SOCIAL DETERMINANTS OF HEALTH DATA INTEGRATION FRAMEWORK

Addressing social determinants of health data integration barriers in Nueces County, Texas

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CONTRIBUTING AUTHORS

The Water Institute: Dr. Kateryna Wowk served as project director, lead author of this report, Action Committee lead, thematic coding and analysis lead, and lead for data visualization in the geospatial tool. Dr. Jessica Henkel led project components and writing on structured decision-making. Dr. Kathryn Keating also helped to lead thematic coding analysis and led visualization of the project's logic models. Dr. Charles Wallace contributed to thematic coding and provided support to the project's Working Group on Data Integration.

Texas A&M University Corpus Christi (TAMUCC): Dr. Miguel Perez III led work and writing to help understand how social determinants of health data may operationally be integrated into health information technology. Mukesh Subedee led the curation and organization of all project datasets to make them available through the project's products. Brach Lupher led development of the geospatial tool.

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Action Committee			
Organization	**Representative**	**Position**	**Interest**
Working Group on SDOH Logic Models			
Coastal Bend Council of Governments	Emily Martinez, MPA	Director of Regional Economic Development	Regional gov't
Corpus Christi Planning Department	Annika G. Yankee	Planning Manager	City gov't
Corpus Christi Metropolitan Planning Organization	Craig Casper, AICP, CTP CEP	Senior Transportation Planner	MSA transportation
Coastal Bend Community Organizations Active in Disaster; United Way	Janna Shoe, LBSW-IPR, CRS	Chairperson; Outreach & Disaster Coordinator, Coastal Bend	Non-profit
Coastal Bend Air Quality Partnership	Sharon Bailey Murphy, MPA, CHMM, REM	Executive Director	Regional non-profit
Coastal Bend Center for Independent Living	Judy Telge, BS	Director of Development	Community-based org.
Keepers of the Garden	Tevin Gray, Master Gardener	Owner	Community-based org.
Texas Children in Nature Network	Sarah Coles, MALS, Med	Executive Director	Community-based org.
Esperanza de Tejas	Brianna Davis, MSW	Founder & CEO	Community-based org.
Gulf Reach Institute	Suraida Nañez-James, MS	Founder and CEO	Youth leadership
Working Group on SDOH Data Integration			
Corpus Christi Nueces County Public Health District	Denzel Otokunrin, MPH	Public Health Administrator-Protection Division | Epidemiologist	Public Health
Driscoll Children's Hospital	Beth Becker, BSN/BBA/ RNC NIC/CPHQ and Lesley Martinez MPH, CPH, CIC	Patient Safety Manager	Healthcare System
Amistad Community Health Center	Eric Baggerman, MD	CEO and Pediatrician	Healthcare System
Nueces Center for Mental Health and Intellectual Disabilities	Mark Hendrix MS, LPC	Deputy Chief Executive Officer	Healthcare System
Driscoll Health Plan	Karl Serrao, MD, FAAP, FCCM	Chief Medical Officer and Pediatric Intensivist	Health Insurance

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PREFACE

This project sought to better understand the health disparities and vulnerabilities in at-risk communities in Nueces County, Texas that stem from social determinants of health (SDOHs). These SDOHs were also linked to climate and environmental factors, with the explicit goal of facilitating the integration of data on key SDOH, climate and environmental factors to improve health outcomes and address health disparities. With that goal in mind, the project endeavored to identify and address challenges related to such data integration, including, for example, the capacity needed to identify, access, and curate data, the lack of standardized tools for collecting data, the need to ensure data privacy, and the need for greater collaboration between healthcare providers and social service organizations.

This report is intended to support public and private health practitioners in Nueces County, Texas, in better understanding which SDOH, climate, and environmental data may be important to consider in assessing health outcomes. It is also intended to guide the health communities in specific steps that can be taken to assess and integrate such data. The report also may support additional decision-makers in social service and community-based organizations, as well as in government.

The project team has previous success engaging communities and decision-makers to build and validate relationships between key factors (Olander et al., 2020, 2021) and used a similar process to explore and validate linkages relevant to Nueces County and its at-risk communities. This included implementing a community-based participatory research (CBPR) process with local experts and in the at-risk neighborhood of Molina. The project team brings expertise in advancing CBPR, including specifically in Nueces County (Wowk et al., 2023). Finally, the team brought its expertise in structured decision-making to inform a process that guided discussions and recommendations. This report is the second of four project deliverables:

1. *Priority Actions to Address Key Social Determinants of Health: Recommendations from the Project to Address Social Determinants of Health Data Integration Barriers in Nueces County, Texas*

   Audience: Local and state government representatives; Corpus Christi-Nueces County Public Health District; local health and social service institutions. Purpose: Provide a high-level project overview and findings, as well as recommendations for next steps to decision-makers.

2. ***Social Determinants of Health Data Integration Framework: Addressing Social Determinants of Health Data Integration Barriers in Nueces County, Texas***

   Audience: Public and private health practitioners; social service and community-based representatives; government representatives; academia. Purpose: Guide health practitioners and other interested representatives in various options they can take to assess and integrate SDOH, climate and environmental data, including detailed steps and an assessment of tradeoffs.

3. *Social Determinants of Health in Nueces County: Evidence for Logic Models Informed by Diverse Ways of Knowing.*

Audience: Technical experts; grant writers. Purpose: Provide detailed documentation on the evidence used to build the project's logic models, including across different ways of knowing.

4. *Geospatial Nueces County Community Health & Environment Tool*

   Audience: Health practitioners; Corpus Christi-Nueces County Public Health District; local and state government representatives; social service institutions; community-based organizations; academia; the public. Purpose: Enable visual analysis of health, SDOH, climate and environment conditions at the census tract level across Nueces County, and make all data available for download and integration. Available at: https://geored.org/

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LIST OF ACRONYMS AND ABBREVIATIONS

Acronym	Term
ACS	American Community Survey
BIPOC	Black, Indigenous, and other People of Color
BRFSS	Behavioral Risk Factor Surveillance System
CBPR	Community-based Participatory Research
CDC	Centers for Disease Control
CHIRP	Comprehensive Hospital Increase Reimbursement
CRM	Customer Relationship Management
EMR	Electronic Medical Record
GeoID	Geographic Identifier
GeoRED	Geospatial Resilient Economic Development
HIPPA	Health Insurance Portability and Accountability Act
LUCA	Local Update of Census Addresses
NEET	Not in Education, Employment or Training
PD&R	Department of Housing and Urban Development Office of Policy Development and Research
SDM	Structured Decision Making
SDOH	Social Determinants of Health
SSI	Supplemental Security Income
SNAP	Supplemental Nutrition Assistance Program
TAMUCC	Texas A&M University Corpus Christi
TIPPS	Texas Incentives for Physicians and Professional Services

INTRODUCTION

Texas public health reports identify a need to link health and social care by differentiating between actions taken at the individual level, which address health-impacting needs by connecting patients with social services, and actions taken at the community level, which holistically support systemic changes through, for instance, policy, infrastructure, or social systems (Texas Health Improvement Network [THIN], 2020). Community level action is needed to create conditions that profoundly shape opportunities for health and well-being (Texas Health Institute, 2021). A foundational step is understanding relevant social determinants of health (SDOHs), which play a critical role in identifying and explaining the root causes of health disparities. SDOHs are the non-medical factors that significantly influence health outcomes. These are the conditions in which people are born, grow, live, work, and age, including factors like income, education, housing, and access to nutritious food and safe environments (CDC, 2024a). When SDOHs are at a lower quality, as is often seen in marginalized communities, it can significantly exacerbate unequal sensitivities to climate and environmental risks and amplify health disparities (Gao et al., 2023; Putsoane et al., 2024; Smith et al., 2022).

Despite the impact SDOHs have on disparate health outcomes, however, understanding of how data on the conditions in which people live, grow, work and age can be, or is being, integrated with health data systems to improve health outcomes is nascent. Improving this understanding is critical, especially for communities and neighborhoods where non-medical factors may disproportionately impact well-being and quality of life. Such is the case in Nueces County, Texas, home to the City of Corpus Christi, which is ranked 9th in the nation as the most economically disadvantaged, and 6th in the nation as the highest in food insecurity (Patel et al., 2021). Of the county's 353,178 residents, 62% are Hispanic (U.S. Census Bureau, 2020). Many of these communities, such as those in the Westside of Corpus Christi, have faced historical discrimination that has contributed to significant health disparities (Gurrola, 2015; Texas Health Institute, 2021). For example, in a low socio-economic status community of color, the life expectancy rate is 70 years, whereas just 10 miles away individuals of high socio-economic status can expect to live 85 years (Texas Health Institute, 2021). This stark difference in life expectancy becomes clearer when examining chronic diseases in specific neighborhoods, such as the Corpus Christi Westside neighborhood of Molina (census tracts 1703, 1704, 1801 and 1602, **Error! Reference source not found.**) which has higher rates of hypertension, diabetes, obesity, asthma, and depression (Table 1).

PROJECT GOAL & FACTORS OF FOCUS

This project sought to better understand the health disparities and vulnerabilities in Molina and additional at-risk communities in Nueces County that stem from SDOHs. These SDOHs were also linked to climate and environmental factors, with the explicit goal of facilitating the integration of data on key SDOHs to improve health outcomes and address health disparities. Because of the importance of understanding disparities in Molina and similarly disadvantaged neighborhoods throughout the county, the five diseases with higher rates in Molina became the health outcomes of focus for the project (Table 1). These health outcome factors, as well as SDOHs, and climate and environmental factors were selected in collaboration with the project's Action Committee of local experts (see the **Error! Reference source not found.** section for a full list of Action Committee members).

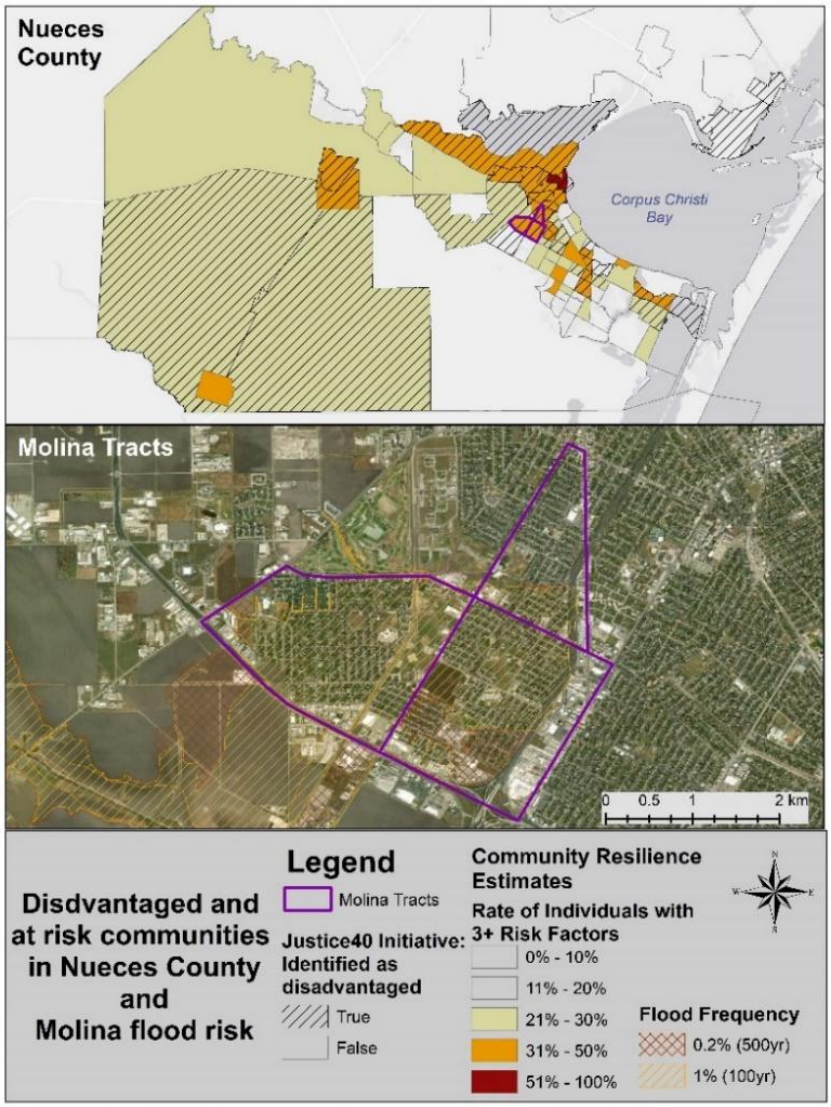

Figure 1. Map of Nueces County and the Molina Neighborhood, showing Molina as disadvantaged, with higher risk factors and significant flood risk (Texas Water Development Board, 2022; U.S. Census Bureau, 2020; US Council on Environmental Quality, 2022)

Table 1. Nueces SDOH Project Health Outcome Factors

Chronic Disease	Molina § ¥	Nueces County ¥	Texas ¤	U.S. ¤
Hypertension	41.5	34	32.2	32.4
Diabetes	21.5	14.7	11.5	10.9
Obesity	45.3	39.8	36.1	33.9
Asthma	9.8	9.1	8.4	9.8
Depression	22.8	22.7	18.6	20.5

§ Mean of data for tracts 1703, 1704, 1801 & 1602
¥ Data collected from the CDC PLACES for 2019
¤ Data collected from CDC Behavioral Risk Factor Surveillance System for 2021

Factors related to the above disparities are listed in **Error! Reference source not found.** and include extreme heat for hypertension, food access for diabetes and obesity, and air quality for asthma. These factors also include varying links for mental health concerns, such as rising temperatures and humidity, which are associated with high levels of stress (Ding et al., 2016) and increases in emergency department visits for depression (Vida et al., 2012). Expanding research in this area, especially among Black, Indigenous, and other People of Color (BIPOC), provides the foundation for development and promotion of evidence-based policy recommendations to galvanize systems-level change (Patel et al., 2021) for at risk communities especially vulnerable to environmental factors (Ailshire & Brown, 2020; Chakraborty et al., 2011; Ringquist, 1997).

