



**Texas Medicaid Managed Care  
Focus Study  
Social Determinants of Health and Their Impact on Health Care  
Quality Measures in the CHIP and STAR/STAR Kids/STAR Health  
Populations**

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## ABBREVIATIONS

Adolescent Well Care Visit	AWC
Agency for Healthcare Research and Quality	AHRQ
Attention Deficit Disorder	ADD
Attention Deficit Hyperactivity Disorder	ADHD
Centers for Disease Control	CDC
Centers for Medicare and Medicaid Services	CMS
Child and Adolescent Access to Primary Care Practitioner	CAP
Children’s Health Insurance Program	CHIP
Concordance Statistic	C
Emergency Department	ED
External Quality Review	EQR
External Quality Review Organization	EQRO
Health and Human Services Commission	HHSC
Healthcare Effectiveness Data and Information Set	HEDIS ®
Human Papilloma Virus	HPV
Immunization for Adolescents	IMA
Immunization for Children	CIS
Improving Medicare Post-Acute Care Transformation	IMPACT
Low Birth Weight	LBW
Managed Care Organization	MCO
National Committee for Quality Assurance	NCQA
Obstetrician-Gynecologist	OB-GYN
Pediatric Quality Indicator 14 Asthma Admission Rate	PDI 14
Pediatric Quality Indicators	PDI
Prenatal and Postpartum Care	PPC
Prevention Quality Indicators	PQI
Primary Care Physician	PCP
Primary Care Provider	PCP
Sexually Transmitted Disease	STD
Social Determinants of Health	SDOH

State of Texas Access Reform – Medicaid Managed Care

STAR

Well Child Visit in the 3<sup>rd</sup>, 4<sup>th</sup>, 5<sup>th</sup>, and 6<sup>th</sup> Years of Life

W34

Well Child Visit in the First 15 Months of Life

W15

## EXECUTIVE SUMMARY

The Texas Health and Human Services Commission (HHSC) administers Medicaid health benefits to approximately 4.3 million individuals. Due to increasing interest regarding the impact of social determinants of health (SDOH) on Medicaid health outcomes, this study evaluated the presence of significant associations between a comprehensive set of SDOH variables and key health care quality measures for (1) the Texas Medicaid and Children’s Health Insurance Program (CHIP) population under age 19 in 2018 and (2) the Texas Medicaid pregnant women population in 2018. Additionally, this study estimated the degree (as a percentage) to which individual SDOH variables contributed to the collective SDOH impact by analyzing the statistically significant associations between individual SDOH variables and the performance outcomes of each quality measure per study population.

A total of 13 key health care quality measures were selected as study outcomes (ten quality measures for the children and adolescent population and three quality measures for the pregnant women population). Quality measures data were compiled by the Texas Medicaid External Quality Review Organization (EQRO) and derived from Healthcare Effectiveness Data and Information Set (HEDIS®) and Agency for Healthcare Research and Quality (AHRQ) Pediatric Quality Indicators (PDI) measure specifications, using Medicaid claims, encounters, and enrollment data. A total of 24 SDOH variables were included in this study representing various socioeconomic, environmental, and behavioral determinants relevant to each study population. The SDOH variables were reported at the county level and obtained from valid public data sources (e.g., administrative data, census data, survey data, and public health surveillance data). Since the datasets used in this study included member-level county information, the quality measures data and SDOH variables data were linked and analyzed at the county level. The SDOH variables were also grouped into the following five categories: 1) “Demographic Attributes” (Race/Ethnicity), 2) “Health Behaviors”, 3) “Availability and Access to Health Care Services”, 4) “Social and Economic Environment”, and 5) “Physical Environment”. Additional information about the quality measures and SDOH variables included in this study (e.g., data sources and measure specifications) can be found in Appendices I and II.

In this study, the analytic approach began with evaluating whether the addition of SDOH variables increased the statistical model’s ability to predict the inclusion of members in the numerator of quality measures better than random chance and better than a model that only

included demographic variables. Next, this study analyzed the extent to which individual SDOH variables were significantly associated with meeting the numerator criteria of each quality measure per study population. Detailed information about the analytic approach can be found in the Methods section.

Based on the study results, for each study population when SDOH variables were included in the statistical modeling, the model's ability to predict whether a member met the numerator criteria for quality measures increased and was more accurate than the model with demographic variables alone, suggesting that these SDOH variables influenced quality measure performance to some degree. While the models including SDOH variables showed increased accuracy for both study populations, the modelling seemed to be more sensitive for the children and adolescent population (i.e., the level of increased modeling accuracy was relatively less for the pregnant women population). Moreover, the number of individual SDOH variables with significant associations varied by study population and per quality measure, highlighting that not every SDOH variable contributed equally to the observed impact of SDOH on quality measure performance.

Among children and adolescents, four SDOH variables (Race/Ethnicity, Access to Exercise Opportunities, Rate of Physical Inactivity, and Access to Mental Health Providers) were significantly associated with eight of the ten quality performance measures assessed. Another seven SDOH variables (Rate of Sexually Transmitted Disease (STD), Rate of Adult Smoking, Rate of Adult Obesity, Access to Primary Care Physicians (PCP), Rate of Uninsured Adults, Rate of Violent Crime, and Air Pollution) were significantly associated with seven of the ten quality measures for this study population. Overall, based on the categorization of SDOH variables, "Social and Economic Environment" and "Health Behaviors" were the two SDOH categories showing the largest influence on the performance outcomes of the quality measures for this study population.

Among pregnant women, three SDOH variables (Rate of Adult Smokers, Access to Mental Health Providers, and Rate of Violent Crime) were significantly associated with the performance outcomes of all three of the quality measures for this study population. Another twelve SDOH variables were significantly associated with the performance outcomes of at least two of the three quality measures for this study population. The individual SDOH variables with the largest influence on the performance outcomes of each of the three quality measures were Food Insecurity



on Timeliness of Prenatal Care, Air Pollution on Postpartum Care, and Race/Ethnicity on Low Birth Weight (LBW) Babies.

When interpreting the results of this study, a few limitations should be considered. The SDOH variables used in this study were collected from a variety of data sources, and as such, the greatest common level of analysis was conducted at the county level, which may not necessarily reflect the social context of the individual Medicaid member and may mask differences within a county and any individual exposures. Furthermore, as a cross-sectional study, while the results indicated that there were significant associations between individual SDOH variables and the performance outcomes of quality measures, the results could not be interpreted as direct causal relationships.

Given these limitations, several recommendations could be considered by policy makers, Medicaid MCOs, and providers. For example, access to member-level SDOH data could further improve the accuracy of statistical modeling as well as help identify which individual SDOH variables are significantly associated with quality measure performance at the member-level. Member-level SDOH data could be standardized and collected during Medicaid and CHIP enrollment, via health care diagnostic codes related to SDOH (e.g., Z codes) documented by providers, or using member surveys by Medicaid managed care organization (MCO). Regardless of the approach, mutual engagement and buy-in among policy makers, providers, and MCOs is essential. Alternatively, another recommendation would be to build off the study's findings to prioritize interventions and strategies addressing SDOH for Medicaid members. For example, prioritization could be based on the SDOH category or individual SDOH variable with the largest influence (e.g., the SDOH variables within the SDOH category, "Social and Economic Environment", or the individual SDOH variable, Access to Mental Health Providers, which was significantly associated across most quality measures for both study populations). As policy makers, MCOs, and providers look to better understand the impact of SDOH on Medicaid health outcomes, this study provided important findings supporting the relevance of SDOH variables collectively and individually on key measures of health care quality for children, adolescents, and pregnant women in Texas Medicaid.

## INTRODUCTION

As defined by the World Health Organization, social determinants of health (SDOH), the “conditions in which people are born, grow, live, work and age”<sup>1</sup>, are gaining recognition as significant contributors to overall health status. Examples of SDOH include housing conditions, food insecurity, available transportation to health care services, social norms and attitudes, and other socio-economic conditions<sup>2,3</sup>, and SDOH can be grouped into five major categories: “Demographic Attributes”, “Health Behaviors”, “Availability and Access to Health Care Services”, “Social and “Economic Environment”, and “Physical Environment”. Research indicates that unmet social needs, such as food insecurity, unstable housing, and poverty, can negatively impact health status and serve as risk factors for many chronic diseases such as diabetes, obesity, and depression.<sup>4,5</sup> One study found that the estimated number of deaths in the United States attributable to SDOH, such as low education, racial segregation, low social support, and income inequality, was comparable to the number of deaths attributed to heart disease, cerebrovascular disease, and lung cancer.<sup>6</sup> A national initiative, known as Healthy People 2020, outlined a 10-year strategy for improving the health for all populations and recommended moving the focus of health care beyond treating diseases to addressing the SDOH contributing to disease states.<sup>7</sup> Moreover, the Centers for Disease Control and Prevention (CDC) emphasizes that addressing SDOH is necessary for achieving health equity.<sup>2</sup>

According to a national Medicaid survey by the Kaiser Family Foundation, Medicaid managed care organizations (MCO) are increasingly engaging in activities addressing SDOH for their members. A number of states now require Medicaid MCOs to screen members for certain social needs and refer members to social services as needed.<sup>8,9</sup> There are emerging efforts by hospitals, providers, and health plans to address SDOH through innovative payment models, provider education regarding SDOH, and coordination with community-based organizations in the social services sector.<sup>8-10</sup> Additionally, national studies on Medicaid managed care populations have shown that investing in SDOH initiatives results in cost savings through decreased rates of unnecessary hospital readmissions and emergency department (ED) visits.<sup>11,12</sup> A 2018 case-control study conducted on Medicaid and Medicare Advantage members revealed that the members who were connected with social services showed a 10% reduction in health care costs.<sup>11</sup> Additionally, a study conducted by the Robert Wood Johnson Foundation revealed a significant reduction in costs when SDOH were addressed, as observed by a 17% reduction in ED utilization, 26%

reduction in ED spending, 53% reduction in inpatient spending, and 23% reduction in outpatient spending.<sup>13</sup>

With an estimated population of 29 million people<sup>14</sup>, Texas is the second most populated state in the United States, and the Texas Health and Human Services Commission (HHSC) administers Medicaid health benefits to approximately 4.3 million individuals.<sup>15</sup> While the vast majority of Texas Medicaid members are children and pregnant women (e.g., 44% of all state resident children and 52% of all state births), other Medicaid beneficiaries include people with disabilities or people over age 65 who meet the income eligibility requirement (e.g., income up to 74% of the federal poverty level).<sup>15</sup> Since 95% of Texas Medicaid beneficiaries are enrolled in Medicaid managed care, the Medicaid MCOs in Texas are key partners in supporting initiatives that address SDOH to improve the health status of their members. At the state level, understanding the impact of SDOH on Medicaid members is an important step towards developing a statewide approach for continuously improving the quality of health care delivered to all Medicaid beneficiaries.

## **Background**

With increasing national attention on SDOH, many health care payers have looked to assess the impact of SDOH on various health outcomes. For example, the Improving Medicare Post-Acute Care Transformation (IMPACT) Act of 2014 (H.R. 4994)<sup>16</sup> created an initiative to study the effect of socioeconomic status on quality, resource use, and other performance-based measures for individuals in the Medicare program. The National Committee for Quality Assurance (NCQA) conducted a similar analysis but on Medicare Advantage plans and found that while socioeconomic status did not significantly impact the results for some quality measures, socioeconomic status did contribute to a disparity in results for other quality measures<sup>17</sup>. Building off these analyses, this study expanded the assessment of SDOH beyond simply socioeconomic status and assessed the impact of SDOH on key health care quality measures for Texas Medicaid managed care populations.

