Appendix

Differential Associations of Homelessness with Emergency Department Visits and Hospitalizations by Race, Ethnicity, and Gender

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Section 1. California Whole Person Care pilot program

California’s Whole Person Care (WPC) pilot program consisted of 25 different Pilots in 26 California counties that provided care coordination, behavioral health, and social services to high utilizers Medicaid beneficiaries.1

Who was eligible for WPC?

WPC eligibility criteria included one of the following measures based on California’s Medicaid claims and enrollment data from 1/1/2017 to 12/31/2018:

- At least two emergency department (ED) visits;
- At least one inpatient hospitalization
- At least one ED visit with a mental health or substance use disorder diagnosis
- An incarceration aid code
- Homeless keywords (homeless, no residence/no permanent address, transient, hotel/motel/manor/lodge, services care/hospital/clinic/health care, pathway/bridge/freeway, jail, unknown/don’t know, undomiciled/general delivery/shelter/bus/train station/airport) in the beneficiary’s street address

How did WPC determine enrollees’ homelessness status?

WPC Pilots used various methods to determine whether enrollees were experiencing homelessness, including homeless management information system databases, self-report, and program identification and enrollment through street outreach or at homeless shelters.
Section 2. Construction of the Homelessness Indicator

We identified Medicaid beneficiaries experiencing homelessness based on diagnosis codes and place of service codes in Medicaid claims data and using textual classification data mining on beneficiaries’ residential addresses in Medicaid enrollment data.

Address-based indicators

Based on beneficiaries’ residential addresses, we created three homelessness flags: (1) keyword indicator, (2) non-existent indicator, and (3) facility indicator.

The keyword indicator identified homelessness using residential addresses that included keywords indicative of homelessness. We searched for the following keywords, reported by categories, listed below.

- Homeless: homeless and its typos (e.g., hmless, homelessness), None, UNK (unknown), undomicited, N/A, No AD (address), No Address, No physical address, no residence address, bad address, transient, No Home
- Lodging: hotel, lodge, shelter, in tank, jail, prison
- Outdoor locations: in vehicle, phone, somewhere, here and there, motor, car, lot, trailer, various, streets, place to place, park, bridge, airport, freeway, HWY (highway), highway
- Post office or similar: general delivery, MSC (mail services center), BOX (PO box)
- Organization: hosp (hospital), clinic, medical center, health care, care center, services care, social assistance, community services

Some of the keyword searches may incorrectly code those whose real home address includes keywords such as “highway or hospital” in the street names. To avoid such errors, we geo-matched enrollees’ residential addresses to existing Census Bureau databases by using the “PROC GEOMATCH” statement in SAS 9.4.1 We then excluded those individuals from the homeless group if their home addresses matched to an actual address.

The non-existent indicator identified homelessness using addresses that only matched on zip code (the rest of the addresses did not match any real address) or were out of the street range using the “PROC GEOMATCH” statement.

The facility indicator identified homelessness using databases of addresses for California substance abuse and mental health treatment centers 2, hospitals, clinics, and social security administration offices. Since many homeless people enrolled in Medicaid during health care or social services encounters, we identified beneficiaries as experiencing homelessness if their residential addresses matched an address found in these databases. The complete list of databases can be found below.

Claims-Based Indicators

In addition, we further created the fourth homelessness indicator, ICD/POS indicator, using Medicaid claims data. Beneficiaries were identified as experiencing homelessness if they had a
diagnosis code of Z59.0 (International Classification of Diseases, Tenth Revision, Clinical Modification code which indicates homelessness) or a “place of service” code of 4 (standard field in Medicaid data that indicates if the service was provided at a facility or location whose primary purpose is to provide temporary housing to homeless individuals).

We constructed these four indicators (keyword, non-existent, facility, ICD/POS) based on monthly data. We then aggregated them to annual data by categorizing enrollees as experiencing homelessness if they were flagged as homeless in any previous month using any indicator.

