Saudi Journal of Medicine and Public Health

https://saudijmph.com/index.php/pub

https://doi.org/10.64483/202631834

Medication Safety and Continuity Across the Pre-Hospital to In-Hospital Emergency Continuum.

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Abstract

Medication safety in emergency care depends on information and decisions that cross organizational boundaries, from dispatch and ambulance to the emergency department (ED), ward, and community, yet each step is typically owned by a different profession and recorded in a different system. This narrative review synthesizes literature published between 2017 and 2023 on medication safety and continuity across the pre-hospital to in-hospital emergency continuum, integrating the contributions of pharmacy, emergency medical services (EMS), nursing, medical secretarial support, and epidemiological surveillance. Evidence indicates that failures concentrate at transitions: handover content, medication history accuracy, interruption-prone administration, and fragmented documentation. Pharmacist-led reconciliation, team-based verification, structured handover, administrative documentation support, and surveillance-driven learning each show promise but are rarely evaluated together. We propose an integrated five-pillar framework with a phased roadmap and identify priorities for system-level research.

Keywords: medication safety; continuity of care; emergency medical services; clinical pharmacy; epidemiological surveillance.

Introduction

A toxicology result is often treated as a number Medication-related harm is one of the most persistent and costly threats to patient safety. A systematic review and meta-analysis of preventable harm across care settings found that roughly 6% of patients experience preventable harm and that medication-related events are among its most frequent sources (Panagioti et al., 2019). A complementary synthesis confirmed that preventable medication harm occurs across care settings rather than in any one of them (Hodkinson et al., 2020). Economic modeling for England estimated 237 million medication errors a year in the National Health Service, with an annual cost of about £98.5 million (Elliott et al., 2021), and United States surveillance attributes a large and recurring volume of ED visits to medication harms, led by anticoagulants, antibiotics, and diabetes agents (Budnitz et al., 2021). In response, the World Health Organization (WHO) launched its third Global Patient Safety Challenge, Medication Without Harm, which targets severe avoidable medication-related harm through action on high-risk situations, polypharmacy, and transitions of care (Donaldson et al., 2017; Sheikh et al., 2017; WHO, 2017). The later Global Patient Safety Action Plan 2021–2030 positioned safe clinical processes, including medication use, as a core priority for health systems (WHO, 2021).

Emergency care is an especially demanding setting for these risks. It is better understood as a chain of linked functions than as a place: recognition and activation, dispatch, pre-hospital assessment and treatment, transport, ED resuscitation and stabilization, and onward admission, observation, or discharge (Reynolds et al., 2017). Patients move along this chain quickly, are frequently unable to give a reliable medication history, and are treated by

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Receive Date: 30 August 2026, Revise Date: 27 October 2026, Accept Date: 13 November 2026

clinicians who have never met them, often with high-alert drugs close at hand. Pre-hospital care has historically received less patient-safety scrutiny than inpatient care, yet a trigger-tool study of Swedish ambulance services identified 4.3 adverse events per 100 missions, most judged avoidable and many arising from deviations from standard of care or incomplete documentation (Hagiwara et al., 2019). At the next link, a quantitative analysis of EMS handoffs of critically ill and injured patients to an ED measured what information was actually transferred and concluded that further training in handoff delivery was needed (Goldberg et al., 2017). Information lost at one link is rarely recovered at the next.

Despite this, the literature remains organized by profession and site. Pharmacy research concentrates on hospital reconciliation, EMS research on protocols and cross-checks, nursing research on administration errors, informatics research on records, and public health research on population surveillance. Each stream is valuable, but the patient experiences them as a single journey, which is precisely the unit of analysis advocated by contemporary work-system models of patient safety (Carayon et al., 2020). Two contributors to continuity are especially under-examined: medical secretarial and administrative staff, who create, route, and reconcile much of the written record, and epidemiological surveillance, which can convert fragmented individual events into system learning.

This narrative review therefore asks three questions. First, where does medication safety fail along the pre-hospital to in-hospital continuum? Second, what do pharmacy, EMS, nursing, and medical secretarial support contribute to preventing those failures? Third, how can epidemiological surveillance connect these contributions in a learning system? We conclude with an integrated framework and an implementation roadmap. Section 2 describes the review approach, Sections 3 to 5 synthesize the evidence, and Section 6 presents the framework, limitations, and conclusions.