Table 2. SDOH and Climate and Environment Factors

SDOH Factors M N	Climate (C) or Environmental (E) Factor
Access to Greenspace [A]	Heat (C) (E)
Accessible Housing [A]	Flooding (C) (E)
Culture [A]	Storm (C) (E)
Disconnected Youth [N]	Particulate Matter (C) (E)
Employment [M N]	Ozone (C) (E)
Education [M]	Lead Exposure (E)
English Proficiency [M]	Wastewater Discharge (E)
Food Access [N]	Traffic
Hardship* [M]	
Healthcare Access [N]	
Income [M N]	
Literacy [A]	
Race & Ethnicity [M]	
Safety [N]	
Transportation [A]	

[A] SDOH added by Action Committee
[M] SDOH in Molina neighborhood
[N] SDOH in Nueces County
* Hardship combines unemployment, age dependency, education, per capita income, crowded housing, and poverty into a single score (Christus Spohn, 2023)

In addition to the project's factors of focus, it is helpful to understand the roles of the different advisory groups. Individuals in each group may be found in the Acknowledgements section. The groups include:

Action Committee: A group of local experts across health institutions, social service organizations, community-based organizations and government whose function was to guide implementation of the project's methodology and co-produce the project's products.

Action Committee Working Group on SDOH Logic Models (SDOH Logic Models Working Group): A sub-group of the Action Committee with expertise in socio-economic conditions in Nueces County whose function was to guide development of the SDOH Logic Models, including by contributing local knowledge as a significant way of knowing.

Action Committee Working Group on SDOH Data Integration (SDOH Data Integration Working Group): A sub-group of the Action Committee with expertise in health organizations whose function was to guide understanding of how SDOH may optimally be integrated into health information technology.

FRAMEWORK PURPOSE & OVERVIEW

FRAMEWORK PURPOSE

The purpose of this framework is twofold:

1. Provide background on the project, including how SDOH data were prioritized, collected, and mechanisms for data integration were established; and
2. Provide an operational understanding for health practitioners and other decision-makers on how they might use the project's outputs to facilitate their own integration of SDOH data. This includes providing examples of outcomes such integration might support.

Health practitioners and other professionals are encouraged to contact the framework authors to discuss discrete institutional needs and how the outputs of this project can support their organization's goals.

FRAMEWORK OVERVIEW

This data integration framework provides background and operational guidance on how health practitioners can better integrate data on SDOHs in heath data systems, including by integrating curated data for Nueces County that is available for download. The framework is organized as follows:

I. Part I describes the domains into which SDOHs are typically organized. The key SDOHs for this project are then defined. Finally, Part I describes how the Action Committee Working Group on SDOH Logic Models guided the project in understanding which SDOH data should be used to assess impacts to which health outcomes. Informed by peer-reviewed literature and state and local reports, the Logic Model Working Group used their local knowledge to identify relevant connections between specific SDOHs and health outcomes, helped the project team visualize these connections in logic models, and, where feasible, made links to local data.

II. Part II delves into SDOH data sources for Nueces County, including specifying the spatial scale at which data were primarily collected and identifying different categories and sources of SDOH data. The majority of Part II then focuses on the process used by the Action Committee Working Group on SDOH Data Integration to determine the best methods, tools, and processes to facilitate integration of SDOH data by health practitioners. This process was informed by the tenets of structured decision-making, a transparent and objective-orientated approach that can support identifying actionable alternatives for complex problems where there are multiple stakeholders and interests (Gregory et al., 2012). Part II concludes with a decision output from the SDOH Data Integration Working Group that prioritizes methods for key SDOHs data integration into health information technology, including the identification of the working group objectives the proposed methods would achieve.

III. Part III provides a description of the resulting methods, tools, and products. This section also provides an operational guide that can be used by health practitioners and other stakeholders to integrate SDOH data into organizational information technology or for other purposes, for instance needs assessments or funding proposals. This guide is further supplemented with a detailed user guide that can be found on https://geored.org/.

PART I: DEFINING SOCIAL DETERMINANTS OF HEALTH DATA IN NUECES COUNTY

DOMAINS

While organizations may frame SDOHs differently, the most widely accepted and used framework, particularly by agencies like the U.S. Centers for Disease Control (CDC) and initiatives like Healthy People 2030, groups SDOH into five key domains: economic stability; education access and quality; healthcare access and quality; neighborhood and built environment; and social and community context (Healthy People 2030, 2025). These domains are interconnected, and a deficit in one area can often exacerbate challenges in others, leading to poorer health outcomes and greater health inequities. Additional details about each of these five domains are provided below.

Economic Stability

This domain focuses on the financial resources people have and how they impact their health. Key issues include:

- Employment status (unemployment, underemployment)
- Income and wealth
- Food security (access to nutritious food)
- Housing stability (affordable and stable housing)

Education Access and Quality

This domain highlights the connection between education and health and well-being. Important areas include:

- Early childhood education and development
- High school graduation rates
- Enrollment in higher education
- Educational attainment levels
- Language and literacy skills

Healthcare Access and Quality

While SDOH are non-medical factors, access to and quality of healthcare services are crucial. This domain considers:

- Access to healthcare services (including primary care and specialty care)
- Health insurance coverage
- Health literacy (ability to understand health information and make informed decisions)
- Access to culturally competent care

Neighborhood and Built Environment

This domain examines how the places where people live, work, and play affect their health. It includes factors like:

- Quality of housing (safe, affordable, lead-free)

- Access to reliable transportation
- Availability of healthy foods (e.g., grocery stores, farmers' markets, not food deserts)
- Environmental conditions (e.g., air and water quality, exposure to toxins)
- Crime levels
- Availability of green spaces and places for physical activity

Social and Community Context

This domain focuses on the relationships and interactions within a community and their impact on health. Key issues include:

- Race and ethnicity
- Disconnected youth
- Single parent households
- Social cohesion and support networks
- Civic participation
- Exposure to violence

DEFINITIONS

Addressing these domains and determinants requires a collaborative approach involving healthcare, education, housing, transportation, economic development, and community organizations. As such, it is critical that shared definitions are formed by collaborating partners, such that a multi-institutional and multi-sectoral approach can be advanced that signifies what might be needed in terms of data collection, research, and the evaluation of the impact of policies or alternative solutions on health. For the purposes of this project, the Action Committee worked to define each SDOH factor of focus (Table 3). The specific factors that were chosen for this project were based on previous work that identified the significance of each in impacting health outcomes in at-risk communities in Nueces County (Texas Health Institute, 2021; THIN, 2020), or were added at the suggestion of Action Committee members. Table 2 identifies those SDOH factors that were added by the committee of local experts.

Table 3. Nueces SDOH Project Definitions

SDOH	Definition
Economic Stability	
Income	Money received, especially on a regular basis, for work or through investments.
Employment	Activity in which an individual works or performs a service in exchange for wages or other remuneration. This encompasses aspects such as job security, workplace environment, income level, and access to resources.
Accessible Housing	Accessible affordable housing refers to housing that is both economically within reach for individuals and specifically designed or modified to meet the needs of people with disabilities or those who are disadvantaged due to age or other factors. Affordable housing is housing that a household can pay for while still having enough money for other necessities.
Hardship	Hardship combines unemployment, age dependency, education, per capita income, crowded housing, and poverty into a single score
Education Access and Quality	
Education	Level of educational attainment, including the knowledge and skills needed to make informed health decisions, understand health information, and engage in healthier lifestyles.

SDOH	Definition
English Proficiency	A person's ability to use and comprehend spoken and written English effectively, enabling them to communicate meaningfully in various contexts.
Literacy	Literacy is defined as the ability to read, write, speak, and listen effectively, enabling individuals to communicate and make sense of the world around them.
Healthcare Access and Quality	
Healthcare Access	The extent to which people have equitable, affordable, and available access to needed healthcare services. This definition includes both physical accessibility and availability via financial means, transportation options, and other factors.
Neighborhood and Built Environment	
Food Access	Extent and characteristics of individuals or communities that lack access to healthy and affordable food options. It involves assessing factors such as food sources, income levels, and coping strategies at the household level.
Access to Green Space	Refers to the availability and proximity of natural environments, such as parks, gardens, and woodland areas, for community use. It is essential for promoting physical activity, social interaction, and overall well-being, as these spaces encourage outdoor activity and foster a sense of community.
Transportation	Transportation is closely linked with built environment factors. It can also impact access to employment, education, healthy food, social engagements, faith-based institutions, and health care. Access to reliable transportation includes access to a personal vehicle, safe environments for walking or biking, and/or access to adequate public transportation services.
Social and Community Context	
Race & Ethnicity	Race refers to groups of people classified based on physical traits, such as skin color, hair texture, or eye shape. Ethnicity pertains to cultural characteristics, including shared language, food, music, dress, values, and beliefs, which are often connected to common ancestry.
Disconnected Youth	Refers to teenagers and young adults aged 16 to 24 who are neither employed nor enrolled in school. This term highlights the challenges faced by individuals who are not in education, employment, or training (NEET).
Safety	The condition of not being in danger or of not being dangerous. Safety can also refer to the control of recognized hazards in order to achieve an acceptable level of risk.
Culture	Culture is a broad concept that encompasses the social norms, institutions, and behaviors of a human society, as well as the knowledge, beliefs, arts, laws, customs, capabilities, and habits of the people in those groups. It can also be defined as the characteristic features of everyday existence shared by people in a place or time, such as diversions or a way of life.

IDENTIFYING DATA THAT MATTERS

It is important to understand the overwhelming amount of data available and numerous decisions needed to meaningfully assess how SDOHs may impact health outcomes and health disparities at the community level. While finer-resolution and more localized data are often needed, huge data repositories such as those offered by the U.S. Census Bureau exist to help understand trends. However, deciding which datasets in these repositories should be used can be a significant task for researchers trained to assess the data, let alone for health practitioners and other decision-makers that are often already at or over capacity. To integrate SDOH data to better understand and address health disparities, one has to identify the specific SDOHs that matter and subsequently identify the corresponding data that are available and may be used to facilitate assessment. The SDOH Logic Model Working Group was critical in advancing the first part of this task.

Working Group on SDOH Logic Models

The SDOH Logic Model Working Group provided context and understanding of how SDOH, along with climate and environmental factors were, or were not, connected to specific health outcomes in Nueces County. Figure 2 shows an example of the logic model developed for asthma. Logic models are visual tools that support design, planning, communication, evaluation and learning. They are graphical interpretations to organize information about how the world works, or is anticipated to work, conveying schemes, projects, or programs in a concise format (Knowlton & Phillips, 2012). While logic models have been used for some time to support program performance evaluation (McLaughlin & Jordan, 1999), increasingly they are being used to understand complex systems and to capture the adaptive nature of systems and interventions in healthcare (Mills et al., 2019).

To analyze the complex relationships between health, the environment and SDOH while ensuring equity was placed at the center of the work, the team relied on the social well-being framework for logic models as presented in Ota et al. (2022), which emphasizes equitable process over eventual outcomes (Ota et al., 2022). However, in building an initial version of the models to bring to the Working Group for comment, the project team ran into a challenge. Logic models most often depict the expected outputs and outcomes of a theory of change or a program, providing an evidence base for a specified end (Knowlton & Phillips, 2012). Yet the task of this project was not to understand the anticipated effects from a specific action or intervention, but rather to understand which SDOH, climate and environmental factors impacted which health outcomes. The project team thus adapted the approach to focus on mapping the complexity of connections, instead of identifying pathways that lead to specific outputs and outcomes.

The project team facilitated virtual working group meetings from June 2024–May 2025 to understand where connections may be present. This input was used, alongside peer-reviewed literature and state and local assessments, to build initial versions of the logic models for each health outcome. At an in-person workshop held in June 2025, the Committee further refined their input by assessing the draft models and responding to a focused set of discussion questions. Additional input from community members in Molina was also gathered from semi-structured surveys issued at two community events and included in the logic model. In the final step, structural equation modeling was used to validate linkages, and findings were contextualized with qualitative content analysis from the project. Additional details of this process is described in further detail in the project's evidence library (Keating, et al., 2025).

For the purposes of this framework, the critical step enabled by the logic model development was the identification of *which* SDOH, climate, and environmental factors are linked to which health outcomes. With that understanding, health practitioners and others can triangulate specific datasets they should use when assessing SDOH impacts on health and health disparities. The process described in this framework makes those data available to facilitate such assessment.

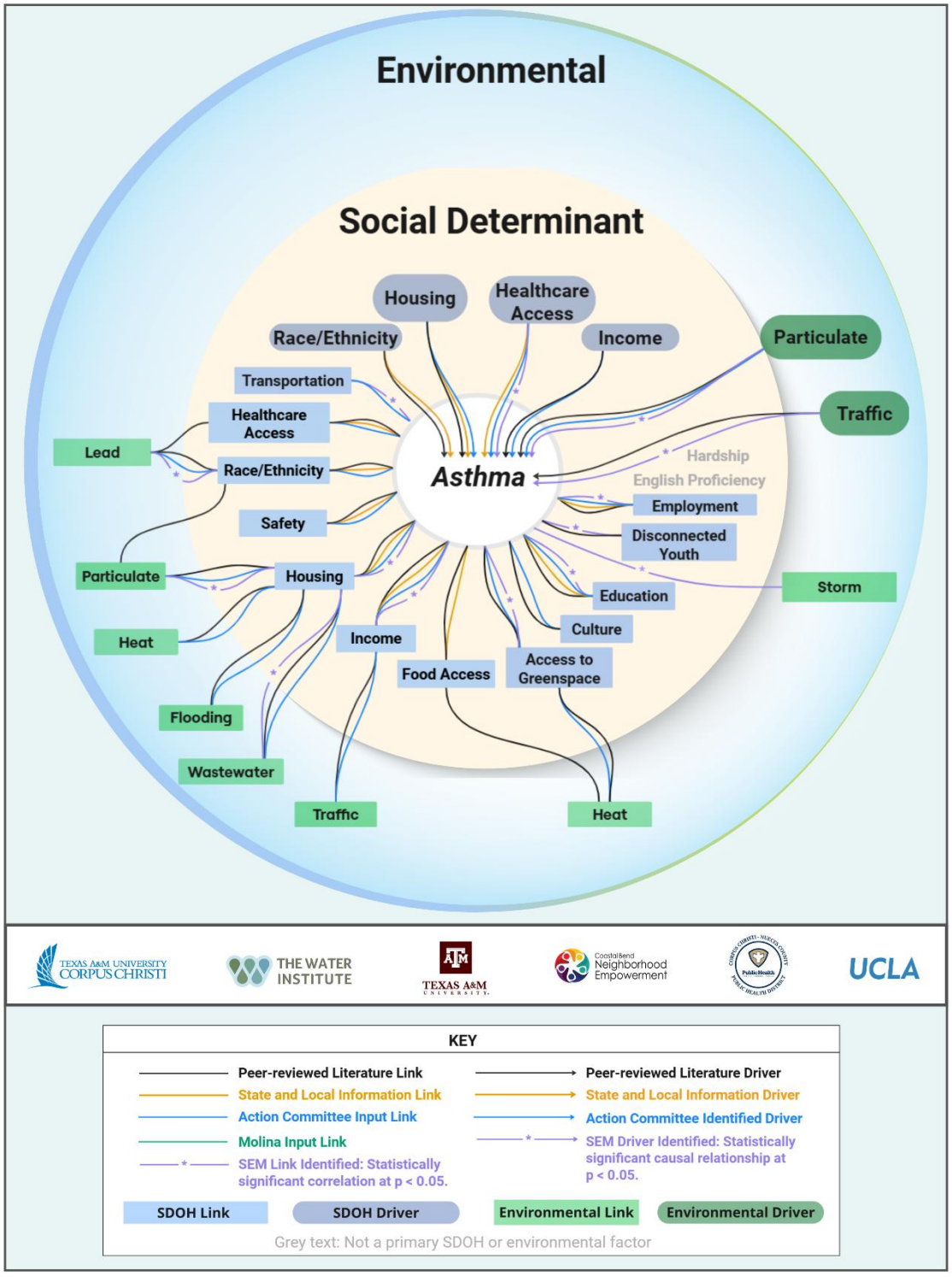

Figure 2. Nueces County SDOH Logic Model for Asthma. The logic model shows which SDOHs are causal (identified as a driver; rounded boxes) or correlated (identified as a link; square boxes) to asthma outcomes, showing different kinds of evidence. Structural Equation Modeling links and drivers are marked with an asterisk (*) to indicate relationships that are statistically significant with p-value < 0.05, meaning there can be reasonable confidence that there is some non-zero association. Further details are available in the project's evidence library (Keating, et al., 2025).

