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Admission PaO2 and Mortality Among Pediatric ICU Patients and Critically Ill Subgroups

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Introduction

- **Hyperoxia** = supra-physiologic oxygen tension
- Hyperoxia → reactive oxygen species → cell damage, cell death, inflammation *in vitro*
- Adult studies suggest an association between hyperoxia and mortality
- Pediatric studies mostly demonstrate similar association
  - Limited to general PICU populations*
  - Limited to single center studies*

Study Objectives

1. Evaluate whether hyperoxia on admission to the pediatric intensive care unit is associated with increased mortality in a multi-center dataset.

2. Evaluate the relationship between hyperoxia on admission and mortality in specific diagnostic subgroups.

Study Design

- Retrospective multicenter observational study

- Virtual Pediatric Systems (VPS) database
  - Clinical pediatric critical care database
  - >135 participating hospitals in North America
  - Robust data quality control

- All non-cardiac patients ≤ 18 yo with PaO2 recorded in first hour of ICU admission

- Primary outcome = ICU mortality

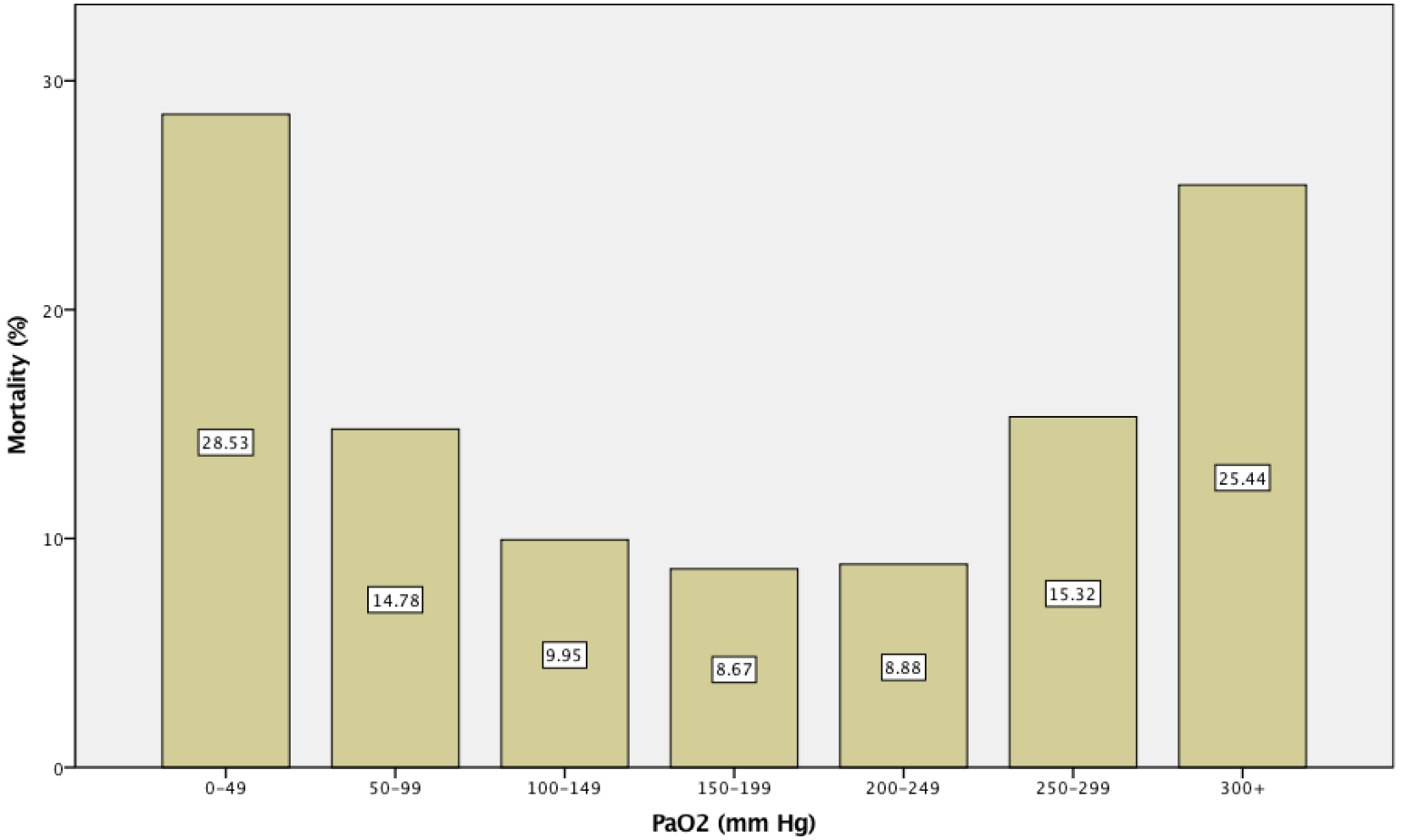
Data Analysis

- Pediatric index of mortality (PIM) 3 scores obtained from VPS
- Modified PIM3 scores calculated by excluding PaO2 term
- VPS admission data, ICD9 and ICD10 codes used to identify diagnostic subgroups
  - Trauma, head trauma, sepsis, renal failure, hemorrhagic shock, post-arrest

