



# Beyond Classical Risk Adjustment Socioeconomic Status and Hospital Performance in Urologic Oncology

Anobel Y. Odisho, MD MPH<sup>1</sup>, Ruth Etzioni, PhD<sup>2</sup>, John L. Gore, MD MS<sup>1,2</sup>  
<sup>1</sup>Department of Urology, University of Washington, Seattle, WA; <sup>2</sup>Fred Hutchinson Cancer Research Center

UNIVERSITY of  
WASHINGTON

✉ @anobelodisho ✉ odisho@uw.edu

## Background

- 30-day readmission rate has become a prevailing measure of hospital and health system performance
- Medicare ties reimbursement to readmission rates
- SES impacts variety of health conditions, including readmissions
- Medicare models incorporate demographics and comorbidities, but not socioeconomic status (SES)

## Objective

- Determine if adding SES to Medicare risk-adjustment models impacts hospital rankings
- Assess differential impact of patient SES on Safety Net Hospital readmission rates for more equitable assessment of performance

## Methods

### Data

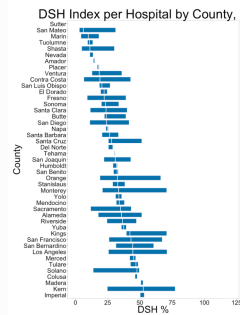
- All adult acute care admissions in non-federal hospitals from 2007-2011 in California
- We assessed comorbidities with the Elixhauser Index
- Patient SES derived from US Census data based on patient ZIP codes
- For each patient, we calculated a Diez-Roux Neighborhood Score derived from median household income, median home value, % completed high school, % completed college, % with cap gains/dividend/interest income, % with professional occupations
- We defined Safety Net Hospital (SNH) as those hospitals in the top quartile of Medicare Disproportionate Share Index (DSH)

### Statistical Methods

- Separated cohort into training and validation samples (75/25%)
- Created multivariate logistic regression models and compared observed rates to model predicted rates
- Models were compared with ROC curves, AUC calculation
- Compared differences in predicted and observed ranking with Wilcoxon signed rank test
- Permutation testing to compare rankings of SNH and non-SNHs

## Results

Characteristics of Cystectomy, Partial Nephrectomy, and Radical Nephrectomy cohorts based on readmission status. Unless otherwise noted, values represent median (interquartile range).



