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Research Article

Multidisciplinary Approaches to Acute Drug Poisoning Management Involving Nursing, Medical Laboratory, Pharmacy, and Emergency Medical Services

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Abstract:

Acute drug poisoning represents a significant public health concern, necessitating a comprehensive management strategy that involves a multidisciplinary approach. The collaboration of nursing, medical laboratory teams, pharmacy professionals, and emergency medical services (EMS) is crucial for effective and timely intervention. Nurses play a pivotal role in the initial assessment and monitoring of the patient's vital signs, observing symptoms, and administering antidotes or supportive treatments as directed by medical protocols. Medical laboratory personnel are essential for conducting rapid diagnostic tests that help determine the specific substances involved in

multidisciplinary approach,
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the poisoning, guiding appropriate therapeutic interventions. Additionally, pharmacy professionals contribute by ensuring the availability of necessary antidotes and advising on medication interactions, thus optimizing patient outcomes. The integration of EMS into the acute drug poisoning management framework enhances rapid response capabilities, allowing for immediate transportation and stabilization of patients in critical conditions. EMS personnel are trained to recognize signs of drug toxicity and initiate life-saving measures while en route to medical facilities. This collaborative approach not only streamlines communication among healthcare providers but also ensures that each discipline contributes its expertise to address the multifaceted challenges of drug poisoning. Effective education and training across these disciplines further improve the synergy in managing acute poisonings, reducing morbidity and mortality associated with such incidents. By fostering teamwork among nursing, laboratory, pharmacy, and EMS personnel, healthcare systems can enhance their readiness to respond to acute drug poisoning cases effectively.

1. Introduction

Acute drug poisoning remains one of the most time-critical presentations in emergency care, and its effective management cannot be delivered by any single profession working in isolation [1]. The poisoned patient moves through a chain of care that begins in the community with emergency medical services, passes through emergency department resuscitation and nursing surveillance, depends on laboratory toxicology for diagnostic precision, and requires pharmacist expertise for antidote selection, dosing, and pharmacokinetic assessment. When these functions are integrated through shared protocols and structured communication, outcomes improve; when they remain siloed, delays in decontamination, antidote administration, and result interpretation become predictable sources of harm [2]. The interdisciplinary model of acute poisoning care has therefore moved from an aspirational ideal to an operational necessity, particularly as the toxicological landscape becomes more complex with novel psychoactive substances, polysubstance overdoses, and prolonged-release formulations.

The first decisive interventions in acute poisoning occur before the patient reaches a hospital. Emergency medical services personnel are responsible for scene safety, toxin identification, airway protection, ventilatory support, intravenous access, and, in many systems, early antidote administration [3]. The prehospital assessment must combine a focused toxidrome-oriented examination with scene intelligence: containers, patches, syringes, and bystander reports often provide the most reliable exposure history available. Paramedics and emergency medical technicians are trained to recognize the clinical signatures of opioid toxicity, cholinergic crisis, sympathomimetic excess, and sedative-hypnotic depression, and to initiate treatment according to protocol rather than awaiting laboratory confirmation. Naloxone is the cornerstone of prehospital opioid overdose management and can be administered intranasally, intramuscularly, or intravenously, with titration to respiratory effect rather than to full consciousness in order to avoid precipitated withdrawal in chronic opioid users [4]. Atropine is used for organophosphate poisoning, hydroxocobalamin for suspected cyanide exposure, and activated charcoal may be administered during transport when the airway is protected and ingestion has occurred within the appropriate time window [5]. The prehospital decision to administer charcoal must weigh the risk of aspiration against the benefit of toxin adsorption, and it is contraindicated in patients with altered consciousness unless the airway has been secured.

