BHI Report:
Examining the relationship between socioeconomic factors and preventable diabetes- and hypertension-related inpatient admissions

OCTOBER 2021

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ABOUT THE QUALIFIED ENTITY CERTIFICATION PROGRAM

In June 2019, Blue Health Intelligence® (BHI®) was named a certified National Qualified Entity (QE). With this distinction, BHI gained access to all Medicare fee-for-service (FFS) claims for acute care, post-acute care, physician office, and pharmacy services for more than 59 million individuals each year. BHI has combined FFS Medicare data with its already rich set of commercial claims from 200+ million unique individuals and 20+ billion claims to help address healthcare's triple aim – better care for individuals, better health for populations, and lower costs for all. Specifically, the QE program was created as part of the Affordable Care Act with the purpose of combining Medicare data with a commercial claims data set and using it to report back publicly on health system quality measures.

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ABOUT BLUE HEALTH INTELLIGENCE

Leveraging the power of claims data from more than 200 million Americans, BHI delivers insights that empower healthcare organizations to improve patient care, reduce costs, and optimize performance. With the largest, most up-to-date, and uniform data set in healthcare, BHI provides an accurate representation of the health profile of commercially insured Americans. Blue Health Intelligence (BHI) is a trade name of Health Intelligence Company, LLC, an independent licensee of the Blue Cross Blue Shield Association.

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EXECUTIVE SUMMARY

This report examines the relationship between diabetes related Prevention Quality Indicators (PQIs) and socioeconomic factors. The following Agency for Healthcare Research and Quality (AHRQ) PQIs pertaining to either diabetes or the common diabetic comorbidity of hypertension are included:

- PQI 01 Diabetes Short-Term Complications Admission Rate
- PQI 03 Diabetes Long-Term Complications Admission Rate
- PQI 07 Hypertension Admission Rate
- PQI 14 Uncontrolled Diabetes Admission Rate
- PQI 16 Lower-Extremity Amputation among Patients with Diabetes Rate

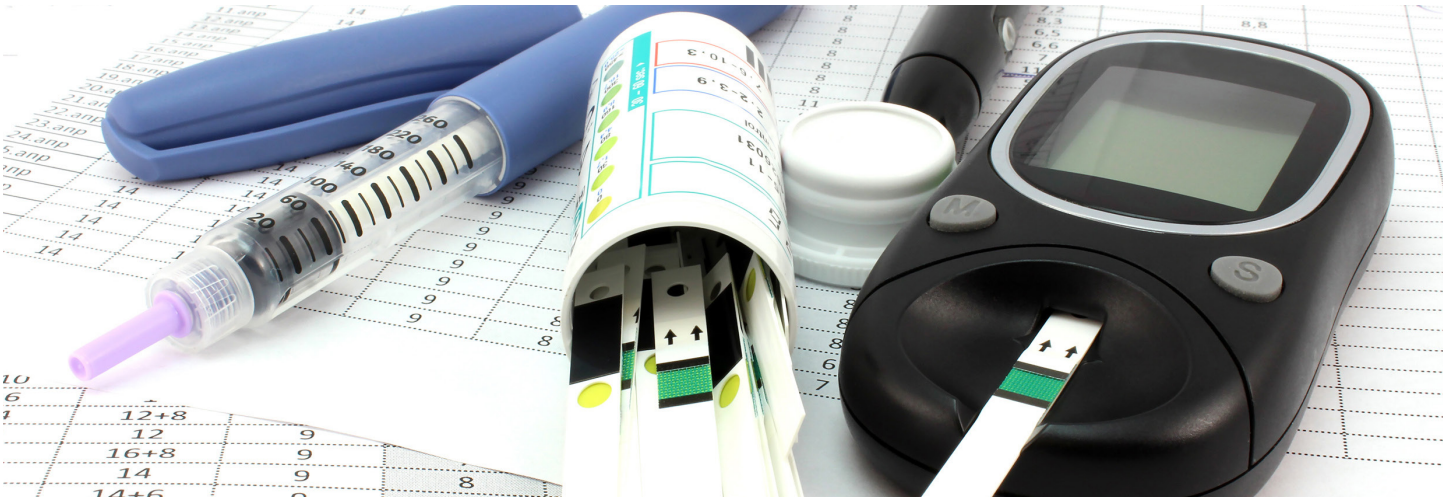
These PQIs are analyzed in relation to various social determinants of health (SDOH) and demographic factors, including payer type (commercial vs. Medicare), age, sex, and socioeconomic status (SES) Index. The SES Index used is a widely accepted measure of socioeconomic status comprised of seven individual component measures, which are grouped into the five broader constructs of housing, income, wealth, education, and occupation. The data in this report are from calendar year 2019 and include over 20 million commercial and Medicare inpatient hospital admissions. These data are joined to the SES Index at the member ZIP code level for use in evaluation.

The overall combined payer rates for the five PQIs studied show a reasonable match to the 2021 AHRQ benchmarks, confirming the validity of the measure calculations. Across all PQIs studied, the observed admission rates are greater for those with a payer type of Medicare compared to those with a commercial payer. Diabetes Short-Term Complications Admissions Rate (PQI 01) showed the greatest observed admission rates in the younger age groups (18 to 39 years, 40 to 64 years) as compared to the older age groups (65 to 74 years, 75 years and older); however, all other PQIs showed higher observed admission rates as age increased. For hypertension admissions (PQI 07), females demonstrated greater observed admission rates than males; whereas, males showed greater observed admission rates than their female counterparts for all other PQIs.

Across all PQIs, there were distinct relationships between observed admission rates and the SES Index. The lowest SES Index exhibited the highest observed admission rates, while the highest SES Index exhibited the lowest observed admission rates, further emphasizing the pronounced relationship between SDOH and healthcare outcomes. All five constructs of the SES Index showed similar relationships as demonstrated by the overall SES Index. The key findings from stratifying these PQIs by socioeconomic and demographic factors include that observed admission rates are generally higher for those with a payer type of Medicare, older age groups, males, and those with a lower SES Index.

The results of this report confirm well-established findings of peer-reviewed research that SDOH significantly impact healthcare outcomes. Differences exist between the observed admission rates for the five PQIs and all demographic and socioeconomic factors studied, emphasizing the need for future research to address these disparities and achieve health equity.

REPORT OVERVIEW



Background and Purpose

Diabetes is a relevant topic of study due to its high prevalence and ability to be effectively managed if diagnosed early and treated appropriately. The prevalence of diabetes has significantly increased over the last 20 years, resulting in an estimated 10.5% of the U.S. population diagnosed with diabetes as of 2020 (CDC, 2020). Even during the COVID-19 pandemic, diabetes remained the 8th overall cause of death in the U.S. in 2020 (Ahmad *et al.,* 2020). Due to this impact, diabetes has become a focus of U.S. public health policy, as evidenced by the inclusion of diabetes-related goals in Healthy People 2020, a framework for national objectives to improve the health of Americans (ODPHP, Healthy People 2020). While prevention and management are possible, it has been shown that social determinants of health (SDOH) significantly impact the outcomes of patients with diabetes (Walker *et al.*, 2016).

SDOH are the environmental circumstances in which people live that affect a wide range of health, functioning, and quality-of-life outcomes and risks (ODPHP, Healthy People 2030). Social determinants contribute to health disparities and inequities across many chronic conditions, including diabetes. This report examines the relationships between preventable diabetes and hypertension admission rates and socioeconomic status (SES) measures to inform the potential of improved access to preventive care to reduce avoidable hospitalization. The data contained in the report reinforce the profound impact that SDOH, including SES, have on health outcomes.

Overview of Measures

The five Prevention Quality Indicators (PQIs) selected for this report provide a comprehensive overview of the state of preventive diabetic care in the United States. PQIs are widely used and accepted population-based quality measures, which are developed and maintained by the Agency for Healthcare Research and Quality (AHRQ). In general, PQIs quantify admissions that may have been prevented if accessible, high-quality, and timely preventive outpatient care was utilized. Eligible admissions include hospitalizations with either the condition or outcome of interest among the number of people at risk for that outcome during 2019 (AHRQ, 2020). Lower PQI rates suggest the study population has access to quality outpatient care, resulting in fewer potentially avoidable admissions. The PQIs described as follows were included as they specifically relate to diabetes:

- **PQI 01 Diabetes Short-Term Complications Admission Rate:** Admissions for a principal diagnosis of diabetes with short-term complications (ketoacidosis, hyperosmolarity, or coma) per 100,000 for the population at risk, ages 18 years and older.
- **PQI 03 Diabetes Long-Term Complications Admission Rate:** Admissions for a principal diagnosis of diabetes with long-term complications (renal, eye, neurological, circulatory, or complications not otherwise specified) per 100,000 for the population at risk, ages 18 years and older.
- **PQI 14 Uncontrolled Diabetes Admission Rate:** Admissions for a principal diagnosis of diabetes without mention of either short-term (ketoacidosis, hyperosmolarity, or coma) or long-term (renal, eye, neurological, circulatory, or other unspecified) complications per 100,000 for the population at risk, ages 18 years and older.
- **PQI 16 Lower-Extremity Amputation among Patients with Diabetes Rate:** Admissions for any-listed diagnosis of diabetes and any-listed procedure of lower-extremity amputation (except toe amputations) per 100,000 for the population at risk, ages 18 years and older. Excludes any listed diagnosis of traumatic lower-extremity amputation admissions.

