Original Article

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# Arterial Blood Gas Acid-base Disturbances and their Association with ICU Admission in Emergency Patients with Acute Dyspnoea: A Cross-sectional Study

Internal Medicine Section

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## ABSTRACT

**Introduction**: Arterial Blood Gas (ABG) analysis simultaneously assesses oxygenation, ventilation, and acid-base status. Acid-base disturbances are common in Emergency Department (ED) patients with acute dyspnoea, yet their predictive value for Intensive Care Unit (ICU) admission across heterogeneous multi aetiology presentations remains poorly characterised in the Indian emergency medicine setting.

**Aim**: To characterise ABG-derived acid-base disturbance patterns and evaluate their association with ICU admission among adult ED patients presenting with acute dyspnoea.

**Materials and Methods**: A cross-sectional study was conducted in the ED and Critical Care Unit, Smt. B. K. Shah Medical Institute and Research Centre, Sumandeep Vidyapeeth University, Vadodara, Gujarat, India, from June to November 2025. Eighty-nine consecutive adults (≥18 years) with acute dyspnoea presenting to the ED were enrolled. All patients underwent ABG analysis as part of routine emergency care. ABG parameters including pH (Potential of Hydrogen), PaCO2 (Partial Pressure of Arterial Carbon Dioxide), PaO2 (Partial Pressure of Arterial Oxygen), HCO3 - (Bicarbonate), lactate, A-a gradient (Alveolar-Arterial Oxygen Gradient), and S/F ratio (SpO2/FiO2) were assessed. Patients were classified into five mutually exclusive acid-base categories based on standard criteria: respiratory acidosis (pH <7.35 and $PaCO_2$ >45 mmHg), metabolic acidosis (pH <7.35, $PaCO_2$ <35 mmHg, and $HCO_3^-$ <22 mEq/L), mixed acidosis (pH <7.35, $PaCO_2$ >45 mmHg, and $HCO_3^-$ <22 mEq/L), alkalosis (pH >7.45), and normal pH (7.35-7.45). ICU admission criteria were based on standard clinical indicators: haemodynamic instability, need for ventilatory support, or multi-organ dysfunction - not on ABG parameters alone. Statistical analysis included the Mann-Whitney U test, Kruskal-Wallis test, Spearman rank correlation, Chi-square test, and Receiver Operating Characteristic (ROC) curve analysis with Youden index. ROC analysis was performed for arterial pH, $PaCO_2$, $HCO_3^-$, lactate, and S/F ratio. Exact p-values are reported; p-value <0.05 was considered statistically significant.

**Results:** A total of 89 patients were enrolled (mean age 54.3±12.1 years; 64 males (71.9%), 25 females (28.1%). Mean Respiratory Rate (RR) was 27.2±5.4 breaths/min and mean $SpO_2$ was 88.3±7.6%. ICU admission rate was 80.9% (n=72); 17 (19.1%) were managed in the general ward. Acidaemia was observed in 47 patients (52.8%): respiratory acidosis 18 (20.2%), metabolic acidosis 13 (14.6%), mixed acidosis 16 (18.0%); alkalosis 10 (11.2%); normal pH 32 (36.0%). ICU admission rates differed significantly by acid-base category (Chi-square p-value=0.001): mixed acidosis 100%, respiratory acidosis 94.4%, metabolic acidosis 92.3%, normal pH 71.9%, alkalosis 40.0%. Arterial pH was significantly lower in ICU patients versus ward patients 7.283±0.153 vs 7.428±0.066; p-value <0.001). ROC analysis demonstrated that arterial pH was the strongest predictor of ICU admission (AUROC=0.830; sensitivity 71%, specificity 82%, Positive Predictive Value (PPV) 94.4%, Negative Predictive Value (NPV) 31.0% at cutoff pH ≤7.36). Compared to arterial pH, the S/F ratio showed lower discriminatory performance (AUROC=0.657).

**Conclusion:** Arterial pH ≤7.36 identifies high-risk patients with greater discriminative accuracy than oxygenation-based indices, and ABG acid-base pattern assessment may be incorporated as an important triage parameter in the management of emergency dyspnoea.

