# Title Page:

Test Performance of Serum Bicarbonate in Identifying Hypercapnia Across Settings and Diseases

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Conflicts of Interest:

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Author contributions:

B.W.L Study concept design, Data acquisition/analysis, Manuscript drafting/revision/editing, Literature Review, Statistics, Guarantor of the integrity of the entire study

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# Abstract:

Purpose:

Methods: Outpatient, emergency room, and inpatient encounters during 2022 were requested from the TriNetX research network, which summarizes health record data from 80 medical systems in the USA.

Results: 870,019 patients were included.

Conclusions:

# Introduction:

# Methods:

## Study design:

We performed a retrospective, cross-sectional analysis of healthcare encounters between January 1, 2022, and December 31, 2022. Data were obtained from the TriNetX Research Network18, which contains federated, anonymized health record data from 80 healthcare institutions in the United States. The study was exempted by the University of Utah Institutional Review Board (University of Utah IRB #­00152089).

## Subjects:

An enriched sample of healthcare encounters (ambulatory, emergency, and inpatient) where a reasonable clinician might have suspected hypercapnic respiratory failure was requested. Full criteria are listed in the Supplemental Materials. Briefly, encounters meeting any of the following criteria were included: patients who received a diagnostic code for any respiratory failure, patients who had a pre-existing condition known to cause hypercapnia, patients who received a procedure code for non-invasive or invasive ventilation, patients who had an arterial blood gas or venous blood gas obtained, and patients with severe obesity. These criteria were chosen to approximate the spectrum of patients in which bicarbonate levels would potentially be used to screen for hypercapnic respiratory failure in clinical practice19, but bicarbonate levels themselves were not included to avoid incorporation bias20. The first encounter for each patient-reason-for-suspicion permutation was used.

## Data collection:

Patient encounters were categorized based on their level of care (ambulatory, emergency, or inpatient; whether critical care time was billed). Demographics, vital signs (first recorded), laboratory results (within 24 hours), diagnoses (ICD-10 codes), medications (categorized as either prescribed during the current encounter or preceding the current encounter), and procedures were collected. Serum bicarbonate (reported as an integer) and potassium from basic metabolic panels were used as the index tests and were identified using LOINC codes. Arterial blood gas bicarbonate values, which are calculated using the Henderson-Hasselbach equation and measurements of arterial pH and CO2 gas tension, were not used because they would not be available when a provider would potentially use the findings investigating (deciding who needs definitive workup with an ABG)21.

Several data control methods were applied, explained in detail in the Supplemental Material. Encounters were required to have at least 1 data element of each type (ensuring participating centers were submitting all categories of data during the time), variables outside physiologic ranges were removed, and positive/negative control measures were developed (findings that should always or never co-occur, such as a code for invasive mechanical ventilation when neuromuscular blockade is used). Distributions of covariates were examined after each exclusion to assess the plausibility of the missing-at-random assumption for key covariates. Outcomes and characterizations were all performed within the same encounter of interest to minimize the risk of data discontinuity.

## Statistical Analysis:

Statistical analyses were performed using Stata version 18 (StataCorp, College Station, TX).

# Results:

Of 2,115,791 potentially eligible encounters in the enriched sample, 870,019 patients were included after excluding institutions that did not submit all the required data elements. The mean age was 58 (±18) years, and 53% were female. 66% were white, 19% were Black, and 6% were Hispanic by self-reported ethnicity/race.

# Discussion

# Tables and Figures;

## Table 1 Characteristics of patients with or without ABG verification of hypercapnia status in the enriched cohort.

Figure 1 Inclusion Flow Diagram

A flowchart of data

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# References: