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From Prehospital Recognition to Antidote Stewardship an Integrative Review of Paramedic, Clinical Laboratory, Forensic Toxicology, and Pharmacy Roles in Acute Poisoning

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ABSTRACT: Acute poisoning requires decisions before the substance, dose, and timing of exposure are fully established. Information can become fragmented between ambulance assessment, laboratory investigation, toxicological interpretation, and antidote provision. This review examines how paramedics, clinical laboratory professionals, forensic toxicologists, and pharmacy teams can coordinate these activities while preserving clinical authority and evidentiary safeguards. A targeted integrative review purposively selected twenty verified publications within a 2010–2026 eligibility window. Indexed records, available full texts, and professional statements were examined using structured charting and qualitative comparison. The corpus included randomized trials, observational studies, evidence reviews, and consensus guidance addressing naloxone, acetylcysteine, toxicology testing, specimen collection, and antidote availability. Findings indicate that treatment decisions require clinical context rather than unqualified reliance on positive or negative drug screens. Naloxone studies demonstrate formulation-specific differences, while acetylcysteine research distinguishes treatment tolerability from protection against liver injury. Laboratory findings require documentation of timing, analytical coverage, and uncertainty. Forensic specimen procedures serve a distinct purpose and should operate alongside urgent treatment without delaying it. Antidote stewardship encompasses preparedness, appropriate selection, access, monitoring, and reassessment rather than stock possession alone. The

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synthesis proposes a dual-purpose information framework connecting clinical action with appropriately authorized evidence preservation. No participants were recruited, and no patient records or institutional outcomes were analysed. The framework remains conceptual and has not been prospectively validated. Future evaluation should examine information completeness, specimen integrity, antidote access, workload, confidentiality, and patient outcomes before claims of effectiveness are made across different services and healthcare systems. Local adaptation remains essential throughout.

1 INTRODUCTION

Acute poisoning presents a coordination problem as well as a diagnostic and therapeutic problem. An ambulance team may observe respiratory depression without a reliable exposure history. A laboratory may receive a specimen without the time of ingestion, while pharmacy staff may receive an antidote request before the clinical rationale is complete. Forensic toxicologists may subsequently need to establish what an analytical result can support and whether the specimen history is adequate. The present review examines these interfaces rather than treating each profession as an isolated service. Its focus is the continuity of useful information from recognition to reassessment, including the circumstances in which clinical and evidentiary purposes require different procedures.

Out-of-hospital naloxone research illustrates why coordination must preserve uncertainty. Chou et al. (2017) synthesized comparative and observational evidence and found substantial limitations in route and transport comparisons. Dietze et al. (2019) subsequently examined intranasal and intramuscular administration in a supervised injecting facility, whereas Skulberg et al. (2022) studied administration by ambulance personnel. Their different products, settings, and endpoints make a simple statement that one route is always superior inappropriate. Williams et al. (2019) also issued conditional recommendations supported by low or very low certainty. A useful handover therefore records the preparation actually given, its timing, observed response, and continuing respiratory concerns rather than merely recording that naloxone was administered.

Antidote stewardship extends beyond administration of a particular medicine. It includes decisions about readiness, distribution, authorized selection, safe preparation, monitoring, and review of ongoing need. Dart et al. (2018) recommended a formal local assessment of antidote requirements and distinguished different expectations for access. Saudi evidence demonstrates why local information matters. Alsugoor (2022) examined poisoning presentations and antidote availability across hospitals in Qassim, while Abu Esba et al. (2023) described six years of use at a tertiary institution. These sources address different units of analysis: patients, hospital inventories, and consumption over time. Neither establishes that every hospital needs identical quantities, or that a stocked product is necessarily accessible at the moment of need.

The relationship between exposure history, laboratory results, and treatment is particularly visible in acetaminophen poisoning. Dart et al. (2023) developed a consensus approach incorporating patterns of ingestion, investigation, monitoring, and treatment reassessment. Treatment safety also has several dimensions. Bateman et al. (2014) investigated a modified acetylcysteine schedule in a randomized trial principally concerned with adverse effects, while later observational evaluations considered broader clinical implementation. For the present review, this literature makes the practical question more precise: which information must move between assessment, laboratory, and pharmacy services for an authorized clinician to interpret a result and review a treatment plan? The question concerns continuity of reasoning, not the automatic adoption of any regimen.

Evidence on acetylcysteine requires careful separation of tolerability and clinical protection. Pettie et al. (2019) evaluated implementation of the SNAP regimen across three hospitals and compared liver outcomes and adverse reactions with preceding practice. Wong et al. (2020) evaluated a different two-bag approach using a multicentre observational comparison. These studies support attention to protocol design and monitoring, but they are not interchangeable trials of a single intervention. A proposed interdisciplinary framework must therefore retain regimen identity, sampling times, reasons for treatment interruption, and the criteria used by an authorized clinician to continue or stop therapy. It cannot infer that a shorter or simpler schedule is appropriate for every exposure.

Drug testing presents a related problem: an analytical finding is not the same as a complete explanation of illness. Stolbach et al. (2022) distinguished detection of an opioid-related substance from conclusions about dose, timing, intent, or impairment. The statement also makes clear that common opiate assays do not cover every opioid. This distinction is important when an initial screen appears inconsistent with the observed clinical syndrome. A result should reach its recipient together with relevant limitations and, where appropriate, a route for specialist clarification. An unqualified negative result can create false reassurance, while an unqualified positive result can promote diagnostic closure or unjustified attribution.

Specimen quality is an upstream determinant of interpretation. Dinis-Oliveira et al. (2017) reviewed collection procedures for clinical and forensic toxicological analysis, emphasizing case-specific selection and handling. Saitman et al. (2014) reviewed false-positive interference in urine immunoassays, showing why presumptive results require analytical caution. More recently, Rosano et al. (2025) compared broad definitive testing with routine immunoassay in emergency department specimens and identified substantial differences in detection. This analytical comparison does not, by itself, establish that universal expanded testing improves outcomes or is feasible within emergency turnaround times. It instead identifies a gap between what a particular test examines and what staff may assume it excludes.

The clinical value of testing depends on the question being asked. Bhalla (2014) discussed the utility and pitfalls of bedside screens, while Hoffman et al. (2026) distinguished routine investigations, targeted quantitative assays, and qualitative drug testing. The distinction matters because some investigations characterize physiological disturbance, some help guide toxin-specific decisions, and others document exposure without directly determining immediate management. Pharmacy teams can contribute a medication history and identify administered medicines relevant to interpretation. Laboratory staff can explain method coverage, sample suitability, and reporting limits. Forensic toxicologists can address evidentiary interpretation where their expertise is required. These contributions should supplement the clinical assessment rather than substitute for it.