2. Review Approach

This study is a narrative review, chosen because the question spans professions, settings, and study designs that cannot be pooled quantitatively. The aim was interpretive synthesis and framework development rather than estimation of a pooled effect. Because narrative reviews are vulnerable to selection bias, the approach is stated in full.

Sources were selected purposively to cover each link of the continuum and each of the five disciplines named in the title. Eligible sources were peer-reviewed articles, systematic reviews, trials, and international or professional guidance published between 2017 and 2025 that addressed medication safety, handover, reconciliation, administration, documentation, or surveillance in pre-hospital, ED, or transition-of-care settings. Where pre-hospital or administrative evidence was sparse, evidence from adjacent settings, such as hospital wards and ambulatory care, was admitted and is flagged as indirect wherever it is used. The resulting evidence base comprises 43 sources, the most recent published in 2023, and includes systematic reviews and meta-analyses, randomized and observational studies, qualitative and theoretical work, and technical guidance from WHO and patient safety organizations.

Findings were organized thematically in three passes. The first mapped failure points along the continuum. The second mapped the evidence-supported contribution of each profession. The third identified how surveillance data could connect those contributions. Study quality was considered informally: pooled estimates from systematic reviews were preferred to single studies, and the design and setting of single studies are stated where they limit generalization. No formal risk-of-bias scoring was performed, and the review was not registered.

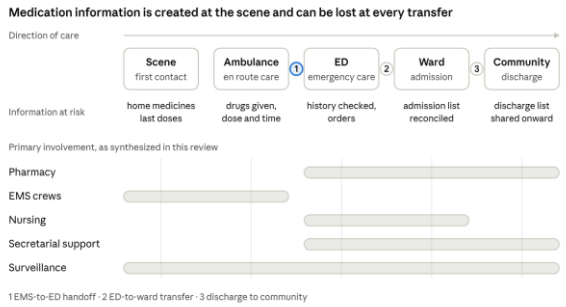
In this paper, the continuum is the chain from first contact through ED care to admission, observation, or discharge. Medication safety follows the WHO usage of avoiding preventable harm from medicines (Donaldson et al., 2017). Medication continuity is the accurate and timely transfer of three things: what a patient takes, what has been given, and what is intended, so that each successive clinician can act on a complete picture. Medical secretarial support refers to administrative and clinical-support staff, including unit clerks, ED registration and records staff, and clerical roles in ambulance services, who handle patient information but do not make clinical decisions.

Evidence on medical secretarial staff specifically is very limited. Rather than omit the role, the review draws on studies of documentation workload and scribe support as indirect evidence and labels the inference as such. Readers should treat conclusions about this role as hypotheses for testing.

3. Where Medication Safety Fails Along the Continuum

Figure 1 maps the continuum and shows where medication information is created, transferred, and at risk of loss. Three information streams run through it: the patient's pre-existing regimen, the treatment given before arrival, and the treatment started in the ED. Each stream can be lost at a transition. Table 1 summarizes the principal failure points and the evidence supporting them, and the subsections below take each link in turn.

Figure 1. Medication Information Flow and Professional Involvement Across the Emergency Continuum



3.1 First Contact: Not Knowing What the Patient Takes

At first contact, the central problem is that the clinician does not know what the patient takes. Patients who are acutely unwell, cognitively impaired, or intoxicated cannot be relied on to report, relatives may be absent, and medicine containers at the scene are inconsistently collected. The consequences are not abstract. ED visits attributed to medication harm are dominated by drug classes with narrow therapeutic margins, particularly anticoagulants (Budnitz et al., 2021), and national surveillance documented a 30% rise in ED visits for suspected opioid overdose in the United States between July 2016 and September 2017 (Vivolo-Kantor et al., 2018). Because pharmacist and clinician attention is scarce, identifying which patients are most at risk matters: a prospective validation study tested clinical criteria that identify ED patients at high risk of adverse drug events (Hohl et al., 2018). The reconciliation literature adds that the target should be a correct medication list rather than a completed form. Rose et al. (2017) argue that the accuracy of the list, the patient's involvement in verifying it, and its use by the next clinician matter more than the act of reconciling itself. For the pre-hospital phase, this implies that what the crew sees, hears, and records at the scene is the earliest and sometimes the only evidence of the home regimen.