Decontamination is another core EMS function: removal of contaminated clothing, dry brushing of solid agents, copious water irrigation for dermal and ocular exposures, and removal from inhaled hazards prevent ongoing absorption and protect receiving staff from secondary contamination [6]. Early notification of the receiving emergency department and, where available, the regional poison control center allows the hospital team to prepare antidotes, reserve critical care capacity, and anticipate the need for extracorporeal elimination. The prehospital phase is therefore not simply transport; it is the point at which the trajectory of poisoning is often set. Toxidrome recognition in the field also helps EMS crews choose the most appropriate receiving facility and pre-alert the hospital to the likely need for specific antidotes or advanced airway management [7].

Airway management is particularly consequential in poisoned patients because depressed consciousness and loss of protective reflexes increase the risk of aspiration. Bag-valve-mask ventilation is the initial approach when ventilation is inadequate, while endotracheal intubation is indicated for a Glasgow Coma Scale score below nine, failure to protect the airway, refractory hypoxia, or inadequate ventilation despite non-invasive support; pre-intubation fluid resuscitation and cautious sedation selection reduce the risk of

post-intubation hypotension [8]. Field antidote administration has expanded substantially in recent years, and EMS protocols increasingly include naloxone, atropine, hydroxocobalamin, and, in selected systems, other agents under medical direction [9]. Early notification of the poison control center and the receiving emergency department is equally important, because it allows pharmacy to prepare antidotes, laboratory to prioritize specimens, and nursing to prepare monitoring equipment before the patient arrives [10].

2. Emergency Department Resuscitation and Nursing Surveillance

On arrival, the emergency department assumes responsibility for definitive stabilization, diagnostic evaluation, and disposition. The physician-led primary survey follows a toxicology-modified ABCDE sequence, with simultaneous attention to airway patency, ventilatory adequacy, circulatory status, neurological disability, and exposure with temperature measurement [11]. Toxidrome recognition remains the most efficient bedside diagnostic method because laboratory results are rarely available at the moment of initial resuscitation. The CRESS framework—consciousness, respirations, eyes, secretions, and skin—allows rapid categorization of the poisoned patient into opioid, sympathomimetic, cholinergic, anticholinergic, sedative-hypnotic, or serotoninergic patterns, guiding empirical antidote and supportive care decisions while awaiting analytical confirmation [12]. The focused toxicological history should establish the substance or substances involved, the route of exposure, the dose and timing, co-ingestants, underlying medical and psychiatric conditions, and the patient's access to prescription and over-the-counter medications. When the history is unreliable, which is common in intentional overdose, the clinical examination and laboratory data must drive management.

Nursing is the discipline that converts episodic medical decisions into continuous, safe care. The emergency nurse is responsible for triage acuity assignment, serial vital sign measurement, cardiac monitoring, pulse oximetry, neurological checks, fluid balance, and early recognition of deterioration [13]. In poisoned patients, subtle trends matter: a falling Glasgow Coma Scale score, rising respiratory rate, changing pupil size, or new arrhythmia may precede overt decompensation by minutes to hours. Nurses administer activated charcoal, perform gastric lavage when indicated, manage intravenous infusions of antidotes such as N-acetylcysteine, and monitor for adverse drug reactions. They also coordinate the sequence of investigations, ensure that samples are collected at the correct time relative to antidote administration, and communicate laboratory results back to the medical team in real time. The nursing role extends to psychological support and safety planning, particularly in deliberate self-poisoning, where the risk of repeat attempt is substantial and disposition planning must address psychiatric assessment, social work involvement, and follow-up arrangements [14]. Nursing documentation of exposure history, observed symptoms, and response to treatment frequently becomes the most complete longitudinal record of the patient's early course and is essential for subsequent poison center consultation and quality review.

3. The Medical Laboratory:

Laboratory medicine provides the analytical backbone of poisoning management, but its value depends on appropriate test selection and realistic expectations about turnaround time. Basic tests—electrolytes, renal function, liver function, blood gas analysis, lactate, glucose, coagulation studies, and osmolality—are available rapidly and are often more useful for guiding supportive care than comprehensive drug screening [15]. The osmolal gap and anion gap are classic screening tools for toxic alcohol exposure, although their sensitivity is limited and normal values do not exclude clinically significant poisoning. Immunoassay screens for common drugs of abuse provide rapid qualitative results but are prone to cross-reactivity and false negatives, particularly with synthetic cannabinoids, novel benzodiazepines, and fentanyl analogues. Confirmatory testing by gas chromatography–mass spectrometry or liquid chromatography–tandem mass spectrometry is more specific but is usually performed in reference laboratories, with turnaround times measured in hours to days; consequently, management decisions in acute poisoning must rarely wait for confirmatory results [16- 18].

