Impairment Measures	Core	Daytime symptoms	Standards Subcommittee (2016)
	Core	Nighttime awakenings	Standards Subcommittee (2016)
	Core	Frequent use of short-acting beta-agonists (SABA)	Standards Subcommittee (2016)
	Core	Activity limitation due to asthma; Reduce activity limitations among persons with asthma	Standards Subcommittee (2016); Healthy People 2020 RD-4
Composite Measures	Core	Asthma Control	Standards Subcommittee (2016)
	Core	Health Status	Standards Subcommittee (2016)
	Core	Asthma Severity	Reddel et al. (2009); Wildfire et al. (2012)
	Supplemental	Optimal Asthma Control	CMS Quality ID #398

Figure 1. Classification of Asthma Control

LEVELS OF ASTHMA CONTROL			
Characteristic	Controlled (All of the following)	Partly controlled (Any measure present in any week/year)	Uncontrolled
Daytime symptoms	None (\leq twice/week)	> twice/week	Three or more features of partly controlled asthma present in any week
Limitations of activities	None	Any	
Nocturnal symptoms/awakening	None	Any	
Need for reliever/rescue treatment	None (\leq twice/week)	>twice/week	
Lung function* (PEF or FEV1)	Normal	<80% predicted or personal best	
Exacerbations	None	One or more/year	One in any week

***Lung function is not a reliable test for children 5 years and younger**

Note. Classification of asthma-according to asthma control. Adapted from 'Classification of asthma according to revised 2006 GINA: Evolution from severity to control,' by E.A. Koshak, 2007, *Annals of thoracic medicine*, 2(2), 45.

Recommended Reimbursement Measures

Of the full list of existing assessment and monitoring of asthma severity and control measures, the Work Group recommends that Comprehensive Asthma Interventions track and report on the following measures to increase the potential of reimbursement from health care.

Composite Measures

Asthma control is defined as the extent to which the various manifestations of asthma have been reduced or removed by treatment.⁵⁹ While there are important clinical tools that evaluate physiologic and inflammatory measures to assess asthma control, it is important to employ tools that take into account "patient-reported domains of impairment and risk and objective measures of lung function."⁶⁰ A patient-centered approach to monitoring and reporting asthma control should include a validated instrument that provides a quantifiable score indicating whether the person with asthma is well-controlled or not. The use of such survey instruments is valued since they provide service providers with reliable short-term indicators of asthma control. These types of patient-centered performance measures can be tied to reimbursement by serving as an evidence-based indicator linked to improving asthma outcomes. The age-appropriate surveys listed in Figure 2 include the name of

the validated instrument and the score range for well-controlled asthma. It should be noted that the impairment domain of asthma control includes exacerbations, which are not included in the ACT, C-ACT, or ACQ, but are assessed in the Composite Asthma Severity Index described below.

Optimal asthma control⁶¹ is a two-component composite measure that tracks quality improvement by measuring the percentage of the overall patient population with well-controlled asthma that are not at risk for exacerbations. This composite measure is unique in that it combines a patient-reported short-term asthma control measure and a measure of long-term control in terms of acute care visits. Therefore, optimal asthma control, which combines both risk and impairment measures, directly links asthma control to utilization based on the level of control and risk of exacerbation. This measure is recommended because it utilizes a patient-reported outcome measure (PROM) for asthma control and combines it with a claims-based measure for acute health care utilization.

The performance rates for the two components are measured for pediatric patients, ages 5-17, and adult patients, ages 18-50. The first component of this composite measure allows for use of age-appropriate validated

Figure 2. Asthma Control Questionnaires

ASTHMA CONTROL QUESTIONNAIRES			
Test	Age Range	Score Range	Control
TRACK	2-4	0-100	Controlled ≥ 80
Childhood Asthma Control Test™ (C-ACT)	4-11	0-27	Controlled >19
Asthma Control Test™ (ACT)	12+	5-25	Controlled ≥ 20 , Poorly controlled ≤ 19 , Uncontrolled ≤ 15
Asthma Control Questionnaire (ACQ)	≥ 12	0-6	Well controlled ≤ 0.75 , Poorly-controlled ≥ 1.50
Asthma Therapy Assessment Questionnaire (ATAQ)	5-17 (cATAQ) or adult ≥ 18	0-4	Controlled 0, Poorly controlled 1-2, Very poorly controlled 3-4

Note. Asthma Control Questionnaires. Adapted from “Clinical Tools to Assess Asthma Control in Children,” by C. Dinakar, B.E. Chipps, 2017, *Pediatrics*, 139(1), e20163438.

survey instruments, which are listed in Figure 2, that rely on patient engagement and a validated self-report to measure whether a patient’s asthma is well-controlled. The second component determines whether patients with asthma are considered not at elevated risk of exacerbations, which is the case if the total number of ED visits and inpatient hospitalizations are less than two in the past 12 months. Patients are considered at elevated risk of exacerbations if the total number of ED visits and inpatient hospitalizations was greater than two in the past 12 months, or the patient was not screened and no reason was given for the lack of screening.

At the patient level the best way to determine **asthma severity** is using validated survey instruments that provide a numerical score for asthma control that can be compared over time. A composite measure also allows for inclusion of multiple components to assess differences between groups. Spirometry is an important clinical measure that needs to be included in a comprehensive assessment to track pulmonary function over time and can sometimes be used to confirm a clinical suspicion of asthma.⁶² Spirometry measures forced expiratory volume (FEV1) which is considered a gold standard in measurement of lung function but can have issues with children who are “likely to have FEV1 values within the normal range when clinically stable.”⁶³ Traditionally, spirometry is recommended as a diagnostic tool for the clinician’s office while peak expiratory flow meters are better designed for monitoring.⁶⁴ Spirometry in the home setting is contingent on program design and type

of personnel employed since it requires continuous training and supervision to maintain quality control during implementation. This measure could be used by home visiting programs, employing a nurse or other qualified provider, to ensure all patients with asthma are routinely monitored over time.

