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# Low colorectal cancer screening uptake and persistent disparities in an underserved urban population

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## Abstract

Colorectal cancer (CRC) screening has increased substantially in New York City in recent years. However, screening uptake measured by telephone surveys may not fully capture rates among underserved populations. We measured screening completion within one year of a primary care visit among previously unscreened patients in a large urban safety-net hospital and identified sociodemographic and health-related predictors of screening.

We identified 21,256 patients aged 50-75 who were seen by primary care providers (PCPs) in 2014, of whom 14,425 (67.9%) were not up-to-date with screening. Since PCPs facilitate the majority of screening, we compared patients who received screening within one year of an initial PCP visit to those who remained unscreened using multivariable logistic regression.

Among patients not up-to-date with screening at study outset, 11.5% (1,658 patients) completed screening within one year of a PCP visit. Asian race, more PCP visits, and higher area-level income were associated with higher screening completion. Factors associated with remaining unscreened included morbid obesity, ever smoking, Elixhauser comorbidity index of 0, and having Medicaid/Medicare insurance. Age, sex, language, and travel time to the hospital were not associated with screening status. Overall, 39.9% of patients were up-to-date with screening by 2015.

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In an underserved urban population, CRC screening disparities remain, and overall screening uptake was low. Since more PCP visits were associated with modestly higher screening completion at one year, additional community-level education and outreach may be crucial to increase CRC screening in underserved populations.

## INTRODUCTION

Colorectal cancer (CRC) screening, most commonly by colonoscopy or fecal occult blood testing (FOBT), has been shown to reduce CRC incidence and mortality[1-4]. Current guidelines recommend screening for CRC starting at age 50 for average-risk individuals[5]. An estimated 62% of the US population is up-to-date with CRC screening[6]. In New York City (NYC), screening has increased substantially over the past 15 years, corresponding to dedicated efforts by the Citywide Colorectal Cancer Control Coalition (C5) and the NYC Department of Health and Mental Hygiene (DOHMH)[7]. Screening data in NYC is obtained using the NYC Community Health Survey, an annual telephone survey conducted by the DOHMH. This survey data showed that NYC CRC screening rates increased from 42% in 2003 to 70% in 2010 and has since remained stable[8].

Although these statistics are encouraging, self-reported telephone surveys like the Community Health Survey may not represent all demographics or fully capture disparities[9]. Nationally, there are well-documented screening disparities by age, education level, income, insurance status, and healthcare access[10]. In the 2015 National Health Interview Survey (NHIS), non-Hispanic whites had the highest screening uptake at 65%, followed by African Americans (62%), Hispanics (50%), and Asians (49%)[11]. Other surveys have shown similar racial/ethnic differences, and lower screening rates in immigrants and non-English speakers[12-14].

The Community Health Survey reported that racial/ethnic disparities in screening had been eliminated in 2013[7]. Importantly, although the survey was conducted in a variety of languages, it could not reach individuals without a telephone, interviewed only one adult per household, and excluded adults living in group quarters (e.g. college dormitories, nursing facilities). Additionally, only 40.5% of all eligible participants responded to the survey [8]. Therefore, the NYC Community Health Survey may not capture the true screening rates within NYC's large medically underserved populations.

Therefore, we evaluated the rates of screening completion in primary care patients at Bellevue Hospital Center, the oldest and one of the largest public safety-net hospitals in the United States. Bellevue Hospital provides care to a diverse population with disproportionately low income and high rates of uninsured[15]. Because most patients are informed about cancer screening during primary care visits, our main aim was to measure one-year CRC screening completion rates— the rate at which previously unscreened patients underwent CRC screening after seeing a primary care provider (PCP). Second, we aimed to identify sociodemographic and medical predictors of screening completion within this uniquely diverse patient population.