To participate in federal funding for Medicaid managed care programs, the Centers for Medicare & Medicaid Services (CMS) requires external quality review (EQR) by an organization independent from the state. Since 2002, the Institute for Child Health Policy at the University of Florida has served as the external quality review organization (EQRO) for Texas Medicaid and the Children's Health Insurance Program (CHIP). Following CMS guidance for EQR Protocol 6, the

EQRO reports quality measures for Texas Medicaid and CHIP MCOs each reporting year. The quality measures derive from nationally recognized quality assessment programs including the NCQA, which developed a set of quality measures for the managed care industry known as the Healthcare Effectiveness Data and Information Set (HEDIS®),<sup>18</sup> and the Agency for Healthcare Research and Quality (AHRQ), which developed quality measures known as Prevention Quality Indicators (PQI) and Pediatric Quality Indicators (PDI).<sup>19</sup> In Texas Medicaid and Children’s Health Insurance Program (CHIP), these nationally recognized quality measures serve as key indicators of MCO and provider performance on the delivery of high quality care to Medicaid members. Therefore, the Medicaid member enrollment data and quality measures data available through the EQRO presented this study with an excellent opportunity to evaluate the association between SDOH variables and key health care quality measures on Texas Medicaid managed care populations.

### **Objective and Aims**

The objective of this study was to evaluate the impact of a comprehensive set of SDOH variables on key health care quality measures for (1) the Texas Medicaid and CHIP population under age 19 in 2018 and (2) Texas Medicaid pregnant women in 2018. The aims of this study were to analyze significant associations between the SDOH variables and the quality measures for each study population and to estimate the degree (as a percentage) by which individual SDOH variables significantly contributed to the overall impact of SDOH on the performance outcomes of the quality measures.

## **METHODS**

### **Data**

The Medicaid and CHIP member enrollment data provided basic demographic information such as age, gender, race/ethnicity, and county of residence on eligible Medicaid members for this study. The claims and encounter data were used to identify Medicaid members who met the criteria for numerator inclusion in the quality measures.

### **Study Outcomes – Quality Measures**

A total of thirteen key health care quality measures were selected as study outcomes, of which ten quality measures were selected for the children and adolescent population, and three

quality measures were selected for the pregnant women population (see **Table 1**). As defined by HEDIS® or AHRQ, each quality measure included numerator and denominator specifications that defined whether high quality health care was delivered to an eligible individual or whether favorable health outcomes were produced for an eligible individual. When the performance criteria for the numerator or denominator are satisfied, as defined by the measure specifications, then an eligible individual may be counted in the numerator or denominator values for a given quality measure. For instance, for the Children Immunization quality measure, an eligible Medicaid member whose combination of recommended vaccinations has been received, as defined by the measure specifications, would satisfy the performance criteria to count towards the numerator. In most instances, quality measure specifications are defined such that satisfying the numerator performance criteria results in an overall rate that represents high quality health care (e.g., the Children Immunization represents all recommended child vaccinations received). However, quality measures may also be defined such that satisfying the numerator performance criteria results in an overall rate that represents low quality health care. For instance, the Asthma Admission Rate quality measure has inverse performance directionality in that satisfying the numerator performance criteria means that a potentially preventable asthma-related hospital stay has occurred, which represents low quality health care or an unfavorable health outcome.

In **Table 1**, each of the quality measures selected for the study populations are listed by measure title, measure description, and measure source. Additional information regarding the quality measures included in this study can be found in Appendix II.

**Table 1: Study Outcomes**

<b>Study Outcomes - Children and Adolescents</b>		
<b>Quality Measure</b>	<b>Measure Description</b>	<b>Source</b>
Children Immunization	Childhood vaccines protect children from a number of serious and potentially life-threatening diseases. Numerator criteria include children 2 years of age who had a combination of recommended immunizations. (Combination 2: diphtheria, tetanus and acellular pertussis; polio; measles, mumps and rubella; haemophilus influenza type B; hepatitis B, varicella vaccines)	HEDIS®
Adolescent Immunization	Vaccines are a safe and effective way to protect adolescents against potential deadly diseases. Numerator criteria include adolescents 13 years of age who had a combination of recommended immunizations.	HEDIS®

	(Combination 1: Meningococcal and tetanus, diphtheria, acellular pertussis vaccines)	
Adolescent HPV Immunization	Numerator criteria include adolescents who had the complete human papillomavirus (HPV) vaccine series.	HEDIS®
Follow-up after Initiation ADHD Medication	Numerator criteria include children or adolescents with follow-up visit during 30-day initiation of prescribed attention-deficit/hyperactivity disorder (ADHD) medication.	HEDIS®
Follow-up during Continuation ADHD Medication	Numerator criteria include children or adolescents with follow-up visits (at least 2) during continuation and maintenance phase after initiation of attention-deficit/hyperactivity disorder (ADHD) medication.	HEDIS®
Asthma Admission Rate (Pediatric Quality Indicator 14)	Asthma related admissions are potentially preventable inpatient stays. Numerator criteria include asthma related acute inpatient stays among children aged 2-17 years.	AHRQ
Annual Primary Care Visit	Access to primary care is important for the health and well-being of children and adolescents. Numerator criteria include children and young adults 12 months-19 years of age who had a visit with a primary care practitioner (PCP).	HEDIS®
15-Month Old Well Child Visits	Assessing physical, emotional and social development is important at every stage of life, particularly with children and adolescents. Numerator criteria include children with 6 or more well child visits in the first 15 months of life	HEDIS®
Ages 3, 4, 5, 6-Year Old Well Child Visits	Numerator criteria include children 3-6 years of age who received one or more well-child visits with a primary care practitioner during the measurement year.	HEDIS®
Adolescent Well Care Visits	Numerator criteria include adolescents and young adults 12-19 years of age who had at least one comprehensive well-care visit with a primary care practitioner or an OB/GYN practitioner during the measurement year.	HEDIS®
<b>Study Outcomes - Pregnant Women</b>		
<b>Quality Measure</b>	<b>Measure Description</b>	<b>Source</b>
Timeliness of Prenatal Care	Timely and adequate prenatal care can prevent poor birth outcomes. Numerator criteria include pregnant women who received a prenatal care visit in the first trimester.	HEDIS®
Postpartum Care	Numerator criteria include women with deliveries who had a postpartum visit on or between 21 and 56 days after delivery.	HEDIS®
Low Birth Weight (LBW) Babies	Babies born early or with low birth weight (LBW) can experience serious health problems. Certain maternal behaviors or exposures can contribute to low birth weight	AHRQ

	babies. Numerator indicates LBW babies. Custom measure was created based on LBW diagnosis codes identified by AHRQ for Pediatric Quality Indicators Low Birth Weight Categories. Specifications are available in Appendix II.	
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### **Independent Variables - Social Determinants of Health (SDOH) Variables**

A comprehensive set of 24 SDOH variables were included in this study as independent variables, and the selected SDOH variables represented socioeconomic, environmental, and behavioral determinants relevant to each study population. The data for the SDOH variables were obtained from a variety of valid public data sets including:

- Administrative data: Data collected and maintained to document the provision of services or programs to individuals.
- Census data: Data collected by the United States Federal Statistical System to assess the nation’s people and economy.
- Survey data: Data collected from individuals and organizations through survey methods recording subjective responses about living conditions and the health of the community.
- Public health surveillance data: Data collected to report the occurrence of public health events or health conditions, monitor community health problems, and inform public health policy and strategies.

Due to the range of data sets accessed for the SDOH variables data, the smallest common level of analysis was at a county level. Moreover, since county information was available in the Medicaid and CHIP enrollment data, the SDOH variables data and quality measures data were linked and analyzed at the county level.

Additionally, the SDOH variables were grouped into the following five SDOH categories:

- Demographic Attributes: Demographic attributes are variables related to the individual member. Gender and Age were used as control variables when appropriate. Race/Ethnicity was the only demographic attribute assessed as an individual SDOH variable within this SDOH category, and Race/Ethnicity was assessed in all statistical models.
- Health Behaviors: Health behaviors as SDOH variables are expressed as rates within the community that reflect lifestyle actions that affect health outcomes (such as Rate of Physical Inactivity) or lifestyle actions that increase one’s risk of disease (such as Rate of Adult Smoking and Rate of Sexually Transmitted Disease (STD)).

- **Availability and Access to Health Care Services:** Access to affordable, quality, and timely health care services can help prevent diseases and detect health issues sooner, enabling individuals to live longer, healthier lives. The SDOH variables within this category represent the availability of medical providers within a geographic area, such as primary care physicians and specialty care physicians.
- **Social and Economic Environment:** The SDOH variables within this category represent the socioeconomic conditions of a community, such as income levels, educational attainment, employment status, safety, and degree of social supports, can significantly affect the health and expected lifespan of individuals living within the community.
- **Physical Environment:** The quality and infrastructure of the physical environment that individuals live and work directly and indirectly impact health outcomes through the air they breathe, water they drink, housing they live in, and transportation available for work and school.

In **Table 2**, each of the 24 SDOH variables assessed in the statistical models for both study populations are listed and grouped under one of the five SDOH categories. Additional details regarding the SDOH variables included in this study can be found in [Appendix I](#).

**Table 2: Social Determinants of Health (SDOH) Variables by SDOH Category**

<b>Demographic Attributes</b>
Race/Ethnicity
<b>Health Behaviors</b>
Access to Exercise Opportunities
Rate of Sexually Transmitted Disease (STD)
Rate of Teen Births
Rate of Adult Smoking
Rate of Adult Obesity
Rate of Physical Inactivity
<b>Availability and Access to Health Care Services</b>
Access to Primary Care Physicians (PCP)
Transportation
Access to Mental Health Providers
Access to OB/GYN (obstetrics and gynecology) Providers
Rate of Uninsured Adults
<b>Social and Economic Environment</b>



Rate of High School Graduation
Rate of Unemployment
Food Insecurity
Rate of Children in Single-Parent Households
Rate of Violent Crime
Rate of Injury Deaths
Rate of Children in Poverty
Rate of Disconnected Youth
Availability of Social Associations
<b>Physical Environment</b>
Air Pollution
Rate of Severe Housing Problems
Lead Exposure

## ANALYSIS

The analyses were conducted to evaluate the contribution of each SDOH variable (the independent variables) to the likelihood of a member meeting the numerator criteria for each quality measure (the dependent variables). SDOH variables information was available in varying unit measurements, either as a percentage, a rate per 1000, a count, or a number, all of which designated a reporting value for that SDOH variable at the county level. To account for variations in measurement units and scale, the SDOH variables were standardized by Z-scores that were used in logistic regression models for each of the quality measures assessed. The SDOH variables were also attributed to the 254 counties within Texas, and multiple imputation was used to account and approximate for any null or missing SDOH values for some counties. Thus, the SDOH variables were assigned to each member based on the member’s county of residence. Specifically for the Low Birth Weight (LBW) model in the pregnant women study population, the county assignment was derived from the record of the newborn, which was presumed to be the county of residence for the pregnant mother, and allowed this model to reflect the impact of the SDOH variables experienced before birth.