Results

- 13,071 patient encounters over 5 year period (2015-2019)
  - From 136 different medical centers
- Overall mortality = 13.5%
- Hyperoxia is rare
  - 25.5% with PaO2 > 200 mm Hg
  - 7.8% with PaO2 > 300 mm Hg
  - 1.3% with PaO2 > 500 mm Hg

All patients, raw mortality by PaO2



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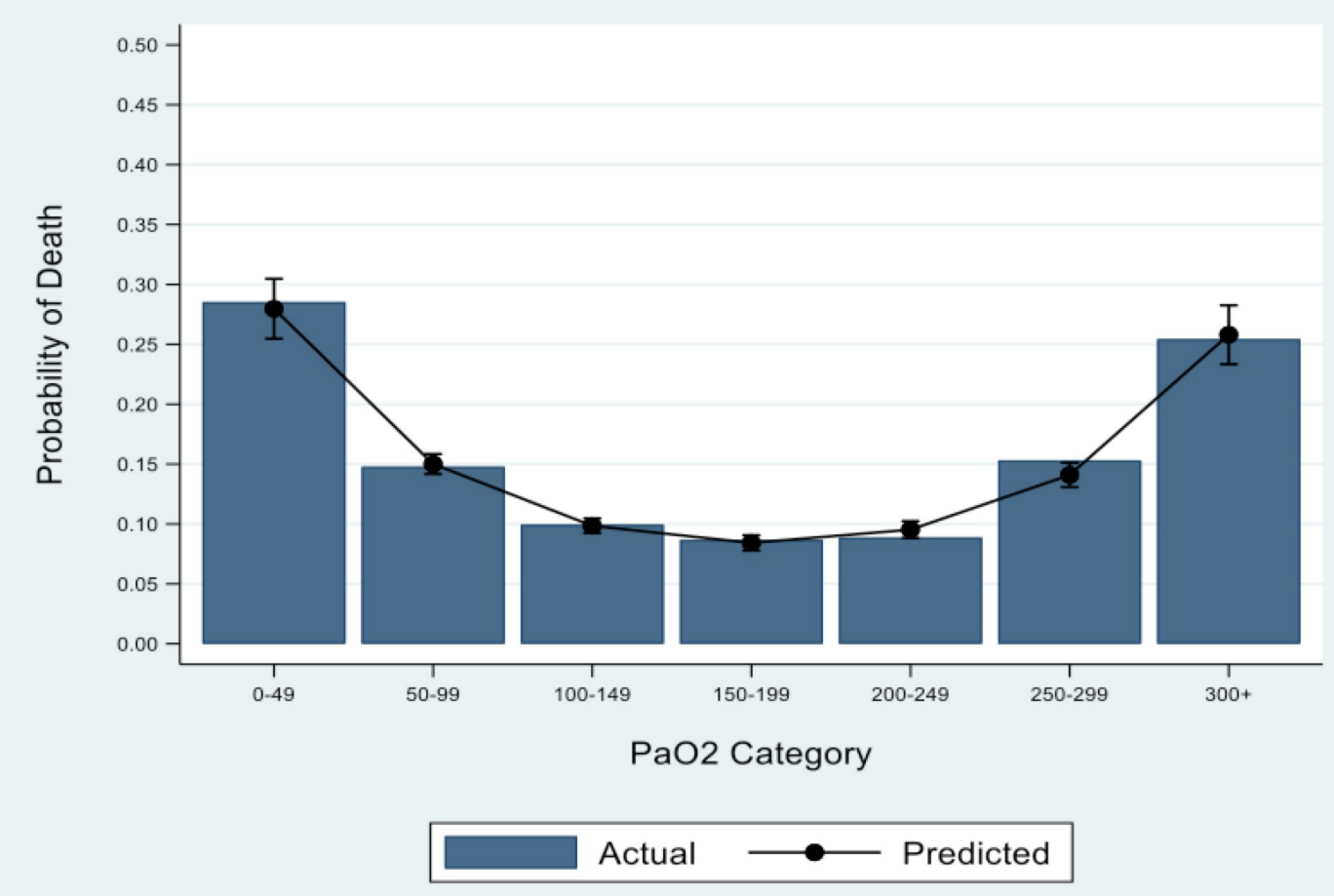
All patients, logistic regression model

