Association Between Palliative Care Consultation and Outcomes in Patients Hospitalized with Acute Decompensated Heart Failure

NIS Analysis for the RCOP Match Mentorship Program

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## Preamble:

* **Reference Studies:**
  + [Kavalieratos et al., 2017](https://doi.org/10.1016/j.jacc.2017.08.036)
  + [Webb et al., 2025](https://doi.org/10.1016/j.cardfail.2024.06.005)
* **Study Objective:** To evaluate the association between palliative care consultation and in-hospital outcomes, healthcare resource utilization, and discharge disposition among patients hospitalized with acute decompensated heart failure, using a nationally representative U.S. inpatient database.
* **Data Source:** Retrospective cross-sectional analysis of the National Inpatient Sample (NIS) from 2018 to 2020. The NIS is part of the Healthcare Cost and Utilization Project (HCUP) and provides a stratified sample of inpatient discharges from U.S. community hospitals across all payers.
* **Cohort Definition:** Patients were included if they met the following criteria
  + Age ≥18 years
  + Hospitalization flagged as involving acute decompensated heart failure, identified using ICD-10-CM diagnosis codes (see below)
  + Non-missing data for palliative care consultation status
  + APR-DRG Risk of Mortality classification of “Major” or “Extreme” to ensure inclusion of patients with substantial illness severity, in whom palliative care consultation would be clinically relevant and to enhance comparability across groups
* **Exposure of Interest:** Palliative care consultation, defined by the presence of ICD-10-CM code Z51.5 (“Encounter for palliative care”) in any diagnosis position.
* **Outcomes of Interest:**
  + **Primary Outcome:**
    - In-hospital mortality
    - Length of stay (LOS), in days
    - Inflation-adjusted total hospital charges (2020 USD)
    - Favorable discharge, defined as routine discharge to home, home health care, SNF, intermediate care, or another facility
* **ICD-10 Code Definitions:**
  + **Heart Failure (inclusion diagnosis):**
    - ICD-10-CM:
      * I50.\* (Heart failure)
      * I0981, I110, I130, I132 (Hypertensive and rheumatic HF-related conditions)
      * I97130, I97131 (Postprocedural cardiac dysfunction)
      * O29121, O29122, O29123, O29129 (Pregnancy-related cardiac disease)
      * Z95811, Z95812 (Presence of heart assist devices or heart transplant status)
  + **Palliative Care Consultation (exposure):**
    - ICD-10-CM:
      * Z51.5\* (“Encounter for palliative care”)
* **Covariates for Adjustment:** All models adjusted for
  + **Demographic Factors:** Age, sex, race/ethnicity
  + **Socioeconomic Factors:** Primary payer, ZIP code–level income quartile
  + **Clinical Factors:** Elixhauser comorbidity index (aggregate score), APR-DRG risk of mortality
  + **Hospital-Level Factors:** Hospital region, bed size, teaching status, and urban/rural location
* **Statistical Methods:**
  + **Univariable Analysis:**
    - Categorical variables: Compared using Pearson’s chi-square test with Rao & Scott adjustment
    - Continuous variables: Analyzed using the design-based Kruskal–Wallis test, a non-parametric alternative suitable for survey-weighted data
  + **Multivariable Analysis:**
    - Binary outcomes (e.g., mortality, favorable discharge): Modeled using survey-weighted logistic regression with the quasibinomial family
    - Continuous outcomes (e.g., LOS, total charges): Modeled using survey-weighted linear regression with the gaussian family
    - All estimates were reported as adjusted odds ratios (aORs) or beta coefficients, with 95% confidence intervals
* **Software:** All statistical analyses were performed using the R Statistical Language (Version 4.5.0; R Foundation for Statistical Computing, Vienna, Austria), incorporating survey-weighted procedures via the *survey* package to account for the complex sampling design of NIS.