PART II: DATA SOURCES AND PROCESSES FOR INTEGRATION

SDOH data refers to quantitative and qualitative information about the five key domains mentioned above: Economic Stability; Education Access and Quality; Health Care Access and Quality; Neighborhood and Built Environment; and Social and Community Context (Healthy People 2030 & U.S. Department of Health and Human Services, 2025). Data may be characterized by their source and level of granularity. For example, individual-level data are collected by practitioners from surveys, questionnaires or screening tools, or Electronic Medical Records that can include clinical notes on socioeconomic conditions or challenges. Community-level data such as Census data provides demographic, socioeconomic, housing and transportation data at various spatial scales, such as by block group, census block, zip code or county (US Census Bureau, 2025). Additional community-level data are available through public health surveillance surveys and systems such as the CDC's PLACES project or Behavioral Risk Factor Surveillance System (CDC, 2024b, 2024c). Data on the environment, crime, infrastructure or community assets also are considered community-level data (Ravaghi et al., 2023).

Such data can support planning for public health and broader policies including through needs assessments, resource allocation, policy advocacy and disaster preparedness and response. SDOH data can also improve clinical practice and patient care through improving patient screening and referrals, care coordination, and population health management. However, after identifying relevant SDOHs, health practitioners also need to have access to curated SDOH data. As was demonstrated through this project, it is time-intensive to locate, assess and prioritize varying SDOH data sets that may apply to diverse decision-making needs in a community. Further, there is a lack of standards to ensure interoperability of diverse data from varying systems and platforms (Cantor & Thorpe, 2018; He et al., 2023), making the curation of data even more resource constrained.

VARIABLES AND SUPPORTING DATA

Using the recommendations from the SDOH Logic Model Working Group on which SDOHs were important to investigate for specific health outcomes in Nueces County (See Part I), the project team assessed the availability of data to support assessment of those SDOH variables.

SDOH DATA INTEGRATION OBJECTIVES

While the project team was responsible for data identification, assessment and curation, a Data Integration Working Group was needed to help provide a prioritized pathway forward to facilitate the integration of the data into the practices and policies of health practitioners. The SDOH Data Integration Working Group consisted of health practitioner and social organization experts (see **Error! Reference source not found.** section to review expertise of specific working group members).

Working Group on SDOH Data Integration

At an initial gathering of the SDOH Data Integration Working Group in June 2024, members met to better understand the common and individual goals, challenges, and potential solutions in linking SDOH data with public and private health data systems. With representation of health service providers in the Molina neighborhood, Corpus Christi and throughout the County, the objectives of the initial gathering were to:

1. Understand working group motivations for integrating SDOH data;
2. Co-develop a problem statement on integrating SDOH data with health information technology;
3. Co-develop common objectives to integrating SDOH data, and ideate alternative solutions; and
4. Develop a virtual process to continue this work.

To address the first meeting objective, members provided written statements on why their organization considered SDOHs an important topic. These are provided in summary in Table 4, which served as a guidepost when considering the outcomes that might be achieved through SDOH data integration.

The SDOH Data Integration Working Group was identified as the set of decision makers that ultimately will decide how data on SDOHs could best be integrated with their public and private health information technology systems. However, as described in Table 4, each working group member had similar, but disparate goals for SDOH integration. Thus, the project team identified the need for a clear decision-making framework to guide assessment of tradeoffs and alternative paths forward.

Table 4. Summary of statements from health practitioners: Why SDOHs?

Organization	Summary of Statement
Nueces County Health and Wellness Community Health Improvement Center	It is essential to gather data to better understand lack of access. The county does not provide health services – they provide access. This includes access to data, services, making sure the budget is run well, and other essential things for indigent care, e.g., roads, bridges. If a road is blocked, that limits services.
TAMUCC College of Nursing	Data can be used for curricula for the community to better understand not only how to take care of patients, but how income and background can impact access of patients.
MHP Salud	It is beneficial to have data to improve access to healthcare and social services. Organization does enrollment for assisted care, providing resources for those looking for other services, e.g., food access for foodbanks.
Driscoll Children's Hospital	Looking for evidence-based practices to reduce health disparities. This includes securing a health portal (MyChart) to connect patients and healthcare providers, and by adding training courses for staff on health equity. Also, there may be health screenings, such as mental health screening, which could reduce the number of hours spent in an ER, or learning if there are cultural aspects to investigating why some patients are readmitted.
Corpus Christi-Nueces County Public Health District	SDOH are background data needed to support policy making, e.g., to require caloric indicators on food at small shops. Public health is all encompassing, and we must look at all factors, including supporting exercise more, but also the sidewalk that enables that exercise. We also need to support health education.
Driscoll Health Plan	Integrating SDOH data is important to achieve the organization's mission- to gain a deeper understanding of what affects health outcomes and identify issues often overlooked to better meet the needs of members. There is a need to create the data linkages, and link back to and serve data on SDOHs in a way that is digestible.
Amistad Community Health Center	It is key to make healthcare accessible to everyone. Data are hard to come by, and it will be important to ensure the data are valid and accurate, and to understand real numbers versus anecdotal information. It is important to base our work on community needs, and we know there is more need than current surveys identify.

PROCESS TO PRIORITIZE DATA INTEGRATION METHODS

Given the variety of challenges to the integration of SDOH data into public and private health information technology system, the project team applied a structured decision making (SDM) framework to guide the discussions and recommendations of the SDOH Data Integration Working Group. SDM is an approach that uses the principles of decision analysis to identify actionable alternatives for complex problems, often when there are multiple stakeholder and interests (Gregory et al., 2012; Figure 3). SDM is implemented through the "PrOACT" process that includes: (1) clarification of the **Pr**oblems impeding the decisions (Decision Context); (2) articulating the **O**bjectives of the decision makers and stakeholders; (3) identifying **A**lternatives that can advance those objectives; (4) evaluating the **C**onsequences of potential alternatives on the desired objectives; and (5) considering **T**radeoffs as part of optimizing selection of an alternative to ultimately support deciding and acting on recommendations. The project team implemented SDM in this case through rapid prototyping, where the PrOACT cycle relies on eliciting attendee input and/or interpretation of existing and available information, as opposed to development or application of quantitative models or tools.

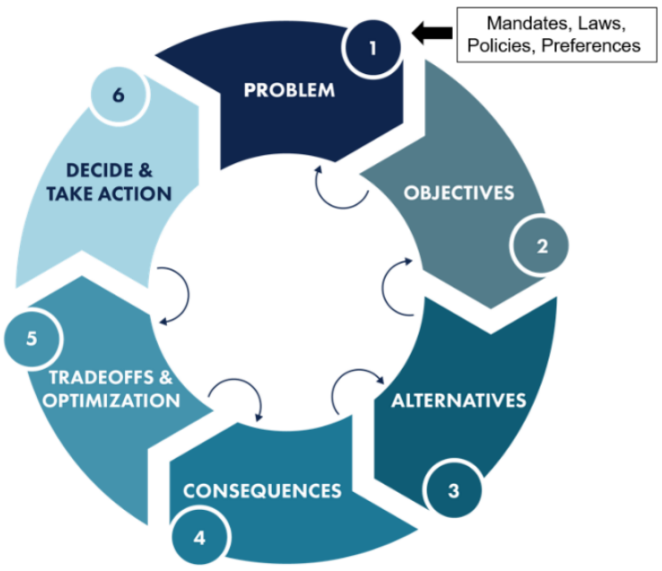

Figure 3. The PrOACT cycle underlying structured decision making (SDM). Adapted from Runge et al. (2013).

Describe Problem and Objectives

Aligning to the first step, at the outset the working group co-developed the following decision statement:

> To support integrating SDOH (**the trigger**) the Nueces Health Action Committee SDOH Data Integration Working Group (**the decision-maker**) needs a process and tools to link data on SDOHs (**the action**) across existing public and private health data systems in Nueces County (**the scope**) given limited staff and financial resources, privacy concerns, out-of-date data, and disparate data systems (**the constraints**). The process/tool will be developed for Nueces County within 1 year (**the frequency and timing**).

The group then agreed to a set of objectives needed to fulfill the decision statement and each member voted on which three objectives they wanted to prioritize. Table 5 lists these objectives and votes, as well as whether each objective was classified as a fundamental or means objectives. Fundamental objectives represent the core reasons why a decision is being made, focusing on the ultimate goals or desired outcomes (**the why**). Means objectives are the actions or steps taken to achieve those fundamental objectives (**the how**).

Table 5. SDOH Data Integration Working Group Objectives

Working Group Objectives	Fundamental / Means	Votes
Maximize SDOH availability.	Fundamental	4
Maximize trust (reproducibility).	Means	0
Maximize awareness in community of access/services.	Fundamental	8
Maximize awareness of service providers of how to connect to SDOH data.	Fundamental	6
Minimize cost.	Means	0
Address legal concerns (HIPAA compliance, privacy)	Means	3
Maximize data sharing across partner institutions.	Fundamental	5
Maximize use of Logic Model Working Group recommendations.	Means	0

Following the initial workshop the SDOH Data Integration Working Group held a virtual meeting to refine and confirm the final fundamental objectives. These were:

- Maximize SDOH availability.
- Maximize service provider accessibility to SDOH data.
- Maximize service provider ability to provide community access to services.
- Maximize data sharing across partner institutions.

Identify Alternatives

Identify Data Usage

As part of identifying action items and developing alternatives for data integration, SDOH Data Integration Working Group participants were asked whether they were currently using or collecting SDOH data across the project's 13 SDOHs. A total of six practitioner groups responded and indicated for each SDOH whether they collect, use public data, look for data on, or do not discuss the SDOH factor. Results of the survey, as shown in Figure 4, indicate that of those who responded to the survey, the majority of the health practitioners are collecting some amount of SDOH data across multiple factors. All factors, except access to green space, have at least one organization in Nueces County collecting data, with several organizations using public data to assess patients' needs.

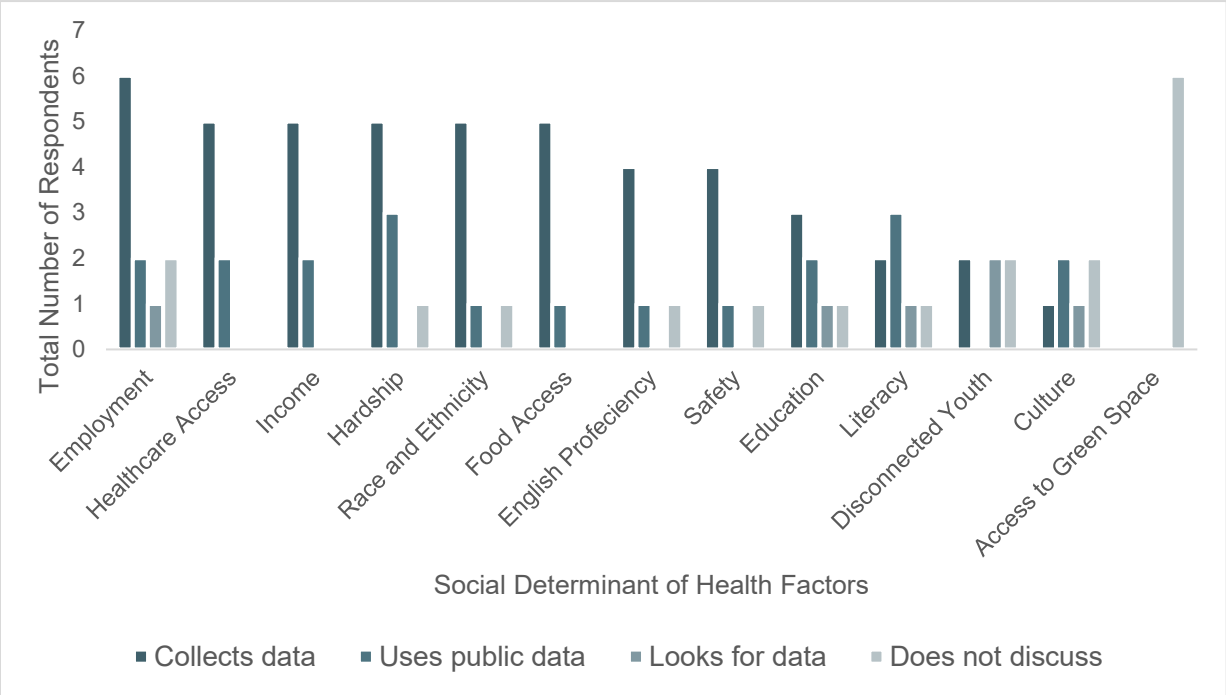

Figure 4. SDOH Data Integration Working Group responses on use and collection of SDOH data in Nueces County.

When asked how SDOH data was being used by their organizations, the SDOH Data Integration Working Group indicated that while some organizations are required to collect demographic data that can be used as SDOH data (i.e., zip code, Veteran status, age, disability, parenthood and pregnancy), they are also collecting data on housing, safety, food insecurity, cultural preferences and linguistic needs. These data are collected to help navigate and connect clients to appropriate resources. Often data are gathered as part of patient intake packets, with the goal of updating the data annually.