**Keywords:** Emergency department triage, Intensive care unit prediction, Respiratory acidosis

## INTRODUCTION

Dyspnoea is a frequently encountered symptom, affecting nearly 50% of hospitalised patients in acute tertiary care settings and approximately 25% of ambulatory patients. Community-based studies have reported a prevalence of mild-to-moderate dyspnoea ranging from 9-13% among adults, increasing to 15-18% in individuals aged ≥40 years and 25-37% among those aged ≥70 years. In the United States, shortness of breath accounts for nearly 3-4 million ED visits annually [1]. Its aetiologies are mechanistically diverse, including Chronic Obstructive Pulmonary Disease (COPD) exacerbations, pneumonia, heart failure, sepsis, Diabetic Ketoacidosis (DKA), and renal failure, all of which may produce characteristic disturbances in oxygenation, ventilation, and acid-base homeostasis [2].

The ABG analysis provides simultaneous information across all three physiological domains and is routinely performed in patients with acute respiratory distress [3], Whilst oxygenation indices such as the $SpO_2/FiO_2$ (S/F) ratio have received considerable research attention as triage tools [4], the independent prognostic value of acid-base disturbance type and severity for ICU admission in an unselected multi-aetiology ED dyspnoea cohort has been less systematically studied, particularly in the Indian emergency medicine context.

Acid-base disturbances in acute dyspnoea reflect distinct pathophysiological mechanisms. Respiratory acidosis signals primary ventilatory failure, as occurs in COPD exacerbations and severe pneumonia. Metabolic acidosis arises from tissue hypoperfusion in sepsis, lactic acidosis, or primary metabolic disorders such as DKA. Mixed acid-base disorders - defined as the concurrent presence of both

respiratory and metabolic acidosis - indicate compound physiological derangement and generally portend the most severe clinical trajectories [5]. Understanding which acid-base pattern carries the greatest ICU risk has direct implications for rapid ED triage decisions.

Prior studies have individually characterised acid-base status in specific diagnoses such as COPD exacerbations [6] and sepsis [7], but comprehensive classification across a multi-aetiology ED dyspnoea cohort, with systematic ICU outcome recording, is lacking from the Indian emergency medicine literature. Oxygenation-based indices such as the $SpO_2/FiO_2$ (S/F) ratio have been validated primarily in ICU settings [4] and may fail to capture the full severity of non pulmonary causes of dyspnoea such as DKA, sepsis, and renal failure, where metabolic derangement drives deterioration independently of pulmonary gas exchange [8]. This study addresses that gap by providing a comprehensive characterisation of ABG acid-base patterns and comparing their predictive value for ICU admission against the S/F ratio in a real-world Indian emergency setting. The specific objectives were to: (i) characterise the distribution of ABG-derived acid–base disturbance patterns in adult ED patients with acute dyspnoea; (ii) evaluate the association of arterial pH and related ABG parameters with ICU admission; and (iii) compare the predictive performance of arterial pH against the $SpO_2/FiO_2$ (S/F) ratio for ICU admission.

## MATERIALS AND METHODS

A hospital-based cross-sectional study was conducted in the ED and Critical Care Unit of Smt. B. K. Shah Medical Institute and Research Centre, Sumandeep Vidyapeeth University, Vadodara, Gujarat, India from June 2025 to November 2025. Study preparation, protocol development, and administrative arrangements commenced in June 2025. Ethical approval was obtained from the Institutional Human Research Review Protocol (HRRP) Committee (Approval No. 25124) on 19/09/2025. Participant enrolment and prospective data collection were initiated only after obtaining ethical approval and continued until November 2025. Written informed consent was obtained from all participants or their legally authorised representatives prior to inclusion in the study.

**Sample size:** The sample size was calculated assuming an AUROC of 0.75 for arterial pH based on the study by Burri E et al., with 80% power and a two-sided alpha error of 0.05 using the Hanley JA and McNeil BJ method, yielding a minimum required sample size of 74 patients; after considering 20% possible exclusions and missing data, a target sample size of 90 patients was planned, of which 89 patients were finally enrolled [9,10].

**Inclusion criteria:** Consecutive adult patients aged ≥18 years presenting to the ED with acute breathlessness as the primary presenting complaint and undergoing ABG analysis as part of routine emergency evaluation were included in the study. During the study period, a total of 102 patients were screened, of whom 89 patients fulfilled the eligibility criteria and were enrolled.

**Exclusion criteria:** Patients were excluded if they had: (i) trauma-related breathlessness, (ii) Glasgow Coma Scale (GCS) score <13 at presentation; or (iii) requirement for immediate endotracheal intubation before initial clinical assessment. Of the 102 patients screened, 13 were excluded: five trauma patients, seven with GCS <13 and one requiring immediate intubation.