Spirometry utilized alone can provide false positives and misleading values if quality control is not ensured. Because spirometry does not have a definition for ‘normal’ values, a patient’s personal best value taken during periods of complete control is required to serve as a goal and to compare with future values.^{65,66} Guidelines suggest that peak expiratory flow (PEF) is not used to monitor children routinely but is accepted for adults with poor perception of airflow limitation or severe asthma.⁶⁷ Validated instruments such as the Asthma Control Questionnaire (ACQ) and the Composite Asthma Severity Index (CASI) measure FEV1, while spirometry is not required in the commonly use Asthma Control Test (ACT). Spirometry data may also be affected if care is not taken to ensure quality control in “equipment selection and maintenance, calibration, operator training and competence, and patient performance.”⁶⁸ PEF readings can be reproducible, less costly, and more manageable for patients who are properly trained to conduct the measurement themselves.^{69,70} Because results can be misleading, spirometry alone cannot establish an asthma diagnosis as “airflow limitation may be mild or absent, particularly in children” suggesting that spirometry must be paired with other forms of assessment.⁷¹ Therefore, the Work Group

recommends using a composite measure, such as the **Composite Asthma Severity Index (CASI)**, to monitor severity of the disease.

The **Composite Asthma Severity Index** is a patient level measure that allows for the monitoring of asthma severity over time. Developed by the National Institute of Health, the Composite Asthma Severity Index is a scored test used to determine the severity of asthma, the risks associated, and the level of treatment required to manage control of asthma. Its scores “include five domains: day symptoms and albuterol use, night symptoms and albuterol use, controller treatment, lung function measures [based on spirometry], and exacerbations.”⁷² By incorporating multiple dimensions and calculating a score ranging from 0 to 20, the CASI can assist in more accurately determining current impairment and future risk while still accounting for differences between treatment groups. The use of the CASI is recommended because of the multidimensional nature of asthma, which manifests differently from person to person, but also varies for individuals over time. Comprehensive Asthma Interventions that provide guidelines-based care may result in patients rapidly achieving control that results in uniformity of scores.⁷³ The importance of using an asthma severity composite measure is it complements the use of asthma control tests by attempting to quantify severity and is “especially sensitive to changes in environmental interventions where the reduction of exposures should lead to both reduced symptoms and medications.”⁷⁴

CONTROL OF ENVIRONMENTAL FACTORS & CO-MORBID CONDITIONS THAT AFFECT ASTHMA



“Substantially reducing exposure to irritants or inhalant allergens in the home may reduce inflammation, symptoms, and need for medication. Several comorbid conditions can impede asthma management, so they also need to be recognized and treatment of these conditions may improve asthma control.”⁷⁵

Overview

The degree of control a patient has over their health is determined, in part, by their environment and any co-morbid conditions. Asthma exacerbations often occur in the home where indoor environmental control practices can be deployed to target common exposures. Patients who are aware of and act to mitigate environmental factors that lead to exacerbations have better outcomes. Control of environmental factors is also a key component (component 3) of a Comprehensive Asthma Intervention. While the focus of this report is control of environmental factors it is important to note that the assessment of asthma control depends on the correct diagnosis of symptoms that are influenced or shared by many comorbid conditions.⁷⁶ The existence of co-morbid conditions may make it harder to assess and evaluate if the patient achieves control over their asthma; therefore such conditions need to be accounted for in asthma management plans as well as in the evaluation.

Co-morbidities and risk factors related to physical and social determinants of health also contribute to asthma morbidity and disproportionately burden vulnerable populations such as children and minorities. Such risk factors, including socioeconomic status, race, and access to health care, place certain groups at greater risk due to underlying social structures and political, economic, and legal institutions. If tracked, the comorbidities and risk factors respectively included in Figure 3 and Figure 4 would allow for the further segmentation of the target asthma population into subpopulations for the purposes of population health management.

Existing Measures

Many organizations have contributed to the literature on control of environmental factors that affect asthma. In Table 3 is a list of the existing measures that have been identified.

Recommended Reimbursement Measures

Of the full list of existing environmental factors that affect asthma measures, the Work Group recommends that

Table 3

Domain	Type	Measure	Source
Indoor Allergens	Core	Reduce indoor allergen levels: cockroaches	Healthy People 2020 EH-13.1
	Core	Reduce indoor allergen levels: mouse	Healthy People 2020 EH-13.2
Tobacco Use	Core	Reduce the proportion of nonsmokers exposed to secondhand smoke	Healthy People 2020 TU-11
	Core	Increase the proportion of smoke-free homes	Healthy People 2020 TU-14
	Supplemental	Tobacco smoke exposure: screening ⁷⁷	AAAAI Measure #2
	Supplemental	Tobacco smoke exposure: intervention ⁷⁸	AAAAI Measure #3
Environmental Health	Emerging	Environmental health assessment	Crocker (2011), Matsui et al. (2016), Krieger (2010)
	Emerging	Environmental remediation (Tier 1 - minor vs Tier 2 - moderate/major)	Crocker (2011), GHHI (2017)
	Emerging	Environmental control supplies	American Lung Association (2015) + Crocker (2011)
Composite Measures	Emerging	Environmental Scoring System	Dong et al. (2018)

Comprehensive Asthma Interventions track and report on the following measures to increase the potential of reimbursement from health care.

