90-Day Readmissions After Pancreaticoduodenectomy For Pancreatic Cancer

2025\_June\_NRD\_A27\_90Days

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## Preamble:

* **Reference Studies:**
  + [Aguayo et al., 2020](https://www.journalofsurgicalresearch.com/article/S0022-4804(20)30359-0/abstract)
* **Study Objective:**
* To identify patient- and hospital-level predictors of 90-day all-cause hospital readmission among adults hospitalized with pancreatic cancer undergoing pancreaticoduodenectomy using a nationally representative dataset. This study also evaluates the clinical and economic burden of readmission in this high-risk population, including its associations with in-hospital mortality, length of stay (LOS), and hospital charges.
* **Data Source:**
* A retrospective cohort study using the 2016–2017 Nationwide Readmissions Database (NRD), developed by the Healthcare Cost and Utilization Project (HCUP). The NRD enables tracking of individual patients across hospitalizations within a given year via synthetic identifiers, capturing discharges from U.S. community hospitals and supporting survey-weighted national estimates through complex sampling design.
* **Cohort Definition:**
* Index hospitalizations were included if they met all of the following criteria:
  + Adults aged ≥18 years
  + Had a diagnosis of pancreatic cancer (C25)
  + Undergoing pancreaticoduodenectomy
  + Non-elective admission
  + Index discharge by the end of November to allow for a complete 90-day follow-up period
  + Complete data on LOS and NRD\_DAYSTOEVENT, required to compute discharge dates
* **Outcomes of Interest:**
  + Primary Outcome:
    - Binary indicator of 90-day readmission (Yes/No)
  + Secondary Outcomes:
    - In-hospital mortality (binary)
    - Length of stay (LOS, in days)
    - Total hospitalization charges (inflation-adjusted to 2017 USD)
* **Outcome Definitions:**
  + Readmission:
    - Defined using NRD’s linkage variables. Readmissions were identified only among patients with qualifying index events.
    - Trauma-related hospitalizations were excluded only from the readmission pool to avoid injury-related returns.
  + Mortality:
    - In-hospital death recorded during index or readmission (DIED = 1)
  + LOS:
    - Reported in days; modeled as count outcome
  + Charge:
    - Derived from HCUP’s TOTCHG variable and adjusted to 2017 dollars using Consumer Price Index (CPI) data
* **Covariates:**
  + Demographic & Socioeconomic Factors:
    - Age (categorized: 18–49, 50–64, 65–79, 80+)
    - Sex
    - Primary expected payer (Insurance; Medicare, Medicaid, Private, Other)
    - ZIP-based median income quartile
  + Clinical Characteristics:
    - Elixhauser comorbidity index
  + Hospital Characteristics:
    - Hospital bed size (Small, Medium, Large)
    - Urban/rural teaching status (Metropolitan, teaching vs non-teaching, etc.)
* **Statistical Methods:**
  + Survey Design and Weighting:
    - All analyses incorporated NRD’s complex sampling design via the survey and srvyr packages.
  + Descriptive Statistics:
    - Weighted baseline characteristics of index hospitalizations were summarized and stratified by 90-day readmission status to compare patients who were readmitted versus those who were not.
    - Stratification was performed using a derived binary variable, which categorized patients as:
      * With 90-day readmission
      * Without readmission
    - P-values from statistical tests (Rao–Scott adjusted chi-square for categorical variables; Kruskal–Wallis test for continuous variables).
    - The five most common principle diagnoses for readmission were reported according to decreasing prevalence
  + Multivariable Regression:
    - A survey-weighted logistic regression modeled predictors of 90-day readmission.
    - The model included demographic, clinical, hospital-level, and index-stay factors.
    - Results were exponentiated to yield odds ratios (ORs) with 95% confidence intervals.
* **Software:** All analyses were conducted in R Statistical Language (Version 4.5.0; R Foundation for Statistical Computing, Vienna, Austria).