Database of Health Care and Social Service Facility Addresses

- County offices to apply for Health Coverage, Medi-Cal, and Other Benefits
  - https://www.dhcs.ca.gov/services/medi-cal/Pages/ApplyforMedi-Cal.aspx
  - https://www.dhcs.ca.gov/services/medi-cal/Pages/CountyOffices.aspx

- County office locations for Los Angeles County
  - http://dpss.lacounty.gov/wps/portal/dpss/main/home/office-locations?program=medical&title=Medi-Cal%20Offices

- List of Federal Qualified Health Centers
  - https://www.dhcs.ca.gov/dataandstats/AI/Documents/FQHC/FQHC_Current_Rates/FQHC_RHC_CURRENT_RATES_12-19-18.pdf

- List of substance use and mental health treatment centers located in California from the Substance Abuse and Mental Health Services Administration (SAMHSA)
  - https://findtreatment.samhsa.gov/locator
Section 3. Accounting for misclassification bias

Although measurement error for continuous variables and misclassification for discrete variables have received great attention in prior empirical studies, it is hard to observe in many situations. However, we obtained the predictive performance metrics of our constructed homelessness indicator by comparing it with the pilot-reported homelessness status in the WPC enrollment data. With this information, we can measure the misclassification in our homelessness indicator using the standard confusion matrix. Table A1 displays the confusion matrix. Based on Table A1, we have the following measures for prediction performance.

\[
\text{Sensitivity} = \Pr(+|D) = 65.58% \\
\text{Specificity} = \Pr(-|\sim D) = 70.19% \\
\text{Positive predictive value} = \Pr(D|+) = 59.43% \\
\text{Negative predictive value} = \Pr(\sim D|-) = 75.38%
\]

Misclassification in our primary independent variable (homelessness) can introduce systematic biases into the second-stage econometric estimations. Misclassification usually underestimates the effect from the second-stage econometric estimation but amplifies the effect in some cases.\(^{40,44}\) The ability to quantify such error can mitigate estimation biases.

In the case of misclassification bias in a linear regression with one regressor, suppose the regression equation is \(Y = \beta_0 + \beta_1 X + \epsilon\). Instead of true value \(X\) we observe \(\hat{X}\), which contains misclassification. We also assume \(\hat{X}\) is independent of \(Y\) given \(X\); for example, no differential misclassification. Yang, et al. (2018) proved the extent to which misclassification biases the econometric estimation of \(\beta_1\).\(^2\)

\[
E(\hat{\beta}_1|\hat{X}) = \beta_1 [\Pr(X = 1|\hat{X} = 1) + \Pr(X = 0|\hat{X} = 0) - 1] \\
= \beta_1 [\Pr(D|+) + \Pr(\sim D|-) - 1] \\
= \beta_1 (59.43% + 75.38% - 1) \\
= \beta_1 \times 0.3481
\]

It suggests that if we regress health care utilization on the homelessness classifier, we will underestimate the true association. The true association (\(\beta_1\)) is 2.87 (1/0.3481) times as large as the estimated association (\(\hat{\beta}_1\)).

For multivariate regression models, it is difficult to get a closed-form solution for the estimated bias. We applied the misclassification simulation extrapolation (MC-SIMEX) approach; see Kuchenhoff, Mwalili, and Lesaffre (2006) for theoretical explanations.\(^3\) It involves two steps.

Step 1. Simulation. In the simulation step, \(\hat{X}(\lambda_k)\) is generated by adjusting the degree of misclassification errors based on the \(\lambda\) power of the misclassification matrix \((M_{00}, 1-M_{11}, 1-M_{00}, M_{11})\); \(M_{00}\) denotes specificity and \(M_{11}\) denotes sensitivity. In our study, the matrix is (0.70, 0.34, 0.30, 0.66). Intuitively, we impose various degrees of misclassification bias in \(\hat{X}\) by
adjusting the value of specificity and sensitivity. We will then obtain corresponding estimated association between being homelessness and health care utilization, for example, $\beta(\lambda_1)$, $\beta(\lambda_2)$, $\beta(\lambda_3)$, $\beta(\lambda_4)$.

Step 2. Extrapolation. We then estimate a parametric function $\beta(\lambda)$ based on $\beta(\lambda_1)$, $\beta(\lambda_2)$, $\beta(\lambda_3)$, $\beta(\lambda_4)$ and extrapolate to $\beta(-1)$ to approximate estimates without misclassification bias.

