500 Class 03 (Zoom)

https://thomaselove.github.io/500-2025/

2025-01-30

Agenda for Zoom Call

Thursday 2025-01-30 from 10 to 11 AM. Zoom details in your email and on Canvas.

- The SUPPORT / Right Heart Catheterization Study
- Lab 1 (How did it go?)
- Rosenbaum, Chapter 4
- A little bit of OSIA and Proposal Advice

Class 04: Nothing but R code

Section 1

The SUPPORT study

Studying Right Heart Catheterization in SUPPORT

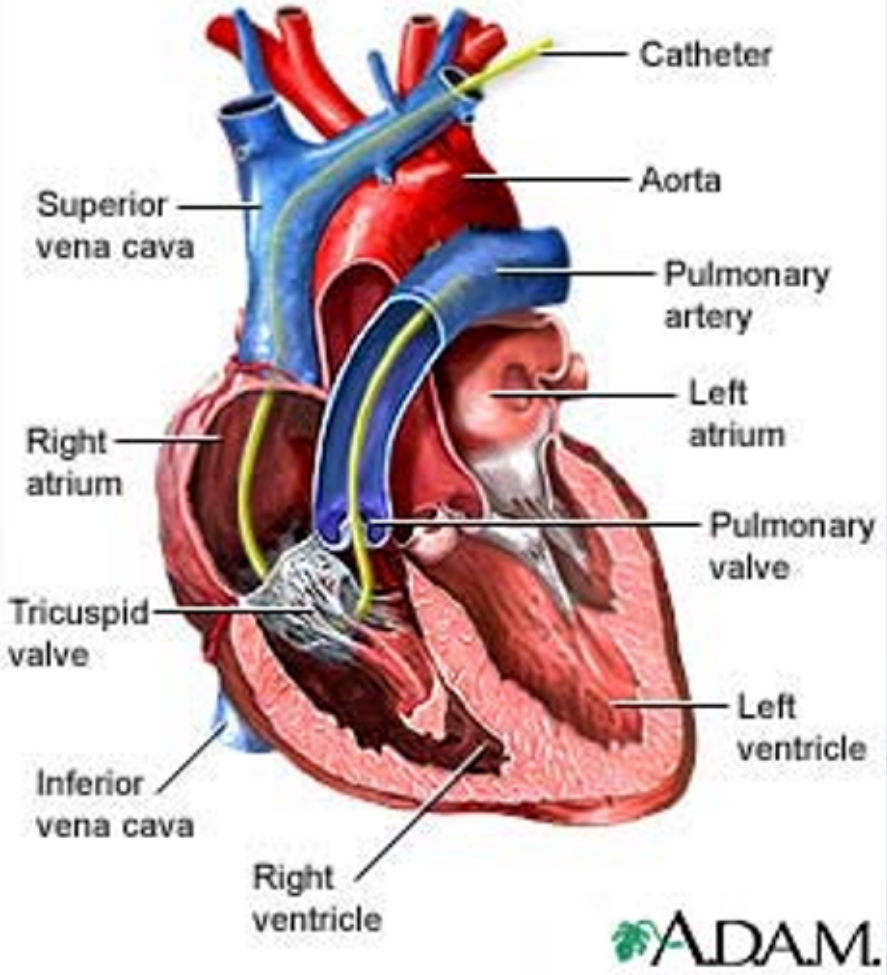
SUPPORT: Study to Understand Prognoses and Preferences for Outcomes and Risks of Treatments[1]

- Goal: Examine the association between the use of RHC during the first 24 hours in the ICU and outcomes
- Outcomes: survival, length of stay, intensity and costs of care
- Sample: 5,735 critically ill adult ICU patients in nine disease categories

Study was prospective!

[1] Connors et al. 1996

Right Heart / Swan-Ganz / Pulmonary Artery Catheterization



Pass a thin flexible tube:

1. **to obtain diagnostic information about the heart**
2. **for monitoring of heart function in the critically ill.**

http://www.nlm.nih.gov/medlineplus/ency/imagepages/18087.htm

Does the RHC do more harm than good?

Prior (small) observational studies comparing RHC to non-RHC patients:

- RR of death higher in RHC elderly patients than non-RHC elderly
- RR of death higher in RHC patients with acute MI than non-RHC patients with MI
- Patients with higher than expected RHC use had higher mortality

Big Problem: Selection Bias. Physicians (mostly) decide who gets RHC and who doesn't.

Why not a RCT?