Studies have shown that over 70% of diabetics are also diagnosed with high blood pressure (Walker *et al.*, 2016). Therefore, due to the high rate of hypertension as a comorbidity of the diabetic population, the PQI described as follows was also selected for inclusion:

- **PQI 07 Hypertension Admission Rate:** Admissions with a principal diagnosis of hypertension per 100,000 for the population at risk, ages 18 years and older. Excludes kidney disease combined with dialysis access procedure admissions and cardiac procedure admissions.

The above PQIs are analyzed and stratified by demographic and socioeconomic factors, which have been shown to impact measure performance. The following dimensions were used to analyze the study population further:

- Payer type (commercial vs. Medicare)
- Age
- Sex
- Socioeconomic Status (SES) Index

AHRQ devised a widely accepted SES Index, which uses individual measures of socioeconomic status with weighted coefficients to serve as an index of overall socioeconomic status. The SES Index includes seven individual component measures, based on U.S. Census data at the ZIP code area-level, pertaining to five broader social constructs (Figure 1; AHRQ, 2008).

Construct	Measure	Definition
Housing		
	Crowding	Percentage of households containing one or more person per room
Income		
	Poverty	Percentage of persons below the federally defined poverty line
	Median income	Median household income standardized to range from 0 to 100
Wealth		
	Property	Median value of owner-occupied units, standardized to range from 0 to 100
Education		
	Higher education	Population 25 years and older with a bachelor's degree or higher
	Low education	Population 25 years and older without completion of high school
Occupation		
	Unemployment	Civilian labor force unemployment rate

Figure 1: Principal components of the SES Index grouped by construct as outlined by AHRQ (2008)

AHRQ defines the scoring algorithm as follows with each individual SES measure accompanied by a coefficient found from a principal components analysis (AHRQ, 2008):

> SES Index Score = 50 + (0.11*median household income score) + (-0.10*% below federal poverty line) + (-0.08*% unemployed) + (0.10*% college graduates) + (-0.11*% education below 12th grade) + (0.08*median property value score) + (-0.07*% crowded households)

The coefficients function as measures of association between the individual measures and SES. The negative and positive values attributed to the coefficients demonstrate the direction of the relationship between the measure and SES. For instance, a positive sign indicates an association with higher SES, whereas a negative sign reflects an association with lower SES (AHRQ, 2008). The subsequent portions of this report and analysis use both the overall SES Index and its seven individual component measures, grouped at times into these five broader SES constructs.

METHODOLOGY AND DATA SOURCES

Data Sources

This report uses combined payer data to construct the reference population and analytic data set. The overall combined payer reference population totals 85,790,386 individuals in 2019 over the age of 18. The commercial payer population consists of 46,931,886 (54.71%) members between the ages of 18 and 64 with coverage at any point during 2019 from the BHI National Data Repository (BDR). The Medicare population, referred to simply as Medicare throughout the report, includes 38,858,500 (45.29%) beneficiaries age 18 and older with Part A coverage for at least one month in 2019 who were not enrolled in a Medicare Advantage product for any part of that same year. In total, this report encompasses 20,710,114 inpatient hospital admissions from combined payer data sources spanning the calendar year 2019.

The SES Index and its seven component measures are based on data from the 2019 American Community Survey (ACS), which publishes metrics on the composition of a specific geography in terms of the population, housing, and economics. There are seven individual component measures selected from the ACS for each five-digit ZIP code that are standardized on a scale of 0 to 100 and then passed through AHRQ's scoring algorithm to calculate a single SES Index value for each ZIP code. Both the ACS data and AHRQ's SES Index are available for public use on their respective sites (AHRQ, 2008; U.S. Census Bureau, 2021). The SES Index values, along with the seven component measures, were then joined to the commercial and Medicare data in this report based on either the member's or beneficiary's residential ZIP code to be able to stratify the PQI admission rates by the SES Index and the component measures. The resulting data represented 37,731 ZIP code areas. Less than 0.1% of combined payer claims records were found to be missing SES Index dimensions upon joining based on a five-digit ZIP code and were excluded from the analysis.

The data used in this report present a few limitations. This report uses health plan data approved for use in public reporting from BHI's National Data Repository (BDR). The BDR is comprised of medical and pharmacy claims, membership data, and provider data for more than 200 million Americans – all contributed monthly by Blue Cross Blue Shield Plans for their commercial populations. Any claim records not associated with these select preapproved plans and products were excluded. As mentioned, claims records missing the SES Index dimension data were removed, as well.

Input File Creation and PQI Calculation

BHI calculated the five PQIs of interest using the current 2020 version of the publicly available AHRQ SAS QI Software (AHRQ, 2020). The input data contained inpatient admissions records from the combined payer population and served as the source of the numerators. Records were excluded from the input data if they documented transfers, obstetric admissions, had missing ZIP code areas, were associated with individuals less than 18 years old, or were classified as high-resource intensity "pre-MDC" MS-DRGs (AHRQ, 2020).

As AHRQ (2020) outlined, the input file included the following key elements to derive the PQI observed rates. Payer type was incorporated as an additional element for analysis.

- Patient characteristics (age, sex, and ZIP code of residence)
- ICD-10-CM principal and secondary diagnosis codes
- ICD-10-PCS principal and secondary procedure codes
- Medicare Severity-Diagnosis Related Group (MS-DRG) and Major Diagnostic Category (MDC) codes, which further describe classification and severity of diagnoses and procedures
- Admission source, point of origin (PointOfOriginUB04), and admission type codes

The resulting analytic data set contained 17,115,674 eligible inpatient admissions, of which 2,882,830 (16.84%) admissions were attributed to commercially insured members and 14,232,844 (83.16%) admissions were associated with Medicare beneficiaries. The software published by AHRQ includes a module that performs risk adjustment based on age and gender using AHRQ's reference population. With age and sex as dimensions of interest for this report, the observed rates were utilized in place of AHRQ risk-adjusted rates for the PQIs.

The reference population, serving as the denominator data, used all eligible commercial members between the ages of 18 and 64 and Medicare beneficiaries over the age of 18. The population data were aggregated at the ZIP code area-level and stratified by age in five-year intervals, sex, and payer type for 2019. The SAS QI Software outputted the observed rates first by Federal Information Processing Standards (FIPS) state and county codes and then followed by ZIP code. The numerator represented the total number of admissions with either the condition or disease of interest, and the denominator reflected the population at risk for the given geographical area.

Dimensions: Study Population Characteristics

- The payer type is dichotomized as either commercial, denoting the commercially insured members, or Medicare beneficiaries.
- Demographics, specifically age and sex, were included as instructed by the documentation provided by AHRQ (2020).
- Age was categorized into the four AHRQ-defined groups: 18 to 39 years, 40 to 64 years, 65 to 74 years, and ages 75 and older. Commercial members over the age of 64 were excluded from the analysis to prevent double-counting these members since these members are also dually eligible for Medicare.
- Sex reflects biological sex as recorded in the claims data.
- AHRQ SES Index and its five constructs of housing, income, wealth, education and occupation defined by seven individual component measures: crowding, poverty, income, property, higher education, low education, and unemployment.

Determination of Cut Points

Cut points for the overall SES Index and its seven component measures were based on standard cut points used in previously published works by Krieger *et al*. (1997, 2003), which set a precedent in the field of measuring socioeconomic position, as well as the Bureau of Labor Statistics recent report on the state of unemployment (2021). Approaches to determining cut points included quintiles, categorical classifications, and threshold values. The standard categorical classifications were defined by Krieger *et al.* (1997, 2003) who use both percentile distributions (quintiles) and a priori considerations (i.e., federal definitions of high poverty). A priori cut points are often preferred over percentile distributions as they provide the added benefit of making comparisons easier across geographic areas. The measures and their respective categories resulting from the cut points used are defined in Figure 2 (see next page.)

