Predictors of Critical Care, Mechanical Ventilation, and Mortality Among Hospitalized Patients with COVID-19 in an Electronic Health Record Database

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Disclosures

- This work was funded by Optum Epidemiology
- AKC, CL, MCD, CRC, RPO, RVG, JNS, CE, NDL, FTW, JDS are (or were at the time of work) employees at Optum and may own stock in United Health Group, Optum's parent company

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Background

- There is significant heterogeneity in the clinical presentation of COVID-19 infection, ranging from patients who are asymptomatic to those with severe disease
- It is important to determine predictors of serious outcomes as patients may decline rapidly after initially presenting with mild symptoms
- Identifying predictors of serious outcomes may enable clinicians to deliver appropriate care to patients early as well as inform interventions to reduce risk of death

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Objective

- To determine demographic and clinical predictors associated with serious outcomes (i.e., critical care, mechanical ventilation, and death) among hospitalized COVID-19 patients in a large electronic health record (EHR) database that is representative of a geographically diverse U.S. population

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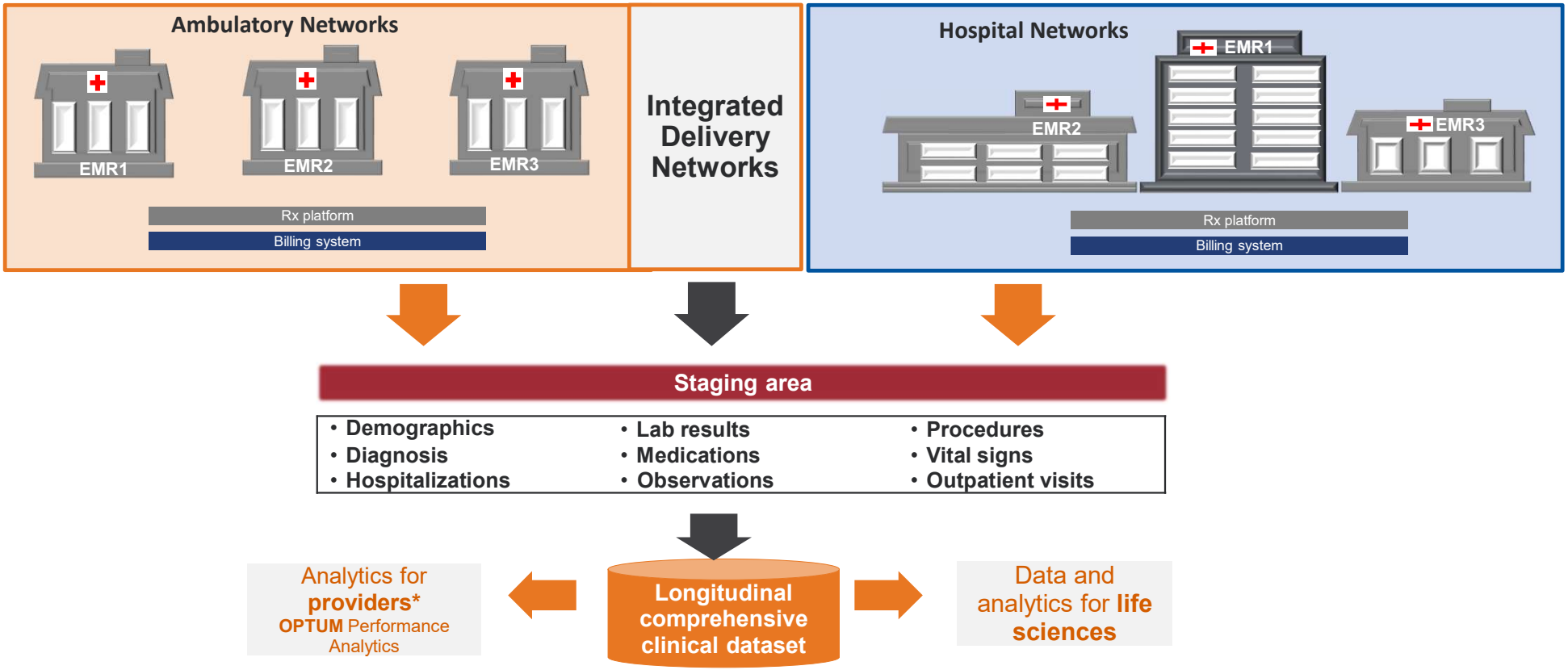
Data Source: Optum's COVID-19 EHR database



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Study Population

- Retrospective cohort study
- Patients with COVID-19 infection between January and November 2020
  - ICD-10-CM diagnosis code U07.1 -and/or-
  - Positive SARS-CoV-2 viral test
- Hospitalizations identified by presence of an inpatient healthcare encounter
- Cohort entry date was the later of the date of confirmed infection or the date of hospital admission

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Assessment of Covariates and Outcomes

- Ascertainment of covariates
  - Demographic characteristics: on the date of cohort entry
  - Comorbidities: in the 21 days prior to cohort entry
  - Vital signs, laboratory results, symptoms, diagnoses, treatments: during hospitalization
- Outcome identification
  - Critical Care: defined by Current Procedural Terminology, 4th Edition (CPT-4) codes.
  - Mechanical ventilation: intubation, ventilation, ECMO defined by CPT-4 and ICD-10 procedure codes.
  - Death: defined by the Social Security Administration's Death Master File or as indicated within the medical record.

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Statistical Analysis

- Baseline characteristics were examined overall and according to outcome (critical care, mechanical ventilation, and death)
- Logistic regression models were used to estimate unadjusted and adjusted odds ratios (OR) and corresponding 95% confidence intervals (CI)
  - Adjusted models included age, gender, region, race, and week of cohort entry