When asked how SDOH data was being stored, answers varied by respondent. Generally, data are stored in electronic health records that are unique to each health organization. Working group members were also concerned that SDOH data are not collected in consistent formats across organizations, but did note that some SDOH data are reported to the state of Texas through the Texas Incentives for Physicians and Professional Services (TIPPS) program and the Comprehensive Hospital Increase Reimbursement Program (CHIRP).

Identify Actions for Data Integration

Given that the survey identified that all working group members are collecting some level of SDOH data, the project team was interested to further learn why, if they all had SDOH data, did the participants remain interested in improved public and/or partner data availability for SDOHs? To solicit responses to this question and identify and develop different integration alternatives that aligned with the identified working group objectives, participants engaged in virtual exercises to identify different integration actions and activities that could be implemented or developed. The results of these exercises highlight a variety of actions that align with how SDOH data could be: 1) extracted; 2) made more available and accessible; and 3) support data integration by health practitioners. These actions were grouped into six alternatives, outlined in Table 6 below.

Table 6. SDOH Data Integration Working Group Alternatives

Alternatives	Action Outputs
1. Develop Data Inventory	• Describe and list available datasets, including individual organizations' data. • Develop data dictionary (metadata).
2. Provide Downloadable Data	• Provide automated table with summary data that is downloadable (outside of existing systems, e.g., EPIC), which supports integration into health information technology. • Allow for "selection" of SDOHs to generate report for use in grant writing, to prioritize resources and improve services, particularly at the community level.
3. Provide Data Dashboard	• Assess SDOH data to improve surveys/tools used in needs assessments • Provide outputs that can be used for staff SDOH training. • Link data between tool and healthcare provider data.
4. Leverage Existing Partner Data for Data Download	• Include local data in SDOH data download. • Include needs assessment data. • Standardize reporting. • Link partner data between tool and healthcare provider data.
5. Leverage Existing Partner Data for Data Dashboard	• Include local data in SDOH data dashboard. • Include needs assessment data. • Standardize reporting. • Link partner data between tool and healthcare provider data.
6. System "Flag" for SDOHs	• Integrate SDOH data into an institution's health information technology (EMR) to improve services at the individual level. • Increase organizational ability to track referrals.
Project Team: Improve Product Usability	• Provide training for users on submitting and exporting data to facilitate usability. • Develop use-case scenarios to facilitate usability.

Evaluate Alternatives and Forecast Consequences

The project team aggregated these actions into a set of draft potential alternative strategies related to the tools that could be developed to address the identified data integration objectives. These actions, or alternatives, were refined through discussions with the working group, and an evaluation exercise was conducted to assess each against the working group objectives. To complete the evaluation exercise, the project team developed an Excel workbook to evaluate the different potential stages of development for an SDOH data tool. Working group members were provided with instructions that included descriptions of the types of data needed to support each alternative, the main outputs the alternative would support, and described the training needed to facilitate use of each output. Members were then asked to rank each alternative based on: 1) the alternative's impact on the working group objectives; 2) organizational staff time required to complete the alternative; and, 3) the organizational costs required to complete the alternative. The summary results of the evaluation exercise across all working group members can be seen in Figure 5.

For each objective and development stage select the appropriate level of impact of the stage relative to each objective from the drop-down. **This evaluation should be from the perspective of your organization.** See descriptions of how to evaluate on a relative scale below.		Development Stages					
		1: Public SDOH Data Inventory	**2: Public SDOH Data Download**	**3: Public SDOH Data Dashboard**	**4: Leverage Partner Data SDOH Data Download**	**5: Leverage Partner Data SDOH Data Dashboard**	**6: SDOH Integration into Health Information Technology (e.g., internal system flag)**
Objectives	**Maximize SDOH availability**	+	++	+++	+++	+++	+++
	Maximize service provider access to/use of SDOH data	+	++	+++	+++	+++	+++
	Maximize service provider ability to provide community access to	/	/	/	++	++	+
	Maximize data sharing across partner institutions	++	++	+	+++	+++	+++
Constraints	**Staff time**	+++++	++++	+	++	++	+
	Cost	$$$$$	$$$$	$	$$	$$	$$$

Objectives evaluation		**Staff time evaluation**		**Cost evaluation**	
Drop-down selection	**Relative scale**	**Drop-down selection**	**Relative scale**	**Drop-down selection**	**Relative scale**
---	Very negative impact on the objective	0	No staff time required to implement	0	No cost to implement
--	Negative impact on the objective	+	Minimal staff time required to implement	$	Minimal cost to implement
-	Somewhat negative impact on objective	++	Minimal-moderate staff time required to implement	$$	Minimal - moderate cost to implement
/	Neutral/No impact on the objective	+++	Moderate staff time required to implement	$$$	Moderate cost to implement
+	Somehwat postive impact on objective	++++	Moderate-large amount of staff time required	$$$$	Moderate - high cost to implement
++	Positive impact on the objective	+++++	Large amount of staff time required	$$$$$	High cost to implement
+++	Very positive impact on the objective	++++++	Very large amount of staff time required (i.e., new staff member needed)	$$$$$$	Very high cost to implement

Figure 5. SDOH Data Integration Working Group evaluation exercise to assess potential project outputs.

Assess Tradeoffs

The project team then assessed the mean values of the evaluation of each alternative against the working group objectives and against requirements of member organizations in terms of staff time and financial resources (costs). The results of this assessment can be seen in Figure 6 and Figure 7, respectively. As shown in Figure 6, working group members felt that each of the data integration alternatives would have at least a somewhat positive impact on each objective, with the alternative that would allow for partner data download, a partner data dashboard, and the integration of data directly into individual organization health systems scoring the highest across all objectives (Alternatives 4–6). As shown in Figure 7, however, working group members were concerned that the staff time and cost for some of these alternatives could be prohibitive.

In discussions with working group members, some key points that were raised in assessing the alternatives were that SDOH data not only need to be more accessible but also more *usable*, meaning that each option should also provide guidance on how to use the data. For example, while an SDOH data inventory (Alternative 1) was identified as aligned with maximizing SDOH availability and access, working group members noted that significant staff time would be needed to use the inventory to find, access and download identified data, and would need to be led by in-house experts. Given this, members suggested a curated set of downloadable data (Alternative 2) would better facilitate data use. Downloadable data can also support providers' assessment of need in specific populations where referrals may help, yet many members also emphasized the difficulty and level of effort needed to interpret additional data. Toward this end, members emphasized that a dashboard (Alternative 3) could take some of the onus off providers by providing summary statistics to assist assessment of where local solutions are needed. By offering a visual dashboard, health practitioners and organizations would save time needed to access, interpret, and use the data.

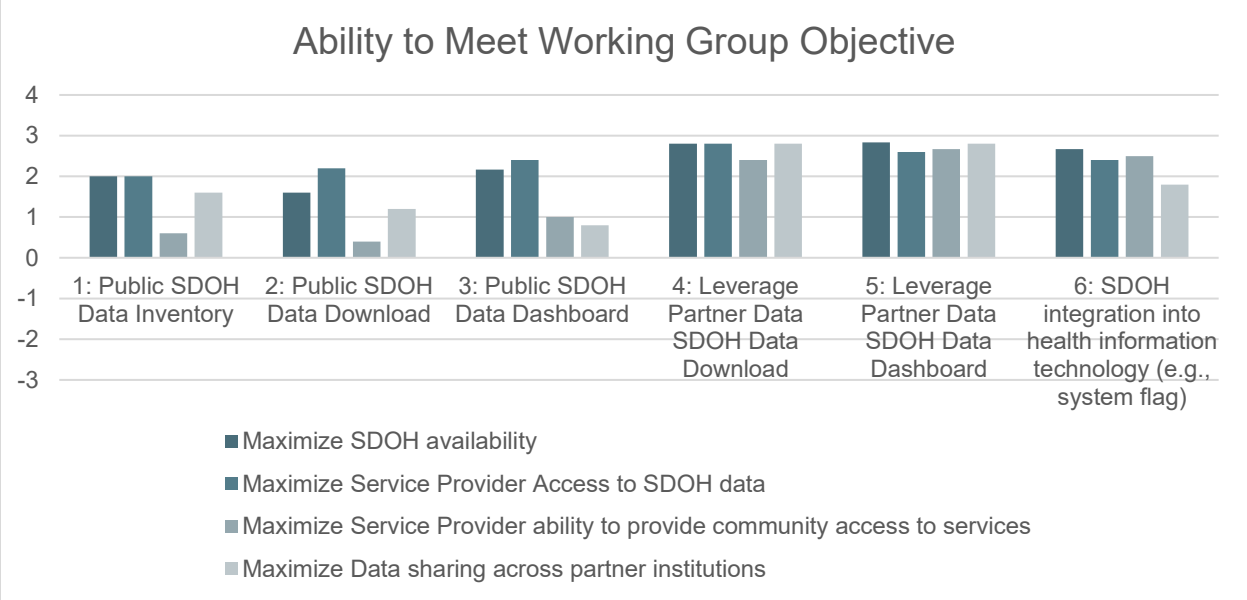

Figure 6. Evaluation Exercise – Alternatives' Ability to Meet Working Group Objectives. The average score for each alternative against each of the fundamental objectives is shown where "---" = -3, and "+++" = 3. Note: No alternative was scored negatively against the objectives.

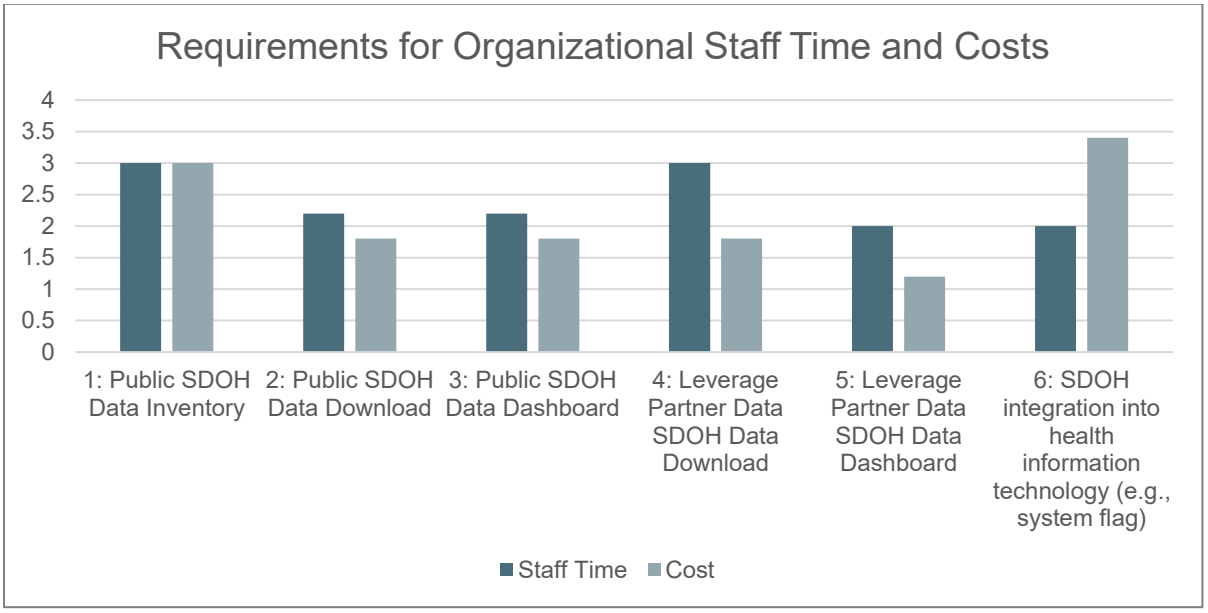

Figure 7. Evaluation Exercise – Alternatives' Requirements for Organizational Resources. The average score for each alternative is shown where "0" = "No staff time required" or "No cost to implement", and "6" = "Very large amount of staff time" or "Very high cost to implement."

Regarding the use of local partner data, members emphasized the need to ensure local data are readily usable and consider the temporal differences in data releases by various partners, which could complicate integration. However, because they are required to use it for reporting, most health practitioner organizations have such data readily available, and thus working group members agreed alternatives that leverage partner data could provide a significant value add for all objectives (Alternatives 4–5). Yet, while members highlighted the potential of local data in better understanding local needs, effort would be needed to streamline usability and data collection to facilitate uptake.

Finally, members discussed the potential of a system flag in depth (Alternative 6). This alternative would allow SDOH data to be integrated directly into electronic medical record (EMR) systems such as Epic. A field could be created in the electronic form where, once a patient's address is entered, relevant SDOH data are pulled for that address and a "flag" identifies any SDOHs that are a known concern for the area. Members emphasized that such a tool could both help providers ask more targeted questions as well as provide more specific referrals to resources that can address the SDOH needs identified as concerning. It would also be beneficial to integrate the SDOH data that organizations already collect into the same tool, to make those data more actionable instead of just using those data for reporting. One member added that such a tool would have the largest impact of all alternatives, as public and partner SDOH data would be targeted for use in daily decision making, whereas the other alternatives would provide support for the use of SDOH data for grant applications, needs assessments and potentially for programmatic improvements. However, all members felt that this alternative would be the most time-consuming and costly to organizations, as they would need to integrate the data, work with their EHR companies to alter their software, devise a system for interpreting and responding to the flags, provide training to staff, and maintain the tool and system.

Decide and Take Action

Given the benefits and tradeoffs discussed above, the SDOH Data Integration Working Group provided final recommendations for the project team to pursue. These are listed in Table 7.

Table 7. Final Recommendations for Action

Alternative	Recommended Action	Responsible Entity	Rationale
1. Develop Data Inventory	Pursue	Project Team	Important for data documentation and for facilitating future research.
2. Provide Downloadable Data	Pursue	Project Team	Important to facilitate data integration at minimal organizational cost.
3. Provide Data Dashboard	Pursue	Project Team	Important to facilitate data integration and interpretation at minimal organizational cost.
4. Leverage Existing Partner Data for Data Download	Pursue in Part	Action Committee Members and Project Team	Integration of available data would better meet project objectives, however data that are not readily available would require significant organization staff time.
5. Leverage Existing Partner Data for Data Dashboard	Pursue in Part	Action Committee Members and Project Team	Integration of available data would better meet project objectives, however data that are not readily available would require significant organization staff time.
6. System "Flag" for SDOHs	Delay	Action Committee Members	Significant benefit to project objectives, however significant organizational costs would also need to be expended.

