***Supplemental Appendices\***

**1. Instrumental variable analysis**

Description of instrumental variable analyses

Two-stage residual inclusion (2SRI) is a method for instrumental variable analysis appropriate for the setting of exposure and outcome variables which are not normally distributed continuous measures (and therefore do not meet the assumptions required for valid two stage least squares estimation(2SLS)[27][24–26]).

The first stage of this process employed a logistic regression model to predict the probability of receipt of a PNB conditional on age (restricted cubic spline with 5 knots), biological sex (binary), neighborhood income quintile (5-level categorical variable), rurality (binary), procedure (categorical), HOMR score (continuous linear), each Elixhauser comorbidity (binary), each specified drug class (binary), year of surgery (categorical), resource utilization band (categorical), frailty (binary) and preoperative long-term care residence (binary) plus the instrumental variable (proportion of patients at the same hospital who received a PNB in the previous year; continuous).

The second stage model was a generalized linear model with a log link and gamma response distribution. Postoperative LoS was the dependent variable, receipt of a PNB was the exposure of interest, the raw residual from the first stage model was included, and covariate adjustment was made for age (restricted cubic spline with 5 knots), biological sex (binary), neighborhood income quintile (5-level categorical variable), rurality (binary), procedure (categorical), HOMR score (continuous linear), each Elixhauser comorbidity (binary), each specified drug class (binary), year of surgery (categorical), resource utilization band (categorical), frailty (binary) and preoperative long-term care residence (binary).

We calculated both the regression coefficient and the attributable effect size estimate (i.e., difference in days between exposure groups) using bootstrap techniques. All 2SRI effect estimate and 95% confidence intervals were calculated using 1000 bootstrap samples that were created with a 1:1 sampling rate with replacement. Confidence intervals were based on the 2.5th and 97.5th percentiles. To estimate the regression coefficient, our model was run in each of the 1000 bootstrap samples and the regression coefficient was based on the median value for the exposure of interest. For the attributable effect size estimate, we predicted the LoS for all individuals using the primary adjusted regression model, and the difference in days was based on the median difference between the predicted LoS values for comparing those who did and did not receive a PNB in each bootstrap sample.

We tested the robustness of our IV estimation in two additional analyses. First, because we lack consensus on the type of residual (e.g., raw vs. a variety of available scaled residuals) most appropriate for 2SRI analyses, we re-calculated the attributable days using deviance scaled residuals (as opposed to the raw residuals used in the first 2SRI analysis). We also completed a 2SLS analysis (using the same covariate adjustment above) using PROC SYSLIN in SAS.

Results of additional instrumental variable analyses

*2SRI with deviance residuals:* Adjusted decrease in LOS 1.04, 95%CI 0.89-1.18

*2SLS:* 2.25 day decrease in LOS with PNB, 95%CI 1.47-3.03

**2. Propensity score analysis**

Description of propensity score analysis

The second additional approach was a propensity score matched analysis where each individual who received a PNB was matched 1:1 to an individual without a PNB. The propensity score was generated from a logistic regression model that predicted receipt of a PNB with the following predictor variables: age (restricted cubic spline with 5 knots), biological sex (binary), neighborhood income quintile (5-level categorical variable), rurality (binary), procedure (categorical), HOMR score (continuous linear), each Elixhauser comorbidity (binary), each specified drug class (binary), year of surgery (categorical), resource utilization band (categorical), frailty (binary) and preoperative long-term care residence (binary).

The match was made exactly on hospital (to account for clustering) and then using a caliper equivalent to 0.2 standard deviations of the logit of the propensity score and employing a greedy matching algorithm. This process resulted in successful matching of 8 261 (82.4%) of patients who received a PNB to a similar patient from the same hospital who did not receive a PNB. Absolute standardized differences (ASD) for all measured covariates were <0.10 between matched groups, and overall standardized differences across variables decreased from 0.104 to 0.01 after matching.

Comparison between the matched PNB and no PNB groups were calculated using a generalized linear model with a log link and gamma distributed error that accounted for the paired nature of the data.

**Hospital fixed-effects analysis**

Description of hospital fixed-effects analysis

The third additional approach, post-hoc as it was reviewer-requested, was a regression analysis that adjusted for all of the measured covariates plus a categorical variable which represented each hospital as a fixed effect. All covariates included in the primary generalized linear model with a log link and gamma response distributions were added, with length of stay as the dependent variable and, instead of clustering at the hospital-level, we included the hospital indicator variable as a fixed effect.