3.2 Pre-Hospital Administration

Pre-hospital medication administration combines high-stakes drugs, weight-based dosing, and a challenging physical environment. The Swedish trigger-tool study found that most adverse events were avoidable and that most arose from deviations from standard of care and incomplete documentation (Hagiwara et al., 2019). A human-factors analysis of EMS medication practice argued that conventional verification does not reliably prevent errors, and evaluated a team-based cross-check process designed around how crews actually work (Misasi & Keebler, 2019). Workforce strain compounds the risk: burnout among EMS professionals has been associated with workforce-reducing factors such as intention to leave and absenteeism (Crowe et al., 2018), which erodes the experience and staffing stability on which safe practice depends. Documentation is itself a safety issue at this link. A drug that is given but not recorded, or recorded in a patient care record that never reaches the ED, is functionally a drug not given from the receiving team's perspective.

3.3 The EMS-to-ED Handoff

The EMS-to-ED handoff is the highest-risk information transfer in the continuum because it is brief, verbal, and often delivered while the receiving team is already acting. The quantitative study of handoffs of critically ill and injured patients showed that the content of handoff can be measured and that it warrants further training (Goldberg et al., 2017). Incomplete documentation was also a leading origin of adverse events in the Swedish study (Hagiwara et al., 2019). Inpatient evidence shows what structured communication can achieve: a multicenter before-and-after study of a program that standardized handoff and engaged families was associated with fewer medical errors and preventable adverse events (Khan et al., 2018). Pre-hospital handoff has not been tested with equivalent rigor, so extending that finding to emergency settings is an inference. Even so, three medication questions are central to any handoff: what the patient was taking, what the crew gave and when, and what the patient is known to react to.

3.4 Medication Use Inside the Emergency Department

Within the ED, errors arise from the interaction of crowding, interruption, and multitasking. A prospective direct observation study found that task errors by emergency physicians were associated with interruptions, multitasking, fatigue, and working memory capacity (Westbrook et al., 2018). The nursing counterpart of the same problem is documented in a review of direct observational studies, which characterizes interruptions during medication administration as frequent (Schroers, 2018). National incident reports from England and Wales have linked medication administration errors to patient mortality (Härkänen et al., 2019). High-alert medication lists, such as that of the Institute for Safe Medication Practices (ISMP, 2018), identify drug classes in which the consequences of error are most severe, including anticoagulants, insulin, opioids, and neuromuscular blocking agents. Many of these classes are used routinely in emergency resuscitation, so the emergency setting concentrates exactly the drugs that tolerate error least.

3.5 Leaving the Emergency Department

Exit from the ED is the final transition in the emergency continuum and the most thoroughly studied. A Cochrane review concluded that medication reconciliation can reduce medication discrepancies, although the certainty of evidence for clinical outcomes was limited (Redmond et al., 2018). A randomized trial in Australia found that having pharmacists complete the medication management plan in discharge summaries reduced the proportion of summaries containing at least one medication error from 61.5% to 15% (Tong et al.,

2017). After discharge, a systematic review documented that medication errors and related harm are common in the move to community care (Alqenae et al., 2020), and a meta-analysis evaluated whether communication interventions at discharge reduce readmission, treating communication quality as a modifiable determinant of outcome (Becker et al., 2021). WHO guidance names transitions of care as a priority area for medication safety (WHO, 2019), and the Joint Commission's National Patient Safety Goals require organizations to maintain and communicate accurate patient medication information (The Joint Commission, 2023).

Table 1. Principal Medication-Safety Failure Points Along the Pre-Hospital to In-Hospital Continuum

Link in the continuum	Typical failure mode	Contributing factors	Representative evidence
First contact	Unknown or unverified home medicines; missed anticoagulant or opioid exposure	Patient unable to report; no record access; time pressure	Budnitz et al. (2021); Hohl et al. (2018); Rose et al. (2017); Vivolo-Kantor et al. (2018)
Pre-hospital administration	Selection or dosing error; deviation from protocol; unrecorded doses	Time pressure, environment, workforce strain	Crowe et al. (2018); Hagiwara et al. (2019); Misasi & Keebler (2019)
EMS-to-ED handoff	Omitted drugs, doses, and times; record unavailable at the bedside	Verbal and unstructured transfer; parallel clinical activity	Goldberg et al. (2017); Hagiwara et al. (2019); Khan et al. (2018; inpatient analogue)
ED ordering and administration	Interrupted or multitasked tasks; high-alert drug errors	Crowding, fatigue, task switching	Härkänen et al. (2019); ISMP (2018); Schroers (2018); Westbrook et al. (2018)
ED-to-ward or discharge	Admission discrepancies; discharge summary errors; post-discharge harm	Multiple lists; unclear ownership	Alqenae et al. (2020); Becker et al. (2021); Redmond et al. (2018); Tong et al. (2017)