The modern toxicology laboratory contributes far more than a yes-or-no answer. Quantitative assays for acetaminophen, salicylate, ethanol, methanol, ethylene glycol, lithium, digoxin, and specific antidotes allow clinicians to apply nomograms, assess severity, and determine the need for extracorporeal elimination. Enzymatic screening for ethylene glycol, for example, has been shown to yield results within twelve hours of the first fomepizole dose in approximately 79% of cases, with a median turnaround time of 391 minutes, which is clinically acceptable for a test that determines whether alcohol dehydrogenase

blockade should continue [16]. Rapid acetaminophen testing can produce results in under twenty-five minutes, facilitating early N-acetylcysteine administration within the critical eight-hour window and reducing the risk of acute liver failure [17]. Laboratory professionals also provide interpretive commentary, delta checks, and consultation on specimen timing and interference, and they play a central role in biobanking and toxicovigilance for emerging substances [19]. The laboratory is therefore not a passive service but an active participant in the diagnostic reasoning that shapes antidote and elimination decisions.

4. Clinical Pharmacy:

Clinical pharmacy brings a distinctive form of expertise to poisoning management: the ability to translate pharmacological principles into patient-specific antidote and supportive care plans. Poisoned patients frequently receive multiple medications simultaneously—antidotes, vasopressors, sedatives for intubation, antiarrhythmics, and electrolyte replacements—and the risk of drug–drug interactions, dosing errors, and administration-related harm is high. Emergency medicine clinical pharmacists are trained to evaluate antidote indications, calculate weight-based and renal-adjusted doses, recommend alternative agents during shortages, and monitor for therapeutic endpoints and adverse effects [20]. In opioid toxicity, the pharmacist can advise on naloxone titration strategies that reverse respiratory depression without precipitating severe withdrawal. In acetaminophen poisoning, the pharmacist ensures that the N-acetylcysteine regimen is appropriate for the patient's weight, hepatic function, and time since ingestion, and monitors for anaphylactoid reactions. In toxic alcohol poisoning, the pharmacist calculates fomepizole or ethanol dosing and anticipates the need for hemodialysis [20].

Antidote stocking is a pharmacy responsibility with direct clinical consequences. The pharmacist assigned to the emergency department must maintain a par levels system for critical antidotes, track expiry dates, and review usage patterns so that stock reflects local epidemiology and hospital capability [21]. A failure to locate fomepizole within the hospital has been documented to cause a six-hour delay in antidote administration, illustrating how a pharmacy logistics failure becomes a patient safety event. Clinical pharmacists also serve as the institutional bridge to poison control center toxicologists, translating telephone recommendations into actionable orders and ensuring that uncommon antidotes are procured, prepared, and administered correctly [23]. During outbreaks involving contaminated drug supplies or novel intoxicants, pharmacy leadership becomes essential for alternative sourcing, compounding, and rationing decisions [22]. The pharmacist's contribution is therefore both cognitive and operational: it spans bedside dosing decisions and the supply-chain resilience that makes those decisions possible.

5. Coordination at the Interfaces:

The disciplines described above do not naturally align. Emergency medicine prioritizes immediate stabilization, nursing prioritizes continuous surveillance and safe administration, laboratory prioritizes analytical accuracy and throughput, and pharmacy prioritizes pharmacological optimization and supply security. Without deliberate coordination, these priorities can produce friction: the laboratory may be asked for a test that will not change management, the pharmacist may be excluded from bedside decisions until an antidote is already needed, and the nurse may be left to reconcile conflicting instructions. Shared protocols are the most effective antidote to fragmentation. A poisoning management protocol should specify triage criteria, toxidrome-based empirical treatment, laboratory test ordering algorithms, antidote administration procedures, consultation triggers for poison control and medical toxicology, and disposition criteria. The protocol should be developed jointly by representatives of all four disciplines and reviewed against local antidote availability and transfer capabilities [24].