SUMMARY OF ACTIONS: SDOH COMMUNITY HEALTH & ENVIRONMENT TOOL, DOWNLOAD AND DASHBOARD

The SDOH Data Integration Working Group recommended that the final actions of developing a data inventory, providing downloadable data and providing a data dashboard be taken. The working group also recommended leveraging existing partner data to the extent feasible for the data download and data dashboard.

Because the project team was already building a geospatial tool to visualize SDOH data for Nueces County, it was decided to incorporate the recommended alternatives into that existing portfolio of work. Thus, recommended alternatives were developed in the geospatial Community Health & Environment Tool. Although members noted the difficulty of using a data inventory, the project team moved this alterative forward to provide data source documentation for all SDOH data and define all fields and terms in the inventory. Appendix A provides details on the final data selected by this project, including the SDOH variable, corresponding data, relevant dataset, spatial scale, and how the file is named in the project.

The project team then set out to offer a curated data set that was built on suggested data from the Logic Model Working Group through the geospatial Community Health & Environment Tool itself, which is further described in Part III. This dataset took significant effort to build, which emphasizes the point made by SDOH Data Integration Working Group members that simply because data are publicly available does not make them usable, especially by health practitioners and professionals who do not have capacity to expend on finding, downloading and curating data. Interestingly, while the project team had planned to

build an SDOH database to support the creation of the Community Health & Environment Tool, they were not planning to also offer those SDOH data for download. That output is a direct result of applying an SDM process with the SDOH Data Integration Working Group, which required significant effort above and beyond that which was required to populate data in the geospatial tool. Similarly, the project team had not conceived of providing a data dashboard to accompany the geospatial tool, but in understanding the importance of the visual tool to working group members, the team pivoted to incorporate this function.

In leveraging local partner data, the project team recognized the value of these alternatives but encountered difficulties in obtaining data from all Action Committee organizations, including those in the health practitioner field but also those in social services and community work. Additional time and resources would be required to more fully implement alternatives to leverage such data in the data download and data dashboard. At a minimum, the project team was able to incorporate health screening data from the Corpus Christi Nueces County Public Health District that was gathered as a part of this project into the Community Health & Environment Tool. It is the intent of the project team to continue local data integration in subsequent work.

Spatial Scale and Available Data

The SDOH Data Integration Working Group and the larger Action Committee emphasized throughout the project that data at the zip code level—as much SDOH data are currently visualized—is simply not granular enough to assess need at the neighborhood or community level, where SDOH conditions can change drastically from block to block or neighborhood to neighborhood. With this at the forefront of their thinking, the project team sought to provide all outputs with data provided at a more granular scale.

The project team first attempted to collect data at the census block group level, to support finer resolution data relevant to specific neighborhoods. This task proved challenging, as comparable data are not available for census block groups across the project's SDOHs. The team was able to find comparable data at the census tract level, however, and thus this is the scale that was selected for data assessment and visualization. Figure 8 shows the 97 census tracts across Nueces County, which provides a finer resolution assessment than gathering data for 38 county zip codes.

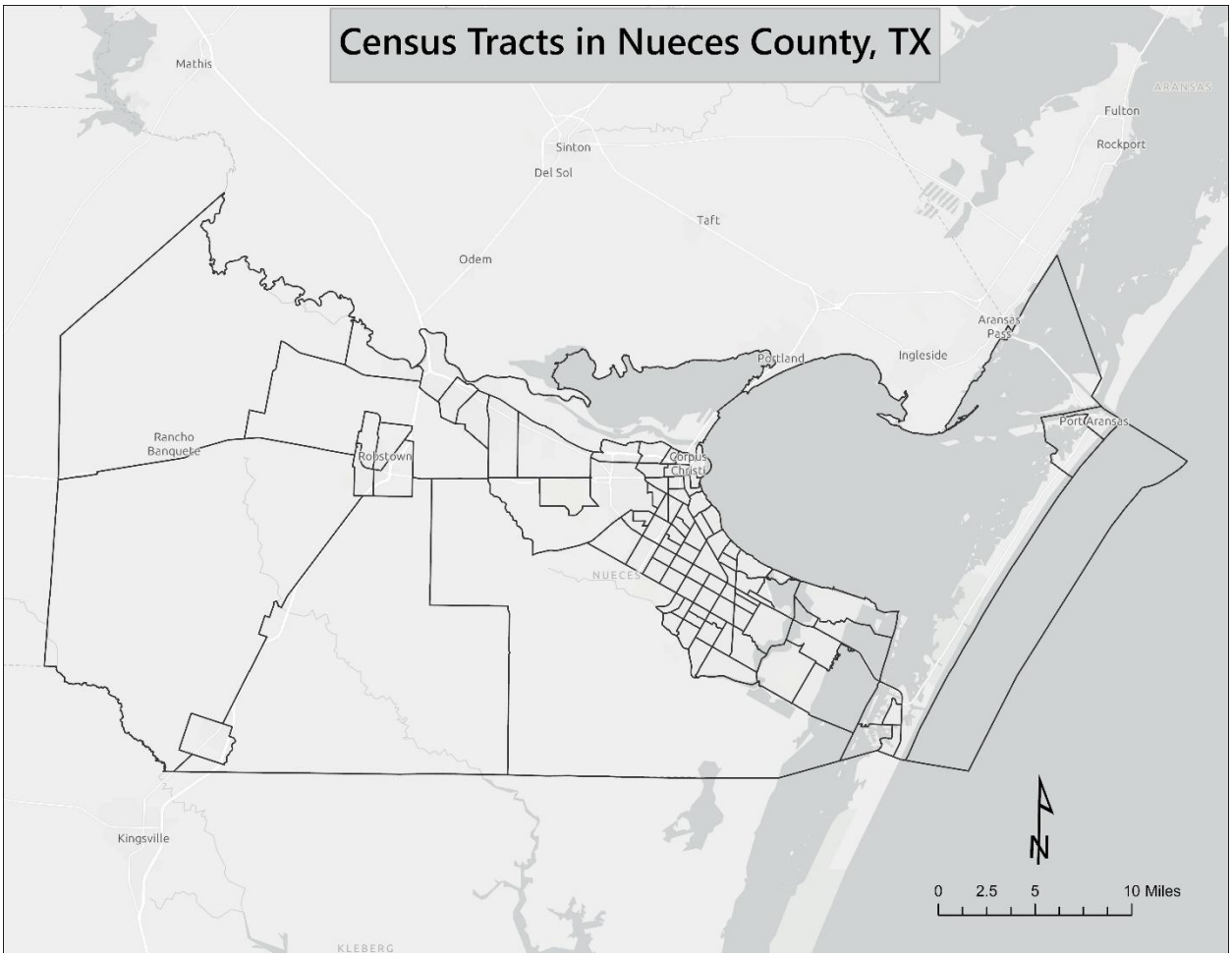

Figure 8. Nueces County Census Tract Map showing 97 Census Tracts in the county.

Data collection and curation was then conducted for each SDOH. Again, decisions had to be made on which datasets were most salient to relevant SDOHs in Nueces County. For example, income data are provided in many different brackets, across different years, and for some specific subsets of the population. Where the project team had outstanding questions, the Action Committee provided guidance to maintain focus on those data most relevant to Nueces County, and particularly those most relevant to at-risk communities in the county. Appendix A provides details on the final data selected by this project.

PART III: VISUALIZING AND INTEGRATING SDOH DATA IN NUECES COUNTY

NUECES COMMUNITY HEALTH & ENVIRONMENT TOOL, DOWNLOAD AND DASHBOARD

The Nueces Community Health & Environment Tool, data download and data dashboard were co-designed with the project's Action Committee members to ensure the products optimally support decision-making for improved health and SDOH outcomes in Nueces County. The SDM process described above helped to tailor these outputs to meet the needs of health practitioners, community-based organizations and government and quasi-government organizations. The following provides a snapshot of data and capabilities that are included in each product. Following this description, detailed guidance is provided for health practitioners as they consider using and/or integrating the project's products and data. It is important to note that further detailed guidance on using the features described below is available through the user guide for the Community Health & Environment Tool, which can be found on the Geospatial Resilient Economic Development (GeoRED) platform at: https://georedorg/ (Regional Resilience Partnership, 2025).

Data Inventory

The data inventory provides data source documentation for the resulting geospatial tool by cataloguing all data collected, curated, and offered through this project across SDOH, environmental, and health realms. Decisions were made with the Action Committee on which SDOH datasets would be prioritized for this project, and the inventory provides summary information for each. For SDOH data, the inventory includes the original field name, name for the project, the SDOH factor the data supports, the specific type of SDOH data provided, the geographic scale and the time step. All SDOH data sets are derived from the U.S. Census Bureau, other than access to greenspace, which was calculated for this project as an index by considering the proportion of buffered green space area that falls within each census tract in the county. For environmental and health outcome data, the inventory includes the factor name and a brief description of the data.

Given the importance of understanding locally available datasets to understand the importance of SDOHs in affecting health outcomes (as described in Part II), additional future work will be needed to further develop the inventory to include local data.

Geospatial Community Health & Environment Tool

The Community Health & Environment Tool provides two geographic identifiers: Nueces County census tracts, the scale at which most of the data are provided, and city of Corpus Christi districts, an important scale to consider for city planning. The tool enables the overlay of SDOH and environmental data on health data for analysis (Figure 9).

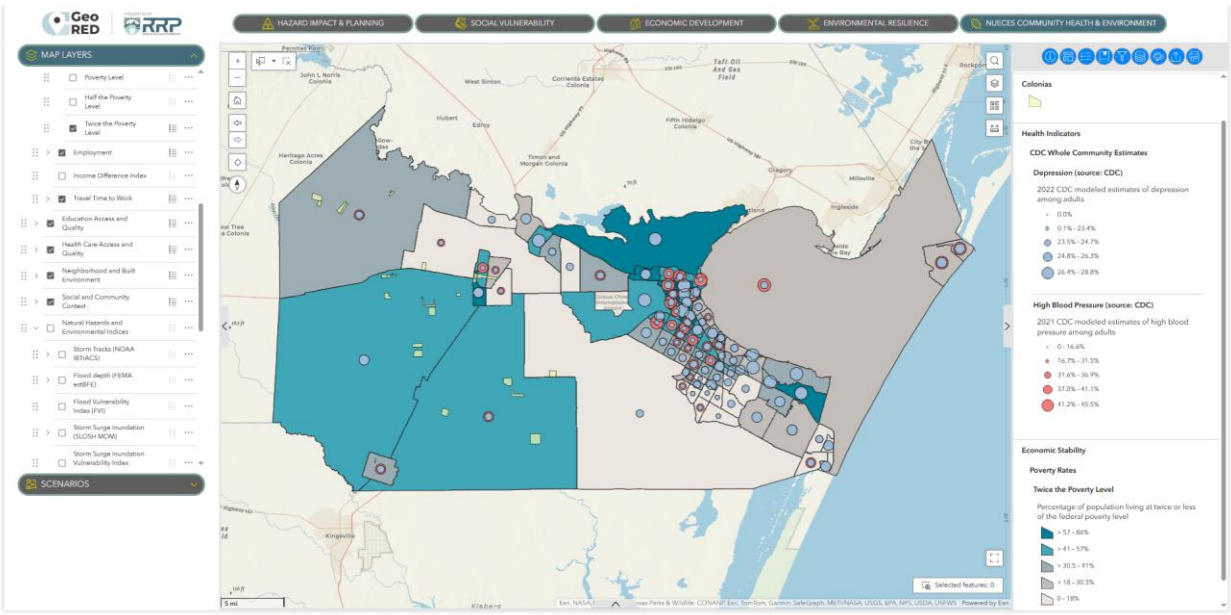

Figure 9. Example analysis enabled in the Community Health & Environment Tool for Nueces County, Texas. Data are grouped into SDOH categories. Image shows CDC data on depression rates and rates of high blood pressure, overlaid on poverty data (twice the federal poverty level).

For health data, two primary datasets are provided (see **Error! Reference source not found.**). The Center for Disease Control PLACES data provides model-based estimates based on data from Behavioral Risk Factor Surveillance System (BRFSS), Census decennial population counts and annual county population estimates, and the American Community Survey 5-year estimates (CDC, 2024c). These estimates are provided for all five health outcomes of focus for the project (asthma, diabetes, hypertension, obesity, and depression). In addition, local health data were collected for this project and created into a new layer for the tool. Approximately 500 individuals from across the county participated in health assessments, which provided direct observations and locally collected screening data. This enabled the team to capture and provide real-world measurements from individuals in the community. Notably, while the project was conducted under the oversight of the Texas A&M University-Corpus Christi Institutional Review Board (IRB) (IRB Number: TAMU-CC-IRB-2023-0981), local health data included in the tool were collected and provided by the Corpus Christi-Nueces County Public Health District and thus aligned to the department's processes for maintaining confidentiality, which consists of information encryption that is password protected.

The tool then organizes SDOH data curated for the project (see **Error! Reference source not found.**) Variables and Datasetsaccording to the five key domains: economic stability, education access and quality, health care access and quality, neighborhood and built environment, and social and community context (Healthy People 2030 & U.S. Department of Health and Human Services, 2025).

Environmental data are then included as historical observations and as a set of natural hazards and environmental indices, focusing on flood and heat impacts (see **Error! Reference source not found.**). Environmental Protection Agency index factors are offered, including the agency's indices for hazardous waste, lead paint exposure, air quality measures, superfund proximity, traffic proximity, and wastewater discharge. All environmental data are viewable at the census tract level.

Finally, self-response rates from households that responded to the 2020 U.S. Census also are provided as a layer at the census tract level. It is important to consider that U.S. Census and American Community Survey (ACS) data, as with all data, have strengths and limitations when it comes to understanding the nuances of community health and SDOHs (Table 8). The Decennial Census involves collecting data on households nationwide both online, by phone, and in-person. Each year, addresses are received from the U.S. Postal Service. Census also runs a program called Local Update of Census Addresses Operation (LUCA) and conducts LUCA just prior to a Decennial Census. ACS data collection uses a random sample of addresses and collects data through mail, phone, internet, and in-person interviews. In both the Decennial Census and ACS, the data that are collected are a direct result of who responds. It is well documented in primary literature that in communities of lower socioeconomic status, survey response rates can be low—at times exceptionally low—and thus the potential for nonresponse bias may be critical to assess (Jang & Vorderstrasse, 2019; Roberts et al., 2020). This layer provides important context to health practitioners and decision makers alike as they consider areas and neighborhoods that may have greater need than is demonstrated through census data alone.