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# METHODS

## Study Design

We conducted a retrospective chart review of primary care patients who were not up-to-date with CRC screening at Bellevue Hospital Center. Data from PCP visits from 2004-2014, guaiac-based FOBT (gFOBT) results from 2013 to 2015, and colonoscopies and sigmoidoscopies performed from 2004 to 2016 were extracted from the electronic medical record. Patients who were unscreened at the initial PCP visit in 2014 were considered screened at one year if they completed gFOBT, colonoscopy, or sigmoidoscopy within the year[4,16]. We compared participants who were screened at one year to those who remained unscreened at one year. The study was conducted in accordance with the ethical guidelines of the Belmont Report, and was approved by the NYU School of Medicine Institutional Review Board (Study I6-01503).

At Bellevue, existing strategies to increase CRC screening included outreach mailings for patients, annual report cards to providers about screening rates, a part-time patient navigator who assisted with colonoscopy scheduling and bowel preparation education, and expedited pre-procedure appointments with a gastroenterology nurse practitioner. One notable barrier to screening was the lack of an electronic medical record reminder for providers to order CRC screening, which was implemented after the study period.

## Participants

We identified all patients age 50-75 years who had at least one PCP office visit in 2014. Individuals with missing ZIP code data were excluded. Next, we excluded patients who were up-to-date with CRC screening at the time of their initial visit, defined as having completed a colonoscopy in the past ten years, a sigmoidoscopy in the past five years, or gFOBT in the past one year, based on procedure codes in the medical record. The remaining patients—those not up-to-date with CRC screening—were included in the primary analysis.

## Variables

Individual-level variables of interest included age, sex, race, ethnicity, country of origin, preferred language, ZIP code, BMI, smoking status, and insurance type. The modified Elixhauser comorbidity index—a weighted summary score of 31 medical conditions—was calculated using ICD 9/10 codes[17]. The Elixhauser comorbidity index has been shown to outperform the Charlson comorbidity index in predicting mortality[18-20]. We used the number of years that patients visited their PCPs between 2004 and 2014 as a measure of healthcare utilization, although the number of visits per year was unavailable.

Area-level data was obtained at the level of Primary Care Service Areas (PCSAs) using the Dartmouth Atlas of Health Care[21]. Area-level variables included population density, PCPs per capita, specialists per capita, median household income, education level, and percentage of white/black/Hispanic/Asian residents within the PCSA. In addition, we calculated average travel time on public transit from each residential ZIP code to the hospital using Google Maps (Mountain View, CA, USA) based on a noon arrival time.

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### Outcomes

The primary outcomes were screening completion rates at one year after the initial PCP visit and sociodemographic and medical factors that predict screening completion. We measured screening completion rate over the study period rather than overall cross-sectional proportion screened, in order to identify specific modifiable factors or groups that can be potential targets for interventions.

### Analysis

We compared individuals who were screened vs. unscreened at one year on bivariate analysis using chi-squared and t-tests. Variables with $P < 0.10$ on bivariate analysis were then included in a multivariable logistic regression model. A two-tailed $P < 0.05$ was considered statistically significant in this model. To assess whether screening completion increased with longer follow up, we conducted a sensitivity analysis examining gFOBT completion through 2015 (one additional year) and colonoscopy/sigmoidoscopy completion through 2016 (two additional years). All statistical analyses were performed using R version 3.5.0 (Foundation for Statistical Computing, Vienna, Austria)

## RESULTS

We identified 21,256 patients from 190 countries with at least one PCP visit in 2014 and available ZIP code data. Of these, 6,831 (32.1%) were up-to-date with CRC screening at the time of their initial visit and excluded from the analysis. Supplementary Table 1 compares characteristics of these patients who were up-to-date with screening with those not up-to-date. Age was inversely correlated with being up-to-date with screening, and there was a 15% difference in screening uptake between those in the 50-54 (24.7%) and 70-75 (40.2%) age groups. Hispanics (34.1%) and blacks (33.4%) had a higher baseline screening rate than Asians (26.4%). Groups with low screening uptake at baseline included individuals who spoke Chinese, had low to normal BMI, had only one PCP visit in 2014, and had an Elixhauser score of 0.

