

Strategic Asthma Plan

City of Houston

2019 - 2024



HOUSTON HEALTH
DEPARTMENT

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INTRODUCTION

EXECUTIVE SUMMARY

In August of 2019, the Houston Health Department entered into a cooperative agreement with the CDC's National Asthma Control Program to lead a 5-year collaborative effort to improve asthma control services and reduce the burden of asthma for children and adults in the most populous city in Texas. Six months before the first case of COVID19 was reported in the United States, a coalition consisting of a broad range of stakeholders came together to start the process of mapping out a framework to meet the challenge of eradicating preventable death and disability due to asthma among Houstonians, particularly among our most vulnerable neighbors. Over the next year, throughout the pandemic, the Texas Gulf Coast Asthma Coalition took form, and its members engaged in the focused deliberation, evaluation, design, and prioritization of strategies around asthma surveillance, innovation and quality improvement in care delivery, workforce development, policy and community engagement. The *Strategic Asthma Plan for the City of Houston* is the product of this collective effort and represents a shared vision of proactive, accessible, inclusive, and coordinated systems that lead to effective asthma prevention and care. This document also reflects several guiding principles that are integrated into each goal and strategy in this plan.

- Collaboration – a dedication to building a community around asthma care
- Data-driven – to ground the decision-making process
- Rigor in evaluation – a commitment to honest reflection in the spirit of continuous quality improvement
- Health Equity- more than reducing disparities, a lens through which every aspect of the plan and planning process is viewed

This strategic plan is organized around five areas of focus that address the unique challenges facing Houston regarding asthma control. Each one outlines a rationale for its inclusion with objectives, strategies, and suggested measures. Each area of focus can potentially be tackled independently but also intersects with the other identified topics.

- Surveillance
- Guidelines-based care of asthma
- Tobacco Control
- Environmental Justice
- Linkages to Care

This strategic plan is a living document and will be updated on an annual basis to reflect intervention outcomes, lessons learned, and the discovery of new challenges or priorities.

ACKNOWLEDGEMENTS

The Houston Health Department Asthma Prevention and Control Program would like to acknowledge our valued partners who contributed their time, effort, guidance, and expertise in the development of this strategic plan.

Centers for Disease Prevention & Control (CDC) National Asthma Control Program

Texas Gulf Coast Asthma Coalition, including:

American Heart Association (AHA)
American Lung Association (ALA)
Baylor College of Medicine (BCM)
The Council on Recovery
Environmental Defense Fund (EDF)
Harris County Public Health (HCPH)
Houston Independent School District (HISD)
MD Anderson EndTobacco Program
Rice University, Urban Data Platform (UDP)
Texas Children's Health Plan (TCHP)
Texas Children's Hospital (TCH)
Texas Department of State Health Services (TDSHS)
Thermo Fisher Scientific

Houston Health Department Information Technology (IT)

In memory of Noah Delgado

BACKGROUND

CITY OF HOUSTON

Houston is the 4th largest metroplex in the U.S. and nexus of Harris County, the 3rd most populous county in the nation. An estimated 2.3 million people live in Houston, with 25.1% of the population under the age of 18¹. Houston is an incredibly diverse city - 43% of the population is of a racial minority group and 45% is of Hispanic or Latino origin¹. The median household income in the city is \$52,338, significantly lower than the national median of \$62,843¹. Similarly, approximately 20.1% of Houstonians are living below the poverty level, compared to the national percentage of 13.4%¹. Houston's poverty disproportionately affects its African American and Hispanic populations.

Houston hosts the largest medical center in the world, which is home to eight different academic and research institutions as well as 21 different hospital systems including the largest children's hospital in the nation – Texas Children's Hospital. In spite of the resources available, according to 2019 Census Bureau data, Houston had the highest uninsured rates for populations under

the age of 65 in the U.S.². The uninsured rate in Houston in 2019 was 25.4%, more than tripling the national uninsured rate for children and adults of 8.0%^{1,2}. In 2017, a reported one in five uninsured children in the U.S. lived in Texas, accounting for about 835,000 children³.

Houston is also home to the largest petrochemical complex in the nation, located in the Port of Houston along a 52-mile expanse known as the Houston Ship Channel. This complex stretches along almost half of the Ship Channel's length and is composed of nearly 200 private and public industrial terminals and several major refineries⁴.

Composed of over 2 million people living in the Houston metropolitan area, it is no surprise that the city experiences significant traffic daily. With a lack of infrastructure supporting public transportation outside the main downtown areas, and an intrinsic city culture favoring private transportation, Houstonians' use of public transportation is limited which further contributes to the traffic burden contributing to the high levels of outdoor air pollution.

Houston is a city composed of older housing stock, where an estimated 36.0% of homes, accounting for 849,200 housing units, in the city were built prior to 1980 and 5.9%, accounting for 138,900 housing units, were built prior to 1950⁵. It is an unfortunate fact that some of the most vulnerable communities in the city live in older and poorer housing that is at higher risk of containing indoor environmental hazards, such as mold, mildew, and cockroaches, to name a few.

Houston is located in the gulf coast region of Texas, classified as a humid sub-tropical climate, affecting the ease of breathing and increasing risk of breathing problems during periods of higher humidity⁶. Summers in Houston can be especially brutal in terms of humidity, with an average relative humidity ranging from around 60% in the afternoon to as high as over 90% in the morning⁶. Houston is known to have a variety of allergens, such as tree pollen, grass pollen, ragweed pollen, and mold spores. The City's allergy profile can be separated into three main allergy seasons, distinguished by the type of allergen that is most prolific at the time⁷.

Its location also makes Houston vulnerable to the consequences of climate change. At the end of August 2017, three days after the official start of Autumn, Hurricane Harvey stalled over Texas and dumped 33 trillion gallons of water across the gulf coast and set a continental US record for rainfall exceeding 50 inches⁸. This resulted in extensive flooding in the city with dozens of fatalities and substantial economic costs. In 2020, although much less devastating, Houston was impacted by an overactive Atlantic hurricane season which had 30 named storms, 13 hurricanes and 6 major hurricanes: the most on record according to the National Oceanic and Atmospheric Administration⁹.

ASTHMA PREVENTION AND CONTROL PROGRAM (APCP)

The Houston Health Department (HHD) has a mission to work in partnership with the community to promote and protect the health and social well-being of Houstonians and the

environment in which they live. The health department has a long history of positioning asthma control as a priority. Based on a Community Health Assessment facilitated by the HHD, specific asthma improvement objectives were featured in a Community Health Improvement Plan (CHIP) that was adopted and is currently being implemented over a three-year period (2019-2021).

The Houston Health Department's (HHD) Asthma Prevention and Control Program (APCP) resides within the Bureau of Community and Children's Environmental Health. The program was officially formed with the awarding of the Houston Asthma Control through Evidence-based Interventions Project (HACEIP), as part of the CDC's National Asthma Control Program. The APCP coordinates planning, training and asthma control initiatives with internal and community strategic partners, and the Texas Gulf Coast Asthma Coalition, consisting of stakeholders from school districts, hospital systems, Managed Care Organizations (MCOs), academics, health care providers, public health professionals, and Non-Governmental Organizations (NGOs).

The APCP also houses and leads other asthma initiatives in addition to the HACEIP. The APCP conducts an intensive school-based asthma management project that supports children attending schools located in high-rate asthma attack regions, known as the Environmental Mobile Unit (EMU) project. This project centers around an asthma mobile unit that visits schools and daycares to assess, monitor, and educate children who have poorly controlled and uncontrolled asthma, incorporating evidence-based curriculum and strategies. It also includes a home visitation component targeted at the children's caregivers that focuses on asthma self-management education and trigger reduction. Previously, the APCP also participated in a CDC-funded Hurricane Crisis Cooperative Agreement with as asthma phone survey as its core component, focusing on the impact of Hurricane Harvey on asthma exacerbations in children living in flooded zip codes.

ASTHMA BURDEN

Asthma is a significant public health issue in Houston that has warranted attention from the medical and public health communities. In 2016, an estimated 1,956 hospital discharges in the city were due to asthma, of which 44% were children¹⁰. Data provided by the CDC 500 Cities/PLACES Project show an estimated 9.0% of adults in Houston had asthma in 2018¹¹. Houston Independent School District (HISD), the largest school district in the city, has over 6,000 students with asthma¹². HISD estimates that about 37% of these children's asthma is currently not being managed correctly or at all¹².

A multitude of factors contribute to exacerbations of asthma in both adults and children living in Houston including: higher poverty levels, older housing stock, mold, hurricanes and flooding, extreme heat waves, and proximity to industrial sites and other pollution sources. Houston Health Department (HHD) research indicates pervasive outdoor air pollution stemming from the largest petrochemical complex in the U.S. triggers asthma attacks¹³. Houston is the only city in

the U.S. to alert residents when mixtures of ozone and nitrogen oxides extending for multiple days have historically posed an increased risk of an asthma attack¹⁴.

There are economical impacts for Houstonians associated with asthma as well. When factoring in transportation, emergency room, and hospital costs, an uncontrolled asthma attack can cost up to an estimated \$10,000¹². High utilization of ambulance services for this mostly preventable health emergency creates significant costs for the city, it is also a likely indicator of a similar pattern in lack of asthma control in ED visits and hospitalizations¹².

