POSTER #RWD94

Targeting a Modifiable Risk Factor:

A Causal Framework Informs Strategies to Reduce Pressure Injuries

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Background

- Pressure injuries (PrIs) are a serious complication in critically ill patients, with low serum albumin frequently being identified as a risk factor.
  - Despite the abundant literature on the association of hypoalbuminemia with PrI formation, a causal relationship remains a critical gap.
  - Identifying if hypoalbuminemia is causal is critical as it is a modifiable risk factor.
- The Roadmap for Causal Inference is a systematic process that guides researchers from formulating a well-stated research question to specifying a causal model, intervening on it to generate counterfactuals, linking it to observed data, estimating causal effects, and finally interpreting the results. It provides a structured approach for addressing causal questions while considering uncertainties and statistical modeling [1].

Methods

- The goal of the project was to estimate the interventional effect of serum albumin on pressure injury development using (non-interventional) observational data
- The data comes from the MIMIC IV dataset, capturing hospital admissions from 2008 to 2019 for almost 300,000 patients [2].
- We applied the steps of the roadmap for causal inference to estimate the protective effect of increased albumin against developing PrIs.
- Collaborative targeted maximum likelihood estimation (C-TMLE) [3] was used to estimate the Average Treatment Effect (ATE) of albumin on the development of PrIs.
- In addition, we estimated heterogeneous treatment effects, i.e., were there certain patients who would or wouldn't benefit from *exogenous* (externally-introduced) albumin.

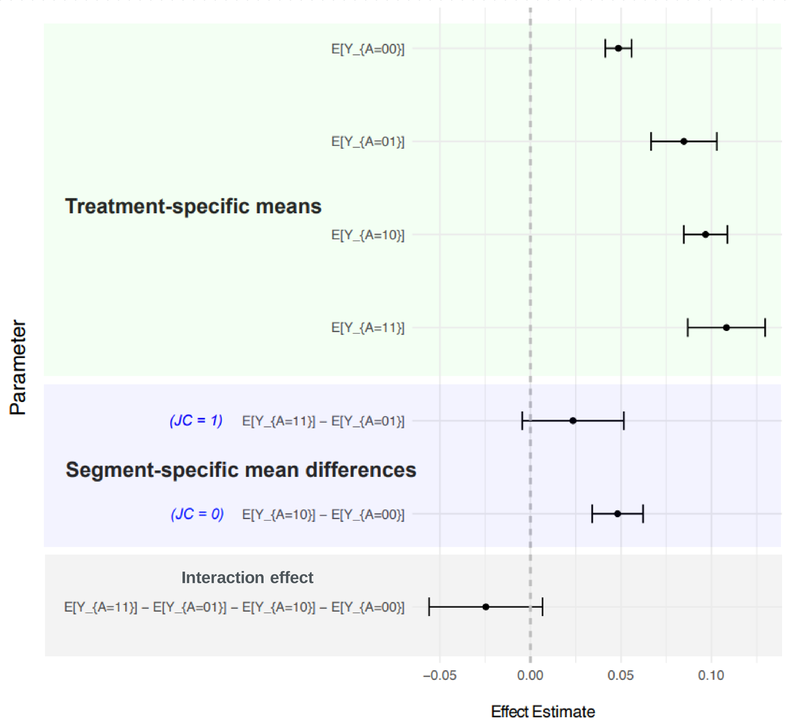

Figure 1. Treatment-specific means stratified by JC status: 1 = chronic kidney or liver disease. *(dashed line is null effect)*

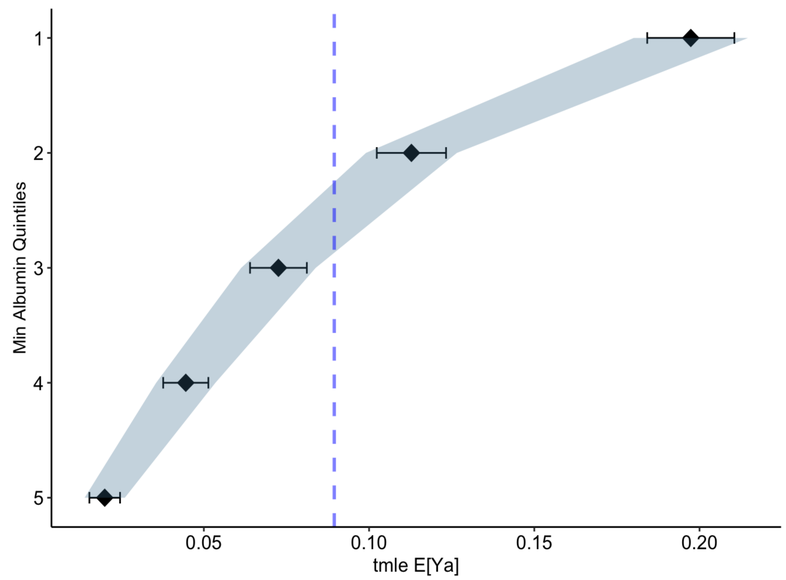

Figure 2. Dose-response curve: Expected means for counterfactual serum albumin quintiles (shaded area is 95% simultaneous confidence band). *(dashed line is cohort average PrI rate)*

Results

- Of 17,504 eligible cases, 1,566 developed a pressure injury (8.9%).
- The serum albumin treatment-specific means showed a significant protective effect [Figure 1]
- Additionally, when considering albumin exposure quintiles, the effect estimate is monotonic, increasing the risk with decreasing albumin quintiles [Figure 2]

Conclusions

- Serum albumin likely plays a causal (protective) role in PrI formation, although for a subset of patients with kidney or liver problems the benefit is attenuated.
  - This diminished benefit is likely due to pathology in albumin synthesis in liver disease and loss of albumin through the urine in kidney disease, e.g., in proteinuria, a hallmark of kidney disease.
- **The roadmap for causal inference proved to be an effective causal framework for statistical learning to identify and apply an estimation strategy all while accounting for potential confounding mechanisms.**

REFERENCES

1. Dang and Balzer (2023). Start with the Target Trial Protocol, Then Follow the Roadmap for Causal Inference. Epidemiology, Volume 34, Number 5. DOI: 10.1097/EDE.0000000000001637
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3. Zheng, W. and van der Laan, M. (2010). Asymptotic Theory for Cross-Validated Targeted Maximum Likelihood Estimation. Working Paper 273, University of California, Berkeley, Berkeley, CA.