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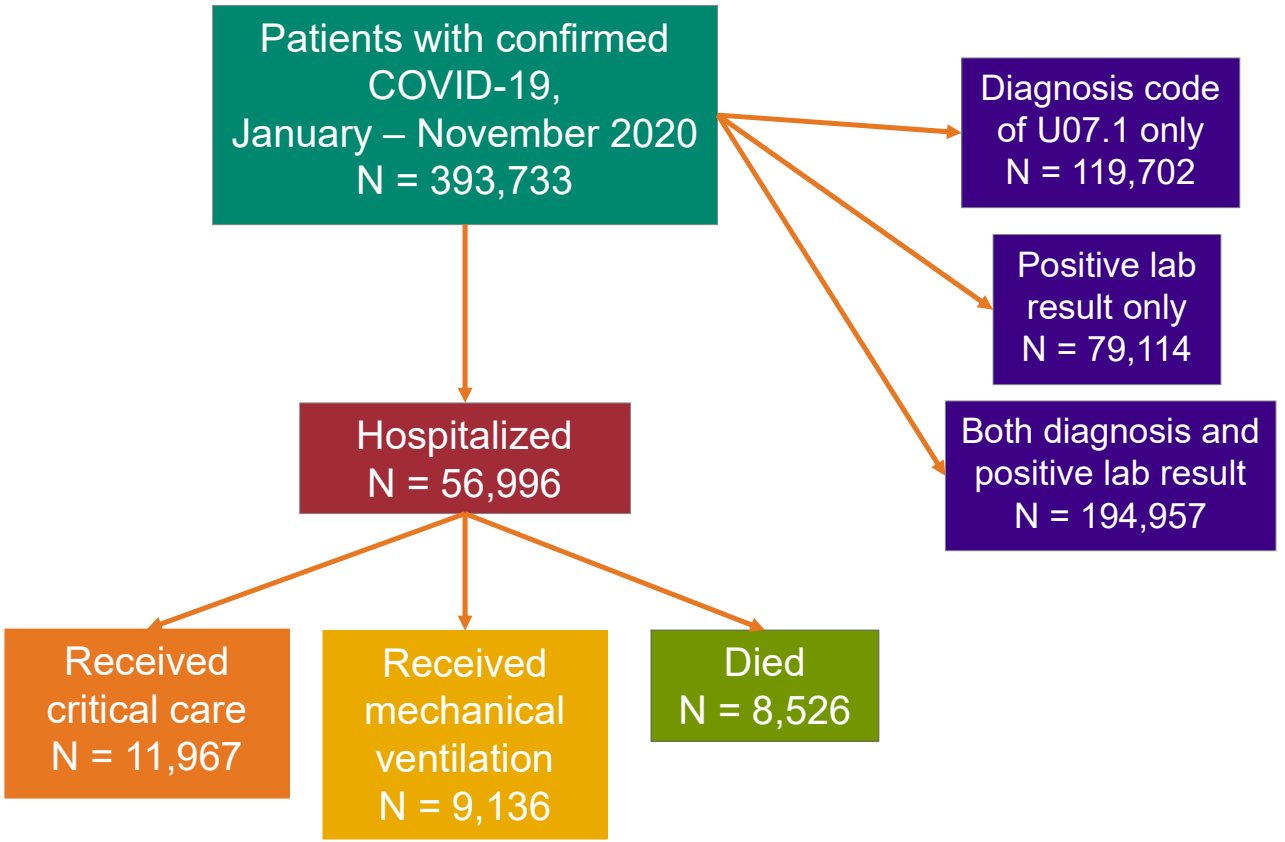
Flow Chart



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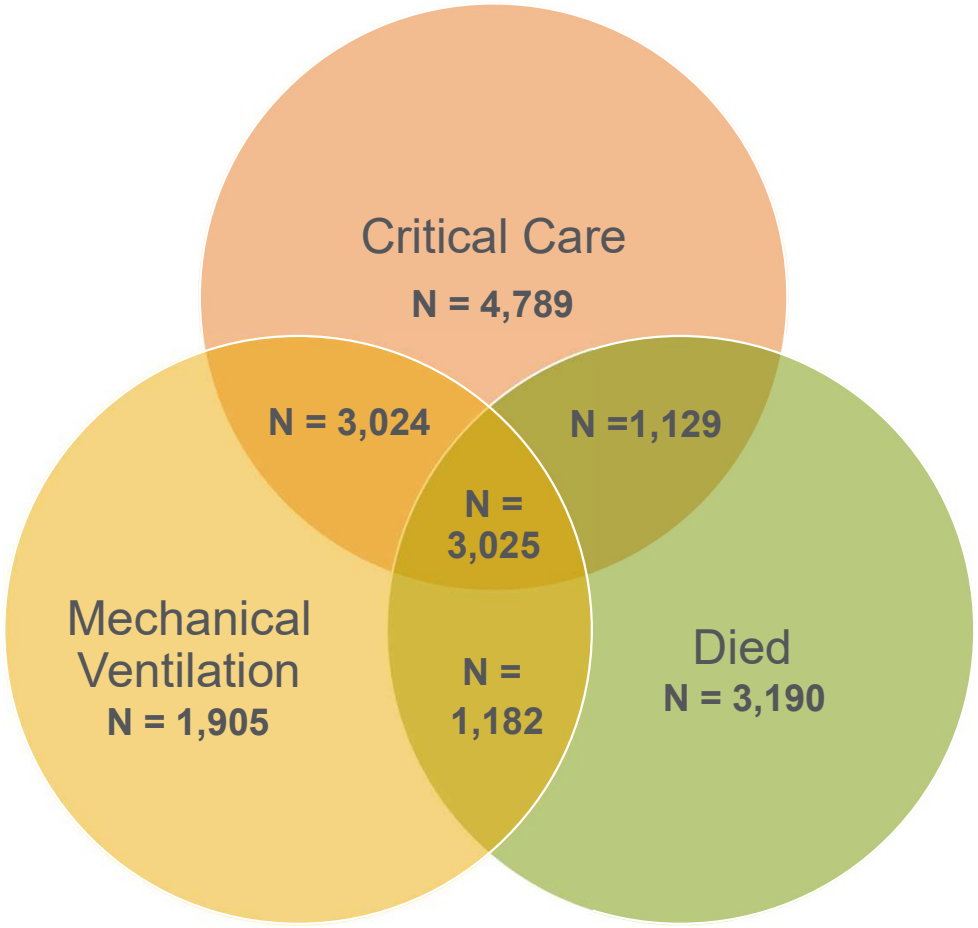
Overlap in Patients Experiencing Each Outcome



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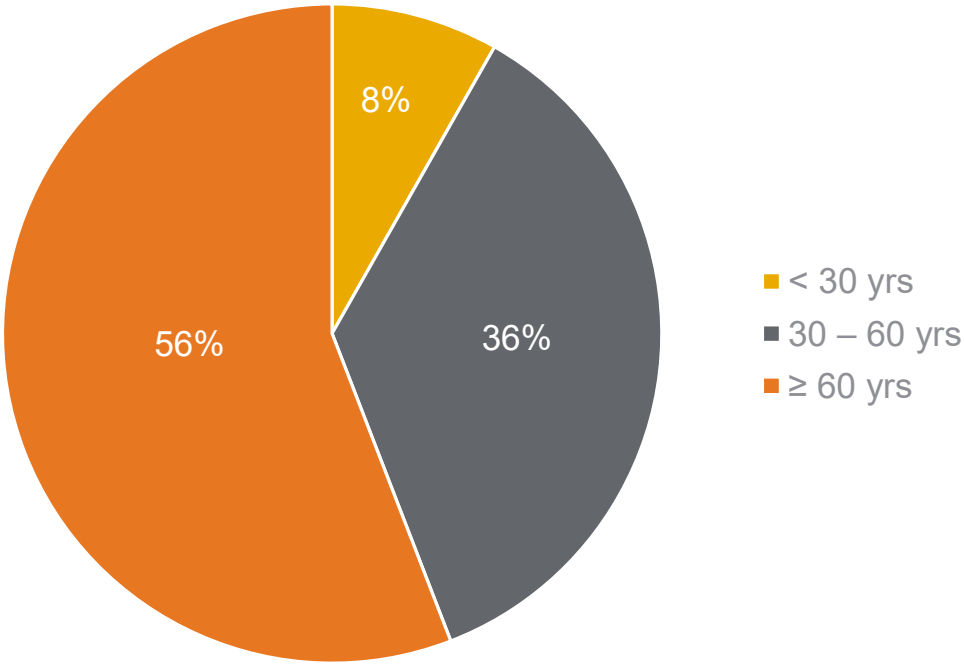
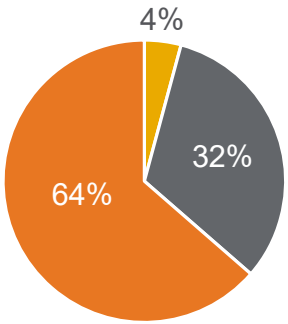
Demographic Characteristics: Age