ASTHMA PREVALENCE

The HACEIP receives asthma prevalence data from the Behavioral Risk Factor Surveillance System (BRFSS), as analyzed by the Texas Department of State Health Services' Chronic Disease Epidemiology Branch.

Data collected from the 2017-2019 BRFSS indicate that 7.0% of adults reported having current asthma, with 12.0% of adults reporting that they ever had asthma in their lifetime¹⁵. Comparatively, combined data collected from the 2014, 2015, and 2019 BRFSS indicate that 4.2% of children reported having current asthma, with 6.4% of children reporting that they ever had asthma in their lifetime¹⁵.

HOSPITALIZATIONS

The HACEIP receives asthma-related hospitalization data from the Texas Department of State Health Services' Texas Health Care Information Collection (THCIC).

In 2018, there were **19,314** asthma-related hospitalizations (where asthma was listed as either the principal or other diagnosis) in City of Houston zip codes, as reported by 193 healthcare institutions. When limiting to hospitalizations where asthma was listed as the principal diagnosis, there were **2006** hospitalizations in City of Houston zip codes in 2018 (accounting for 10.4% of the asthma-related hospitalizations). This equates to an estimated **86.8** hospitalizations due to asthma (where asthma is listed as the principal diagnosis) per 100,000 population in Houston. The age-specific hospital discharge rate due to asthma for children comes out to an estimated **51** hospitalizations per 100,000 population of children in Houston¹⁵. The age-specific hospital discharge rate due to asthma for adults comes out to an estimated **33** hospitalizations per 100,000 population of adults in Houston¹⁵. Over 85% of hospitalizations where asthma was listed as the principal diagnosis originated in the Emergency Department.

Figures 1, 2, and 3 below show the breakdowns of 2018 hospitalizations due to asthma (where asthma was listed as the principal diagnosis) by quarter, age, and race, respectively. An estimated one-third of asthma hospitalizations occurred within the first quarter of 2018, from January 1st through March 31st, supporting the idea that the cold weather during these months may negatively impact asthma control. Furthermore, over 40% of the asthma hospitalizations occurred in children under the age of 18 years, highlighting the inequity impacting the youngest

age groups. Similarly, the Black/African American population bears a disproportionate burden, accounting for over 44% of asthma hospitalizations in 2018.

Figure 1: 2018 Asthma Hospitalizations (Principal Diagnosis), by Quarter

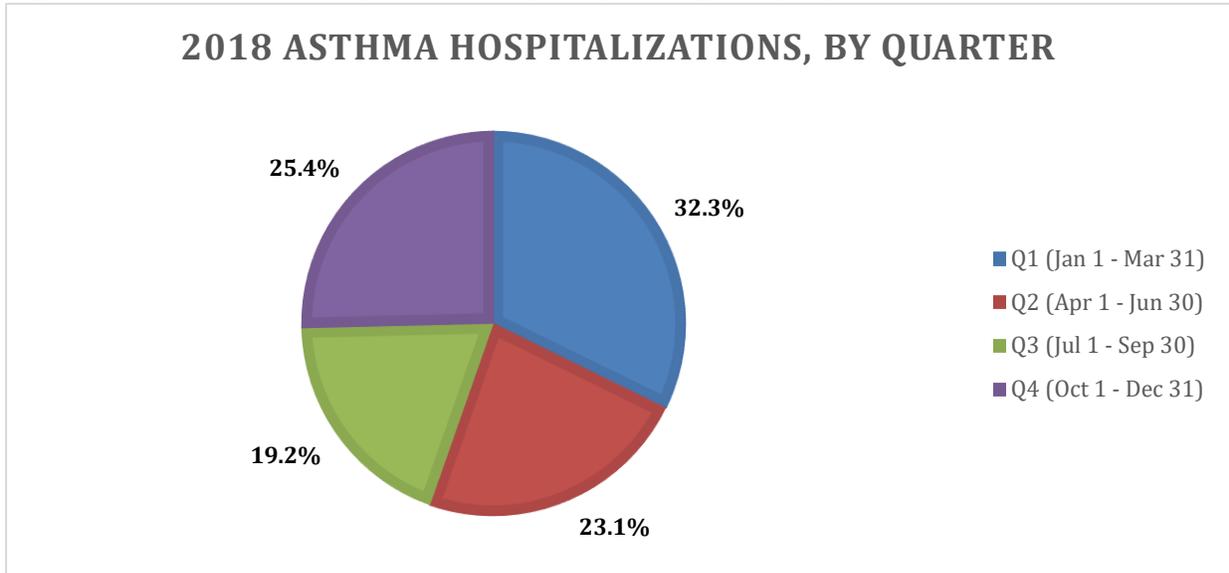


Figure 2: 2018 Asthma Hospitalizations (Principal Diagnosis), by Age

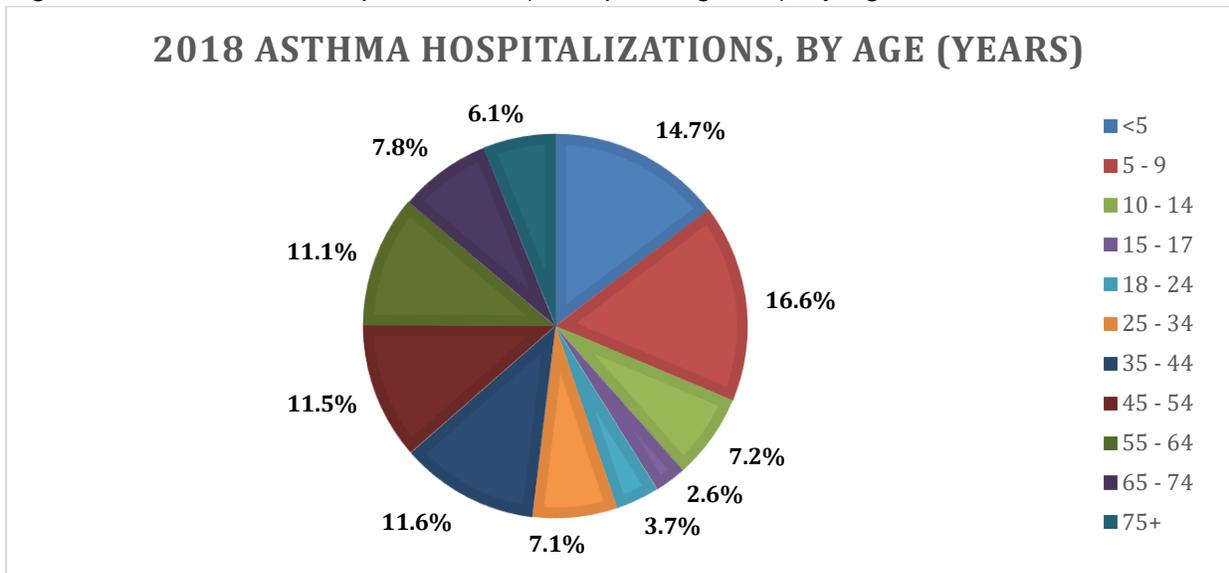
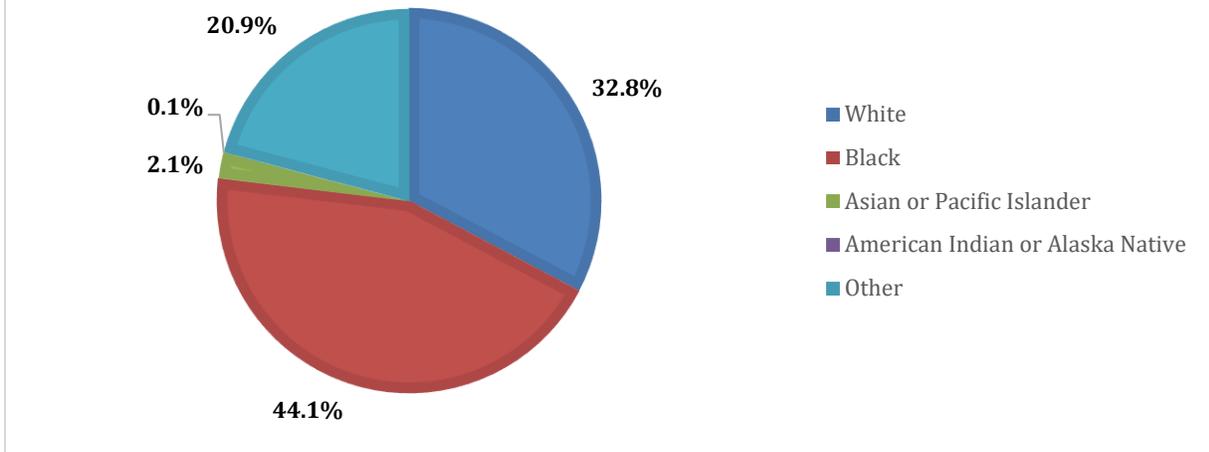