Table 8. Strengths and Limitations of using Census Data for Understanding Local Contexts

Theme	Context
Strengths	
Broad Coverage	Census data, including ACS, provides comprehensive demographic and socioeconomic information across the entire United States. This allows for comparisons between different communities and the identification of broad patterns of vulnerability.
Key Indicators	Census data includes crucial indicators of vulnerability, such as poverty levels, housing conditions, educational attainment, and access to transportation.
Spatial Variability	Much of Census data are available at various geographic levels, including census tracts and census block groups and blocks, which can provide information at varying local scales.
Limitations	
Data Gaps	Certain populations may be undercounted by the census, which can lead to inaccuracies in vulnerability assessments.
Coarseness	While census tracts offer some granularity, they may still be too large to capture the variations in vulnerability within a neighborhood. Micro-level vulnerabilities, such as the specific needs of certain neighborhoods or households or the presence of informal support networks, may be missed.
Temporal Lag	Census data represents a snapshot in time. Rapidly changing conditions, such as economic downturns or natural disasters, may not be immediately reflected in the data. ACS data also may not capture very recent changes in populations.
Additional Context	Census data may not capture finer resolution quantitative and/or qualitative factors that contribute to resilience, such as social cohesion, community leadership, and local knowledge.

Community Health & Environment Tool Data Download

The Community Health & Environment Tool makes all data available for download such that interested users can easily access the data for integration into their own external analyses. These data also could be integrated into operational health information technology by health practitioners seeking to better understand SDOHs in the context of health outcomes (see Health Practitioners Guide: Integrating and Using Data).

Figure 10 shows a snapshot of this functionality. The left-hand pane shows all available data layers. In the center pane, a census tract representing Molina has been highlighted by using the feature's "Point" function. In the right-hand pane, all available data for the highlighted census tract populates, with each dataset available for download. This functionality was specifically identified as a need through the SDM process applied during this project with the purpose of facilitating SDOH data integration into health and other organizational analyses and information technology. More detailed guidance on using the tool and its functions are provided in the spatial platform's user guide (Regional Resilience Partnership, 2025).

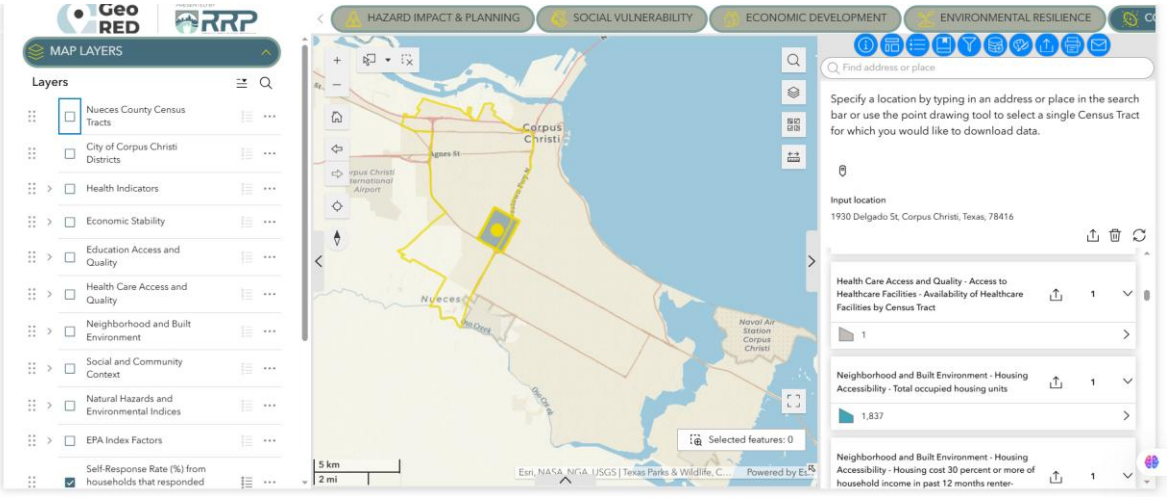

Figure 10. Community Health & Environment Tool showing a Molina neighborhood census tract and the data download function in the right-hand pane.

Community Health & Environment Tool Dashboard

The project's SDM process also identified that, in addition to raw SDOH data, health practitioners have a need for summary statistics provided through functions like a dashboard. Such visualizations provide depth and context for local needs assessments, grant writing, training, and in general provide a snapshot across communities that can be used to better target scarce resources. The Community Health & Environment Tool offers a dashboard as an entry point to providing summary data at the census tract level. Currently, the dashboard provides average rates across the five diseases prioritized by the project, flooding and storm surge rates, and summary data on the tract population. The project team envisions that in subsequent work the dashboard could be updated to support more targeted decision-making needs.

HEALTH PRACTITIONERS GUIDE: INTEGRATING AND USING DATA

There are three primary options for integrating and using the SDOH data produced through this project. Each option reflects a different level of integration into an organization's existing systems and workflows.

Option 1: Integrate with Reporting Data Warehouse

The first option is to place the dataset into a reporting data warehouse rather than the EMR. In this configuration, the data can be joined with other existing reporting tables to generate analyses and visualizations. While this approach is not real-time, it supports a more strategic use of the data by aligning SDOH information with other operational and clinical reporting.

This option carries minimal risk, requires little customization, and can be implemented quickly. Organizations can experiment with the dataset in their reporting environment to determine whether it provides value. If the benefits prove substantial, this option can serve as a steppingstone toward deeper integration, potentially leading to EMR-based workflows (Option 2).

Steps for HCOs to integrate SDOH Data into Their Reporting Data Warehouse (DW)

1. Load the SDOH file into a table
    a. Import the census/SDOH file into their EMR database as its own table.
    b. The table should include patient matching fields such as zip code or, ideally, census tract.
2. Link SDOH data to patient data
    a. Establish a relationship between the patient's demographic information (census tract) and the SDOH table (GeoID).
    b. Crosswalk table discussed below in "Downloading the Dataset" section. This allows the EMR to know which SDOH factors apply to a patient based on where they live.
3. Incorporate into reports
    a. Add the SDOH information into existing dashboards or reports.
    b. For example:
        i. Track Emergency Department visits or readmissions by zip code or census tract.
        ii. Compare no-show rates against transportation access.

Option 1, integration with a reporting data warehouse, combines clinical and operational data with SDOH to reveal risks that clinical data alone does not capture.

Option 2: Integration with EMR

The second option involves downloading the dataset (an Excel file with multiple sheets) from the Community Health & Environment Tool and importing it into the healthcare organization's EMR database. Once incorporated, the data can be used to support workflows within the EMR environment. For example, tables can be joined with registration or encounter data to identify commonalities and provide real-time decision support during patient care.

This approach, however, comes with high costs and technical challenges. Customization requires significant effort and every EMR upgrade introduces the risk of conflicts with the new table. Ongoing maintenance and support are required, and IT teams often weigh the risk of disruption against the uncertain reward. Many organizations may view this option as high-risk, with benefits that are not yet clearly defined.

Steps for HCOs to integrate SDOH Data into EMR

1. Load the SDOH file into a table
    a. Import the census/SDOH file into their EMR database as its own table.
    b. The table should include patient matching fields such as zip code.
2. Link SDOH data to patient data

a. Establish a relationship between the patient's demographic information (ideally, census tract, though zip code may be used) and the SDOH table (GeoID).
b. Crosswalk table discussed below in "Downloading the Dataset" section.
c. This allows the EMR to know which SDOH factors apply to a patient based on where they live.

3. Set up trigger points in the clinical workflow
    a. Identify clinical events where SDOH data could be identified, for example, during patient registration, admission, and scheduling.
    b. Configure a rule so that when a patient's census tract matches a census tract in the SDOH table, the system triggers an action.
4. Define the workflow actions
    a. The triggered action could be:
        i. Displaying a notification or flag to staff.
        ii. Adding a problem or risk factor to the chart.
        iii. Launching a questionnaire or screening form.
        iv. Referring the patient to a social worker.

Though Option 2 may be costly, embedding SDOH into the EMR reduces manual data lookup and makes patient risk information available at the right point in the workflow. This allows providers to identify at-risk patients earlier, enabling them to connect with resources and develop improved care plans.

Option 3: Use the Community Health & Environment Tool

The third option is to rely on viewable analyses within the geospatial Community Health & Environment Tool, which can be found on the GeoRED platform at: https://geored.org/. In this case, the dataset remains external to the organization. None of the healthcare organization's internal data are transferred into GeoRED. Users view the project's dataset, which organizes health and SDOH indicators by geographic identifiers at the census tract level. While useful for visualization and general reference, this option does not allow integration with organizational data. As a result, its utility in clinical workflows is limited, as practitioners would need to exit from viewing EMRs to refer to the GeoRED tool.

Considerations Across Options

Healthcare organizations often hesitate to integrate external tables directly into their EMRs (Option 2) because of the associated risks with system disruption, added maintenance during upgrades, and uncertain value. In contrast, the reporting warehouse approach (Option 1) is low-risk and allows organizations to assess whether the dataset provides measurable benefit before investing in deeper integration. From an IT leadership perspective, Option 1 offers the best balance of feasibility, cost, and potential value. If reporting demonstrates clear utility, organizations can then consider moving toward real-time workflow integration in the EMR (Option 2). Option 3, by comparison, is limited to stand-alone use of the Community Health & Environment Tool. While helpful for individual lookups, it is unlikely to be adopted widely by providers, who generally prefer to remain within their established EMR workflows. Healthcare organization roles that may be most interested in this option are care coordinators/case managers, population health managers, public health departments, and researchers.

Downloading the Dataset

The dataset can be downloaded directly from the Community Health & Environment Tool. At present, it is a one-time download, and the update frequency has not yet been determined. A crosswalk table may be needed to align census tract level data from the tool with specific zip codes. HUD's Office of Policy Development and Research (PD&R) provides a HUD-USPS Zip Code Crosswalk table available for programming in this situation (Department of Housing and Urban Development, 2025). This file maps zip codes to census geographies such as tracts, including a GEOID for each tract/county. Each record includes the zip code and GeoID. Nueces County zip codes can be joined to corresponding census tracts.

Recommendations for Dataset Download and Organizational Tracking

Ongoing improvements to both the dataset and the Community Health & Environment Tool should occur with an understanding of healthcare organizational use of the data, download frequency, organizational type, and geographic region of the data downloads. If future updates to the tool become feasible with additional funding, the project team should consider adding a short set of fields that the tool requests users to complete when downloading the data. By capturing user names, institutional affiliations and contact information, the team could enable follow-up communication to gather feedback on how the data are being used and how the data or the tool's functionality might be improved. This process would require the development of a form and the maintenance of a customer relationship management (CRM) database.

FUTURE SDOH DATA INTEGRATION NEEDS

While this project made curated SDOH data available for integration into health information organizations and technology through a set of options, there were additional needs identified that the project was not able to deliver in this phase. First, local health practitioner organizations, governmental organizations and social service institutions see great value in sharing and integrating locally refined data to understand SDOHs in the context of health outcomes. The Community Health & Environment Tool incorporates publicly available SDOH data at the census tract scale, but additional local data, such as 211 data or neighborhood-level needs data collected by community-based organizations was identified as a desired input, should future updates to the tool be possible. In addition, whether and how SDOH data may be made interoperable with an individual organization's EMRs remains to be determined. This project also identified the need for greater definition of the value that interoperability will bring to health organizations and, more importantly, the communities they serve. Future actions in this area could include targeted working sessions with individual health practitioners and their technology teams, which was noted by Driscoll Children's Hospital representatives as a practical next step. Notably, however, another challenge persists in meeting Driscoll's needs for the tool. Pediatric health data are more difficult to obtain than was anticipated. The Community Resilience Center at The Water Institute is working to identify whether additional funding may support the inclusion of these data in the tool, as the pursuit, collection and curation of the data will be the most significant steps. Following curation, the team at TAMUCC, which hosts the geospatial tool, has indicated that pediatric health data layers would not be difficult to add. It is hoped that the team will be able to follow up with a diverse team at Driscoll.

While additional advances in the incorporation of SDOH data into health information and technologies have been identified, this project has made an important contribution to understanding the SDOH conditions that impact health in at-risk communities in Nueces County, while making data on those conditions available to health practitioners, social and governmental organizations and the public.

CONCLUSION

This framework and its resulting products can help ensure interventions and policies address health disparities by being responsive to the challenges faced by at-risk communities in Nueces County, Texas. This includes better infusing health organizations, public policy, and community leaders with the data they identified and need to drive evidence-based approaches. By examining SDOHs linked to health outcomes, strategies can be better targeted to protect the health of at-risk populations. Understanding linkages across SDOHs, the environment, climate and health outcomes requires collaboration among public health, healthcare, social services, planning, and environmental organizations. It also necessitates integrating community perspectives into decision-making processes to ensure interventions and policies are responsive to the unique needs and challenges of communities.

Integrating data on SDOHs into health organizations and health information technology is also crucial for achieving improved health outcomes in at-risk communities. By considering factors like socioeconomic status, education, neighborhood, and access to food and housing, healthcare providers can gain a more complete picture of a patient's health beyond their clinical data. This enables them to provide more personalized and holistic care that addresses the root causes of health issues, not just the symptoms. For health information technology, incorporating SDOH data allows for better risk stratification, predictive modeling, and the development of targeted interventions for vulnerable populations. Ultimately, this approach moves healthcare from a reactive, illness-focused model to a proactive, prevention-oriented one that accounts for the complex social and environmental factors that shape health and well-being.

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APPENDICES

APPENDIX A. VARIABLES AND DATASETS

Table A-1. Health Variables and Datasets

Health Variable	Description
CDC Whole Community Estimates	CDC Whole Community Estimates provides modeled estimates from the CDC the rates of a specific health outcome in the entire population. This dataset provides model-based estimates based on data from Behavioral Risk Factor Surveillance System (BRFSS), Census decennial population counts and annual county population estimates, and the American Community Survey 5-year estimates. The six factors that are available are: Asthma, Depression, Diabetes, High Blood Pressure, Obesity, and High Cholesterol.
Corpus Christi Nueces County Public Health District (CCNCPHD) Health Assessment	CCNCPHD individual responses provides rates of specific health outcomes among individuals who participated in a health screening in 2025. A number of factors are calculated from this health screening dataset provided by CCNCPHD including Percentage of patients with high cholesterol, Percentage of patients with high blood sugar, Percentage of patients with high blood pressure and Percentage of patients who are obese, etc.

