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Preventable Hospitalization Rates and Neighborhood Poverty among New York City Residents, 2008–2013

Angelica Bocour ⓘD and Maryellen Tria

ABSTRACT *Knowing which demographic groups have higher rates of preventable hospitalizations can help identify geographic areas where improvements in primary care access and quality can be made. This study assessed whether preventable hospitalization rates by neighborhood poverty decreased from 2008 to 2013 and whether the gap between very high and low poverty neighborhoods changed. We examined trends in age-adjusted preventable hospitalization rates and rate ratios by neighborhood poverty overall and by sex using JoinPoint regression. Prevention Quality Indicators (PQIs) developed by the Agency for Healthcare Research and Quality were applied to inpatient hospitalization data from the New York State Department of Health's Statewide Planning and Research Cooperative System. PQIs were classified into composites. From 2008 to 2013, preventable hospitalization rates per 100,000 adults across each poverty group decreased. For very high poverty neighborhoods (ZIP codes with ≥30 % of persons living below the federal poverty level (FPL)), there were significant decreases overall (3430.56 to 2543.10, annual percent change [APC] = −5.91 %), for diabetes (676.15 to 500.83, APC = −5.75 %), respiratory (830.78 to 660.29, APC = −4.85 %), circulatory (995.69 to 701.81, APC = −7.24 %), and acute composites (928.18 to 680.17, APC = −5.62 %). The rate ratios also decreased over time; however, in 2013, the rates for very high poverty neighborhoods were two to four times higher than low poverty neighborhoods (ZIP codes with <10 % of persons below the FPL). While preventable hospitalization rates have decreased over time, disparities still exist. These findings underscore the need to ensure adequate access to quality and timely primary care among individuals living in high poverty neighborhoods.*

KEYWORDS *Preventable hospitalizations, Ambulatory care sensitive hospitalizations, Neighborhood poverty*

INTRODUCTION

Preventable hospitalizations are admissions that could have potentially been prevented with quality outpatient care. Delaying or not receiving care for conditions such as asthma, diabetes, and hypertension can result in hospitalizations that may have been avoided.[1] Hospitalizations tend to be more resource intensive than outpatient care; therefore, preventable hospitalizations (also called ambulatory care-sensitive hospitalizations) are often used as an indicator of health system efficiency.[2] Knowing which demographic groups have higher rates of preventable hospitalizations can highlight disparities in access to quality

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and timely primary care and help identify populations for whom improvements in the health care system may be most beneficial.[3, 4] Previous research has documented that preventable hospitalizations are associated with an individual's lack of health insurance,[5] regular medical provider or source of care,[6, 7] and continuity of care,[8] and with underlying disease prevalence.[4] A relationship between provider supply and preventable hospitalizations has also been found although the relationship with supply is not consistent.[4, 9–13] For example, not every study finds that low provider supply is a significant predictor of preventable hospitalizations. Additionally, Black race and Hispanic ethnicity[8, 14–16] have been associated with higher rates of preventable hospitalizations.

Neighborhood characteristics may also be relevant, as preventable hospitalizations are associated with residence in low-income neighborhoods.[1] A growing literature documents the intersection between place and health, building on evidence that poor health outcomes tend to be concentrated in certain neighborhoods, due both to socioeconomic inequities and a lack of available health care resources.[17–19] Neighborhood economic and social characteristics (e.g., average household income, racial/ethnic composition) have been shown to be associated with the prevalence and quality of management of chronic conditions such as hypertension and diabetes,[20–22] and with factors that can undermine individual health, such as a lack of access to healthy foods[23, 24] and increased exposure to poor environmental conditions.[25, 26]