4. Professional Contributions to Medication Continuity

The failure points in Section 3 are not owned by any single profession, which is why they persist. This section reviews what pharmacy, EMS, nursing, and medical secretarial support each contribute, how strong the supporting evidence is, and where the contributions need to connect. Table 2 summarizes the argument.

4.1 Pharmacy

Pharmacists have the strongest evidence base for improving medication continuity, but it is concentrated inside the hospital. A systematic review of emergency medicine pharmacist roles described a broad scope that spans medication history taking, review of orders, participation in resuscitation, and discharge and follow-up activities (Roman et al., 2018). The clearest trial evidence in this review comes from the discharge end of the pathway, where pharmacist completion of medication management plans reduced discharge summary errors from 61.5% to 15% (Tong et al., 2017). Cochrane evidence likewise supports reconciliation as a means of reducing discrepancies, with the caveat that effects on clinical outcomes remain uncertain (Redmond et al., 2018).

Three implications follow for the continuum. First, pharmacist time is best directed by risk. Validated criteria for identifying high-risk ED patients (Hohl et al., 2018) allow a limited pharmacy workforce to prioritize the patients most likely to benefit. Second, pharmacists should be accountable for the quality of the list rather than the completion of a process (Rose et al., 2017), which means verifying against more than one source and recording the source and the level of confidence. Third, pharmacist reach should extend upstream and downstream. Upstream, it means contributing to ambulance formularies, dosing aids, and the verification procedures evaluated by Misasi and Keebler (2019). Downstream, it means linking to community pharmacy and primary care, consistent with WHO guidance on medication safety in transitions of care (WHO, 2019). The literature reviewed here contains no controlled evaluation of pharmacist-led pre-hospital interventions, which is a notable gap given how much of the risk begins there.

4.2 Emergency Medical Services

EMS clinicians generate the first medication data in the emergency record and deliver the first treatment, so their contribution to continuity has two parts: capturing the home medication picture and documenting what was given. Safety performance in this setting differs from the hospital. The Swedish trigger-tool study shows that adverse events occur at a measurable rate and are mostly avoidable (Hagiwara et al., 2019), and the cross-check study offers a model of verification designed with human-factors engineering rather than imposed as a generic double-check (Misasi & Keebler, 2019). Verification that is bolted on tends to be abandoned under pressure, so process design should minimize steps while preserving the independence of the check. The workforce dimension cannot be separated from this.

Burnout is associated with workforce-reducing factors among EMS professionals (Crowe et al., 2018), and fatigue and stress are credible contributors to error, as the ED evidence on task errors suggests (Westbrook et al., 2018).

EMS contribution to continuity also depends on the data reaching the receiving team. Electronic patient care records can in principle make the pre-hospital record available at the bedside, and interoperability standards such as Fast Healthcare Interoperability Resources (FHIR) are designed for this kind of exchange (Ayaz et al., 2021). Yet verbal handoff remains the point at which content is most visibly incomplete (Goldberg et al., 2017). Health-system frameworks argue that pre-hospital care should be planned as an integral part of emergency care rather than a separate service (Reynolds et al., 2017), and that argument applies directly to medication information: the ambulance record and the ED record should be one record in two chapters.

4.3 Nursing

Nurses administer most medicines in the ED and often receive the pre-hospital handoff at triage or in the resuscitation bay, so their role spans both continuity and execution. Clinical reasoning is central to safe administration. An integrative review identified the reasoning practices that support safe administration, which indicates that safety depends on cognitive work and not only on rote adherence to checks (Rohde & Domm, 2018). That cognitive work is repeatedly disrupted. Direct observational studies describe interruptions as characteristic of the administration process (Schroers, 2018), and observation of emergency clinicians links interruptions and multitasking to task errors (Westbrook et al., 2018). National incident data link administration errors to mortality (Härkänen et al., 2019). A study in teaching hospitals in Iran documented both the prevalence and types of errors among nurses and the barriers to reporting them (Fathi et al., 2017), and under-reporting matters for the surveillance function discussed in Section 5 because it distorts the picture on which learning depends.