### Study Procedure

A structured case record proforma was used for data collection. Demographic details, co-morbidities, and clinical parameters, including temperature, heart rate, blood pressure, RR, and peripheral oxygen saturation ($SpO_2$), were recorded at presentation. $SpO_2$was measured using continuous pulse oximetry (Nellcor™ pulse oximeter) and the first stable 15-second average was documented. Oxygen delivery modality and estimated fraction of inspired oxygen ($FiO_2$) were noted. ABG analysis was performed in the ED during the initial assessment before ward or ICU disposition, and parameters including arterial pH, $PaCO_2$, $PaO_2$, $HCO_3^-$, lactate, and alveolar-arterial (A-a) oxygen gradient were recorded. The $SpO_2/FiO_2$ (S/F) ratio was calculated as $SpO_2$ (%) divided by $FiO_2$ (decimal fraction). Dyspnoea severity was assessed using the modified Medical Research Council (mMRC) dyspnoea scale [11].

**ICU admission criteria:** The ICU admission decisions were made by the treating emergency physician and intensivist based on standard clinical criteria independent of ABG parameters alone. Criteria included: persistent haemodynamic instability (systolic BP <90 mmHg or MAP <65 mmHg), respiratory failure requiring non invasive or invasive ventilation, $SpO_2$ <90% on ≥10 L/min oxygen, severe metabolic derangement (lactate >4 mmol/L), or clinical judgment of impending deterioration. ABG-derived acid-base parameters were not used as sole or primary determinants for ICU admission, and therefore do not constitute selection bias in the statistical outcome analysis [12].

**Acid-base classification**

Patients were classified into five mutually exclusive groups based on standard ABG criteria:

(1). Respiratory acidosis: pH <7.35, $PaCO_2$ >45 mmHg, $HCO_3^-$ >26 mEq/L (or appropriately elevated for compensation);

(2) Metabolic acidosis: pH <7.35, $PaCO_2$ <35 mmHg, $HCO_3^-$ <22 mEq/L;

(3) Mixed acidosis: pH <7.35, $PaCO_2$ >45 mmHg, and $HCO_3^-$ <22 mEq/L (concurrent respiratory and metabolic acidosis);

(4) Alkalosis: pH >7.45. Alkalosis was not further subdivided into respiratory and metabolic subtypes due to the small group size (n=10)

(5) Normal pH: 7.35–7.45 [13].

## STATISTICAL ANALYSIS

Statistical analysis was performed using Python version 3.12 (SciPy v1.11). Continuous variables were expressed as mean±Standard Deviation (SD) whilst categorical variables were presented as frequencies and percentages. The Mann-Whitney U test was used for comparisons between two groups, whilst the Kruskal-Wallis test was employed for comparisons across multiple acid-base categories. Spearman rank correlation coefficient (ρ) was used to assess associations between ABG parameters and the $SpO_2/FiO_2$ (S/F) ratio. Categorical variables were compared using the Chi-square test. ROC curve analysis with Youden index was performed to determine the optimal arterial pH cut-off for prediction of ICU admission, and sensitivity, specificity, Positive PPV, and NPV were calculated. The Area Under the Receiver Operating Characteristic Curve (AUROC) was determined and compared for arterial pH, $PaCO_2$, $HCO_3^-$, lactate, and S/F ratio. Exact p-values were reported throughout, and a p-value <0.05 was considered statistically significant.

## RESULTS

A total of 89 patients were enrolled. Mean age was 54.3±12.1 years; 64 (71.9%) were male and 25 (28.1%) were female. Seventy-two patients (80.9%) required ICU admission; 17 (19.1%) were managed in the general ward. Seven-day in-hospital mortality was 6.7% (n=6, all in the ICU group). The most common oxygen delivery modalities were face mask in 41 patients (46.1%), nasal cannula in 27 patients (30.3%), non-rebreather mask in 14 patients (15.7%), and room air in 7 patients (7.9%); mean estimated $FiO_2$ was 0.41±0.14. Dyspnoea severity scores at presentation were: mMRC grade 3-4 in 74 patients (83.1%). Triage category was red in 54 patients (60.7%) and yellow in 35 patients (39.3%) [Table/Fig-1].