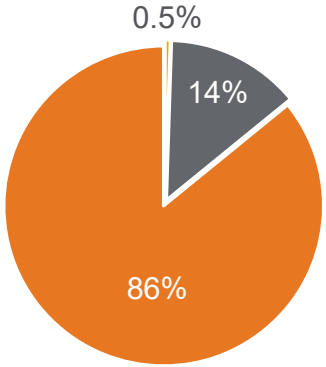
All Hospitalized Patients with COVID-19



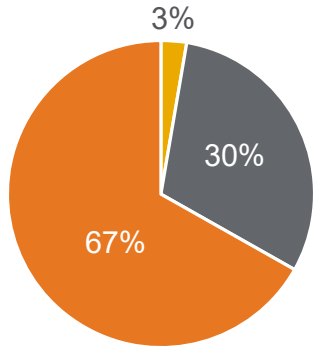
Critical Care



Death



Mechanical Ventilation



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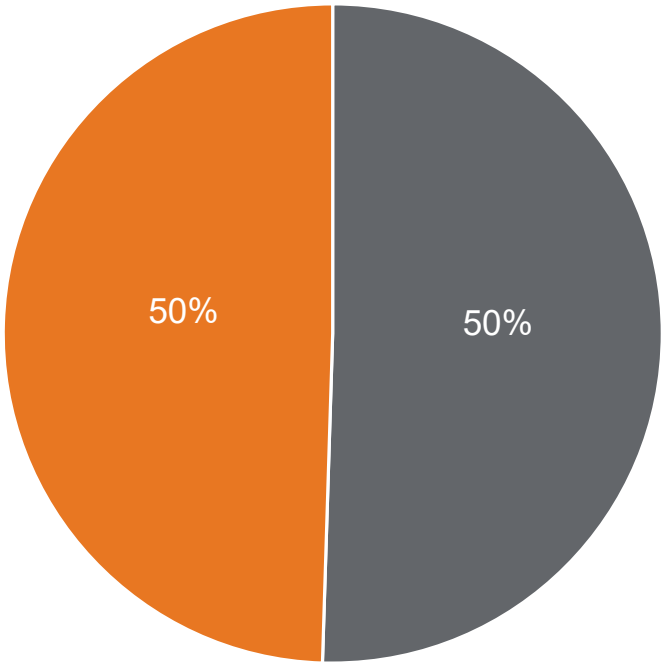
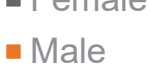
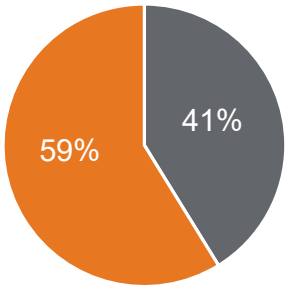
Demographic Characteristics: Sex

All Hospitalized Patients with COVID-19

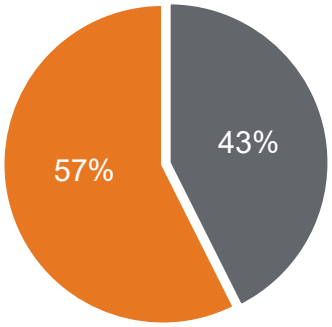




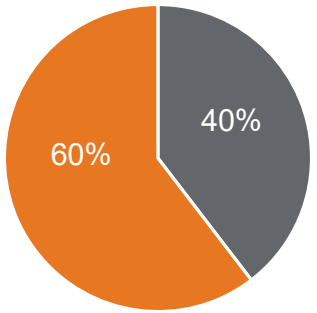
Critical Care



Death



Mechanical Ventilation



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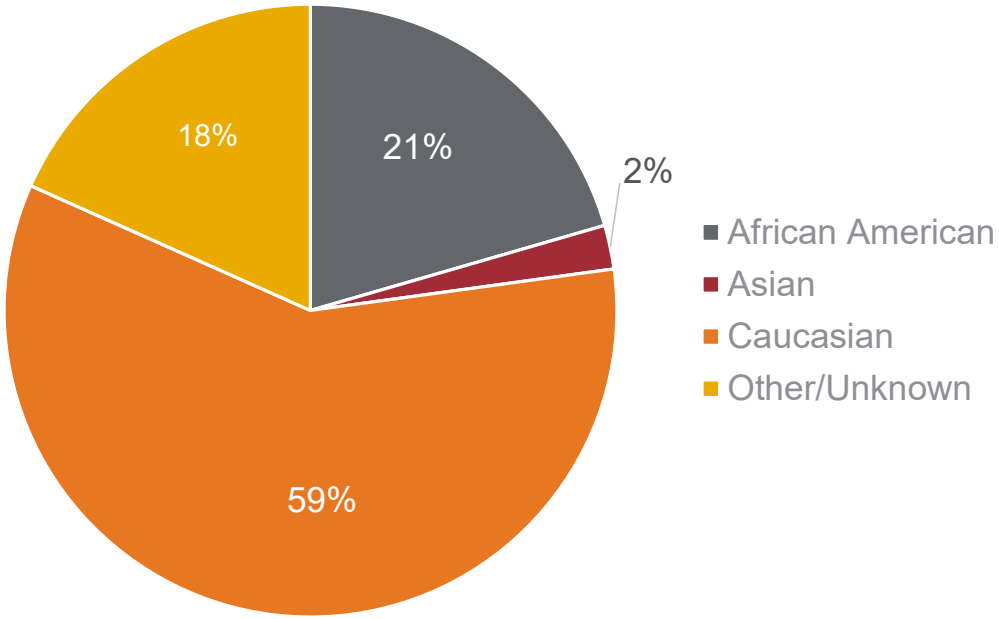
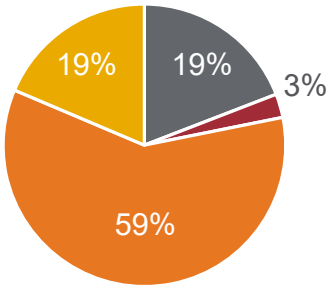
Demographic Characteristics: Race