Tobacco Use

Environmental Tobacco Smoke (ETS), or secondhand smoke, containing cancer-causing and other toxic chemicals is an irritant for persons with asthma; strong evidence indicates that exposure leads to a greater number of ear infections, respiratory infections, and asthma exacerbations.⁷⁹ Since there is no risk-free exposure to ETS, and any exposure negatively affects the health of adults and children, the best protection is the elimination of ETS exposure in all homes, schools, worksites, and public places.⁸⁰ Comprehensive Asthma Interventions should measure their impact on **reducing the proportion of nonsmokers exposed to secondhand smoke** and **increasing the proportion of smoke-free homes**. Given the great impact ETS exposure has on health outcomes and health care utilization, these measures can be of great value in making the business case for program reimbursement to health care.

It has been reported that 21% of persons with asthma smoke, 53% of children with asthma are exposed to ETS, 17.6% of exposures are in the home, and low income children have a higher exposure to ETS.⁸² Since there is no risk-free exposure to ETS, and any exposure negatively affects the health of adults and children, the best protection is the elimination of ETS exposure in all homes, schools, worksites, and public places.⁸³ There are two existing core measures in Healthy People 2020 related to the home environment: (TU-11) aimed at reducing the proportion of non-smokers exposed to ETS and (TU-14) increasing the proportion of smoke-free homes.

Environmental Health

An **environmental health assessment** during a home visit incorporates a walk-through assessment in which the educator, environmental assessor, or other personnel identify and list triggers in a written format. Asthma triggers in the home can be more accurately identified when assigned personnel conduct the assessment in the home as opposed to a review reported by the patient in a clinic setting.^{84,85,86} Any environmental health assessment should

Figure 3. Comorbidities of Asthma

COMORBIDITIES OF ASTHMA	
Allergic rhinitis	Neurologic disorders
Atherosclerotic cardiac disease and circulatory disorders	Obesity
Bronchitis and bronchopneumonia	Obstructive lung disease (COPD)
Connective tissue diseases	Paradoxical vocal fold movement [vocal cord dysfunction (VCD)]
Dermatologic conditions (eczema)	Pregnancy
Gastroesophageal reflux (GERD) and other gastrointestinal disease	Psychologic disease (anxiety, depression, behavioral disorders)
Immunologic and hematologic diseases	Respiratory infection
Metabolic disorders	Rhinitis and rhinosinusitis

Note. Adapted from "Asthma and comorbidities" by D.K. Ledford, R.F. Lockey, 2013, *Current opinion in allergy and clinical immunology*, 13(1), 78-86.

Figure 4. Risk Factors

Domain	Type	Measure	Source
Population Health	Core	Race/ethnicity Poverty Status Parental educational attainment	Standards Subcommittee (2016)
Provider or Practice Level	Core	Exposure to environmental factors inside homes	Standards Subcommittee (2016)
Patient Level	Core	No usual source of health care Personal Doctor	Standards Subcommittee (2016)
Need for reliever/rescue treatment	Supplemental	Weight status Lack of health insurance coverage Type of health insurance coverage Unable to pay medical bills	Standards Subcommittee (2016)

Note. Risk Factors. Adapted from "Measures to Identify and Track Racial Disparities in Childhood Asthma: Asthma Disparities Workgroup Subcommittee Recommendations" by the Standards Subcommittee of the Asthma Disparities Workgroup, 2016, Atlanta: Centers for Disease Control and Prevention.

individually enumerate whether triggers were assessed, identified, and recommended for remediation. The best practice for an in-home environmental assessment is using a comprehensive assessment that measures all hazards in the home using a tool such as GHFI's [Comprehensive Environmental Health & Housing Assessment \(CEHHA\)](#). The scope of work developed from the comprehensive environmental assessment of home-based asthma triggers is the key to distinguishing the level of intensity required for the intervention to remediate the home environment.

To support the use of a multi-trigger, multi-component environmental health assessment are findings from a systematic review on indoor allergen interventions that compared 59 randomized and 8 nonrandomized studies and found that single component interventions were ineffective at reducing asthma measures compared to interventions that bundled multiple strategies.⁸⁷ An environmental health assessment that bundles multiple strategies and includes high-efficiency particulate air filtration (HEPA) vacuums has the highest strength of

Figure 5. Environmental Control Supply List

ENVIRONMENTAL HEALTH SUPPLY LIST	
Moderate Intensity Supplies	Major Intensity Supplies
Medicine bag (inhalers, spacers)	Carpet removal and flooring installation
HEPA-type vacuum and parts	Gutter repair
Home cleaning supplies	Landscaping regrading
Base IPM supplies	Mold major (>12 square feet)
Carpet steam clean	Plumbing major
IPM contractor	Roof repair major
Mold minor (<10 square feet)	Venting, bathroom
Plumbing minor	Venting, dryer
Roof repair minor	Venting, kitchen
Air conditioning (small units)	Air conditioning systems
Air purifiers	Furnace cleaning
Dehumidifiers	Furnace replacement
Furnace filters	Gas stove/oven replacement
Weatherization/energy efficiency (minor)	Hot water heater replacement
Safety/injury prevention (minor)	Refrigerator replacement
	Weatherization/energy efficiency (major)
	Safety/injury prevention (major)

evidence in reducing indoor allergens and is linked to improved quality of life and less asthma-related symptoms.⁸⁸ If a comprehensive environmental health assessment by a professional inspector is not possible, the use of questionnaires and visual inspections can alleviate the cost burden associated with rigorous environmental assessments that are required in research settings while still providing a qualitative assessment of hazards.⁸⁹

Environmental remediation (minor, moderate, and major): The EMHOME Work Group recommends classifying the level of intensity of environmental remediation services into minor, moderate, or major. According to Crocker et al., “any changes in the home – structural or nonstructural – designed to reduce asthma triggers were defined as major remediation.”⁹⁰ The need to classify environmental remediations by level of intensity allows for the possibility

of distinguishing the difference in resource use and costs by various asthma home-visiting programs for purposes of comparison. The following are the recommended classifications and their definitions:

Major: Remediation that results in any structural changes to the home.