After excluding participants who were up-to-date with screening, a total of 14,425 patients (67.9%) were included for the primary analysis. In this group, 1,658 (11.5%) patients completed screening within one year of their initial PCP visit. Table 1 compares characteristics of patients who received screening with those who remained unscreened at one year The largest absolute difference observed was between categories of healthcare utilization—9.1% screened among patients with PCP visits in two separate years vs. 15.9% screened among patients with visits in three or more years with at least two visits before 2012 (6.8% absolute difference, $P<0.01$). A statistically significant difference was also found in screening uptake between whites and Asians (8.5% vs. 13.9%, $P<0.01$). Smaller but statistically significant differences were found between subgroups of ethnicity, language, country of origin, BMI, insurance type, smoking status, comorbidity score, and area-level median household income.

Table 2 shows results of the multivariable logistic regression model. Independent predictors of screening completion included Asian race (OR 1.58, 95% CI 1.23-2.05), Mexican country

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of origin (OR 1.43, 95% CI 1.09-1.86), three or more PCP visits since 2004 (OR 1.61, 95% CI 1.21-2.13), and higher area-level income (> 100,000 USD: OR 1.44, 95% CI 1.03-2.00). Predictors of remaining unscreened included morbid obesity (OR 0.74, 95% CI 0.59-0.93), ever smoking (OR 0.75, 95% CI 0.63-0.90), having Medicaid (OR 0.69, 95% CI 0.54-0.88) or Medicare (OR 0.79, 95% CI 0.62-0.99) compared to private insurance, and having an Elixhauser comorbidity score of 0 (OR 0.75, 95% CI 0.65-0.86). Age, sex, language, travel time to the hospital, and area-level education were not significantly associated with screening status.

A sensitivity analysis extending the time frame for screening completion for gFOBT through 2015 and for colonoscopy and sigmoidoscopy through 2016 resulted in a slightly higher screening uptake of 14.7%.

## DISCUSSION

Among individuals overdue for CRC screening, screening completion within one year of an initial PCP visit was low overall at 11.5%. Extending the screening time frame by an additional 1-2 years only increased the absolute screening uptake by 3.2%. On multivariable logistic regression, Asian race, Mexican country of origin, more PCP visits, and higher median household income were all statistically significant predictors of screening completion. Conversely, morbid obesity, positive smoking history, insurance with Medicare or Medicaid, and an Elixhauser comorbidity index of 0 were associated with incomplete screening. However, the absolute differences in screening completion between all categories were modest.

Adding together the individuals who were up-to-date with screening at the outset of the study with those who were screened within one year, up to 39.9% of primary care patients would have been up-to-date with screening at the end of 2015. The true figure would be lower, since a proportion of previously up-to-date individuals would have become overdue for screening during this year. Since even a screening rate of 39.9% is substantially lower than the 70% uptake reported in the NYC Community Health Survey, these results support our hypothesis that telephone surveys may overestimate screening in an underserved population. Compared to the population surveyed by the Community Health Survey, our study population included a higher proportion of Hispanics (27.6% vs 23.4%) and Asians (15.0% vs 10.0%) and fewer individuals who preferred English primarily (44.6% vs 65.9%) [22]. At Bellevue Hospital, uninsured visits made up 31% of all clinic visits, compared to 11% on average at other voluntary non-profit NYC hospitals.[15] These figures highlight the substantial differences between the population sampled by the telephone survey and NYC's medically underserved population. Therefore, despite great improvements in CRC screening in NYC overall, there remains a clear screening gap in our safety-net hospital population.

Reported CRC screening rates in other underserved populations have varied widely. Among unscreened patients at a safety-net hospital in Fort Worth/Tarrant County, Texas, CRC screening completion at 1 year was 12.1%, similar to our figure[23]. At Parkland Hospital System in Dallas, Texas, screening completion rate among unscreened patients was 29.6% at 1 year[24]. A later study at the same center observed a rate of 45.1% after 18 months[25].