Poison control centers are a critical external node in the multidisciplinary network. They provide twenty-four-hour toxicological consultation, assist with risk assessment, recommend antidote regimens for unfamiliar poisons, and help determine whether transfer to a higher level of care is necessary. The emergency department–poison center relationship has traditionally depended on telephone communication, which can introduce delays and information loss, but structured notification and collaborative care phases improve continuity. When poison center recommendations are integrated into the electronic health record and communicated to nursing and pharmacy simultaneously, the likelihood of timely antidote administration increases. The pharmacist often serves as the operational link between the poison center and the bedside, while the nurse provides the serial clinical observations that allow the toxicologist to refine recommendations. The laboratory supports this loop by prioritizing specimens from poisoned patients, communicating critical values directly to

the responsible clinician, and documenting assay limitations that affect interpretation [24].

6. Special Populations and Situations That Demand Enhanced Coordination

Pediatric poisoning amplifies the need for multidisciplinary precision because small volumes of concentrated products can produce severe toxicity, and weight-based dosing errors carry disproportionate consequences. A toddler who ingests a single tablet of a cardiovascular drug may require intensive monitoring, and the laboratory must adjust reference ranges and specimen volumes accordingly. Nursing assessment must account for developmental stage and inability to report symptoms, while pharmacy must calculate micro-doses and prepare dilutions that are not commercially available [14]. Adolescent intentional overdose introduces additional complexity, including psychiatric comorbidity, polysubstance use, and repeat self-harm risk; discharge planning must therefore integrate mental health services, social work, and primary care. Older adults are vulnerable because age-related declines in hepatic and renal clearance prolong toxin elimination, polypharmacy increases the likelihood of interactions, and comorbidities reduce physiological reserve. Antidote dosing in this group frequently requires renal adjustment, and the pharmacist's review is indispensable [18].

Pregnancy adds a further dimension: the fetus may be exposed to the toxin, to antidotes, and to maternal physiological changes that alter drug distribution and elimination. Management decisions must balance maternal stabilization with fetal safety, and obstetric, neonatal, and toxicology teams may need to be engaged simultaneously. Outbreaks and mass exposures—such as contaminated illicit drug supplies, industrial releases, or foodborne toxicants—require a public health dimension that extends beyond individual patient care. In these situations, the laboratory becomes a surveillance tool, pharmacy manages scarce antidote stocks, emergency medical services perform field triage and decontamination at scale, and nursing coordinates surge capacity and infection control. The multidisciplinary model must therefore be scalable from the single patient to the population [22].

7. Barriers, Quality Improvement, and the Path Forward

Several persistent barriers undermine multidisciplinary poisoning care. Limited access to antidotes in smaller hospitals, inadequate training in toxicology for front-line staff, poor data collection systems, and communication gaps between prehospital and hospital teams are frequently cited. Antidote shortages and stockouts can force clinicians to use second-line agents or await transfer, and the absence of a shared record between poison centers and emergency departments can lead to duplicated or conflicting recommendations. Interprofessional education is an underused remedy: joint simulation of poisoning scenarios, shared case reviews, and cross-disciplinary toxicology rounds build the mutual trust and role clarity that protocols alone cannot create. Mobile decision support tools, telemedicine toxicology consultation, and integrated electronic records show promise for closing communication gaps, particularly in rural and resource-limited settings [24].