We used the R package “mcsimex” to implement the approach. For computation reasons, we used a 30% random sample of our overall analytic sample for the MC-SIMEX model. We also used a linear regression model in which MC-SIMEX performs better in correcting misclassification bias. Nonetheless, in Table A6, we showed that estimates from non-linear models from the full sample and the 30% random sample are consistent. Based on the 30% random sample, estimates from the linear model are slightly different from those from non-linear models. We found the misclassification-corrected estimate using MC-SIMEX is about 2.40 times as large as estimates without bias correction.
Section 4. A bias analysis for unmeasured confounders based on E-values

VanderWeele and Ding (2017) introduced the concept of E-value, defined as the minimum strength of association that an unmeasured confounder would need to have with both the treatment and the outcome to fully explain away a specific treatment-outcome association, conditional on the measured covariates. We used formulas from VanderWeele and Ding (2017) to compute the E values to assess omitted variable bias.  

Binary outcomes. For binary outcomes, we compute the E values based on the Odds Ratio (OR) from a logistic regression.

We first transformed OR to Risk Ratio (RR):

\[ RR \approx \sqrt{OR} \]

We compute the E values using the following formula for RR > 1:

\[ E_{value} = RR + \sqrt{RR \times (RR - 1)} \]

Count outcomes. For count outcomes, we first obtained Rate Ratios from a negative binomial regression. We then used the following formula and replaced Risk Ratio (RR) with Rate Ratios.

\[ E_{value} = RR + \sqrt{RR \times (RR - 1)} \]

Our bias analyses found that E-values for our analyses range from 1.20 to 9.35 (Table A7). It means that an unmeasured confounder associated with both being homeless and health care utilization by a risk ratio of 1.20- to 9.35- fold each, above and beyond the measured confounders included in our statistical models, could explain away the observed association. Thus, our evidence for causality looks plausibly strong because substantial unobserved confounding is required to reduce the observed association to null. In other words, the bias from unmeasured confounding is not a big concern for our results.
Appendix References

1. Pourat N, Chuang E, Chen X, et al. *Interim evaluation of California’s Whole Person Care (WPC) program*. Los Angeles (CA): UCLA Center for Health Policy Research; 2019.

2. Yang M, Adomavicius G, Burtch G, Ren Y. Mind the Gap: Accounting for Measurement Error and Misclassification in Variables Generated via Data Mining. *Information Systems Research*. 2018;29(1):4-24.

3. Kuchenhoff H, Mwalili SM, Lesaffre E. A general method for dealing with misclassification in regression: the misclassification SIMEX. *Biometrics*. 2006;62(1):85-96.

4. VanderWeele TJ, Ding P. Sensitivity Analysis in Observational Research: Introducing the E-Value. *Ann Intern Med*. 2017;167(4):268-274.
### Table A1. Confusion matrix of the constructed homelessness indicator

| Homelessness indicator (Predicted, \( \hat{X} \)) | WPC pilot-reported homelessness status (True, \( X \)) | Total |
|-----------------------------------------------|------------------------------------------------|-------|
|                                               | Beneficiaries experiencing homelessness (\( D, X = 1 \)) |       |
| Beneficiaries experiencing homelessness (+, \( \hat{X} = 1 \)) | 24,552 | 16,758 | 41,310 |
| Beneficiaries not experiencing homelessness (-, \( \hat{X} = 0 \)) | 12,889 | 39,457 | 52,346 |
| **Total**                                      | 37,441 | 56,215 | 93,656 |

Notes. WPC denotes California’s Whole Person Care (WPC) Pilots program. The confusion matrix was obtained by comparing the constructed homelessness indicator with WPC piloted-reported homelessness status, based on 93,656 WPC enrollees in 2017 and 2018. WPC Pilots used a variety of methods to determine whether enrollees were experiencing homelessness, including homeless management information system databases, self-report, and program identification and enrollment through street outreach or at homeless shelters.
Table A2. Emergency Department (ED) visits outcomes by race, ethnicity, and gender groups