- RHC directly measures cardiac function
- Some MDs believe RHC is necessary to guide therapy for some critically ill patients
- Procedure is very popular - existing studies haven't created equipoise

81 Characteristics used to predict PS(RHC usage)

- Age, Sex, Race
- Education, Income, Insurance
- Primary and Secondary Disease category
- Admission diagnosis category (12 levels)
- ADL and DASI 2 weeks before admission
- DNR status on day 1
- Cancer (none, local, metastasized)
- 2 month survival model
- Weight, temperature, BP, heart rate, respiratory rate
- Comorbid illness (13 categories)
- Body chemistry (pH, WBC, PaCO_2_, etc.)

Panel (7 specialists in clinical care) specified important variables related to the decision to use or not use a RHC.

RHC vs. Non-RHC patients

RHC patients were more likely to

- Be male, have private insurance, enter the study with ARF, MOSF or CHF

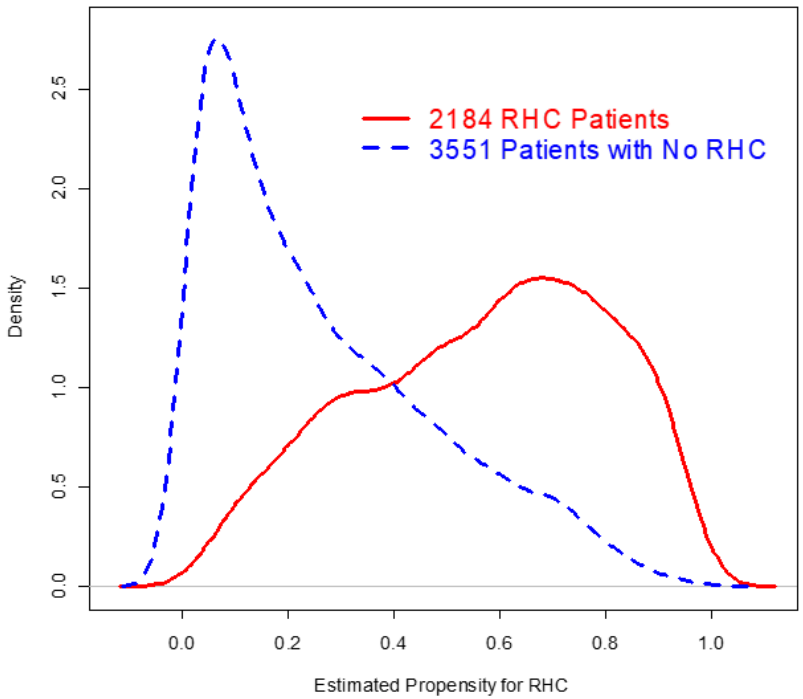
RHC patients were less likely to

- Be over 80 years old, have cancer, have a DNR order in the first 24 hours of hospitalization