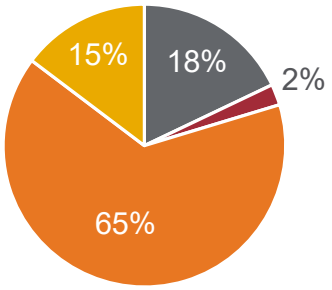
All Hospitalized Patients with COVID-19



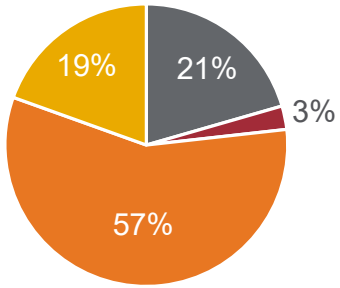
Critical Care



Death



Mechanical Ventilation



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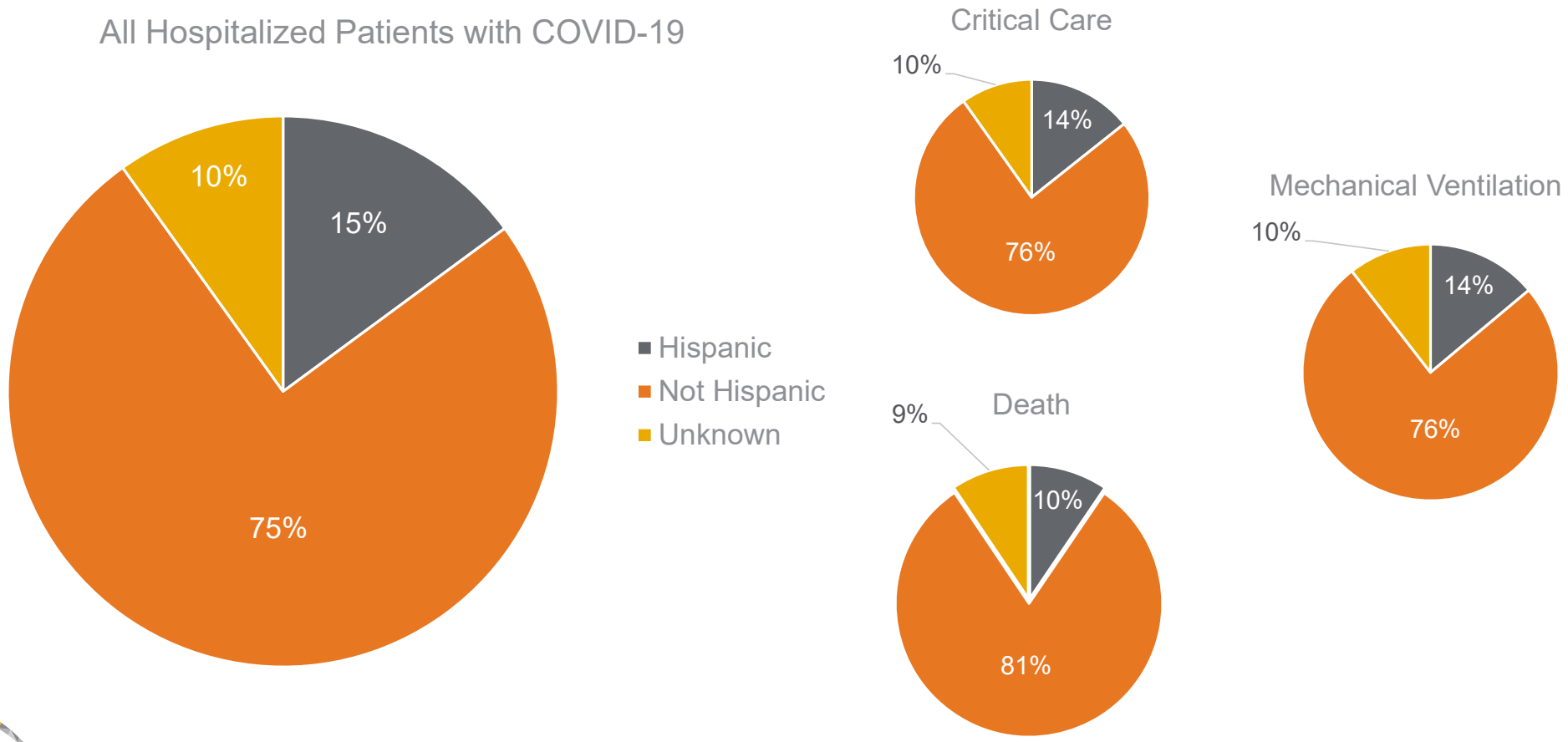
Demographic Characteristics: Ethnicity