| Race/Ethnicity-Gender Group | Sample Size | Number of ED Visits | Frequent (4+) ED Visit (%) | Any ED due to mental health disorders (%) | Any ED due to substance use disorders (%) |
|-----------------------------|-------------|---------------------|---------------------------|------------------------------------------|------------------------------------------|
|                             | BEH         | NBEH                | BEH | NBEH | Δ (pp) | BEH | NBEH | Δ (pp) | BEH | NBEH | Δ (pp) |
| **Panel A. Males**          |             |                     |     |      |        |     |      |        |     |      |        |
| AIAN                        | 2,193       | 3,461               | 1.82| 1.13 | 0.69   | 12.40| 6.93 | 5.47   | 9.26 | 6.30 | 2.96   |
| Asian                       | 4,694       | 43,749              | 0.80| 0.58 | 0.22   | 4.71 | 2.27 | 2.44   | 5.67 | 2.77 | 2.90   |
| Black                       | 36,506      | 59,381              | 1.84| 1.21 | 0.63   | 13.35| 7.97 | 5.38   | 9.61 | 5.83 | 3.78   |
| Hispanic                    | 65,659      | 257,539             | 1.52| 1.04 | 0.48   | 10.62| 5.41 | 5.21   | 8.82 | 5.57 | 3.25   |
| NHOPI                       | 2,018       | 14,432              | 1.15| 0.76 | 0.38   | 7.04 | 3.82 | 3.22   | 8.18 | 4.14 | 4.03   |
| Other or Multiracial        | 7,157       | 35,012              | 1.50| 0.97 | 0.53   | 10.06| 5.16 | 4.90   | 10.24| 5.47 | 4.77   |
| Unknown                     | 16,106      | 45,489              | 1.64| 0.87 | 0.77   | 12.05| 5.14 | 6.91   | 12.68| 7.24 | 5.44   |
| White                       | 72,368      | 184,604             | 1.70| 0.98 | 0.72   | 12.62| 5.72 | 6.90   | 12.10| 7.06 | 5.04   |
| **Panel B. Females**        |             |                     |     |      |        |     |      |        |     |      |        |
| AIAN                        | 3,030       | 6,885               | 1.61| 1.33 | 0.28   | 12.90| 9.32 | 3.58   | 10.63| 8.09 | 2.54   |
| Asian                       | 7,445       | 81,327              | 0.72| 0.57 | 0.15   | 3.94 | 2.01 | 1.93   | 4.37 | 2.84 | 1.53   |
| Black                       | 46,512      | 115,110             | 1.88| 1.37 | 0.50   | 14.84| 9.85 | 4.99   | 8.89 | 6.70 | 2.19   |
| Hispanic                    | 103,522     | 638,429             | 1.38| 1.08 | 0.31   | 9.72 | 6.13 | 3.59   | 7.66 | 5.14 | 2.51   |
| NHOPI                       | 2,885       | 25,091              | 1.02| 0.75 | 0.27   | 7.00 | 3.63 | 3.37   | 6.66 | 3.73 | 2.92   |
| Other or Multiracial        | 9,719       | 63,999              | 1.36| 0.98 | 0.37   | 9.88 | 5.40 | 4.48   | 9.28 | 5.82 | 3.46   |
| Unknown                     | 13,747      | 61,970              | 1.45| 0.94 | 0.52   | 11.20| 5.72 | 5.47   | 11.81| 7.21 | 4.61   |
| White                       | 79,498      | 311,893             | 1.59| 1.09 | 0.50   | 12.64| 7.08 | 5.57   | 12.22| 8.18 | 4.04   |

Notes: N=2,421,491. Shown are unadjusted health care utilization by race/ethnicity-gender groups. BEH denotes beneficiaries experiencing homelessness, and NBEH denotes beneficiaries who did not experience homelessness. Δ denotes the unadjusted difference in outcome between beneficiaries experiencing homelessness and those not experiencing homelessness. pp represents percentage points. ED denotes Emergency Department. AIAN denotes American Indian and Alaska Native. NHOPI denotes Native Hawaiian and Pacific Islander. Race and ethnicity categories are listed in alphabetical order.
Table A3. Hospitalization outcomes by race, ethnicity, and gender groups