The combined evidence suggests that fragmentation is not resolved merely by ordering more tests or creating a longer handover form. A documented result is useful only if its purpose, timing, limitations, and responsible recipient remain visible. The review therefore treats the information accompanying a specimen or medicine request as part of the care process. It also recognizes that a specimen collected for urgent treatment may not automatically satisfy the procedures required for a later legal question.

Broader clinical guidance supports the need to connect early assessment with subsequent decisions. Rungta et al. (2024) developed a position statement addressing common poisoning problems in emergency and intensive care settings. Lavonas et al. (2023) focused on cardiac arrest and life-threatening toxicity, where resuscitation and toxin-specific interventions require specialist judgment. Mégarbane et al. (2020) integrated severity assessment, investigation, supportive care, and treatment recommendations for pharmaceutical and recreational drug poisoning. The scope and evidence grading of these publications differ, and their recommendations should not be converted into a universal protocol detached from patient characteristics, available expertise, and local authorization.

Together, the twenty core publications establish a defensible starting point for examining professional interfaces. They provide direct comparisons of selected antidote strategies, observational accounts of use and availability, analytical evaluations, and professional recommendations. They do not provide a controlled evaluation of the entire combined pathway proposed here. The literature is consequently used to support individual components and identify interpretive limits. The relationship among those components is developed as a theoretical synthesis, with explicit separation between published findings and the framework introduced by this manuscript.

The participating disciplines contribute different forms of knowledge. Paramedics can document the initial scene, reported exposure, physiological observations, and treatments delivered during transport. Clinical laboratory professionals can safeguard specimen suitability, perform validated testing, and communicate results and limitations. Forensic toxicologists can address analytical interpretation and evidence handling when a medicolegal purpose exists. Pharmacists can contribute medication reconciliation, antidote logistics, compatibility and preparation advice, and treatment monitoring within their authorized role. Pharmacy technicians can assist with procurement, inventory, and supply processes under applicable supervision. None of these descriptions transfers prescribing authority or clinical responsibility simply because a professional appears in the framework.

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The primary question is how these contributions can be organized into a coherent information pathway from suspected exposure to antidote reassessment. The subsidiary questions concern which information must accompany a handover or specimen, where clinical and forensic purposes diverge, and which claims about testing or treatment require qualification. The aim is to construct an evidence-informed conceptual model that can guide future protocol development and evaluation. This aim is narrower than demonstrating improvements in survival, treatment delay, or diagnostic accuracy, because no new clinical or organizational data are collected.

The review is internationally oriented while retaining examples relevant to Saudi services. The inclusion of Saudi antidote studies supports discussion of local preparedness but does not justify conclusions about the institutions associated with the manuscript contributors. Their workplaces were not study sites. The manuscript proceeds through a critical review of twenty publications, a transparent account of selection and synthesis, and a results chapter presenting the derived framework. Three original figures describe coordination, the purposes of evidence, and the cycle of antidote stewardship. They are conceptual representations rather than measured patient pathways or quantitative estimates of treatment benefit.

2 LITERATURE REVIEW

Out of hospital naloxone evidence

Chou et al. (2017) systematically reviewed naloxone administration and decisions about transport after reversal of suspected opioid overdose. Thirteen studies met the review criteria, including trials and cohort studies with different routes and formulations. Evidence for several comparisons was limited, and uncontrolled reports of outcomes after nontransport could not establish comparative safety. The review therefore supports caution when a protocol treats initial reversal as equivalent to completed care. Its methodological strength is explicit evidence assessment; its limitation is the small and heterogeneous evidence base available at that time. Later products and changing opioid exposure patterns also restrict direct transfer to current services. For the proposed framework, the relevant contribution is to preserve information about response, recurrence concerns, and disposition rather than reduce the episode to administration of an antidote.

Naloxone in a supervised injecting facility

Dietze et al. (2019) conducted a double-blind, double-dummy randomized trial in a supervised injecting facility in Sydney. The analysis included 197 participants receiving intranasal or intramuscular naloxone under the study protocol. Rescue treatment was needed more frequently after the intranasal preparation, and no major adverse events were reported in either group. Randomization strengthens the comparison for the preparations and population examined. However, a supervised facility differs from an uncontrolled scene, and the result should not be generalized to all nasal products or exposure patterns. The trial contributes to the framework by showing why route alone is an incomplete medication record. The formulation, administration time, subsequent respiratory assessment, and additional treatment remain relevant during transfer.

Comparative interpretation

The systematic review and supervised-facility trial address related questions at different levels. The first identifies limits in the available comparative evidence; the second adds a controlled comparison of specific preparations. Together they support product-specific interpretation rather than an unqualified preference based only on route. Forensic confirmation and laboratory screening are not prerequisites for recognizing an urgent clinical response requirement. The framework therefore preserves both the initial observations and subsequent reassessment, while leaving product selection to current authorized protocols.

Naloxone administered by ambulance teams

Skulberg et al. (2022) evaluated two naloxone preparations in a blinded, double-dummy, non-inferiority trial conducted by ambulance personnel in Norway. The per-protocol analysis comprised 201 participants, with heroin suspected in most cases. Recovery of adequate spontaneous breathing

within the specified early interval was more frequent after the intramuscular preparation, and additional naloxone was more often needed after the intranasal preparation. The prehospital setting gives the study direct relevance to paramedic practice, although the exposure profile and selected products constrain generalization. The results should therefore be interpreted together with the actual treatment delivered and the population studied. For the framework, the central implication is that an antidote handover must preserve observations after administration, including whether the expected response occurred. A record showing that treatment was given cannot replace reassessment.

Conditional guidance for emergency medical services

Williams et al. (2019) developed evidence-based recommendations for emergency medical services using an existing systematic review and a structured guideline process. The recommendations concerning naloxone routes were conditional and supported by low or very low certainty. The publication considered practical issues such as titration, speed of effect, device characteristics, and exposure to needles, rather than treating pharmacological response as the only decision criterion. This broader perspective helps explain why guidance and individual route-comparison trials may appear to emphasize different considerations. Its limitations include imprecision in the underlying literature and changes in opioid products and administration devices. Within the proposed framework, the guidance supports recording the rationale for a locally authorized approach and ensuring access to reassessment. It should not be read as a claim that all routes are equivalent in every circumstance.