Measure Name	Definition	Cut Point Approach and Resulting Categories	Reference for Cut Point Approach
SES Index	SES Index at the ZIP code area-level from the combined commercial and Medicare data	Quintiles: Q1: 33.9 – 49.2 Q2: 49.3 – 51.3 Q3: 51.4 – 53.1 Q4: 53.2 – 55.8 Q5: 55.9 – 74.2	(Berkowitz *et al.*, 2015)
Crowding	Percentage of households containing one or more person per room	Categorized into four levels: C1 (Lowest): 0 – 4.9 C2: 5 – 9.9 C3: 10 – 19.9 C4 (Highest): 20 – 100	(Krieger *et al.*, 2003)
Property	Functioning as a proxy for wealth, the median value of owner-occupied units, standardized to range between 0 and 100	Categorized into four levels: C1 (Lowest): 0 – 4.9 C2: 5 – 9.9 C3: 10 – 19.9 C4 (Highest): 20 – 100	(Krieger *et al.*, 2003)
Poverty	Percentage of persons living below the federally defined poverty line	Categorized into four levels: C1 (Lowest): 0 – 4.9 C2: 5 – 9.9 C3: 10 – 19.9 C4 (Highest): 20 – 100	(Krieger *et al.*, 2003)
Income	Median household income, standardized to range between 0 and 100	Categorized into five levels: C1 (Lowest): 0 – 19.9 C2: 20 – 39.9 C3: 40 – 59.9 C4: 60 – 79.9 C5 (Highest): 80 – 100	(Krieger *et al.*, 2003)
Higher Education	Percentage of persons aged 25 years or older with at least four years of college	Categorized into four levels: C1 (Lowest): 0 – 14.9 C2: 15 – 24.9 C3: 25 – 39.9 C4 (Highest): 40 – 100	(Krieger *et al.*, 2003)
Low Education	Percentage of persons aged 25 years or older with less than a twelfth-grade education	Categorized into four levels: C1 (Lowest): 0 – 14.9 C2: 15 – 24.9 C3: 25 – 39.9 C4 (Highest): 40 – 100	(Krieger *et al.*, 2003)
Unemployment	Percentage of persons aged 16 years or older in the labor force who are unemployed dichotomized as either high or low unemployment	Threshold value of 5.8%: Low: 0 – < 5.8 High: ≥ 5.8	(Bureau of Labor Statistics, 2021)

Figure 2: Cut points for SES Index and its seven component measures

FINDINGS

Overall Distributions and Observed Admission Rates

BHI calculated the overall combined payer type (commercial and Medicare) data by counting the number of discharge records with the health outcome of interest divided by the population at risk. The AHRQ QI documentation defines the population at risk as an estimate of the number of people at risk for that outcome over a given period (AHRQ, 2020).

The overall observed admission rates presented in this report align closely with the 2021 nationwide comparative rates published in the 2021 AHRQ Prevention Quality Indicators (PQI) benchmark data tables [Figure 3]. AHRQ generates these benchmarks from discharge data provided by the 2018 AHRQ Healthcare Cost and Utilization Project (HCUP) State Inpatient Databases (SID), which contain information from participating hospitals across 48 U.S. states on all inpatient discharges (AHRQ, 2021). Observed admission rates for short-term diabetes complications (PQI 01) revealed lower rates when compared to the nationwide benchmark; however, all other PQIs studied (PQIs 03, 07, 14, and 16) revealed higher rates than the national benchmark.

The differences between the two sets of rates can be explained by the data sources and the reference population used. The reference population used in this report contains BHI's commercial and Medicare data sources, whereas the 2021 version of the AHRQ benchmarks used U.S. Census population estimates. While the combined payer data reflect a vast number of commercial members and Medicare beneficiaries, the AHRQ benchmarks represent a larger, more generalizable population provided by the U.S. Census data. Despite these inherent differences, the overall combined payer observed admission rates illustrate a valid picture of this population's health. Additionally, the overall combined payer rates for the five PQIs studied show a reasonable match to the 2021 AHRQ benchmarks, confirming the validity of the measure calculations.

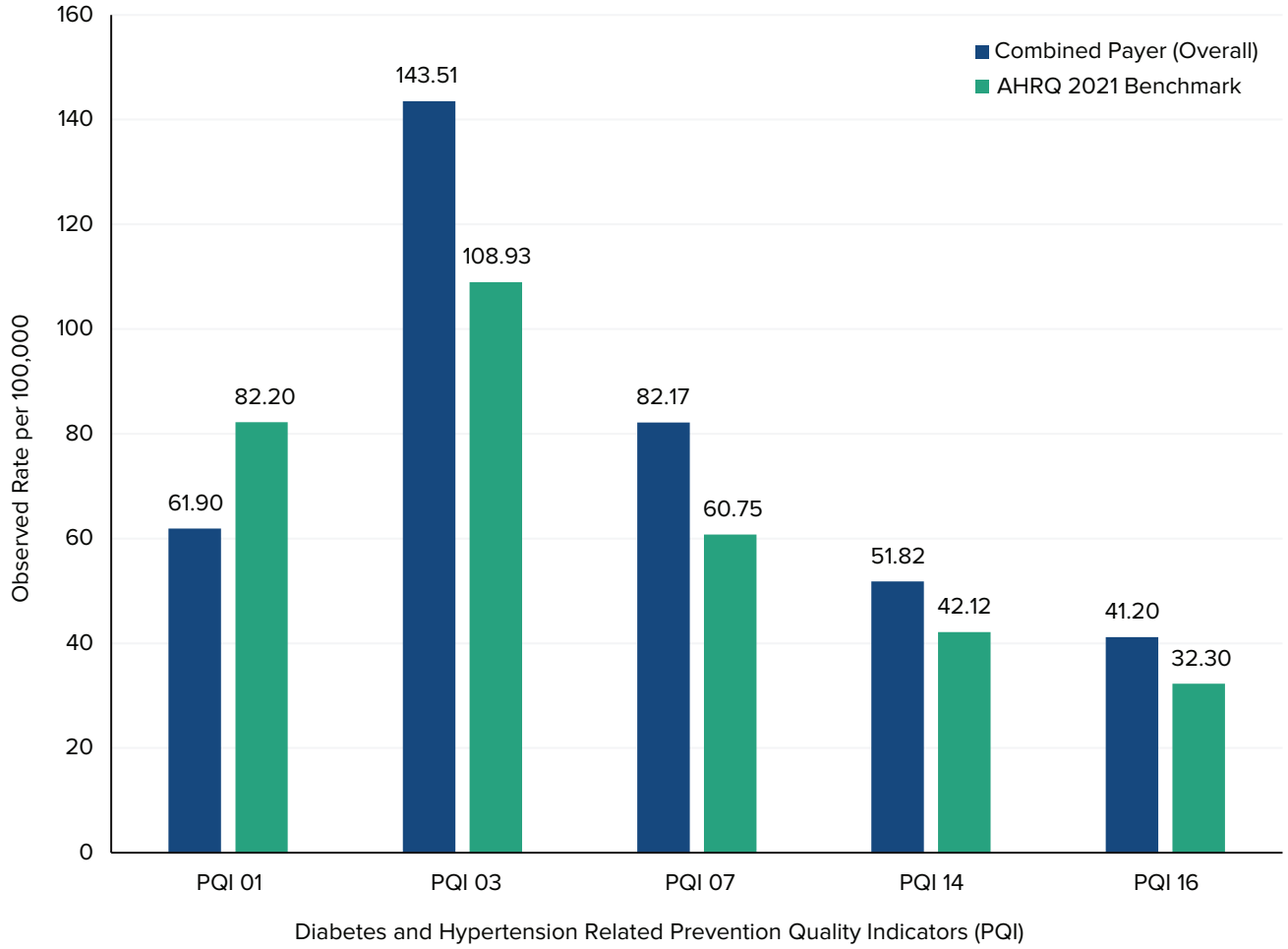


Figure 3. Observed admission rates derived from combined payer (overall) data compared to the 2021 AHRQ benchmark data tables' PQIs for the overall population

FINDINGS

The graphs depict the PQI observed rates multiplied by 100,000, which are interpreted as the rates per 100,000 for the population at risk [Figure 3; Figure 4; Figure 5].[1] We assessed payer type and demographics (age and sex), along with the SES Index and its seven individual measures grouped by socioeconomic construct [Figure 4; Figure 5; Table 1a and 1b in the Appendix]. The horizontal dashed lines indicate the overall combined payer type rates, which provide a point of reference for the dimensions and measures evaluated [Figure 4]. All analyses were conducted in SAS software version 9.4 (SAS, 2013).

Payer Type, Demographics, SES Index, and SES Constructs

Payer Type

Across all PQIs pertaining to diabetes and hypertension, those with a payer type of Medicare showed greater observed rates than those with a commercial payer. It is important also to consider how these findings are correlated with the age of Medicare enrollees. The Medicare payer type consists of two unique and quite different populations: individuals under the age of 65 with either disabilities or end-stage renal disease and adults enrolled in Medicare over the age of 65. These groups have meaningfully disparate rates, which factor into the overall Medicare payer type rate [Figure 6 in the Appendix]. Interpreting these rates with respect to age helps provide better insight into how the Medicare and commercial payer type populations differ.

Age

When exploring the relationship between age and PQI observed rates, we found PQIs related to long-term diabetes complications (PQI 03), hypertension (PQI 07), uncontrolled diabetes (PQI 14), and lower-extremity amputations among patients with diabetes (PQI 16) admission rates all increased as age increased, which suggests greater observed rates in admissions for these health outcomes and conditions of interest [Figure 4]. However, age and short-term complications diabetes (PQI 01) admissions revealed an inverse relationship, where members of the younger age groups (18 to 39 years, 40 to 64 years) demonstrated the greatest observed rates as compared to lower observed admission rates among members in the older age bands of 65 to 74 years and ages 75 and older. When assessing age by payer type, the reason for the disparate rates among the four age bands became clearer. Even though Medicare beneficiaries between the ages of 18 and 64 constituted only 5,558,933 (10.59%) individuals out of the total 52,490,819 combined payer population less than 65 years old, these younger Medicare beneficiaries contributed a greater number of diabetes- and hypertension-related admissions totaling 2,356,732 (45.00%) out of 5,236,756 admissions for these age groups. The Medicare population between the ages of 18 to 64 contains people with disabilities, end-stage renal disease, and similar debilitating conditions. This particularly high-risk group drives higher observed admission rates as compared to the Medicare beneficiaries over the age of 65 [Figure 6 in the Appendix].