- Unadjusted logistic regression with PaO2 modeled as quadratic term



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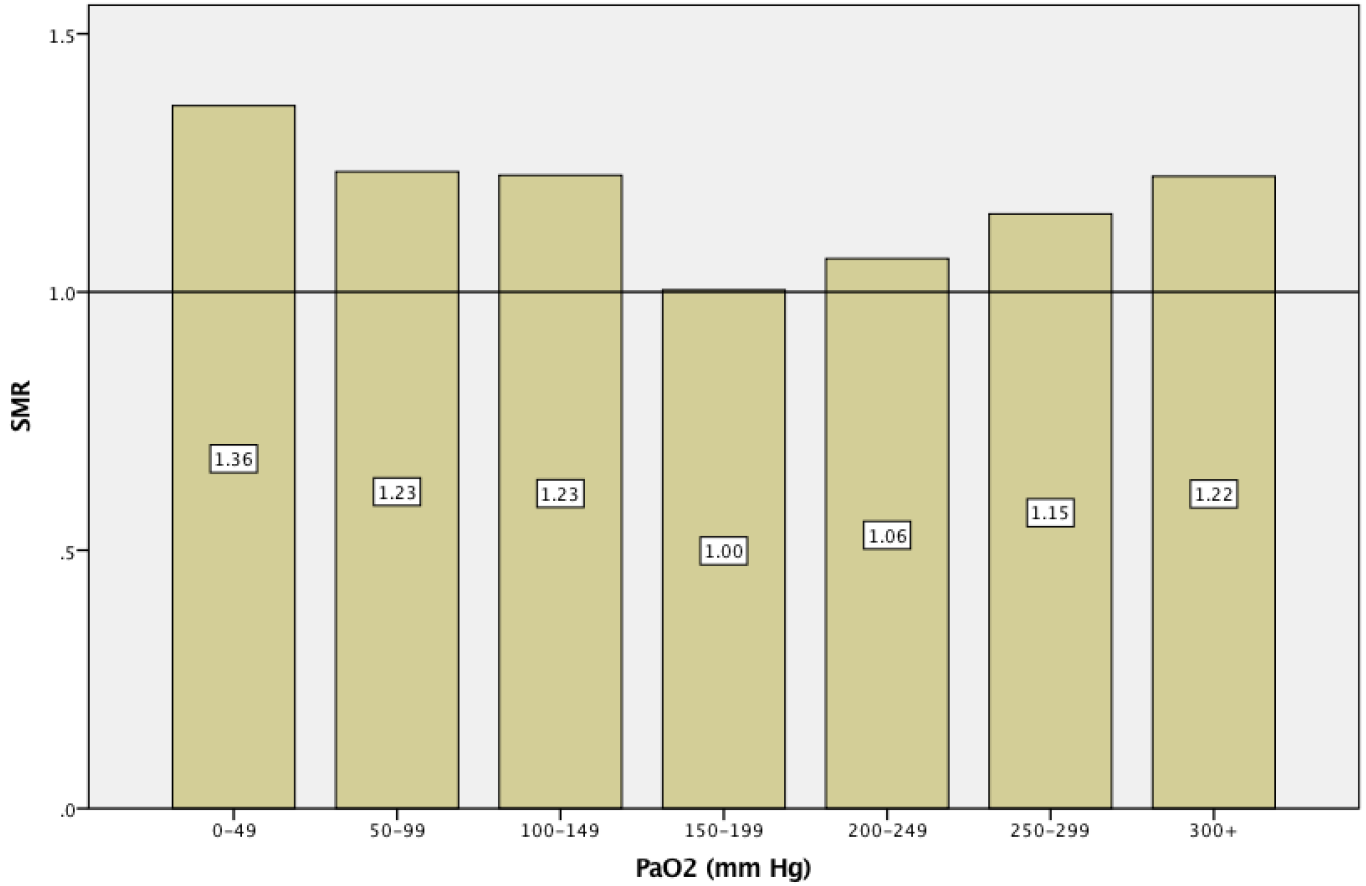
All patients, SMR by PaO2

- Standardized mortality ratio (SMR)
- SMR = observed / expected mortality
- Expected mortality calculated using modified PIM3 equation



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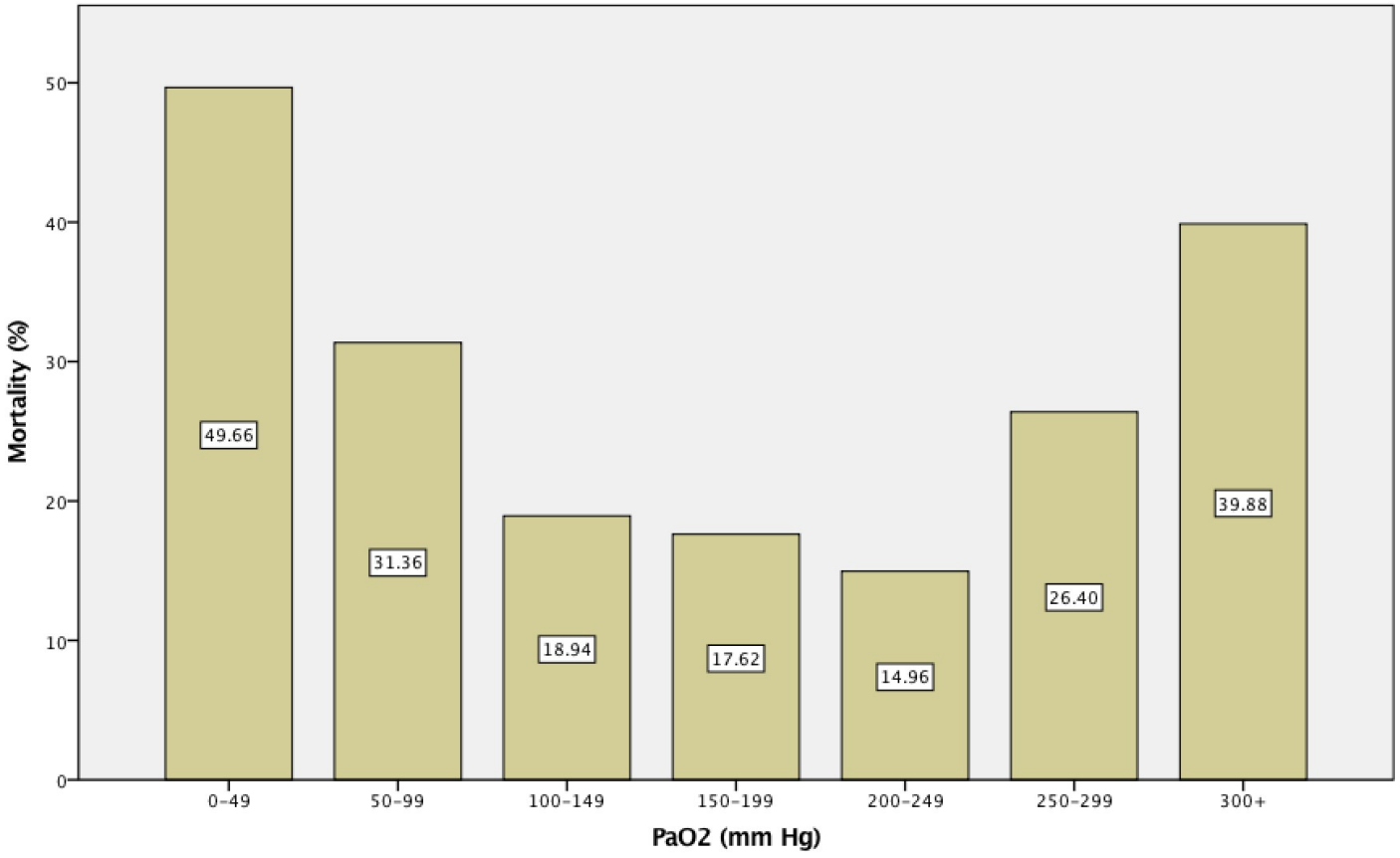
Trauma patients, raw mortality by PaO2