|                       | Cystectomy<br>Not Readmitted | Cystectomy<br>Readmitted | p     | Partial Neph<br>Not Readmitted | Partial Neph<br>Readmitted | p     | Radical Neph<br>Not Readmitted | Radical Neph<br>Readmitted | p     |
|-----------------------|------------------------------|--------------------------|-------|--------------------------------|----------------------------|-------|--------------------------------|----------------------------|-------|
| Cases (n)             | 2,788                        | 983                      |       | 5,028                          | 528                        |       | 12,043                         | 1,003                      |       |
| Age                   | 70 (62-77)                   | 71 (63-77)               | 0.43  | 61 (52-69)                     | 63 (53-72)                 | <0.01 | 64 (55-73)                     | 67 (57-76)                 | <0.01 |
| Sex (% Male)          | 82.5                         | 82.5                     | 1.00  | 81.8                           | 82.9                       | <0.01 | 82.6                           | 82.9                       | 0.78  |
| Elixhauser Sum        | 2.8 ± 1.5                    | 3.0 ± 1.6                | <0.01 | 2.6 ± 1.4                      | 2.9 ± 1.5                  | <0.01 | 2.8 ± 1.5                      | 3.4 ± 1.7                  | <0.01 |
| Diez-Roux Score       | 0.99 (1.80-4.38)             | 1.25 (1.70-4.45)         | 0.25  | 1.18 (2.10-4.74)               | 0.82 (2.45-4.47)           | 0.17  | 0.10 (2.69-3.66)               | -0.41 (2.89-3.21)          | <0.01 |
| Income (\$K)          | 65.1 (51.8-81.8)             | 66.8 (51.5-83.8)         |       | 67.0 (51.9-83.7)               | 63.5 (52.3-83.4)           |       | 62.1 (48.9-80.0)               | 60.4 (48.1-76.2)           |       |
| Home Value (\$100K)   | 440 (311-619)                | 445 (327-618)            | 0.53  | 445 (319-630)                  | 424 (319-611)              | 0.32  | 400 (286-586)                  | 390 (282-550)              | 0.02  |
| % with Cap Income     | 25.7 (17.2-33.6)             | 26.3 (17.5-34.0)         | 0.17  | 25.2 (16.2-34.2)               | 23.5 (14.2-33.7)           | 0.25  | 22.8 (14.7-31.8)               | 21.5 (14.0-30.6)           | <0.01 |
| % Completed HS        | 87.7 (88.8-92.8)             | 88.2 (78.9-93.2)         | 0.69  | 87.5 (77.5-93.2)               | 85.8 (76.4-92.8)           | 0.09  | 85.4 (75.0-92.1)               | 83.7 (74.1-91.6)           | 0.02  |
| % Completed College   | 29.3 (18.1-43.8)             | 31.0 (19.9-44.1)         | 0.21  | 30.2 (18.0-46.3)               | 27.9 (17.1-45.5)           | 0.18  | 27.2 (16.3-41.1)               | 25.1 (15.7-38.6)           | <0.01 |
| % Prof Occupations    | 16.9 (11.9-23.7)             | 17.2 (12.1-24.0)         | 0.41  | 17.5 (11.7-24.6)               | 16.8 (11.5-24.0)           | 0.18  | 16.0 (10.5-22.7)               | 14.9 (10.2-21.8)           | <0.01 |
| Ethnicity (%)         |                              |                          |       |                                |                            |       |                                |                            |       |
| White                 | 54.5 (31.0-70.6)             | 53.8 (31.3-70.6)         | 0.97  | 49.4 (27.4-66.8)               | 47.8 (25.8-64.8)           | 0.18  | 46.5 (25.1-63.7)               | 43.9 (22.8-64.0)           | 0.03  |
| Black                 | 24.1 (2.1-53.8)              | 23.9 (2.1-53.8)          | 0.19  | 24.1 (3.1-54.0)                | 31.0 (3.1-59.6)            | 0.07  | 24.1 (3.1-60.0)                | 24.1 (4.4-60.0)            | 0.42  |
| Hispanic              | 24.8 (13.3-40.9)             | 23.9 (12.7-40.9)         | 0.72  | 25.3 (13.4-43.4)               | 27.5 (14.2-48.7)           | 0.06  | 28.0 (15.1-47.0)               | 29.8 (16.4-51.9)           | <0.01 |
| Asian                 | 7.4 (3.6-14.6)               | 8.0 (3.8-16.0)           | 0.18  | 8.4 (4.1-17.0)                 | 7.8 (3.9-15.7)             | 0.31  | 7.7 (3.7-15.4)                 | 7.7 (3.7-15.3)             | 0.22  |
| Rural (Patient) (%)   | 4.4                          | 4.1                      | 0.73  | 3.1                            | 2.1                        | 0.21  | 3.7                            | 2.8                        | 0.18  |
