500 Class 08 (Zoom)

https://thomaselove.github.io/500-2024/

2024-03-07

Agenda for Today's Zoom

- How did Lab 3 go?
- Tanenbaum (2017) paper
- Rosenbaum Chapter 7 discussion

Section 1

Tanenbaum JE et al. (2017) Propensity Matched Analysis of Outcomes and Hospital Charges for Anterior versus Posterior Cervical Fusion for Cervical Spondylotic Myelopathy

Propensity Matched Analysis of Outcomes and Hospital Charges for Anterior versus Posterior Cervical Fusion for Cervical Spondylotic Myelopathy

Joseph E Tanenbaum, BA[1,2,3,*], **Daniel Lubelski, MD**[1,3,4,6], **Benjamin P. Rosenbaum, MD**[1,3], **Edward C. Benzel, MD**[1,3], and **Thomas E Mroz, MD**[1,3,5]

Abstract for Tanenbaum et al. (1/4)

STUDY DESIGN: Retrospective analysis of data from the Nationwide Inpatient Sample (NIS), a nationally representative, all-payer database of inpatient diagnoses and procedures in the United States.

OBJECTIVE: To compare anterior cervical fusion (ACF) to posterior cervical fusion (PCF) in the treatment of cervical spondylotic myelopathy (CSM).

SUMMARY of BACKGROUND DATA: Previous studies used retrospective single-institution level data to quantify outcomes for CSM patients undergoing cervical fusion. It is unclear whether ACF or PCF is superior with regards to charges or outcomes for the treatment of CSM.

Abstract for Tanenbaum et al. (2/4)

METHODS: We used NIS data to compare ACF to PCF in the management of CSM. All patients 18 years or older with a diagnosis of CSM between 1998–2011 were included.

ACF patients were matched to PCF patients using propensity scores based on patient characteristics (number of levels fused, spine alignment, comorbidities), hospital characteristics, and patient demographics.

Multivariable regression was used to measure the effect of treatment assignment on in-hospital charges, length of hospital stay, in-hospital mortality, discharge disposition, and dysphagia diagnosis.

National Inpatient Sample (1/2)

This study used Nationwide Inpatient Sample (NIS) data from 1998–2011.

- Established by the Agency for Healthcare Research and Quality (AHRQ), the NIS is the largest all-payer healthcare database in the United States.
- The NIS contains a 20% stratified sample of all hospital discharges from 1988–2011.
- Within the database, each entry corresponds to a single hospital admission.

National Inpatient Sample (2/2)

- Using the NIS, national estimates can be generated by assigning weighted values to each hospital discharge.
- The NIS includes data on patient demographics, comorbidities, diagnoses, procedures performed, outcomes (e.g., length of hospital stay, hospital charges, mortality), and hospital features.
- Finally, the NIS codes admission diagnoses, procedures, and in-hospital complications using ICD-9-CM codes.
- In order to mitigate bias, data were used starting in 1998 because the sampling strategy of the NIS changed that year.
- Furthermore, Elixhauser comorbidity data were collected beginning in 1998.

Elixhauser Comorbidity Index

The Elixhauser Index is a composition of thirty comorbidities characterizing significant conditions associated with in-hospital mortality, including acute and chronic comorbidities.

- The Elixhauser index allows for standardized risk adjustment in administrative databases such as the NIS.
- The Elixhauser Index Score ranges from zero to thirty, with zero indicating that a patient has none of the thirty comorbidities and thirty indicating that a patient has all thirty of the comorbidities.

Matched Cohorts

We generated matched cohorts using a propensity scoring method to minimize the effect of baseline characteristic imbalances between the ACF and PCF cohorts.

- We assigned a propensity score to each hospitalization based on the likelihood of treatment using a multivariable logistic regression that included number of levels fused, spine alignment, patient demographics, hospital characteristics, and payment source as covariates.
- Similar propensity scores between the two cohorts were matched using a nearest-neighbor method within .02 standard deviations of the calculated score without replacement.