Sex

When comparing the relationships between PQIs pertaining to diabetes vs. sex, males generally showed greater observed rates than their female counterparts [Figure 4]. We found a marked difference in observed rates for hypertension admissions (PQI 07) where the relationship inverted between males and females. Females instead demonstrated greater rates of hypertension admissions (97.11 per 100,000) than males (66.33 per 100,000). This finding aligned with the 2021 AHRQ benchmark data, where males exhibited a lower hypertension admission rate of 54.56 per 100,000 population as compared to females with a rate of 66.64 per 100,000 population (AHRQ, 2021).

SES Index

The relationships between the SES Index categorized as quintiles, and PQIs 01, 03, 07, 14, and 16 express that higher SES Index scores exhibit lower observed rates for diabetes complications, hypertension, and lower-extremity amputations among patients with diabetes [Figure 4; Table 1a in the Appendix]. Across all PQIs analyzed, there is a clear relationship between observed admission rates and the SES Index. The lowest SES Index quintile demonstrated the highest observed rates, and the highest SES Index quintile was associated with the lowest observed rates. These striking relationships continue to illustrate the inextricable link between SES and health.

SES Constructs

BHI further explored the relationships between the PQIs related to diabetes and hypertension and the five constructs of the SES Index defined by their associated individual component measures: housing (crowding), income (poverty and income), wealth (property), education (higher and low), and occupation (unemployment) [Figure 1; Figure 5]. Similar to the associations observed between the overall version of the SES Index (categorized as quintiles) and the PQIs of interest, meaningful relationships were seen both in strength and direction when comparing the individual SES Index components to the five PQIs pertaining to diabetes and hypertension admissions [Figure 5; Table 1b in the Appendix].

[1]BHI presents these standardized observed rates to portray a more meaningful unit of measurement. The standardized observed rates allow for easier comparisons to be made across dimensions of interest, specifically looking at the differences between the commercial and Medicare populations and evaluating the overall combined population's observed rates. The appendix presents results of statistical tests of the value of odds ratios (ORs) that compare rates for population subgroups compared to a reference group.

FINDINGS

Housing
Housing, measured by crowding, captures the percentage of households that average one or more persons per room. As crowding increased, the observed rates also increased for long-term diabetes complications admission rates, uncontrolled diabetes admission rates, and lower- extremity amputations among patients with diabetes (PQIs 03, 14, and 16, respectively). A straightforward relationship did not exist for short-term diabetes complications admission rates and hypertension admission rates (PQIs 01 and 07, respectively).

Wealth
Property, a proxy for wealth, demonstrated that as the standardized median values of owner-occupied homes increased incrementally across the four categories, the observed rates decreased for each PQI.

Income
The construct of income, characterized by standardized median household income and percentage of persons below the poverty line revealed nearly mirror-image, inverse relationships when comparing the observed rates for these two component measures. As percentage of poverty increased, so did the PQI observed rates; whereas, observed rates for each PQI decreased as percentage of income increased.

Education
Education, both higher and low, generally resembled the construct of income, which demonstrated inverse relationships between the individual component measures and PQIs. Higher education exhibited lower PQI admission rates; whereas, observed rates rose as the percentage of those with low education increased. However, the observed rates for short-term diabetes complications, hypertension, and uncontrolled diabetes (PQIs 01, 07, and 14, respectively) either maintained similar rates or decreased as percentages of low education increased. This finding deviated from the relationship found between the first two bands of low education (0%-14.9% and 15%-24.9%), where the observed rates increased as percentage of lower education also increased.

Occupation
The relationship between unemployment and PQIs also paralleled the income construct: higher percentages of unemployment were associated with increased observed diabetes and hypertension admission rates.

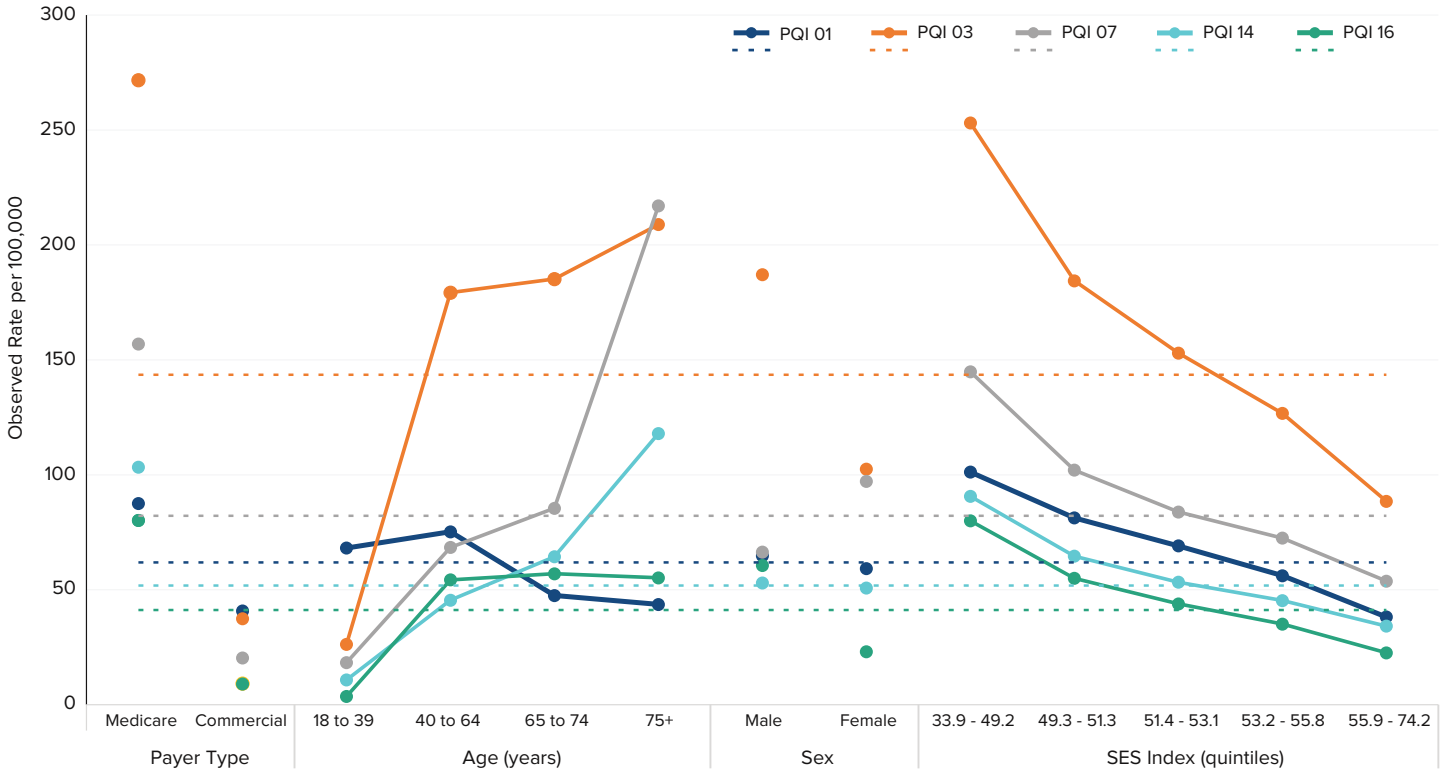


Figure 4. Distribution of PQI observed admission rates per 100,000 by payer type[2], age in four groups, sex[3], and the SES Index as quintiles as compared to the overall combined payer type observed admission rates illustrated by the dashed lines

[2]Observed admission rate for PQI 14 and commercial payer type: 9.16 per 100,000
[3]Observed admission rate for PQI 01 and male: 64.79 per 100,000