## ABG Parameters: ICU vs Ward

ICU patients had significantly lower arterial pH (7.283±0.153 vs 7.428±0.066; p-value <0.001), higher $PaCO_2$ (41.6±19.7 vs 32.4±9.3 mmHg; p-value=0.033), lower $HCO_3^-$ (20.1±7.2 vs 22.3±3.9 mEq/L; p-value=0.032), and higher lactate (1.90±1.95 vs 0.96±0.87 mmol/L; p-value=0.022) [Table/Fig-1].

| Parameter | ICU (n=72) | Ward (n=17) | p-value (ICU vs Ward) |
|---|---|---|---|
| Age, years (mean±SD) | 55.1±12.0 | 50.8±12.5 | 0.174 |
| Male sex, n (%) | 57 (79.2%) | 7 (41.2%) | 0.005 |
| Female sex, n (%) | 15 (20.8%) | 10 (58.8%) | 0.005 |
| Heart rate, beats/min (mean±SD) | 104.2±16.3 | 99.1±15.4 | 0.298 |
| Systolic BP, mmHg (mean±SD) | 125.8±23.4 | 120.4±19.8 | 0.401 |
| Respiratory Rate (RR), breaths/min | 27.6±5.6 | 25.8±4.6 | 0.190 |
| $SpO_2$, % (mean±SD) | 87.4±7.8 | 91.5 ± 6.3 | 0.019 |
| Arterial pH (mean±SD)* | 7.283±0.153 | 7.428±0.066 | <0.001 |
| $PaCO_2$, mmHg (mean±SD)* | 41.6±19.7 | 32.4±9.3 | 0.033 |
| $HCO_3^-$, mEq/L (mean±SD)* | 20.1±7.2 | 22.3±3.9 | 0.032 |
| Serum lactate, mmol/L (mean±SD)* | 1.90±1.95 | 0.96±0.87 | 0.022 |
| $PaO_2$, mmHg (mean±SD) | 97.4±79.2 | 106.2±73.1 | 0.512 |
| S/F ratio (mean±SD)* | 238.9±101.6 | 283.8±117.9 | 0.048 |
| 7-day mortality, n (%) | 6 (8.3%) | 0 (0%) | 0.169 |

**[Table/Fig-1]:** Baseline characteristics and ABG parameters by clinical disposition. *P <0.05 vs. ward group (Mann-Whitney U test). SD: standard deviation; S/F: $SpO_2/FiO_2$ ratio.

## Acid-Base Disturbance Distribution and ICU Rates

The ICU admission rates differed significantly across acid-base categories (Chi-square=19.52, p-value=0.001): mixed acidosis 100% (16/16), respiratory acidosis 94.4% (17/18), metabolic acidosis 92.3% (12/13), normal pH 71.9% (23/32), and alkalosis 40.0% (4/10) [Table/Fig-2]. The Kruskal-Wallis test confirmed significant differences in pH across groups (H=76.91, p-value <0.001). [Table/Fig-2] shows that $PaCO_2$ and $HCO_3^-$ values differ predictably across acid-base categories by definition; therefore, p-values for these parameters across groups are not clinically informative and have been omitted.

Metabolic acidosis patients had the highest mean S/F ratio (321.7±118.3) despite 92.3% ICU admission, confirming that oxygenation indices alone fail to identify critically ill patients with non pulmonary dyspnoea. The notably elevated lactate in the respiratory acidosis group (2.88±3.26 mmol/L), higher than in the metabolic group (1.88±1.48 mmol/L), is explained by the COPD-predominant composition of this group (67% COPD): severe COPD exacerbations may produce secondary lactic acidosis from respiratory muscle fatigue, right ventricular strain, and tissue hypoxia, rather than primary metabolic derangement. This is distinct from the pure anion-gap metabolic acidosis of DKA.

## ABG Parameter Correlations

Spearman correlation analysis showed that $PaCO_2$ had the strongest inverse correlation with S/F ratio (ρ=–0.576, p-value <0.001), indicating that rising hypercapnia is associated with a worsening oxygenation index [Table/Fig-3].

| ABG parameter | Spearman ρ with S/F Ratio | p-value |
|---|---|---|
| $PaCO_2$ | -0.576 | <0.001 |
| Arterial pH | +0.319 | 0.002 |
| $HCO_3^-$ | –0.177 | 0.094 (NS) |
| $PaO_2$ | +0.106 | 0.320 (NS) |
| Serum Lactate | –0.239 | 0.024 |

**[Table/Fig-3]:** Spearman correlations of ABG parameters with $SpO_2/FiO_2$ (S/F) ratio. NS: Not statistically significant. S/F: $SpO_2/FiO_2$ ratio. ABG: Arterial blood gas.