The set of SDOH variables were initially evaluated independently for the children and adolescent study population and for the pregnant women study population. During this preliminary exploration of the selected SDOH variables, there was an original inclusion of three separate SDOH variables of Food Environment Index, Food Desert, and Food Insecurity (Hunger Scale);

however, these three SDOH variables were found to be strongly correlated with each other ( $\rho > 0.8$ ). In order to reduce variance between these three SDOH variables, only Food Insecurity (Hunger Scale) was ultimately included in the statistical modeling and results of this study, while Food Environment Index and Food Desert were excluded.

For the children and adolescent study population, the models were adjusted for gender and CHIP status (yes/no), and since age was frequently an inclusion criteria itself for this population's quality measures, age was excluded from these models. For the pregnant women population, the models were adjusted for age, and since gender was an inclusion criteria itself for this population, gender was excluded from these models. Specifically, for the Low Birth Weight (LBW) model for pregnant women, newborn gender was maintained in the models, but age was excluded from the models since all of the babies were newborns. For both study populations, Race/ethnicity information was available through member enrollment data and was assessed as a SDOH variable within the models using White/Non-Hispanic as the reference group compared to Hispanic, Black, American Indian/Alaskan, Pacific Islander/Asian, and "Unknown/Other" (as categorized in the enrollment data).

After the preliminary data exploration assessing multi-collinearity in the independent SDOH variables, a stepwise approach was used to build various logistic models using SDOH variables to increase model outcome predictability while reducing error. Concordance (C) statistics were used to determine the quality and accuracy of the model. Concordance statistics are often used to assess the ability of a model to predict an outcome and identify the degree of randomness between pairs of observations. The concordance index (c-statistic) is a measure used to assess a logistic regression's ability to predict an outcome using the variables included in the model. C is calculated using two values, percent of concordance pairs and percent of tied pairs. To determine those values, probabilities (scores) are calculated for each observation using the equation created by the model. The score for every observation with the outcome of interest (inclusion in the numerator) is compared to every observation without the outcome of interest (exclusion from the numerator). If the observation in the numerator has a higher score than the observation excluded from the numerator, the pair is "concordant." If the observation in the numerator has a lower score than the observation excluded from the numerator, the pair is "discordant." If the two observations have the same score, the pair is "tied." The percent of concordance is the percent of pairs that are "concordant," or where the predicted probability for an observation with the outcome (inclusion

in the numerator) is higher than the predicted probability of an observation without the outcome (not included in numerator). C is then calculated as the sum of the number of concordant pairs and half the number of tied pairs divided by the total number of pairs. C is often compared to the area under the curve. A C-value is used as a measure of accuracy for the model such that a C-value of 0.50 corresponds to the model randomly predicting the response, and a C-value of 1.0 corresponds to the model perfectly discriminating the response.<sup>20-21</sup>

There were three steps in the creation of each model. First, a model including only control demographic variables as appropriate (gender, CHIP enrollment, age) was developed. Second, a model adding all of the SDOH variables was developed. Third, a final model was developed including only those SDOH and demographic variables found to be significantly associated with the dependent variable. Concordance statistics were then calculated for each of the three models, and this analytic process was repeated for each quality measure per study population.

The relative contribution of each individual SDOH variable to the overall impact of SDOH on the given dependent variable (quality measure) was computed by taking the absolute value of the regression coefficient divided by the sum of the absolute values of all coefficients.

## RESULTS

For each study population, the model's ability to accurately predict numerator inclusion for a quality measure increased when SDOH variables were included in the modeling than when the model only included demographic variables, suggesting that these SDOH variables influence quality measure performance to some degree. However, the number of individual SDOH variables with significant associations varied by study population and per quality measure, highlighting that not every SDOH variable contributed equally to the observed impact of SDOH on quality measure performance.

### Children and Adolescents

Among children and adolescents, when SDOH variables were added to the modeling, all models showed increased accuracy in predicting inclusion in the numerator of the quality measure in comparison to a model that only included demographic variables. In **Table 3**, the percent concordance and associated C-values for the three different models are shown for each of the ten quality measures for this study population: a) the model using demographic variables alone (e.g., gender and program), b) the model adding all 24 SDOH variables (e.g., gender, program, and

SDOH variables), c) the model including only the SDOH and demographic variables found to be statistically significant (e.g. significant gender and program and significant SDOH variables). Based on the results in **Table 3**, for all ten quality measures, the percent concordance increased when all the SDOH variables were added into the modeling, in comparison to when using only demographic variables, and these results were not due to random chance (i.e., C-value >0.50).

As shown in **Table 3**, the degree of accuracy of each model is reflected in the size of the percent concordance, which varied by quality measure. For example, when the models included SDOH variables, the percent concordance ranged from 55.26% for 15-Month Old Well Child Visits to 66.89% for Asthma Admission Rate (PDI 14), meaning a model including SDOH variables was able to accurately predict receipt of recommended 15-month old well child visits 55% of times and asthma admissions 67% of times for children and adolescents. The degree of change between models with and without SDOH variables is reflected in the percent concordance differentials. For example, the percent concordance differential when adding SDOH variables was largest for Annual Primary Care Visit at +31.4 percentage points, meaning that in comparison to a model only including demographic variables, a model including SDOH variables increased in accuracy by 31.4 percentage points (or 20% in c-value) for predicting receipt of annual primary care visits among children and adolescents. For most of the quality measures, further restricting the model to include only statistically significant SDOH and demographic variables did not make a meaningful change in the model's ability to predict numerator inclusion, as seen by the minimal difference in percent concordance between models with all SDOH variables and models with only significant SDOH variables.

**Table 3: Children and Adolescents – Comparison of Three Models using Percent Concordance and C-values**

	Children Immunization			Adolescent Immunization		
	Gender and Program	All SDOH	Significant SDOH	Gender and Program	All SDOH	Significant SDOH
<b>Percent Concordance</b>	29.65%	56.33%	56.22%	31.33%	59.14%	59.02%
<b>C-value</b>	0.51	0.57	0.57	0.52	0.60	0.60
	Adolescent HPV Immunization			Follow-up after Initiation ADHD Medication		
	Gender and Program	All SDOH	Significant SDOH	Gender and Program	All SDOH	Significant SDOH
<b>Percent Concordance</b>	32.38%	60.14%	57.91%	27.32%	55.73%	55.49%
<b>C-value</b>	0.52	0.61	0.59	0.51	0.56	0.56
	Follow-up during Continuation ADHD Medication			Asthma Admission Rate (PDI 14)		
	Gender and Program	All SDOH	Significant SDOH	Gender and Program	All SDOH	Significant SDOH
<b>Percent Concordance</b>	26.18%	56.39%	53.54%	36.77%	66.81%	66.89%
<b>C-value</b>	0.52	0.57	0.55	0.57	0.67	0.67
	Annual Primary Care Visit			15-Month Old Well Child Visits		
	Gender and Program	All SDOH	Significant SDOH	Gender and Program	All SDOH	Significant SDOH
<b>Percent Concordance</b>	29.70%	61.10%	61.10%	28.92%	55.26%	54.83%
<b>C-value</b>	0.51	0.62	0.62	0.51	0.56	0.56
	Ages 3,4,5,6-Year Old Well Child Visits			Adolescent Well Care Visits		
	Gender and Program	All SDOH	Significant SDOH	Gender and Program	All SDOH	Significant SDOH
<b>Percent Concordance</b>	28.90%	57.05%	56.99%	30.20%	59.38%	59.42%
<b>C-value</b>	0.51	0.58	0.58	0.51	0.60	0.60

According to the comparative modeling that was conducted, the selected set of SDOH variables contributed to some degree to the ability to predict numerator inclusion on quality measures for the children and adolescent population. Thus, the next analytic steps were to evaluate the presence of any significant associations between individual SDOH variables and each of the ten quality measures for this study population. Appendix III provides additional information including the estimates of the model coefficients to show how the individual SDOH variables contributed to each quality measure and the directionality of this impact. An inverse directionality indicates an inverse association between the SDOH variable and the numerator criteria for the quality measure.

In the following sections, the results for each of the ten quality measures for the children and adolescent population are presented, describing which of the individual SDOH variables showed significant associations with the quality measures, the degree (as a percentage) to which the individual SDOH variable contributed to the collective impact of SDOH, and which corresponding SDOH categories were most impactful. While there was not one unique SDOH variable significantly associated with all quality measures for the children and adolescent population, Race/Ethnicity, Access to Exercise Opportunities, Rate of Physical Inactivity, and Access to Mental Health Providers were significantly associated with the most quality measures overall (eight of the ten quality measures for this study population). The next most common SDOH variables were Rate of Sexually Transmitted Disease (STD), Rate of Adult Smoking, Rate of Adult Obesity, Access to Primary Care Physicians (PCP), Rate of Uninsured Adults, Rate of Violent Crime, and Air Pollution, which were significantly associated with seven of the ten quality measures for this study population. Based on the categorization of SDOH variables, “Social and Economic Environment” and “Health Behaviors” were the two SDOH categories showing the largest impact on the quality measures for this study population.

### ***Children Immunization***

As shown in **Table 4**, fourteen SDOH variables were significantly associated with Children Immunization. The largest individual SDOH contributors on this quality measure were Race/Ethnicity (13.21%), Rate of Children in Poverty (13.22%), and Rate of Disconnected Youth (10.04%). Based on the categorization of SDOH variables, “Social and Economic Environment” and “Health Behaviors” showed the largest categorical influences on quality measure performance (34.10% and 33.07%, respectively).

Interpretation: The following fourteen SDOH variables in **Table 4** were significantly associated with timely receipt of recommended vaccinations for children (e.g., the combination of diphtheria, tetanus and acellular pertussis; polio; measles, mumps and rubella; haemophilus influenza type B; hepatitis B and Varicella vaccines). In particular, the top individual SDOH contributors were Race/Ethnicity and Rate of Children in Poverty, each contributing to 13.2% of the observed SDOH impact on immunization status for children. The effect of Race/Ethnicity aligns with prior reports showing differences in vaccination rates by race and ethnicity among children born in Texas between 2012-2015, when Black/Non-Hispanic children were consistently less likely to have received all recommended vaccines by age 2 compared to White/Non-Hispanic children, while Hispanic children seemed to have similar or higher rates than White/Non-Hispanic children.<sup>22</sup> Lower rates of disconnected youth was associated with children receiving recommended vaccinations and, surprisingly, living in areas with higher rates of children in poverty was also associated with children receiving recommended vaccinations.