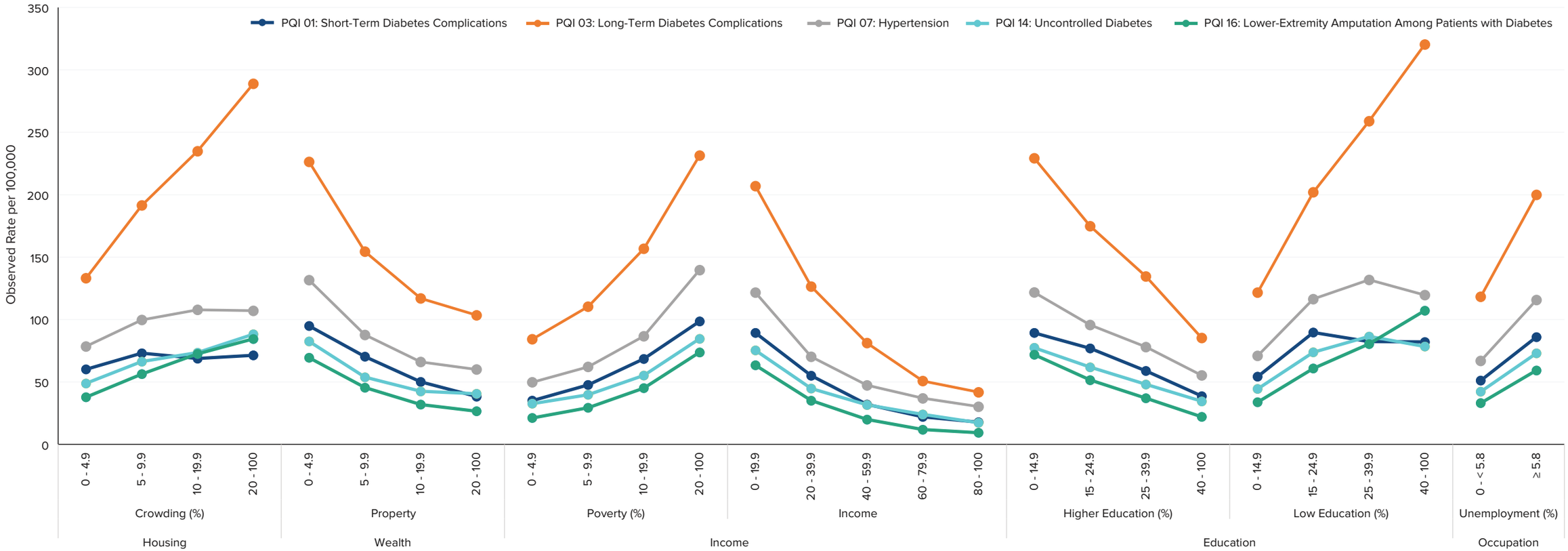


Figure 5. Distribution of PQI observed admission rates per 100,000 for the population at risk by SES construct and their seven component measures

CONCLUSION

BHI found it meaningful to explore the relationships between short-term and long-term diabetes complications, hypertension, uncontrolled diabetes, and lower-extremity amputation among patients with diabetes admission rates and the dimensions/measures of payer type, demographics (age and sex), and SES Index, as well as its individual components. The overall combined payer observed rates aligned with the 2021 AHRQ benchmark data, despite slightly higher admission rates in long-term diabetes complications (PQI 03), hypertension (PQI 07), and a lower rate for short-term diabetes complications admissions (PQI 01). The payer type comparison revealed that Medicare beneficiaries exhibited greater observed admission rates across all PQIs as compared to commercially insured members. Higher observed admission rates for long-term diabetes complications, uncontrolled diabetes, and lower-extremity amputations among patients with diabetes were found in older age bands and among males, except for short-term diabetes complications (PQI 01) and hypertension (PQI 07) admission rates where younger age bands and females, respectively, expressed higher admission rates.

This report's findings reaffirm the significant impact that SDOH have on health outcomes. The observed admission rates for short-term (PQI 01) and long-term diabetes complications (PQI 03), hypertension (PQI 07), uncontrolled diabetes (PQI 14), and lower-extremity amputations among patients with diabetes (PQI 16) all exhibited clear relationships with SES Index: observed admission rates decreased as SES Index increased. With the lowest SES Index cohort having between 2.65 and 3.55 greater odds of an admission for any of the five PQIs as compared to the highest SES Index cohort [Table 2 in the Appendix].

These findings corroborate published research and demonstrate the need for continued effort in addressing disparities within diabetic and hypertensive care. Each of the seven individual component measures that constitute the SES Index demonstrated significant relationships with the five PQIs pertaining to diabetes and hypertension admissions. For example, the individual measure of income resulted in the greatest magnitude of ORs; the odds of a diabetes- or hypertension-related admission and falling within the lowest income cohort (0%-19.9%) were 4.02 to 6.79 greater than those of the highest income cohort (80%-100%) [Table 2 in the Appendix]. This finding demonstrates the potential impact that growing income inequality may have on population health.

There are limitations to this report and analysis. The payer type comparison should be interpreted with caution especially when comparing across age bands. Medicare beneficiaries over the age of 65 typically possess greater observed admission rates as compared to commercial members; however, these older age bands (65 to 74 years and ages 75 and older) solely represent Medicare beneficiaries and no members with commercial payer types. Additionally, Medicare beneficiaries between the ages of 18 and 64 represent a unique subset of the population characterized by either severe disability or end stage renal disease (i.e., requiring renal dialysis or a kidney transplant) (U.S. Department of Health & Human Services, 2014). Even though these younger individuals with Medicare only represent a fraction of individuals (10.59%) out of the combined payer population less than 65 years old, their admissions total 45% out of the 5,236,756 admissions from combined payers falling within the younger age bands [Figure 6 in the Appendix].

There are many opportunities for future research to continue exploring the impact of SES and SDOH on diabetes and hypertension care outcomes. Specifically, additional analysis of SDOH dimension interactions on quality measure outcomes could better inform the relationship between dimensions. The SES Index is not the sole representative of SDOH. A multitude of dimensions and measures exist to characterize the relationship between SES and health, which include but are not limited to food access and healthcare utilization – all of which could be included in future analyses. While this report focuses on diabetes and hypertension care, similar analyses of the impact of SDOH could be performed for other chronic health conditions. The intersection of SDOH and healthcare outcomes provide an expansive landscape for future analyses and collaborations.

APPENDIX

Table 1a. Distribution of Prevention Quality Indicator (PQI) observed admission rates per 100,000 by payer type, demographics, and SES Index as quintiles

	PQI 01: Short-Term Complications Diabetes Admission Rate			**PQI 03**: Long-Term Complications Diabetes Admission Rate			**PQI 07**: Hypertension Admission Rate			**PQI 14**: Uncontrolled Diabetes Admission Rate			**PQI 16**: Lower-Extremity Amputation Among Patients with Diabetes Rate		
	Admissions	Population at Risk	Observed Rate	Admissions	Population at Risk	Observed Rate	Admissions	Population at Risk	Observed Rate	Admissions	Population at Risk	Observed Rate	Admissions	Population at Risk	Observed Rate
Overall	53,100	85,776,937	61.90	123,101	85,776,653	143.51	70,485	85,776,446	82.17	44,447	85,776,365	51.82	35,340	85,776,336	41.20
Payer Type															
Medicare	33,978	38,854,623	87.45	105,572	38,854,375	271.71	60,954	38,854,176	156.88	40,151	38,854,096	103.34	31,132	38,854,072	80.13
Commercial	19,122	46,922,314	40.75	17,529	46,922,278	37.36	9,531	46,922,270	20.31	4,296	46,922,269	9.16	4,208	46,922,264	8.97
Demographics															
Age (Years)															
18 to 39	15,967	23,424,562	68.16	6,133	23,424,200	26.18	4,273	23,424,123	18.24	2,510	23,424,081	10.72	833	23,424,042	3.56
40 to 64	21,849	29,056,549	75.19	52,093	29,056,618	179.28	19,873	29,056,483	68.39	13,214	29,056,451	45.48	15,780	29,056,470	54.31
65 to 74	9,357	19,699,557	47.50	36,476	19,699,558	185.16	16,830	19,699,556	85.43	12,679	19,699,558	64.36	11,224	19,699,556	56.98
75+	5,927	13,596,269	43.59	28,399	13,596,277	208.87	29,509	13,596,284	217.04	16,044	13,596,275	118.00	7,503	13,596,268	55.18
Sex															
Male	26,966	41,621,663	64.79	77,850	41,621,580	187.04	27,607	41,621,474	66.33	22,040	41,621,453	52.95	25,179	41,621,450	60.50
Female	26,134	44,155,274	59.19	45,251	44,155,073	102.48	42,878	44,154,972	97.11	22,407	44,154,912	50.75	10,161	44,154,886	23.01
SES Index															
33.9 - 49.2	11,058	10,925,370	101.21	27,648	10,925,259	253.06	15,821	10,925,227	144.81	9,903	10,925,206	90.64	8,735	10,925,203	79.95
49.3 - 51.3	10,265	12,635,181	81.24	23,304	12,635,107	184.44	12,895	12,635,057	102.06	8,165	12,635,043	64.62	6,947	12,635,045	54.98
51.4 - 53.1	9,600	13,893,883	69.10	21,252	13,893,834	152.96	11,647	13,893,821	83.83	7,400	13,893,804	53.26	6,092	13,893,797	43.85
53.2 - 55.8	10,107	18,017,555	56.10	22,831	18,017,503	126.72	13,059	18,017,467	72.48	8,160	18,017,456	45.29	6,315	18,017,453	35.05
55.9 - 74.2	11,000	28,829,640	38.16	25,513	28,829,617	88.50	15,491	28,829,590	53.73	9,857	28,829,601	34.19	6,501	28,829,588	22.55

APPENDIX

Table 1b: Distribution of Prevention Quality Indicator (PQI) observed rates per 100,000 by SES Index constructs consisting of seven individual component measures