Previously we found that in 2007, that adults living in high poverty neighborhoods had higher preventable hospitalization rates,[27] adding to the literature on neighborhood poverty and poor health outcomes.[28–32] Given that access to high quality primary care has been receiving renewed attention as part of efforts to transform the health care delivery system (e.g., patient centered medical home[33] and advanced primary care[34, 35]), and the presence of place-based initiatives in NYC to improve the overall resiliency of neighborhoods and support the health of individuals have been initiated or will be implemented,[23] we examined preventable hospitalization rates in New York City by neighborhood poverty to determine if a gap between high and low poverty neighborhoods still exists. In addition, with the health insurance expansion components of the 2010 Patient Protection and Affordable Care Act and requirement of coverage for certain clinical preventive services at no cost, we would expect that preventable hospitalizations would decrease after 2014. This analysis can also serve as a baseline for future trend analyses measuring the impact of health reform.

METHODS

Data Sources and Definitions

Inpatient hospitalization data were obtained from the New York State Department of Health's Statewide Planning and Research Cooperative System (SPARCS) (2008–2013). SPARCS is a comprehensive patient level all payer data reporting system including every hospital discharge in New York State. The analysis was limited to hospitalizations of NYC residents (as determined by patient zip code of residence) in any hospital in NYS (inside or outside of NYC).

The Agency for Healthcare Research and Quality (AHRQ) Prevention Quality Indicators (PQI) version 4.5a definitions were applied to inpatient hospitalizations and categorized into the following composites: overall (any PQI); diabetes (PQI 1—diabetes short-term complications, PQI 3—diabetes long-term complications, PQI 14—uncontrolled diabetes, and PQI 16—lower-extremity amputation); respiratory (PQI 5—chronic

obstructive pulmonary disease or asthma in older adults, PQI 15—asthma in younger adults); circulatory (PQI 7—hypertension, PQI 8—heart failure, PQI 13—angina without procedure); and acute (PQI 10—dehydration, PQI 11—bacterial pneumonia, PQI 12—urinary tract infection).[36]

We used the DOHMH's Bureau of Epidemiology Services NYC interpolated intercensal population estimates from the US Census Bureau and ZIP code-level poverty groups with poverty status based on the American Community Survey (ACS) poverty definitions. The 2009–2013 5-year ACS file was used for all hospitalization years. This file was used to assign a neighborhood poverty level to a ZIP code and that ZIP code retained that poverty level for all 6 years. Neighborhood poverty was defined as the percent of the population in a given ZIP code with a household income below the federal poverty threshold. Population estimates and inpatient hospitalizations based on the patient's ZIP code of residence were grouped into the standard four neighborhood poverty categories used by the DOHMH: low poverty (<10 % of the population below the federal poverty level); medium (10 to <20 %); high (20 to <30 %); and very high poverty (≥30 %).

Statistical Analysis

Preventable hospitalization rates were calculated for each neighborhood poverty level and age-adjusted to the US 2000 Standard Population using the following age groups: 18–24 years, 25–44 years, 45–64 years, and 65 years and over. Rates were also stratified by sex. We calculated the preventable hospitalization rate ratio and standard errors of very high poverty neighborhoods to low poverty neighborhoods from 2008 to 2013 using SAS version 9.2. The rate ratios for 2008 and 2013 were compared using a two-sample z-test.

Temporal trends examining age-adjusted rates and rate ratios were generated by fitting log-linear regression models using Joinpoint software version 4.2.0.1 (National Cancer Institute). Statistical significance was defined as $P < 0.05$.

RESULTS

Very high poverty neighborhoods had the highest rates of preventable hospitalizations every year for each composite but not each individual PQI (data not shown). From 2008 to 2013, there was a decrease in preventable hospitalization rates overall and for each composite (Fig. 1). The declines were statistically significant ($P < 0.05$) for each poverty group, for overall preventable hospitalizations and for each composite (diabetes, respiratory, circulatory, and acute) except for respiratory hospitalizations in the low poverty group. The annual percent change was greater for high poverty and very high poverty groups than medium and low poverty groups for overall preventable hospitalizations (high poverty: –6.15 %, $P < .001$; very high poverty: –5.91 %, $P < .001$), diabetes (high poverty: –4.80 %, $P = 0.004$; very high poverty: –5.75 %, $P < .001$), respiratory (high poverty: –5.16 %, $P < .001$; very high poverty: –4.85 %, $P = 0.002$), circulatory (high poverty: –7.13 %, $P < .001$; very high poverty: –7.24 %, $P = 0.001$), and acute conditions (high poverty: –6.74 %, $P = 0.001$; very high poverty: –5.62 %, $P < .001$) (Fig. 1).