**Table 4: Significant SDOH Variables on Children Immunization**

SDOH Category	SDOH Variable	Percent Contribution to Collective SDOH Impact
Demographic Attributes	Race/Ethnicity	13.21%
Health Behaviors	Access to Exercise Opportunities	3.36%
	Rate of Sexually Transmitted Disease (STD)	10.49%
	Rate of Teen Births	4.31%
	Rate of Adult Smoking	6.89%
	Rate of Adult Obesity	5.54%
	Rate of Physical Inactivity	2.48%
Availability and Access to Health Care Services	Access to Primary Care Physicians (PCP)	8.68%
	Transportation	4.93%
Social and Economic Environment	Rate of Injury Deaths	3.788%
	Rate of Children in Poverty	13.22%
	Rate of Disconnected Youth	10.04%
	Availability of Social Associations	7.06%
Physical Environment	Lead Exposure	6.01%

### ***Adolescent Immunization***

As shown in **Table 5**, thirteen SDOH variables were significantly associated with Adolescent Immunization. The largest individual SDOH contributors on this quality measure were Access to Mental Health Providers (13.16%), Rate of Sexually Transmitted Disease (STD) (10.06%), and Rate of Children in Poverty (9.85%). Based on the categorization of SDOH variables, “Social and Economic Environment” showed the largest categorical influence on quality measure performance (46.93%), while “Physical Environment” showed zero categorical influence on quality measure performance (i.e., there were not any SDOH variables within the “Physical Environment” category with significant associations on quality measure performance).

Interpretation: The following thirteen SDOH variables in **Table 5** were significantly associated with timely receipt of recommended vaccinations for adolescents (e.g., the combination of meningococcal and tetanus, diphtheria, acellular pertussis vaccines). Higher access to mental health providers, lower rates of STDs, and, surprisingly, living in areas with higher rates of children in poverty were associated with adolescents with recommended vaccinations.

**Table 5: Significant SDOH Variables on Adolescent Immunization**

<b>SDOH Category</b>	<b>SDOH Variable</b>	<b>Percent Contribution to Collective SDOH Impact</b>
Demographic Attributes	Race/Ethnicity	8.54%
Health Behaviors	Rate of Sexually Transmitted Disease (STD)	10.06%
	Rate of Adult Obesity	7.74%
	Rate of Physical Inactivity	4.61%
Availability and Access to Health Care Services	Access to Primary Care Physicians (PCP)	6.18%
	Access to Mental Health Providers	13.16%
	Rate of Uninsured Adults	2.76%
Social and Economic Environment	Rate of Unemployment	8.12%
	Rate of Violent Crime	9.60%
	Rate of Injury Deaths	5.02%
	Rate of Children in Poverty	9.85%
	Rate of Disconnected Youth	7.69%
	Availability of Social Associations	6.65%



### ***Adolescent Human Papilloma Virus (HPV) Immunization***

As shown in **Table 6**, eighteen SDOH variables were significantly associated with Adolescent HPV Immunization. The largest individual SDOH contributors on this quality measure were Rate of Children in Poverty (11.86%), Food Insecurity (11.76%), and Access to OB/GYN Providers (8.33%). Even after adjusting for all other SDOH variables, Race/Ethnicity was not significantly associated with this quality measure. Based on the categorization of SDOH variables, “Social and Economic Environment” and “Health Behaviors” showed the largest categorical influences on quality measure performance (41.76% and 29.18%, respectively).

Interpretation: The following eighteen SDOH variables in **Table 6** were significantly associated with timely receipt of recommended HPV vaccination for adolescents. Higher access to OB/GYN providers, lower rates of food insecurity, and, surprisingly, living in areas with higher rates of children in poverty were associated with adolescents with recommended HPV vaccinations.

**Table 6: Significant SDOH Variables on Adolescent HPV Immunization**

<b>SDOH Category</b>	<b>SDOH Variable</b>	<b>Percent Contribution to Collective SDOH Impact</b>
Health Behaviors	Access to Exercise Opportunities	5.87%
	Rate of Sexually Transmitted Disease (STD)	3.28%
	Rate of Teen Births	6.81%
	Rate of Adult Smoking	6.50%
	Rate of Adult Obesity	3.10%
	Rate of Physical Inactivity	3.62%
Availability and Access to Health Care Services	Access to Primary Care Physicians (PCP)	3.85%
	Access to Mental Health Providers	3.70%
	Access to OB/GYN Providers	8.33%
	Transportation	3.11%
Social and Economic Environment	Rate of Unemployment	5.14%
	Food Insecurity	11.76%
	Rate of Violent Crime	2.52%
	Rate of Children in Poverty	11.86%
	Rate of Disconnected Youth	3.92%
	Availability of Social Associations	6.56%
Physical Environment	Air Pollution	8.39%

SDOH Category	SDOH Variable	Percent Contribution to Collective SDOH Impact
	Rate of Severe Housing Problems	2.06%

***Follow-up after Initiation of Attention Deficit/Hyperactivity Disorder (ADHD) Medication***

As shown in **Table 7**, twelve SDOH variables were significantly associated with Follow-up after Initiation of Attention Deficit/Hyperactivity Disorder (ADHD) Medication. The largest individual SDOH contributors on this quality measure were Availability of Social Associations (20.12%), Race/Ethnicity (14.19%), and Air Pollution (9.35%). Based on the categorization of SDOH variables, “Social and Economic Environment” showed the largest categorical influence on quality measure performance (37.55%) to the overall impact of SDOH on follow-up after ADHD medication initiation.

Interpretation: The following twelve SDOH variables in **Table 7** were significantly associated with a follow-up visit completed within 30 days of initiating ADHD medication for children or adolescents. Less air pollution and, surprisingly, fewer social associations were associated with follow-up visits for children and adolescents on ADHD medication. White/Non-Hispanic children and adolescents were more likely to have follow-up visits for ADHD medication compared to children and adolescents of all other Race/Ethnicity groups (Hispanic, Black, American Indian/Alaskan, Pacific Islander/Asian, and “Unknown/Other”).

**Table 7: Significant SDOH Variables on Follow-up after Initiation ADHD Medication**

SDOH Category	SDOH Variable	Percent Contribution to Collective SDOH Impact
Demographic Attributes	Race/Ethnicity	14.19%
Health Behaviors	Access to Exercise Opportunities	6.53%
	Rate of Sexually Transmitted Disease (STD)	6.14%
	Rate of Adult Smoking	5.00%
Availability and Access to Health Care Services	Access to Mental Health Providers	4.64%
	Rate of Uninsured Adults	8.22%
Social and Economic Environment	Rate of High School Graduation	3.43%
	Food Insecurity	6.43%
	Rate of Injury Deaths	7.57%
	Availability of Social Associations	20.12%
Physical Environment	Air Pollution	9.35%
	Rate of Severe Housing Problems	8.39%

### ***Follow-up Care during Continuation of ADHD Medication***

As shown in **Table 8**, three SDOH variables were significantly associated with Follow-up Care during Continuation of ADHD Medication. The largest individual SDOH contributor on this quality measure was Availability of Social Associations (37.10%).

Interpretation: It should be noted that the number of children and adolescents who qualified for this quality measure was considerably lower than for all other quality measures, reducing the statistical power of the model to identify any statistically significant associations. In other words, the results should be interpreted with caution since this model was underpowered to appropriately evaluate the impact and contribution of each of the SDOH variables considered. Of note, fewer social associations were again associated not only with follow-up visits after initiation but also during continuation of ADHD medication treatment for children and adolescents. Given that the directionality of the associations is unexpected, further research would be needed to better understand these results since resources and tools that help parents and caregivers coordinate the follow-up care needed for successful ADHD medication management has been linked to improved health for children and adolescents with ADHD.<sup>23,24</sup> However, since the Availability of Social Associations SDOH variable was a general variable that captured the total number of membership associations in a county, an SDOH variable that more accurately captures how associations with relevant resources and tools for this population would allow for better evaluation of the effect.

**Table 8: Significant SDOH Variables on Follow-up Continuation ADHD Medication**

<b>SDOH Category</b>	<b>SDOH Variable</b>	<b>Percent Contribution to Collective SDOH Impact</b>
Health Behaviors	Access to Exercise Opportunities	34.60%
Social and Economic Environment	Rate of Injury Deaths	28.30%
	Availability of Social Associations	37.10%

### ***Asthma Admission Rate (Pediatric Quality Indicator 14)***

Out of all the models for the quality measures for the children and adolescent population, the model for Asthma Admission Rate (PQI 14) had the highest percent concordance (66.89%), or degree of accuracy, in predicting the performance outcome 67% of the time. As shown in **Table 9**, thirteen SDOH variables were significantly associated with Asthma Admission Rate. The largest individual SDOH contributors on this quality measure were Race/Ethnicity (14.75%) and Air Pollution (11.07%). Based on the categorization of SDOH variables, “Physical Environment,”

which included Air Pollution and Rate of Severe Housing Problems, and “Social and Economic Environment” showed the largest categorical influences on quality measure performance (19.82% and 37.01%, respectively).

Interpretation: The following thirteen SDOH variables in **Table 9** were significantly associated with asthma-related inpatient admissions among children and adolescents. White/Non-Hispanic children and adolescents were less likely to have asthma-related admissions compared to children and adolescents of all other Race/Ethnicity groups (Hispanic, Black, American Indian/Alaskan, Pacific Islander/Asian, and “Unknown/Other”). Surprisingly, less air pollution was associated with increased rates of asthma-related admissions. The directionality of the association is unexpected and contrary to that of prior studies, so the finding should be interpreted with caution, acknowledging that the aggregate nature of this analysis may mask variation of air pollution within counties and any individual member-level exposures to air pollution. One possible explanation for this unexpected result could be that the SDOH variable for air pollution is acting as a proxy for confounding variables related to urbanization, such as improved access to medications for chronic conditions like asthma or improved access to medical providers and emergency care.<sup>24-26</sup>

**Table 9: Significant SDOH Variables on Asthma Admission Rate**

SDOH Category	SDOH Variable	Percent Contribution to Collective SDOH Impact
Demographic Attributes	Race/Ethnicity	14.75%
Health Behaviors	Access to Exercise Opportunities	8.71%
	Rate of Physical Inactivity	4.69%
Availability and Access to Health Care Services	Access to Mental Health Providers	5.09%
	Access to OB/GYN Providers	5.07%
	Rate of Uninsured Adults	4.86%
Social and Economic Environment	Food Insecurity	8.62%
	Rate of Children in Single-Parent Households	8.58%
	Rate of Violent Crime	6.29%
	Rate of Children in Poverty	4.84%
	Rate of Disconnected Youth	8.68%
Physical Environment	Air Pollution	11.07%
	Rate of Severe Housing Problems	8.75%

### ***Annual Primary Care Visit***

Out of all the models for the quality measures for the children and adolescent population, the model for Annual Primary Care Visit had the largest percent concordance differential when SDOH variables were added, increasing in accuracy by up to 31.4 percentage points. As shown in **Table 10**, nineteen SDOH variables were significantly associated with the Annual Primary Care Visit. The largest individual SDOH contributors on this quality measure were Rate of Uninsured Adults (12.89%), Rate of Unemployment (10.83%), and Access to Primary Care Physicians (9.73%). Based on the categorization of SDOH variables, “Availability and Access to Health Care Services” and “Social and Economic Environment” showed the largest categorical influences on quality measure performance (33.03% and 36.22%, respectively).

Interpretation: The following nineteen SDOH variables in **Table 10** were significantly associated with completed annual visits with a primary care practitioner for children and adolescents. Higher access to primary care physicians was associated with higher rates of completed primary care visits among children and adolescents. However, surprisingly, living in areas with higher rates of uninsured adults and unemployment were also associated with higher rates of completed primary care visits among children and adolescents; the directionality of these associations is unexpected, so these findings should be interpreted with caution, acknowledging that the aggregate nature of this analysis may mask variation within counties and any individual member-level exposures. One possible explanation for these unexpected results could be that the SDOH variable for unemployment is acting as a proxy for confounding variables related to Medicaid enrollment, which could be related to improved access to Medicaid network medical providers and health care services.