| Race/Ethnicity-Gender Group | Sample size | Number of hospitalizations | Frequent (2+) Hospitalizations (%) | High frequent (4+) Hospitalizations (%) | Length of Stay |
|-----------------------------|-------------|-----------------------------|-------------------------------------|-----------------------------------------|---------------|
|                             | BEH  | NBEH | BEH | NBEH | Δ | BEH | NBEH | Δ | BEH | NBEH | Δ | BEH | NBEH | Δ |
| **Panel A. Males**          |      |      |      |      |   |      |      |   |      |      |   |      |      |   |
| AIAN                        | 2,193 | 3,461 | 0.41 | 0.37 | 0.05 | 7.75 | 6.67 | 1.08 | 2.14 | 1.56 | 0.58 | 2.49 | 2.09 | 0.40 |
| Asian                       | 4,694 | 43,749 | 0.40 | 0.36 | 0.04 | 7.78 | 6.17 | 1.60 | 1.51 | 0.95 | 0.56 | 2.97 | 2.29 | 0.68 |
| Black                       | 36,506 | 59,381 | 0.39 | 0.35 | 0.04 | 7.05 | 6.48 | 0.57 | 2.09 | 1.54 | 0.55 | 2.26 | 2.21 | 0.05 |
| Hispanic                    | 65,659 | 257,539 | 0.35 | 0.29 | 0.06 | 6.62 | 5.13 | 1.49 | 1.74 | 1.07 | 0.67 | 2.19 | 1.65 | 0.54 |
| NHOPI                       | 2,018 | 14,432 | 0.43 | 0.38 | 0.04 | 8.08 | 6.75 | 1.33 | 1.93 | 1.21 | 0.72 | 3.07 | 2.55 | 0.52 |
| Other or Multiracial        | 7,157 | 35,012 | 0.32 | 0.25 | 0.07 | 5.99 | 4.34 | 1.65 | 1.45 | 0.85 | 0.60 | 2.16 | 1.44 | 0.72 |
| Unknown                     | 16,106 | 45,489 | 0.51 | 0.36 | 0.15 | 9.43 | 6.30 | 3.13 | 2.86 | 1.37 | 1.49 | 3.53 | 2.15 | 1.38 |
| White                       | 72,368 | 184,604 | 0.43 | 0.37 | 0.06 | 8.43 | 6.55 | 1.88 | 2.24 | 1.47 | 0.77 | 2.69 | 2.10 | 0.59 |
| **Panel B. Females**        |      |      |      |      |   |      |      |   |      |      |   |      |      |   |
| AIAN                        | 3,030 | 6,885 | 0.34 | 0.35 | -0.01 | 5.51 | 5.75 | -0.24 | 1.12 | 1.03 | 0.09 | 1.55 | 1.58 | -0.03 |
| Asian                       | 7,445 | 81,327 | 0.32 | 0.32 | 0.00 | 5.05 | 4.46 | 0.59 | 0.50 | 0.55 | -0.06 | 1.63 | 1.58 | 0.04 |
| Black                       | 46,512 | 115,110 | 0.32 | 0.31 | 0.01 | 5.31 | 5.08 | 0.23 | 1.01 | 0.95 | 0.06 | 1.60 | 1.67 | -0.07 |
| Hispanic                    | 103,522 | 638,429 | 0.32 | 0.29 | 0.03 | 4.80 | 3.95 | 0.85 | 0.74 | 0.54 | 0.20 | 1.44 | 1.18 | 0.26 |
| NHOPI                       | 2,885 | 25,091 | 0.34 | 0.34 | 0.00 | 5.51 | 4.96 | 0.55 | 1.04 | 0.66 | 0.38 | 2.05 | 1.70 | 0.36 |
| Other or Multiracial        | 9,719 | 63,999 | 0.29 | 0.27 | 0.01 | 4.32 | 3.78 | 0.54 | 0.72 | 0.48 | 0.24 | 1.43 | 1.19 | 0.24 |
| Unknown                     | 13,747 | 61,970 | 0.36 | 0.32 | 0.04 | 6.00 | 4.96 | 1.05 | 1.56 | 1.05 | 0.52 | 2.26 | 1.60 | 0.66 |
| White                       | 79,498 | 311,893 | 0.35 | 0.34 | 0.01 | 6.18 | 5.38 | 0.80 | 1.28 | 1.11 | 0.18 | 1.92 | 1.60 | 0.32 |