Comparative interpretation

The ambulance trial and emergency medical services guideline should be read alongside one another, with attention to their different products, questions, and practical priorities. A guideline may consider titration and needle exposure in addition to an early respiratory endpoint. The synthesis retains these distinctions rather than treating apparent differences as simple contradiction. Communication should describe what was observed and administered, because a recipient cannot reconstruct the clinical episode reliably from a generic label such as overdose treated.

Hospital preparedness for antidote access

Dart et al. (2018) convened a multidisciplinary expert panel to develop recommendations for antidote stocking in hospitals providing emergency care. The process used literature summaries and iterative agreement to address both quantities and acceptable access timeframes. The panel recommended local hazard vulnerability assessment, acknowledging that requirements depend on the risks and services of each hospital. This approach shifts the question from whether a medicine appears on a list to whether the required treatment can reach the patient when needed. Nevertheless, the recommendations are consensus guidance rather than an experimental evaluation of a stocking intervention. Their numerical targets should not be adopted without considering the local population, referral network, and procurement arrangements. It also treats stock review and access testing as separate activities, because a stored antidote may remain operationally unavailable.

Antidote availability in Saudi hospitals

Alsugoor (2022) retrospectively examined acute toxicity presentations and antidote availability in fourteen hospitals in Qassim during 2020. The study included 264 patients and described differences in the availability of selected treatments across the participating institutions. However, inventory findings and recorded management are different outcomes, and the study cannot establish the clinical consequences of each unavailable product. Retrospective records and hospital differences limit generalization. The present framework uses the study to justify local assessment of supply arrangements rather than to characterize all Saudi hospitals. Pharmacy professionals can combine exposure patterns, stock records, and referral arrangements when reviewing preparedness. Laboratory and emergency teams can help identify time-sensitive analytical and treatment needs.

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Comparative interpretation

Stocking guidance and regional inventory research both support attention to preparedness, but they answer different questions. Consensus identifies considerations for planning, whereas a retrospective hospital study describes local experience and availability. Their combination suggests a need to review actual access arrangements and exposure patterns. It does not establish the number of units that any particular institution should hold. Such decisions require local assessment, including referral capability and the operational route by which an antidote reaches the treating team.

Antidote use over six years

Abu Esba et al. (2023) reviewed antidote use at a tertiary care hospital in Saudi Arabia over six years. The study was motivated by the practical difficulty of planning stocks when individual antidotes may be used infrequently. It described the treatments consumed and the poisoning contexts in which they were required, providing information relevant to pharmaceutical planning. Its value lies in relating inventory decisions to actual institutional experience over time. Its limitation is that a retrospective account from one large centre cannot define requirements for every hospital or predict rare outbreaks reliably. Low historical use should therefore not be equated with absence of future need. Within the framework, consumption records form one input to preparedness alongside local hazards and transfer arrangements. The publication supports a feedback cycle in which pharmacy teams review use and access after events.

Consensus on acetaminophen poisoning

Dart et al. (2023) developed a consensus statement for acetaminophen poisoning in the United States and Canada. A panel representing four toxicology societies used a modified Delphi process alongside review of published literature and poison-centre guidance. The statement addressed investigation, treatment, and reassessment. Its contribution is an explicit connection between the exposure history, timed measurements, and treatment decisions. Its jurisdictional context also requires consideration before adaptation elsewhere. For this review, the statement demonstrates why laboratory results should not be detached from ingestion timing and clinical circumstances. Pharmacy advice can support safe implementation of an authorized regimen, while laboratory staff can clarify analytical issues. The framework retains those interfaces without reproducing a dosing protocol or assuming that the contributors are authorized to make every clinical decision described.

Comparative interpretation

The utilization study and acetaminophen consensus statement connect two levels of stewardship. One concerns preparedness across time; the other concerns decisions during an individual clinical episode. A treatment can be appropriate but unavailable, or available without being appropriate for a particular patient. The proposed model therefore separates readiness from patient-specific authorization and reassessment. It uses historical consumption as planning evidence while retaining contingency for unusual events and clinical needs that past records may not predict.

Randomized evidence on acetylcysteine tolerability

Bateman et al. (2014) conducted a randomized factorial trial at three United Kingdom hospitals to examine a modified acetylcysteine schedule and antiemetic pretreatment. Of 222 randomized participants, 217 were assessable at the early primary endpoint. The modified schedule reduced the combined early endpoint involving vomiting, retching, or rescue antiemetic treatment, and severe anaphylactoid reactions were less frequent. The trial provides stronger causal evidence for these tolerability outcomes than an uncontrolled implementation report. However, it was not powered to establish non-inferiority for prevention of liver injury. That limitation is essential when translating a safety finding into a treatment policy. In the framework, regimen design, interruption, and adverse reaction management remain distinct from the judgment that treatment has achieved its protective purpose. Laboratory monitoring and authorized clinical reassessment are therefore retained.

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Clinical implementation of the SNAP regimen

Pettie et al. (2019) evaluated implementation of the SNAP acetylcysteine regimen at three hospitals using prospectively collected data before and after the change. The comparison comprised 3,340 patients and examined liver outcomes alongside adverse reactions. Liver injury measures were similar between groups, while treatment for acetylcysteine-associated reactions was less common after implementation. However, a before-and-after design remains vulnerable to temporal changes, case-mix differences, and documentation practices. The findings should not be treated as identical to a randomized effectiveness comparison. For the framework, the study highlights the need to monitor both therapeutic outcomes and treatment burden after a protocol change. Pharmacy teams may assist with preparation and safety review, and laboratories provide relevant measurements, but decisions to extend or stop treatment remain clinically authorized.

Comparative interpretation

The trial and implementation cohort form a useful sequence of evidence without erasing design differences. Reduced adverse reactions are clinically relevant, but treatment tolerability and protection against liver injury remain separate endpoints. Observational follow-up adds information about routine use while retaining potential confounding. The framework consequently requires a record of the regimen, relevant laboratory findings, and reasons for continuation or interruption. It does not interpret protocol simplification as permission to remove monitoring or substitute supply staff judgment for clinical review.