**Table 10: Significant SDOH Variables on Annual Primary Care Visit**

<b>SDOH Category</b>	<b>SDOH Variable</b>	<b>Percent Contribution to Collective SDOH Impact</b>
Demographic Attributes	Race/Ethnicity	4.96%
Health Behaviors	Rate of Sexually Transmitted Disease (STD)	1.61%
	Rate of Teen Births	8.14%
	Rate of Adult Smoking	2.02%
	Rate of Adult Obesity	1.82%
	Rate of Physical Inactivity	4.10%

SDOH Category	SDOH Variable	Percent Contribution to Collective SDOH Impact
Availability and Access to Health Care Services	Access to Primary Care Physicians (PCP)	9.73%
	Access to Mental Health Providers	2.40%
	Access to OB/GYN Providers	2.70%
	Rate of Uninsured Adults	12.89%
	Transportation	5.31%
Social and Economic Environment	Rate of High School Graduation	5.87%
	Rate of Unemployment	10.83%
	Rate of Injury Deaths	4.58%
	Rate of Children in Poverty	3.60%
	Availability Social Associations	8.41%
	Rate of Violent Crime	2.93%
Physical Environment	Air Pollution	6.46%
	Rate of Severe Housing Problems	1.64%

**15-Month Old Well Child Visits**

As shown in **Table 11**, seventeen SDOH variables were found to be significantly associated with 15-Month Old Well Child Visits. The largest individual SDOH contributors on this quality measure were Air Pollution (12.14%), Rate of Children in Single-Parent Households (11.33%), and Access to Primary Care Physicians (9.48%). Based on the categorization of SDOH variables, all four SDOH categories contributed quite similarly to the overall SDOH impact (each between 20.76-28.05%).

Interpretation: The following seventeen SDOH variables in **Table 11** were significantly associated with receiving 6 or more recommended well child visits within the first 15 months of life, indicating an important interplay across most of the SDOH variables. Higher access to primary care physicians was associated with higher rates of completed 15-month old well child visits. However, surprisingly, higher rates of air pollution and children in single-parent households were also associated with higher rates of completed 15-month old well child visits; the directionality of these associations is unexpected, so these findings should be interpreted with caution, acknowledging that the aggregate nature of this analysis may mask variation within counties and any individual member-level exposures. One possible explanation for these unexpected results could be that the SDOH variable for air pollution is acting as a proxy for confounding variables related to urbanization, such as improved access to medical providers and health care services,

which is also supported by the significant association between Access to Primary Care Physicians and this quality measure.

**Table 11: Significant SDOH Variables on 15-Month Old Well Child Visits**

SDOH Category	SDOH Variable	Percent Contribution to Collective SDOH Impact
Demographic Attributes	Race/Ethnicity	6.38%
Health Behaviors	Access to Exercise Opportunities	6.55%
	Rate of Sexually Transmitted Disease (STD)	5.79%
	Rate of Adult Smoking	4.51%
	Rate of Adult Obesity	3.46%
	Rate of Physical Inactivity	2.73%
Availability and Access to Health Care Services	Access to Primary Care Physicians (PCP)	9.48%
	Access to Mental Health Providers	4.43%
	Access to OB/GYN Providers	2.55%
	Rate of Uninsured Adults	5.30%
Social and Economic Environment	Food Insecurity	7.85%
	Rate of Children in Single-Parent Households	11.33%
	Rate of Violent Crime	3.79%
	Rate of Disconnected Youth	5.08%
Physical Environment	Air Pollution	12.14%
	Rate of Severe Housing Problems	3.33%
	Lead Exposure	5.29%

***Ages 3, 4, 5 and 6-Year Old Well Child Visits***

As shown in **Table 12**, seventeen SDOH variables were significantly associated with Ages 3, 4, 5 and 6-Year Old Well Child Visits. The largest individual SDOH contributors on this quality measure were Rate of Unemployment (12.39%), Rate of Uninsured Adults (11.17%), and Air Pollution (9.18%). Based on the categorization of SDOH variables, “Social and Economic Environment” provided the greatest categorical influence on this quality measure (41.46%).

Interpretation: The following seventeen SDOH variables in **Table 12** were significantly associated receiving annual well child visits for children ages 3 through 6 years old. Again, surprisingly, higher rates of air pollution, unemployment, and uninsured adults were associated with higher rates of completed well child visits for children ages 3 through 6 years old; the directionality of these associations is unexpected, so these findings should be interpreted with

caution, acknowledging that the aggregate nature of this analysis may mask variation within counties and any individual member-level exposures. One possible explanation for these unexpected results could be that the SDOH variable for air pollution is acting as a proxy for confounding variables related to urbanization, such as improved access to medical providers and health care services, which is also supported by the significant association between Access to Primary Care Physicians and this quality measure.

**Table 12: Significant SDOH Variables on Ages 3, 4, 5, and 6-Year Old Well Child Visits**

SDOH Category	SDOH Variable	Percent Contribution to Collective SDOH Impact
Demographic Attributes	Race/Ethnicity	3.84%
Health Behaviors	Access to Exercise Opportunities	3.56%
	Rate of Teen Births	8.16%
	Rate of Adult Smoking	4.09%
	Rate of Adult Obesity	2.97%
	Rate of Physical Inactivity	2.12%
Availability and Access to Health Care Services	Access to Primary Care Physicians (PCP)	4.30%
	Access to Mental Health Providers	6.21%
	Rate of Uninsured Adults	11.17%
	Transportation	2.93%
Social and Economic Environment	Rate of High School Graduation	2.08%
	Rate of Unemployment	12.39%
	Food Insecurity	8.55%
	Rate of Children in Single-Parent Households	7.56%
	Rate of Violent Crime	5.28%
	Rate of Children in Poverty	5.60%
Physical Environment	Air Pollution	9.18%

***Adolescent Well Care Visits***

As shown in **Table 13**, sixteen SDOH variables were significantly associated with Adolescent Well Care Visits. The largest individual SDOH contributors on this quality measure were Rate of Unemployment (13.09%) and Rate of Uninsured Adults (12.52%). Based on the categorization of SDOH variables, “Health Behaviors” (30.02%) had the greatest categorical influence on quality measure performance.



Interpretation: The following sixteen SDOH variables in **Table 13** were significantly associated receiving annual well care visits for adolescents. Of note, several of the significant individual SDOH contributors for Adolescent Well Care visits were the same as those for the Ages 3, 4, 5, 6-Year Old Well Child Visits. Again, surprisingly, higher rates of unemployment and uninsured adults were associated with higher rates of completed well care visits for adolescents; the directionality of these associations is unexpected, so these findings should be interpreted with caution, acknowledging that the aggregate nature of this analysis may mask variation within counties and any individual member-level exposures. One possible explanation for these unexpected results could be several of the SDOH variables acting as proxies for confounding variables related to urbanization and Medicaid enrollment, such as improved access to Medicaid network medical providers and health care services, which is also supported by the significant association between Access to Primary Care Physicians and this quality measure.

**Table 13: Significant SDOH Variables on Adolescent Well Care Visits**

<b>SDOH Category</b>	<b>SDOH Variable</b>	<b>Percent Contribution to Collective SDOH Impact</b>
Demographic Attributes	Race/Ethnicity	10.26%
Health Behaviors	Access to Exercise Opportunities	3.77%
	Rate of Sexually Transmitted Disease (STD)	4.53%
	Rate of Teen Births	11.55%
	Rate of Adult Smoking	4.31%
	Rate of Adult Obesity	2.12%
	Rate of Physical Inactivity	3.74%
Availability and Access to Health Care Services	Access to Primary Care Physicians (PCP)	4.84%
	Access to Mental Health Providers	4.56%
	Access to OB/GYN Providers	1.52%
	Rate of Uninsured Adults	12.52%
Social and Economic Environment	Rate of Unemployment	13.09%
	Food Insecurity	6.04%
	Rate of Violent Crime	3.60%
Physical Environment	Air Pollution	10.97%
	Rate of Severe Housing Problems	2.59%

## Pregnant Women

In **Table 14**, the percent concordance and associated C-values for the three different models are shown for each of the ten quality measures for the pregnant women population: a) the model using demographic variables alone (e.g., gender and program), b) the model adding all 24 SDOH variables (e.g., gender, program, and SDOH variables), c) the model including only the SDOH and demographic variables found to be statistically significant (e.g. significant gender and program and significant SDOH variables).

Based on the results in **Table 14**, while the models including SDOH variables showed increased accuracy (size of the percent concordance), the modelling seemed to be less sensitive overall for the pregnant women population than for the children and adolescent population. For example, when the models included SDOH variables, the percent concordance for the pregnant women population did not range widely, only between 54.78% for Postpartum Care to 56.90% for Low Birth Weight Babies, meaning a model including SDOH variables was able to accurately predict receipt of timely postpartum care 55% of times and low birth weight babies 57% of times, which is only moderately better than random chance. The degree of change between models with and without SDOH variables is reflected in the percent concordance differentials, and the largest percent concordance differential for pregnant women was for Low Birth Weight Babies at +22.7 percentage points, meaning that in comparison to a model only including demographic variables, a model including SDOH variables increased in accuracy by 22.7 percentage points for predicting babies born with low birth weight.

**Table 14: Pregnant Women – Comparison of Three Models using Percent Concordance and C-values**

	Timeliness of Prenatal Care		
	Age Only	All SDOH	Significant SDOH
<b>Percent Concordance</b>	50.45%	56.24%	55.50%
<b>C-value</b>	0.51	0.56	0.56
	Postpartum Care		
	Age Only	All SDOH	Significant SDOH
<b>Percent Concordance</b>	51.28%	54.78%	54.72%
<b>C-value</b>	0.51	0.55	0.55

	Low Birth Weight (LBW) Babies		
	Age Only	All SDOH	Significant SDOH
<b>Percent Concordance</b>	34.20%	56.90%	56.24%
<b>C-value</b>	0.54	0.57	0.57

### *Timeliness of Prenatal Care*

As shown in **Table 15**, fifteen SDOH variables were significantly associated with Timeliness of Prenatal Care. The largest individual SDOH contributors on this quality measure were Food Insecurity (18.63%), Availability of Social Associations (9.37%), and Rate of Teen Births (7.98%). Based on the categorization of SDOH variables, “Social and Economic Environment” (62.20%) showed the largest categorical influence on quality measure performance.

Interpretation: The following fifteen SDOH variables in **Table 15** were significantly associated with timely receipt of prenatal care during the first trimester. Lower rates of food insecurity, greater availability of social associations, and lower rate of teen births were associated with timely receipt of prenatal care during the first trimester.