Figure 3: 2018 Asthma Hospitalizations (Principal Diagnosis), by Race

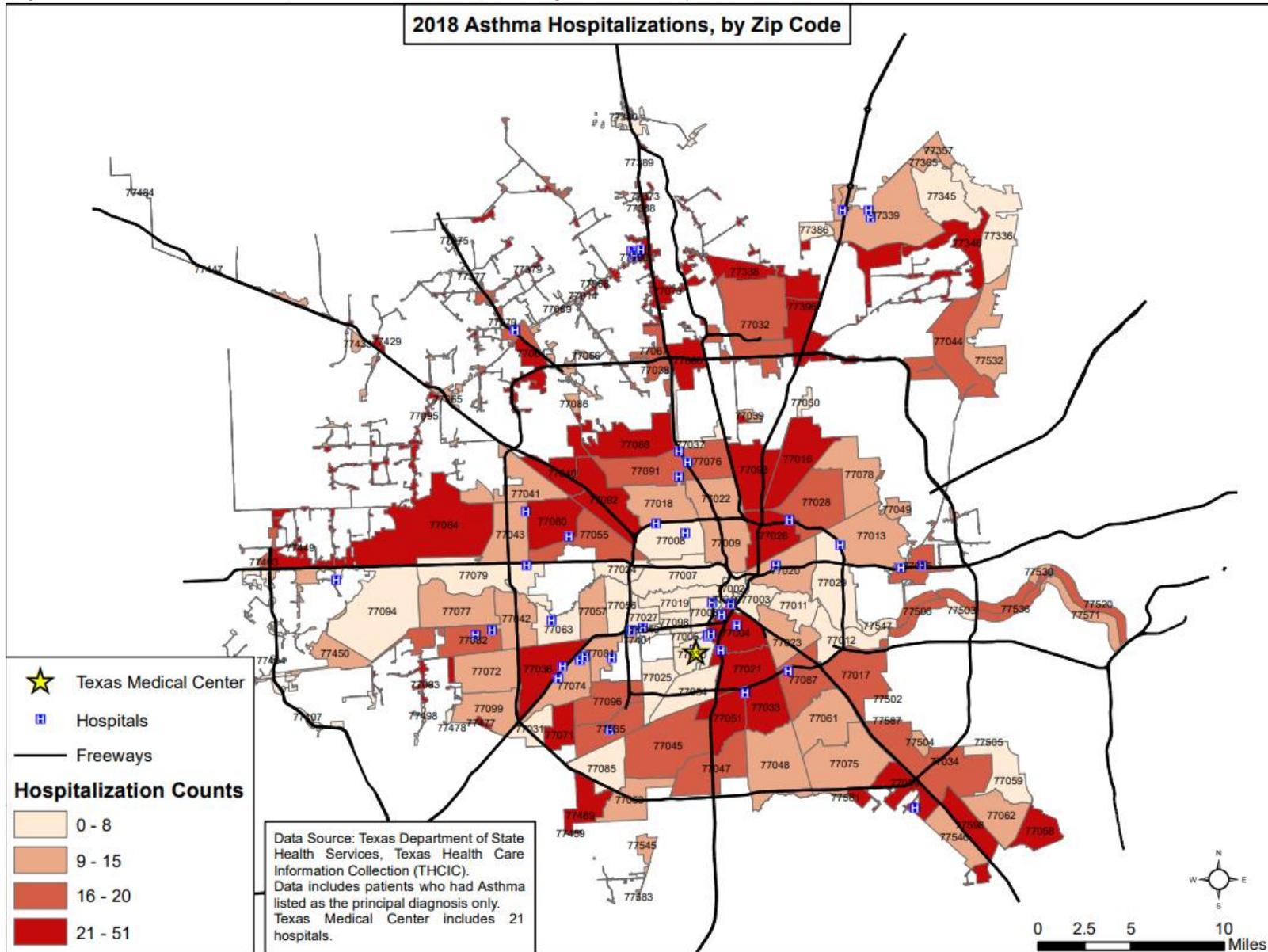
2018 ASTHMA HOSPITALIZATIONS, BY RACE



Mapped counts of 2018 hospitalizations due to asthma (where asthma was listed as the principal diagnosis) by zip code can be found in Figure 4 below.

Further breakdowns of the asthma-related hospitalizations can be found in the Appendix at the end of the document, in *Table A.1: 2018 Asthma-Related Hospitalizations in City of Houston Zip Codes*.

Figure 4: 2018 Asthma Hospitalizations (Principal Diagnosis) in City of Houston Zip Codes



EMERGENCY DEPARTMENT (ED) VISITS

The HACEIP receives asthma-related emergency department (ED) data from the Texas Department of State Health Services' Texas Health Care Information Collection (THCIC).

In 2018, there were **55,529** asthma-related ED visits (where asthma was listed as either the principal or other diagnosis) in City of Houston zip codes, as reported by 277 healthcare institutions. When limiting to ED visits where asthma was listed as the principal diagnosis, there were **14,365** ED visits in City of Houston zip codes in 2018 (accounting for 25.9% of the asthma-related ED visits). This equates to an estimated **621.9** ED visits due to asthma (where asthma is listed as the principal diagnosis) per 100,000 population in Houston. The age-specific ED discharge rate due to asthma for children comes out to an estimated **481** ED visits per 100,000 population of children in Houston¹⁵. The age-specific ED discharge rate due to asthma for adults comes out to an estimated **252** ED visits per 100,000 population of adults in Houston¹⁵.

Figures 5, 6, and 7 below show the breakdowns of 2018 ED visits due to asthma (where asthma was listed as the principal diagnosis) by quarter, age, and race, respectively. Unlike asthma hospitalizations, ED visits appear evenly distributed across the year, where no quarter showed an unequal difference. However, when stratifying by age and race, similar patterns can be seen for ED visits as in hospitalizations, as described in the previous section. Almost 50% of the asthma ED visits occurred in children under the age of 18 years, highlighting greater impacts to the youngest age groups. Similarly, the Black/African American population bears a disproportionate burden, accounting for over 50% of asthma ED visits in 2018.

Figure 5: 2018 Asthma Emergency Department Visits (Principal Diagnosis), by Quarter