Moderate: Remediation that includes the provision of environmental control supplies (e.g., furnace filters), services (e.g., integrated pest management), or minor repairs (e.g., patching holes) with the involvement of a health educator and/or environmental assessor.

Minor: Remediation that includes in-home education and assessment as well as low-cost items but does not include environmental control supplies and services.⁹¹

Environmental control supplies are used to remediate the home environment⁹² and can generally be similarly classified into either minor, moderate, or major supplies. The minor level intervention supplies are limited to the provision of low-cost items such as hypoallergenic pillow and mattress covers.⁹³ For a further breakdown of environmental control supplies classified as moderate and major, see Figure 5. Comprehensive Asthma Interventions should track the quantity and costs of supplies used for each home to understand average costs. Knowing average costs will allow programs to more accurately calculate return on investment to effectively make the case to health care for reimbursement.

Composite Measures

The **Environmental Scoring System (ESS)** produces a cumulative score between 0-6 based on a sum of six binary measures: dust, mold, pests, smoke, pets, and chemicals.⁹⁴ The score is based on a visual assessment of exposures and a parental self-report. These six measures are important because they are the most common triggers for asthma, but they are not the only environmental asthma triggers and should therefore be considered the minimum necessary for the measurement and monitoring of environmental health triggers in the home. The ESS is significant for home visiting programs because it is a simple, validated instrument that produces a numerical score, allowing for comparison with intermediate or long-term outcomes. This instrument is a process measure with the potential of linking an improved home environment to outcomes that would assist in facilitating reimbursement of environmental remediation services.

EDUCATION FOR A PARTNERSHIP IN CARE/PATIENT SELF-MANAGEMENT EDUCATION

Overview

Effective asthma management requires a “partnership between the clinician and the person who has asthma (and the caregiver, for children).”⁹⁶ This partnership in care/patient self-management education is a key component (component 2) of a Comprehensive Asthma Intervention. A patient-centered partnership in care helps develop the trust necessary for an effective program, which may require the use of different types of educators (e.g. nurses, respiratory therapists, community health workers) and take place in settings outside the clinic (e.g. homes, schools, community settings). Therefore, asthma programs “should be organized, designed, and implemented to encourage involvement of a multi-disciplinary team in health behavior change, education, and health care (e.g. physician, physician assistant, nurse practitioner, nurse, pharmacist, health educator, respiratory therapist, social worker, and trained lay volunteer).”⁹⁷ The type of personnel conducting the home visit can vary and successful home visiting programs have employed various types of personnel including “community health workers (CHWs), sanitarians, nurses, and doctors, with current evidence showing no difference in outcomes.”⁹⁸ The Community Guide Systematic Review of Comprehensive Asthma Interventions found that return on investment (ROI) ranged from -0.91 to 13.00 suggesting that some interventions did not offset the

“Self-management education improves patient outcomes (e.g., reduced urgent care visits, hospitalizations, and limitations on activities as well as improved health status, quality of life, and perceived control of asthma) and can be cost-effective. Self-management education is an integral component of effective asthma care and should be treated as such by health care providers as well as by health care policies and reimbursements.”⁹⁵

amount invested, and that higher ROIs were associated with interventions that targeted high utilizers.⁹⁹ Because the qualifications of personnel used have an impact on program cost, programs can augment their potential savings by assigning personnel according to the “intensity of patients’ needs” and by using the “most efficient staffing models possible.”¹⁰⁰

Patient self-management education depends not only on education, but also effective communication that helps reinforce the patient’s self-management abilities. Education alone does not lead to improved adherence, but effective communication can improve outcomes if consistently reinforced throughout treatment as patients “often internalize the respiratory symptoms of asthma (cough, wheeze, shortness of breath, and/or chest tightness).”¹⁰¹ Self-regulation “describes that the degree to which people acquire skills (education) depends upon” both interpersonal and external factors which are often “acted upon in isolation.”¹⁰² Strengthening communicative abilities in personnel can ensure that interpersonal factors are accounted for when providing education.

Existing Measures

Many organizations have contributed to the literature on education for a partnership in care/patient self-management education. In Table 4 is a list of the existing measures that have been identified.



Recommended Reimbursement Measures

Of the full list of existing education for a partnership in care/patient self-management education measures, the Work Group recommends that Comprehensive Asthma Interventions track and report on the following measures to increase the potential of reimbursement from health care.

Environmental Health

The **proportion of persons with current asthma who receive formal patient education** is an important measure for two main reasons. First, it allows Comprehensive Asthma Interventions to track and report the number of clients served, demonstrating a track record of success and an understanding of operational capacity. Second, it allows programs to create an accurate per client budget, which is a key input for any return on investment calculation. Programs can track this measure by reporting internally on all clients served.