- n = 2,702
- Overall mortality = 25.80%



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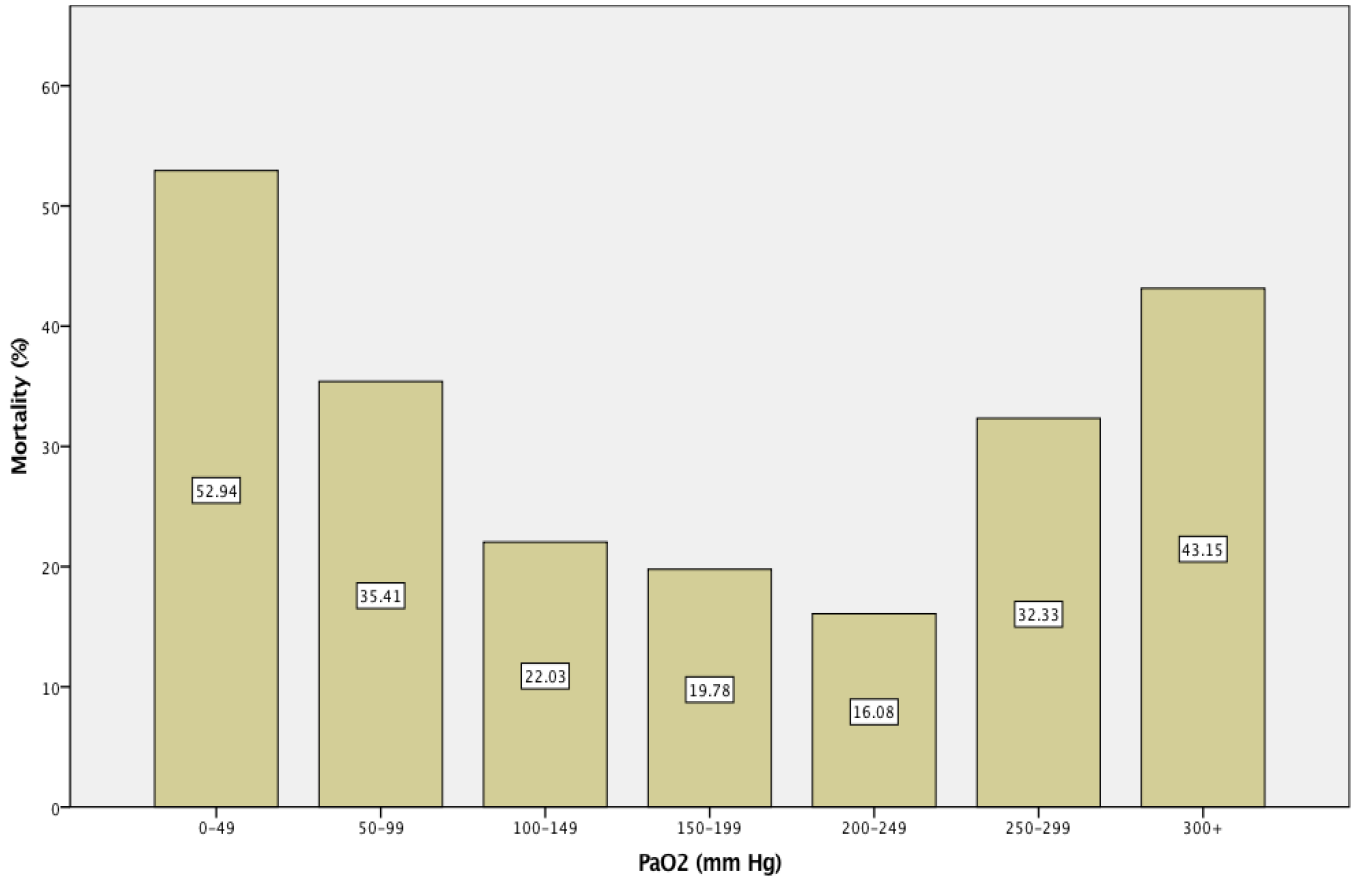
Head trauma patients, raw mortality by PaO2