## ROC Curve Analysis

Arterial pH yielded the highest AUROC of 0.830 (p-value <0.001), substantially exceeding all other ABG parameters. $PaCO_2$ yielded AUROC=0.670 (p-value=0.029), serum lactate AUROC=0.680 (p-value=0.022), $HCO_3^-$ AUROC=0.659 (p-value=0.042), and S/F ratio AUROC=0.657 (p-value=0.045). P/F ratio (AUROC=0.606, p-value=0.178) and A-a gradient (AUROC=0.358, p-value=0.071) did not reach statistical significance. For arterial pH, the optimal cut-off of ≤7.36 by the Youden index gave sensitivity 71%, specificity 82%, PPV 94.4%, NPV 31.0%, and Youden J=0.532. Of 54 patients with pH ≤7.36, 51 (94.4%) required ICU admission. ROC curves for all parameters are shown in [Table/Fig-4,5]. The pH cut-off of 7.36, whilst close to the lower limit of the normal physiological range (7.35), is justified analytically as it maximises the Youden index across the entire study population and is consistent with thresholds reported in prior literature. The low NPV of 31.0% reflects the high ICU base rate in this tertiary referral cohort (80.9%) and should not be used to exclude the need for ICU admission.

# DISCUSSION

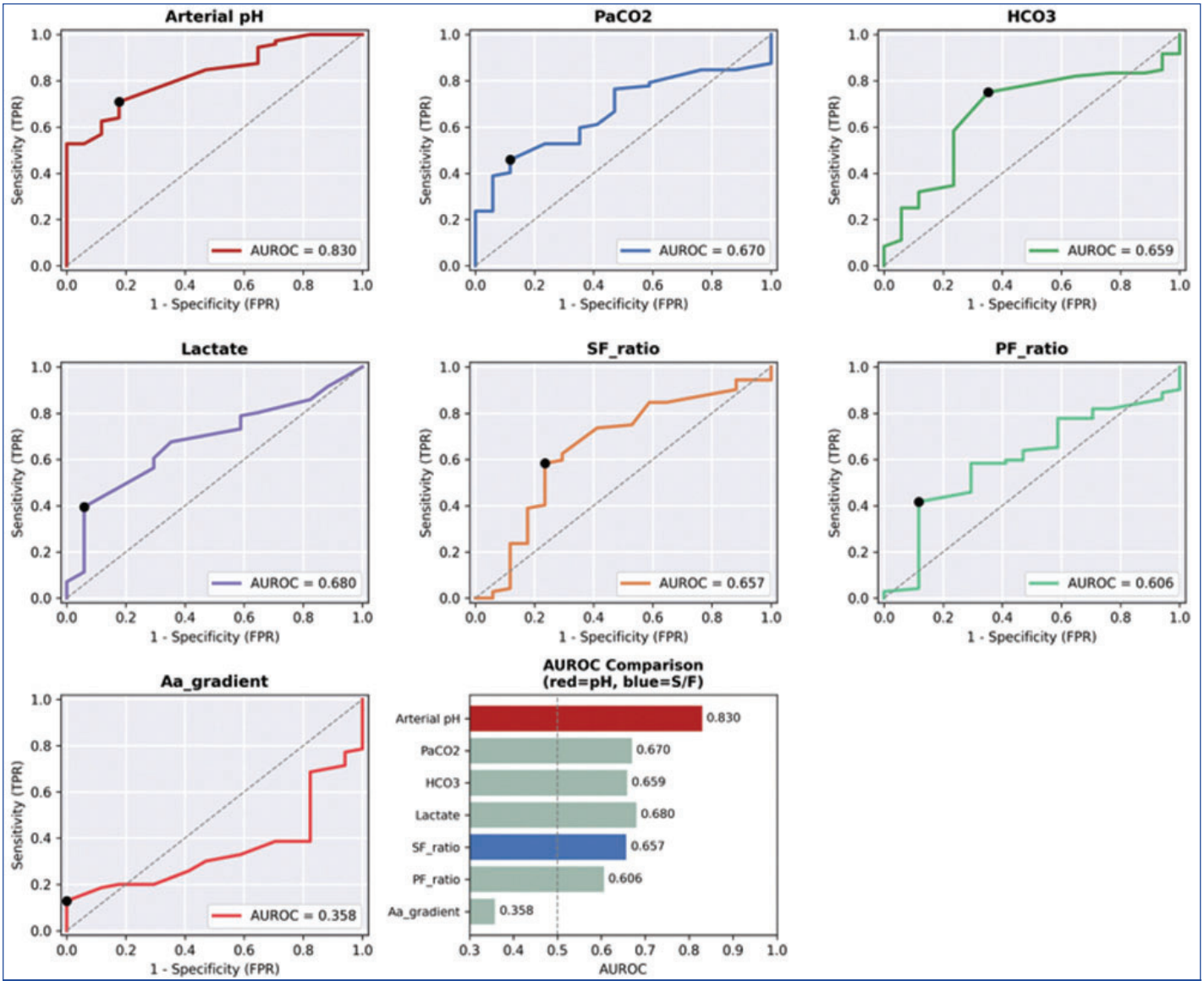
Three principal findings are noteworthy. First, acidaemia was common (52.8%), and the acid-base pattern strongly predicted ICU admission, with mixed acidosis at 100% and respiratory acidosis at 94.4%. Second, arterial pH was the single strongest ABG predictor of ICU admission, achieving an AUROC of 0.830 with an optimal cutoff of ≤7.36, substantially superior to the S/F ratio oxygenation index (AUROC 0.657). Third, metabolic acidosis patients had paradoxically high S/F ratios despite near-universal ICU admission, demonstrating a critical blind spot in oxygenation-based triage tools.