**Table 15: Significant SDOH Variables on Timeliness of Prenatal Care**

SDOH Category	SDOH Variable	Percent Contribution to Collective SDOH Impact
Health Behaviors	Rate of Teen Births	7.98%
	Rate of Adult Smoking	5.78%
	Rate of Adult Obesity	2.13%
Availability and Access to Health Care Services	Access to Mental Health Providers	4.39%
	Assess to OB/GYN Providers	6.71%
	Rate of Uninsured Adults	4.91%
Social and Economic Environment	Rate of High School Graduation	4.26%
	Rate of Unemployment	6.80%
	Food Insecurity	18.63%
	Rate of Children in Single-Parent Households	4.65%
	Rate of Violent Crime	6.80%
	Rate of Injury Deaths	4.22%
	Rate of Children in Poverty	7.47%
Availability of Social Associations	9.37%	
Physical Environment	Air Pollution	5.90%

### ***Postpartum Care***

As shown in **Table 16**, fifteen SDOH variables were significantly associated with Postpartum Care. The largest individual SDOH contributors on this quality measure were Air Pollution (14.59%), Race/Ethnicity (11.83%), and Availability of Social Associations (10.70%). Based on the categorization of SDOH variables, “Social and Economic Environment” and “Physical Environment” showed the largest categorical influences on quality measure performance (28.12% and 21.04%, respectively).

Interpretation: The following fifteen SDOH variables in **Table 16** were significantly associated with completed postpartum care visits on or between 21 and 56 days after delivery. White/Non-Hispanic pregnant women were more likely to have timely postpartum care compared to pregnant women of all other Race/Ethnicity groups (Hispanic, Black, American Indian/Alaskan, Pacific Islander/Asian, and “Unknown/Other”). Greater availability of social associations and, surprisingly, higher rates air pollution were associated with timely receipt of postpartum care. The directionality of the association with Air Pollution is unexpected, so this finding should be interpreted with caution, acknowledging that the aggregate nature of this analysis may mask variation within counties and any individual member-level exposures. One possible explanation for this unexpected result could be that the SDOH variable for air pollution acting as a proxy for confounding variables related to urbanization, such as improved access to medical providers and health care services, which is also supported by the significant association between Access to OB/GYN Providers and this quality measure.

**Table 16: Significant SDOH Variables on Postpartum Care**

<b>SDOH Category</b>	<b>SDOH Variable</b>	<b>Percent Contribution to Collective SDOH Impact</b>
Demographic Attributes	Race/Ethnicity	11.83%
Health Behaviors	Access to Exercise Opportunities	7.90%
	Rate of Sexually Transmitted Disease (STD)	5.74%
	Rate of Adult Smoking	5.52%
	Rate of Physical Inactivity	2.26%
Availability and Access to Health Care Services	Access to Primary Care Physicians (PCP)	5.58%
	Access to Mental Health Providers	2.60%
	Assess to OB/GYN Providers	6.25%
	Transportation	3.17%

SDOH Category	SDOH Variable	Percent Contribution to Collective SDOH Impact
Social and Economic Environment	Rate of Children in Single-Parent Households	5.25%
	Rate of Violent Crime	3.75%
	Rate of Disconnected Youth	8.42%
	Availability of Social Associations	10.70%
Physical Environment	Air Pollution	14.59%
	Rate of Severe Housing Problems	6.45%

**Low Birth Weight (LBW) Babies**

As shown in **Table 17**, eight SDOH variables were significantly associated with the Low Birth Weight (LBW) Babies quality measure. The largest individual SDOH contributors on this quality measure were Race/Ethnicity (21.24%) and Rate of Adult Smoking (13.94%). Based on the categorization of SDOH variables, “Health Behaviors” (36.81%) showed the largest categorical influence on quality measure performance.

Interpretation: The following eight SDOH variables in **Table 17** were significantly associated with babies born with low birth weight (<2,500 grams). White/Non-Hispanic pregnant women were less likely to have low birth weight babies compared to pregnant women of all other Race/Ethnicity groups (Hispanic, Black, American Indian/Alaskan, Pacific Islander/Asian, and “Unknown/Other”). Surprisingly, living in areas with lower rates of adult smoking were associated with higher rates of babies born with low birth weight. The directionality of this association is unexpected and contrary to that of prior studies, so the finding should be interpreted with caution, acknowledging that the aggregate nature of this analysis may mask variation of adult smoking within counties and any individual member-level exposures to second-hand smoke.

**Table 17: Significant SDOH Variables on Low Birth Weight (LBW) Babies**

SDOH Category	SDOH Variable	Percent Contribution to Collective SDOH Impact
Demographic Attributes	Race/Ethnicity	21.24%
Health Behaviors	Rate of Sexually Transmitted Disease (STD)	12.18%
	Rate of Adult Smoking	13.94%
	Rate of Physical Inactivity	10.69%
Availability and Access to Health Care Services	Access to Mental Health Providers	9.96%
	Rate of Unemployment	10.38%

SDOH Category	SDOH Variable	Percent Contribution to Collective SDOH Impact
Social and Economic Environment	Rate of Violent Crime	9.27%
	Rate of Injury Deaths	12.34%

**DISCUSSION AND STUDY LIMITATIONS**

This study found that a model including SDOH variables was more accurate in predicting whether an individual would meet the numerator performance criteria of a quality measure than a model without SDOH variables and not due to random chance. In other words, this overall finding suggested that the social context in which Medicaid and CHIP members lived, as represented by the set of SDOH variables included in this study, was important to better understanding performance outcomes on key health care quality metrics, such as NCQA HEDIS® and AHRQ PDI measures.

Additionally, this study found that the number of individual SDOH variables with significant associations varied by study population and per quality measure, highlighting that although the social context was an important overall consideration, not every SDOH variable contributed equally to the observed impact of SDOH on quality measure performance. For example, per study population, the modelling seemed to be more sensitive for the children and adolescent population than for the pregnant women population, but even within the pregnant women population, the observed impact of SDOH variables was greater for the Low Birth Weight (LBW) quality measure than for the other two quality measures for that study population, Timeliness of Prenatal Care and Postpartum Care.

Moreover, the individual SDOH variables showing significant associations for any given quality measure were not necessarily significant across all quality measures. For example, for the pregnant women population, only three SDOH variables (Rate of Adult Smoking, Access to Mental Health Providers, and Rate of Violent Crime) were significantly associated with all three of the quality measures for that study population, but none of these three SDOH variables contributed the largest individual influence among all models for this study population. For the children and adolescent population, there were not any SDOH variables that were significantly associated with all ten of the quality measures for that study population. However, four SDOH variables (Race/Ethnicity, Access to Exercise Opportunities, Rate of Physical Inactivity, and Access to Mental Health Providers) were statistically associated with eight out of the ten quality

measures for children and adolescents, but none of these four SDOH variables contributed the largest individual influence among all models for this study population.

Of note, for both study populations, Race/Ethnicity was frequently found to be significantly associated for most quality measures, even after including all of the other SDOH variables in the model. This finding suggested that race and ethnicity contributed significantly to quality measure performance, independent of the other SDOH variables included in the model, and that the correlation of race and ethnicity on quality measures at the county-level or even more granular community-level should be further evaluated to identify and control for any potential confounding effects on SDOH analyses. This finding also concurred with prior research demonstrating disparities in health care services across different racial and ethnic groups, particularly regarding preventive care, even after adjusting for individual and contextual factors<sup>28</sup>. The pathways explaining these disparities have been described as multiple<sup>29</sup> and may possibly include other socioeconomic and health care system variables associated with race and ethnicity not captured or missing from this study.

Furthermore, grouping the SDOH variables into five categories: 1) “Demographic Attributes” (Race/Ethnicity), 2) “Health Behaviors”, 3) “Availability and Access to Health Care Services”, 4) “Social and Economic Environment”, and 5) “Physical Environment” provided another lens in which to interpret the overall findings as well as assess any potentially interrelated SDOH variables. Based on the categorization of SDOH variables, “Social and Economic Environment” showed the largest categorical influence on quality measure performance for most models. However, it should be noted that this SDOH category contained the largest number of individual SDOH variables within its grouping, which could reflect that this SDOH category had more available data to evaluate SDOH impacts to begin with. Still, this limitation should not diminish the categorical influence and relevance of “Social and Economic Environment” but rather suggest caution in establishing and denoting higher importance of one SDOH category over another SDOH category.

When interpreting the results of this study, a few additional limitations should be considered since SDOH variables posed challenges in statistical modeling. First, the individual must be assigned to a social “community”. However, given the variety of available SDOH data sources for this study, the “community” was defined as the individual’s county of residence, which

may not have reflected the social context of the individual Medicaid member and may have masked differences within a county and any individual exposures.

Second, the assigned value of a SDOH variable to the county may not have been representative of the subjects in the study. For example, this study used Rate of Uninsured Adults as one of the SDOH variables assessed. Yet, since none of the subjects were uninsured (i.e., all subjects were Medicaid members), this SDOH variable only reflected the rate of uninsured adults in the community where the subject lived. Although the characteristics of the neighborhood where individuals live are acknowledged risk factors for health outcomes<sup>30-32</sup>, using broad geographic-level risk factors to indirectly assess specific individual-level risk factors may have reduced the ability to capture an accurate effect. For instance, the Rate of Adult Smoking was not significantly associated with pediatric asthma-related hospital admissions, even though household smoking is a well-known risk factor for pediatric asthma exacerbations<sup>33,34</sup>. Rather, Rate of Adult Smoking at the county level may not have been sensitive enough to capture the expected effect.

Third, SDOH variables may have been strongly interrelated among themselves. This study attempted to control for such confounding by proactively identifying highly correlated SDOH variables and, when appropriate, consolidating correlated SDOH variables into a single representative SDOH variable (e.g., Food Insecurity). However, other interrelationships may have existed across the SDOH variables, which the analysis may not have been able to appropriately control, or an individual SDOH variable may have acted as a proxy for another factor that may not have been captured or accurately in this study.

Fourth, for most models across both study populations, the resulting C-values were only slightly above the random effects point (0.50), and this finding should not be discouraging because it might imply that there were other variables missing from the modeling. For example, other influencing variables may have included underlying clinical risk factors, parental or guardian-related factors (especially for the children and adolescent population), the MCO-related factors (health plan design and additional benefits), and provider-related factors (type of organization and services). Especially where the directionality of significant associations was unexpected, findings need to be interpreted with caution, given the multiple and complex types of factors captured through the set of SDOH variables.



Finally, as a cross-sectional study design, while the results indicated that there were significant associations between individual SDOH variables and the performance outcomes of quality measures, the results could not be interpreted as direct causal relationships.

Given these limitations, several recommendations could be considered by policy makers, Medicaid MCOs, and providers. First, access to member-level SDOH data could further improve the accuracy of statistical modeling, help identify which individual SDOH variables are significantly associated with quality measure performance at the member level, and supplement valuable information for clinical care planning. To encourage member-level assignment of SDOH values, a set of standardized SDOH variables could be defined and member-level SDOH data could be collected during Medicaid and CHIP enrollment or by the MCOs or providers. Since there are a variety of collection points for such SDOH data, including upon enrollment, during a clinic visit, during case management, and using member surveys, the approach to SDOH data collection should be systematic and standardized where possible.

Second, building mutual engagement and buy-in among policy makers, providers, and MCOs regarding the impact of SDOH on quality measure performance is important. Providers and their care teams could be the key players for screening and documenting member-level SDOH data in the medical record and MCOs could be the key players for capturing and analyzing such SDOH data within the claims data; regardless, engagement and buy-in should be collaborative since there is value in medical records which capture clinical progress and claims data which capture health care service utilization. In fact, diagnostic Z codes (ICD-10-CM codes in categories Z55-Z56)<sup>35</sup> already exist that define SDOH and other non-medical factors that may influence a patient's health status or health behaviors, including education and literacy, employment, housing, lack of adequate food or water, or exposure to physical or community risk factors. However, unless provider and MCO engagement and buy-in to use Z codes is high, this avenue for member-level SDOH data collection may not succeed.