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With respect to cross-sectional screening rates, 46.8% of patients were up-to-date with screening in 2015 in a study of federally qualified health centers (FQHCs) in Oregon and California[26], comparable to our overall up-to-date rate of 39.9%. Data from US Health Resources & Services Administration (HRSA) Health Centers, which are designated primary care centers that provide services regardless of patients' ability to pay, showed CRC screening rates of 40-44% nationally in 2016-2018, with rates of 44-50% in New York state[27]. These findings taken together consistently show that screening rates in underserved patient populations are lower than corresponding national- and state-level screening rates reported in the general population.

Asians had the lowest screening uptake at baseline (Supplementary Table 1) but had 5.4% higher absolute screening completion (58% higher in relative terms) than whites at one year. This finding is consistent with prior studies that have shown Asian Americans have the lowest cross-sectional screening rate in the US but have higher screening completion than other racial/ethnic groups when actively engaged by the healthcare system[11],[28-30].

Prior studies have found Hispanics to have higher screening uptake rates compared to Caucasians[24,28,31]. This relationship was not seen in our study, although patients born in Mexico were more likely to complete screening. In addition, language was not associated with screening completion in our population, though 55% of individuals preferred a language other than English. This may reflect the widespread use of interpreter services within our institution that minimized the impact of patient-physician language discordance.

We found that a greater number of PCP visits distributed over a longer period of time was associated with higher screening completion. A higher frequency of office visits has similarly been shown to predict CRC screening completion in other studies[24-26]. This suggests that the length of the patient-provider relationship is important for obtaining appropriate preventive care. Perhaps providers under time constraints are unable to address non-acute issues such as screening until a second or third appointment. Higher PCP visit frequency may also be a proxy for increased health awareness, access, and willingness to undergo medical interventions—all factors that contribute to higher screening uptake.

## Strengths and Limitations

The strengths of our study include its large sample size and diverse, underserved population. A few limitations should also be noted. First, because our institution is the flagship medical center for a network of public hospitals and clinics in NYC, it is possible that patients received primary care at our institution but underwent CRC screening at another facility. Our data does not capture screening at other facilities and therefore may underestimate the true screening uptake. We calculated travel time between residential ZIP codes and our hospital on the assumption that individuals who lived further away may be more likely to undergo screening at another facility, and we found no difference in screening rates by travel time. However, we acknowledge that individuals may have obtained screening at other facilities for reasons other than distance. Second, some patients are seen in Bellevue's primary care clinic as follow up from an emergency visit or hospitalization, which may lead to lower screening rates than would be expected in a more stable outpatient panel. Nevertheless, 75% of our study population had multiple primary care visits between 2004 and 2014, which

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suggests some measure of long-term care. Finally, there was substantial missing data for race, ethnicity, smoking status, and BMI in our electronic health record. However, there is no reason to believe this led to differential exposure misclassification.

### Conclusions

In a diverse, medically underserved population, screening uptake within one year of an initial PCP visit was low overall at 11.5%. This was substantially lower than estimates from a citywide telephone survey of the general population. Asian race and more frequent PCP visits predicted screening completion, but absolute differences between subgroups were small. These findings suggest that even with counseling at PCP visits, it is difficult to successfully screen patients in an underserved population. Therefore, combining PCP visits with additional community-based targeted interventions may be needed to improve overall screening rates.