Quality improvement in poisoning care should measure processes that reflect coordination, not merely individual clinical outcomes. Useful indicators include time from emergency department arrival to antidote administration for time-critical poisons, proportion of poisoned patients for whom a poison center consultation was documented, laboratory turnaround for acetaminophen and ethylene glycol, incidence of medication errors in antidote dosing, and completion of psychiatric assessment before discharge after intentional self-poisoning [25]. Review of these indicators in a multidisciplinary forum allows each profession to see how its work affects the others and identifies system failures that no single discipline could correct alone. The ultimate measure of success is not the brilliance of any one intervention but the reliability of the sequence: early recognition, appropriate decontamination, timely antidote, accurate laboratory support, safe administration, and planned follow-up [25].

Table 1. *Laboratory Tests in Acute Poisoning: Typical Turnaround and Clinical Utility*

Test	Typical Turnaround	Principal Clinical Use	Limitations
Basic metabolic panel	30–60 minutes	Anion gap, renal function, glucose, electrolytes	Non-specific
Arterial blood gas	15–30 minutes	Acid–base status, oxygenation, lactate	Does not identify toxin
Osmolality	30–60 minutes	Osmolal gap for toxic alcohols	Insensitive at low concentrations
Acetaminophen	25 minutes to 2 hours	Nomogram-guided N-	Timing of level critical

quantitative		acetylcysteine	
Salicylate quantitative	1–2 hours	Severity assessment; dialysis indication	Not a screen for all salicylates
Ethanol	1–2 hours	Co-ingestion assessment; osmolal gap interpretation	Does not detect other alcohols
Ethylene glycol enzymatic screen	Median approximately 6.5 hours	Guide fomepizole and dialysis decisions	Not universally available
Comprehensive drug screen	24–72 hours or longer	Confirmatory identification	Too slow for acute management
Methemoglobin	30–60 minutes	Diagnose oxidant poisoning	Requires specific request

Table 2. *Core Antidotes and the Contributions of Each Discipline*

Antidote	Primary Toxin(s)	Emergency Medicine Role	Nursing Role	Laboratory Role	Pharmacy Role
Naloxone	Opioids	Recognize opioid toxidrome; order titration	Monitor respiratory rate and consciousness; administer repeated doses	Not routinely required for diagnosis	Advise titration strategy; ensure stock
N-Acetylcysteine	Acetaminophen	Apply nomogram; decide treatment duration	Administer infusion; monitor for anaphylactoid reaction	Quantitative acetaminophen level; liver function tests	Verify weight-based regimen; assess hepatic function
Fomepizole	Methanol, ethylene glycol	Suspect toxic alcohol; initiate therapy empirically	Monitor neurological and renal status	Osmolal and anion gaps; ethylene glycol level	Calculate dose; coordinate dialysis timing
Atropine	Organophosphates	Recognize cholinergic crisis; titrate to secretions	Monitor heart rate, secretions, and oxygenation	Cholinesterase level where available	Recommend dose escalation; manage supply
Hydroxocobalamin	Cyanide	Suspect from smoke inhalation or industrial exposure	Monitor blood pressure and colorimetric interference	Lactate and venous oxygen saturation	Ensure availability; advise on infusion
Physostigmine	Anticholinergic delirium	Distinguish from other delirium	Monitor cardiac rhythm and seizures	Drug screen to exclude other causes	Assess risk-benefit in conduction disease

8. Conclusions

Acute drug poisoning is a clinical condition in which time, uncertainty, and physiological fragility intersect. Emergency medical services establish the prehospital trajectory through airway management, antidote administration, and decontamination. Emergency medicine provides toxidrome-based resuscitation and disposition decisions. Nursing sustains continuous surveillance, safe administration, and psychological support. The medical laboratory supplies the quantitative and qualitative data that refine diagnosis and guide elimination strategies. Clinical pharmacy ensures that antidotes are available, correctly dosed, and pharmacologically appropriate. No single profession can deliver all of these functions, and the interfaces between them are where the greatest gains—and the greatest risks—lie. Strengthening shared protocols, structured communication, interprofessional education, and measurement of coordination-sensitive processes is therefore not an administrative refinement but a clinical imperative. The poisoned patient is best served when the four pillars of emergency medicine, nursing, laboratory medicine, and pharmacy operate as a single system rather than as four separate services.

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