## Descriptive Analyses

### Baseline Characteristics

| **Characteristic** | **Overall** N = 2,111*1* | **Without Readmission** N = 1,584*1* | **With 90-day readmission** N = 527*1* | **p-value***2* |
| --- | --- | --- | --- | --- |
| Age (years) |  |  |  | 0.7 |
| 18–49 | 124 (5.9%) | 97 (6.1%) | 27 (5.1%) |  |
| 50–64 | 651 (31%) | 477 (30%) | 174 (33%) |  |
| 65–79 | 1,098 (52%) | 822 (52%) | 275 (52%) |  |
| 80+ | 239 (11%) | 188 (12%) | 51 (9.8%) |  |
| Sex |  |  |  | 0.5 |
| Male | 1,103 (52%) | 815 (51%) | 288 (55%) |  |
| Female | 1,009 (48%) | 769 (49%) | 240 (45%) |  |
| Median Income Quartile |  |  |  | 0.8 |
| 0-25th percentile | 626 (30%) | 461 (30%) | 165 (32%) |  |
| 26th to 50th percentile | 490 (24%) | 375 (24%) | 115 (22%) |  |
| 51st to 75th percentile | 498 (24%) | 377 (24%) | 120 (23%) |  |
| 76th to 100th percentile | 457 (22%) | 335 (22%) | 122 (23%) |  |
| Hospital Bed Size |  |  |  | 0.5 |
| Small | 83 (3.9%) | 57 (3.6%) | 26 (4.9%) |  |
| Large | 1,505 (71%) | 1,148 (72%) | 357 (68%) |  |
| Medium | 523 (25%) | 379 (24%) | 144 (27%) |  |
| Hospital Teaching Status |  |  |  | 0.057 |
| Metropolitan, non-teaching | 219 (10%) | 159 (10%) | 60 (11%) |  |
| Metropolitan, teaching | 1,865 (88%) | 1,411 (89%) | 454 (86%) |  |
| Non-metropolitan | 27 (1.3%) | 14 (0.9%) | 13 (2.5%) |  |
| Insurance |  |  |  | 0.8 |
| Private | 539 (26%) | 410 (26%) | 129 (24%) |  |
| Medicaid | 234 (11%) | 166 (11%) | 68 (13%) |  |
| Medicare | 1,257 (60%) | 946 (60%) | 311 (59%) |  |
| Other | 79 (3.8%) | 59 (3.8%) | 20 (3.7%) |  |
| Elixhauser comorbidity index | 4.96 (2.11) | 4.91 (2.09) | 5.12 (2.16) | 0.3 |
| *1*n (%); Mean (SD) | | | | |
| *2*Pearson's X^2: Rao & Scott adjustment; Design-based KruskalWallis test | | | | |

## Readmission Hospitalization Characteristics

### In-Hospital Mortality Among Readmitted Patients

Readmission hospitalizations resulted in:

1. Deaths (n): 17
2. Death Rate (%): 3.3%
3. Death Rate (95% CI): 1.13% to 5.47%

### Resource Utilization During Readmission

Readmission hospitalizations resulted in:

1. Median Length of Stay (IQR), days: 4 (IQR: 3–7)
2. Median Total Charges (IQR): $38,584 (IQR: $19,612–$62,295)

## Top causes of readmission

| Diagnosis Code | ICD-10 Description | Proportion |
| --- | --- | --- |
| A41 | Other sepsis | 0.1410 |
| C25 | Malignant neoplasm of pancreas | 0.1140 |
| E86 | Volume depletion | 0.0451 |
| K31 | Other diseases of stomach and duodenum | 0.0335 |
| G89 | Pain, not elsewhere classified | 0.0334 |

## Multivariable Regression

### 90-Day Readmission:

| **Characteristic** | **OR** | **95% CI** | **p-value** |
| --- | --- | --- | --- |
| Age (years) | 0.99 | 0.96, 1.01 | 0.2 |
| Sex |  |  |  |
| Male | — | — |  |
| Female | 0.88 | 0.62, 1.27 | 0.5 |
| Median Income Quartile |  |  |  |
| 0-25th percentile | — | — |  |
| 26th to 50th percentile | 0.89 | 0.58, 1.37 | 0.6 |
| 51st to 75th percentile | 0.94 | 0.59, 1.51 | 0.8 |
| 76th to 100th percentile | 1.08 | 0.61, 1.90 | 0.8 |
| Hospital Bed Size |  |  |  |
| Small | — | — |  |
| Large | 0.67 | 0.34, 1.30 | 0.2 |
| Medium | 0.87 | 0.38, 1.98 | 0.7 |
| Hospital Teaching Status |  |  |  |
| Metropolitan, non-teaching | — | — |  |
| Metropolitan, teaching | 0.85 | 0.56, 1.27 | 0.4 |
| Non-metropolitan | 2.69 | 0.91, 7.96 | 0.073 |
| Insurance |  |  |  |
| Private | — | — |  |
| Medicaid | 1.30 | 0.71, 2.37 | 0.4 |
| Medicare | 1.23 | 0.64, 2.34 | 0.5 |
| Other | 1.14 | 0.54, 2.41 | 0.7 |
| Elixhauser comorbidity index | 1.04 | 0.97, 1.12 | 0.2 |
| Abbreviations: CI = Confidence Interval, OR = Odds Ratio | | | |