- n = 1,859
- Overall mortality = 28.86%



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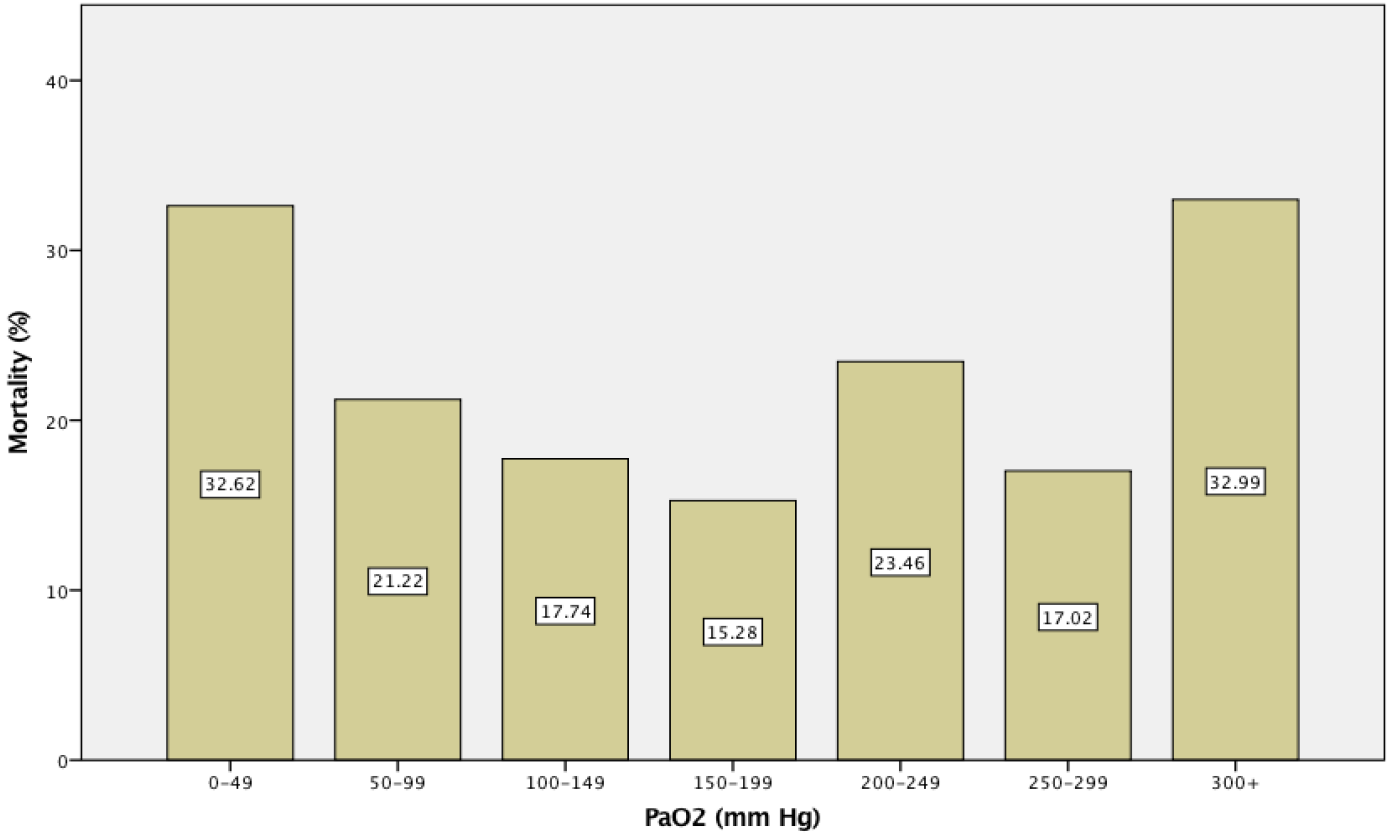
Sepsis patients, raw mortality by PaO2