A multicentre comparison of acetylcysteine regimens

Wong et al. (2020) conducted the multicentre 2NAC observational study comparing a two-bag acetylcysteine regimen with a historical three-bag approach. The analysis examined acute liver injury and adverse reactions, with a defined early-presentation group used for the primary non-inferiority assessment. The two-bag regimen met that study's non-inferiority criterion in the specified group and was associated with fewer non-allergic anaphylactic reactions. These findings add clinically relevant information about simplified delivery, but the historical comparison permits confounding and should not be described as a randomized trial. The definition of liver injury and the timing of presentation also matter when comparing this study with other publications. The framework uses the study to distinguish regimen simplification from indiscriminate shortening of care. Accurate exposure timing, laboratory monitoring, and reassessment remain necessary.

Interpretation of opioid urine tests

Stolbach et al. (2022) issued an American College of Medical Toxicology position statement on urine opiate and opioid testing. The statement explains that detection indicates an analyte within the limits of the method, rather than establishing the dose, timing, intent, or degree of impairment. It also distinguishes routine opiate immunoassays from testing needed for several synthetic or structurally different opioids. Its importance for this review is the explicit separation of analytical presence from clinical causation and forensic attribution. The framework therefore requires staff to communicate test coverage and avoid treating a negative routine screen as universal exclusion. A positive result similarly needs contextual interpretation. The position statement supports prompt clinical assessment when poisoning is suspected, while emphasizing that confirmatory analytical work and medicolegal conclusions answer questions that may differ from the immediate treatment decision.

Comparative interpretation

The acetylcysteine study and opioid testing statement concern different toxins but share an interpretive requirement: neither a treatment label nor a test label contains all information needed for a decision. A regimen comparison must retain its population and outcome definition; a urine result must retain its analytical scope and clinical limitations. The synthesis treats context as essential to safe transfer of information. It preserves uncertainty explicitly instead of translating qualified findings into unrestricted clinical rules.

Collection for clinical and forensic analysis

Dinis-Oliveira et al. (2017) reviewed procedures for collecting biological samples for clinical and forensic toxicological analysis. The guidance addresses routinely collected and alternative specimens and emphasizes that analytical interpretation depends on the material available and its handling. It also recognizes that procedures require adaptation to the individual case. The present framework uses the publication to distinguish specimen suitability from evidentiary continuity and to preserve collection timing, identification, and handling information. It does not assume that every clinically collected sample automatically meets forensic requirements. Forensic toxicology expertise becomes particularly important when an authorized legal question exists, while urgent assessment and treatment proceed according to clinical need. The publication supports coordination of purposes without requiring that every poisoning episode be converted into a forensic investigation.

False positive interference in immunoassays

Saitman et al. (2014) reviewed false-positive interference in commonly used urine drug immunoassays. The review assessed published reports of cross-reactivity across several drug classes and treated initial positive results as presumptive until assessed using an independent analytical method where needed. Its contribution is to explain a mechanism by which an apparently clear laboratory finding can become misleading when assay limitations are omitted. The evidence is method-specific and includes heterogeneous reports, so a listed interferent should not be assumed to affect every platform. Within the framework, medication history and the laboratory's knowledge of its own assay become complementary information sources. Pharmacy staff can help identify relevant administered or reported medicines, while laboratory professionals assess whether a proposed interference is plausible for the method used. It supports qualified reporting and appropriate escalation of unexpected results.

Comparative interpretation

Collection guidance and interference literature demonstrate two distinct ways in which a reliable-looking result may be misunderstood. The first concerns what happened before analysis, and the second concerns what a particular method can detect or misclassify. Their implications should not be merged into a single generic warning. The framework assigns separate attention to specimen identification and handling, assay characteristics, and interpretation. Where legal consequences are possible, additional evidentiary requirements must be established rather than assumed from routine clinical processing.

Definitive testing in emergency department specimens

Rosano et al. (2025) compared definitive urine testing for a broad set of drugs and metabolites with routine immunoassay in specimens from 400 emergency department patients. The analysis identified substantially more drug findings using definitive methods and documented limitations related to immunoassay coverage and sensitivity. This is direct analytical evidence that different testing strategies can generate different exposure information from the same clinical population. It does not establish that every detected substance caused the presentation or that broader testing improves survival, treatment speed, or resource use. Selection of patients and local drug patterns also limit extrapolation. The framework uses the study to require a clear distinction between an assay's target range and the clinical question. Expanded testing may support clarification in selected circumstances, but its availability, turnaround, and consequences require evaluation.

Utility and limitations of bedside screening

Bhalla (2014) reviewed the usefulness and pitfalls of bedside toxicology screens in emergency care. The article contrasts the convenience of rapid immunoassays with limitations in sensitivity, specificity, and coverage, and discusses the value of targeted assays for selected toxic exposures. As a narrative review, it offers practical analytical reasoning rather than a comparative estimate of patient benefit. Changes in assay technology and local exposure patterns also mean that its examples require current laboratory confirmation. Its relevance to the

framework is the need to specify what decision a requested test is intended to inform. A broad screening label can conceal substantial differences between platforms and cannot substitute for knowledge of the method. The review supports collaboration between clinicians, laboratory professionals, and pharmacy teams when results are unexpected or clinically discordant.

Comparative interpretation

The analytical comparison and bedside-testing review both question the assumption that a routine screen represents a comprehensive toxicological assessment. Their designs and dates differ, and neither establishes a universal testing strategy. More detected substances do not automatically mean better decisions. The synthesis therefore links investigation to an explicit clinical or evidentiary question, and requires a route for discussing discordant findings. This supports selective escalation while avoiding the unsupported claim that every emergency department needs identical definitive testing capacity.

Contemporary laboratory reasoning in poisoning

Hoffman et al. (2026) reviewed laboratory testing in poisoned patients, distinguishing routine physiological investigations from targeted quantitative toxicology and qualitative drug testing. The article explains that some measurements directly inform management, whereas qualitative drug results are often less useful for immediate decisions and can be misinterpreted. Its recent publication offers an updated conceptual account of test selection and interpretation, although the paediatric journal context requires care when applying examples across age groups. It is an educational review rather than a trial establishing an optimal testing package. The framework draws on its distinction between analytical detection and decision-relevant information. A laboratory request should identify the suspected exposure and relevant timing, while the report should state limitations that affect interpretation. Pharmacy and paramedic information can supply context that an isolated specimen cannot provide.

A structured emergency and intensive care approach

Rungta et al. (2024) developed an Indian Society of Critical Care Medicine position statement addressing poisoning in emergency and intensive care practice. An expert group reviewed common clinical questions, assessed available evidence, and reached consensus statements. The publication links assessment, investigation, and treatment when exposure is uncertain. Its structured development supports transparent discussion of evidence strength, but recommendations remain partly dependent on expert judgment and the clinical environment for which they were prepared. The framework uses this source to place testing and antidote decisions within an organized clinical assessment rather than a sequence driven only by laboratory confirmation. It also highlights the importance of referral and specialist input for difficult presentations. Its contribution is contextual clinical guidance supporting coordination while preserving authorized decision-making and resuscitation priorities.