## Baseline table:

| **Characteristic** | **Overall** N = 2,358,740*1* | **No** N = 2,195,520*1* | **Yes** N = 163,220*1* | **p-value***2* |
| --- | --- | --- | --- | --- |
| Age, y | 72 (14) | 72 (14) | 78 (12) | <0.001 |
| Sex |  |  |  | <0.001 |
| Female | 1,120,585 (48%) | 1,039,045 (47%) | 81,540 (50%) |  |
| Male | 1,238,075 (52%) | 1,156,400 (53%) | 81,675 (50%) |  |
| Race |  |  |  | <0.001 |
| White | 1,539,080 (67%) | 1,418,035 (66%) | 121,045 (76%) |  |
| Asian or Pacific Islander | 53,065 (2.3%) | 49,785 (2.3%) | 3,280 (2.1%) |  |
| Black | 464,795 (20%) | 442,880 (21%) | 21,915 (14%) |  |
| Hispanic | 191,765 (8.3%) | 181,870 (8.4%) | 9,895 (6.2%) |  |
| Other | 64,775 (2.8%) | 61,155 (2.8%) | 3,620 (2.3%) |  |
| Insurance payer |  |  |  | <0.001 |
| Medicaid | 228,390 (9.7%) | 219,885 (10%) | 8,505 (5.2%) |  |
| Medicare | 1,782,455 (76%) | 1,647,430 (75%) | 135,025 (83%) |  |
| Other | 98,380 (4.2%) | 92,575 (4.2%) | 5,805 (3.6%) |  |
| Private | 247,335 (10%) | 233,595 (11%) | 13,740 (8.4%) |  |
| Income quartile |  |  |  | <0.001 |
| $1 - $51,999 | 754,715 (33%) | 713,445 (33%) | 41,270 (26%) |  |
| $52,000 - $65,999 | 625,095 (27%) | 581,350 (27%) | 43,745 (27%) |  |
| $66,000 - $87,999 | 533,045 (23%) | 492,235 (23%) | 40,810 (25%) |  |
| $88,000 or more | 406,045 (18%) | 370,850 (17%) | 35,195 (22%) |  |
| Hospital region |  |  |  | <0.001 |
| Midwest | 556,800 (24%) | 513,610 (23%) | 43,190 (26%) |  |
| Northeast | 428,570 (18%) | 397,780 (18%) | 30,790 (19%) |  |
| South | 945,445 (40%) | 886,060 (40%) | 59,385 (36%) |  |
| West | 427,925 (18%) | 398,070 (18%) | 29,855 (18%) |  |
| Hospital bedsize |  |  |  | <0.001 |
| Large | 1,134,805 (48%) | 1,050,205 (48%) | 84,600 (52%) |  |
| Medium | 695,880 (30%) | 649,280 (30%) | 46,600 (29%) |  |
| Small | 528,055 (22%) | 496,035 (23%) | 32,020 (20%) |  |
| Hospital location/teaching status |  |  |  | <0.001 |
| Rural | 216,580 (9.2%) | 205,370 (9.4%) | 11,210 (6.9%) |  |
| Urban, non-teaching | 469,230 (20%) | 440,745 (20%) | 28,485 (17%) |  |
| Urban, teaching | 1,672,930 (71%) | 1,549,405 (71%) | 123,525 (76%) |  |
| APR-DRG risk of mortality |  |  |  | <0.001 |
| Extreme | 729,665 (31%) | 643,515 (29%) | 86,150 (53%) |  |
| Major | 1,629,075 (69%) | 1,552,005 (71%) | 77,070 (47%) |  |
| No. of comorbidities |  |  |  | <0.001 |
| One comorbidity | 127,815 (5.4%) | 119,770 (5.5%) | 8,045 (4.9%) |  |
| Two or more comorbidities | 2,230,925 (95%) | 2,075,750 (95%) | 155,175 (95%) |  |
| *1*Mean (SD); n (%) | | | | |
| *2*Design-based KruskalWallis test; Pearson's X^2: Rao & Scott adjustment | | | | |

## Univariable analysis:

| **Characteristic** | **Overall** N = 2,358,740*1* | **No** N = 2,195,520*1* | **Yes** N = 163,220*1* | **p-value***2* |
| --- | --- | --- | --- | --- |
| In-hospital mortality | 90,155 (3.8%) | 47,715 (2.2%) | 42,440 (26%) | <0.001 |
| Length of stay (days) | 5.0 (3.0, 8.0) | 5.0 (3.0, 8.0) | 6.0 (3.0, 10.0) | <0.001 |
| Inflation-adjusted total charge ($) | 40,947 (23,904, 74,178) | 40,470 (23,752, 72,883) | 48,768 (26,712, 94,615) | <0.001 |
| Favorable discharge | 2,164,770 (92%) | 2,046,615 (93%) | 118,155 (72%) | <0.001 |
| *1*n (%); Median (Q1, Q3) | | | | |
| *2*Pearson's X^2: Rao & Scott adjustment; Design-based KruskalWallis test | | | | |