Lastly, building off this study's findings, another recommendation would be to further explore the impact of SDOH on quality measure performance by strategically targeting fewer SDOH variables based on largest SDOH categorical influence (e.g., the SDOH variables within the "Social and Economic Environment" category) or largest degree of individual SDOH variable influence (e.g., Access to Mental Health Providers, which was a significant SDOH variable across all quality measures for the pregnant women population). A targeted approach could inform how

policy makers, providers, and MCOs prioritize interventions and strategies addressing SDOH for Medicaid members. For example, since “Access to Mental Health Providers” was commonly identified as a significant SDOH variable across most quality measures in both study populations, a potential intervention could focus on the provision of mental health services via telehealth modalities, thus reducing the need for geographically-accessible mental health providers. Since Rate of Violent Crime was another frequently identified significant SDOH variable, a possible strategy could focus on increasing the number of community hotlines for women experiencing domestic violence and programs that create community safety zones for children and adolescents.

As policy makers, MCOs, and providers look to better understand the impact of SDOH on Medicaid health outcomes, this study provided important findings supporting the relevance of SDOH variables collectively and individually on key measures of health care quality for children, adolescents, and pregnant women in Texas Medicaid.

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## Appendix I: Social Determinants of Health (SDOH) Variables Data

SDOH Variable	Data Source	Description of the SDOH Variable
<b>Demographic Attributes</b>		
Race/Ethnicity	Enrollment Data	White/Non-Hispanic as the reference group compared to Hispanic, Black, American Indian/Alaskan, Pacific Islander/Asian and unknown/other. Used as a SDOH variable.
Gender	Enrollment Data	Binary variable (Male/Female). Male used as reference. Used in all models.
Program	Enrollment Data	Binary variable (Medicaid/CHIP) used in all models as a control factor.
<b>Health Behaviors</b>		
Access to Exercise Opportunities	Business Analyst, Delorme map data, ESRI, & US Census Tiger line Files	Three sources are combined to create the measure that rates the access to exercise opportunities through the identification of parks, community centers, gyms, walking trails, etc.
Rate of Sexually Transmitted Disease (STD)	National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention	This dataset reports the rate of chlamydia, a sexually transmitted disease (STD).
Rate of Teen Births	National Center for Health Statistics - Natality Files	This reports the rate of teen births, as derived from vital records.
Rate of Adult Smoking	Behavioral Risk Factor Surveillance System	This reports the rate of smoking among adults, as derived from self-reported data.
Rate of Adult Obesity	United States Diabetes Surveillance System	This reports the rate of adult obesity from self-reported data on height, weight, and BMI.
Rate of Physical Inactivity	United States Diabetes Surveillance System	This is a rate of adult physical inactivity derived from self-reported data on hours engaged in physical activity per week.
<b>Availability and Access to Health Care Services</b>		
Access to Primary Care Physicians	Area Health Resource File/American Medical Association	The rate of primary care physicians per population is used to define access.
Transportation	Local Area Transportation Characteristics for Households (LATCH Survey)	This data is an estimate of a person's miles traveled, per day.
Access to Mental Health Providers	CMS, National Provider Identification	The rate of mental health providers per population is used to define access.
Access to OB/GYN Providers	Mapping Medicare Disparities Tool	The availability of obstetricians and gynecologists per population is used to define access.

<b>SDOH Variable</b>	<b>Data Source</b>	<b>Description of the SDOH Variable</b>
Rate of Uninsured Adults	Small Area Health Insurance Estimates	The estimates of health insurance coverage are used to derive estimates on the number of people without health insurance.
<b>Social and Economic Environment</b>		
Rate of High School Graduation	ED Facts	The rate of children who graduate high school.
Rate of Unemployment	Bureau of Labor Statistics	The rate of unemployment among adults.
Food Insecurity	Map the Meal Gap	The percentage of population who lack adequate access to food for an active, healthy life for all household members and limited or uncertain availability of nutritionally adequate foods.
Rate of Children in Single-Parent Households	American Community Survey, 5-Year Estimates	The rate of single parent households with children.
Rate of Violent Crime	Uniform Crime Reporting – FBI	Data provided by nearly 17,000 law enforcement agencies across the United States are used to report the rate of violent crime. Violent crime classification includes rape or sexual assault, robbery, aggravated assault, simple assault, domestic violence and violent crime involving injury.
Rate of Injury Deaths	National Center for Health Statistics - Mortality Files	The rate of deaths that are a result of injury.
Rate of Children in Poverty	Small Area Income and Poverty Estimates	The rate of children who live in families with income below the poverty threshold (100% of the Federal Poverty Guideline).
Rate of Disconnected Youth	The American Community Survey (ACS)	The percentage of teens and young adults ages 16-19 who are neither working nor in school.
Availability of Social Associations	County Business Patterns	The total number of membership associations in a county. The associations include membership organizations such as civic organizations, fitness centers, sports venues, sports organizations, churches and religious organizations, political organizations, labor organizations, business organizations, and professional organizations.
<b>Physical Environment</b>		
Air Pollution	Environmental Public Health Tracking Network	An assessment of air pollution created by monitoring and modeling the exposure to ozone and fine particles between 0.1 micrometers and 2.5 micrometers (PM 2.5)



<b>SDOH Variable</b>	<b>Data Source</b>	<b>Description of the SDOH Variable</b>
Rate of Severe Housing Problems	Comprehensive Housing Affordability Strategy (CHAS) data	The extent of households with housing problems and household income low enough to qualify for housing assistance as reported by CHAS.
Lead Exposure	Texas Department of Health and Human Services	Data from the surveillance system of blood lead test results for children.

## Appendix II: Quality Measures Data

Quality Measure	Data Source	Description of the Quality Measure
Member ID	Enrollment file	Medicaid member ID or unique dummy ID
<b>Children and Adolescents</b>		
CIS: Immunization for Children	Quality Indicator EQRO file; HEDIS®	Childhood vaccines protect children from a number of serious and potentially life-threatening diseases. Numerator criteria include children 2 years of age who had a combination of recommended immunizations. Childhood Immunization Combination 2: diphtheria, tetanus and acellular pertussis; polio; measles, mumps and rubella; haemophilus influenza type B; hepatitis B, varicella vaccines
IMA: Immunization for Adolescents	Quality Indicator EQRO file; HEDIS®	Vaccines are a safe and effective way to protect adolescents against potential deadly diseases. Numerator criteria include adolescents 13 years of age who had a combination of recommended immunizations. Adolescent Immunization Combination 1: At least one meningococcal conjugate vaccine, plus at least one tetanus, diphtheria toxoids and acellular pertussis (TDAP) vaccine
HPV: HPV Immunization for Adolescents	Quality Indicator EQRO file; HEDIS®	Recommended vaccines are a safe and effective way to protect adolescents from vaccine-preventable diseases, including HPV. Numerator criteria include adolescents who had the complete human papillomavirus vaccine series.
Follow-up after Initiation ADHD Medication	Quality Indicator EQRO file; HEDIS®	Initiation Phase: Medication for ADHD can control symptoms when managed appropriately in children and adolescents. Numerator criteria include children or adolescents with prescribed attention-deficit/hyperactivity disorder (ADHD) medication.
Follow-up during Continuation ADHD Medication	Quality Indicator EQRO file; HEDIS®	Continuation & Management Phase: It is important that children and adolescents be monitored by a physician to ensure that ADHD medications are prescribed and managed correctly. Numerator criteria include children or adolescents who continued attention-deficit/hyperactivity disorder (ADHD) medication.
Annual Primary Care Visit	Quality Indicator EQRO file; HEDIS®	Access to primary care is important for the health and well-being of children and adolescents. Numerator criteria include children and young adults 12 months to 19 years of age who had a visit with a primary care practitioner (PCP).

<b>Quality Measure</b>	<b>Data Source</b>	<b>Description of the Quality Measure</b>
15-Month Old Well Child Visits	Quality Indicator EQRO file; HEDIS®	Assessing physical, emotional and social development is important at every stage of life, particularly with children and adolescents. Numerator criteria include children with at least 6 well child visits in the first 15 months of life.
Ages 3, 4, 5, 6-Year Old Well Child Visits	Quality Indicator EQRO file; HEDIS®	Assessing physical, emotional and social development is important at every stage of life, particularly with children and adolescents. Numerator criteria include children and adolescents with one or more annual visits in the 3 <sup>rd</sup> , 4 <sup>th</sup> , 5 <sup>th</sup> , and 6 <sup>th</sup> years of life.
Adolescent Well Care Visits	Quality Indicator EQRO file; HEDIS® <i>Process Outcome</i>	Assessing physical, emotional and social development is important at every stage of life, particularly with children and adolescents. Numerator criteria include adolescents age 12-19 years old who had at least one comprehensive well-care visit with a primary care practitioner or an OB/GYN practitioner during the measurement year. Note: While the criteria include individuals 12-21 years old, this study only included members 12-19 years old.
Asthma Admission Rate (Pediatric Quality Indicator 14)	Quality Indicator EQRO file; AHRQ	Asthma related admissions are potentially preventable inpatient stays. Numerator criteria include asthma related acute inpatient stays among children aged 2-17 years. It excludes cases with a diagnosis code for cystic fibrosis and anomalies of the respiratory system, obstetric admissions, and transfers from other institutions.
<b>PREGNANT WOMEN</b>		
Timeliness of Prenatal Care	Quality Indicator EQRO file; HEDIS® <i>Process Outcome</i>	Prenatal Care: Timely and adequate prenatal care can prevent poor birth outcomes. Numerator criteria include pregnant women who received a prenatal care visit as a member of the organization in the first trimester.
Postpartum Care	Quality Indicator EQRO file; HEDIS® <i>Process Outcome</i>	Postpartum Care: Appropriate postpartum care can prevent complications. Numerator criteria include women with deliveries who had a postpartum visit on or between 21 and 56 days after delivery.
Low Birth Weight (LBW) Babies	Custom created measure based out of AHRQ specifications.	Babies born early or with low birthweight can experience serious health problems. Certain maternal behaviors or exposures can contribute to low birth weight babies. Denominator criteria include all members with a date of birth during calendar year 2018. Numerator indicates LBW. A custom measure was created based on LBW

Quality Measure	Data Source	Description of the Quality Measure
		diagnosis codes identified by AHRQ for Pediatric Quality Indicators Low Birth Weight Categories (claim/encounter facility or professional with ICD-10 diagnosis code any position: P05.0X-P05.1X & P07.00-03, & P07.14-18.)