An **Asthma Action Plan** is a written plan created by a patient and their doctor to help patients control their asthma. Each plan is written specifically for the unique needs of that patient's asthma and includes instructions on daily self-management and actions to take if symptoms

worsen.¹⁰³ It should include instructions on medication use, how to adjust medication if symptoms worsen, and when to seek medical care.¹⁰⁴ Comprehensive Asthma Programs should track how many of their clients have an Asthma Action Plan, as many providers and health plans value this tool since it is viewed as documentation of patient engagement with their primary care provider.

Environmental health education in the home setting

differs from self-management education in that environmental education focuses on learning to reduce asthma triggers in the home-setting, while self-management education instructs the patient on topics such as symptom monitoring and treatment modification. While self-management education can occur outside of the home, environmental health education requires home visiting to teach the patient or caregiver how to assess, identify, and remediate triggers as well as how to change behaviors that increase the risk of asthma exacerbations. By identifying triggers in the home, education can also be conducted simultaneously and “increase participation and retention relative to classes.”¹⁰⁵ Asthma programs can measure the number of instances where environmental health education was provided in a home setting. By tracking this measure, programs are able to document the intensity of environmental health education necessary



Table 4

Domain	Type	Measure	Source	
Health Care Quality	Core	Increase the proportion of persons with current asthma who receive formal patient education	Healthy People 2020 RD-6	
	Core	Increase the proportion of persons with current asthma who receive written asthma management plans from their health care provider	Healthy People 2020 RD-7.1	
	Core	Increase the proportion of persons with current asthma who receive education about appropriate response to an asthma episode, including recognizing early signs and symptoms or monitoring peak flow results; Taught how to recognize early symptoms	Healthy People 2020 RD-7.3; Standards Sub-committee (2016)	
	Core	Asthma Action Plan	Standards Subcommittee (2016)	
	Core	Taught how to use an inhaler	Standards Subcommittee (2016)	
	Core	Taught how to respond to episodes of asthma	Standards Subcommittee (2016)	
	Core	Taught how to monitor peak flow for daily therapy	Standards Subcommittee (2016)	
	Core	Increase the proportion of persons with current asthma who have been advised by a health professional to change things in their home, school, and work environments or reduce exposure to irritants or allergens to which they are sensitive according to NAEPP guidelines; Advised to change home/school/work environment	Healthy People 2020 RD-7.5; Standards Sub-committee (2016)	
	Core	Asked about symptom frequency	Standards Subcommittee (2016)	
	Core	Asked about relief inhaler frequency	Standards Subcommittee (2016)	
	Core	Asked about activity limitation	Standards Subcommittee (2016)	
	Core	Flu vaccination	Standards Subcommittee (2016)	
	Self-Management Strategies	Core	Routine asthma visits in past year	Standards Subcommittee (2016)
		Core	Any preventative medication use	Standards Subcommittee (2016)
Core		Regular use of preventative medication	Standards Subcommittee (2016)	
Core		Short-acting beta-agonist overuse	Standards Subcommittee (2016)	
Core		Action taken to address environment	Standards Subcommittee (2016)	
Emerging		Environmental health education in the home setting	Crocker (2011), Coffman (2008)	
Emerging		Duration of environmental health education	Akinbami et al. 2012	
Emerging		Proportion of home visits completed by type of educator (nurse, respiratory therapist, community health worker, etc.)	Gardner et al. (2015), Krieger (2010)	

to meet the needs of the family, which often varies depending on their knowledge, behavior patterns, and the condition of the home. This measure is important for reimbursement, as environmental health education is key to maintaining a healthy home, which improves health outcomes and reduces health care utilization and costs.

The **duration of the environmental health education** is an important measure to track because personnel time can be the largest component of intervention resources and costs, but it is often difficult to measure.¹⁰⁶ “Personnel time in administering interventions should be measured to help evaluate required resources and cost. The method for measuring personnel time should be clearly justified and the limitations acknowledged.”¹⁰⁷ Environmental health education should take place in the home setting and be billed with some existing current procedural terminology (CPT) codes that are stratified by time, with each code corresponding with the length of the visit. Unfortunately, it is not common practice to bill for environmental health education, so this will need to be negotiated with health plans and state Medicaid programs.

The **proportion of home visits completed by type of educator** is important to track, as it will directly impact program budget, intervention costs, and return on investment calculations. The type of educator can vary depending on the program and may include nurse practitioners, nurses, respiratory therapists, or non-medical professionals such as social workers, community health workers, and promotores.^{108, 109} Training and hiring personnel to work in their own communities has been effective at building trust due to shared culture, language, and life experiences, which facilitates the creation of interventions that are better tailored to the patient and improves the likelihood of adherence to treatment plans.^{110,111,112} By entering the home, personnel can adequately assess environmental triggers and evaluate concerns and barriers that would not be as readily apparent in a clinic setting. This advantage has led to decreased utilization of emergency services, improved caregiver quality-of-life, decreased symptoms days, and fewer unscheduled emergency visits.¹¹³ Programs need to collect cost data that differentiates home visit costs by personnel type.

MEDICATION ADHERENCE

Overview

Asthma medications can be categorized as long-term control or quick relief (or “rescue” or “relievers”).¹¹⁵ More specifically, asthma medications can be reported by drug class, such as inhaled corticosteroids, long-acting b-agonists, SABAs, leukotriene-modifying drugs, anti-IgE therapy, and systemic corticosteroids. The National Institutes of Health subcommittee recommends that records of asthma medications used should capture the drug name, dose, and duration.^{116,117}

The World Health Organization defines adherence as “the extent to which a person’s behavior...corresponds with agreed recommendations from a health care provider.”¹¹⁸ Medication compliance differs from adherence in that adherence suggests the patient is not only taking their medication, but also agrees with their doctor’s recommendations.¹¹⁹ Medication adherence is a key indicator of effective treatment because poor adherence decreases the maximum health benefits that can be derived from an intervention. Adherence decreases as a result of various factors, including symptom-free periods, prohibitive cost, and distant pharmacies.