	PQI 01: Short-Term Complications Diabetes AdmissionRate			**PQI 03**: Long-Term Complications Diabetes AdmissionRate			**PQI 07**: Hypertension Admission Rate			**PQI 14**: Uncontrolled Diabetes Admission Rate			**PQI 16**: Lower-Extremity Amputation Among Patients with Diabetes Rate		
	Admissions	Population at Risk	Observed Rate	Admissions	Population at Risk	Observed Rate	Admissions	Population at Risk	Observed Rate	Admissions	Population at Risk	Observed Rate	Admissions	Population at Risk	Observed Rate
Housing > Crowding															
0 - 4.9	43,824	72,845,499	60.16	97,019	72,845,212	133.19	57,169	72,845,084	78.48	35,593	72,845,043	48.86	27,562	72,845,013	37.84
5 - 9.9	5,873	8,036,383	73.08	15,387	8,036,371	191.47	8,015	8,036,338	99.73	5,330	8,036,332	66.32	4,529	8,036,331	56.36
10 - 19.9	1,947	2,830,823	68.78	6,650	2,830,824	234.91	3,053	2,830,820	107.85	2,081	2,830,817	73.51	2,054	2,830,818	72.56
20 - 100	338	473,471	71.39	1,368	473,466	288.93	507	473,471	107.08	418	473,464	88.29	400	473,465	84.48
Wealth > Property															
0 - 4.9	9,895	10,439,175	94.79	23,616	10,439,082	226.23	13,724	10,439,017	131.47	8,604	10,438,992	82.42	7,243	10,438,989	69.38
5 - 9.9	22,586	32,112,260	70.33	49,596	32,112,126	154.45	28,186	32,112,099	87.77	17,288	32,112,056	53.84	14,616	32,112,056	45.52
10 - 19.9	13,869	27,698,374	50.07	32,398	27,698,304	116.97	18,290	27,698,278	66.03	11,775	27,698,290	42.51	8,836	27,698,272	31.90
20 - 100	5,007	13,056,243	38.35	13,508	13,056,236	103.46	7,835	13,056,199	60.01	5,299	13,056,203	40.59	3,475	13,056,197	26.62
Income > Poverty															
0 - 4.9	4,229	12,080,499	35.01	10,172	12,080,483	84.20	6,007	12,080,460	49.72	3,934	12,080,470	32.56	2,549	12,080,463	21.10
5 - 9.9	12,852	26,953,477	47.68	29,754	26,953,454	110.39	16,740	26,953,397	62.11	10,730	26,953,378	39.81	7,919	26,953,377	29.38
10 - 19.9	22,342	32,588,368	68.56	51,095	32,588,263	156.79	28,256	32,588,201	86.71	18,008	32,588,180	55.26	14,706	32,588,167	45.13
20 - 100	12,805	12,994,247	98.54	30,073	12,994,090	231.44	18,154	12,994,069	139.71	10,993	12,994,042	84.60	9,581	12,994,034	73.73
Income															
0 - 19.9	21,415	23,981,053	89.30	49,589	23,980,886	206.79	29,145	23,980,811	121.53	18,041	23,980,785	75.23	15,208	23,980,770	63.42
20 - 39.9	27,015	49,050,568	55.08	62,035	49,050,438	126.47	34,435	49,050,368	70.20	21,949	49,050,338	44.75	17,216	49,050,330	35.10
40 - 59.9	3,067	9,583,580	32.00	7,782	9,583,571	81.20	4,541	9,583,559	47.38	3,031	9,583,564	31.63	1,911	9,583,558	19.94
60 - 79.9	248	1,122,597	22.09	570	1,122,599	50.78	415	1,122,595	36.97	270	1,122,595	24.05	133	1,122,595	11.85
80 - 100	40	224,838	17.79	94	224,838	41.81	68	224,838	30.24	39	224,838	17.35	21	224,838	9.34
Education > Higher Education															
0 - 14.9	9,903	11,085,424	89.33	25,404	11,085,298	229.17	13,488	11,085,247	121.68	8,576	11,085,226	77.36	7,966	11,085,213	71.86
15 - 24.9	17,951	23,337,958	76.92	40,796	23,337,855	174.81	22,322	23,337,803	95.65	14,436	23,337,764	61.86	12,027	23,337,770	51.53
25 - 39.9	14,465	24,560,427	58.90	33,047	24,560,385	134.55	19,169	24,560,352	78.05	11,803	24,560,355	48.06	9,096	24,560,334	37.04
40 - 100	9,916	25,641,528	38.67	21,856	25,641,498	85.24	14,185	25,641,471	55.32	8,856	25,641,471	34.54	5,670	25,641,470	22.11
Education > Low Education															
0 - 14.9	35,657	65,761,766	54.22	79,967	65,761,626	121.60	46,586	65,761,537	70.84	29,226	65,761,505	44.44	22,196	65,761,482	33.75
15 - 24.9	12,832	14,312,057	89.66	28,909	14,311,935	201.99	16,665	14,311,877	116.44	10,566	14,311,863	73.83	8,710	14,311,862	60.86
25 - 39.9	3,158	3,835,456	82.34	9,931	3,835,425	258.93	5,056	3,835,408	131.82	3,317	3,835,400	86.48	3,085	3,835,394	80.44
40 - 100	588	716,509	82.06	2,296	716,501	320.45	857	716,502	119.61	562	716,499	78.44	768	716,500	107.19
Occupation > Unemployment															
0 - < 5.8	30,044	58,821,411	51.08	69,523	58,821,305	118.19	39,315	58,821,192	66.84	24,830	58,821,165	42.21	19,465	58,821,151	33.09
≥ 5.8	22,179	25,794,046	85.98	51,563	25,793,851	199.90	29,836	25,793,801	115.67	18,822	25,793,771	72.97	15,285	25,793,756	59.26

APPENDIX

Statistical Summary

Overall Distributions and Observed Rates: The overall distributions of the five included PQIs (PQIs 01, 03, 07, 14, and 16) for the combined payer data were non-normal and negatively skewed. Distributions were found to be non-normal with Kolmogorov-Smirnov Tests for Normality ($p < 0.01$). Each PQI exhibited a left-skewed distribution, where between 46.38% and 65.72% of ZIP code area-level PQI observed rates equaled zero. The skewness resulted from a large proportion of the observed rates for these five PQIs either totaling zero or having low observed admission rates. However, these zero values reveal the health of the ZIP code areas in which the population resides. Diabetes complications and hypertension admissions rates are relatively low among members representing 37,731 ZIP code areas within the U.S. The admissions contributing to these observed rates are considered less common events.

Odds Ratios: In addition to the observed admission rates presented in the main body of the report, the odds ratios (ORs) and associated 95% confidence intervals (95% CI) were calculated for each population dimension and measure. This statistical test demonstrates the odds of an admission event given specific, independent predictors, which in this case were the member attributes of age, sex, payer type, and SES Index as individual dimensions and broken down into its seven component measures (Szumilas, 2010). The resulting *p*-value for each combination of dimension and PQI was significant at the 0.05 level, suggesting there is a meaningful difference in the observed admission rates across the various cohorts defined in this study [Table 2]. All analyses were conducted in SAS software version 9.4 (SAS, 2013).

Age: A direct relationship was observed between increased age and odds of admission for each of the PQIs in this study except PQI 01. Unique to PQI 01, the younger cohorts (ages 18 to 39 years and ages 40 to 64 years) have 1.56 to 1.72 greater odds, respectively, of admissions related to short-term diabetes complications as compared to the older age cohorts. These results are consistent with a recently published longitudinal study, which shows that young adults bear the most significant burden when it comes to acute complications of diabetes (Benoit *et al.*, 2020).

Sex: Males had greater odds of an admission related to either short-term or long-term diabetes complications (PQI 01 and PQI 03, respectively), uncontrolled diabetes (PQI 14), and lower-extremity amputation among patients with diabetes (PQI 16) as compared to their female counterparts. The largest difference exists in lower-extremity amputation among patients with diabetes (PQI 16), for which males had 2.63 greater odds of an admission as compared to females. However, for hypertension (PQI 07), males demonstrated 0.68 lesser odds of an admission as compared to females.

Payer Type: Medicare beneficiaries exhibited greater odds of an admission related to any of the PQIs evaluated as compared to the commercially insured member population. The odds of an admission related to either short-term or long-term diabetes complications (PQI 01 and PQI 03, respectively), hypertension (PQI 07), uncontrolled diabetes (PQI 14), and lower-extremity amputation among patients with diabetes (PQI 16) ranged from 2.15 (PQI 01) to 11.29 (PQI 14).

SES Index: There was a statistically significant, indirect relationship between the SES Index and admission rates across all PQIs. The lowest SES Index cohort had 2.65 to 3.5 greater odds of experiencing an admission compared to the highest SES cohort. The ranges of the 95% CI calculated around the OR for each cohort are discrete, with no overlap among categories for any of the PQIs. This strongly supports the assertion that there are better-expected quality outcomes (i.e., fewer expected admissions) with increased SES status, represented by the higher SES Index cohorts.

Crowding: The ORs for the SES Index construct of housing, measured by crowding, were the smallest in magnitude compared to the other SES Index component measures assessed. There is a meaningful difference in the odds of admission for crowded areas compared to the lowest crowding cohort across all PQIs.

