Clinical and Toxicological Predictors of Intensive Care Unit Admission in Acute Poisoning: A Narrative Review of Recent Evidence (2024–2025)

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Abstract

Acute poisoning is a major cause of morbidity, mortality, and hospitalization in intensive care units. Accurate risk stratification is essential for guiding triage and optimizing outcomes.

This is a narrative review on clinical and toxicological predictors of admission in intensive care units. Databases searched included PubMed, Embase, and Scopus using the following keywords: “acute poisoning,” “ICU admission,” “predictors,” and “toxins.” Studies reporting adult or pediatric cohorts were included.

The major clinical predictors include coma (GCS ≤8), hemodynamic instability, respiratory distress, severe metabolic acidosis (pH <7.25), elevated lactate, and electrolyte disturbances. High-risk toxins—organophosphorus pesticides, paraquat, cardiotoxic drugs, and psychotropic agents—are strongly associated with critical illness. Validated scoring systems, especially the new Poisoning Mortality Score (new-PMS), outperform classical tools. Emerging biomarkers such as urinary 8-oxoGuo show promising prognostic value.

In summary, multimodal approaches integrating clinical assessment, toxin-specific risk factors, validated scoring systems, and emerging biomarkers optimize ICU triage in acute poisoning. External validation and integration into emergency workflows are needed.

Keywords: Acute poisoning, ICU admission, clinical predictors, toxicological predictors, scoring systems, biomarkers

Acute poisoning continues to impose a substantial global burden, resulting in hundreds of thousands of hospitalizations and significant mortality annually (1,2). ICU admission decisions are critical in toxicology, balancing timely critical care with limited resources. Historically, ICU triage relied on physician judgment, which is variable.

Recent studies highlight the utility of validated scoring systems and novel biomarkers to complete bedside assessment (1,3,5). Consistent bedside predictors include GCS ≤8, refractory hypotension, hypoxemia (PaO_2/FiO_2 <300), and severe metabolic acidosis (pH <7.25) (4,6). Novel scoring systems such as new-PMS, REMS, and NEWS2 outperform traditional PSS in predicting adverse outcomes (1,3,6).

This review summarises recent evidence on clinical and toxicological predictors, scoring systems, biomarkers, and practical integration into emergency and critical care practice.

A structured narrative search was conducted across PubMed, Embase, and Scopus for articles published between January 2024 and September 2025. Keywords included: "acute poisoning," "ICU admission," "toxins," "scoring system," and "biomarkers." Studies reporting predictors of ICU admission in adult or pediatric populations were included. Reviews, case reports, and non-English articles were excluded. Two independent reviewers screened articles, resolving disagreements by consensus. Relevant studies were synthesized qualitatively.

Clinical Predictors of ICU Admission

Neurological impairment: GCS ≤8 indicates airway compromise and the need for mechanical ventilation (1,2,4). Pediatric new-PMS incorporates altered mental status, achieving ~85% predictive accuracy (2). Seizures, especially status epilepticus, increase ICU risk (6).

Cardiovascular instability: Refractory hypotension and need for vasopressors are strongly associated with poor outcomes, particularly in organophosphorus and paraquat poisoning (4,5,9).

Table 1. Clinical Predictors of ICU Admission in Acute Poisoning

Predictor	Definition / Threshold	Impact on ICU Admission	References
Neurological impairment	GCS ≤8; altered mental status	Strong predictor; indicates airway protection and ventilation	(1,2,4)
Seizures	Status epilepticus	Increases ICU risk and length of stay	(6)
Hypotension	Systolic BP <90 mmHg, refractory to fluids	Associated with poor prognosis; need for vasopressors	(4,5,9)
Cardiac arrhythmias/shock	From beta-blockers, CCBs, TCA	Requires ICU monitoring; high mortality	(10,12)
Respiratory compromise	PaO_2/FiO_2 <300, ARDS, mechanical ventilation	Strong predictor of ICU admission	(9,11)
Metabolic disturbances	pH <7.25, lactate >4 mmol/L, electrolyte disturbances	Independent predictor of ICU need and mortality	(5,12)

Arrhythmias and cardiogenic shock from beta-blockers, calcium channel blockers, or tricyclic antidepressants often require ICU monitoring (10,12).

Respiratory distress: PaO_2/FiO_2 <300, ARDS, or mechanical ventilation predicts ICU admission (9,11). Paraquat ingestion carries high mortality with hypoxemia and pulmonary fibrosis (5,11).

Metabolic disturbances: Severe acidosis (pH <7.25), elevated lactate, and electrolyte disturbances are independent predictors of ICU need and mortality (5,12).

The main clinical predictors of ICU admission in acute poisoning are summarized in Table 1.