Existing Measures

Many organizations have contributed to the literature on medications and medication adherence. In Table 5 is a list of the existing measures that have been identified.

Recommended Reimbursement Measures

Of the full list of existing medication/medication adherence measures, the Work Group recommends that

“When choosing among treatment options, consider domain of relevance to the patient (impairment, risk, or both), patient’s history of response to the medication, and patient’s willingness and ability to use the medication.”¹¹⁴

Comprehensive Asthma Interventions track and report on the following measures to increase the potential of reimbursement from health care.

The **proportion of persons with current asthma with prescribed inhalers who receive instruction in their use** should be tracked by monitoring whether patients have answered ‘no’ when asked whether they have used quick relief rescue inhalers or whether they have used more than three canisters of quick relief rescue inhalers in the past three months. If answering ‘no’ to either of those questions, the patient is determined to have received proper use instructions. This measure is important to track as overuse or underuse of medications signal that guidelines are not always followed and there is room to improve the quality of care.¹²⁰ Ensuring that inhaled corticosteroids are used in adequate amounts “can improve pulmonary physiological characteristics, and may reduce resource use for asthma attacks” due to a reduction in avoidable emergency services and associated costs.¹²¹ Programs can track this information by keeping accurate data from home visits and comparing the results

Table 5

Domain	Type	Measure	Source
Medication Utilization	Core	Increase the proportion of persons with current asthma with prescribed inhalers who receive instruction on their use	Healthy People 2020 RD-7.2
	Core	Increase the proportion of persons with current asthma who do not use more than one canister of short-acting inhaled beta agonist per month	Healthy People 2020 RD-7.4
Medication Adherence	Emerging	Types of nonadherence	WHO (2003)
	Emerging	Barriers to adherence	WHO (2003)

to the city, county, or national baseline established using the 2008 National Health Interview Survey Asthma Supplement (NHISAS). Given the correlation between proper medication usage and improved health outcomes, this measure is important to track for reimbursement.

The **proportion of persons with current asthma who do not use more than one canister of short-acting inhaled beta agonist (IBA) per month** should be tracked in order to evaluate proper adherence to medication and asthma control. Overuse of IBA is dangerous and indicates that asthma is not well controlled; evidence has shown that IBA overuse is associated with death and near death.¹²² The use of inhaled corticosteroids (ICS) should relieve the need to use IBA, a rescue medication, because ICS “prevent asthma symptoms, improve pulmonary physiological characteristics, and may reduce resource use for asthma attacks.”¹²³ If rescue medications are used too often, it is a signal that a different part of the treatment plan is not working properly. Programs can track this information by keeping accurate data from home visits and comparing the results to the city, county, or national baseline established using the 2008 National Health Interview Survey Asthma Supplement (NHISAS). Given the correlation between proper medication usage and improved health outcomes, this measure is important to track for reimbursement.

CARE COORDINATION

Overview

Care coordination encompasses all health care services that a patient receives in any setting – whether it is a hospital, clinic, school, home, or community organization. Care coordination helps patients connect with services more efficiently by “reducing duplication of effort, easing transitions and limiting gaps between service providers,” and for parents or caregivers, aiding in the management of the child’s care.¹²⁵ Best practices of care coordination result in a seamless transition of service and communication of information between different settings and providers, as gaps in coverage can lead to worsening outcomes, patient distrust, and decreased adherence to regimens.¹²⁶ The goal of care coordination is to identify the specific needs of a patient, create a personalized plan, and ensure that it is followed through at every step and according to all guidelines. Managing care across multiple settings includes the ability to “use data sources, leverage infrastructure, [and] readily communicate with health care providers.”¹²⁷ Care coordination improves the patient’s experience and leads to increases in follow-ups, enhanced outcomes, better quality of life, reduced disparities, and decreased costs and utilization.^{128,129,130,131}

Care coordination is most necessary when information and processes do not flow smoothly between different care providers and when patients are unsure of next steps or instructions. For these individuals, multiple transitions in care can lead to poor outcomes and increased costs.^{132,133}

Advancing care coordination can include broad approaches such as improving medication management or building stronger health information technology, as well as specific strategies such as evaluating risk factors, building tailored care plans, and monitoring patients during follow-ups. Successful care coordination is key to ensuring benefits accrue to the patients, providers, and payers. Care coordination at the population level can lead to decreased health care costs, which, by demonstrating the “favorable impact on costs of asthma care models,” can “assist in advocating coverage by private health insurers.”¹³⁴ Comprehensive Asthma Interventions can serve as a bridge between community health and clinical care.

“A client-centered, assessment-based, interdisciplinary approach to integrating health care and social support services in which an individual’s needs and preferences are assessed, a comprehensive care plan is developed, and services are managed and monitored by an identified care coordination following evidence-based standards of care.”¹²⁴

Existing Measures

Many organizations have contributed to the literature on care coordination. In Table 6 is a list of the existing measures that have been identified.

Recommended Reimbursement Measures

Of the full list of existing care coordination measures, the Work Group recommends that Comprehensive Asthma Interventions track and report on the following measures to increase the potential of reimbursement from health care.