Comparative interpretation

The laboratory review and clinical position statement place analytical work within a broader assessment of the patient. The laboratory contributes information with defined limits; the clinical team integrates it with exposure history and physiological findings. The framework follows that division while recognizing the importance of timely specialist consultation. Its proposed coordination arrangements are transferable questions for local adaptation, not evidence that all services should adopt the same tests, staffing levels, or treatment protocols.

Life threatening toxicity and resuscitation

Lavonas et al. (2023) published an American Heart Association focused update on cardiac arrest and life-threatening toxicity due to poisoning. Structured evidence reviews informed guidance on selected toxin groups, supportive interventions, and antidotes. The publication is especially relevant when an evolving poisoning presentation requires urgent resuscitation rather than waiting for complete analytical identification. However, the population and severity addressed are narrower than the full spectrum of poisoning, and evidence certainty varies between interventions. The present framework therefore uses the update to establish the priority of clinically indicated emergency

action, without turning its content into a dosing manual. Paramedic observations, rapid laboratory communication, and pharmacy access can support the authorized resuscitation team. Forensic documentation remains a parallel concern when appropriate, rather than a prerequisite for treatment.

Multidisciplinary guidance for drug poisoning

Mégarbane et al. (2020) developed multidisciplinary recommendations for pharmaceutical and recreational drug poisoning through a committee representing five scientific societies. The process considered severity, toxicological investigation, supportive care, decontamination, enhanced elimination, and antidotes using structured questions and evidence grading. Forty-one statements were produced, many relying on expert opinion because direct evidence was limited. The guideline therefore offers both a broad clinical structure and a clear reminder that consensus strength is not identical to trial evidence. Its scope excludes some other forms of poisoning, limiting unrestricted generalization. For this review, the publication supports connecting clinical risk assessment with appropriately selected investigation and treatment. It also reinforces the value of distinguishing the established findings of individual studies from proposed organizational arrangements.

Comparative interpretation

These broad guidance documents support a clinical foundation for coordination but do not validate the complete framework. The literature gap concerns how information, specimens, and treatment requests move between professions while serving distinct purposes. The twenty publications together justify examining that gap through conceptual synthesis. They provide no common effect estimate and no direct comparative evaluation of the proposed system. The results chapter therefore presents derived relationships and an evaluation agenda, rather than simulated clinical outcomes.

3 METHODOLOGY

This manuscript uses a targeted integrative literature review with conceptual framework development. Its purpose is to connect evidence from several methodological traditions around a practical coordination question, rather than estimate the pooled effect of one intervention. The integrative approach follows the principle of using existing literature to develop a new conceptual account (Torraco, 2016). Twenty core publications were purposively selected to cover prehospital recognition and response, laboratory interpretation, specimen handling, and antidote stewardship. Five supplementary methodological or professional publications support review reporting and role interpretation. No new observations, interviews, laboratory experiments, or institutional records were collected.

Discovery and bibliographic verification were completed on 16 November 2026. Searches combined acute poisoning, naloxone, acetylcysteine, laboratory testing, urine drug screens, forensic specimen collection, antidote availability, and pharmacy services. Public scholarly web searches identified relevant titles and professional documents. MEDLINE-indexed records were retrieved through Europe PMC using title, PMID, or DOI queries, and accessible full texts were obtained where available. Representative queries included TITLE:"Evidence-Based Guidelines for EMS Administration of Naloxone", TITLE:"Definitive urine drug testing in emergency medicine", and EXT_ID:37552484 AND SRC:MED. These were targeted discovery and verification searches, not an exhaustive reproducible search of every database.

Eligibility required publication between January 2010 and 16 November 2026, a clearly identifiable bibliographic record, and direct relevance to at least one review domain. Human clinical studies, analytical evaluations, reviews, and professional guidance were eligible. Animal-only experiments, unrelated chronic exposure research, duplicate reports of the same publication, and inaccessible claims without adequate supporting information were not used. The selected core sources actually span 2014–2026. Their deliberate mix reflects the need to examine service interfaces, not an attempt to present twenty independent clinical trials. Table 1 defines the interpretive boundaries.

Table 1 Eligibility and interpretation boundaries

Dimension	Inclusion or procedure	Interpretive boundary
Period	2010 to 16 November 2026	Core publications span 2014–2026

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Dimension	Inclusion or procedure	Interpretive boundary
Focus	Acute poisoning and four professional domains	No claim to cover every toxin or service
Evidence	Trials, observational studies, reviews, guidance	Design and recommendation strength retained
Verification	Indexed metadata and accessible source text	Abstract-only claims identified
Synthesis	Qualitative comparison and conceptual integration	No pooled clinical effect or causal pathway estimate
Exclusions	Unrelated research and unsupported claims	No fabricated screening or participant counts

Bibliographic verification checked author names, publication year, journal, volume, pagination or article number, and DOI. Final issue dates were used where these differed from early online indexing, with publisher information checked for discrepancies. The specimen-collection article is cited using its 2017 publication date. Table 2 records the core corpus and the source material available for analysis. Professional full-text statements were also consulted when the indexed record did not provide an abstract. Access categories describe the material examined, not the methodological quality of the publication.

The unit of extraction was a statement linking a professional task, information requirement, analytical limitation, or treatment decision with a relevant context. Charting recorded the study design, setting, population or material examined, principal finding, stated limitations, and relevance to the four domains. Observational associations, randomized comparisons, analytical findings, and consensus recommendations were kept distinct. Numerical findings were retained only when their denominators and endpoints were clear. The review did not treat multiple publications about naloxone or acetylcysteine as independent confirmations of the same effect, because populations, products, regimens, and designs differed.

Selection was purposive, a protocol was not preregistered, and independent duplicate screening or extraction was not performed. No PRISMA identification totals, exclusion counts, or reliability coefficients are reported because those processes were not conducted. Reporting principles from Page et al. (2021), Tricco et al. (2018), and Peters et al. (2020) informed transparency about sources and limitations; the manuscript does not claim full compliance with a systematic or scoping review protocol. These limitations reduce confidence in completeness and make the synthesis an evidence-informed theoretical account rather than a definitive effectiveness review.

