Abdominal aortic aneurysm (AAA) is a pervasive condition with high morbidity, affecting 2-4% of adults in the U.S., with 0-40% mortality in ruptured AAA cases. Surgical repair can mitigate the risk of rupture, however open surgery is associated with high risk of complication. Endovascular aneurysm repair (EVAR) is a less invasive repair procedure, and is associated with lower short-term mortality, but it is unclear whether it has long-term benefits. There are concerns that EVAR is less effective in the long-term, leading to reinterventions. Clinical trials comparing the procedure are limited in size, scope, or follow-up. Since we use a large Medicare enrollment dataset with long-term follow-up in our analysis, in order to establish causal estimates of EVAR. In particular, we analyze the Medicare data based on the semiparametric accelerated failure time model. Reintervention due to causal factors is carried out using a weighted bootstrap approach.

**Summary**

**Abdominal Aortic Aneurysm**

- Surgical repair options
  - Open repair: conventional treatment, more invasiveness, long recovery
  - Endovascular: less invasive, concerns about efficacy
- Little convincing comparative effectiveness research

**Challenges of IVs in Survival Analysis**

- Traditional IV methods rely on linearity
- Few randomized controlled trials
- No small sample size adjustment
- Lack of IV analysis on semiparametric survival analysis

**Inference via Bootstrap**

- Too computationally demanding to resample the data and solve a maximum likelihood equation
- Instead, relate the variance of \( \hat{\beta}_{IV} \) to the variance of \( \hat{\beta}_{AFT} \)
- The approach of (Zeng and Lin, 2008) only involves evaluations of the estimating equation

**Simulation**

- \( t = \log (X / (\alpha^{Z} + 1)) \)
- \( X = \log (X / (\alpha^{Z} + 1)) \)
- \( C = \exp (\hat{\beta} X) \)

**Nonlinearity between \( Z \) and \( X \) to demonstrate structural assumptions not necessary**

- Two other methods investigated:
  - Rank-based IV estimator without inverse weighting (not theoretically justified)
  - Two-stage procedure: replace \( X \) with predictions of \( X \) using linear model with \( Z \)

**Analysis of Medicare Enrollment Data**

- AAA Backgound
  - Randomized controlled trials
  - No small sample size adjustment

- Instrumental variable
  - Less invasive, concerns about efficacy
- Randomized controlled trials
  - Better than other institutions
  - More patients and endovascular repair
- Our analysis is consistent with a recent study of ruptured AAA which provides sensitivity analysis to bias due to unmeasured confounding (Wright et al., 2014)

**Conclusions**

- Our estimating equation is not monotone and often has poor behavior in small samples
- Sensitivity of the bootstrap procedure

**Remaining Challenges**

- Analysis adjusting for unmeasured confounding suggests
  - May be some benefit for open repair for ruptures cases
  - More comprehensively treated provided by open repair leads to reduction in mortality for more serious AAA cases
  - Rupture cases are more serious than typical AAA cases; conclusion may be different for non-rupture cases
  - Our analysis is consistent with a recent study of ruptured AAA which provides sensitivity analysis to bias due to unmeasured confounding (Wright et al., 2014)

**Motivation**

- Endovascular and open repair of abdominal aortic aneurysm.
- Rupture cases are more serious than typical AAA cases;
- Our analysis is consistent with a recent study of ruptured AAA which provides sensitivity analysis to bias due to unmeasured confounding (Wright et al., 2014)

**References**