Three practical implications follow. Nurses can protect high-risk tasks from interruption, particularly for high-alert drugs on lists such as that of ISMP (2018). The triage or resuscitation nurse's receipt of the pre-hospital handoff can be designed as a medication checkpoint at which the home medication source and the time of last doses are captured. And nurses can be treated as full partners in medication history and reconciliation, with pharmacists supporting rather than replacing that activity. The evidence for the second and third points is indirect, drawn from the interruption and handoff literatures rather than from trials of nursing-led continuity interventions in emergency care.

4.4 Medical Secretarial Support

Medical secretarial and administrative staff are rarely discussed in medication-safety research, yet they handle the artifacts on which continuity depends: registration data, pre-hospital records, transfer and referral documents, discharge summaries, and the routing of results and letters. Direct evidence on their effect on medication safety is thin, so this review draws on three indirect bodies of evidence. First, documentation burden is large. Studies using electronic health record event logs and time-motion observation found that primary care physicians spent a majority of their working day on EHR tasks (Arndt et al., 2017) and split their time roughly evenly between direct patient contact and desktop medicine (Tai-Seale et al., 2017), and a systematic review found that EHR adoption often lengthened documentation time (Baumann et al., 2018). Second, delegating documentation can help. A randomized trial of scribes found gains in physician satisfaction and charting efficiency (Gidwani et al., 2017), and a primary care study associated scribes with improved physician workflow and patient experience (Mishra et al., 2018). Third, interoperable data flows depend on accurate administrative data, including reliable patient identification, because standards-based exchange only moves whatever was entered at source (Ayaz et al., 2021).

All of this evidence comes from ambulatory settings and concerns documentation burden rather than medication safety, so extension to emergency secretarial roles is an inference. The plausible functions are specific: matching the pre-hospital record to the correct encounter at arrival, chasing missing records, assembling discharge documents for clinician and pharmacist review, and transmitting them to the primary care provider and community pharmacy. Incomplete documentation was a leading origin of adverse events in pre-hospital care (Hagiwara et al., 2019), which suggests that this clerical work is a safety function and not merely overhead. The boundary needs to be clear. Administrative staff should not make clinical judgments; their role is data integrity and routing, supported by checklists, defined escalation routes, and training in what constitutes a medication-relevant gap.

4.5 Reading the Contributions Together

Taken together, the professions form a relay in which each depends on the quality of what the previous one passed on. Pharmacists verify and reconcile, EMS and nurses capture and administer, and administrative staff move and preserve the record. The weakest evidence sits where the relay passes between organizations, which is exactly where Table 1 locates the failures.

Table 2. Role-Based Contributions to Medication Safety and Continuity

Role	Principal contribution	Evidence-supported interventions	Main evidence gap
Pharmacy	Verified medication history; risk-based review; discharge medication plans	Pharmacist-completed discharge plans (Tong et al., 2017); reconciliation (Redmond et al., 2018); risk criteria (Hohl et al., 2018); ED roles (Roman et al., 2018)	Pre-hospital and community-linked models
EMS	First medication data; first treatment; record of doses given	Team-based cross-check (Misasi & Keebler, 2019); trigger-tool surveillance (Hagiwara et al., 2019)	Handoff and record transfer outcomes (Goldberg et al., 2017)
Nursing	Triage receipt of handoff; ED administration; patient interaction	Interruption protection (Schroers, 2018); reasoning support (Rohde & Domm, 2018); high-alert vigilance (ISMP, 2018)	Nurse-led continuity trials in emergency care
Medical secretarial support	Record matching, routing, and completeness; discharge document transmission	Documentation support and scribes (Gidwani et al., 2017; Mishra et al., 2018), indirect only	Direct effect on medication safety
Epidemiological surveillance	Pattern detection; linkage of EMS, ED, and inpatient data; feedback	Surveillance principles (Groseclose & Buckeridge, 2017); incident reporting frameworks (Archer et al., 2017)	Integrated pre-hospital and in-hospital medication signals