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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**Table 1.**

Baseline characteristics of patients not up-to-date with colorectal cancer screening, by screening status at 1 year

| Variable | | Unscreened at 1 year, N (%) | Screened at 1 year, N (%) | P |
|---|---|---|---|---|
| | Total | 12,767 (88.5) | 1,658 (11.5) | |
| **Age** | Age mean (SD) | 59.6 (6.7) | 59.2 (6.7) | 0.06 |
| **Sex** | Female | 6977 (88.4) | 920 (11.6) | 0.52 |
| | Male | 5790 (88.7) | 738 (11.3) | |
| **Race** | White | 1299 (91.5) | 121 (8.5) | **<0.01** |
| | Black | 1939 (89.7) | 223 (10.3) | |
| | Asian | 2730 (86.1) | 441 (13.9) | |
| | Unknown | 6799 (88.6) | 873 (11.4) | |
| **Ethnicity** | Non-Hispanic or Latino | 5663 (89.1) | 692 (10.9) | **<0.01** |
| | Hispanic or Latino | 3551 (88.9) | 443 (11.1) | |
| | Unknown | 3553 (87.2) | 523 (12.8) | |
| **Language** | English | 5754 (89.4) | 684 (10.6) | **<0.01** |
| | Spanish | 3720 (88.6) | 479 (11.4) | |
| | Chinese | 2018 (85.9) | 331 (14.1) | |
| | Other | 1275 (88.6) | 164 (11.4) | |
| **Country of origin** | United States | 3790 (90.3) | 407 (9.7) | **<0.01** |
| | Mexico | 551 (85.3) | 95 (14.7) | |
| | China | 1674 (86.4) | 264 (13.6) | |
| | Dominican Republic | 1192 (87.9) | 164 (12.1) | |
| | Ecuador | 509 (87.7) | 71 (12.2) | |
| | Puerto Rico | 658 (89.0) | 81 (11.0) | |
| | Bangladesh | 227 (89.0) | 28 (11.0) | |
| | Other | 4166 (88.4) | 548 (11.6) | |
| **BMI** | 10-24.9 | 2815 (87.1) | 418 (12.9) | **<0.01** |
| | 25-29.9 | 3257 (87.4) | 468 (12.6) | |
| | 30-34.9 | 1872 (88.5) | 243 (11.5) | |
| | 35+ | 1061 (90.3) | 114 (9.7) | |
| | Unknown | 3762 (90.1) | 415 (9.9) | |
| **Smoking Status** | Never Used | 3778 (85.6) | 635 (14.4) | **<0.01** |
| | Ever Used | 1748 (89.5) | 206 (10.5) | |
| | Unknown | 7241 (89.9) | 817 (10.1) | |
| **Healthcare Utilization** | Visit in 2014 only | 3267 (88.9) | 407 (11.1) | **<0.01** |
| | Visits in 2 years | 1751 (90.9) | 175 (9.1) | |
| | Visits in 3+ years, ≥1 visit in 2012-2013 | 7378 (88.0) | 1006 (12.0) | |
| | Visits in 3+ years, none in 2012-2013 | 371 (84.1) | 70 (15.9) | |