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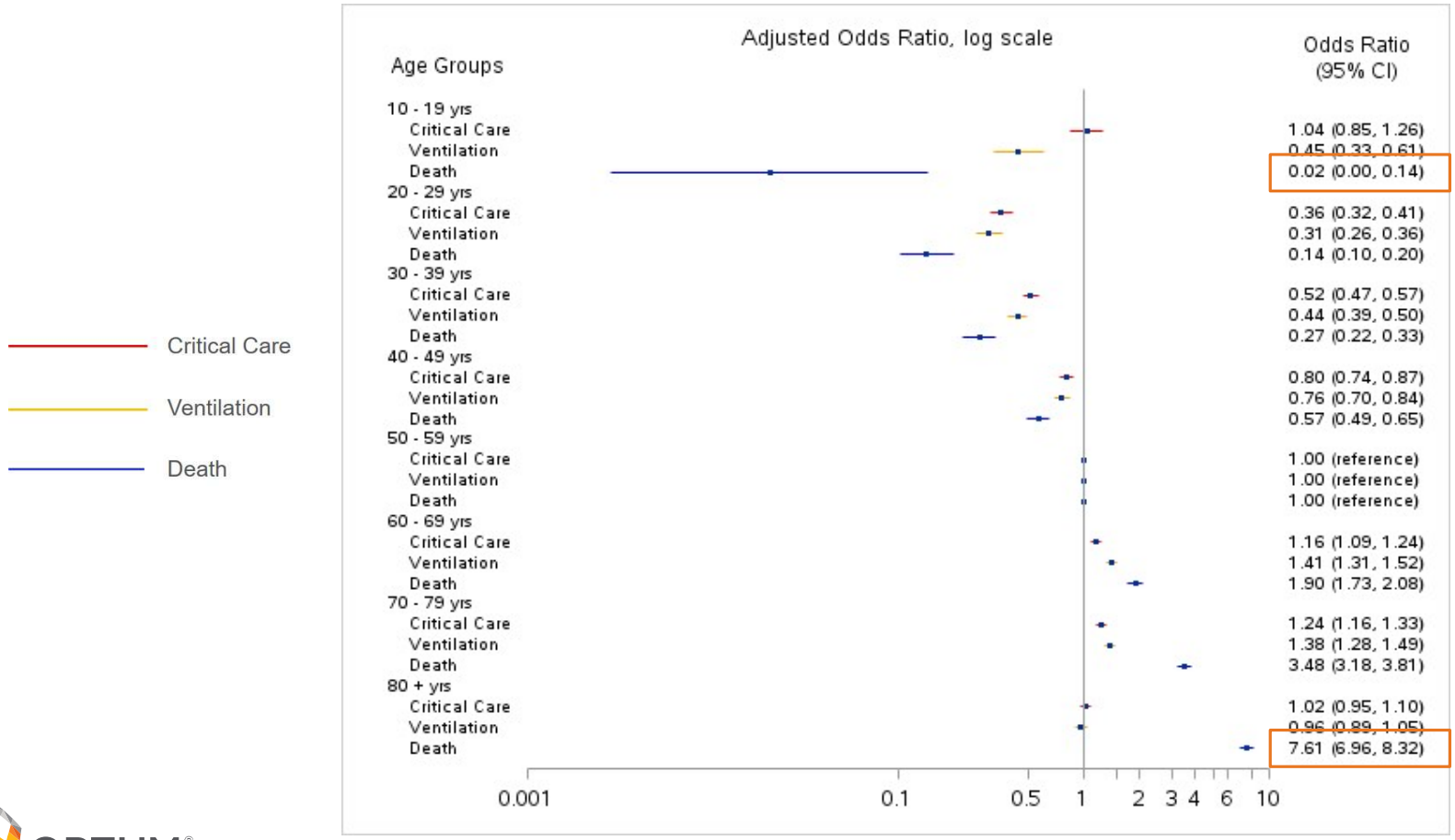
Association between Age and Outcomes



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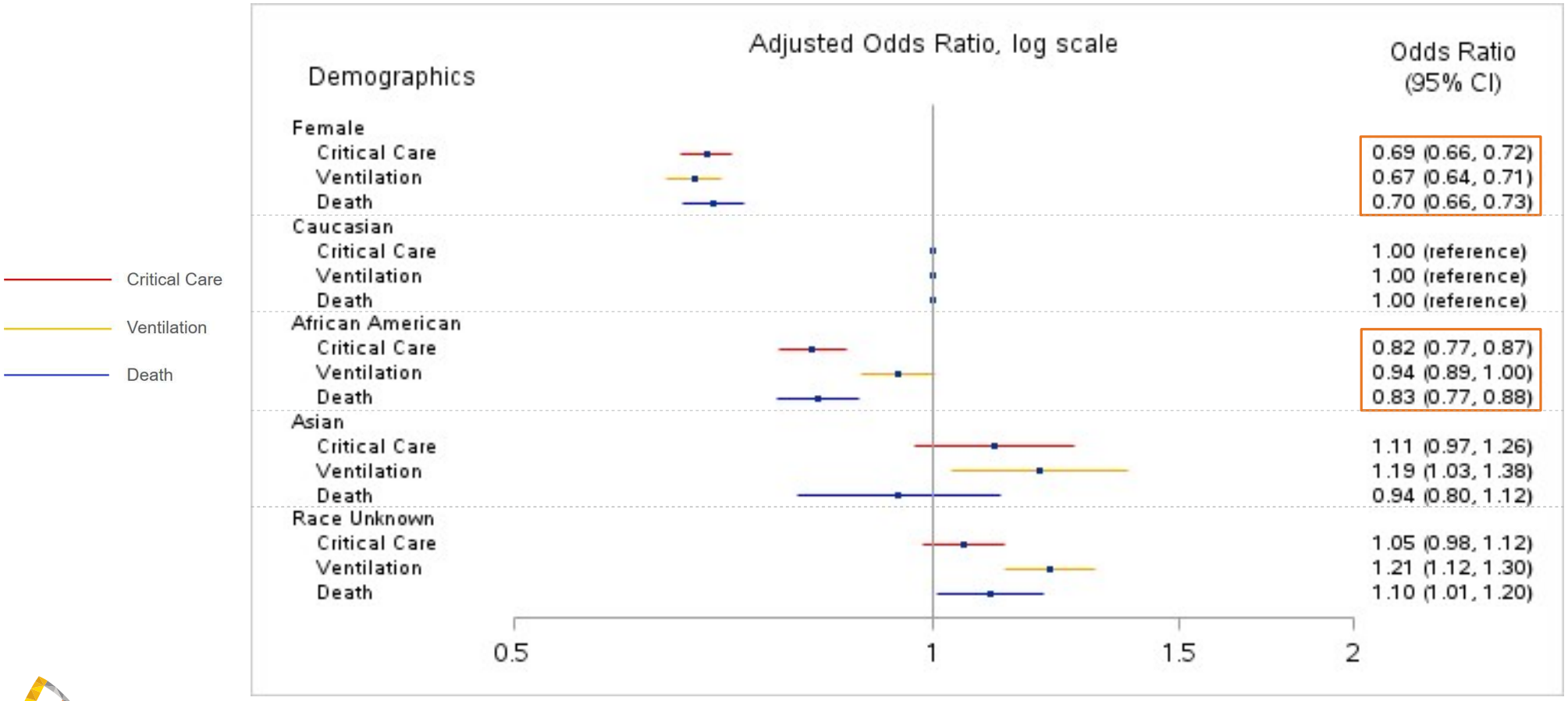
Associations between Other Demographic Variables and Outcomes