Notes: N=2,421,491. Shown are unadjusted health care utilization by race/ethnicity-gender groups. BEH denotes beneficiaries experiencing homelessness, and NBEH denotes beneficiaries who did not experience homelessness. Δ denotes the unadjusted difference in outcome between beneficiaries experiencing homelessness and those not experiencing homelessness. pp represents percentage points. ED denotes Emergency Department. AIAN denotes American Indian and Alaska Native. NHOPI denotes Native Hawaiian and Pacific Islander. Race and ethnicity categories are listed in alphabetical order.
### Table A4. Differential impacts of homelessness on emergency department visits by race, ethnicity, and gender groups

| Race, Ethnicity and Gender groups | Number of ED Visits | Frequent (4+) ED Visits (pp) | Any ED due to mental health disorders (pp) | Any ED due to substance use disorders (pp) |
|----------------------------------|---------------------|-----------------------------|---------------------------------------------|---------------------------------------------|
|                                  | Marginal Effects    | Marginal Effects            | Marginal Effects                            | Marginal Effects                            |
|                                  | Lower bound         | Upper Bound                 | Lower bound                                | Upper bound                                |
|                                  | 95% CI              | 95% CI                      | 95% CI                                     | 95% CI                                     |
| **Panel A. Males**               |                     |                             |                                             |                                             |
| AIAN                             | 0.59                | 0.38                        | 0.80                                       | 3.93                                       | 2.55                                       | 5.31                                       | 0.96                                       | -0.22                                     | 2.13                                       | 1.90                                       | 0.47                                       | 3.32                                       |
| Asian                            | 0.17                | 0.12                        | 0.22                                       | 2.01                                       | 1.47                                       | 2.55                                       | 1.31                                       | 0.68                                     | 1.95                                       | 2.15                                       | 1.67                                       | 2.63                                       |
| Black                            | 0.50                | 0.46                        | 0.54                                       | 3.63                                       | 3.34                                       | 3.92                                       | 1.05                                       | 0.70                                     | 1.39                                       | 1.77                                       | 1.41                                       | 2.13                                       |
| Hispanic                         | 0.34                | 0.27                        | 0.41                                       | 3.08                                       | 2.77                                       | 3.38                                       | 0.35                                       | 0.14                                     | 0.56                                       | 1.30                                       | 1.10                                       | 1.49                                       |
| NHOPI                            | 0.34                | 0.20                        | 0.49                                       | 2.29                                       | 1.41                                       | 3.16                                       | 1.46                                       | 0.14                                     | 2.77                                       | 2.47                                       | 1.36                                       | 3.58                                       |
| Other or Multiracial             | 0.39                | 0.26                        | 0.51                                       | 2.91                                       | 2.28                                       | 3.54                                       | 1.35                                       | 0.71                                     | 2.00                                       | 1.94                                       | 1.44                                       | 2.43                                       |
| Unknown                          | 0.52                | 0.47                        | 0.57                                       | 3.94                                       | 3.49                                       | 4.40                                       | 1.47                                       | 0.93                                     | 2.00                                       | 1.77                                       | 1.47                                       | 2.07                                       |
| White                            | 0.51                | 0.47                        | 0.56                                       | 4.00                                       | 3.70                                       | 4.30                                       | 1.45                                       | 1.22                                     | 1.69                                       | 2.06                                       | 1.89                                       | 2.23                                       |
| **Panel B. Females**             |                     |                             |                                             |                                             |                                             |                                             |                                             |                                             |                                             |                                             |                                             |                                             |
| AIAN                             | 0.23                | 0.14                        | 0.32                                       | 2.28                                       | 1.46                                       | 3.11                                       | 0.55                                       | -0.19                                    | 1.29                                       | 1.58                                       | 0.82                                       | 2.34                                       |
| Asian                            | 0.14                | 0.11                        | 0.18                                       | 2.00                                       | 1.53                                       | 2.47                                       | 0.42                                       | -0.10                                    | 0.95                                       | 1.20                                       | 0.54                                       | 1.87                                       |
| Black                            | 0.53                | 0.47                        | 0.58                                       | 4.18                                       | 3.76                                       | 4.59                                       | 0.82                                       | 0.46                                     | 1.18                                       | 1.49                                       | 1.30                                       | 1.68                                       |
| Hispanic                         | 0.26                | 0.21                        | 0.32                                       | 2.40                                       | 1.93                                       | 2.88                                       | 0.57                                       | 0.41                                     | 0.72                                       | 1.55                                       | 1.36                                       | 1.73                                       |
| NHOPI                            | 0.20                | 0.11                        | 0.29                                       | 2.53                                       | 1.86                                       | 3.21                                       | 0.63                                       | -0.21                                    | 1.48                                       | 1.89                                       | 1.31                                       | 2.48                                       |
| Other or Multiracial             | 0.28                | 0.19                        | 0.37                                       | 2.85                                       | 2.08                                       | 3.61                                       | 0.60                                       | 0.21                                     | 0.99                                       | 2.08                                       | 1.74                                       | 2.42                                       |
| Unknown                          | 0.34                | 0.30                        | 0.39                                       | 3.12                                       | 2.55                                       | 3.69                                       | 0.84                                       | 0.47                                     | 1.20                                       | 2.05                                       | 1.84                                       | 2.25                                       |
| White                            | 0.37                | 0.32                        | 0.41                                       | 3.07                                       | 2.77                                       | 3.38                                       | 0.88                                       | 0.68                                     | 1.08                                       | 1.73                                       | 1.60                                       | 1.87                                       |