5. Epidemiological Surveillance as the Connecting Layer

5.1 What Surveillance Adds

Public health surveillance is the systematic, ongoing collection, analysis, and interpretation of health data for action. Recent advances include the use of electronic data sources and greater attention to evaluating surveillance systems themselves (Groseclose & Buckeridge, 2017). Applied to medication safety, surveillance asks population-level questions that no single clinician can answer: which drugs, doses, and patient groups are involved in harm; where along the continuum the harm arises; whether it is rising or falling; and whether an intervention changed it. Existing examples show the value. National ED surveillance attributed a large burden of visits to medication harms and identified the leading drug classes (Budnitz et al., 2021), and tracking of suspected opioid overdose visits documented a rapid national rise that would have been invisible to any single hospital (Vivolo-Kantor et al., 2018).

5.2 Data Sources Along the Continuum

Four families of data are relevant. The first is electronic EMS patient care records, which capture drugs administered, times, and clinical impression. The second is ED and inpatient records, including medication orders, reconciliation entries, and discharge documents. The third is incident and near-miss reports. The fourth is structured record review, such as the trigger tool that Hagiwara et al. (2019) applied to randomly selected pre-hospital records to estimate adverse event incidence without relying on voluntary reporting. Each family has distinct strengths. Records supply denominators and timing, incident reports capture context and near misses, and trigger tools estimate incidence. Each also has a characteristic weakness: records are incomplete when documentation is incomplete, incident reports depend on the willingness to report, and record review is labor-intensive.

Reporting behavior is shaped by culture. A theoretical review identified the individual, team, and organizational factors that affect patient safety incident reporting (Archer et al., 2017), and the study of nurses in Iran documented concrete barriers to reporting medication errors (Fathi et al., 2017). Surveillance that depends on voluntary reports therefore needs a just-culture approach and visible feedback, because clinicians report when they see that reports lead to change. It also needs careful interpretation. A rising report rate can signal improving safety culture rather than worsening safety.

5.3 Linking the Pre-Hospital and In-Hospital Record

The decisive technical challenge is linkage. A pre-hospital drug administration, an ED order, and a post-discharge adverse event are rarely joined, so a harm that begins in the ambulance appears in the data as an ED or inpatient problem, and its origin is lost. Standards-based interoperability such as FHIR offers a route to common data structures, although the systematic review of its implementations also catalogs the challenges that implementers face (Ayaz et al., 2021). Linkage depends on administrative data quality and a reliable patient identifier, which ties surveillance back to the secretarial function discussed

in Section 4.4. It also raises governance questions. Linked data should follow data-minimization and access-control principles, and the purpose of linkage should be learning and safety improvement rather than individual performance management.

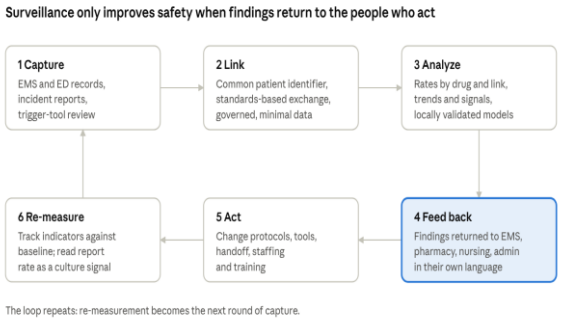
5.4 Analytics and Artificial Intelligence

Machine learning is increasingly applied to adverse drug event prevention. A scoping review identified key use cases for artificial intelligence in reducing adverse drug events across prediction, detection, and prevention, and noted that evidence of real-world implementation remained limited (Syrowatka et al., 2022). A broader scoping review of artificial intelligence for patient safety reached a similar conclusion: promising applications exist, including in medication safety, but the evidence base is still maturing (Bates et al., 2021). For emergency care, the implication is cautious optimism. Risk-prediction tools could extend the criteria for high-risk ED patients (Hohl et al., 2018), and text-mining of free-text EMS narratives could surface medication events that structured fields miss. Any such tool should be validated locally, evaluated for equity of performance, and introduced with attention to alert burden, since an unusable alert adds to the interruption problem already described.