| Distance to Hosp (mi) | 32.8 (15.0-82.8)             | 35.4 (17.5-82.5)         | 0.78  | 26.5 (12.5-65.1)               | 26.1 (13.1-66.6)           | 0.38  | 20.6 (10.3-41.7)               | 19.9 (8.1-45.5)            | 0.23  |
| Hospital Volume       | 15.6 (4.2-49.2)              | 16.2 (4.8-49.2)          | 0.64  | 12.6 (5.8-34.4)                | 13.8 (6.8-30.2)            | 0.25  | 19.6 (10.2-32.4)               | 20.4 (10.8-33.8)           | 0.71  |
| Safety Net - SNH (%)  | 10.7                         | 12.1                     | 0.25  | 8.6                            | 8.9                        | 0.90  | 11.7                           | 14.4                       | 0.01  |
| Academic Hospital (%) | 49.5                         | 56.1                     | <0.01 | 50.3                           | 49.1                       | 0.81  | 42.4                           | 45.4                       | 0.06  |
| Urology Residency (%) | 50.1                         | 53.1                     | 0.10  | 36.4                           | 37.1                       | 0.81  | 25.8                           | 31.1                       | <0.01 |
| Payer (%)             |                              |                          |       |                                |                            |       |                                |                            |       |
| Medicare              | 62.9                         | 63.8                     | 0.71  | 37.5                           | 45.5                       | <0.01 | 47.5                           | 58.1                       | <0.01 |
| Medi-Cal              | 5.1                          | 5.7                      |       | 5.8                            | 10.0                       |       | 6.3                            | 6.5                        |       |
| Private               | 28.6                         | 28.0                     |       | 53.0                           | 42.0                       |       | 42.3                           | 36.0                       |       |
| County                | 1.3                          | 1.0                      |       | 1.6                            | 0.8                        |       | 2.1                            | 1.4                        |       |
| Self Pay              | 1.1                          | 0.6                      |       | 1.0                            | 0.8                        |       | 1.0                            | 0.5                        |       |
| Other/Govt            | 0.5                          | 0.3                      |       | 0.6                            | 0.8                        |       | 0.6                            | 0.1                        |       |
| Length of Stay        | 9.0 (7.0-12.0)               | 9.0 (7.0-13.0)           | <0.01 | 4.0 (3.0-6.0)                  | 6.0 (4.0-10.0)             | <0.01 | 4.0 (3.0-6.0)                  | 6.0 (4.0-9.0)              | <0.01 |
| Disposition (%)       |                              |                          |       |                                |                            |       |                                |                            |       |
| Home Health           | 34.2                         | 39.6                     | <0.01 | 87.7                           | 74.8                       | <0.01 | 87.6                           | 74.0                       | <0.01 |
| SNH                   | 53.8                         | 55.6                     |       | 8.6                            | 17.9                       |       | 7.1                            | 14.9                       |       |
| Residential Care      | 10.2                         | 13.5                     |       | 2.7                            | 6.8                        |       | 4.9                            | 11.1                       |       |
| Other                 | 0.1                          | 0.1                      |       | 0.1                            | 0.4                        |       | 0.1                            | 0.0                        |       |
| Admitted/Other        | 1.8                          | 0.1                      |       | 1.8                            | 0.2                        |       | 1.9                            | 0.0                        |       |