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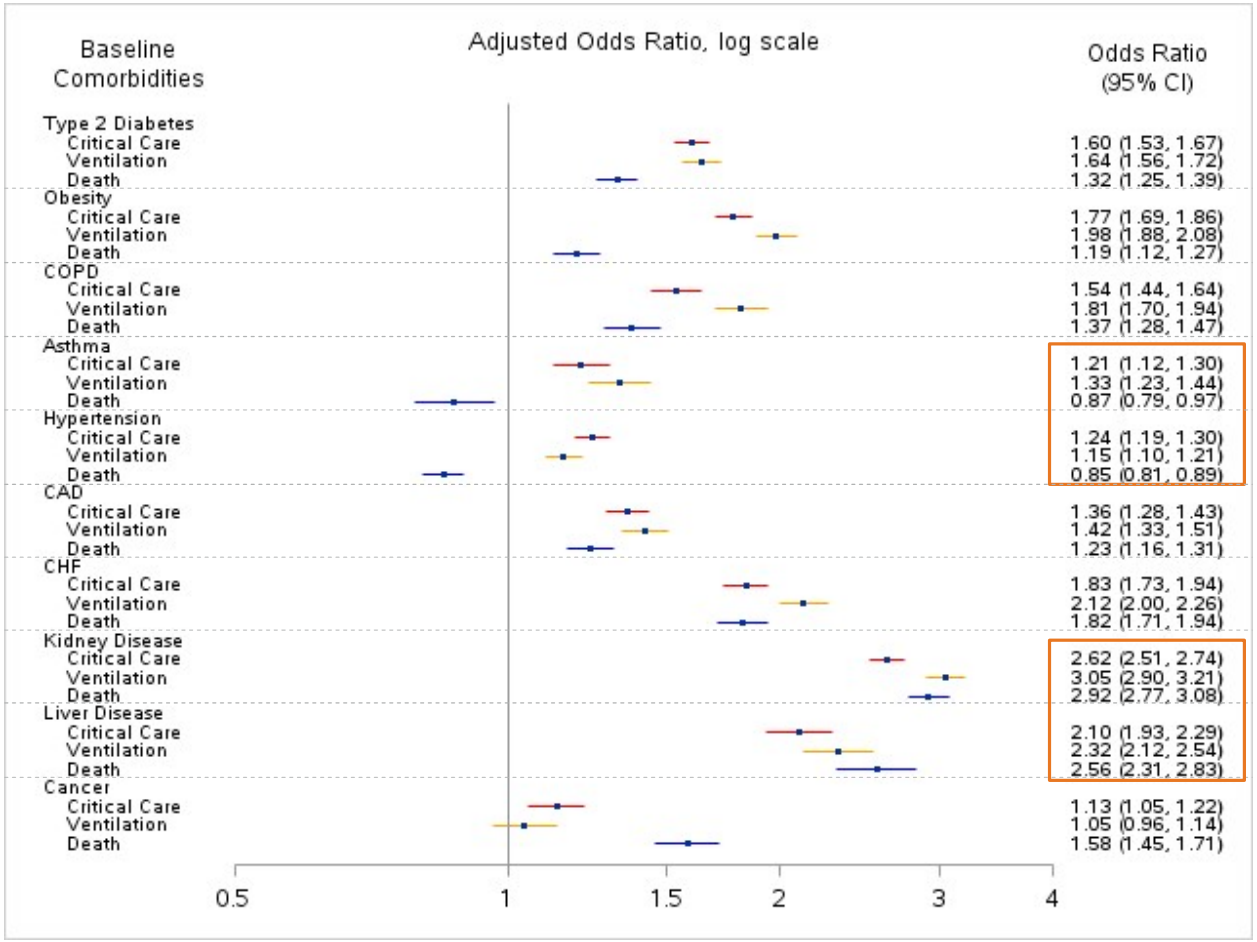
Associations between Baseline Comorbidities and Outcomes



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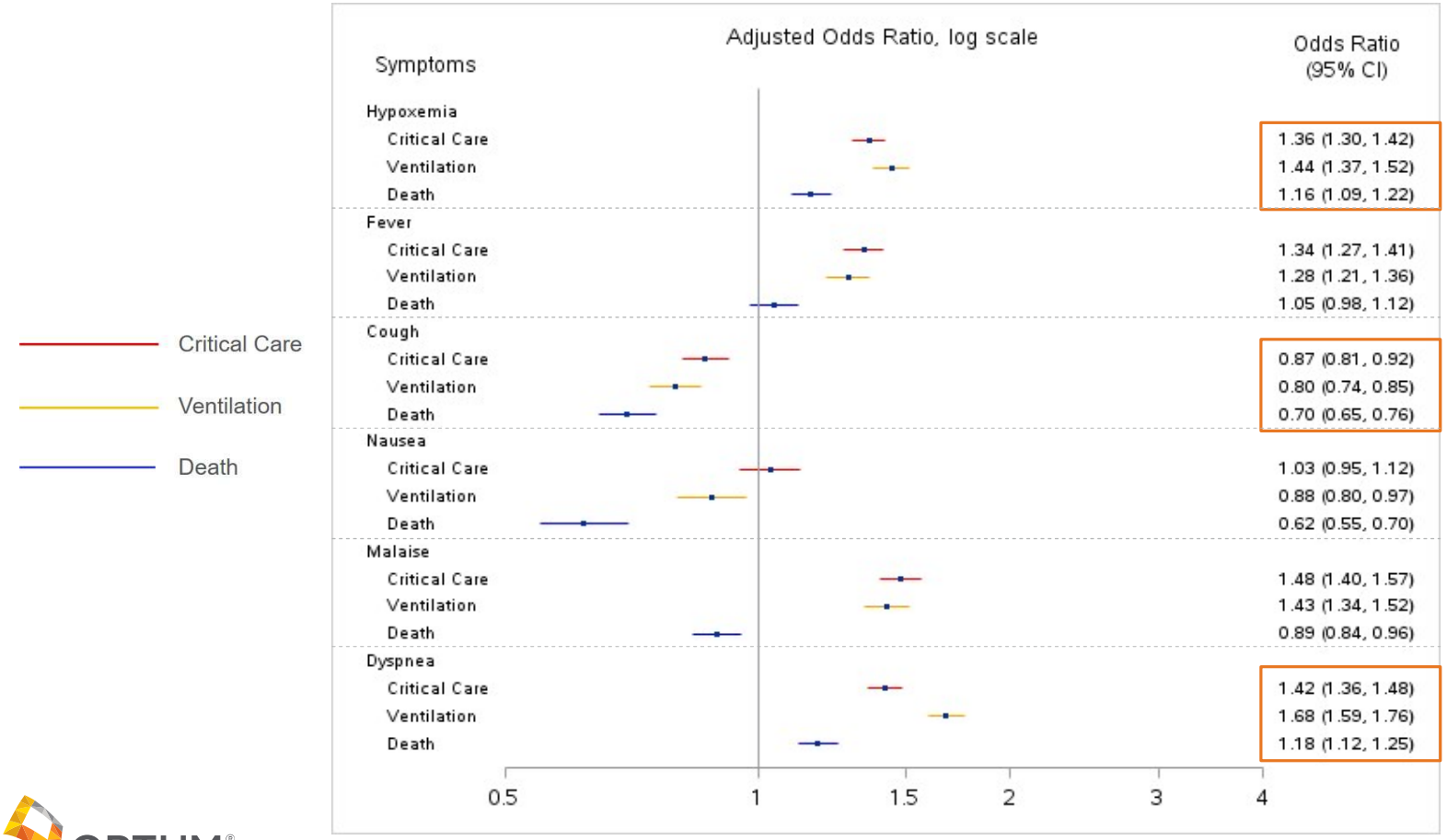
Associations between Symptoms During Hospitalization and Outcomes