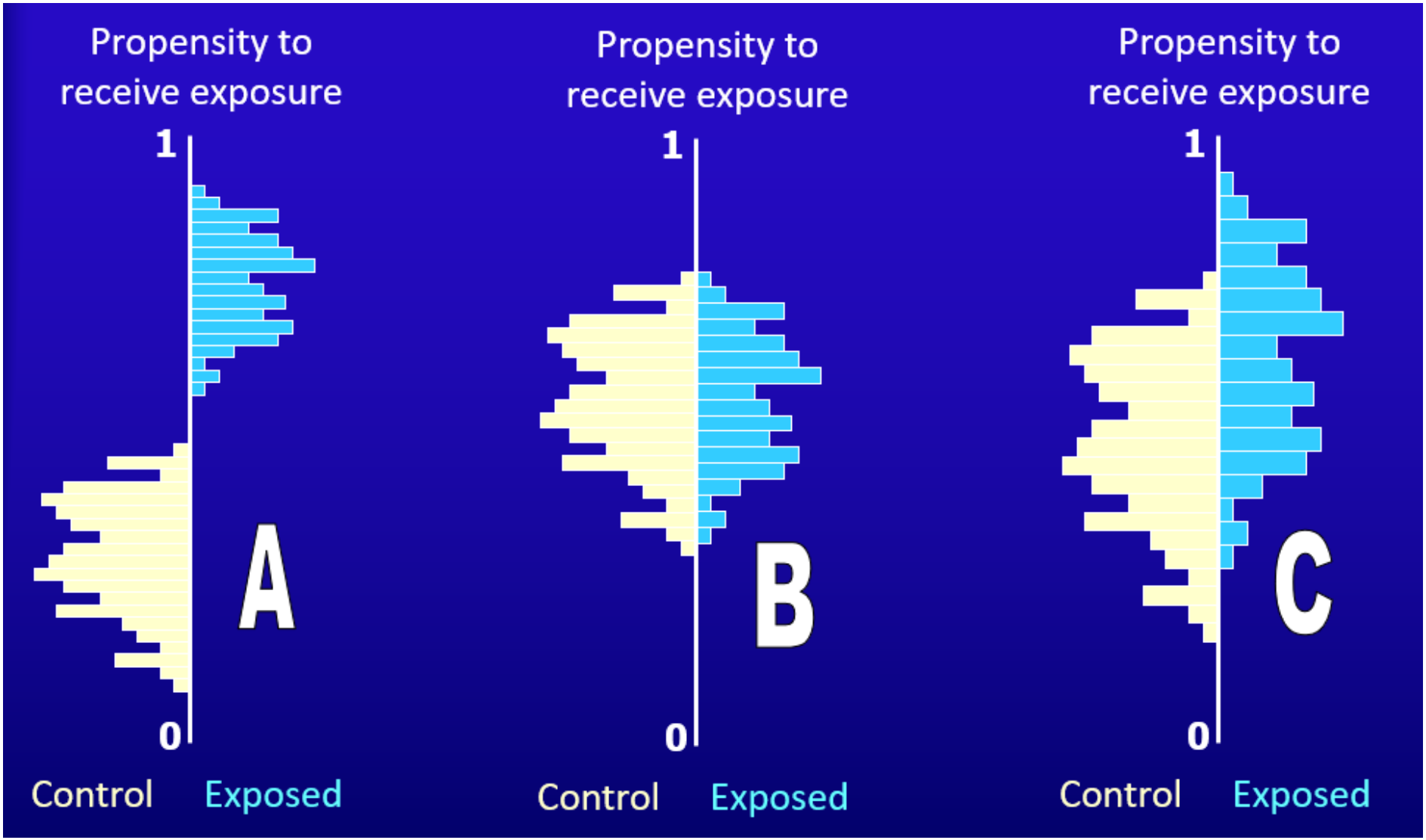
RHC patients had significantly

- Fewer comorbid conditions,
- More abnormal results of vital signs, WBC count, albumin, creatinine, etc.
- Lower model probability of 2-month survival

How Much Overlap do we see in the RHC data?



How Much Overlap do we want?



Right Heart Catheterization and the Perils of Selective Weighting

- 5,735 hospitalized patients in SUPPORT study
  - 2,184 treated (RHC) and 3,551 controls (no RHC).

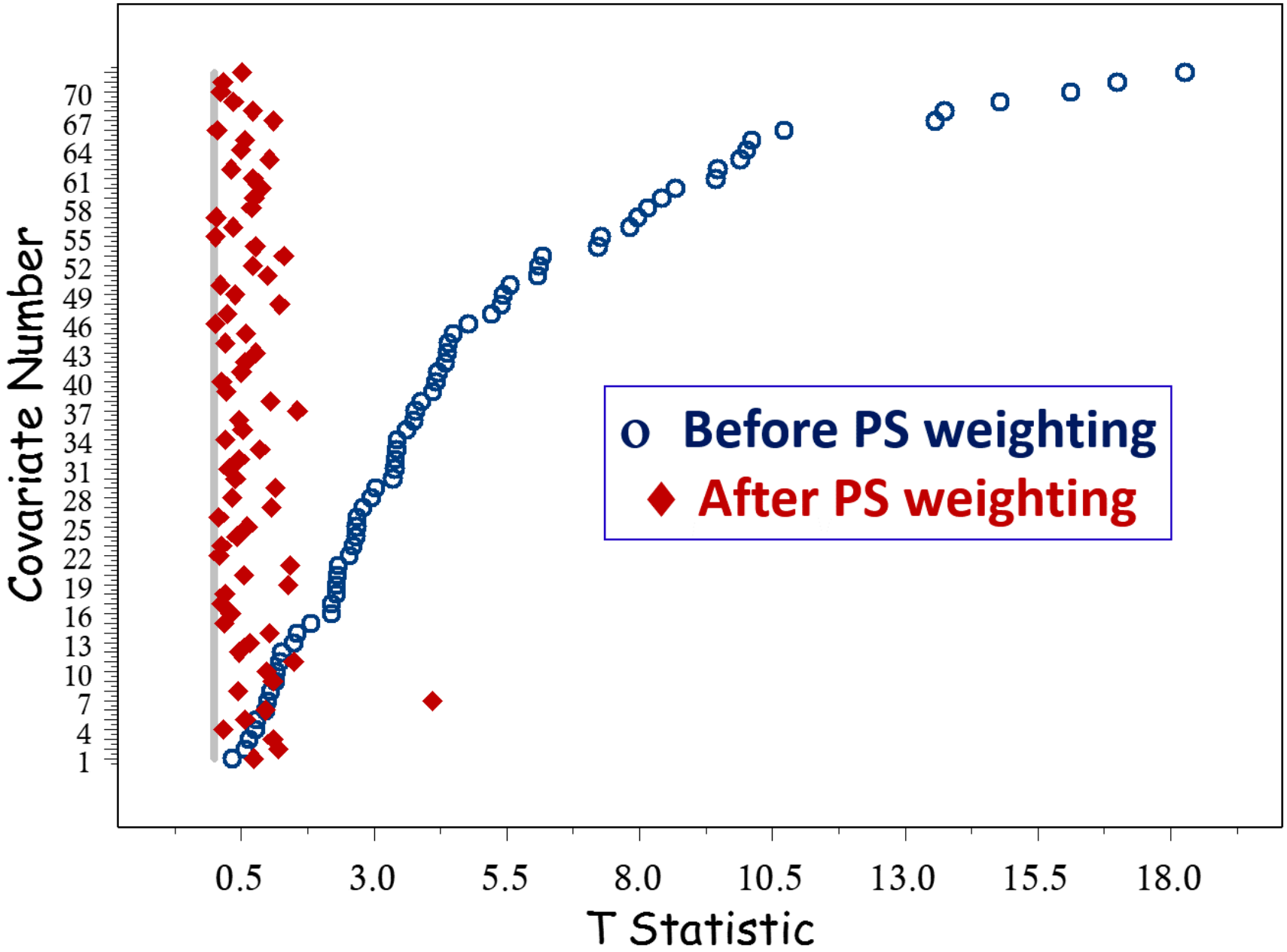
Reweight each treated patient by 1/PS, and each control patient by 1/(1-PS).

- PS model estimated by Hirano and Imbens[2] using 57 of 72 available covariates
  - Selected only those with $|t| > 2.0$
  - Serum potassium, for instance, prior to weighting showed a mean of 4.04 in the RHC group and 4.07 in the "No RHC" group, for a t = -0.99, so it was not included in the propensity model.

Results of this Weighting Approach on the next slide...

[2] Hirano and Imbens 2001, Connors 1996, Hirano, Imbens & Ridder 2003

Absolute T Statistics for RHC vs. No RHC Group Means



Effectiveness of RHC Propensity Score Weighting

- The weighting is based on a propensity model including 57 of the 72 covariates.
- Serum potassium not included in this PS.
- Most means are much closer, although six variables become less balanced (larger absolute t statistic) after weighting. None of these six were in the 57-variable PS model.
- Weighting by the propensity score appears to balance control and treatment groups well.

A "Double Robust" Estimator

1. Fit propensity score model
2. Weight the individual subjects (ATT, commonly) by the propensity score.
3. Directly adjust (via regression) for the propensity score in estimating the treatment effect.

- Forces you to think hard about selection.
- You don't care about parsimony in the PS, so you can maximize predictive value.
- Can fit a very complex PS model, and a smaller outcome model.
- Some hope that if PS model or weighting is helpful, the combination will be helpful.

Section 2

Discussions

Labs

- How did Lab 1 go?
- Lab 1 Sketch should be posted as soon as possible.
- Lab 2 due 2025-02-20 at 9 AM to Canvas.

Progress on Semester Activities

- Building a proposal (first draft due 2-13) for the course project
- Searching for a suitable OSIA paper, and developing a claim by 2-19.

Rosenbaum, Chapter 4

Adjustments for Measured Covariates

For Discussion

- What was the most **important** thing you learned from reading Chapter 4?
- What was the **muddiest**, least clear thing that arose in your reading?
- What questions are at the front of your mind now?

Section 3

Next Time

Setting Up Class 04

The lecture will be a walk-through of the `toy` example, which is a simple simulated observational study of a treatment on three outcomes (one quantitative, one binary, and one time-to-event) which we will use to demonstrate the completion of 13 tasks using R, which include:

- Fitting a propensity score model
- Assessing pre-adjustment balance of covariates
- Estimating the effects of our treatment on our outcomes ...
  - Using matching on the propensity score
  - Using subclassification on the propensity score
  - Using direct adjustment for the propensity score
  - Using weighting on the propensity score

Note we have three other (more realistic) examples we'll share in time: `lindner`, `dm2200` and `rhc`.