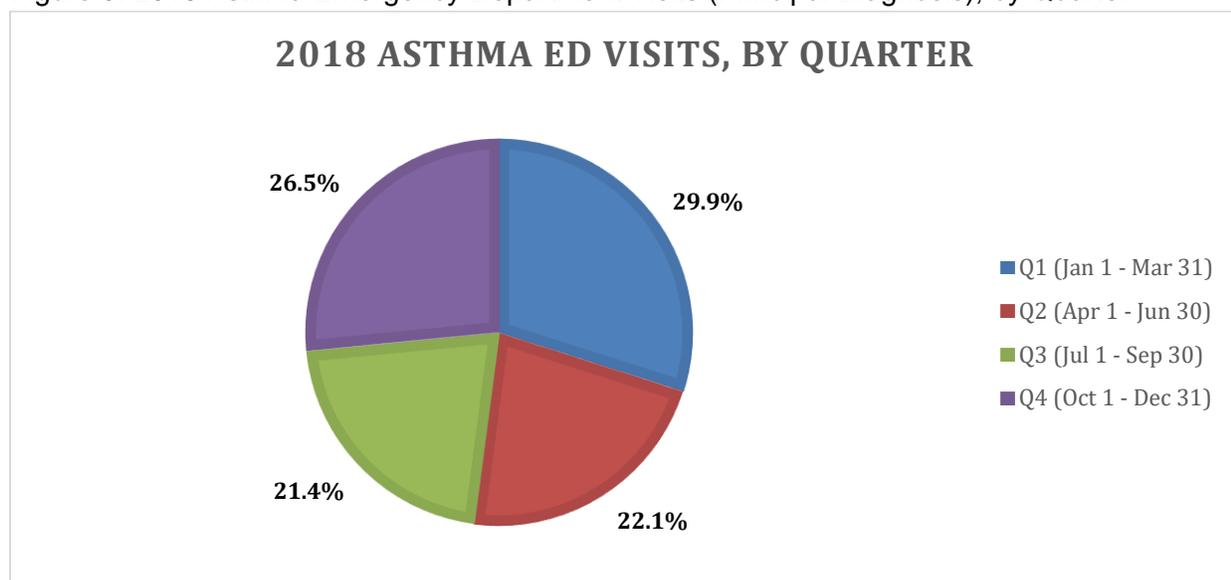


Figure 6: 2018 Asthma Emergency Department Visits (Principal Diagnosis), by Age

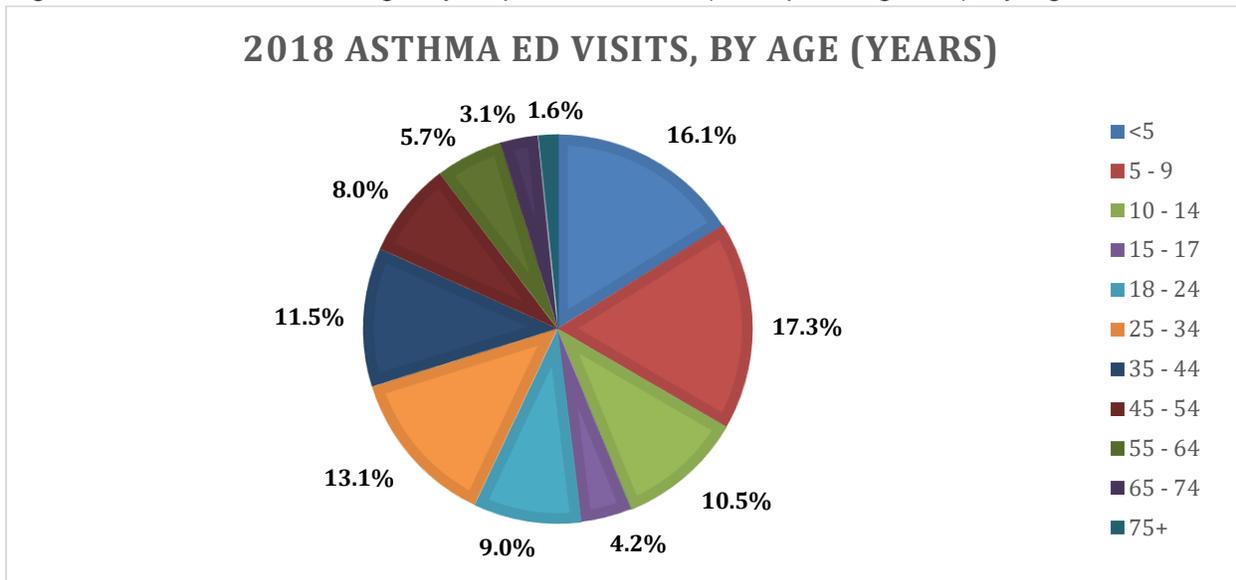
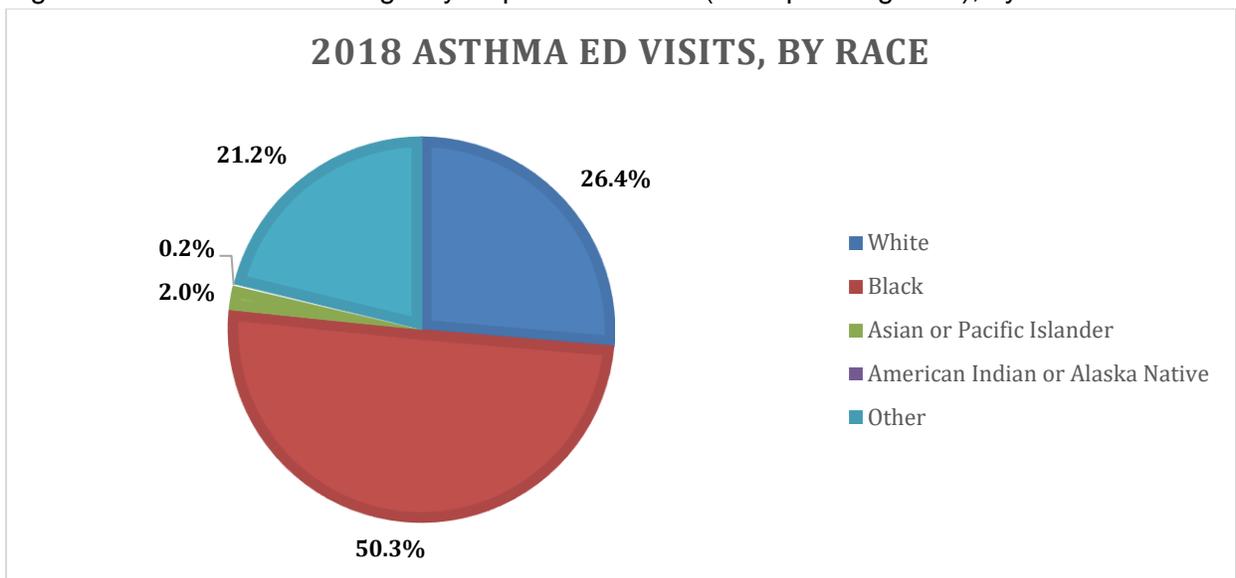


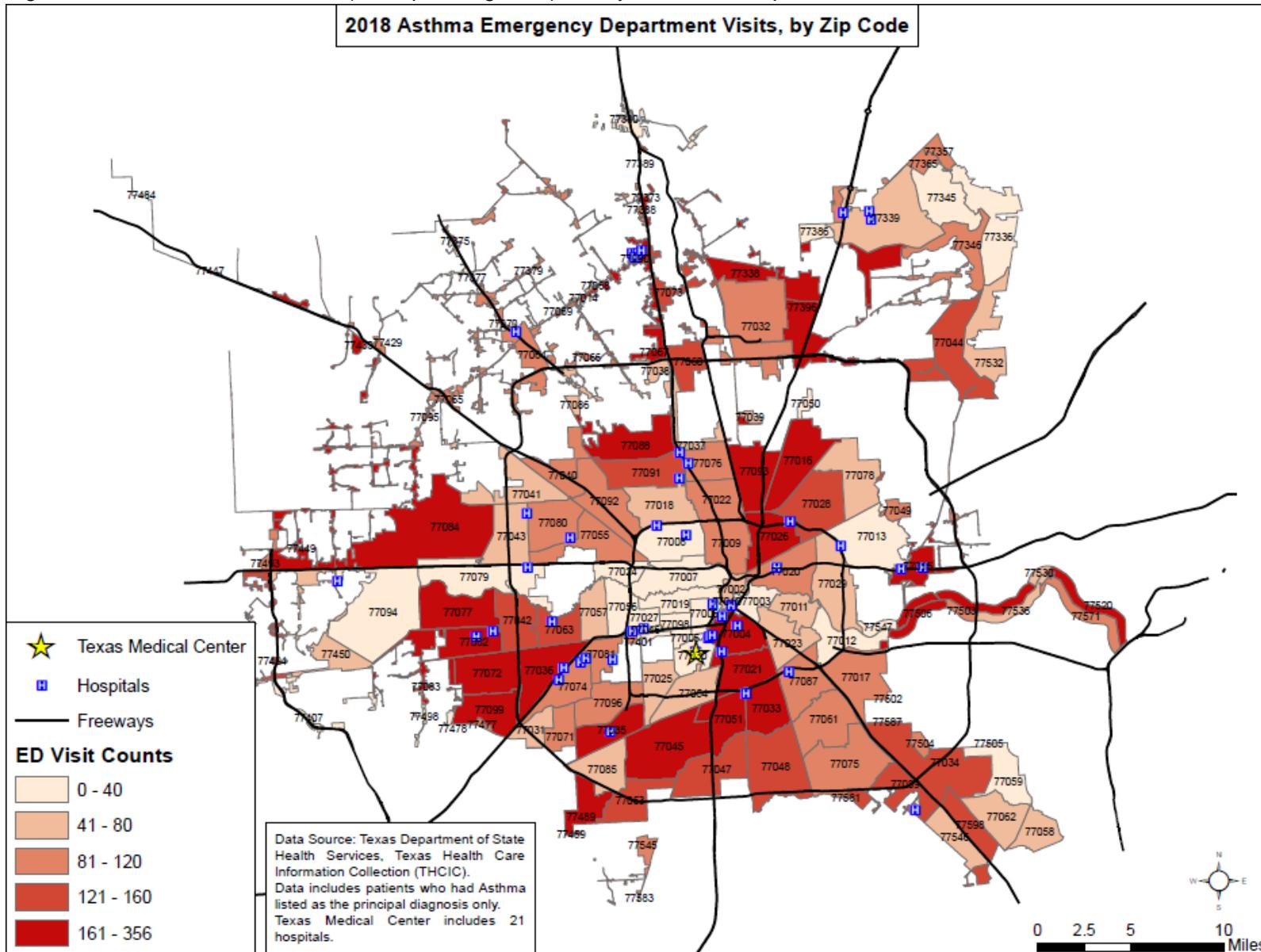
Figure 7: 2018 Asthma Emergency Department Visits (Principal Diagnosis), by Race



Mapped counts of 2018 ED visits due to asthma (where asthma was listed as the principal diagnosis) by zip code can be found in Figure 8 below.

Further breakdowns of the asthma-related ED visits can be found in the Appendix at the end of the document, in *Table A.2: 2018 Asthma-Related Emergency Department (ED) Visits in City of Houston Zip Codes*.

Figure 8: 2018 Asthma ED Visits (Principal Diagnosis) in City of Houston Zip Codes



MORTALITY

The HACEIP receives asthma-related mortality data from the HHD's internal Bureau of Vital Statistics.

In 2018, there were 21 asthma-related deaths (where asthma was listed as either the primary or other factor contributing to death) in City of Houston zip codes. Comparatively, in 2019, there were 18 asthma-related deaths (where asthma was listed as either the primary or other factor contributing to death) in City of Houston zip codes. 2020 mortality data is currently complete through July 30, 2020 only, and to that date there were 28 asthma-related deaths (where asthma was listed as either the primary or other factor contributing to death) in City of Houston zip codes.

HEALTH EQUITY

The burden of asthma is not distributed evenly across the City of Houston. Location and the environmental conditions nearby play a factor, as evidenced by the Houston Ship Channel and associated petrochemical complex, and socioeconomic (SES) characteristics such as race, poverty, access to care also have a large role in affecting health equity.