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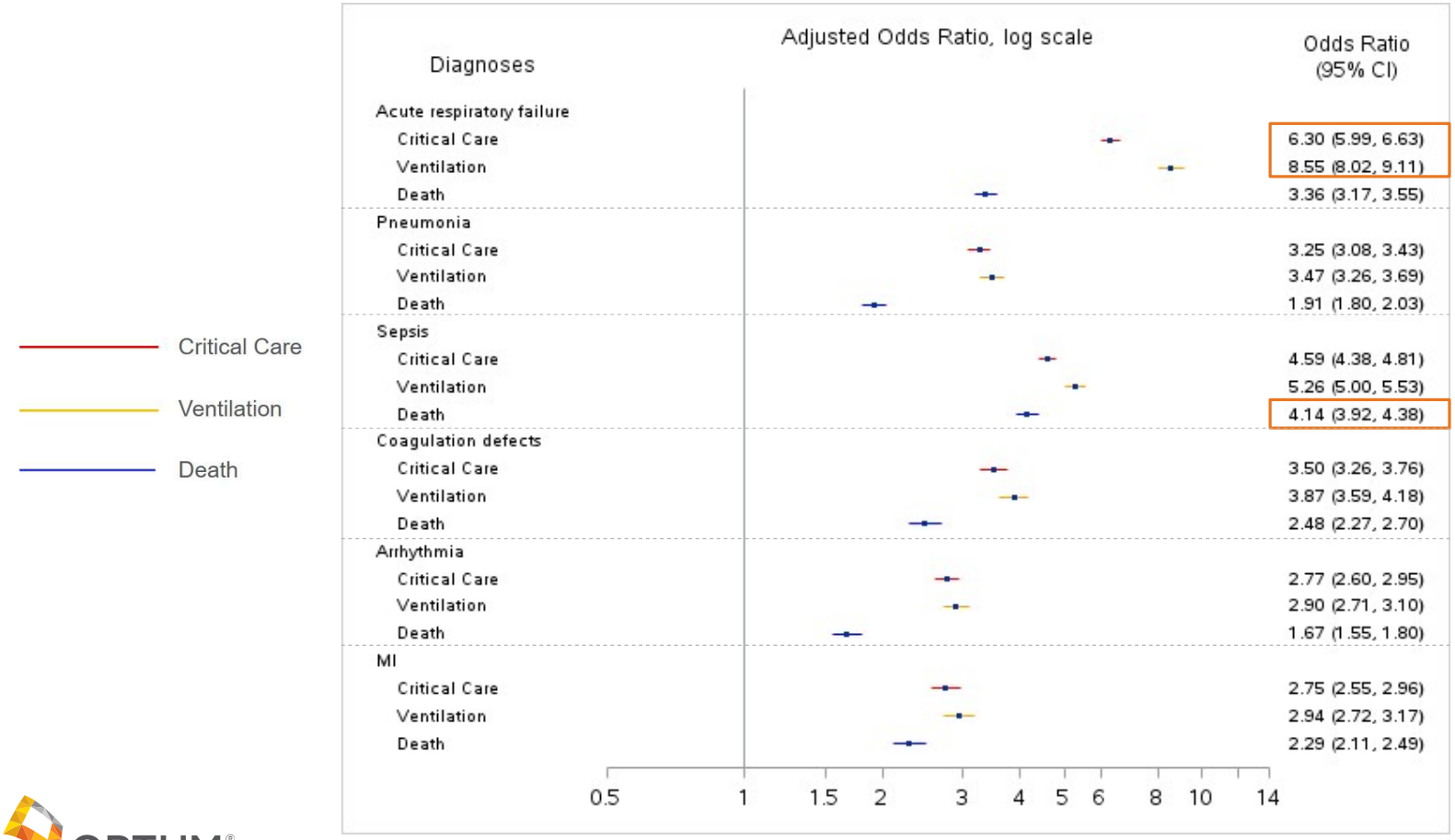
Associations between Diagnoses During Hospitalization and Outcomes



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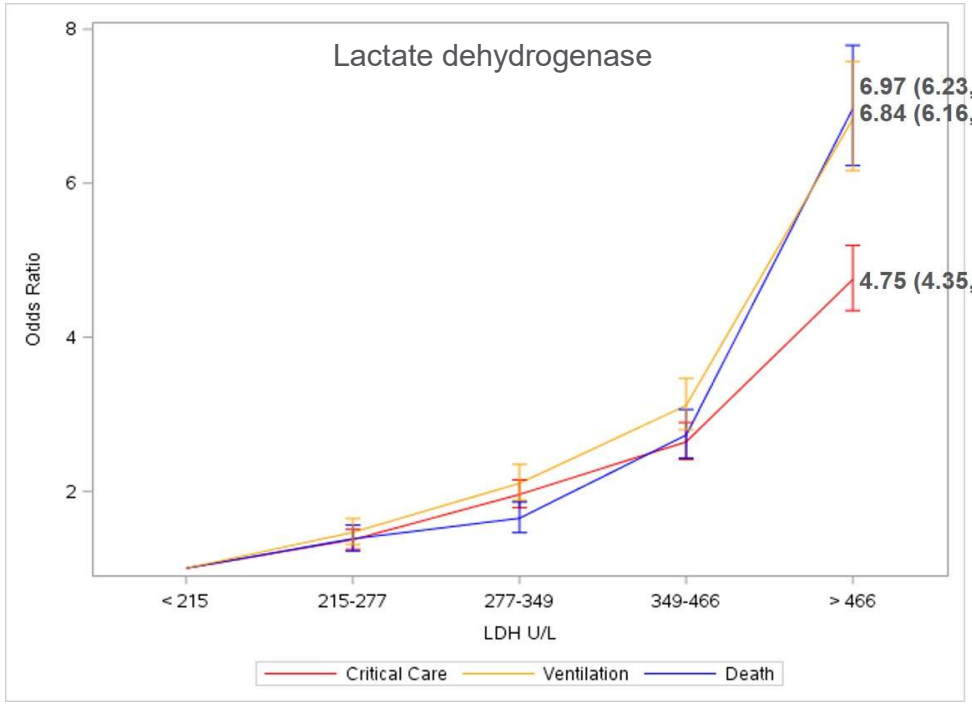
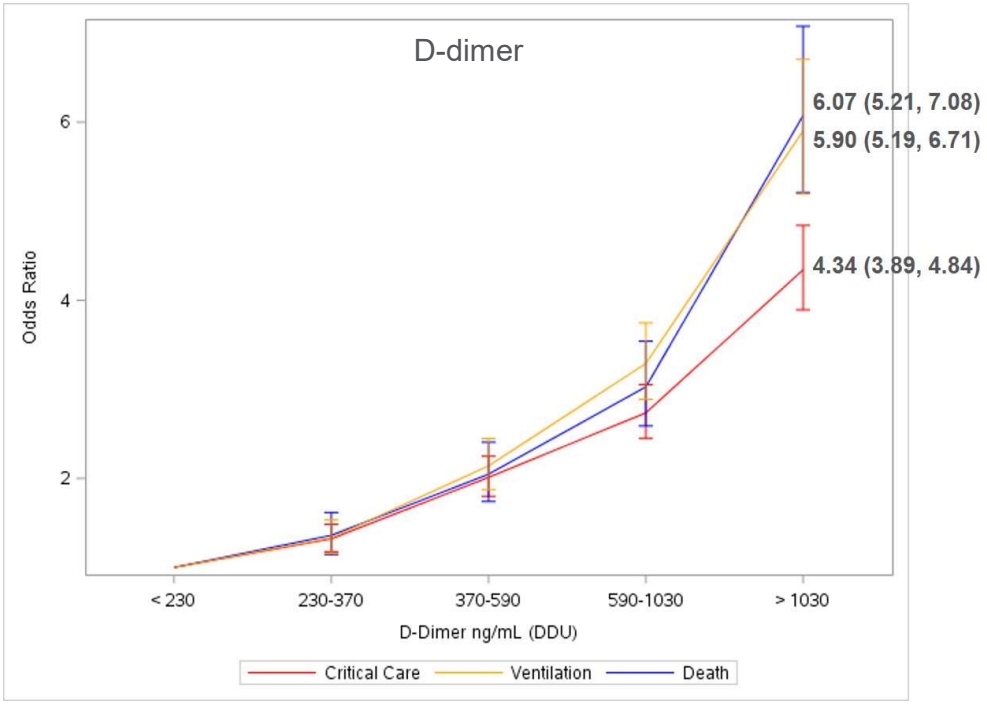
Associations between Lab Tests During Hospitalization and Outcomes





