Tarragona Datathon Notes — Hemoglobin

Github: https://github.com/Lucas-Mc/tarragona-datathon-2022

Statement of problem:
Many patients with sepsis in the ICU are given blood transfusions for low hemoglobin levels. Restrictive transfusion strategies using hemoglobin thresholds of 7.0 g/dL have been shown to be better than "liberal" strategies of transfusing to a hemoglobin of 9.0 g/dL or higher, because there are risks associated with transfusion. However, in practice, the threshold to transfuse is not strictly followed, and physicians frequently prescribe above the 7.0 g/dL threshold. There are two objectives of this project: 1) to determine whether there are disparities in the transfusion threshold across demographics, including race ethnicity, in the ICU; and 2) to develop a calculator that suggests the hemoglobin threshold below which a patient should be transfused.

Restrictive (< 7.0 g/dL)
Liberal (>= 7.0 g/dL)

Studies that favored restrictive over liberal:

Parker et al. 2013, Vilanueva et al. 2013, Walsh et al. 2013, American Society of Thoracic Surgeons (ASTS), American Society of Cardiovascular Anesthesiologists (ASCA)

Studies that favored liberal over restrictive:

Surviving Sepsis guidelines, Rivers et al., 2001, Dellinger et al., 2004

- Blacks received less units of RBCs overall compares to Whites (Prochaska et al., 2022)
- Women and elderly patients present with lower Hb (Valero-Elizondo et al., 2015)
- A restrictive strategy was safe in pediatric patients and just as safe as the liberal strategy (Lacroix et al., 2007)
- Asdf
- Adsf

Literature Review:

1. Prochaska et al., 2022

- Blacks received less units of RBCs overall compared to Whites

- Other races also received less compared to whites but did not reach statistical significance
- At each Hb threshold, a significantly ($p < 0.01$) decreased percentage of Black patients were transfused compared to Whites

2. Bosch et al., 2022

- Transfusions due to crossing the 7.0 g/dL Hb threshold was associated with increased Hb concentrations but no improvement (or potentially worse) in organ dysfunction (SOFA)
- Transfusion should be tested at lower Hb thresholds (e.g., 6.0 g/dL), with dynamic measures (relative decrease in Hb), patient-centered measures (e.g., anemia), or measures of oxygen delivery for risk/benefit ratio

3. Valero-Elizondo et al., 2015

- Women and elderly patients presented with lower Hb
- Elderly patients were more likely to receive a transfusion using the liberal strategy (50% vs. 41%, $p < 0.001$)
- Women have roughly 10% lower Hb levels than men (Murphy et al., 2014)
    - Men had a 13% higher odds of receiving a transfusion ($p = 0.03$)
- Mean Hb trigger for women was lower than men (7.4 g/dL vs. 7.5 g/dL respectively, $p < 0.05$)
    - Possibly due to women having much higher anxiety about receiving a transfusion (Ying et al., 2014)
- One study showed elderly receive transfusions at a much higher rate (Brown et al. 2014)
    - There is a lack of evidence to support this practice, with this study showing restrictive strategies in elderly patients have no difference

4. Lacroix et al., 2007

- A restrictive strategy was safe in pediatric patients whose condition was stable in the ICU and just as safe as the liberal strategy
- In the adult population, a liberal transfusion strategy may be worse
- Critically ill adults may be more vulnerable than children to adverse outcomes with transfusion

5. Burchard et al., 2020

- Females had decreased transfusion requirements (OR = 0.694)

6. Hirano et al., 2019

- The liberal transfusion strategy failed to improve short-term mortality nor long-term outcomes in septic patients compared to the restrictive strategy after meta-analysis including three Randomized Clinical Trials (RCTs)

7. Cable et al., 2019

- N/A

8. Elshinawy et al., 2020

- A liberal transfusion strategy did not improve outcomes compared to a restrictive strategy for PICU patients admitted with sepsis
- The mortality rate was significantly higher in patients transfused using the liberal compared to the restrictive strategy (42.4% vs. 17.6%, p = 0.034) often leading to longer stays, more invasive ventilation, and worse oxygenation parameters
- Comparable PELOD score at admission between the restrictive and liberally treated patients lead to a higher PELOD score (higher incidence of organ failure) in the liberally treated group
    - Higher overall comorbidities, RBC volume, and frequency in the liberally treated group

9. Yuliarto et al., 2022

- The effectiveness of the restrictive and liberal strategies were similar in terms of clinical outcomes in acute anemia critically-ill children
- A higher final Hb is a predictor of better patient outcome (OR = 0.642, p = 0.000) so it may be better to transfuse early