Several Houston Health Department (HHD) studies have been conducted in partnership with Rice University to better understand the inequity of asthma control across racial and ethnic minority populations in Houston, and to indicate where to target interventions. 12,155 EMS ambulance-treated asthma attack cases from 2004 to 2011 were analyzed to identify asthma high rate regions in the city and the factors affecting ambulance utilization for asthma¹⁶. These high rate regions highlight where there is an ambulance utilization rate to treat acute asthma attacks that is over six times higher per 100,000 people than the rest of the city¹⁶. In another HHD study specifically focused on better targeting resources for school-based asthma interventions, ambulance-treated asthma attacks rates were found to be 5, 3, and 2 times greater for elementary, middle, and high schools respectively in the school zones with rates in the upper quartile compared with rates of all other school zones¹². These high-rate school zones coincide with areas of Houston that have large proportions of African American and Hispanic residents and higher rates of poverty. Spatial, temporal, and demographic information in these high-rate areas is being used to inform interventions.

Studies have been conducted to shed light on the additional factors that contribute to health inequities surrounding asthma. A study that highlighted the increased asthma prevalence rates along the Houston Ship Channel also mapped prevalence in relation to poverty across Houston neighborhoods and noted that poverty and asthma went hand-in-hand in many areas of the city¹⁷. Another article's findings show that children with public insurance (a measure that is often used as a proxy to indicate lower socioeconomic status) were twice as likely to be diagnosed

with asthma than children with private insurance¹⁸. When investigating other factors that contribute to neighborhood disadvantage (i.e., poverty, unemployment, the percentage of households receiving public assistance and the percentage of female-headed households with children) in combination with neighborhood pollution and air quality, children living in socioeconomically disadvantaged zip codes typically had higher rates of asthma as well¹⁸.

Even after controlling for socioeconomic aspects associated with these disadvantaged neighborhoods, the researchers still found that black children were over twice as likely to be diagnosed with asthma than white and Asian children¹⁸. Amongst the study sample, 13% of black children ages 2-12 years had asthma diagnoses as compared to 7% of Hispanic children, 4% of Asian children, and 4% of white children, indicating that there may still be more measures involved that influence the observed health disparities, such as exposure to violence and crime, safety concerns, or even chronic stress that can lead to other health impacts¹⁸.

AREAS OF FOCUS

SURVEILLANCE

Surveillance is an integral process in consolidating, analyzing, and presenting data from multiple health systems on specific asthma indicators, which serves a critical role in understanding the burden of asthma in a region. Surveillance allows for an evidence-based, data-driven process that guides program activities geared towards optimizing services, guiding business decisions, and reducing asthma disparities that will lead to improved asthma outcomes at a population-level.

Surveillance has been a critical component in several studies, using various methods to collect and analyze the data needed to form conclusions and guide decisions regarding public health interventions. For example, a pilot study done in Korea conducted surveillance through the use of surveys with the objective of determining the association between the home environment (e.g., indoor air quality) and socioeconomic characteristics with the risk of developing asthma and allergic diseases¹⁹. The distributed surveys in this study, targeting Korean preschool children, formed the basis for and piloted the Korean Surveillance System for Childhood Asthma (KSSCA). With over 1,000 families completing the survey, findings from this pilot shed light on several facets related to childhood asthma, including current and lifetime asthma prevalence, environmental and socioeconomic risk factors for asthma, and parental history for allergic diseases and the associated increased risk for their children to develop asthma (and allergic diseases). The results demonstrate that surveillance is an important tool in assessing the relationships between risk factors and the exacerbation of diseases. Similarly, another study conducted in New York State utilized population-based surveys (i.e., NYS National Asthma Survey, BRFSS, and ACBS) and case-based surveillance through the NYSDOH Occupational Lung Disease Registry to understand the prevalence of work-related asthma (lifetime and current), asthma control status of participants, industry, and exposures²⁰. These surveillance activities allowed the investigators to determine that adults with work-related asthma suffer from worse asthma control and negative socioeconomic impacts compared to adults whose asthma is not work-related, allowing them to identify disparities in the asthma burden and home in on a target population for interventions.

There are many different avenues through which surveillance can be conducted, such as surveys, registries, and electronic health records (EHR), and the most appropriate strategy can vary depending on the context of the surveillance activities. For asthma surveillance, health surveys completed over the phone have been the traditional method for collecting data on asthma prevalence; however, in recent years the trend is shifting towards leveraging EHR as a source of identifying populations with asthma. A study conducted in 2014 comparing traditional phone survey sources to EHR reported that EHR has great potential as a source of asthma health data²¹. Furthermore, the authors stated that while utilizing phone surveys is appropriate when collecting data at a state or national level, they are not as reliable for local-level data.

Objective 1: Develop a city-wide surveillance system and dashboard to assess the burden of asthma in the city and visualize key indicators of asthma control.

Background:

Houston has never had a city-wide surveillance system for asthma, and it is a key objective of the APCP to develop such a system to strengthen and expand the programmatic infrastructure of Houston. By partnering with major healthcare systems in Houston, the APCP aims to receive asthma-related metrics that will inform on the state of asthma in the city. The surveillance system that is being developed will be a dynamic, constantly evolving ecosystem that captures changes in not only how partners are contributing data but also how they are using the collected data to perform quality improvement within their own systems.

One such partner is the HHD's internal Electronic Surveillance System for the Early Notification of Community-based Epidemics (ESSENCE), a database that tracks syndromic surveillance data reported by several healthcare systems in the greater Houston area. The HHD's ESSENCE is a relatively newer database, established in 2017, and is still steadily expanding its partner network that are contributing data. Currently, the HHD's ESSENCE is used to supplement the broader asthma-related ED data collected through the THCIC datasets, and this growing system will form a strong foundation for the APCP's comprehensive surveillance system.

Partners: Rice University; HHD ESSENCE; Texas Department of State Health Services, Texas Health Care Information Collection; Texas Children's Hospital; Texas Children's Health Plan

Strategy 1.1: Increase the number of healthcare organizations (i.e., hospitals, MCOs, clinics, FQHCs, etc.) that actively participate in local asthma surveillance projects and data-sharing agreements related to asthma.

Strategy 1.2: Leverage HHD ESSENCE syndromic surveillance system to segregate asthma-related data and build upon the existing infrastructure to expand the data being reported.

Strategy 1.3: Establish a public dashboard that tracks indicators such as hospitalizations, ED visits, asthma prevalence, etc., which can inform on the burden of asthma in the City.

Objective 2: Monitor trends in asthma-related hospitalizations, ED visits, and other indicators to identify populations suffering from disparities that need heavier engagement and focus.

Background:

A major benefit of an asthma dashboard is the ability to identify populations that are disproportionately affected, allowing healthcare systems, public health organizations, and other stakeholders to target efforts towards these communities. The dashboard also provides a platform to track metrics over time and detect trends, indicating whether asthma control in the city is improving or worsening. Monitoring these trends will enable the APCP to observe the impact of project interventions on indicators of asthma burden and control.

The dashboard can be used for comparative analysis on asthma indicators across healthcare systems. By tracking the trends in the measures that reflect asthma control, healthcare systems can gauge the impact of environmental determinants, policies, and quality improvement activities to guide their own strategic planning. Instead of pulling reports on a regular basis, an asthma dashboard would allow health systems and other stakeholders to monitor aggregate asthma outcomes at a community-level at any point in time.

Strategy 2.1: Link data trends regarding indicators of asthma burden to specific evaluation questions to determine the impact of activities, interventions, and policies implemented from the strategic plan (e.g., how effective project interventions are at decreasing asthma burden in the city).

Strategy 2.2: Implement trend analysis to identify how asthma is affecting target populations over time, how effective healthcare system QI initiatives are, and the evolution of collaborative processes.

GUIDELINES-BASED CARE

In 1989, the National Heart, Lung, and Blood Institute (NHLBI) created a program, now known as the National Asthma Education and Prevention Program (NAEPP), to address asthma issues in the United States. The NAEPP focuses on raising awareness and ensuring appropriate diagnosis and management of asthma to reduce asthma-related morbidity and mortality and to improve the quality of life of individuals with asthma. To that end, the NAEPP published its first expert panel report (EPR) on the diagnosis and management of asthma in 1991. Since then, these guidelines have been revised several times and the Panel Report 3: Guidelines for the Diagnosis and Management of Asthma (EPR-3), published in 2007, have been extensively studied and considered best practice²².

The NAEPP EPR-3 guidelines detail evidence-based recommendations which cover a range of topics under four broad categories: asthma assessment and monitoring; asthma self-management education; control of environmental factors that precipitate asthma exacerbations; and comprehensive pharmacotherapy for long-term management²². In the latter part of 2020, the NAEPP Expert Panel released focused updates to six topic areas within these categories to reflect the substantial progress that has been made in understanding the pathophysiology and treatment of asthma in the last decade including the use of fractional exhaled nitric oxide (FeNO) in diagnosis, medication selection, and monitoring of treatment response in asthma; updates in pharmacotherapy and immunotherapy in asthma management; and a focus on the remediation of indoor allergens (e.g., house dust mites/pets)²³.