Notes. N=2,421,491. Shown are marginal effects of being homeless on high-cost health care utilization by race/ethnicity and gender groups. Marginal effects were calculated after regression models with a three-way interaction term for race/ethnicity, gender, and homelessness indicator. Negative binomial regressions were used for count outcomes, while logistic regressions were used for binary outcomes. ED denotes Emergency Department. pp denotes percentage points. AIAN denotes American Indian and Alaska Native. NHOPI denotes Native Hawaiian and Pacific Islander. Race and ethnicity categories are listed in alphabetical order.
Table A5. Differential impacts of homelessness on hospitalizations by race, ethnicity, and gender groups

| Race, Ethnicity and Gender groups | Number of Hospitalizations | Frequent (2+) Hospitalizations (pp) | High frequent (4+) Hospitalizations (pp) | Length of Stay |
|-----------------------------------|-----------------------------|-------------------------------------|----------------------------------------|--------------|
|                                   | Marginal Effects            | Lower bound 95% CI                  | Upper bound 95% CI                     | Marginal Effects | Lower bound 95% CI | Upper bound 95% CI | Marginal Effects | Lower bound 95% CI | Upper bound 95% CI |
| Panel A. Males                    |                             |                                     |                                        |               |
| AIAN                              | 0.04                        | 0.01                                | 0.07                                   | 1.18          | 0.20                    | 2.17                | 0.63               | 0.09                    | 1.17                |
| Asian                             | 0.01                        | -0.02                               | 0.04                                   | 0.78          | 0.31                    | 1.25                | 0.29               | 0.07                    | 0.52                |
| Black                             | 0.05                        | 0.03                                | 0.07                                   | 0.93          | 0.55                    | 1.31                | 0.61               | 0.43                    | 0.79                |
| Hispanic                          | 0.03                        | 0.02                                | 0.05                                   | 0.79          | 0.60                    | 0.98                | 0.50               | 0.41                    | 0.60                |
| NHOPI                             | 0.04                        | 0.01                                | 0.06                                   | 0.81          | -0.27                   | 1.89                | 0.48               | -0.06                   | 1.02                |
| Other or Multiracial              | 0.04                        | 0.01                                | 0.06                                   | 0.46          | 0.02                    | 0.89                | 0.21               | -0.05                   | 0.47                |
| Unknown                           | 0.04                        | 0.02                                | 0.07                                   | 1.17          | 0.53                    | 1.82                | 0.53               | 0.23                    | 0.84                |
| White                             | 0.05                        | 0.02                                | 0.07                                   | 1.06          | 0.61                    | 1.51                | 0.41               | 0.18                    | 0.65                |
| Panel B. Females                  |                             |                                     |                                        |               |
| AIAN                              | -0.01                       | -0.05                               | 0.04                                   | -0.14         | -0.82                   | 0.53                | 0.09               | -0.23                   | 0.40                |
| Asian                             | 0.01                        | -0.02                               | 0.03                                   | 0.57          | 0.16                    | 0.98                | -0.07              | -0.35                   | 0.21                |
| Black                             | 0.07                        | 0.06                                | 0.09                                   | 1.16          | 0.71                    | 2.12                | 0.31               | 0.20                    | 0.41                |
| Hispanic                          | 0.02                        | 0.01                                | 0.04                                   | 0.62          | 0.43                    | 0.81                | 0.21               | 0.10                    | 0.31                |
| NHOPI                             | 0.01                        | -0.02                               | 0.05                                   | 0.17          | -0.64                   | 0.97                | 0.26               | -0.05                   | 0.57                |
| Other or Multiracial              | -0.03                       | -0.06                               | 0.00                                   | -0.41         | -0.72                   | -0.10               | 0.06               | -0.14                   | 0.27                |
| Unknown                           | 0.01                        | -0.01                               | 0.03                                   | 0.18          | -0.31                   | 0.67                | 0.22               | -0.07                   | 0.51                |
| White                             | 0.01                        | 0.00                                | 0.03                                   | 0.40          | 0.06                    | 0.74                | 0.11               | -0.06                   | 0.28                |