When preventable hospitalization rates were stratified by sex, the rates for the overall composite were similar for males and females. For the diabetes composite, the rates were higher for males than females in very high and high poverty neighborhoods but for the respiratory composites they were higher for females than males in very high and high poverty neighborhoods (Fig. 2). There were statistically significant declines for males and females across all poverty groups for the overall, circulatory and acute composites. However, for the diabetes composite, the decline was not significant for the low poverty
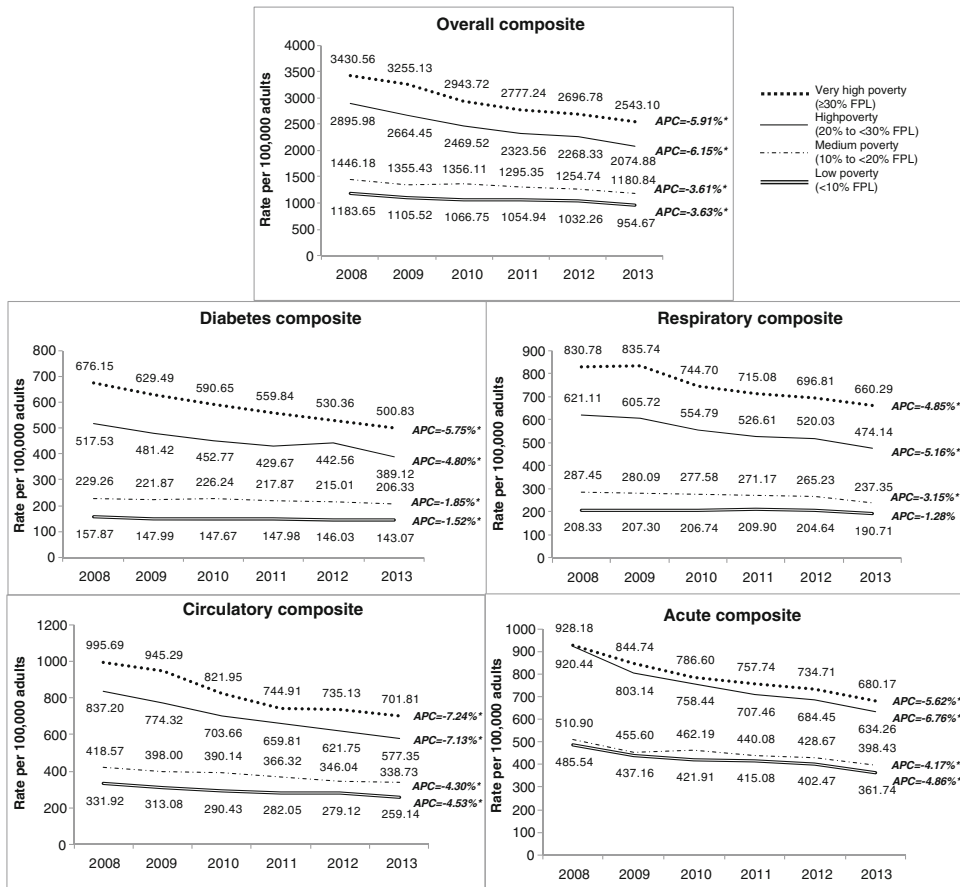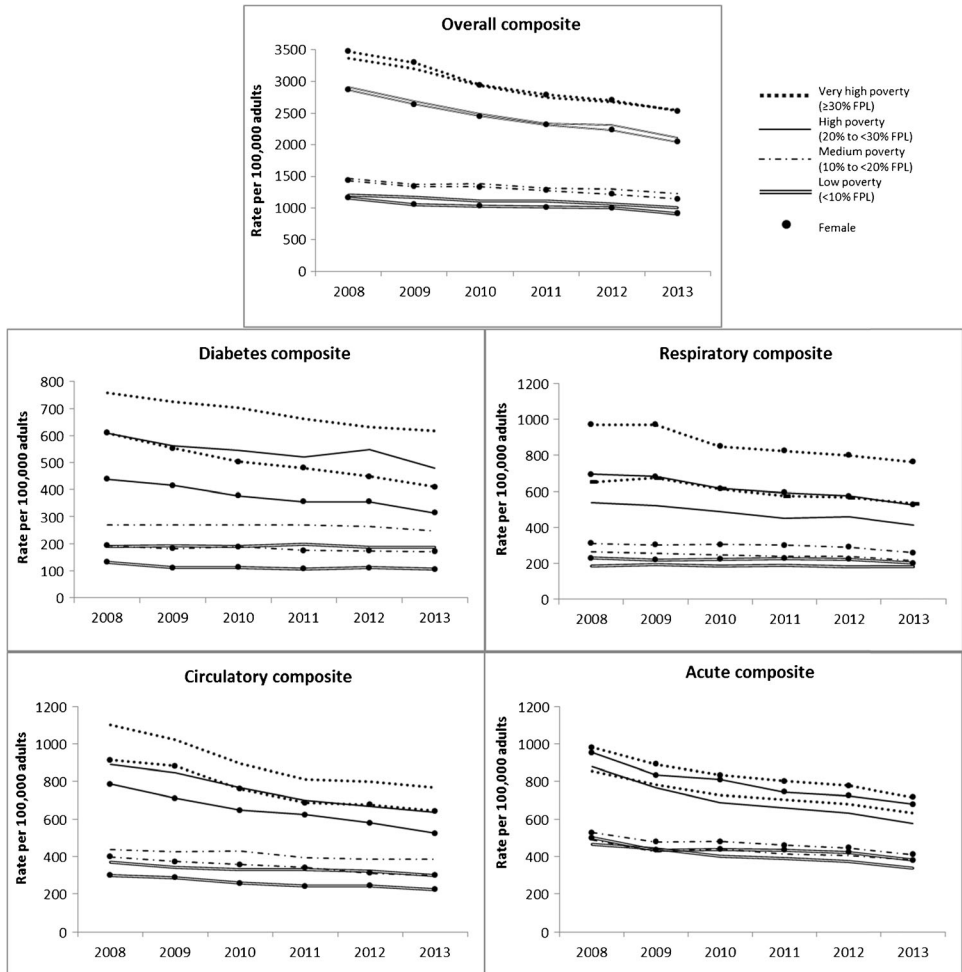
FIG. 1 Preventable hospitalization rates for New York City residents overall and by diabetes, respiratory, circulatory, and acute conditions, by neighborhood poverty 2008–2013. Source: NYS Dept of Health SPARCS 2008–2013 (updated July 2014 for 2008–2010, December 2014 for 2011–2012, June 2015 for 2013). Preventable Hospitalizations based on AHRQ PQI version 4.5a, updated 2014. Population data for rates from NYCDOHMH interpolated intercensal Population Estimates, modified from US Census Bureau, using poverty groups from the American Community Survey 2009–2013. Neighborhood poverty (based on ZIP codes) defined as percent of residents with incomes below 100 % of the Federal Poverty Level, per American Community Survey, 2008–2013. ZIP codes with zero people for whom poverty status could be determined are excluded from the analysis. Rates per 100,000 are age-adjusted to the US 2000 Standard Population.*P < .05. *APC* annual percent change.