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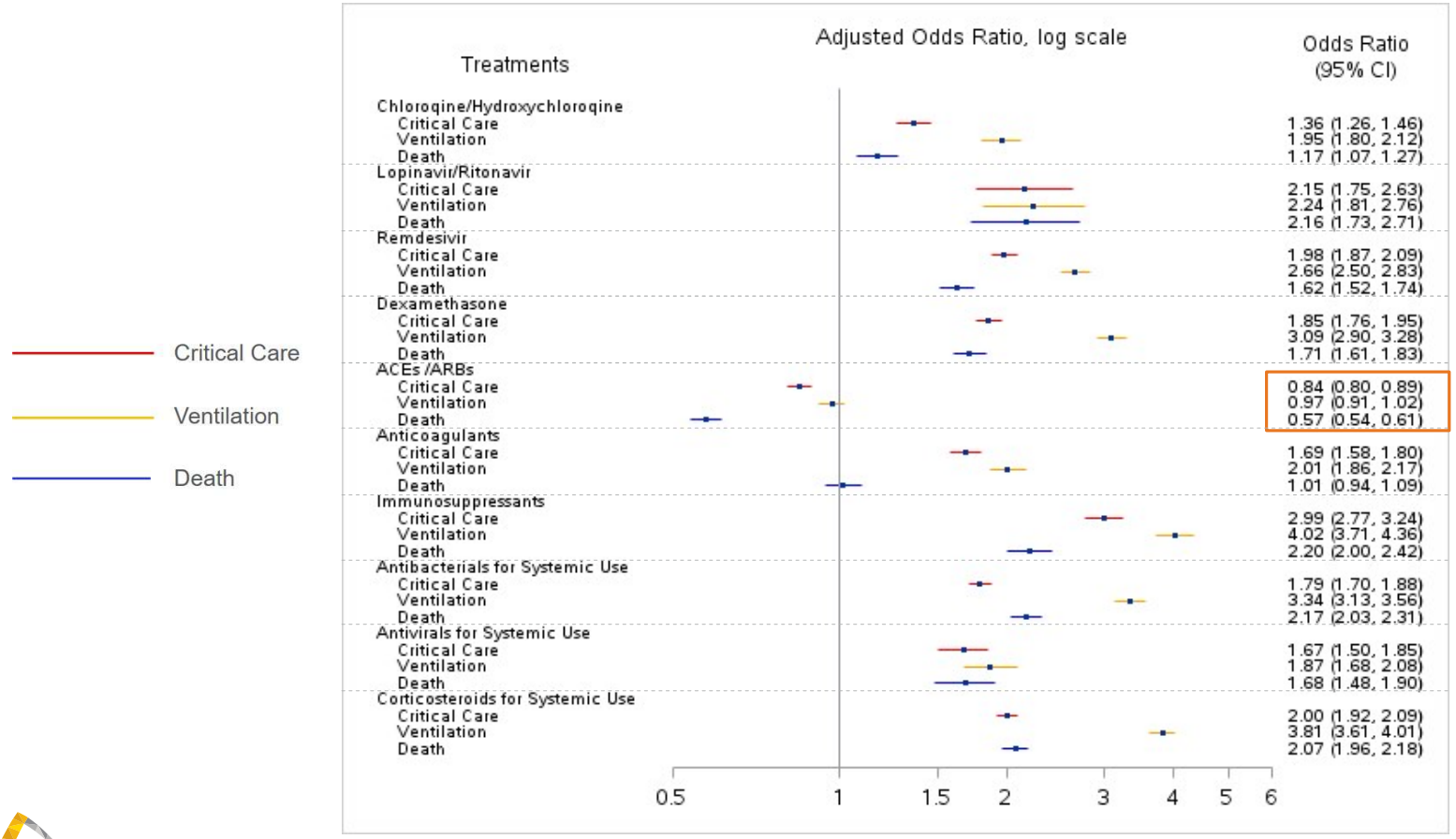
Associations between Treatments Received During Hospitalization and Outcomes



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Discussion

- We found that African Americans were at lower risk of experiencing an outcome compared to Caucasians
  - Despite a higher likelihood of getting and being hospitalized with COVID-19
- Hypertension was positively associated with receipt of critical care and mechanical ventilation, but inversely associated with mortality after adjusting for age and other demographics
- With the exception of ACEs/ARBs, we observed that many treatments received during hospitalization were associated with higher odds of receipt of critical care, mechanical ventilation, or death
  - Most medications, particularly those that were investigational, were only recommended for use among patients with severe disease

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Limitations

- The presence of a diagnosis code in the EHR data may not represent the actual presence of disease
  - We assumed the absence of a diagnosis code meant the patient did not have the disease

- Health care encounters with medical providers who do not contract with Optum would not be observed
  - It is possible that some comorbidities and medications may not have been captured

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Conclusion

- We identified many clinical characteristics that were associated with receipt of critical care, mechanical ventilation, and death among patients hospitalized with COVID-19

- Future studies should move toward causal inference

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Thank you!

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