There is strong evidence to show that asthma control can be improved through adherence to guideline recommendations²⁴. More importantly, the lack of adherence has been linked to poorly controlled asthma which leads to greater morbidity and mortality^{25,26}. And the stakes could not be higher for low SES, minority populations, particularly those individuals living in urban areas where asthma rates are traditionally higher and outcomes poorer^{27,28,29}. This is where guidelines-based care can potentially make the greatest impact. A study carried out in a similar population showed that increased use of guidelines among primary providers resulted in a decrease in hospitalizations and emergency department visits for pediatric patients with asthma³⁰.

Achievement of guideline-based medical management has been identified by CDC's National Asthma Control Program as an important strategy in reducing morbidity and mortality among adults and children with asthma³¹. However, primary care providers that implement guidelines-based asthma care are in the minority and there are a multitude of barriers to patient adherence such as low health literacy and lack of medical benefits^{24,32,33}.

Objective 1: By 2024, increase awareness and implementation of guidelines-based medical management among primary healthcare practitioners.

Background: The Asthma Tools Study, a randomized clinical trial, was created to assess rates of guidelines adherence among family medicine and pediatric practices in children and adults in the US. The study found that overall adherence to the guidelines was poor among the practices that participated. Although adherence to medication recommendations was higher than for non-medication recommendations, one-third of patients with persistent asthma did not receive prescriptions for daily controller medications³³. The barriers for utilization of guidelines-based asthma management are providers' disagreement with recommendations, and their lack of knowledge, outcome expectancy, and confidence to carry out these evidence-based practices; as well as lack of tools, time, and resources^{34,35}. Interventions that include resources and decision support tools (i.e. protocols, guidelines, flowsheets) have demonstrated positive impact on providers' adherence to EPR-3 guidelines^{34,35}. Continuing education related to enhancing communication skills has also shown to effectively support asthma self-management among patients³⁶.

Partners: Texas Gulf Coast Asthma Coalition, Texas Children's Health Plan, Harris Health, Memorial Hermann Hospital System, Texas Children's Hospital, Harris County Family Medicine Association

Strategy 1.1: Implement and maintain surveillance of NAEPP asthma guidelines utilization by surveying a representative sample of the over 4,400 primary care physicians in Harris County on a biennial basis³⁷.

Strategy 1.2: Implement an asthma guidelines communication campaign among primary care providers in Houston that can include grand round seminars, CMEs, newsletter articles and the dissemination of simple tools and resources such as guideline fact sheets, posters and pocket guidelines.

Strategy 1.3: Increase the number of providers who successfully complete continuing education that supports provider-patient communication around asthma care such as the Physician Asthma Care Education (PACE) program, an interactive, multimedia curriculum distributed through the National Institutes of Health.

Objective 2: By 2024, increase the number of health providers that can effectively recommend tailored allergen exposure reduction strategies to patients with asthma.

Background: Environmental control is one of the four cornerstones of the NAEPP EPR-3 guidelines²². Allergen mitigation strategies are aimed at reducing an individual's exposure to indoor asthma triggers. The Expert Panel has recommended that patients should reduce exposure, as much as possible, to allergens to which the patient is sensitized and exposed. For patients with persistent asthma, it is recommended that providers should evaluate the potential role of indoor inhalant allergens (e.g., pollen, animal dander, house dust mites, cockroaches, and certain molds) by using the patient's medical history to identify allergen exposures; perform skin testing or in vitro testing to reliably determine sensitivity to perennial indoor allergens; and assess the significance of positive tests in the context of the patient's medical history²². Additionally, skin or in vitro tests are necessary to educate patients about the role of allergens in their disease as patients are more likely to undertake the measures once they know what they are allergic to²². The asthma guidelines provide a comprehensive list of indoor allergens and recommend using multifaceted allergen-control education interventions as part of a patient's asthma management. The 2020 Focused Updates emphasize the use of multi-component allergen mitigation strategies as best practice and continue to recommend the use of testing for specific allergen sensitization, when appropriate²³.

Partners: Texas Gulf Coast Asthma Coalition, Texas Children's Health Plan, Harris Health, Memorial Hermann Hospital System, Texas Children's Hospital, Harris County Family Medicine Association

Strategy 2.1: Increase the number of primary providers that perform Immunoglobulin E (IgE) allergy testing (skin or in vitro) for children and adults that have persistent or intermittent asthma.

Strategy 2.2: Increase the number of primary providers that have a working knowledge of indoor allergen mitigation strategies by promoting indoor environmental health training such

as Healthy Homes and the National Environmental Education Foundation (NEEF) Environmental Management of Pediatric Asthma Guidelines for Healthcare Providers.

TOBACCO CONTROL

Smoking is the leading cause of preventable disease and death in the United States and Texas³⁸. For adults and children with asthma, exposure to environmental tobacco smoke has long been associated with increased exacerbations, decreased lung function, and greater use of health care services³⁹. And, although tobacco use by adults has come down over the last decade to a historical low where 14% of adults reported to smoke in 2019, not all Americans have benefited equally from this decline³⁸. Smoking and exposure to secondhand smoke continues to have a disproportionate impact on traditionally vulnerable populations including ethnic minorities, LGBTQ+ persons, and those with low socio-economic status. Although African Americans tend to smoke less than White or Hispanic Americans, they are more likely to die from smoking-related diseases⁴⁰. And, African American children and adults are more likely to be exposed to secondhand smoke than any other racial or ethnic group⁴¹. Lesbian, gay, and bisexual (LGB) adults have a smoking rate of 19.2%. That translates to about one in five LGB adults who smoke compared with one in seven straight adults^{38,42}. Persons making less than \$25,000 a year have a smoking rate of 24.7%, close to double the rate among those making \$25,000 a year or more⁴³. People living in poverty smoke cigarettes more heavily and smoke for nearly twice as many years as people with a family income three times the poverty rate⁴⁴.

Adolescents are another vulnerable population that need special attention. The rise of e-cigarettes and vaping among teens has raised concerns that another generation may become dependent on nicotine. In the past seven years, e-cigarettes have become the most common used tobacco product⁴⁵. Five million middle and high school students vaped in 2020⁴⁶. Vaping is known to affect many functions in the body, particularly the respiratory system. Studies have shown vaping can affect many cells in the upper respiratory tract (nose, throat, and lungs), and those who have asthma are particularly sensitive to enduring long-term lung complications⁴⁷. Youth tobacco users are likely to use flavored e-cigarettes that contain chemicals such as diacetyl which can permanently injure the lungs. Breathing in ultrafine vapor particles can cause asthma attacks, coughing, wheezing and shortness of breath⁴⁷.

Houston has made strides towards achieving tobacco-free living for its residents. 2021 marks the 15th year of the adoption of Ordinance No. 2006-1054 prohibiting indoor smoking in Houston public areas and places of employment, which can be found here: http://www.houstontx.gov/health/Environmental/smoking_ordinance.html. In 2014, the Houston Housing Authority implemented an indoor smoke-free policy at the agency's 25 multi-unit public housing facilities four years ahead of HUD's federal directive. The policy provides agency employees and over 16,000 residents who reside in housing authority properties with a smoke-free living environment. In 2019, preempting another federal law, Texas adopted the Senate Bill S.2100, better known as Tobacco 21, which raised the minimum legal age in Texas to purchase tobacco from 18 years to 21 years of age.

Objective 1: By 2024, decrease smoking and exposure to secondhand smoke among people with asthma in vulnerable, disparate or hard to reach populations including racial and ethnic minorities, LGBTQ+ persons and those with low socioeconomic status.

Background: Socioeconomic disparities in cigarette smoking continue to exist despite progress in reducing cigarette smoking in the general population and among certain demographic groups⁴⁸.

Population focused interventions can be effective in reducing the disparities in tobacco control⁴⁹. This can include engaging non-traditional venues and partners such as bars and barbershops^{50,51}. Communication campaigns are more effective when using messaging and media that is culturally appropriate and relevant to specific groups^{52,53}.

Partners: Texas DSHS, MD Anderson Tobacco Prevention, American Heart Association, Harris County Public Health and The Council on Recovery, National Alliance for Hispanic Health

Strategy 1.1: Implement an awareness campaign around disparities and disproportionately of smoking among specific populations in Houston. APCP will work with the Texas Gulf Coast Asthma Coalition, the Tobacco Control Working Group, and other strategic partners to collect or create educational material related to smoking disparities (articles, flyers, social media, seminars) to be disseminated health related professionals and organizations.

Measures: Disseminate at least six (6) unique educational products per year.

Strategy 1.2: Implement alternative communication campaign including social media for tobacco control directed towards disparate and hard to reach populations. Create culturally relevant content that can be posted on multiple social media platforms such as Facebook, Instagram, and Twitter.

Measures: Post at least 6 pieces of content per month. Collect online analytics.

Objective 2: By 2024, increase access to tobacco cessation treatment to youth and adults with asthma, caregivers of children with asthma, and pregnant women.

Background: Quitting smoking is one of the most important things individuals can do to protect their health. However, according to the American Lung Association, Texas received a failing grade on addressing tobacco prevention, cessation funding, and access to cessation services. To date, smoking rates in Texas surpasses that of the United States⁵⁴. In Texas, 15.8% of adults ages 18-44 years, and 24.7% of children under age 18 smoke tobacco products⁴³.