- n = 1,218
- Overall mortality = 22.00%



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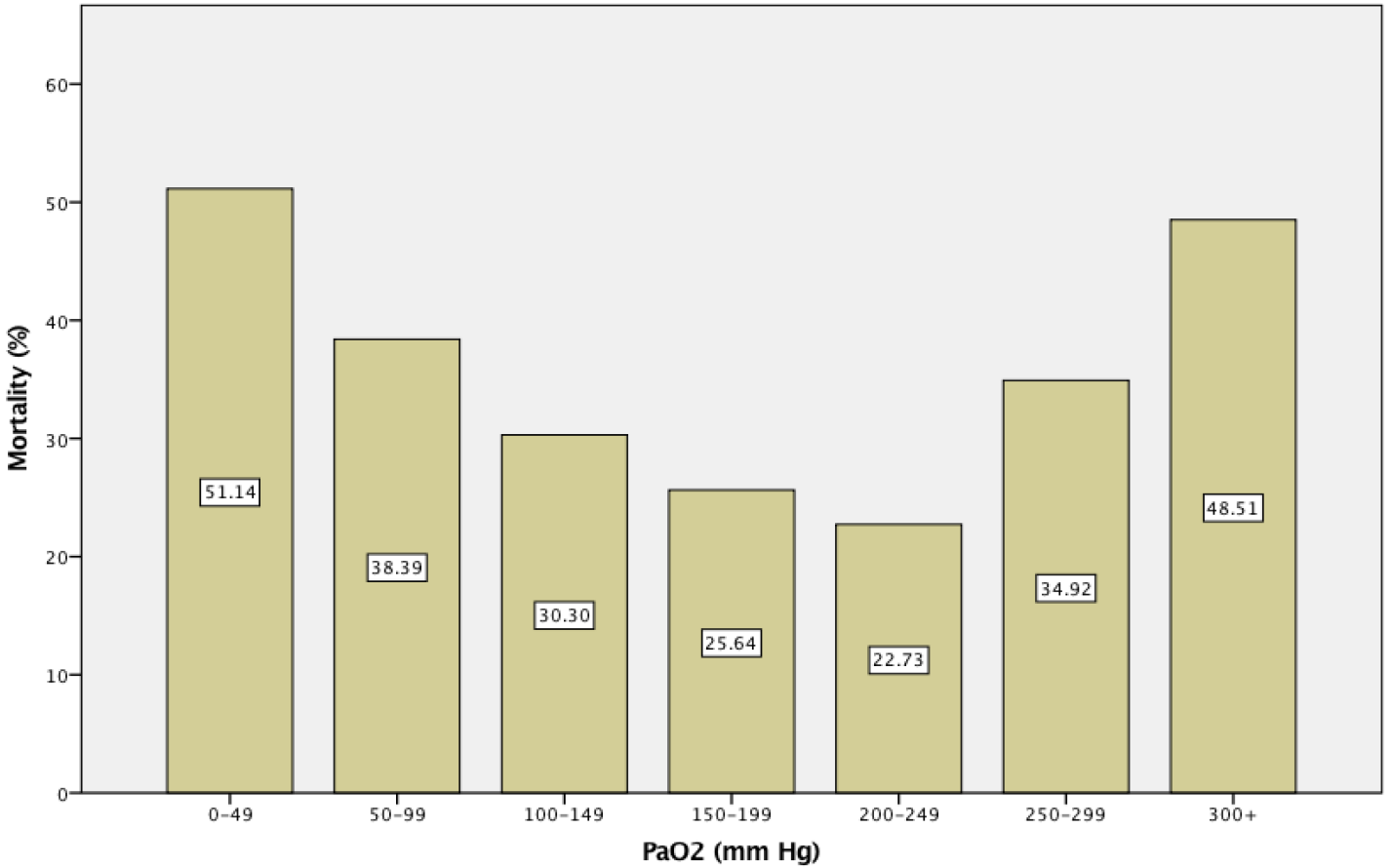
Renal failure patients, raw mortality by PaO2

- n = 969
- Overall mortality = 36.12%



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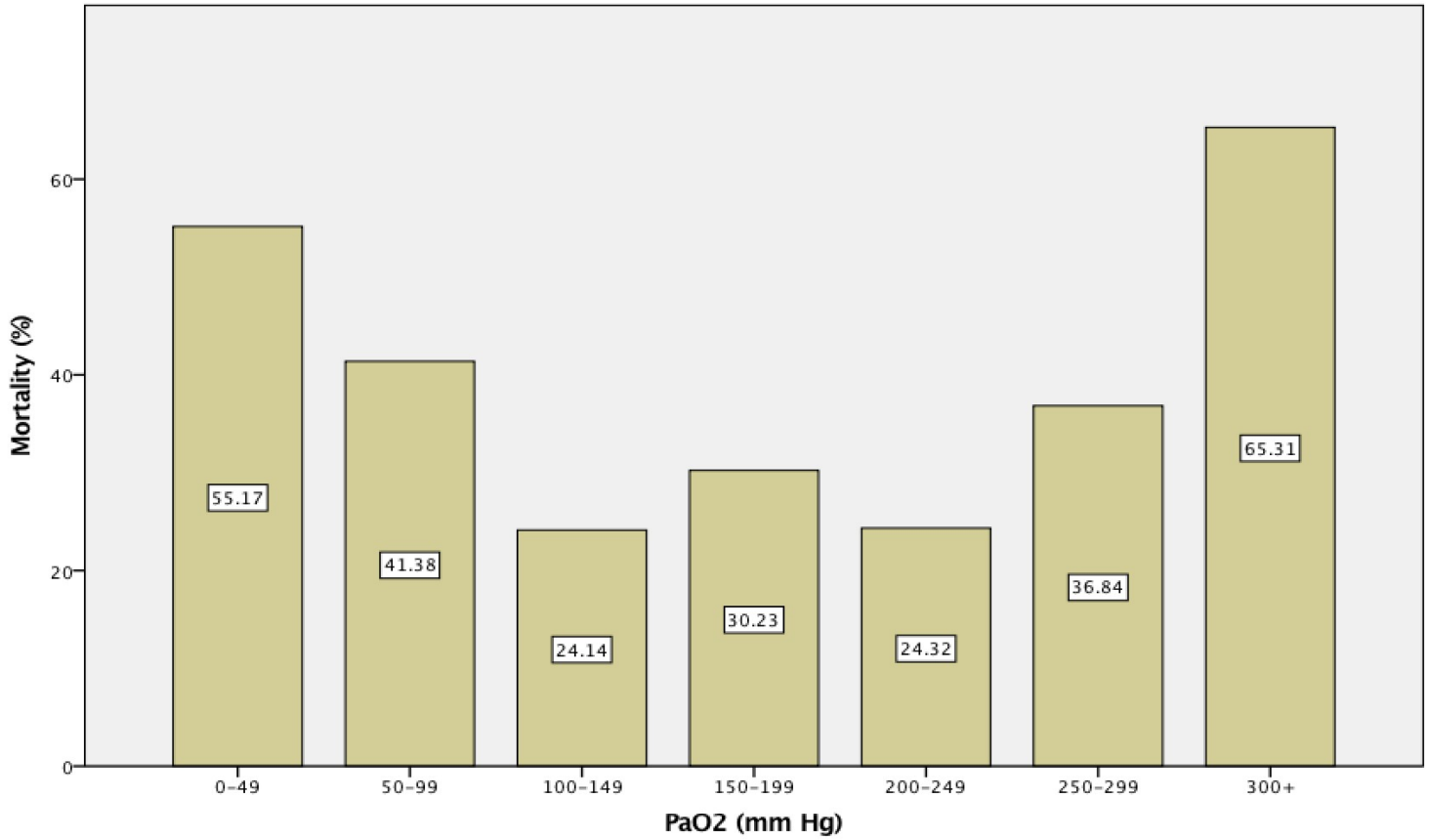
Hemorrhagic shock patients, raw mortality by PaO2