The proportion of persons with current asthma who have had at least one routine follow-up visit in the past 12 months can be measured using state-level



Table 6

Domain	Type	Measure	Source
Care Coordination	Core	Increase the proportion of persons with current asthma who have had at least one routine follow-up visit in the past 12 months	Healthy People 2020 RD-7.6
	Core	Increase the proportion of persons with current asthma whose doctor assessed their asthma control in the past 12 months according to NAEPP guidelines	Healthy People 2020 RD-7.7
	Core	Home Management Plan of Care Document Given to Patient/Caregiver ¹³⁵	National Quality Forum NQF #0338
	Core	Primary Care Connection after Emergency Department Visits for Asthma	CAPQuaM PQMP Asthma IV
	Supplemental	Asthma Discharge Plan	AAA Measure #6 ¹³⁶
Maternal, Infant, and Child Health	Supplemental	Increase the proportion of children with special health care needs who receive care in family-centered, comprehensive, and coordinated systems	Healthy People 2020 MICH-31.2
Educational and Community-Based Programs	Supplemental	Increase the number of community-based organizations providing population-based primary prevention services in chronic disease programs	Healthy People 2030 ECBP-10.7

administrative claims, specific health plan data, hospital discharge data, publicly available health data, or through client survey. According to the EPR-3, because “asthma is highly variable over time, and periodic monitoring is essential,” scheduling follow-up care is a key clinical activity that is part of the assessment and monitoring component.¹³⁷ Patients and caregivers often “resort to the ED as a resource to cope with the fear of an asthma attack or with the lack of access to primary care;” therefore, it is necessary to ensure all persons with asthma have access to routine primary care to treat their chronic condition, monitor asthma control, and prevent acute care use over time.¹³⁸ This measure is important to health plans and providers, as it indicates a strong primary care connection and, as a key performance indicator, can be tied to financial incentives.

Primary Care connection after Emergency

Department visits for asthma measures the proportion of program participants that followed up with their primary care provider after an emergency department visit related to asthma.¹³⁹ This can be measured using state-level administrative claims, specific health plan data, hospital discharge data, or through client survey. According to the EPR-3 guidelines, ensuring follow-up care is critical,

and guidelines suggest that patients are provided with a referral to follow-up care as a treatment strategy in the emergency or urgent care setting.¹⁴⁰ In terms of managing exacerbations in the urgent or emergency care setting, the EPR-3 recommended action steps at discharge include providing a referral to follow-up care and an emergency department asthma discharge plan.¹⁴¹ This measure is important for reimbursement because “poor information transfer and discontinuity are associated with lower quality of care on follow-up, as well as adverse clinical outcomes,” which can lead to “faulty medical decisionmaking” or a failure in adequately monitoring “a patient’s condition during follow-up care.”¹⁴² A randomized trial found that a follow-up appointment provided after an ED visit “increased the rate of follow-up, consistent with the hypothesis that gaining access to an established source of primary care is a significant barrier for urban families.”¹⁴³ ED visits are an optimal opportunity for teachable moments due to “heightened parental concern” and directing it towards scheduling a follow up can improve the child’s future long-term care.¹⁴⁴

The proportion of children with special health care needs who receive care in a family-centered, comprehensive, and coordinated system is measured

using six indicators that ensure high-quality care: the family of children are involved in and satisfied with decision-making and services; children have access to ongoing care in a medical home; families have reliable insurance; children are screened early and continuously; families have reliable access to community-based organizations; and youth are assisted in life transitions. If all six conditions are met, the child is involved in a family-centered, comprehensive, and coordinated system. Healthy People 2020 stratifies this measure into two age groups; children aged 0 to 11 years, and children aged 12 to 17 years. Comprehensive Asthma Interventions provide an opportunity to reach out to high-needs patients that may have other needs besides clinical care and, if qualified for a patient-centered medical home, may be eligible for coverage of care coordination and other community or home-based services. This can be measured by programs using a questionnaire and tracked using a standard data tracking software.

CONCLUSION

Health inequities arise because there are systematic differences in opportunities by which groups can achieve optimal health, leading to unfair but avoidable differences in health outcomes. The unequal distribution of the asthma burden is directly related to the home environment and other social determinants of health, which, if not addressed, will continue to produce inequities in health outcomes that result in greater mortality and morbidity for minorities and children. Many of the environmental factors that contribute to health inequities related to asthma are preventable, especially if persons with asthma are provided with guidelines-based comprehensive care through Comprehensive Asthma Interventions that perform multi-component, multi-trigger interventions to reduce exposure to asthma triggers in the home. The set of measures recommended in this publication were selected to increase the likelihood that Comprehensive Asthma Interventions will be reimbursed sustainably by health care to increase health equity. Asthma is a complex and multi-factorial chronic disease with an established set of disease management protocols. To date, these protocols have not led to the implementation of cost-effective services that ensure equitable asthma outcomes for populations experiencing health disparities. In terms of asthma outcomes, health equity can be ensured only if “policymakers and payers can incentivize the reduction of disparities and the promotion of health equity by building health equity measures into new and existing healthcare payment models.”¹⁴⁵

Population health management, one of the three components of the Triple Aim, is “a patient-centered, integrated care delivery model based on aligned incentives and coordinated, collaborative processes that are built on evidence-based prevention and disease management protocols.”¹⁴⁶ A population health approach is the best way to address social determinants of health, such as housing quality, which are known to have a significant impact on individual health outcomes and are known to affect health, health care utilization, and costs.¹⁴⁷ Population health “requires the consideration of a broader array of the determinants of health than is typical in health care or public health and recognizes shared responsibility for population health outcomes with diffuse accountability” across multi-sector partners – health care, public health,

energy, housing, and other social services.¹⁴⁸ Therefore, a robust and complete analysis of these recommended measures requires the stratification or segmentation of the target population by risk factors and social determinants of health to examine whether the resulting outcomes between different groups are equitable.