## Multivariable logistic regression:

### In-hospital mortality:

| **Characteristic** | **OR** | **95% CI** | **p-value** |
| --- | --- | --- | --- |
| Palliative care encounter |  |  |  |
| No | — | — |  |
| Yes | 11.5 | 11.1, 12.0 | <0.001 |
| Age, y | 1.01 | 1.01, 1.01 | <0.001 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 1.14 | 1.10, 1.18 | <0.001 |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 1.00 | 0.89, 1.12 | >0.9 |
| Black | 0.83 | 0.79, 0.88 | <0.001 |
| Hispanic | 0.91 | 0.85, 0.98 | 0.011 |
| Other | 1.06 | 0.95, 1.17 | 0.3 |
| Insurance payer |  |  |  |
| Medicaid | — | — |  |
| Medicare | 1.06 | 0.98, 1.15 | 0.13 |
| Other | 1.33 | 1.19, 1.49 | <0.001 |
| Private | 1.27 | 1.16, 1.39 | <0.001 |
| Income quartile |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | 0.93 | 0.89, 0.98 | 0.003 |
| $66,000 - $87,999 | 0.90 | 0.85, 0.94 | <0.001 |
| $88,000 or more | 0.91 | 0.86, 0.96 | 0.001 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 1.54 | 1.43, 1.64 | <0.001 |
| South | 1.15 | 1.09, 1.22 | <0.001 |
| West | 1.23 | 1.15, 1.31 | <0.001 |
| Hospital bedsize |  |  |  |
| Large | — | — |  |
| Medium | 0.92 | 0.88, 0.97 | <0.001 |
| Small | 0.95 | 0.89, 1.00 | 0.050 |
| Hospital location/teaching status |  |  |  |
| Rural | — | — |  |
| Urban, non-teaching | 0.77 | 0.71, 0.83 | <0.001 |
| Urban, teaching | 0.78 | 0.72, 0.84 | <0.001 |
| APR-DRG risk of mortality |  |  |  |
| Extreme | — | — |  |
| Major | 0.18 | 0.17, 0.19 | <0.001 |
| Elixhauser comorbidity index | 1.06 | 1.05, 1.07 | <0.001 |
| Abbreviations: CI = Confidence Interval, OR = Odds Ratio | | | |

### Favorable discharge:

| **Characteristic** | **OR** | **95% CI** | **p-value** |
| --- | --- | --- | --- |
| Palliative care encounter |  |  |  |
| No | — | — |  |
| Yes | 0.19 | 0.18, 0.19 | <0.001 |
| Age, y | 1.02 | 1.02, 1.02 | <0.001 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 0.76 | 0.74, 0.77 | <0.001 |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 1.08 | 1.00, 1.17 | 0.047 |
| Black | 1.09 | 1.05, 1.13 | <0.001 |
| Hispanic | 1.11 | 1.06, 1.17 | <0.001 |
| Other | 0.92 | 0.86, 0.98 | 0.011 |
| Insurance payer |  |  |  |
| Medicaid | — | — |  |
| Medicare | 1.21 | 1.16, 1.26 | <0.001 |
| Other | 0.96 | 0.90, 1.02 | 0.2 |
| Private | 1.09 | 1.04, 1.14 | <0.001 |
| Income quartile |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | 1.03 | 1.00, 1.07 | 0.046 |
| $66,000 - $87,999 | 1.05 | 1.01, 1.09 | 0.010 |
| $88,000 or more | 1.02 | 0.98, 1.06 | 0.5 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 0.71 | 0.68, 0.75 | <0.001 |
| South | 0.97 | 0.93, 1.00 | 0.084 |
| West | 0.80 | 0.76, 0.84 | <0.001 |
| Hospital bedsize |  |  |  |
| Large | — | — |  |
| Medium | 0.82 | 0.79, 0.85 | <0.001 |
| Small | 0.62 | 0.60, 0.65 | <0.001 |
| Hospital location/teaching status |  |  |  |
| Rural | — | — |  |
| Urban, non-teaching | 1.59 | 1.50, 1.67 | <0.001 |
| Urban, teaching | 2.27 | 2.17, 2.39 | <0.001 |
| APR-DRG risk of mortality |  |  |  |
| Extreme | — | — |  |
| Major | 2.70 | 2.64, 2.77 | <0.001 |
| Elixhauser comorbidity index | 0.99 | 0.99, 1.00 | 0.077 |
| Abbreviations: CI = Confidence Interval, OR = Odds Ratio | | | |