Table 2 Verified core publications and material examined

Publication	Design family	Main contribution	Access
Chou et al. (2017)	Review	Prehospital response	Abstract
Dietze et al. (2019)	Primary	Prehospital response	Full text
Skulberg et al. (2022)	Primary	Prehospital response	Full text
Williams et al. (2019)	Guidance	Prehospital response	Abstract
Dart et al. (2018)	Guidance	Antidote preparedness	Abstract
Alsugoor (2022)	Primary	Antidote preparedness	Full text
Abu Esba et al. (2023)	Primary	Antidote preparedness	Abstract
Dart et al. (2023)	Guidance	Antidote decisions	Publisher text
Bateman et al. (2014)	Primary	Antidote decisions	Abstract

Publication	Design family	Main contribution	Access
Pettie et al. (2019)	Primary	Antidote decisions	Full text
Wong et al. (2020)	Primary	Antidote decisions	Full text
Stolbach et al. (2022)	Guidance	Testing and interpretation	Society statement
Dinis-Oliveira et al. (2017)	Guidance	Testing and interpretation	Full text
Saitman et al. (2014)	Review	Testing and interpretation	Abstract
Rosano et al. (2025)	Primary	Testing and interpretation	Full text
Bhalla (2014)	Review	Testing and interpretation	Full text
Hoffman et al. (2026)	Review	Testing and interpretation	Abstract
Rungta et al. (2024)	Guidance	Clinical framework	Full text
Lavonas et al. (2023)	Guidance	Clinical framework	Abstract
Mégarbane et al. (2020)	Guidance	Clinical framework	Full text

Synthesis proceeded through within-source interpretation followed by comparison across sources. Statements were initially organized under recognition and handover, specimen and analytical integrity, interpretation of uncertainty, and antidote access and reassessment. Convergent findings supported component practices, while divergent findings prompted examination of study design, product, setting, and outcome. The resulting framework contains two complementary purposes: timely clinical action and appropriately authorized evidentiary preservation. Relationships linking these purposes are interpretive proposals derived from the literature, not tested causal connections.

Critical appraisal was narrative rather than scored. For trials, the analysis considered randomization, setting, selected products, and endpoints; for observational studies, confounding and transferability; for analytical work, assay coverage and the distinction between detection and clinical benefit; and for guidance, development methods and jurisdictional scope. No formal GRADE reassessment or numerical quality ranking was produced. Ortmann et al. (2021) provided supplementary professional context for pharmacy contributions. Table 3 describes proposed responsibilities, subject to local credentialing, staffing, supervision, and clinical governance.

Ethical considerations

The review used published literature and did not recruit participants, access identifiable patient information, or collect biological material. No ethics approval, institutional permission, or waiver is claimed. The ethical analysis concerns the proposed framework: treatment should follow urgent clinical need, and obtaining forensic documentation should not delay clinically indicated care. Specimen collection for legal purposes requires a valid local basis, appropriate authorization, and applicable consent procedures. Clinical collection does not automatically authorize secondary legal use or unrestricted information disclosure.

Records should minimize unnecessary personal information and use access controls appropriate to their purpose. Neutral language is particularly important when substances, self-harm, or potential criminal allegations are involved. A positive screen does not establish intent or impairment. The framework calls for proportionate documentation, respectful communication, and separation of clinical and evidentiary claims. Author affiliations do not imply institutional endorsement, and no contribution, funding, conflict-of-interest declaration, or authorship agreement is invented. Such declarations require

confirmation by the named contributors before submission. Future field evaluation would require its own ethics and governance assessment.

Table 3 Proposed responsibilities and limits of authority

Professional domain	Proposed contribution	Boundary
Paramedicine	Record scene information, observations, treatment, timing, and response	Emergency actions follow authorized protocols
Clinical laboratory	Assess specimens, perform validated assays, communicate results and limits	Detection alone does not establish causation
Forensic toxicology	Advise on evidence handling and interpret results for an authorized question	Clinical specimens are not automatically forensic evidence
Pharmacists	Support reconciliation, antidote access, preparation, monitoring, and review	Prescribing and changes follow authorized clinical governance
Pharmacy technicians	Support inventory, procurement, stock location, and supply records	Clinical decisions require appropriate professional supervision
Authorized clinical team	Integrate findings, direct care, reassess treatment, and arrange follow-up	Retains clinical responsibility; not replaced by the framework

4 RESULTS

The twenty-publication corpus comprises eight primary empirical reports, four evidence or educational reviews, and eight professional guidance publications. Primary reports include three randomized trials, four clinical observational studies, and one analytical comparison. This classification describes design rather than strength. The synthesis identified four connected requirements: retaining prehospital context, preserving specimen and analytical integrity, qualifying interpretation, and connecting antidote access with reassessment. No study evaluated the combined framework, and no pooled effect estimate was calculated.

The first result is a proposed coordination structure linking four professional domains with two shared information requirements: an explicit clinical question and an identifiable next recipient. Figure 1 presents this structure as a hub-and-ring diagram rather than a sequential patient flowchart. Paramedic observations, laboratory findings, forensic interpretation, and pharmacy information contribute different material to the shared record. The centre represents coordination of information; it does not represent a new profession, a prescribing authority, or a mandatory centralized database.

Naloxone evidence supports retaining product and response detail when information crosses a service boundary (Chou et al., 2017; Dietze et al., 2019; Skulberg et al., 2022). A generic entry that an antidote was given loses information needed to understand whether recovery was sustained or further assessment was required. Laboratory evidence similarly supports carrying analytical coverage and sample timing with the result (Stolbach et al., 2022; Hoffman et al., 2026). The framework therefore treats a result without its interpretive context as an incomplete communication, even if the analytical measurement itself is technically correct.

The structure also clarifies role limits. Pharmacy technicians can help establish where a medicine is located and whether supply records are current; those tasks do not confer authority to select treatment. Laboratory personnel can clarify whether a target analyte was assessed; that clarification does not independently determine the cause of altered consciousness. Forensic toxicologists can interpret evidentiary significance within an authorized question, while the treating team remains responsible for immediate clinical decisions. These distinctions are derived organizational principles rather than measured outcomes.