- n = 322
- Overall mortality = 39.44%



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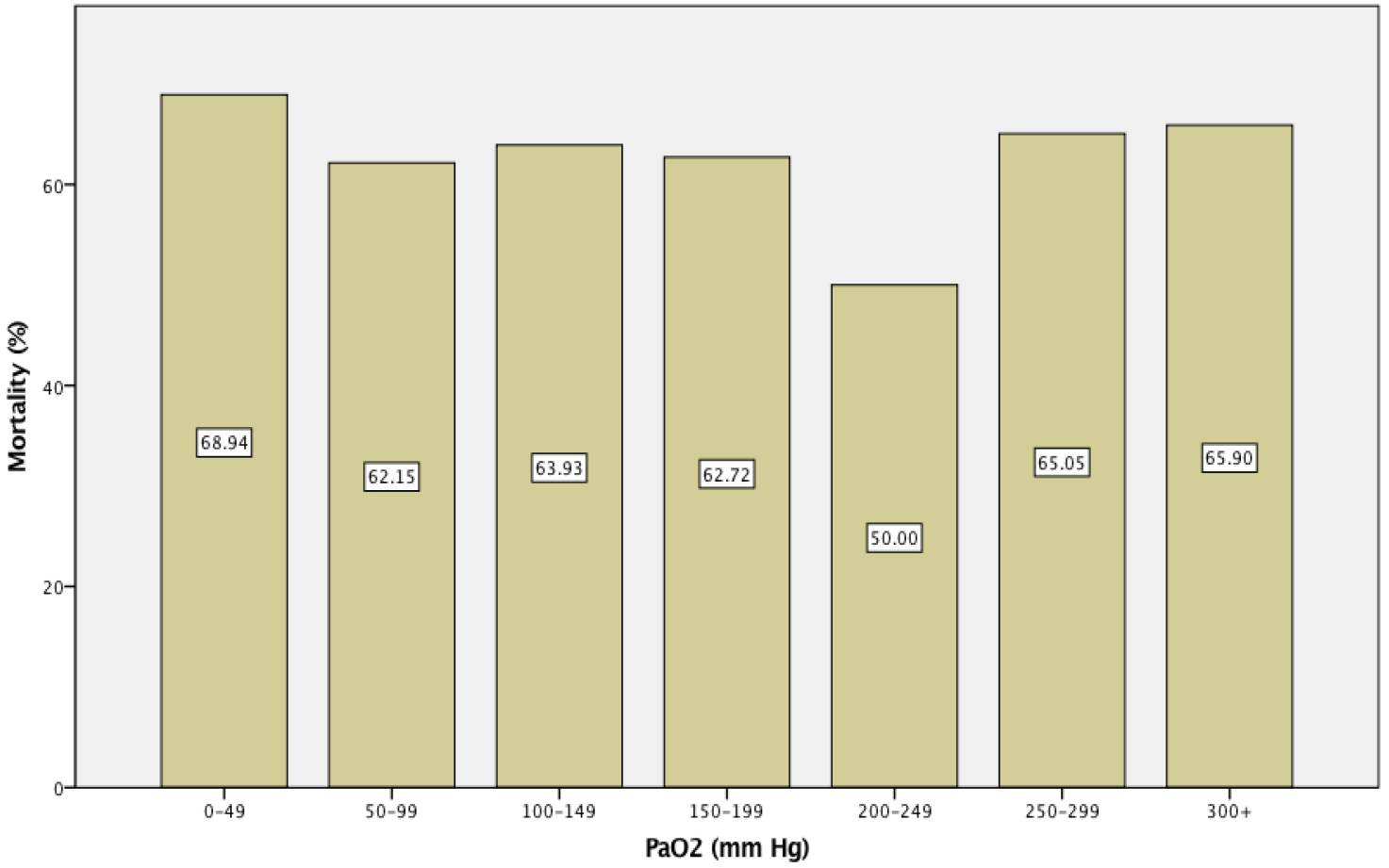
Post-arrest patients, raw mortality by PaO2