### Appendix III: Detailed Results

Significant SDOH Variables				
	Children Immunization		Adolescent Immunization	
	Estimate	Percent	Estimate	Percent
Race/Ethnicity	0.18	13.2%	-0.11	8.5%
Access to Exercise Opportunities	0.05	3.4%	--	--
Rate of Sexually Transmitted Disease (STD)	-0.14	10.5%	-0.13	10.1%
Rate of Teen Births	-0.06	4.3%	--	--
Rate of Adult Smoking	0.09	6.9%	--	--
Rate of Adult Obesity	0.07	5.5%	0.10	7.7%
Rate of Physical Inactivity	-0.03	2.5%	-0.06	4.6%
Access to Primary Care Physicians (PCP)	0.12	8.7%	0.08	6.2%
Access to Mental Health Providers	--	--	0.17	13.2%
Transportation	0.07	4.9%	--	--
Access to OB/GYN Providers	--	--	--	--
Rate of Uninsured Adults	--	--	0.04	2.8%
Rate of High School Graduation	--	--	--	--
Rate of Unemployment	--	--	0.10	8.1%
Food Insecurity	--	--	--	--
Rate of Children in Single-Parent Households	--	--	--	--
Rate of Violent Crime	--	--	-0.12	9.6%
Rate of Injury Death	-0.05	3.8%	0.06	5.0%
Rate of Children in Poverty	0.18	13.2%	0.13	9.8%
Rate of Disconnected Youth	-0.13	10.0%	-0.10	7.7%
Availability of Social Associations	0.09	7.1%	-0.09	6.7%
Air Pollution	--	--	--	--
Rate of Severe Housing Problems	--	--	--	--
Lead Exposure	-0.08	6.0%	--	--

Note: White/Non-Hispanic was used as the reference group for the Race/Ethnicity variable.

<b>Significant SDOH Variables</b>				
	<b>Adolescent HPV Immunization</b>		<b>Follow-up after Initiation ADHD Medication</b>	
	Estimate	Percent	Estimate	Percent
Race/Ethnicity	--	--	-0.21685	14.2%
Access to Exercise Opportunities	0.132907	5.9%	-0.09987	6.5%
Rate of Sexually Transmitted Disease (STD)	-0.07417	3.3%	0.09377	6.1%
Rate of Teen Births	-0.15406	6.8%	--	--
Rate of Adult Smoking	0.147222	6.5%	-0.07644	5.0%
Rate of Adult Obesity	0.070168	3.1%	--	--
Rate of Physical Inactivity	-0.08185	3.6%	--	--
Access to Primary Care Physicians (PCP)	-0.08722	3.9%	--	--
Access to Mental Health Providers	0.083666	3.7%	0.070845	4.6%
Transportation	0.070331	3.1%	--	--
Access to OB/GYN Providers	0.188513	8.3%	--	--
Rate of Uninsured Adults	--	--	0.125701	8.2%
Rate of High School Graduation	--	--	0.052454	3.4%
Rate of Unemployment	0.11632	5.1%	--	--
Food Insecurity	-0.26627	11.8%	0.098292	6.4%
Rate of Children in Single-Parent Households	--	--	--	--
Rate of Violent Crime	0.057106	2.5%	--	--
Rate of Injury Death	--	--	-0.11563	7.6%
Rate of Children in Poverty	0.268367	11.9%	--	--
Rate of Disconnected Youth	-0.08878	3.9%	--	--
Availability of Social Associations	0.148457	6.6%	-0.30748	20.1%
Air Pollution	0.181577	8.0%	-0.14292	9.4%
Rate of Severe Housing Problems	-0.04664	2.1%	-0.1282	8.4%
Lead Exposure	--	--	--	--

Note: White/Non-Hispanic was used as the reference group for the Race/Ethnicity variable.

<b>Significant SDOH Variables</b>				
	<b>Follow-up during Continuation ADHD Medication</b>		<b>Asthma Admission Rate (Pediatric Quality Indicator 14)</b>	
	Estimate	Percent	Estimate	Percent
Race/Ethnicity	--	--	0.406947	14.8%
Access to Exercise Opportunities	-0.17835	34.6%	-0.24027	8.7%
Rate of Sexually Transmitted Disease (STD)	--	--	--	--
Rate of Teen Births	--	--	--	--
Rate of Adult Smoking	--	--	--	--
Rate of Adult Obesity	--	--	--	--
Rate of Physical Inactivity	--	--	-0.12924	4.7%
Access to Primary Care Physicians (PCP)	--	--	--	--
Access to Mental Health Providers	--	--	0.140483	5.1%
Transportation	--	--	--	--
Access to OB/GYN Providers	--	--	0.139757	5.1%
Rate of Uninsured Adults	--	--	-0.13403	4.9%
Rate of High School Graduation	--	--	--	--
Rate of Unemployment	--	--	--	--
Food Insecurity	--	--	-0.23789	8.6%
Rate of Children in Single-Parent Households	--	--	0.236527	8.6%
Rate of Violent Crime	--	--	0.173565	6.3%
Rate of Injury Death	-0.14633	28.3%	--	--
Rate of Children in Poverty	--	--	0.133369	4.8%
Rate of Disconnected Youth	--	--	-0.23951	8.7%
Availability of Social Associations	-0.1915	37.1%	--	--
Air Pollution	--	--	-0.30531	11.1%
Rate of Severe Housing Problems	--	--	-0.24126	8.7%
Lead Exposure	--	--	--	--

Note: White/Non-Hispanic was used as the reference group for the Race/Ethnicity variable.

<b>Significant SDOH Variables</b>				
	<b>Annual Primary Care Visit</b>		<b>15 Month Well Child Visits</b>	
	Estimate	Percent	Estimate	Percent
Race/Ethnicity	0.067579	5.0%	0.08857	6.4%
Access to Exercise Opportunities	--	--	-0.091008	6.6%
Rate of Sexually Transmitted Disease (STD)	0.021991	1.6%	-0.080394	5.8%
Rate of Teen Births	-0.11102	8.1%	--	--
Rate of Adult Smoking	-0.02749	2.0%	0.062558	4.5%
Rate of Adult Obesity	0.024823	1.8%	0.048048	3.5%
Rate of Physical Inactivity	-0.05598	4.1%	-0.037917	2.7%
Access to Primary Care Physicians (PCP)	0.132653	9.7%	0.131698	9.5%
Access to Mental Health Providers	0.032773	2.4%	0.061543	4.4%
Transportation	0.072411	5.3%	--	--
Access to OB/GYN Providers	-0.03684	2.7%	-0.035463	2.6%
Rate of Uninsured Adults	0.175782	12.9%	0.073539	5.3%
Rate of High School Graduation	0.080052	5.9%	--	--
Rate of Unemployment	0.147679	10.8%	--	--
Food Insecurity	--	--	-0.109066	7.9%
Rate of Children in Single-Parent Households	--	--	0.157262	11.3%
Rate of Violent Crime	0.03989	2.9%	-0.052627	3.8%
Rate of Injury Death	-0.06247	4.6%	--	--
Rate of Children in Poverty	0.049054	3.6%	--	--
Rate of Disconnected Youth	--	--	-0.070571	5.1%
Availability of Social Associations	0.114723	8.4%	--	--
Air Pollution	-0.08815	6.5%	0.16856	12.1%
Rate of Severe Housing Problems	-0.02237	1.6%	-0.046216	3.3%
Lead Exposure	--	--	-0.073504	5.3%

Note: White/Non-Hispanic was used as the reference group for the Race/Ethnicity variable.



<b>Significant SDOH Variables</b>				
	<b>Ages 3, 4, 5, 6- Year Old Well Child Visits</b>		<b>Adolescent Well Care Visits</b>	
	Estimate	Percent	Estimate	Percent
Race/Ethnicity	0.043305	3.8%	-0.10535	10.3%
Access to Exercise Opportunities	0.040213	3.6%	0.038719	3.8%
Rate of Sexually Transmitted Disease (STD)	--	--	-0.04656	4.5%
Rate of Teen Births	-0.09204	8.2%	-0.11867	11.6%
Rate of Adult Smoking	0.046201	4.1%	0.044274	4.3%
Rate of Adult Obesity	0.033472	3.0%	0.021788	2.1%
Rate of Physical Inactivity	-0.02394	2.1%	-0.03846	3.7%
Access to Primary Care Physicians (PCP)	0.048511	4.3%	0.049765	4.8%
Access to Mental Health Providers	0.070083	6.2%	0.046838	4.6%
Transportation	-0.03307	2.9%	--	--
Access to OB/GYN Providers	--	--	0.015574	1.5%
Rate of Uninsured Adults	0.126095	11.2%	0.128577	12.5%
Rate of High School Graduation	0.023513	2.1%	--	--
Rate of Unemployment	0.139814	12.4%	0.134463	13.1%
Food Insecurity	-0.09644	8.5%	-0.06205	6.0%
Rate of Children in Single-Parent Households	0.085286	7.6%	--	--
Rate of Violent Crime	-0.05963	5.3%	-0.03699	3.6%
Rate of Injury Death	--	--	--	--
Rate of Children in Poverty	-0.06315	5.6%	--	--
Rate of Disconnected Youth	--	--	--	--
Availability of Social Associations	--	--	--	--
Air Pollution	0.103642	9.2%	0.112689	11.0%
Rate of Severe Housing Problems	--	--	0.026565	2.6%
Lead Exposure	--	--	--	--

Note: White/Non-Hispanic was used as the reference group for the Race/Ethnicity variable.

<b>Significant SDOH Variables</b>						
	<b>Timeliness of Prenatal Care</b>		<b>Postpartum Care</b>		<b>Low Birth Weight (LBW) Babies</b>	
	Estimate	Percent	Estimate	Percent	Estimate	Percent
Race/Ethnicity	--	--	-0.11358	11.8%	0.084186	21.2%
Access to Exercise Opportunities	--	--	0.075891	7.9%	--	--
Rate of Sexually Transmitted Disease (STD)	--	--	-0.05516	5.7%	0.048274	12.2%
Rate of Teen Births	-0.08622	8.0%	--	--	--	--
Rate of Adult Smoking	0.062423	5.8%	0.05297	5.5%	-0.05525	13.9%
Rate of Adult Obesity	0.023034	2.1%	--	--	--	--
Rate of Physical Inactivity	--	--	-0.02166	2.3%	0.04237	10.7%
Access to Primary Care Physicians (PCP)	--	--	-0.05356	5.6%	--	--
Access to Mental Health Providers	0.047424	4.4%	-0.025	2.6%	0.039467	10.0%
Transportation	--	--	-0.03042	3.2%	--	--
Access to OB/GYN Providers	0.07245	6.7%	0.060012	6.2%	--	--
Rate of Uninsured Adults	0.053012	4.9%	--	--	--	--
Rate of High School Graduation	0.045977	4.3%	--	--	--	--
Rate of Unemployment	0.073257	6.8%	--	--	0.041126	10.4%
Food Insecurity	-0.20121	18.6%	--	--	--	--
Rate of Children in Single-Parent Households	0.050239	4.7%	0.050419	5.2%	--	--
Rate of Violent Crime	-0.07343	6.8%	-0.03602	3.8%	0.036741	9.3%
Rate of Injury Death	0.045575	4.2%	--	--	-0.0489	12.3%
Rate of Children in Poverty	0.080657	7.5%	--	--	--	--
Rate of Disconnected Youth	--	--	-0.08084	8.4%	--	--
Availability of Social Associations	0.101212	9.4%	0.102807	10.7%	--	--
Air Pollution	0.063727	5.9%	0.140136	14.6%	--	--
Rate of Severe Housing Problems	--	--	-0.06198	6.5%	--	--
Lead Exposure	--	--	--	--	--	--

Note: White/Non-Hispanic was used as the reference group for the Race/Ethnicity variable.