Table 1 includes about 16 covariates

Table 1

Baseline Characteristics and Demographics

	ACF (N=45,629)	PCF (N=14,439)	P-value
Age (year) ± SD	57.6±12.1	62.6±12.0	<0.001 *
Admission Type			
Elective	77.00%	71.80%	<0.001 *
Emergent	5.75%	9.52%	<0.001 *
Urgent Care	6.87%	7.89%	<0.001 *
Weekend Admission	2.58%	4.06%	<0.001 *
Elixhauser Index Score ± SD	1.4±1.4	2.0±1.6	<0.001 *
Female	46.70%	39.90%	<0.001 *

More on Propensity Analyses

- All covariates from Table 1 (see previous slide) were used to generate a propensity score. We matched 11,671 (pairs of) PCF (and) ACF patients.
- Following the work of Rosenbaum and Rubin, we used a standardized difference with an absolute value greater than 0.10 to determine significance in assessing balance across all measured covariates.
- The variables found to be unbalanced across the two cohorts following matching were included in the final regressions.

Table 2 shows covariates after matching

Table 2

Baseline Characteristics and Demographics for Matched Cohorts

	ACF (N=11,671)	PCF (N=11,671)	Standardized Difference
Age			
Under 30	1%	1%	0.001
Under 40	3%	3%	−0.01
Under 50	14%	16%	−0.065
Under 60	38%	42%	−0.092
Under 70	67%	71%	−0.079
Under 80	91%	92%	−0.027
Admission Type			
Elective	69%	70%	−0.02
Emergent	12%	11%	0.022
Urgent Care	9%	9%	0.003
Weekend Admission	5%	5%	−0.003
Elixhauser Index Score			
0	16%	18%	−0.07
1	25%	26%	−0.022

Five Outcome Models

- A multivariable linear regression model was used to measure the effect of treatment assignment (ACF vs. PCF) and propensity score on **LOS** and **hospital charges**.
- A multivariable logistic regression model was used to measure the effect of treatment assignment and propensity score on **in-hospital mortality**, **discharge disposition**, and **dysphagia diagnosis**.

Abstract for Tanenbaum et al. (3/4)

RESULTS: From 1998–2011, we identified 109,728 hospitalizations with a CSM diagnosis. Of these patients, 45,629 (41.6%) underwent ACF and 14,439 (13.2%) underwent PCF.

The PCF cohort incurred an average of $41,683 more in-hospital charges ($p<0.001$, inflation adjusted to 2011 dollars) and remained in hospital an average of 2.4 days longer ($p<0.001$) than the ACF cohort.

The ACF cohort was just as likely to die in the hospital (OR 0.91, 95% CI 0.68–1.2), 3.0 times more likely to be discharged to home or self-care (95% CI 2.9–3.2), and 2.5 times more likely to experience dysphagia (95% CI 2.0–3.1) than the PCF cohort.

Stability (Sensitivity) Analysis

We also performed a sensitivity analysis by first increasing and then decreasing the number of standard deviations used in the matching algorithm. These two analyses yielded similar results to those described above.

Abstract for Tanenbaum et al. (4/4)

CONCLUSIONS: In treating CSM, ACF led to lower hospital charges, shorter hospital stays, and an increased likelihood of being discharged to home relative to PCF.

Section 2

Discussion of Rosenbaum, Chapter 7

Some Rosenbaum Chapter 7 highlights

Natural Experiments, Discontinuities and Instruments

- Bits and Pieces of Random Assignment in an Otherwise Biased World
  - "Nature has its own lotteries"
- Nature's Natural Experiments
  - The Genes of Siblings (Vaidya et al. on Graves' disease)
  - Hypothetical Siblings
  - "A natural experiment is an attempt to avoid bias in treatment assignment by finding some natural setting in which treatments are nearly randomized."

Some Rosenbaum Chapter 7 highlights

- Discontinuity Designs (Thislethwaite and Campbell) as Natural Experiments
  - Assignment to treatment ends and assignment to control begins abruptly. Let's look at moments just before/after the "door slams shut."
  - DiNardo and Lee on the effect of unionization on wages
- Paul Holland's randomized encouragement experiment
  - What is the effect of encouragement? (randomized)
  - What is the effect of doing what you were encouraged to do? (trickier)
- Instrumental Variables and the Complier Average Causal Effect
  - Angrist, Imbens and Rubin set out five main characteristics/assumptions of a solid instrument
  - "We cannot recognize a complier when we see one."

Rosenbaum, Chapter 7

1. What was the most important thing you learned from reading Chapter 7?
2. What was the muddiest, least clear thing that arose in your reading?

Next Time

Remember, no class next week thanks to Spring Break

We return **in person** at 9 AM in Wolstein Research Building room 1217 on Thursday 2025-03-20.