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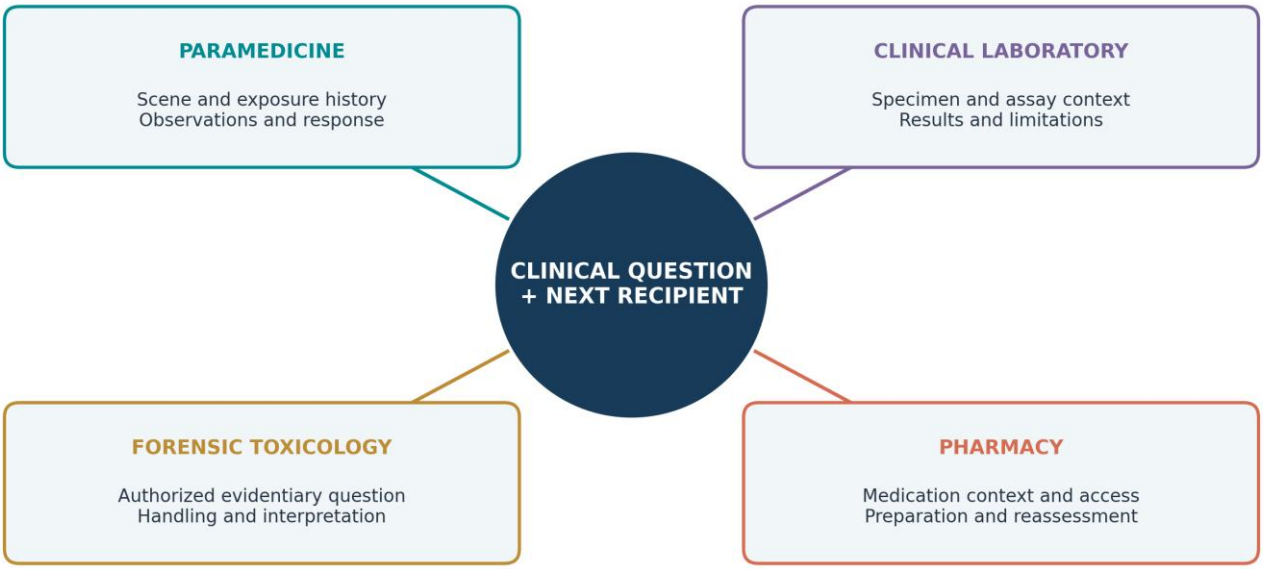


Figure 1 Conceptual coordination wheel linking professional contributions to a shared question and next action. Connections indicate proposed information exchange, not measured causal effects or mandatory referral for every case.

The second result is a distinction among exposure detection, clinical interpretation, and evidentiary adequacy. These concepts overlap but are not interchangeable. A rapid clinical result can be useful for one decision without answering a legal question. Conversely, a carefully preserved specimen may support later forensic work without providing information quickly enough for the initial treatment decision. Figure 2 uses a two-axis purpose map to make this distinction visible. Positions are illustrative and have no numerical scale or diagnostic performance meaning.

The collection guidance of Dinis-Oliveira et al. (2017) supports attention to preanalytical conditions, while Saitman et al. (2014) and Stolbach et al. (2022) support qualification of presumptive results. Rosano et al. (2025) adds analytical evidence that broad definitive testing detects findings outside routine immunoassay coverage. The synthesis consequently distinguishes three questions: whether a substance was detected, whether it plausibly explains the current illness, and whether the specimen and analytical process satisfy an authorized evidentiary purpose. An answer to one question cannot simply be copied into the other two.

The map identifies a practical interface between paramedicine and the laboratory. Reported time of exposure, time of collection, and medicines already administered can affect interpretation and should remain identifiable when available. Missing information should be recorded as unknown rather than reconstructed as fact. A change from a clinical to a legal purpose requires review of authorization and handling requirements. The framework does not prescribe universal forensic sampling or mandatory definitive testing; both depend on the question, the patient, applicable requirements, and available expertise.

This result is particularly relevant to unexpected or discordant findings. A negative routine opioid screen should be interpreted within its coverage, and an unexpected positive result may require laboratory discussion rather than immediate attribution of intent. Escalation should reach the appropriate clinician or analytical specialist. These proposals are designed to protect the distinction between evidence and inference. Their effect on diagnostic error, patient experience, workload, or legal reliability has not been tested in this review.

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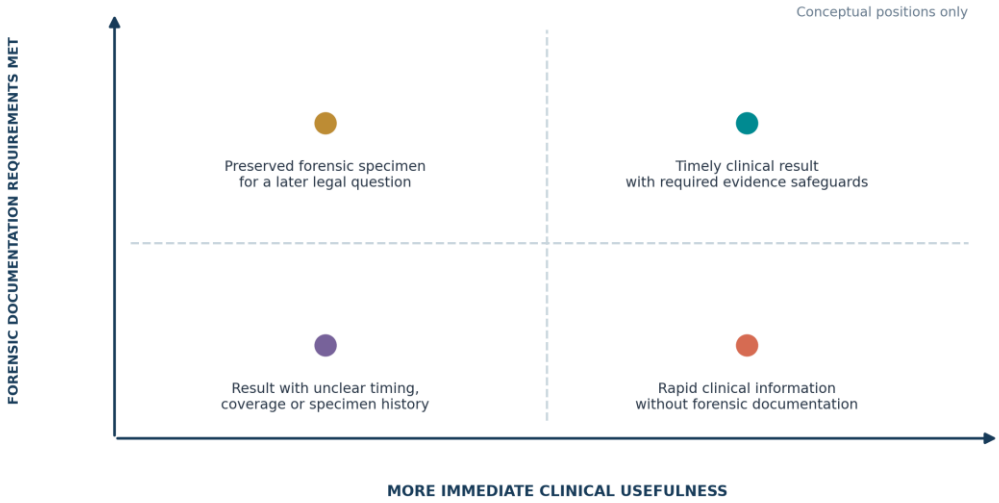


Figure 2 Illustrative map of information purposes in acute poisoning. The horizontal dimension concerns immediate clinical usefulness; the vertical dimension concerns fulfilment of forensic documentation requirements. Positions are conceptual, not rankings of test accuracy.

The third result is a stewardship cycle that separates preparedness from the individual treatment episode. Figure 3 links local hazard assessment and supply planning with authorized selection, delivery, monitoring, and review. The cycle is derived from stocking guidance, Saudi utilization evidence, and antidote studies. Its repeated structure indicates that learning from an episode can inform future preparedness; it does not imply that every stage follows a fixed duration or that cycle completion establishes clinical benefit.

At the preparedness level, Dart et al. (2018), Alsugoor (2022), and Abu Esba et al. (2023) support attention to local need and practical access. At the episode level, acetylcysteine publications distinguish the tolerability of delivery from prevention of liver injury (Bateman et al., 2014; Pettie et al., 2019; Wong et al., 2020). The framework therefore proposes separate documentation of availability, clinically authorized initiation, adverse reactions, and reassessment. Recording only the number of antidote units consumed would not explain why treatment was appropriate, delayed, interrupted, or extended.