Partners: Texas DSHS, MD Anderson Tobacco Prevention, American Heart Association, Harris County Public Health, The Council on Recovery and Texas Children's Hospital

Strategy 2.1: Increase the number of providers who regularly screen for tobacco use and nicotine dependence to specific tobacco products, including e-cigarettes. APCP will work with strategic partners to promote the regular screening among adults and adolescents by utilizing communication tools such as emails, newsletters, flyers, and seminars.

Measures: Create and disseminate three (3) unique communication products per year promoting tobacco use screening.

Strategy 2.2: APCP will work with Tobacco Control Working Group and strategic partners to develop an online, comprehensive resource guide of tobacco cessation programs available to health care providers and community members in the Houston area.

Measures: Publish webpage with tobacco cessation resource guide to be updated quarterly.

Strategy 2:3: Increase the number of health care professionals, including community health workers and school nurses, who can provide tobacco cessation support to adults and adolescents with asthma and caregivers of children with asthma. APCP will work with strategic partners to provide tobacco cessation training to non-traditional health care workers utilizing evidence-based curriculum (i.e. Rx for Change, Nuestras Voces).

Measures: Number of non-traditional health care workers successfully completing tobacco cessation continuing education.

Objective 3: By 2024, reduce the uptake and use of e-cigarettes and other vaping products among young people with asthma.

Background: Texas, as compared to the rest of the United States, has relatively higher rates of vaping among the youth. In 2018, 18.9% of high school students vaped in the nationally, whereas Texas 20.8%. Among younger adolescents, 4.9 % of middle school students in the U.S. vaped while Texas middle school students vape at the rate of 6.0 %⁴⁷. Consequently, 498,000 teens under 18 will die prematurely from smoking⁵⁴. When it comes to initiation of tobacco use, studies have shown that young people are more likely to be influenced by tobacco marketing than by peer pressure as one-third of underage experimentation with smoking is attributable to tobacco marketing⁵⁴.

Strategy 3.1: APCP will work through the asthma coalition's Tobacco Control Working Group to support the expansion of Houston's existing smoking ban ordinance to include a ban on the use of all vaping products, including e-cigarettes, in public spaces within the City of Houston.

Measures: Successful passage of a vaping ban policy for City of Houston.

ENVIRONMENTAL JUSTICE

There is no doubt that encouraging the implementation of evidence-based medical management of asthma at the clinical level and investing in asthma self-management education, influencing behavior change in patients, will lead to positive health outcomes in the intermediate and long term. However, we must also look towards the environmental determinants that can support or handicap programmatic impacts. Climate change, more frequent and violent weather events, and exposure to multiple air pollution sources are the hurdles that Houstonians with asthma must contend with on a continual basis. These are some of the environmental drivers of illness that undermine our medical and public health efforts at the broadest level⁵⁵.

Climate change is an environmental issue and a serious threat to public health. According to the U.S. Environmental Protection Agency (EPA), increased temperatures due to climate change have led to heat waves, flooding, and more intense storms⁵⁶. Higher temperatures, due to climate change, worsens air quality and increases ground-level ozone, which causes airway inflammation and damages lung tissue. Current data suggests that air pollution can cause

asthma and lead to exacerbation for those living with the disease^{57,58}. Hurricanes and floods leave excess moisture and standing water in their wake. Damp buildings and furnishings promote the growth of bacteria, dust mites, cockroaches and mold, which can aggravate asthma and may cause the development of asthma⁵⁹.

The risk of adverse health outcomes, due to climate change and other environmental hazards, falls too often to the most vulnerable - children, people of color, fence-line communities, the poor and those with chronic conditions. Over the last 35 years, hundreds of articles have documented the unequal impacts of environmental hazards on these populations⁶⁰. For over 30 years, Dr. Robert Bullard, known as the Father of Environmental Justice, has chronicled the unbalanced placement of landfills, hazardous waste sites and polluting facilities among the black neighborhoods in Houston^{61,62}. Most recently, multiple studies regarding Hurricane Harvey concluded that not much has changed. In comparison to white, affluent neighborhoods, communities of color and households with lower SES experienced more extensive flooding, reported more physical and mental health problems, and were more likely to be exposed to dangerous chemical releases from the nearby petrochemical complex due to the storm^{63,64}.

Emergency management and preparedness play an important role in mitigating the impacts of climate change and industrial catastrophes at the local level⁶⁵. Preparedness is especially critical for people living with a chronic condition, such as asthma, as they are at additional risk of serious health complications during a disaster⁶⁶. However, in the 2020 report “Climate Change and Health: Assessing State Preparedness”, Texas was categorized as one of the states most vulnerable to climate change yet one of the least prepared to respond⁶⁷.

Efforts to level the environmental playing field for people with asthma can be bolstered by utilizing the principles of environmental justice that are geared towards identifying and confronting the root causes of environmental health disparities⁶⁸. The EPA defines environmental justice as “the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies”. It is both a goal and a method of addressing the inequities that skew the health outcomes related to environmental determinants. Environmental justice requires those most affected be at the forefront of leading change at the most fundamental level. Environmental health advocacy and community-based public health initiatives in Houston are firmly rooted in this justice-centered tradition⁶⁹.

Objective 1: By 2024, increase the number of people with asthma and providers who have knowledge of the environmental determinants of health that contribute to the exacerbation of asthma and the tools to mitigate these factors.

Background: There is a significant body of knowledge linking environmental factors (natural, built, behavior) to respiratory health outcomes in urban settings^{57,59,70}. Environmental health literacy represents the knowledge and skills that enable individuals to identify and reduce their personal risk to environmental health hazards. Increased environmental health literacy can also prompt community action to protect health across a population⁷¹. Additionally, health care

institutions can play an important role in reducing human vulnerability by promoting “healthy home and healthy community” initiatives and policies⁶⁵.

Partners: Environmental Defense Fund, One Breath Partnership, Texas Environmental Justice and Service (TEJAS), Harris County Medical Society, Harris County Academy of Family Physicians, Texas Children’s Health Plan

Strategy 1.1: Implement environmental health education interventions for people with asthma, promoting the awareness, prevention, avoidance and mitigation of environmental hazards that can negatively impact asthma control, especially in environmental justice communities.

Measures: Disseminate four (4) environmental hazard education products per year including written material; messaging geared towards people with asthma regarding environmental determinants of health to be posted on websites and social media; environmental health presentations, workshops, and webinars utilizing evidence-based curriculum such as Healthy Homes and Harvard’s “Climate is Health”.

Strategy 1.2: Increase the number of health care professionals, including community health workers and school nurses, who understand how climate change, environmental hazards, and environmental justice impact asthma outcomes in the Houston area.

Measures: Provide two (2) educational events per year related to environmental health literacy, environmental justice or healthy homes and communities.

Strategy 1.3: Increase the number of people with asthma who utilize Air Quality Index (AQI) tools (i.e. AirNow, AirAware) to make decisions about their outdoor activities.

Measures: Increase the number of new subscriptions to the City of Houston’s Asthma Air Aware Day Warnings via AlertHouston. (Baseline: 5,341 in 2020)

Objective 2: By 2024, increase the proportion of Houstonians with asthma that engage in preparedness activities for environmental disasters such as hurricanes, flooding, chemical releases and infectious disease outbreaks.

Background: A 2014 national survey found that Americans have insufficient ability to identify health risks related to climate change and other environmental conditions⁷². The 2020 FEMA National Household survey found that although 98% of Americans think they are at risk of being impacted by some type of disaster, less than half cannot remember being exposed to preparedness information in the previous six months⁷³. To make people and communities more prepared and resilient in facing future threats, the “Climate Change and Health” report makes recommendations which include prioritizing health equity and protecting high risk populations by addressing social determinants of health; utilizing CDC’s Building Resilience Against Climate Effects (BRACE) framework to guide preparedness work; and plan with communities, not for

them. FEMA recommends that preparedness messaging should be customized to specific groups to achieve greater success in communication.

Partners: Houston Office of Emergency Management, HHD Public Health Preparedness program, Houston Independent School District, Citizen Emergency Response Teams

Strategy 2.1: Increase the number of persons with asthma who receive customized information about disaster preparedness each year.

Measures: Disseminate six unique and culturally relevant communication products related to disaster preparedness for adults and children with asthma. Examples include flyers, web pages, guides, videos and educational activities.

Strategy 2.2: Increase the proportion of families affected by asthma who have an emergency disaster plan that includes specific provisions for children and adults with asthma.

Measures: Number of individuals and families that complete emergency disaster plans which include provisions for asthma.

Strategy 2.3: Increase the number of school districts in the Houston region that require schools to include specific emergency provisions for students and staff with asthma.

Measures: Number of school districts that adopt specific asthma provisions for students and staff in their emergency management plan.