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| --- | --- | --- | --- | --- |
| **SDC Table - Characteristics of Population by High (>8%) vs Low (<8%) Peripheral Nerve Block Use** | | | | |
|  |  | **High PNB n=10 030** | **Low PNB n=55 241** | **ASD†** |
| **Demographics** |  |  |  |  |
| Age at surgery (years; mean (SD)) |  | 79 (14) | 78 (14) | 0.07 |
| Female |  | 68.8 | 67.8 | 0.04 |
| Income Quintile | 1 (lowest) | 21.8 | 22.1 | 0.01 |
|  | 2 | 19.6 | 21.1 | 0.05 |
|  | 3 | 19.5 | 20.0 | 0.00 |
|  | 4 | 19.5 | 19.0 | 0.01 |
|  | 5 (highest) | 19.5 | 17.9 | 0.04 |
| Year of surgery | 2011 | 21.3 | 16.0 | 0.07 |
|  | 2012 | 22.0 | 17.4 | 0.04 |
|  | 2013 | 20.7 | 21.1 | 0.01 |
|  | 2014 | 17.9 | 22.9 | 0.03 |
|  | 2015 | 18.1 | 22.5 | 0.14 |
| **Comorbidities** |  |  |  |  |
| Alcohol abuse |  | 3.7 | 3.4 | 0.05 |
| Atrial arrhythmia |  | 8.7 | 8.5 | 0.01 |
| Blood loss anemia |  | 18.1 | 18.4 | 0.05 |
| Cardiac valve disease |  | 3.2 | 3.4 | 0.01 |
| Coagulopathy |  | 2.7 | 2.6 | 0.03 |
| Chronic obstructive pulmonary disease |  | 11.8 | 11.7 | 0.03 |
| Cerebrovascular disease |  | 4.9 | 4.9 | 0.01 |
| Disease of pulmonary circulation |  | 2.5 | 2.4 | 0.02 |
| Dementia |  | 17.6 | 18.3 | 0.01 |
| Depression |  | 4.7 | 5.0 | 0.01 |
| Deficiency anemia |  | 0.6 | 0.6 | 0.00 |
| Diabetes mellitus without complications |  | 13.4 | 13.8 | 0.00 |
| Diabetes mellitus with complications |  | 14.1 | 13.9 | 0.02 |
| Dialysis |  | 1.5 | 1.5 | 0.02 |
| Drug abuse |  | 0.8 | 0.9 | 0.02 |
| Heart failure |  | 21.2 | 21.0 | 0.01 |
| Hemiplegia |  | 0.9 | 0.8 | 0.02 |
| Hypertension without complications |  | 39.8 | 43.5 | 0.04 |
| Hypertension with complications |  | 0.9 | 0.9 | 0.01 |
| Liver disease |  | 1.4 | 1.5 | 0.00 |
| Malignancy |  | 6.7 | 6.5 | 0.02 |
| Metastases |  | 1.9 | 2.1 | 0.00 |
| Obesity |  | 1.4 | 1.7 | 0.01 |
| Peptic ulcer disease |  | 1.5 | 1.5 | 0.00 |
| Peripheral vascular disease |  | 2.5 | 2.3 | 0.01 |
| Psychoses |  | 1.0 | 1.0 | 0.01 |
| Renal disease |  | 4.1 | 4.1 | 0.00 |
| Rheumatic disease |  | 1.3 | 1.1 | 0.03 |
| Venous thromboembolism |  | 0.8 | 0.7 | 0.01 |
| Weight loss |  | 3.5 | 3.2 | 0.00 |
| Frail |  | 60.2 | 61.2 | 0.01 |
| **One-year mortality risk** |  |  |  |  |
| HOMR score (mean (SD)) |  | 37 (7) | 37 (7) | 0.01 |
| **Medications** |  |  |  |  |
| Anticoagulant |  | 13.0 | 13.0 | 0.02 |
| Antiplatetlet agent |  | 7.3 | 7.6 | 0.02 |
| Antipsychotic |  | 11.4 | 10.2 | 0.03 |
| Benzodiazepine |  | 17.5 | 16.5 | 0.02 |
| Opioid |  | 21.8 | 22.5 | 0.00 |
| Dementia medication |  | 7.8 | 7.6 | 0.01 |
| **Healthcare resource use** |  |  |  |  |
| Long term care facility |  | 14.9 | 15.5 | 0.01 |
| Resource utilization band | 2 (lowest) | 2.4 | 2.0 | 0.01 |
|  | 3 | 14.0 | 13.4 | 0.00 |
|  | 4 | 23.5 | 24.2 | 0.02 |
|  | 5 (highest) | 60.1 | 60.4 | 0.01 |
| **Procedure** |  |  |  |  |
| Implantation of internal device, pelvis |  | 0.3 | 0.2 | 0.02 |
| Implantation of internal device, hip joint |  | 39 | 35.6 | 0.07 |
| Fixation, hip joint |  | 17.1 | 21.6 | 0.09 |
| Fixation, femur |  | 50.8 | 49.2 | 0.01 |
| \*all+A1:E68 column values indicate n (%) unless otherwise indicated; †values grater than 0.10 indicate a substantial difference; ASD: absolute standardized difference; PNB: Peripheral Nerve Block SD standard deviation; HOMR: Hospital One-Year Mortality Risk | | | | |