Toxicological Predictors

High-risk toxins leading to ICU admission:

- **Organophosphorus pesticides**: cholinergic crisis, seizures, respiratory failure (4,9,10).
- **Paraquat**: pulmonary fibrosis, ARDS, multi-organ failure; early renal dysfunction and hypoxemia predict poor outcome (5,11).
- **Cardiotoxic drugs** (beta-blockers, CCBs): refractory shock, conduction abnormalities (10).
- Psychotrope (TCA, others): seizures, coma, arrhythmias (12).

The most common high-risk toxins and their associated ICU complications are presented in Table 2.

Prediction Models and Scoring Systems

New-PMS is robust for adults and children, achieving an AUC 0.947 in adults (1) and ~85% predictive accuracy in pediatric cohorts (2). REMS, NEWS2, and toxin-specific scores (e.g., aconite, sedative-hypnotics) also show good discriminative ability (6–9).

An overview of validated prediction models and scoring systems is shown in Table 3.

Novel Biomarkers

Urinary 8-oxo-7,8-dihydroguanosine (8-oxoGuo) correlates with multi-organ dysfunction, ICU length of stay, and mortality (6). Machine learning models integrating biomarkers demonstrate high predictive accuracy in patients requiring hemodialysis (14).

Epidemiological and Regional Considerations

Poisoning patterns vary by geography: pesticides are the most common in rural regions; pharmaceuticals and recreational drugs in urban areas (4,15). Regional toxicological profiles influence model applicability. Emerging psychoactive substances require continuous model updates (7).

Table 2. High-Risk Toxins Associated with ICU Admission

Toxin / Class	Typical ICU Complications	Key Prognostic Indicators	References
Organophosphorus pesticides	Cholinergic crisis, seizures, respiratory failure	Early recognition; airway support; hypotension	(4,9,10)
Paraquat	Pulmonary fibrosis, ARDS, multi-organ failure	Hypoxemia, renal dysfunction	(5,11)
Cardiotoxic drugs (beta-blockers, CCBs)	Refractory shock, arrhythmias, conduction abnormalities	Hemodynamic instability, need for pacing or ECMO	(10)
Psychotropic medications (TCA, others)	Seizures, coma, arrhythmias	GCS ≤8, cardiovascular instability	(12)

Table 3. Prediction Models and Scoring Systems

Model / Score	Population	Key Predictors	Performance / AUC	Notes / References
New-Poisoning Mortality Score (new-PMS)	Adults & Pediatrics	GCS, hypotension, respiratory failure, metabolic derangements	0.947 (adults)	Outperforms MEWS & PSS; validated in multiple cohorts (1,2)
Pediatric new-PMS	Pediatric	Altered mental status, seizures, metabolic derangements	~85% accuracy	Adapted from adult new-PMS; superior to PSS (2)
REMS	Adult	GCS, BP, HR, SpO_2	AUC ~0.85	Useful in general ICU risk stratification (6,8)
NEWS2	Adult	Vital signs, oxygen requirements	Highest accuracy in predicting ICU admission	Simple bedside tool, validated prospectively (6,8)
Toxin-specific scores	Adult / Pediatric	Toxin-specific features (e.g., aconite, sedative-hypnotics)	Variable	Supports precision risk stratification (7,9)

Implementation and Future Directions

Challenges include reliance on laboratory parameters not available at triage and limited integration into electronic health records. Machine learning approaches show promise for real-time triage (10,14). Future priorities: external validation, rapid point-of-care biomarkers, AI-assisted triage tools.

Conclusions

ICU admission in acute poisoning is predicted by the presence of coma, hemodynamic instability, respiratory failure, and severe metabolic acidosis. High-risk toxins—organophosphorus pesticides, paraquat, cardiotoxic drugs, psychotropics—remain strongly linked to critical illness. Validated scores, especially new-PMS, show high predictive accuracy. Emerging biomarkers such as urinary 8-oxoGuo may refine prognostication. Multimodal approaches integrating bedside assessment, toxin-specific risk factors, validated scores, and emerging technologies optimize ICU triage.

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Ethical Statement: This narrative review was conducted in accordance with the principles of the *Declaration of Helsinki* (as revised in 2013). As this study did not involve human participants or identifiable personal data, formal ethical approval and informed consent were not required.

Competing Interests: The authors declare no competing interests.

Funding: The authors declare that no specific grant from any funding agency in the public, commercial, or not-for-profit sectors was received for this work.

Authors' Contributions

- **Dr Neila Maaroufi:** conceptualization, patient management, manuscript drafting, figure preparation.
- **Dr Sirine Neji:** literature review, discussion drafting, manuscript editing.
- **Dr Ihsen Abdeslem:** supervision, critical review, final approval of the manuscript.
- **Dr Dorsaf Moualhi:** discussion drafting, manuscript editing.
- **Dr Leila Jedidi:** supervision, final approval of the manuscript.