Interpretation of the three figures yields an evaluation agenda rather than an effectiveness claim. A future study could examine completeness of handover fields, specimen identification and timing, communication of analytical limitations, access to selected antidotes, and documentation of reassessment. Clinical outcomes would need separate measurement with appropriate case-mix adjustment or a controlled design. Completeness of a form should not be assumed to reduce mortality, and a shorter delivery time should not be taken as proof of appropriate treatment. Measures also require denominators and explicit definitions before institutional comparison.

The synthesis has important limits. The corpus is purposively selected, several sources were examined only through indexed abstracts, and the theoretical integration has not undergone external validation. Evidence concentrates on selected drugs and service environments; chemical incidents, paediatric subgroups, and resource-limited systems may require different arrangements. The figures accordingly present propositions for local discussion and prospective assessment. The main contribution is a coherent account of how information and responsibilities can connect across the four domains while keeping clinical urgency, analytical limits, and evidentiary purpose distinct.

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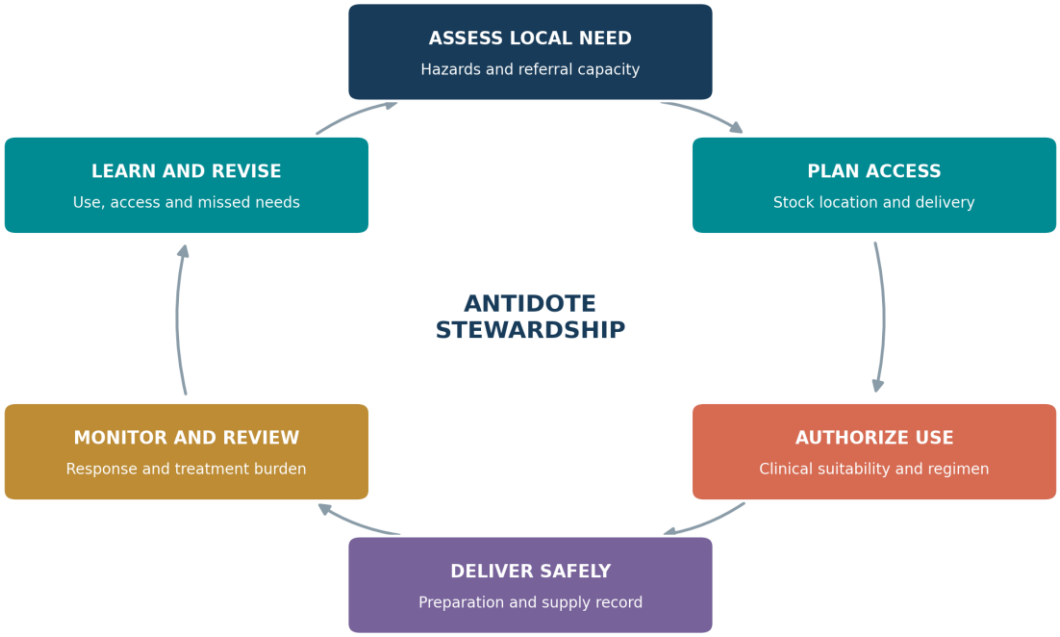


Figure 3 Proposed antidote stewardship cycle from preparedness to review. The stages synthesize different evidence families; the cycle has not been prospectively validated and contains no estimated treatment effect.

5 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

Acute poisoning care depends on decisions made under uncertainty and on information that remains useful. This integrative review examined twenty publications connecting prehospital assessment, laboratory investigation, forensic toxicological interpretation, and pharmacy contributions. The synthesis identifies a requirement to retain context when observations, specimens, results, and medicine requests move between services. A treatment label does not describe response, and a laboratory finding does not independently establish clinical causation or forensic meaning.

The evidence supports several component practices while leaving the proposed combined arrangement untested. Naloxone comparisons require attention to preparation, setting, and endpoint. Acetylcysteine studies distinguish tolerability from prevention of liver injury and retain limitations associated with observational designs. Testing literature separates assay coverage from the assumptions often attached to positive or negative results. Stocking and utilization evidence supports preparedness adapted to local hazards rather than a universal inventory inferred from historical consumption alone.

The resulting framework connects clinical action with appropriately authorized evidence preservation. Its three figures describe professional coordination, distinct information purposes, and an antidote stewardship cycle. They represent theoretical relationships rather than patient counts, probabilities, or demonstrated reductions in harm. Clinical decisions remain with authorized practitioners, and forensic procedures should not delay urgently indicated care.

The principal contribution is therefore conceptual clarity. The review provides a basis for developing local procedures and evaluating their feasibility, confidentiality, workload, and clinical consequences. Because selection was purposive and no institutional data were analysed, further research is required before the framework can be described as effective, generalizable, or ready for unrestricted implementation.

5.2 Recommendations

Healthcare organizations considering this framework should begin by identifying the information needed at each professional interface and the person responsible for acting on it. Local procedures should preserve reported exposure details, relevant observations, treatment timing, specimen collection information, and the limitations of requested assays. Missing information

should remain explicitly unknown until verified. Shared documentation should be proportionate to clinical need and should avoid duplicating records without improving their usefulness.

Laboratory and pharmacy services should establish accessible routes for discussing unexpected findings, assay coverage, medication-related interference, and antidote availability. Pharmacy technicians can support stock control and supply processes under supervision. Pharmacists and authorized clinicians should review treatment suitability, preparation, monitoring, and reassessment using current local protocols and relevant specialist advice. Historical utilization should inform preparedness alongside local hazards and referral arrangements.

Clinical and forensic specimen procedures should have clearly differentiated purposes. Where a legal question exists, staff should verify authorization, consent requirements, identification, handling, and access arrangements. These safeguards should operate alongside timely treatment. Staff education should address neutral documentation and the distinction between substance detection, impairment, and intent.

Before wider adoption, a prospective feasibility study should evaluate information completeness, access arrangements, specimen integrity, privacy, and workload. Clinical outcomes require separate definitions and a comparison strategy. Contributors should confirm authorship, affiliations, funding, and conflicts before submission. Subsequent revisions should respond to observed implementation problems and new evidence, with independent professional review of clinical recommendations and analytical procedures before any institutional protocol is approved or expanded across participating services and healthcare systems.

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