## Multivariable linear regression:

### Length of stay:

| **Characteristic** | **Beta** | **95% CI** | **p-value** |
| --- | --- | --- | --- |
| Palliative care encounter |  |  |  |
| No | — | — |  |
| Yes | 1.5 | 1.3, 1.6 | <0.001 |
| Age, y | -0.04 | -0.04, -0.04 | <0.001 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 0.05 | 0.01, 0.09 | 0.017 |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 0.13 | -0.04, 0.30 | 0.13 |
| Black | 0.06 | -0.02, 0.13 | 0.14 |
| Hispanic | -0.02 | -0.12, 0.09 | 0.7 |
| Other | 0.24 | 0.09, 0.40 | 0.003 |
| Insurance payer |  |  |  |
| Medicaid | — | — |  |
| Medicare | -0.14 | -0.24, -0.03 | 0.012 |
| Other | -0.35 | -0.49, -0.20 | <0.001 |
| Private | 0.32 | 0.18, 0.47 | <0.001 |
| Income quartile |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | 0.06 | 0.00, 0.12 | 0.049 |
| $66,000 - $87,999 | 0.08 | 0.01, 0.15 | 0.019 |
| $88,000 or more | 0.24 | 0.15, 0.34 | <0.001 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 1.3 | 1.2, 1.5 | <0.001 |
| South | 0.45 | 0.33, 0.57 | <0.001 |
| West | -0.50 | -0.64, -0.36 | <0.001 |
| Hospital bedsize |  |  |  |
| Large | — | — |  |
| Medium | -1.0 | -1.2, -0.95 | <0.001 |
| Small | -1.5 | -1.6, -1.4 | <0.001 |
| Hospital location/teaching status |  |  |  |
| Rural | — | — |  |
| Urban, non-teaching | 0.65 | 0.55, 0.74 | <0.001 |
| Urban, teaching | 1.6 | 1.5, 1.7 | <0.001 |
| APR-DRG risk of mortality |  |  |  |
| Extreme | — | — |  |
| Major | -2.6 | -2.7, -2.5 | <0.001 |
| Elixhauser comorbidity index | 0.52 | 0.50, 0.53 | <0.001 |
| Abbreviation: CI = Confidence Interval | | | |

### Inflation-adjusted total charge:

| **Characteristic** | **Beta** | **95% CI** | **p-value** |
| --- | --- | --- | --- |
| Palliative care encounter |  |  |  |
| No | — | — |  |
| Yes | 17,189 | 13,334, 21,044 | <0.001 |
| Age, y | -1,178 | -1,270, -1,085 | <0.001 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 5,756 | 4,895, 6,617 | <0.001 |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 14,205 | 8,844, 19,566 | <0.001 |
| Black | -766 | -2,446, 914 | 0.4 |
| Hispanic | 13,848 | 11,187, 16,509 | <0.001 |
| Other | 15,149 | 10,535, 19,763 | <0.001 |
| Insurance payer |  |  |  |
| Medicaid | — | — |  |
| Medicare | 6,679 | 4,260, 9,097 | <0.001 |
| Other | -1,387 | -4,204, 1,430 | 0.3 |
| Private | 21,520 | 17,275, 25,765 | <0.001 |
| Income quartile |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | 2,913 | 1,481, 4,346 | <0.001 |
| $66,000 - $87,999 | 4,107 | 2,433, 5,781 | <0.001 |
| $88,000 or more | 11,432 | 8,852, 14,012 | <0.001 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 27,464 | 22,973, 31,954 | <0.001 |
| South | 13,840 | 11,101, 16,580 | <0.001 |
| West | 28,311 | 22,840, 33,782 | <0.001 |
| Hospital bedsize |  |  |  |
| Large | — | — |  |
| Medium | -19,585 | -22,774, -16,396 | <0.001 |
| Small | -27,314 | -30,368, -24,259 | <0.001 |
| Hospital location/teaching status |  |  |  |
| Rural | — | — |  |
| Urban, non-teaching | 19,050 | 17,010, 21,090 | <0.001 |
| Urban, teaching | 32,785 | 30,617, 34,952 | <0.001 |
| APR-DRG risk of mortality |  |  |  |
| Extreme | — | — |  |
| Major | -48,647 | -51,122, -46,171 | <0.001 |
| Elixhauser comorbidity index | 6,228 | 5,788, 6,669 | <0.001 |
| Abbreviation: CI = Confidence Interval | | | |