Table A-2. SDOH Variables and Datasets

SDOH Variable	Data Source (s)	Relevant Dataset(s)	Geographic Scale	Description
Economic Stability				
Median Household Income	American Community Survey (ACS)	**B19013**: Median Household Income in the Past 12 Months (in 2022 Inflation-Adjusted Dollars)	Census Tract	Estimates of Median household income in the past 12 months (in 2022 inflation-adjusted dollars).
Poverty Status	American Community Survey (ACS)	**S1701**: Poverty Status in the Past 12 Months	Census Tract	Estimates of population with income below 50, 125, 150, 185, 200, 300, 400 and 500 percent of poverty level.
Employment	American Community Survey (ACS)	**DP03**: Selected Economic Characteristics	Census Tract	Estimates of population 16 years and over in civilian labor force who are unemployed.
Hardship	American Community Survey (ACS)	**B09010**: Living in household with Supplemental Security Income (SSI), Cash Public Assistance Income, or Food Stamps/SNAP in the Past 12 Months for Children Under 18 Years in Households **B19083:** Gini Index of Income Inequality in all households **S0802**: Means of transportation to work by selected characteristics	Census Tract	Estimates of population living in household with Supplemental Security Income (SSI), cash public assistance income, or Food Stamps/SNAP in the past 12 months, under 18 years in household. Gini index ranging from 0 to 1 showing the level of income inequality within census tract. Estimates of travel time to work for workers 16 years and over who did not work from home – travel time ranging from less than 10 minutes to 60 or more minutes.

SDOH Variable	Data Source (s)	Relevant Dataset(s)	Geographic Scale	Description
		DP04: Selected Housing Characteristics		Estimates of total occupied housing units without vehicles.
Housing	American Community Survey (ACS)	**B25106**: Housing Costs as a Percentage of Household Income in the Past 12 Months **DP04**: Selected Housing Characteristics	Census Tract	Estimates of housing costs 30 percent or more of household income in the past 12 months, with various income levels in both owner-occupied/renter-occupied housing units. Percentage of owner-occupied and renter-occupied housing units.
Education Access and Quality				
Education Attainment	American Community Survey (ACS)	**B15002**: Educational Attainment for the Population 25 Years and Over	Census Tract	Estimates of the population 25 years and over who are High school graduates (including equivalency) and with a bachelor's degree.
English Proficiency	American Community Survey (ACS)	**S1601:** Language Spoken at Home	Census Tract	Estimates of population 5 years and over who speak a language other than English and citizens 18 years and over who speak a language other than English.
School Enrollment	American Community Survey (ACS)	**S1401**: School Enrollment	Census Tract	Estimates of the population of different age groups (starting from 3 years to 35 and over) enrolled in school.
Healthcare Access and Quality				
Health Insurance Coverage	American Community Survey (ACS)	**B27010**: Types of Health Insurance Coverage by Age	Census Tract	Estimates of population without health insurance coverage by age groups – under 19 years, 19-34 years, 35-64 years, and 65 and over.
Disability Status	American Community Survey (ACS)	**S1810:** Disability Characteristics	Census Tract	Estimates of population with a disability.
Access to Healthcare facilities	DHS Homeland Infrastructure Foundation-Level Data (HIFLD) and FEMA Hazus	HIFLD data	GIS point layer to census tract	Location of various healthcare facilities (Emergency Operations Center, Kidney Dialysis Center, Medical Care Facility, National Shelter System Facility, Nursing Home, Pharmacy) and number of healthcare facilities in each census tract.
Neighborhood & Built-in Environment				
Internet Subscriptions in Household	American Community Survey (ACS)	**B28011**: Internet Subscriptions in Household	Census Tract	Estimates of households with a Broadband Internet subscription such as cable, fiber optic, or DSL.
Access to Green Space	TNRIS; local data	Park and open space polygon layer	GIS polygon layer to census tract	"Access to Green Space" is defined as approximately 5-minute walk from the green space, which is equivalent 300 m or less than

SDOH Variable	Data Source (s)	Relevant Dataset(s)	Geographic Scale	Description
				a quarter mile. Calculated Normalized Green Space Index considering the proportion of the buffered green space area that falls within each census tract.
Social and Community Context				
Race & Ethnicity	American Community Survey (ACS)	**DP05**: ACS Demographic and Housing Estimates	Census Tract	Estimates of population of various race and ethnicity - Hispanic or Latino (of any race), Black or African American, non-Hispanic, American Indian and Alaska Native, non-Hispanic, Asian, non-Hispanic, Native Hawaiian and Other Pacific Islander, non-Hispanic, Other Race alone, non-Hispanic, Two or More Races, non-Hispanic.
Nativity and Citizenship Status	American Community Survey (ACS)	**B05001**: Nativity and Citizenship Status in the United States	Census Tract	Estimates of population who are U.S. citizen and are not a U.S. citizen.
Disconnected Youth	American Community Survey (ACS)	**B09005**: Household Type for Children Under 18 Years in Households (Excluding Householders, Spouses, and Unmarried Partners)	Census Tract	Estimates of population under 18 years in no spouse/partner present household – with male/female householder.
Single-parent Household	American Community Survey (ACS)	**B11012**: Households by Type	Census Tract	Estimates of male/female householder with children under 18 years, no spouse or partner present.

Table A-3. Environmental Variables and Description

Environmental Variable	Description
Historical Storm Tracks	This dataset shows the tracks, intensity and landfall locations of historical storms that have impacted the Texas coast, including all tropical depressions, tropical storms, and hurricanes recorded from 1842 to 2023. The data is sourced from NOAA's Office for Coastal Management Digital Coast.
Flood Layers – Estimated Base Flood Elevation (BFE)	This dataset, obtained from the Texas Water Development Board's "Flood Quilt," provides estimated floodwater depths for 100-year (1% annual chance) and 500-year (0.2% annual chance) flood events based on engineering flood models. A 100-year flood means there is a 1 in 100 chance of that level of flooding occurring in any given year, while a 500-year flood has a 1 in 500 chance—representing a more extreme but less frequent event.
Flood Vulnerability Index (FVI)	The Estimated Base Flood Elevation (BFE) for a 100-year flood scenario was used to calculate the Flood Vulnerability Index (FVI) at the census tract level. FVI provides a relative measure of flood susceptibility across tracts based on flood depth (severity) and inundation area (extent). Flood depth score is derived from the average flood depth per tract, and inundation area score reflects the percentage of flooded area. Both scores are normalized, and the final FVI is the average of these two components.
Storm Surge Inundation	This dataset, derived from NOAA's SLOSH (Sea, Lake, and Overland Surges from Hurricanes) model, provides Maximum of Maximum (MOM) storm surge inundation extents for hurricane Categories 1 through 5 under high tide conditions. By combining multiple storm

Environmental Variable	Description
	simulations per category, it represents worst-case flooding scenarios and offers a comprehensive view of surge impacts without being tied to specific storm tracks or timing.
Storm Surge Inundation Vulnerability Index (SSVI)	The Storm Surge Vulnerability Index (SSVI) is calculated at the census tract level using SLOSH MOM inundation data for hurricane Categories 1–5 under high tide conditions. For each category, vulnerability is assessed by combining normalized scores of mean inundation depth and percent of tract area flooded. Final vulnerability scores are calculated using weighted averages across all hurricane categories, with weights assigned to balance the frequency of past storms and the severity of their surge impacts.
Access to Greenspace Index (GSI)	The Access to Green Space Index measures proximity-based availability of parks and green areas at the census tract level using data compiled from local and state sources. A 300-meter buffer—representing a 5-minute walk— was applied around green space polygons to estimate accessible area within each tract. The index is calculated as the proportion of tract area within this buffer and normalized using min-max scaling to reflect relative accessibility across tracts.
Normalized Heat Index – Mean Radiant Temperature	The Mean Radiant Temperature (MRT) is a measure of radiant heat exposure a body can experience from both incoming radiation and reflective radiation from surrounding surfaces. A 1-m resolution raster of MRT for the hottest day in 2024 in Nueces County was generated using open-source software (SOLVEIG). Census tract-level metrics were derived via zonal analysis from the hourly MRT raster (14 hours - 07:00 – 20:00) and normalized (0–1) to produce a tract-based heat index.
EPA Index	This dataset includes a set of EPA Index scores that reflect potential environmental exposures and proximity to pollution sources at the census tract level. Indicators include air quality (e.g., nitrogen dioxide, ozone, PM2.5), hazardous site proximity (e.g., Hazardous waste, RMP facilities, Superfund, Toxic releases, Underground storage tanks), and other risk factors such as lead paint exposure, traffic density, and wastewater discharge. Each index is standardized to highlight relative environmental burdens across communities.

APPENDIX B. SDOH LOGIC MODELS

B.1 PROCESS FOR BUILDING THE SDOH LOGIC MODELS

The project team and Logic Model Working Group used diverse sources of evidence to construct the logic models, which were further informed by the SDOH Data Integration Working Group and Molina community members. The project team provided a first draft of the logic models for each health outcome (asthma, diabetes, hypertension, obesity, and depression) using peer-reviewed literature as well as state and local assessments. The Action Committee Working Groups then used their expert local knowledge to identify where they agreed relationships existed between an SDOH, climate or environmental factor and a health outcome, or where they noted such relationships were missing from the literature. Molina community members also provided feedback through surveys, which helped to identify relationships they deemed important at the community level. Finally, the project team used SDOH and health outcome data to conduct structural equation modeling, which is statistical technique that tests relationships between observed variables and unobservable, latent constructs, combining aspects of factor analysis and regression.

For each SDOH, climate and environmental factor, the logic models identify whether the evidence identified the factor as *linked* to the health outcome (correlated), or *driving* the health outcome (causal). The logic models show different kinds of evidence demonstrating different SDOHs, climate and/or environmental factors as links or drivers of the health outcome. Structural Equation Modeling links and drivers are marked with an asterisk (*) to indicate relationships that are statistically significant with p-value < 0.05, meaning there can be reasonable confidence that there is some non-zero association. For further information on the evidence used to build the logic models please see project's evidence library (Keating, et al., 2025).