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| Variable | | Unscreened at 1 year, N (%) | Screened at 1 year, N (%) | P |
|---|---|---|---|---|
| **Insurance** | Private | 1061 (87.8) | 147 (12.2) | **<0.01** |
| | Medicaid | 1552 (91.2) | 150 (8.8) | |
| | Medicare | 2386 (89.7) | 274 (10.3) | |
| | No insurance | 5445 (87.0) | 811 (13.0) | |
| | Other/Unknown | 2323 (89.4) | 276 (10.6) | |
| **Travel Time** | 1-29 mins | 1797 (89.9) | 203 (10.2) | 0.11 |
| | 30-59 mins | 8111 (88.4) | 1065 (11.6) | |
| | 60+ mins | 2859 (88.0) | 390 (12.0) | |
| **Median Household Income in PCSA** | <45,000 | 2806 (89.1) | 343 (10.9) | **0.04** |
| | 45,000-60,000 | 6682 (87.8) | 928 (12.2) | |
| | 60,000-80,000 | 1377 (88.7) | 176 (11.3) | |
| | 80,000-100,000 | 1251 (90.5) | 132 (9.5) | |
| | >100,000 | 651 (89.2) | 79 (10.8) | |
| **Elixhauser Comorbidity Score** | <0 | 3604 (87.3) | 524 (12.7) | **0.02** |
| | 0 | 4323 (89.4) | 514 (10.6) | |
| | 1-6 | 2338 (88.6) | 301 (11.4) | |
| | 7+ | 2502 (88.7) | 319 (11.3) | |
| **% of Hispanics in PCSA** | Highest Quartile (33.1-80.5) | 2911 (89.0) | 361 (11.0) | 0.06 |
| | Q3 (24.0-33.1) | 4149 (87.5) | 594 (12.5) | |
| | Q2 (13.2-24.0) | 2535 (88.9) | 316 (11.1) | |
| | Lowest Quartile (2.2-13.2) | 3172 (89.1) | 387 (10.9) | |
| **% of Blacks in PCSA** | Highest Quartile (24.7-93.6) | 3334 (88.8) | 419 (11.2) | 0.13 |
| | Q3 (9.0-24.7) | 1496 (90.0) | 166 (10.0) | |
| | Q2 (3.5-9.0) | 4639 (88.1) | 628 (11.9) | |
| | Lowest Quartile (0.12-3.5) | 3298 (88.1) | 445 (11.9) | |
| **% of Whites in PCSA** | Highest Quartile (62.9-98.1) | 3049 (90.1) | 336 (9.9) | **<0.01** |
| | Q3 (41.7-62.9) | 2521 (88.8) | 318 (11.2) | |
| | Q2 (32.2-41.7) | 4188 (87.3) | 609 (12.7) | |
| | Lowest Quartile (1.7-41.7) | 3009 (88.4) | 395 (11.6) | |
| **% of Asians in PCSA** | Highest Quartile (36.1-61.9) | 3315 (87.2) | 486 (12.8) | **0.02** |
| | Q3 (15.2-36.2) | 3297 (88.5) | 430 (11.5) | |
| | Q2 (5.3-15.2) | 2798 (89.1) | 341 (10.9) | |
| | Lowest Quartile (0.34-5.3) | 3357 (89.3) | 401 (10.7) | |
| **Population Density in PCSA** | Highest Quartile (75,910-143,300) | 3784 (88.3) | 503 (11.7) | 0.33 |
| | Q3 (50,120-75,910) | 2385 (87.7) | 333 (12.3) | |
| | Q2 (29,680- 50,120) | 3443 (88.7) | 439 (11.3) | |
| | Lowest Quartile (92.5-29,680) | 3155 (89.2) | 383 (10.8) | |
| **PCPs per Capita in PCSA** | Highest Quartile (0.0013-0.004) | 2981 (89.3) | 358 (10.7) | 0.36 |
| | Q3(0.0012-0.0013) | 1012 (88.1) | 137 (11.9) | |

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| Variable | | Unscreened at 1 year, N (%) | Screened at 1 year, N (%) | P |
|---|---|---|---|---|
| | Q2 (0.0006-0.0012) | 5616 (88.1) | 758 (11.9) | |
| | Lowest Quartile (0.00004-0.0006) | 3158 (88.6) | 405 (11.4) | |
| **Specialists per Capita in PCSA** | Highest Quartile (0.003-0.012) | 3106 (89.0) | 384 (11.0) | 0.38 |
| | Q3 (0.001- 0.003) | 2675 (88.4) | 351 (11.6) | |
| | Q2 (0.0007-0.001) | 3942 (87.9) | 543 (12.1) | |
| | Lowest Quartile (0.00009-0.0007) | 3044 (88.9) | 380 (11.1) | |
| **% High School Graduates in PCSA** | Highest Quartile (85.6-98.6) | 3508 (89.5) | 413 (10.5) | 0.07 |
| | Q3 (77.3-85.6) | 2794 (88.8) | 353 (11.2) | |
| | Q2 (69.0-77.3) | 2627 (88.2) | 352 (11.8) | |
| | Lowest Quartile (52.3-69.0) | 3838 (87.7) | 540 (12.3) | |