Wealth: A significant inverse relationship was observed between the construct of wealth, measured by property, and admission rates across all the PQIs. The cohort defined as the least wealthy was found to have greater odds of an admission across all PQIs, with this lowest wealth cohort having between 2.03 (PQI 14) and 2.61 (PQI 16) greater odds of an admission as compared to the wealthiest cohort.

Poverty: A direct relationship between poverty level and admission rate was observed. The cohort representing the highest percentage of persons below the federally defined poverty line had at least 2.5 greater odds of experiencing an admission when compared to cohorts representing lower percentages of persons below the federally defined poverty line. The highest OR of 3.49 was seen between the poverty band of 20%-100% and the lower-extremity amputation among patients with diabetes admission rate (PQI 16).

APPENDIX

Income: This construct of the SES Index resulted in the greatest magnitude of ORs, with the lowest income cohorts (0%-19.9%) having 4.02 (PQI 07) to 6.79 (PQI 16) greater odds of an admission attributed to either diabetes or hypertension as compared to the highest income cohort across all PQIs. Even the second-lowest income cohort (20%-39.9%) exhibited 2.32 (PQI 07) to 3.76 (PQI 16) greater odds of an admission as compared to the highest income cohort. The magnitude of these ORs are greater than nearly all other constructs of SES Index.

Higher Education: For each decrease in higher education, the odds of an admission event increased across all cohorts for the PQIs of interest. The 95% CI calculated for each cohort and measure combination was discrete, suggesting a meaningful difference across the cohorts for each PQI. The cohort for the lowest rate of higher education (0%-14.9%) had more than twice the odds of experiencing either a diabetes- or hypertension-related admission as compared to the cohort representing the highest percentage of persons with a bachelor's degree or higher (40%-100%).

Low Education: Rather than seeing a statistically significant difference in admission rates between each sequential cohort as seen with higher education, the cohort representing the lowest percentage of persons without completion of high school had significantly lower odds of an admission than the other categories for low education. Higher and low education act as corollaries in this instance and reflect the same relationship to the SES Index, just in opposite directions.

Unemployment: The data suggest that members and beneficiaries residing in areas with higher unemployment rates demonstrate roughly 70% greater odds of having a diabetes- or hypertension-related admission as compared to individuals living in ZIP code areas with lower unemployment rates.

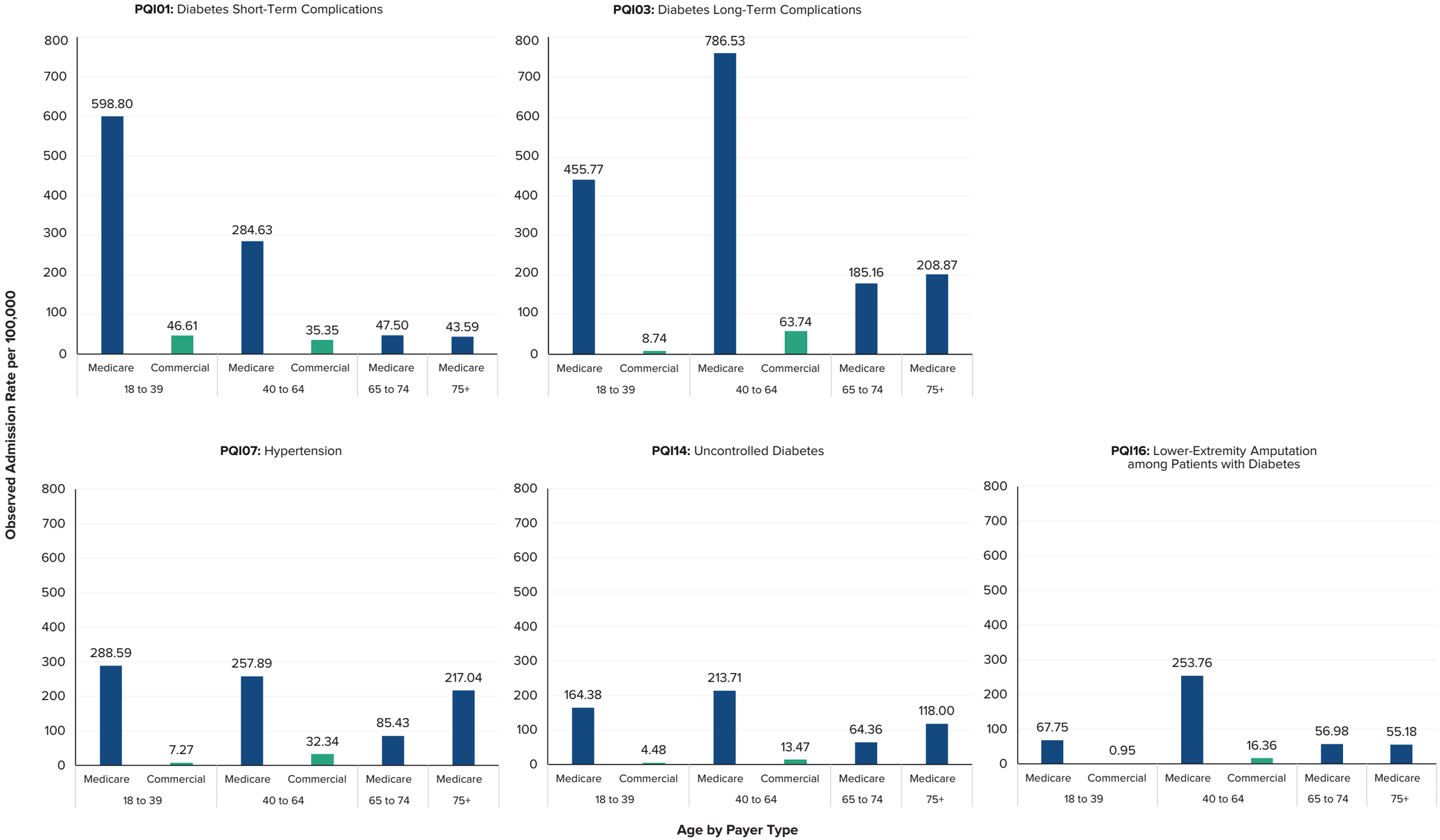


Figure 6. Comparison of payer type by age group

APPENDIX

Table 2. Bivariate associations of PQI observed admission rates vs. payer type, demographics, SES Index, and SES constructs; Referent cohorts indicated by 1* against which all ORs are calculated and reported