| Parameter | Resp acid (n=18) | Met acid (n=13) | Mixed (n=16) | Alkalosis (n=10) | Normal pH (n=32) |
|---|---|---|---|---|---|
| ICU, n (%) | 17 (94.4%) | 12 (92.3%) | 16 (100%) | 4 (40.0%) | 23 (71.9%) |
| pH (mean±SD) | 7.198±0.09 | 7.118±0.21 | 7.303±0.03 | 7.496±0.02 | 7.398±0.03 |
| $PaCO_2$ mmHg | 68.9±12.9 | 20.9±10.7 | 52.4±6.3* | 27.8±3.1 | 34.7±10.7 |
| $HCO_3^-$ mEq/L | 24.9±7.1‡ | 10.5±6.6 | 20.7±1.1* | 22.8±0.4 | 21.4±5.2 |
| Lactate mmol/L | 2.88±3.26† | 1.88±1.48 | 1.85±1.15 | 0.90±0.45 | 1.20±0.86 |
| S/F ratio (mean) | 189.9±45.6 | 321.7±118.3 | 168.7±89.5 | 317.0±26.7 | 267.5±108.0 |
| Main diagnoses | COPD (n=12, 67%), Pneumonia (n=3, 17%), Other (n=3, 17%) | DKA (n=4), Sepsis (n=5), HF (n=4) | Sepsis/MODS (n=13), Other (n=3) | AKI/CKD (n=7), Other (n=3) | COPD (n=11, 34%), HF (n=9, 28%), Pneumonia (n=7, 22%), Other (n=5, 16%) |

**[Table/Fig-2]:** Acid-base categories: revised definitions and ICU outcomes.
Chi-square for ICU rates across groups: p-value=0.001. Kruskal-Wallis for pH: p-value <0.001. *$PaCO_2$ and $HCO_3^-$ in the mixed acidosis group reflect concurrent elevation/reduction as part of the definition — p-values across groups not calculated as differences are defined. ‡Respiratory acidosis $HCO_3^-$ criterion requires $HCO_3^-$ >26 mEq/L or appropriately elevated for compensation; the group mean of 24.9 mEq/L reflects partial compensation in a subset of patients - the $HCO_3^-$ threshold is removed from the classification criterion for this group, which relies on pH <7.35 and $PaCO_2$ >45 mmHg. †Elevated lactate in respiratory acidosis group explained by COPD-related secondary lactic acidosis (see text).
Resp acid: Respiratory acidosis; Met acid: Metabolic acidosis; S/F: $SpO_2/FiO_2$; COPD: Chronic obstructive pulmonary disease; DKA: Diabetic ketoacidosis; MODS: Multi-organ dysfunction syndrome; AKI: Acute kidney injury.