B.1.1 SDOH Logic Models

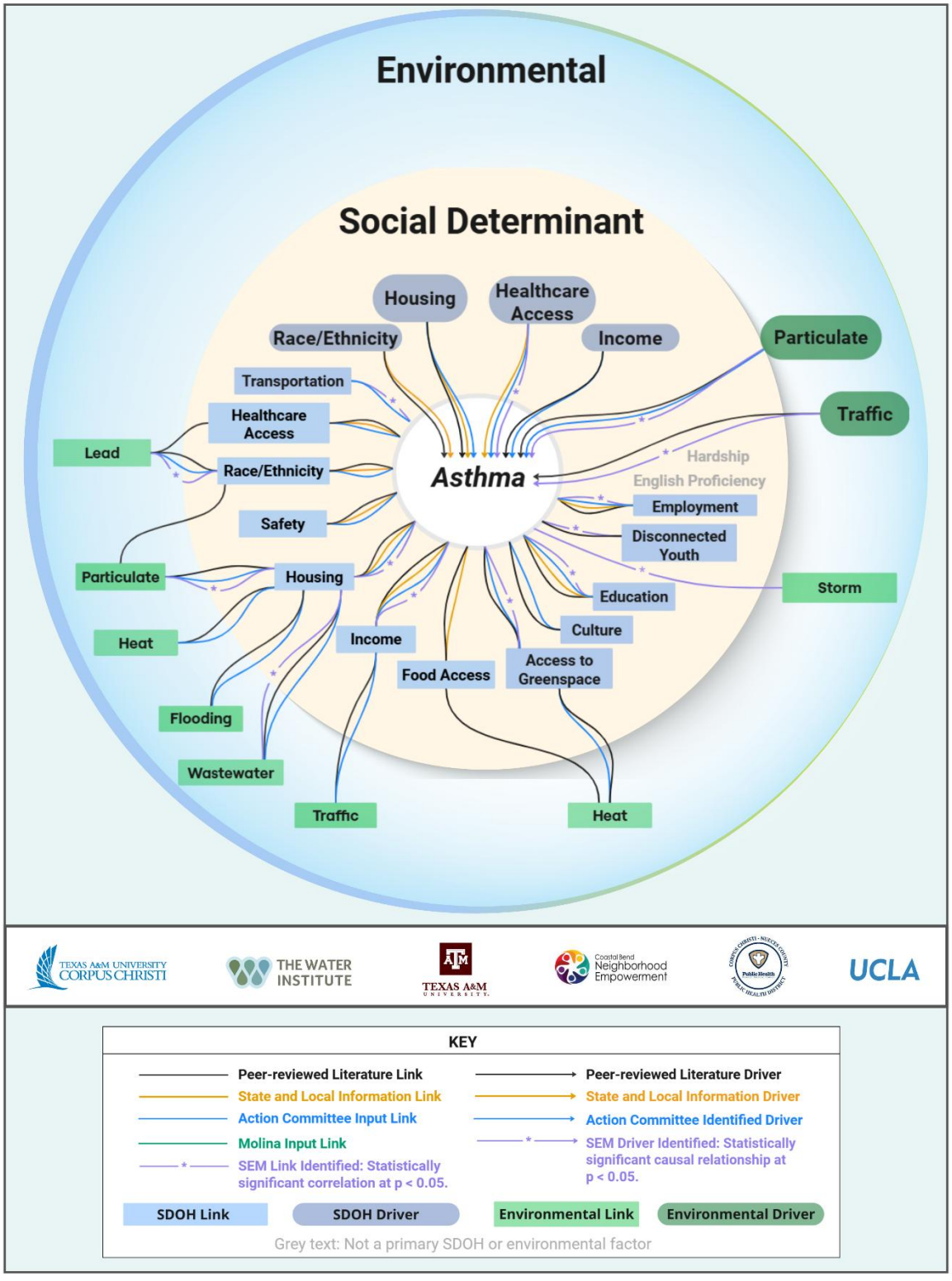

Figure B-1. SDOH Logic Model for Asthma

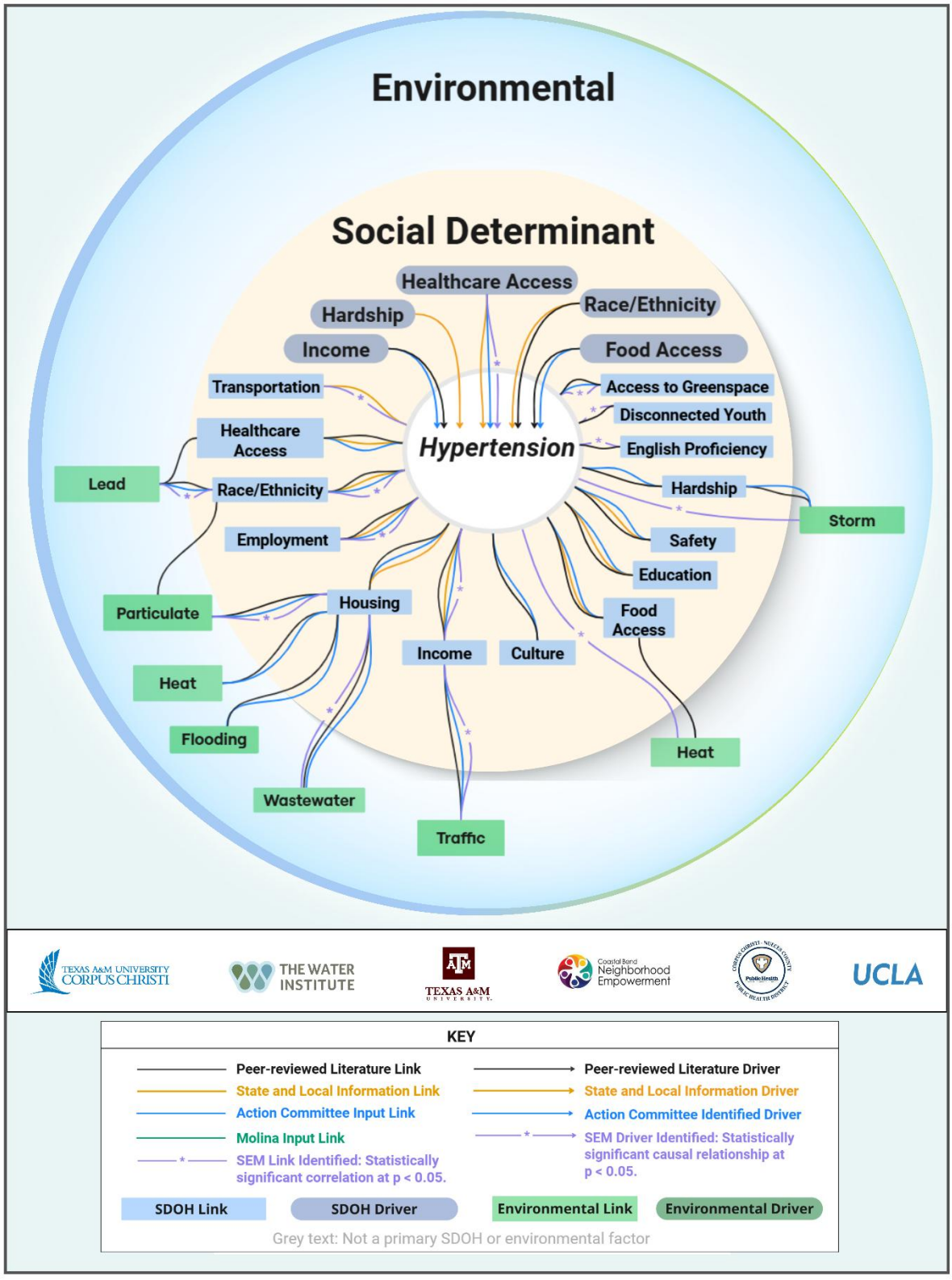

Figure B-2. SDOH Logic Model for Hypertension

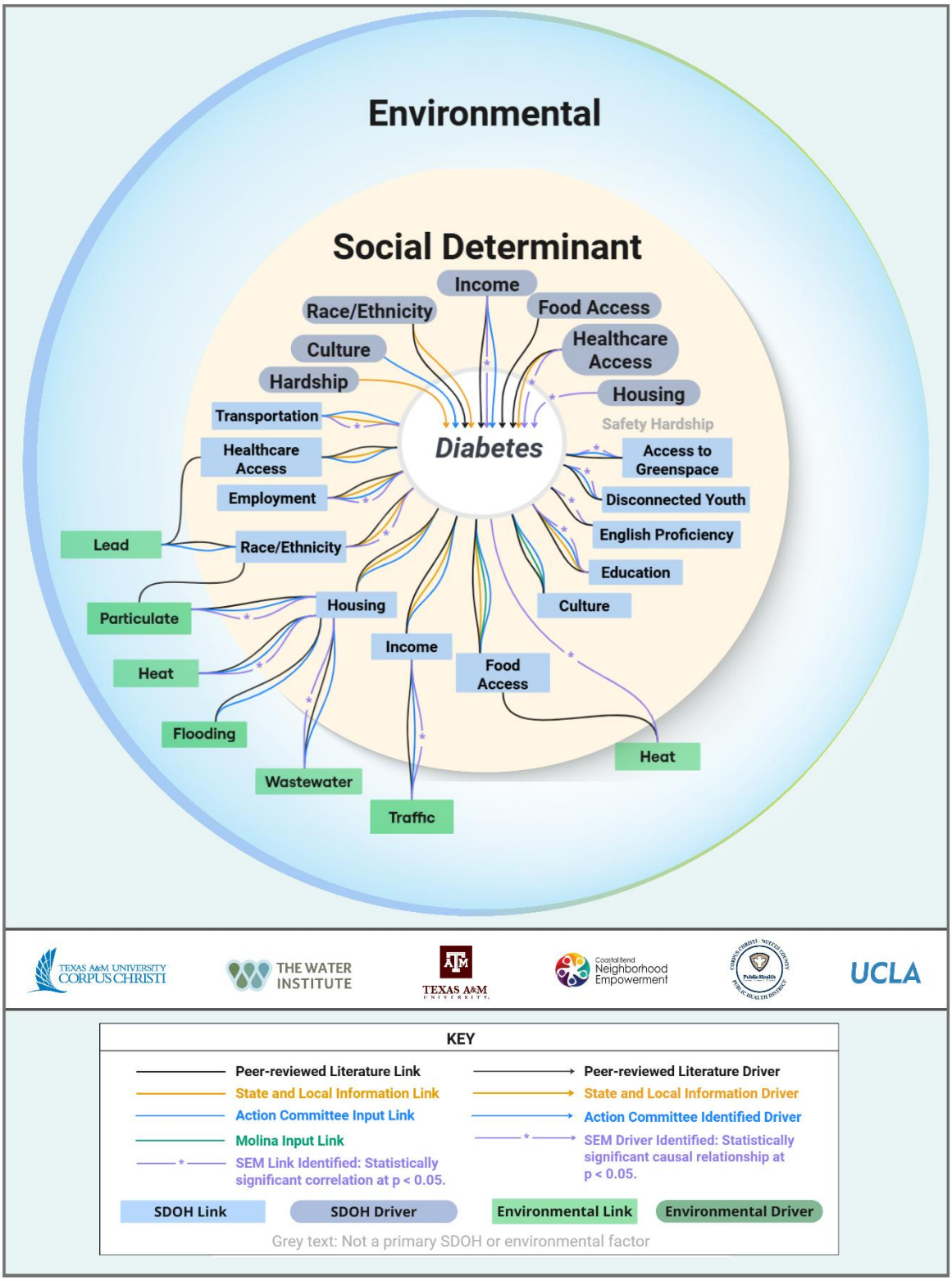

Figure B-3. SDOH Logic Model for Diabetes

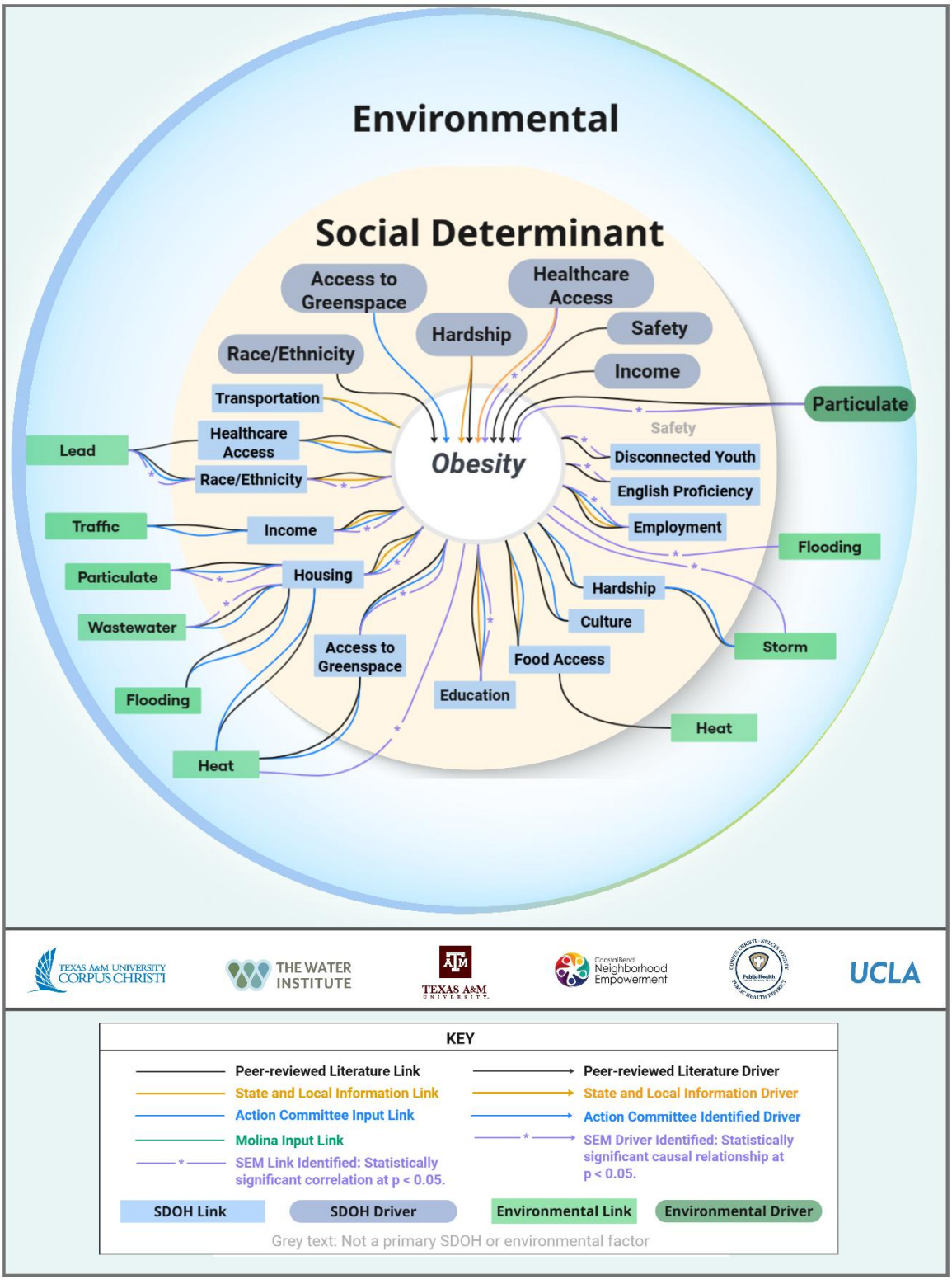

Figure B-4. SDOH Logic Model for Obesity

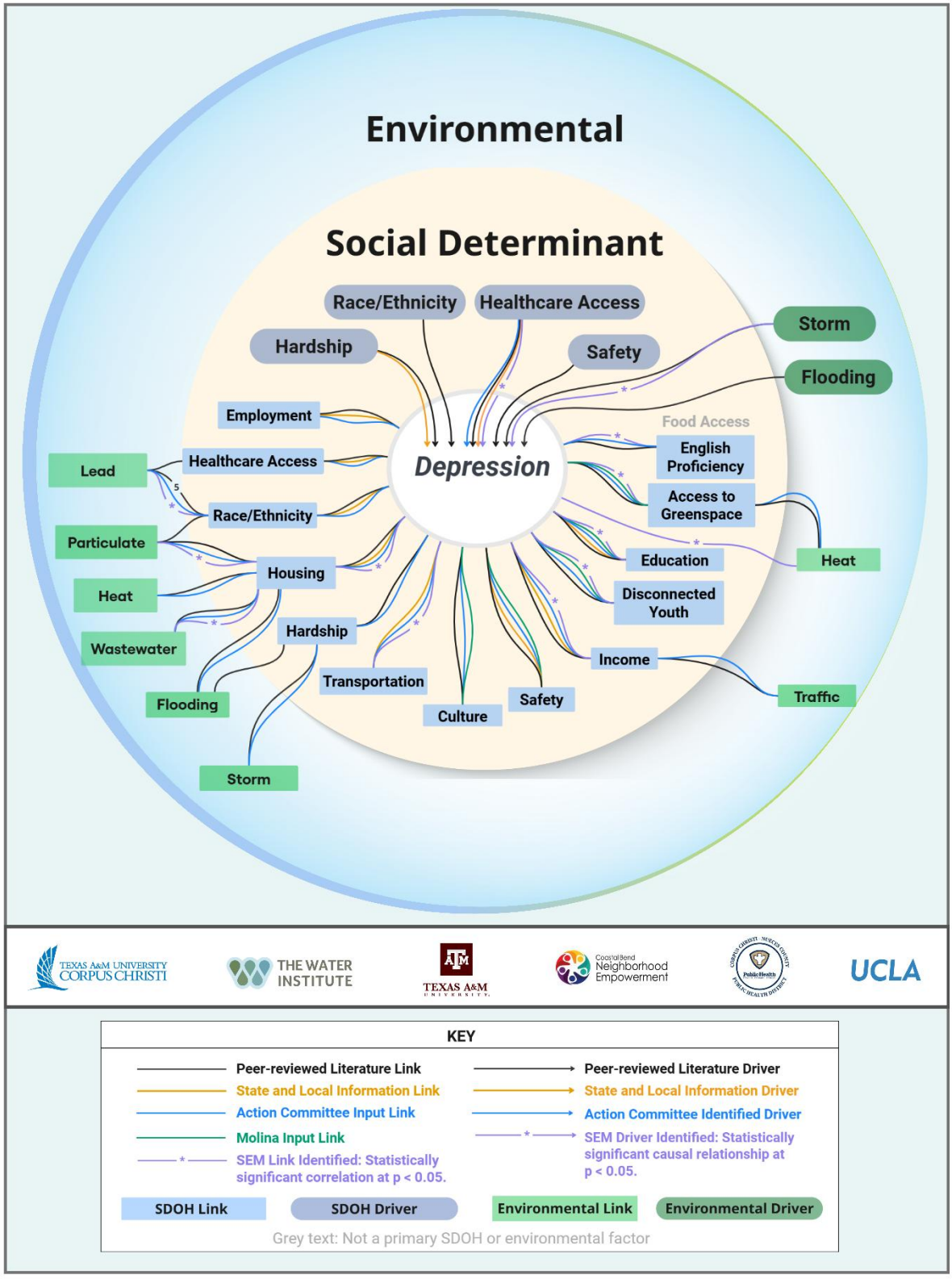

Figure B-5. SDOH Logic Model for Depression

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