LINKAGES TO CARE

Fragmented asthma care has been shown to contribute to poor asthma outcomes⁷⁴. However, delivering asthma care is complex and requires substantial engagement from the patient as well as others. In addition to the primary health care team, care coordination for asthma can enlist multiple stakeholders, including family members, specialists, social service agencies, schools and daycare, as well as community-based organizations⁷⁵. The benefit in creating these linkages in care can include reductions in asthma symptoms, ED visits, activity limitations, and school absences⁷⁶. Additionally, pediatric asthma care coordination has been associated with a positive perception of care, better communication, and self-efficacy related to asthma management⁷⁷. Whether practice-based or community-placed, care coordination that is patient-centered, culturally appropriate and assists with overcoming barriers to services can result in significant positive outcomes that are also self-reinforcing⁷⁸. This can be particularly impactful for ethnic minorities and individuals from low socioeconomic backgrounds who are historically vulnerable to poor asthma outcomes^{79,80}. Although reinforcing linkage and coordination of care is an essential component of any community-centered asthma control program, it does come with challenges. These include limited access to patient records and data, patients that are

served by multiple health care systems or payers, concerns about increased workload among institutional personnel, and difficulty in accessing caregivers⁸¹.

Objective 1: By 2024, increase the percent of publicly insured or uninsured children and adults with asthma presenting to the Emergency Department that receive a referral to a follow-up or supportive care service.

Background: Emergency departments are commonly used for the acute and chronic management needs of patients with asthma and accounted for over 14,000 ED visits in Houston in 2018. That same year, according to the Texas Department of State Health Services, 73% of the people who went to the ED due to asthma were uninsured or publicly insured. Even as the prevalence of asthma starts to plateau, emergency room visits for asthma among ethnic minorities continues for both children and adults⁸². The health care community is acutely aware of the social factors that often drive the disparities in asthma outcomes and account for nearly one-third of annual deaths in the United States⁸³. These social conditions and environmental determinants that challenge an individual's health take center stage in the emergency department through a convergence of unmet needs^{84,85}. Moreover, health care providers want to be part of the solution. A Robert Wood Johnson Foundation national survey of physicians in 2011 found that 76% of doctors want the health care system to connect patients to services that meet their health-related social needs⁸⁶. Locally, in 2018, the Centers for Medicare and Medicaid Services funded an Accountable Health Communities Model pilot project in Houston which includes systematically identifying and addressing the health-related social needs of children and adults utilizing public insurance⁸⁷. The Accountable Health Communities Health-Related Social Needs Screening Tool (AHC HRSN) is being implemented as part of this pilot and includes two core questions that are primary to asthma: (1) indoor air quality hazards, and (2) tobacco use⁸⁸. There is opportunity to build on the current initiatives to benefit individuals with asthma and health-related social needs.

Partners: Texas Health Improvement Network, local Hospital Systems and Managed Care Organizations, Environmental Defense Fund

Strategy 1.1: Create a vulnerability asthma index to identify communities within the city that have increased environmental and social stressors.

Measures: Documented analysis and maps.

Strategy 1.2: Increase the number of hospital EDs that screen for social or environmental determinants of health related to asthma (i.e., exposure to environmental tobacco smoke, environmental hazards in housing, access to primary care).

Measures: Number of hospital systems surveyed.

Strategy 1.3: Increase the number of children and adults with asthma that receive a consult from a community health worker, social worker or caseworker during an ED visit.

Measures: Number of CHWs, social workers and caseworkers assigned to hospital EDs.

Objective 2: By 2024, increase the number of asthma care providers that implement at least one linkage to care intervention strategy for pediatric or adult patients.

Background: A roundtable on population health improvement, conducted by the Institute of Medicine, highlighted how asthma control can be achieved when health care providers partner with community services to provide holistic care⁸⁹. Although research is limited, some barriers to implementing “social prescribing” services have been found to include the implementation approaches, legal agreements, leadership, staff engagement, communication, and lack of services in the community⁹⁰.

Partners: Texas Gulf Coast Asthma Coalition, Harris County Medical Association, Texas Children’s Health Plan

Strategy 2.1: Increase the number of health care providers that have access to guidelines, information and resources related to non-medical, community-based interventions and best practices for the management of asthma in children and adults through a web-based linkage to care tool.

Measures: Number of registered users through website analytics.

Objective 3: By 2024, 90% of primary school students with asthma and their families will have access to asthma control services through their school.

Background: Asthma is the primary reason for missed school days in the U.S., causing approximately 14 million absences in 2013⁹¹. Childhood asthma is also associated with a significant number of missed workdays among their primary caregivers⁹². There is also the concern of school performance. Poorly controlled asthma can contribute to lower academic outcomes among urban minority children, particularly students of Hispanic descent⁹³. Schools can play a critical role in providing education and services for asthma management so that these students remain healthy and are able to fully participate in school activities on par with their peers⁹⁴. School nurses, when empowered with knowledge and resources, can improve the coordination of asthma care and positively impact health outcomes for students with asthma⁹⁵. And, implementing interventions that include care coordination and linkage to care at the school level has shown to improve asthma control among students^{96,97}.

Partners: Houston Independent School District, Texas Children’s Health Plan, Texas Gulf Coast Asthma Coalition

Strategy 3.1: Increase the number of school districts that have health service protocols to screen students with asthma for health and social needs and link students to appropriate services.

Measures: Survey of school district medical service departments.

Strategy 3.2: Increase the number of school nurses that complete training on care coordination and linkage to health and social services for children with asthma including the use of asthma care checklists.

Measures: The number of school nurses that participate in related training.

Strategy 3.3: Increase the number of students with asthma that receive linkage to services for health-related social needs.

Measures: Number of students that receive wrap around services. School district data.

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APPENDIX

Table A.1: 2018 Asthma-Related Hospitalizations in City of Houston Zip Codes

	Asthma-Related		Asthma Principal Dx	
TOTAL	19314	-	2006	10.4%
Quarter				
Q1	5278	27.3%	647	32.3%
Q2	4634	24.0%	464	23.1%
Q3	4553	23.6%	386	19.2%
Q4	4849	25.1%	509	25.4%
Sex				
Male	5650	29.3%	806	40.2%
Female	13664	70.7%	1200	59.8%
Age (years)				
<5	872	4.5%	295	14.7%
5 - 9	840	4.3%	333	16.6%
10 - 14	758	3.9%	144	7.2%
15 - 17	484	2.5%	53	2.6%
18 - 24	1398	7.2%	74	3.7%
25 - 34	2508	13.0%	143	7.1%
35 - 44	2046	10.6%	233	11.6%
45 - 54	2152	11.1%	231	11.5%
55 - 64	2895	15.0%	222	11.1%
65 - 74	2739	14.2%	156	7.8%
75+	2622	13.6%	122	6.1%
Race				
White	8366	43.3%	657	32.8%

Black	6689	34.6%	885	44.1%
Asian or Pacific Islander	573	3.0%	43	2.1%
American Indian or Alaska Native	30	0.2%	2	0.1%
Other	3656	18.9%	419	20.9%
Ethnicity				
Hispanic	8205	42.5%	1024	51.0%
Non-Hispanic	11073	57.3%	979	48.8%
Originated in ED				
Yes	12630	65.4%	1714	85.4%
No	6684	34.6%	292	14.6%
Risk of Mortality				
Minor	10147	52.5%	1267	63.2%
Moderate	4326	22.4%	416	20.7%
Major	3542	18.3%	290	14.5%
Extreme	1299	6.7%	33	1.6%
Illness Severity				
Minor	4172	21.6%	755	37.6%
Moderate	7577	39.2%	684	34.1%
Major	5869	30.4%	506	25.2%
Extreme	1696	8.8%	61	3.0%
Average Length of Stay (days)	4.9	-	2.8	-

Source: Texas Department of State Health Services, Texas Health Care Information Collection (THCIC); 193 facilities reporting.

Table A.2: 2018 Asthma-Related Emergency Department (ED) Visits in City of Houston Zip Codes

	Asthma-Related		Asthma Principal Dx	
TOTAL	55529	-	14365	25.9%
Quarter				
Q1	13549	24.4%	4299	29.9%
Q2	12109	21.8%	3181	22.1%
Q3	13804	24.9%	3073	21.4%
Q4	16067	28.9%	3812	26.5%
Sex				
Male	20475	36.9%	6974	48.5%
Female	35052	63.1%	7389	51.4%
Age (years)				
<5	4826	8.7%	2315	16.1%
5 - 9	5729	10.3%	2481	17.3%
10 - 14	4391	7.9%	1504	10.5%
15 - 17	2332	4.2%	603	4.2%
18 - 24	6403	11.5%	1290	9.0%
25 - 34	9360	16.9%	1888	13.1%
35 - 44	6986	12.6%	1657	11.5%
45 - 54	5780	10.4%	1143	8.0%
55 - 64	4650	8.4%	812	5.7%
65 - 74	3002	5.4%	440	3.1%
75+	2069	3.7%	231	1.6%
Race				
White	15633	28.2%	3786	26.4%
Black/African American	25800	46.5%	7222	50.3%

Asian or Pacific Islander	864	1.6%	290	2.0%
American Indian or Alaska Native	85	0.2%	22	0.2%
Other	13146	23.7%	3045	21.2%
Ethnicity				
Hispanic or Latino	27908	50.3%	7044	49.0%
Not Hispanic or Latino	27617	49.7%	7320	51.0%

Source: Texas Department of State Health Services, Texas Health Care Information Collection (THCIC); 277 facilities reporting.