Risk adjustment models for surgical cohorts. Null hypothesis: rankings from each model are not different from rankings based on observed, unadjusted readmission rates.

AUC values from ROC analysis compare observed with model predicted rankings.

Observed and predicted rankings of hospitals based on 30-day readmission rates, based on Safety Net Hospital (SNH) status.

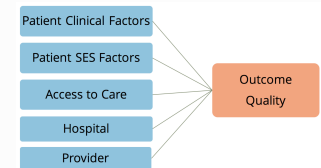
Smaller rank represents lower readmission rates. p values compare selected model to base model using permutation testing.

|  | Cystectomy     |            |       | Partial Nephrectomy |            |       | Radical Nephrectomy |            |       |
|--|----------------|------------|-------|---------------------|------------|-------|---------------------|------------|-------|
| Model  | p vs. Observed | p vs. Base | AUC   | p vs. Observed      | p vs. Base | AUC   | p vs. Observed      | p vs. Base | AUC   |
| Base   | 0.18           | -          | 0.558 | <0.01               | -          | 0.585 | <0.01               | -          | 0.624 |
| Base + SES <sup>1</sup>  | 0.23           | 0.07       | 0.554 | <0.01               | 0.05       | 0.554 | <0.01               | 0.02       | 0.624 |
| Base + SES <sup>1</sup> , Rural <sup>2</sup>                                 | 0.25           | <0.01      | 0.546 | <0.01               | 0.12       | 0.591 | <0.01               | <0.01      | 0.628 |
| Base + Hospital Factors <sup>3</sup>   | 0.51           | <0.01      | 0.580 | <0.01               | <0.01      | 0.583 | 0.01                | <0.01      | 0.630 |
| Base + Hospital Factors <sup>3</sup> + SES <sup>1</sup>                      | 0.49           | <0.01      | 0.578 | <0.01               | <0.01      | 0.573 | 0.02                | <0.01      | 0.631 |
| Base + Hospital Factors <sup>3</sup> + SES <sup>1</sup> + Rural <sup>2</sup> | 0.51           | <0.01      | 0.584 | <0.01               | <0.01      | 0.593 | 0.01                | <0.01      | 0.631 |

|  | Cystectomy |      |           | Partial Nephrectomy |       |           | Radical Nephrectomy |       |           |
|--|------------|------|-----------|---------------------|-------|-----------|---------------------|-------|-----------|
| Model  | Non-SNH    | SNH  | p vs Base | Non-SNH             | SNH   | p vs Base | Non-SNH             | SNH   | p vs Base |
| Observed Rankings  | 67.9       | 74.1 | -         | 95.7                | 82.6  | -         | 126.0               | 123.5 | -         |
| Base   | 69.1       | 68.4 | -         | 93.8                | 91.9  | -         | 125.6               | 125.2 | -         |
| Base + SES <sup>1</sup>  | 69.8       | 65.4 | 0.48      | 90.9                | 106.6 | <0.01     | 120.4               | 145.5 | <0.01     |
| Base + SES <sup>1</sup> , Rural <sup>2</sup>                                 | 69.6       | 66.2 | 0.95      | 91.3                | 104.6 | <0.01     | 121.5               | 141.0 | <0.01     |
| Base + Hospital Factors <sup>3</sup>   | 69.1       | 68.5 | 0.91      | 100.3               | 59.7  | <0.01     | 122.9               | 135.7 | 0.08      |
| Base + Hospital Factors <sup>3</sup> + SES <sup>1</sup>                      | 69.2       | 68.1 | 0.99      | 98.3                | 69.6  | <0.01     | 120.4               | 145.3 | <0.01     |
| Base + Hospital Factors <sup>3</sup> + SES <sup>1</sup> , Rural <sup>2</sup> | 69.0       | 68.8 | 0.77      | 98.1                | 70.4  | <0.01     | 121.7               | 140.3 | 0.04      |

Base model: patient age, sex, surgical approach (open vs. laparoscopic), and Elixhauser comorbidity score.  
<sup>1</sup> SES: Diez Roux Neighborhood score and Ethnicity (% white in ZIP code)  
<sup>2</sup> Rural: RUCA Rural/Urban classification and driving distance from hospital for index admission  
<sup>3</sup> Hospital Factors: Case specific hospital volume (quintiles), number of hospital beds, and academic status

## Discussion



### SES changes the hospital rankings in statistically significant manner

- SES adjustment narrows the gap between expected and observed, accounts for some of the unexplained difference between SNH and non-SNH
- Hospital Factors impact risk adjustment

### Safety Net Hospitals disproportionately punished by traditional risk adjustment models

- Readmission for each surgery is driven by different factors
  - SES, comorbidities, cancer severity, morbidity of the surgery

### AUC may not be the right measure of readmission model performance

- AUC compares with a gold standard. What is the readmission gold standard?
- AUC is low compared with values for diagnostic tests, but approaches the best Medicare risk adjustment models
- Move to new ranking-based methodology

## Conclusion

- SES is critical to risk adjustment for urologic cancer surgery
- There is a differential impact of SES on risk-adjusted readmission rates for SNHs

Funded by Urology Care Foundation Research Scholars Award and the Society for Urologic Oncology

Urology Care  
FOUNDATION