- n = 1,500
- Overall mortality = 63.07%



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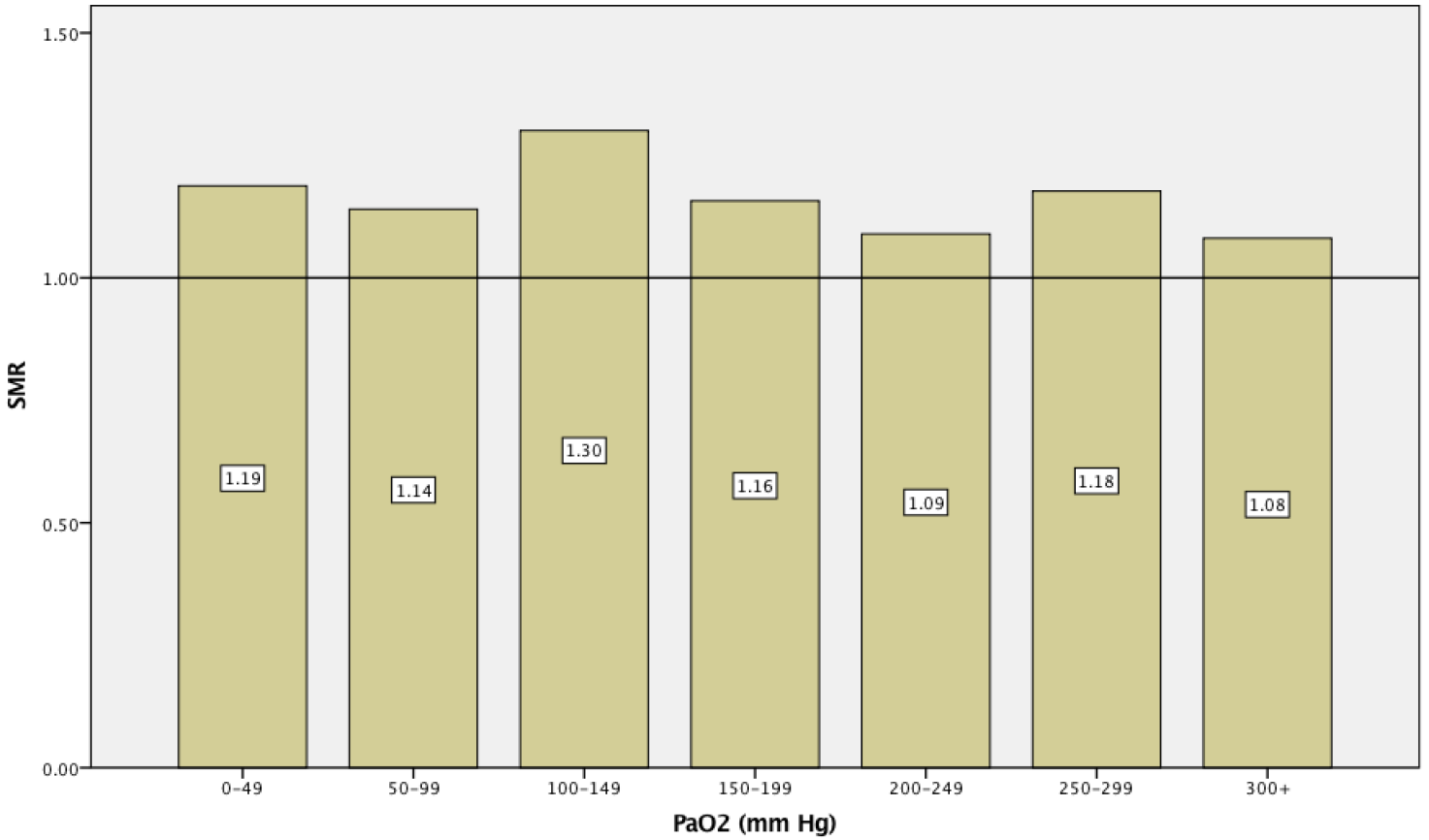
Post-arrest patients, SMR by PaO2

- Standardized mortality ratio (SMR)
- SMR = observed / expected mortality
- Expected mortality calculated using modified PIM3 equation



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Conclusions

- Large, multicenter pediatric cohort study examining hyperoxia
- Admission PaO2 associated with mortality among entire cohort
- Relationship is preserved in some but not all diagnostic subgroups
- Pathophysiology of certain disease states may modify the hyperoxia association
- Future predictive models may benefit from including hyperoxia status
- Limitations
  - Observational study
  - Not all PICU patients have admission PaO2

Moving Forward

- Hypothesis: *Hyperoxia directly contributes to mortality risk*
  - Via ROS or some other molecular mechanism
- Hypothesis: *Hyperoxia is a marker of "aggressive resuscitation"*
  - Loses discriminatory capabilities in "sicker" cohorts like post-arrest
- Does timing of hyperoxia exposure matter?
  - Especially in post-arrest cohort

Thank You!

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