Notes. N=2,421,491. Shown are marginal effects of being homeless on high-cost health care utilization by race/ethnicity and gender groups. Marginal effects were calculated after regression models with a three-way interaction term for race/ethnicity, gender, and homelessness indicator. Negative binomial regressions were used for count outcomes while logistic regressions were used for binary outcomes. ED denotes Emergency Department. pp denotes percentage points. AIAN denotes American Indian and Alaska Native. NHOPI denotes Native Hawaiian and Pacific Islander. Race and ethnicity categories are listed in alphabetical order.
|                     | Emergency Department Visits | Hospitalizations |   |   |   |   |   |   |
|---------------------|----------------------------|------------------|---|---|---|---|---|---|
|                     | Number of ED Visits        | Frequent (4+) ED Visits (pp) | Any ED due to mental health disorders (pp) | Any ED due to substance use disorders (pp) | Number of hospitalizations | Frequent (2+) Hospitalizations (pp) | High frequent (4+) Hospitalizations (pp) | Length of Stay |
| Full sample         |                           |                  |               |               |              |                            |                                 |               |
| Non-linear model    | 0.34***                    | 2.77***          | 0.79***       | 1.47***       | 0.03***      | 0.68***                     | 0.28***                       | 0.53***       |
| Linear model        | 0.32***                    | 3.37***          | 0.96***       | 2.36***       | 0.02***      | 0.75***                     | 0.34***                       | 0.28***       |
| 30% random sample   |                           |                  |               |               |              |                            |                                 |               |
| Non-linear model    | 0.33***                    | 2.74***          | 0.72***       | 1.40***       | 0.03***      | 0.67***                     | 0.28***                       | 0.54***       |
| Linear model        | 0.28***                    | 3.10***          | 0.84***       | 2.23***       | 0.018***     | 0.64***                     | 0.29***                       | 0.26***       |
| MC-SIMEX            | 0.67***                    | 7.41***          | 1.99***       | 5.33***       | 0.044***     | 1.51***                     | 0.69***                       | 0.62***       |
| Ratio (MC-SIMEX/Linear Model) | 2.39         | 2.39             | 2.37          | 2.39          | 2.44         | 2.36                         | 2.38                         | 2.38          |

Notes. N=2,421,491. Shown are marginal effects of being homeless on high-cost health care utilization. Negative binomial regressions were used for count outcomes, while logistic regressions were used for binary outcomes, with control variables described in the main text. ED denotes Emergency Department. pp denotes percentage points. MC-SIMEX denotes misclassification simulation extrapolation approach.
Table A7. Bias analysis for unmeasured confounders based on E-values

|                      | Emergency Department Visits | Hospital Admissions |          |          |          |
|----------------------|-----------------------------|---------------------|----------|----------|----------|
|                      | Number of ED Visits         | Frequent (4+) ED Visits (pp) | Any ED due to mental health disorders (pp) | Any ED due to substance use disorders (pp) | Number of hospital admissions | Frequent (2+) Hospital admissions (pp) | High-frequent (4+) Hospital admissions (pp) | Length of Stay |
| Odds Ratios          | 1.59                        | 1.19                | 1.72     |          |          | 1.03     | 1.18     | 1.39     | 1.07     |
| Rate Ratios          | 1.24                        | 1.78                | 9.35     | 6.04     | 10.65    | 1.20     | 5.93     | 7.53     | 1.34     |
| E values             |                              |                     |          |          |          |          |          |          |          |

Notes: N=2,421,491. Rate Ratios were from negative binomial regressions used for count outcomes. Odds Ratios were from logistic regressions used for binary outcomes. The model specification and control variables were described in the main text. ED denotes Emergency Department. pp denotes percentage points. E values were computed based on formulas developed by VanderWeele and Ding (2017). ED denotes Emergency Department. pp denotes percentage points.