Abbreviations: PCSA, Primary Care Service Area

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**Table 2.**

Predictors of CRC screening completion at one year in previously unscreened patients (N=14,425)

| Variable | | OR | 95% CI |
|---|---|---|---|
| **Age** | Mean (SD) | 1.00 | 0.99, 1.01 |
| **Sex** | Female | REF | |
| | Male | 1.03 | 0.92, 1.14 |
| **Race** | White | REF | |
| | Asian | 1.58 | **1.23, 2.05** |
| | Black | 1.24 | 0.97, 1.58 |
| | Unknown | 1.19 | 0.96, 1.50 |
| **Ethnicity** | Non-Hispanic or Latino | REF | |
| | Hispanic or Latino | 1.02 | 0.86, 1.20 |
| | Unknown | 1.25 | **1.09, 1.43** |
| **Language**[a] | English | REF | |
| | Spanish | 0.97 | 0.83, 1.13 |
| | Chinese | 1.10 | 0.87, 1.38 |
| | Other | 0.99 | 0.81, 1.19 |
| **Country of origin**[b] | United States | REF | |
| | Mexico | 1.43 | **1.09, 1.86** |
| | China | 1.05 | 0.83, 1.33 |
| | Dominican Republic | 1.24 | 1.00, 1.53 |
| | Ecuador | 1.20 | 0.89, 1.59 |
| | Puerto Rico | 1.14 | 0.87, 1.48 |
| | Bangladesh | 0.97 | 0.62, 1.45 |
| | Other | 1.08 | 0.94, 1.26 |
| **BMI** | 10-24.9 | REF | |
| | 25-29.9 | 0.98 | 0.84, 1.13 |
| | 30-34.9 | 0.89 | 0.75, 1.06 |
| | 35+ | 0.74 | **0.59, 0.93** |
| | Unknown | 0.75 | **0.65, 0.88** |
| **Smoking Status** | Never Used | REF | |
| | Ever Used | 0.75 | **0.63, 0.90** |
| | Unknown | 0.66 | **0.59, 0.74** |
| **Healthcare Utilization** | Visit in 2014 only | REF | |
| | Visits in 2 years | 0.86 | 0.71, 1.04 |
| | Visits in 3+ years, ≥1 visit in 2012-2013 | 1.10 | 0.96, 1.26 |
| | Visits in 3+ years, none in 2012-2013 | 1.61 | **1.21, 2.13** |
| **Insurance** | Private | REF | |
| | Medicaid | 0.69 | **0.54, 0.88** |
| | Medicare | 0.79 | **0.62, 0.99** |

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| Variable | | OR | 95% CI |
|---|---|---|---|
| | No insurance | 1.03 | 0.85, 1.25 |
| | Other/Unknown | 0.79 | **0.63, 0.98** |
| **Travel Time** | 1-29 mins | REF | |
| | 30-59 mins | 1.04 | 0.85, 1.26 |
| | 60+ mins | 1.08 | 0.86, 1.36 |
| **Median Household Income in PCSA** | <45,000 | REF | |
| | 45,000-60,000 | 1.19 | **1.03, 1.37** |
| | 60,000-80,000 | 1.20 | 0.95, 1.52 |
| | 80,000-100,000 | 1.33 | 0.96, 1.84 |
| | 100,000+ | 1.44 | **1.03, 2.00** |
| **% High School Graduates in PCSA**[c] | | 0.94 | 0.87, 1.01 |
| **% of Whites in PCSA**[c] | | 0.95 | 0.88, 1.01 |
| **Elixhauser Comorbidity Score** | <0 | REF | |
| | 0 | 0.75 | **0.65, 0.86** |
| | 1-6 | 0.89 | 0.76, 1.04 |
| | 7+ | 0.89 | 0.76, 1.04 |

[a] Country was removed from model to obtain estimates for language.

[b] Language was removed from model to obtain estimates for country

[c] Those with missing data for % high school graduates in PCSA and % of whites in PCSA were excluded from the model.

Abbreviations: PCSA, Primary Care Service Area