group for males and females and for males in the medium poverty group. For the respiratory composite, there was no statistically significant decline in high poverty group.

There was a statistically significant decline in the rate ratio of very high to low poverty groups for overall preventable hospitalizations (annual percent change [APC] = –2.35 %, P = 0.023), diabetes (APC = –4.15 %, P <.001), respiratory (APC = –3.40 %, P = 0.022), and circulatory (APC = –2.76 %, P =0.033) composites. A similar finding was found by sex for males (significant decline for rate ratios for all composites except for the acute composite). For females, the decline was not statistically significant for the rate ratio for the overall, respiratory, and acute composites (Fig. 3). The difference between the two rate

ratios in 2008 and 2013 was only statistically significant for diabetes in the overall population (4.28 vs. 3.50, $P = 0.043$) and among males (4.02 vs. 3.30, $P = 0.025$); there were no differences between the rate ratios in 2008 and 2013 for females (Fig. 3). Preventable hospitalization rates in 2013 for very high poverty neighborhoods ranged from two to four times higher than low poverty neighborhoods.

FIG. 2 Preventable hospitalization rates for New York City residents by neighborhood poverty and sex, 2008–2013. Source: NYS Dept of Health SPARCS 2008–2013 (updated July 2014 for 2008–2010, December 2014 for 2011–2012, June 2015 for 2013). Preventable Hospitalizations based on AHRQ PQI version 4.5a, updated 2014. Population data for rates from NYCDOHMH interpolated intercensal Population Estimates, modified from US Census Bureau, using poverty groups from the American Community Survey 2009–2013. Neighborhood poverty (based on ZIP codes) defined as percent of residents with incomes below 100 % of the Federal Poverty Level, per American Community Survey, 2008–2013. ZIP codes with zero people for whom poverty status could be determined are excluded from the analysis. Rates per 100,000 are age-adjusted to the US 2000 Standard Population. Trends in preventable hospitalization rates not statistically significant for diabetes for females in low poverty neighborhoods, and males in low and medium poverty neighborhoods, and respiratory conditions for females and males in low poverty neighborhoods.