Dimension/Measure	PQI 01		PQI 03		PQI 07		PQI 14		PQI 16	
	OR	[CI 95%]	OR	[CI 95%]	OR	[CI 95%]	OR	[CI 95%]	OR	[CI 95%]
Payer Type										
Medicare	2.15	[2.13, 2.17]	7.27	[7.21, 7.34]	7.72	[7.63, 7.81]	11.29	[11.1, 11.48]	8.93	[8.78, 9.09]
Commercial	1*	-	1*	-	1*	-	1*	-	1*	-
Age (Years)										
18 to 39	1.56	[1.54, 1.59]	0.13	[0.12, 0.13]	0.08	[0.08, 0.09]	0.09	[0.09, 0.09]	0.06	[0.06, 0.07]
40 to 64	1.72	[1.7, 1.75]	0.86	[0.85, 0.87]	0.32	[0.31, 0.32]	0.39	[0.38, 0.39]	0.98	[0.97, 1]
65 to 74	1.09	[1.07, 1.11]	0.89	[0.88, 0.89]	0.39	[0.39, 0.4]	0.55	[0.54, 0.55]	1.03	[1.02, 1.05]
75+	1*	-	1*	-	1*	-	1*	-	1*	-
Sex										
Male	1.09	[1.08, 1.1]	1.83	[1.81, 1.84]	0.68	[0.68, 0.69]	1.04	[1.03, 1.05]	2.63	[2.6, 2.66]
Female	1*	-	1*	-	1*	-	1*	-	1*	-
SES Index										
33.9 - 49.2	2.65	[2.62, 2.69]	2.86	[2.83, 2.89]	2.70	[2.66, 2.73]	2.65	[2.61, 2.69]	3.55	[3.48, 3.61]
49.3 - 51.3	2.13	[2.1, 2.16]	2.08	[2.06, 2.1]	1.90	[1.88, 1.92]	1.89	[1.86, 1.92]	2.44	[2.39, 2.48]
51.4 - 53.1	1.81	[1.78, 1.84]	1.73	[1.71, 1.75]	1.56	[1.54, 1.58]	1.56	[1.53, 1.58]	1.94	[1.91, 1.98]
53.2 - 55.8	1.47	[1.45, 1.49]	1.43	[1.42, 1.45]	1.35	[1.33, 1.37]	1.32	[1.3, 1.35]	1.55	[1.53, 1.58]
55.9 - 74.2	1*	-	1*	-	1*	-	1*	-	1*	-
Crowding										
0 - 4.9	1*	-	1*	-	1*	-	1*	-	1*	-
5 - 9.9	1.21	[1.2, 1.23]	1.44	[1.42, 1.45]	1.27	[1.25, 1.29]	1.36	[1.34, 1.38]	1.49	[1.46, 1.52]
10 - 19.9	1.14	[1.12, 1.17]	1.76	[1.74, 1.79]	1.37	[1.35, 1.4]	1.50	[1.47, 1.54]	1.92	[1.87, 1.96]
20 - 100	1.19	[1.12, 1.26]	2.17	[2.11, 2.23]	1.36	[1.3, 1.43]	1.81	[1.72, 1.9]	2.23	[2.12, 2.36]
Property/Wealth										
0 - 4.9	2.47	[2.43, 2.52]	2.19	[2.16, 2.21]	2.19	[2.16, 2.22]	2.03	[1.99, 2.07]	2.61	[2.55, 2.66]
5 - 9.9	1.83	[1.8, 1.86]	1.49	[1.48, 1.51]	1.46	[1.44, 1.48]	1.33	[1.3, 1.35]	1.71	[1.68, 1.74]
10 - 19.9	1.31	[1.28, 1.33]	1.13	[1.12, 1.14]	1.10	[1.08, 1.12]	1.05	[1.03, 1.07]	1.20	[1.17, 1.22]
20 - 100	1*	-	1*	-	1*	-	1*	-	1*	-
Poverty										
0 - 4.9	1*	-	1*	-	1*	-	1*	-	1*	-
5 - 9.9	1.36	[1.34, 1.39]	1.31	[1.3, 1.33]	1.25	[1.23, 1.27]	1.22	[1.2, 1.25]	1.39	[1.36, 1.43]
10 - 19.9	1.96	[1.92, 1.99]	1.86	[1.84, 1.88]	1.74	[1.72, 1.77]	1.70	[1.67, 1.73]	2.14	[2.09, 2.19]
20 - 100	2.81	[2.76, 2.87]	2.75	[2.72, 2.78]	2.81	[2.77, 2.85]	2.60	[2.55, 2.65]	3.49	[3.41, 3.58]
Income										
0 - 19.9	5.02	[4.24, 5.94]	4.95	[4.43, 5.52]	4.02	[3.53, 4.57]	4.34	[3.66, 5.14]	6.79	[5.39, 8.56]
20 - 39.9	3.10	[2.62, 3.66]	3.03	[2.71, 3.37]	2.32	[2.04, 2.64]	2.58	[2.18, 3.06]	3.76	[2.98, 4.74]
40 - 59.9	1.80	[1.52, 2.13]	1.94	[1.74, 2.17]	1.57	[1.38, 1.78]	1.82	[1.54, 2.16]	2.13	[1.69, 2.69]
60 - 79.9	1.24	[1.04, 1.49]	1.21	[1.08, 1.37]	1.22	[1.06, 1.4]	1.39	[1.16, 1.66]	1.27	[0.99, 1.63]
80 - 100	1*	-	1*	-	1*	-	1*	-	1*	-
Higher Education										
0 - 14.9	2.31	[2.28, 2.35]	2.69	[2.66, 2.72]	2.20	[2.17, 2.23]	2.24	[2.2, 2.28]	3.25	[3.19, 3.31]
15 - 24.9	1.99	[1.96, 2.02]	2.05	[2.03, 2.07]	1.73	[1.71, 1.75]	1.79	[1.77, 1.82]	2.33	[2.29, 2.37]
25 - 39.9	1.52	[1.5, 1.54]	1.58	[1.56, 1.59]	1.41	[1.39, 1.43]	1.39	[1.37, 1.41]	1.67	[1.65, 1.71]
40 - 100	1*	-	1*	-	1*	-	1*	-	1*	-
Low Education										
0 - 14.9	1*	-	1*	-	1*	-	1*	-	1*	-
15 - 24.9	1.52	[1.49, 1.55]	1.62	[1.59, 1.65]	1.66	[1.62, 1.7]	1.75	[1.69, 1.82]	1.71	[1.64, 1.77]
25 - 39.9	1.37	[1.32, 1.42]	1.73	[1.67, 1.78]	1.73	[1.66, 1.8]	1.88	[1.77, 2]	1.83	[1.72, 1.95]
40 - 100	1.29	[1.19, 1.39]	1.93	[1.81, 2.06]	1.28	[1.15, 1.42]	1.34	[1.14, 1.57]	2.37	[2.1, 2.67]
Unemployment										
0 - < 5.8	1*	-	1*	-	1*	-	1*	-	1*	-
≥ 5.8	1.68	[1.67, 1.7]	1.69	[1.68, 1.7]	1.73	[1.72, 1.74]	1.73	[1.71, 1.75]	1.79	[1.77, 1.81]

References

Agency for Healthcare Research and Quality (AHRQ). (2008, January). *Chapter 3: Creation of New Race-Ethnicity Codes and SES Indicators for Medicare Beneficiaries*. Rockville, MD: AHRQ. http://archive.ahrq.gov/research/findings/final-reports/medicareindicators/medicareindicators3.html

Agency for Healthcare Research and Quality (AHRQ). (2020, July). *SAS QI: Prevention Quality Indicators* (Version v2020). AHRQ. https://www.qualityindicators.ahrq.gov/software/sas.aspx

Agency for Healthcare Research and Quality (AHRQ). (2021, July). *Prevention Quality Indicators (PQI) Benchmark Data Tables,* v2021. Rockville, MD: AHRQ. https://www.qualityindicators.ahrq.gov/modules/pqi_resources.aspx#techspecs

Ahmad, F. B. & Anderson, R. N. (2021). The leading causes of death in the US for 2020. JAMA, 325(18), 1829–1830. https://doi.org/10.1001/jama.2021.5469

Benoit, S. R., Hora, I., Pasquel, F. J., Gregg, E. W., Albright, A. L., & Imperatore, G. (2020). Trends in emergency department visits and inpatient admissions for hyperglycemic crises in adults with diabetes in the U.S., 2006–2015. *Diabetes Care*, 43(5), 1057-1064. https://doi.org/10.2337/dc19-2449

Berkowitz, S. A., Traore, C. Y., Singer, D. E., & Atlas, S. J. (2015). Evaluating area-based socioeconomic status indicators for monitoring disparities within health care systems: Results form a primary care network. *Health Services Research*, 50(2), 398-417. https://doi.org/10.1111/1475-6773.12229

Centers for Disease Control and Prevention (CDC). (2020). *National Diabetes Statistics Report, 2020*. Atlanta, GA: CDC. https://www.cdc.gov/diabetes/pdfs/data/statistics/national-diabetes-statistics-report.pdf

Krieger, N., Williams, D. R., & Moss, N. E. (1997). Measuring social class in US public health research: concepts, methodologies, and guidelines. *Annu Rev Public Health*, 18, 341-378. https://doi.org/10.1146/annurev.publhealth.18.1.341

Krieger, N., Chen, J., Waterman, P., Soobader, M., Subramanian, S., & Carson. R. (2003). Choosing area based socioeconomic measures to monitor social inequalities in low birth weight and childhood lead poisoning: The Public Health Disparities Geocoding Project (US). *J Epidemiol Community Health*, 57(3), 186-199. https://dx.doi.org/10.1136%2Fjech.57.3.186

Krieger, N., Waterman, P. D., Chen, J. T., Soobader, M-J., & Subramanian, S. V. (2003). Monitoring socioeconomic inequalities in sexually transmitted infections, tuberculosis, and violence: geocoding and choice of area-based socioeconomic measures--the public health disparities geocoding project (US). *Public Health Rep.*, 118(3), 240-260. https://dx.doi.org/10.1093%2Fphr%2F118.3.240

SAS Institute Inc. (2013). SAS/ACCESS® 9.4 Interface to ADABAS: Reference. Cary, NC: SAS Institute Inc.

Szumilas, M. (2010). Explaining odds ratios. *J Can Acad Child Adolesc Psychiatry*, 19(3), 227-229. Retrieved June 11, 2021, from https://www.ncbi.nlm.nih.gov/pmc/articles/pmid/20842279/

U.S. Bureau of Labor Statistics. (2021, June). *The Employment Situation - May 2021*. Washington, D.C.: United States Department of Labor. https://www.bls.gov/news.release/archives/empsit_06042021.pdf

U.S. Census Bureau, American Community Survey. (2021, January). *2015-2019 American Community Survey 5-year Public Use Microdata Samples (PUMS)*. Suitland, MD: U.S. Census Bureau. https://www.census.gov/programs-surveys/acs/microdata/documentation.html

U.S. Department of Health and Human Services. (2014, September 11). *Who is eligible for Medicare?* https://www.hhs.gov/answers/medicare-and-medicaid/who-is-elibible-for-medicare/index.html

U.S. Department of Health and Human Services, Office of Disease Prevention and Health Promotion (ODPHP). (2021, October 14). *Healthy People 2020: Diabetes*. https://www.healthypeople.gov/2020/topics-objectives/topic/diabetes

U.S. Department of Health and Human Services, Office of Disease Prevention and Health Promotion (ODPHP). *Healthy People 2030: Social Determinants of Health*. Retrieved July 9, 2021, from https://health.gov/healthypeople/objectives-and-data/social-determinants-health

Walker, R. J., Williams, J. S., & Egede, L. E. (2016). Impact of race/ethnicity and social determinants of health on diabetes outcomes. *Am J Med Sci.*, 351(4), 366–373. https://dx.doi.org/10.1016%2Fj.amjms.2016.01.008