| Parameter | AUROC | Cut-off | Sens% | Spec% | PPV% | NPV% | Youden J | p-value |
|---|---|---|---|---|---|---|---|---|
| Arterial pH | 0.830 | ≤7.36 | 71 | 82 | 94.4 | 31.0 | 0.532 | <0.001 |
| Serum Lactate | 0.680 | ≥1.4 | 39 | 94 | 96.6 | 26.7 | 0.330 | 0.022 |
| $PaCO_2$ | 0.670 | ≥39 mmHg | 47 | 88 | 94.4 | 27.8 | 0.348 | 0.029 |
| $HCO_3^-$ | 0.659 | ≤22 | 74 | 65 | 90.0 | 36.7 | 0.387 | 0.042 |
| S/F Ratio | 0.657 | ≤257 | 59 | 77 | 91.5 | 30.2 | 0.354 | 0.045 |
| P/F Ratio | 0.606 | ≤152 | 43 | 88 | 93.9 | 26.3 | 0.307 | 0.178 NS |
| A-a Gradient | 0.358 | ≥1.5 | 14 | 100 | 100.0 | 21.8 | 0.141 | 0.071 NS |

**[Table/Fig-4]:** ROC curve analysis - all ABG parameters for ICU admission prediction (n=89).
AUROC: Area under ROC curve; Sens: Sensitivity; Spec: Specificity; PPV: Positive predictive value; NPV: Negative predictive value; NS: Not statistically significant (P >0.05); S/F: $SpO_2/FiO_2$; P/F: $PaO_2/FiO_2$; A-a: alveolar-arterial gradient.




**[Table/Fig-5]:** Receiver Operating Characteristic (ROC) curves for all ABG parameters evaluated for prediction of ICU admission (n=89).

Burri E et al., analysed ED patients with undifferentiated dyspnoea and demonstrated that pH was an independent multivariable predictor of adverse outcomes [9]. The superior AUROC observed in the present study (0.830) compared to prior reports - including Burri E et al., (AUROC 0.77 for adverse outcomes) [9] and Gutgold A et al., (AUROC 0.74 for in-hospital mortality in extreme acidaemia) [14] - likely reflects the greater baseline disease severity in this high-acuity tertiary referral cohort, where 80.9% of patients required ICU admission.

The association between mixed acidosis (100% ICU admission) and the highest severity aligns with Mochizuki K et al., who demonstrated in an international ICU cohort that combined acidaemia was associated with the highest hospital mortality compared to single-component acid-base disorders [15].

A novel and clinically important finding of the present study was that patients with metabolic acidosis had the highest mean S/F ratio (321.7) despite a 92.3% ICU admission rate. Notably, patients with DKA demonstrated particularly high S/F ratios (mean 471.4) despite universal ICU admission. This is physiologically explicable: in metabolic acidosis, Kussmaul respiration leads to compensatory hyperventilation, which lowers $PaCO_2$ and maintains $SpO_2$, thereby producing a falsely reassuring S/F ratio that masks severe systemic metabolic derangement. Consequently, reliance solely on pulse oximetry or S/F ratio may lead to systematic under-triage of these patients, whilst ABG-based acid-base assessment remains essential.

## Limitation(s)

The single-centre design at a high-acuity tertiary referral centre resulted in a high ICU admission rate (80.9%), which reduces NPV

estimates and limits generalisability to community emergency settings. ABG testing was part of routine care, but universal access to blood gas analysers cannot be assumed across all Indian EDs. The cross-sectional design precludes serial assessment of acid-base changes over time. The small number of mortality events (n=6) limits mortality modelling, and subgroup sizes for metabolic acidosis (n=13) and DKA (n=4) restrict detailed subgroup analysis. Multivariate logistic regression could not be completed due to sample size constraints and will be addressed in future multicentre studies. Future multicentre prospective studies with standardised ABG protocols and 28-day mortality outcomes are required to validate a composite ABG-based triage algorithm for Indian emergency medicine.

## CONCLUSION(S)

Arterial pH, at a threshold of ≤7.36, demonstrates superior discriminative accuracy for ICU admission compared to oxygenation-based indices, and may be incorporated as a useful triage parameter in emergency dyspnoea management to support early risk stratification.

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- Plagiarism X-checker: Apr 25, 2026
- Manual Googling: Jun 15, 2026
- iThenticate Software: Jun 17, 2026 (1%)

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**AUTHOR DECLARATION:**

- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
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