The rate ratios for the individual PQIs for diabetes and respiratory conditions—the composites with the larger disparities between very high and low poverty neighborhoods—showed even greater differences than when rolled up in their respective composites. Lower-extremity amputations were rare (<450 hospitalizations per year for each neighborhood poverty group) and only made up approximately 5 % of preventable diabetes hospitalizations. However, the hospitalization rate for lower-extremity amputation increased over time in very high poverty neighborhoods while it decreased in low poverty neighborhoods, resulting in a rate ratio of 5.22 in 2013 compared to a rate ratio of 3.42 in 2008. A large difference was also observed for uncontrolled diabetes in 2008, 6.98 times higher in very high poverty neighborhoods, which has since decreased to 3.89 in 2013. For respiratory conditions, the proportion of the PQI asthma in younger adults 18–39 years was on average 15 % in very high poverty neighborhoods compared with 6 % in low poverty neighborhoods. The rate ratio for asthma hospitalizations in 2013 was 5.35 (See appendix for rate ratios for each PQI).
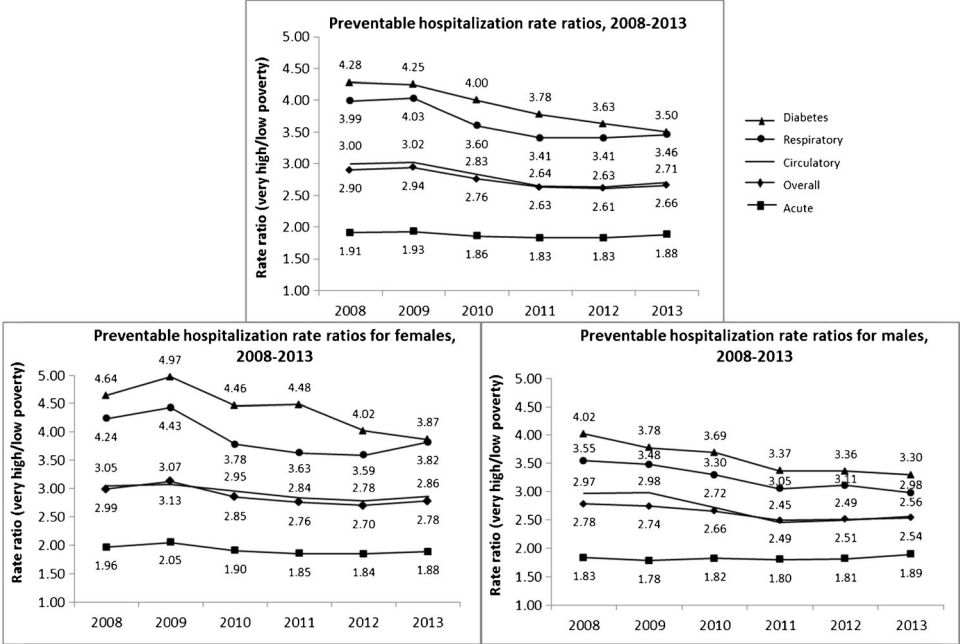
FIG. 3 Preventable hospitalization rate ratios for New York City residents living in very high poverty neighborhoods versus low poverty neighborhoods, overall and by sex, 2008–2013. Source: NYS Dept of Health SPARCS 2008–2013 (updated July 2014 for 2008–2010, December 2014 for 2011–2012, June 2015 for 2013). Preventable Hospitalizations based on AHRQ PQI version 4.5a, updated 2014. Population data for rates from NYCDOHMH interpolated intercensal Population Estimates, modified from US Census Bureau, using poverty groups from the American Community Survey 2009–2013. Neighborhood poverty (based on ZIP codes) defined as percent of residents with incomes below 100 % of the Federal Poverty Level, per American Community Survey, 2008–2013. ZIP codes with zero people for whom poverty status could be determined are excluded from the analysis. Rates per 100,000 are age-adjusted to the US 2000 Standard Population. Trends in rate ratios not statistically significant for acute conditions (overall, for males and for females), and not statistically significant for females for respiratory and overall preventable hospitalizations.

DISCUSSION

We found that preventable hospitalization rates decreased from 2008 to 2013 for all neighborhood poverty groups. However, the overall disparity between very high and low poverty neighborhoods did not significantly decrease between 2008 and 2013. Further, we found that improvements differed by sex. Our finding that very high neighborhood poverty is associated with higher preventable hospitalization rates builds on Billings and colleagues' analysis of New York City hospitalizations 20 years ago (1982 to 1993), although they found the disparity between low-income and high-income neighborhoods increased during that time period.[1] Studies in countries with universal health coverage have also found that preventable hospitalizations are higher for low-income populations and residents living in low-income neighborhoods,[37, 38] suggesting that quality and availability of primary care may be an issue for people living in high poverty neighborhoods regardless of insurance status. In New York City, every very high poverty neighborhood also qualifies as a federally designed Health Professional Shortage Area or Medically Underserved Area in whole or in part, indicating that these areas or populations have a shortage of primary medical care.[39]