The recommended list of measures covers the four components of comprehensive asthma care, care coordination, and outcomes – all of which are integral to the evaluation of a home visiting program in terms of efficacy, cost-effectiveness, and health equity. This final report of the Work Group presents a set of twenty-eight measures and represents an attempt at curatorial research to assist in the production of high-quality evaluations of Comprehensive Asthma Interventions. Although the recommended measures are considered necessary and sufficient for purposes of reimbursement, there are more existing measures identified in the report, and other emerging measures not included, that could also add value if included in an evaluation.

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APPENDIX

Figure 1. Classification of Asthma Control

LEVELS OF ASTHMA CONTROL			
Characteristic	Controlled (All of the following)	Partly controlled (Any measure present in any week/year)	Uncontrolled
Daytime symptoms	None (\leq twice/week)	> twice/week	Three or more features of partly controlled asthma present in any week
Limitations of activities	None	Any	
Nocturnal symptoms/awakening	None	Any	
Need for reliever/rescue treatment	None (\leq twice/week)	>twice/week	
Lung function* (PEF or FEV1)	Normal	<80% predicted or personal best	
Exacerbations	None	One or more/year	One in any week

***Lung function is not a reliable test for children 5 years and younger**

Note. Classification of asthma according to asthma control. Adapted from 'Classification of asthma according to revised 2006 GINA: Evolution from severity to control,' by E.A. Koshak, 2007, *Annals of thoracic medicine*, 2(2), 45.

Figure 2. Asthma Control Questionnaires

ASTHMA CONTROL QUESTIONNAIRES			
Test	Age Range	Score Range	Control
TRACK	2-4	0-100	Controlled \geq 80
Childhood Asthma Control Test™ (C-ACT)	4-11	0-27	Controlled >19
Asthma Control Test™ (ACT)	12+	5-25	Controlled \geq 20, Poorly controlled \leq 19, Uncontrolled \leq 15
Asthma Control Questionnaire (ACQ)	\geq 12	0-6	Well controlled \leq 0.75, Poorly-controlled \geq 1.50
Asthma Therapy Assessment Questionnaire (ATAQ)	5-17 (cATAQ) or adult \geq 18	0-4	Controlled 0, Poorly controlled 1-2, Very poorly controlled 3-4

Note. Asthma Control Questionnaires. Adapted from "Clinical Tools to Assess Asthma Control in Children," by C. Dinakar, B.E. Chipps, 2017, *Pediatrics*, 139(1), e20163438.

Figure 3. Comorbidities of Asthma

COMORBIDITIES OF ASTHMA	
Allergic rhinitis	Neurologic disorders
Atherosclerotic cardiac disease and circulatory disorders	Obesity
Bronchitis and bronchopneumonia	Obstructive lung disease (COPD)
Connective tissue diseases	Paradoxical vocal fold movement [vocal cord dysfunction (VCD)]
Dermatologic conditions (eczema)	Pregnancy
Gastroesophageal reflux (GERD) and other gastrointestinal disease	Psychologic disease (anxiety, depression, behavioral disorders)
Immunologic and hematologic diseases	Respiratory infection
Metabolic disorders	Rhinitis and rhinosinusitis

Note. Adapted from "Asthma and comorbidities" by D.K. Ledford, R.F. Lockey, 2013, *Current opinion in allergy and clinical immunology*, 13(1), 78-86.

Figure 4. Risk Factors

Domain	Type	Measure	Source
Population Health	Core	Race/ethnicity Poverty Status Parental educational attainment	Standards Subcommittee (2016)
Provider or Practice Level	Core	Exposure to environmental factors inside homes	Standards Subcommittee (2016)
Patient Level	Core	No usual source of health care Personal Doctor	Standards Subcommittee (2016)
Need for reliever/rescue treatment	Supplemental	Weight status Lack of health insurance coverage Type of health insurance coverage Unable to pay medical bills	Standards Subcommittee (2016)

Note. Risk Factors. Adapted from "Measures to Identify and Track Racial Disparities in Childhood Asthma: Asthma Disparities Workgroup Subcommittee Recommendations" by the Standards Subcommittee of the Asthma Disparities Workgroup, 2016, Atlanta: Centers for Disease Control and Prevention.

Figure 5. Environmental Control Supply List

ENVIRONMENTAL HEALTH SUPPLY LIST	
Moderate Intensity Supplies	Major Intensity Supplies
Medicine bag (inhalers, spacers)	Carpet removal and flooring installation
HEPA-type vacuum and parts	Gutter repair
Home cleaning supplies	Landscaping regrading
Base IPM supplies	Mold major (>12 square feet)
Carpet steam clean	Plumbing major
IPM contractor	Roof repair major
Mold minor (<10 square feet)	Venting, bathroom
Plumbing minor	Venting, dryer
Roof repair minor	Venting, kitchen
Air conditioning (small units)	Air conditioning systems
Air purifiers	Furnace cleaning
Dehumidifiers	Furnace replacement
Furnace filters	Gas stove/oven replacement
Weatherization/energy efficiency (minor)	Hot water heater replacement
Safety/injury prevention (minor)	Refrigerator replacement
	Weatherization/energy efficiency (major)
	Safety/injury prevention (major)

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