

Defining Gender and Race/Ethnicity-Specific Laboratory Reference Ranges and its Impact on Predicting Post-Operative Acute Kidney Injury and Mortality Outcomes

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Background: Defining laboratory reference ranges is critical to the medical decision-making process and ultimately patient care. Reference ranges are often defined distributionally by the 5th and 95th percentile values of healthy patient labs¹. However, most laboratories use a single reference range for all patients, ignoring potential genetic differences amongst the population². The goal of this study is to determine 1) if gender/ethnicity differences exist in lab reference ranges, and 2) if defining population-specific reference ranges are more associated with adverse postoperative outcomes as compared to the standard range.

Methods: Lab results from outpatient individuals with primary care providers were pulled from the UCLA electronic health record (EHR) to establish specific lab reference ranges based on patient gender and ethnicity for 37 labs, which we defined as the cohort reference range. In the event that patients had more than one visit, the results from the first visit were included in the analysis. In total 385,170 individuals met inclusion criteria, constituting 8,713,072 total lab results. The boundaries of the gender/ethnicity cohort reference ranges were set by the 5th and 95th percentiles of the lab value distribution. For the outcomes analysis, 100,208 anesthesiology cases were extracted including patient demographic data, most recent lab prior to procedure, and post-operative mortality and acute kidney injury (AKI). Patients included in the study were age 18 and older with a hospital length-of-stay greater than 1 day. Patients were then grouped into four categories based on their pre-op lab values: inside the reference range, outside the reference range, inside the cohort range, and outside the cohort range. A logistic regression was performed for each lab to assess the odds ratio of two postoperative outcomes, acute kidney injury and mortality, subsetted by patient gender and ethnicity.

Results: We found that 25 out of the 37 labs demonstrated gender/ethnicity variation. Patients who fall outside of their gender/ethnicity cohort range have a significantly higher odds for postoperative AKI (84% of the time) and mortality (74% of the time) than if they were to fall outside the standard reference range.

Conclusion: Our results show that the standard reference ranges used in clinical settings do not always account for the gender and ethnic diversity of the patient population and that the population specific reference ranges are more closely associated with post-operative outcomes. There may be an opportunity to improve understanding of “normal” lab results by accounting for gender and ethnic diversity in our patient population.

References:

Table 1: Clinical labs assessed in the study

LABS
ALBUMIN_SERUM
ALKALINE_PHOSPHATASEPLASMA
ALT_PLASMA
ANION_GAP
AST_PLASMA
BASE_EXCESS
BASOPHILS
BICARBONATE_ARTERIAL
BICARBONATE_VENOUS
BILIRUBIN_DIRECT_PLASMA
BILIRUBIN_TOTAL_PLASMA
CALCIUM_SERUM
CHLORIDE_SERUM
CREATININE_SERUM
EOSINOPHILS
FIBRINOGEN
GLUCOSE_SERUM_FASTING
GLUCOSE_SERUM_POSTPRANDIAL
HDL_PLASMA
HEMATOCRIT
HEMOGLOBIN_SERUM
IMMATURE_CELLS
INR
LDL_PLASMA
LYMPHOCYTES
MAGNESIUM_PLASMA
MONOCYTES
NEUTROPHILS
PARTIAL_THROMBOPLASTIN_TIME
PLATELET_COUNT
POTASSIUM_SERUM
PREALBUMIN
PROTHROMBIN_TIME
SODIUM_SERUM
TSH
UREA_NITROGEN_BLOOD
WHITE_BLOOD_CELL_COUNT

1. CLSI. Defining, establishing, and verifying reference intervals in the clinical laboratory; approved guideline. 3rd ed. Clinical and Laboratory Standards Institute; 2008.
2. Housman Tahmasebi, Karin Trajcevska, Victoria Higgins & Khosrow Adeli. Influence of ethnicity on population reference values for biochemical markers, *Critical Reviews in Clinical Laboratory Sciences*. May 2018, 55:5, 359-375