There are several limitations with this analysis. We did not analyze patient race/ethnicity because it is not coded reliably for some hospitals in New York State. The New York State Department of Health (NYS DOH) conducted a concordance analysis of race and ethnicity data elements in linked data between SPARCS (hospitalization data) and Medicaid and between SPARCS and Vital Statistics and found that concordance rates varied significantly across hospitals; for 22 of 62 New York City hospitals, fewer than 50 % of matched patients' race was the same in both data sets.[40] As of 2014, NYS DOH is requiring New York State hospitals to collect expanded race and ethnicity data to improve data quality. Although we did not specifically look at race/ethnicity in this analysis, we do know that high poverty areas in New York City also have a high concentration of non-Hispanic Black and Hispanic residents (e.g., approximately three-quarters of very high poverty ZIP codes have populations where 80 % or more of the population was Black or Hispanic[41]). Other analyses have found that Blacks and Hispanics have higher preventable hospitalization rates than other racial/ethnic groups.[8, 14–16] Second, coding of conditions may differ by hospital and may change over time. Third, this was an ecologic study. We did not have data on individual or household income and thus do not know the relative extent to which neighborhood versus individual socioeconomic status drove our findings. Last, we do not know the direction of causality. Living in high poverty neighborhoods may contribute to poorer health that can lead to hospitalization or poor health might lead to residence in high poverty neighborhoods.

This analysis shows that preventable hospitalization rates have been decreasing since 2008 but that the disparity between very high and low poverty neighborhoods still persists. While better access to and utilization of quality health care in high poverty neighborhoods may reduce preventable hospitalization rates and narrow the gap between very high and low poverty neighborhoods, place-based initiatives to improve the physical environment and increase access to healthy food and physical activity are important prevention interventions as well. Additionally, current efforts to transform the Medicaid delivery system and payment reform programs in New York State will likely drive down future preventable hospitalizations for low-income populations. For example, the overall goal of the New York State Delivery System

Reform Incentive Program is a 25 % reduction in avoidable hospital use (avoidable hospitalizations, emergency department visits, readmissions) over 5 years[42]. Furthermore, health care delivery models, such as Patient-Centered Medical Homes and Advanced Primary Care, may improve primary care delivery outcomes, especially for chronic conditions, through better delivery and care coordination. It will be important to monitor over time whether the disparity in rates of preventable hospitalizations by neighborhood poverty decreases as health delivery reform initiatives are more fully implemented and to understand what additional efforts can reduce the preventable hospitalization gap between very high and low poverty neighborhoods.

ACKNOWLEDGMENTS

APPENDIX

TABLE 1 Rate ratios by Prevention Quality Indicator (PQI) for New York City residents living in very high poverty neighborhoods versus low poverty neighborhoods, 2008–2013

	Rate ratio						P value	APC	P value
	2008	2009	2010	2011	2012	2013	(trend)		(2008 vs 2013)
Diabetes									
Short-term complications (PQI 01)	4.68	5.29	4.87	4.57	4.20	3.67	0.179	−3.14	0.057
Long-term complications (PQI 03)	3.70	3.56	3.44	3.38	3.32	3.30	0.004	−2.35	0.147
Uncontrolled diabetes (PQI 14)	6.98	6.52	5.73	4.95	4.71	3.89	0.000	−10.34	<.0001
Lower-extremity amputation PQI 16)	3.42	3.72	4.39	3.78	3.09	5.22	0.372	4.38	0.000
Respiratory									
COPD (PQI 05)	3.77	3.78	3.47	3.23	3.24	3.30	0.017	−3.28	0.305
Asthma (PQI 15)	6.66	7.22	5.25	5.79	5.51	5.35	0.083	−4.84	0.224
Circulatory									
Hypertension (PQI 07)	3.77	3.73	3.30	2.73	2.84	3.03	0.013	−7.1	0.099
Heart failure (PQI 08)	2.75	2.80	2.71	2.58	2.55	2.61	0.041	−1.64	0.431
Angina without procedure (PQI 13)	3.90	3.69	2.73	3.12	2.95	2.89	0.193	−9.73	0.000
Acute									
Dehydration (PQI 10)	1.71	1.71	1.88	1.87	1.93	1.78	0.228	2.16	0.410
Bacterial pneumonia (PQI 11)	1.85	1.93	1.79	1.86	1.78	2.02	0.710	0.54	0.408
Urinary tract infection (PQI 12)	2.24	2.14	1.95	1.76	1.80	1.82	0.010	−4.91	0.199

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