5.5 From Signals to Learning

Surveillance is only valuable if it changes practice. Resilience research in health care defines resilience in terms of how systems adapt to and learn from variation in everyday work (Wiig et al., 2020), which shifts the question from counting failures to understanding how clinicians usually succeed under pressure. Complexity-informed implementation science adds that system change is shaped by interdependence among actors and requires sustained adaptation rather than one-off audits (Braithwaite et al., 2018). Figure 2 translates these ideas into a loop: capture data at each link, link them, analyze patterns, feed findings back to each profession in its own language, act, and re-measure. We propose a small set of candidate indicators for that loop: the proportion of ambulance arrivals with a pre-hospital medication record attached at handover; the proportion of high-risk ED patients with a medication history verified from two sources within a defined time; the proportion of discharge summaries containing a medication error; high-alert drug events per 1,000 ED attendances; and the report rate, interpreted as a culture indicator rather than an outcome. These indicators are illustrative proposals and have not been validated.

Figure 2. Surveillance and Learning Loop Linking Pre-Hospital and In-Hospital Medication Data



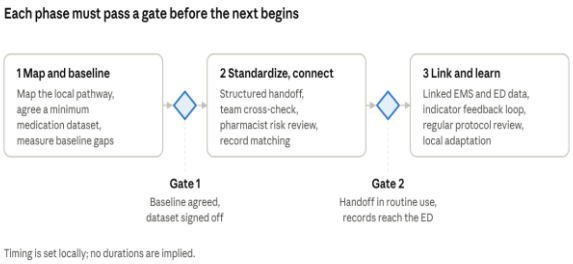
6. Integrated Framework, Discussion, and Conclusion

6.1 A Five-Pillar Framework

The evidence reviewed supports an integrated framework built on five pillars, each owned by a profession but each dependent on the others. The first pillar is verified medication information: a source-weighted medication list, with the source and confidence recorded, owned by pharmacy in the ED and supported by nursing and EMS at the point of first contact (Rose et al., 2017; Roman et al., 2018). The second is structured, closed-loop handover between EMS and the ED, built on a minimum medication dataset: home medicines and their source, drugs given with dose, route, and time, and known allergies or reactions, confirmed by the receiver (Goldberg et al., 2017; Khan et al., 2018). The third is protected administration and verification, combining a team-based cross-check for EMS (Misasi & Keebler, 2019) with interruption protection for high-alert drugs in the ED (Schroers, 2018; ISMP, 2018). The fourth is documentation integrity and routing, owned by medical secretarial support: matching the pre-hospital record to the encounter, chasing gaps, and ensuring that discharge documents reach primary care and community pharmacy (Tong et al., 2017; Hagiwara et al., 2019). The fifth is linked surveillance and learning, which closes the loop (Groseclose & Buckeridge, 2017; Wiig et al., 2020).

Four enablers cut across the pillars: interoperable data standards (Ayaz et al., 2021), a reporting culture that supports learning (Archer et al., 2017), workforce wellbeing and manageable workload (Crowe et al., 2018), and patient and family engagement in verifying the medication list. The framework is consistent with WHO guidance on transitions of care and with the Global Patient Safety Action Plan (WHO, 2019, 2021), and it applies the patient-journey perspective of SEIPS 3.0 (Carayon et al., 2020). Because complex systems rarely change in one step (Braithwaite et al., 2018), Figure 3 proposes a phased roadmap with explicit gates, so that each phase must demonstrate a defined result before the next begins.

Figure 3. Phased Implementation Roadmap for Integrated Medication Continuity



6.2 Discussion

Three patterns in the evidence deserve emphasis. The first is an inversion between where risk arises and where evidence exists. The failure points in Table 1 begin at the scene and the handoff, but the strongest trial evidence concerns discharge (Tong et al., 2017) and hospital reconciliation (Redmond et al., 2018). Pre-hospital studies describe the problem and test verification procedures (Hagiwara et al., 2019; Misasi & Keebler, 2019), but there is little controlled evidence that pre-hospital interventions improve downstream outcomes. Investment follows evidence, so the upstream links remain underserved.

The second pattern is complementarity. Pharmacist reconciliation cannot succeed if the pre-hospital drug record never reaches the ED, and a perfect handoff has little value if the discharge summary is wrong. Each intervention in Table 2 addresses one link, and their effects are likely to be multiplicative rather than additive. This reasoning is an inference from the structure of the continuum and has not been tested empirically, but it argues for evaluating bundles of interventions and no single components in isolation.

The third pattern is that workload is a binding constraint. Documentation burden is already high for clinicians (Arndt et al., 2017; Tai-Seale et al., 2017), and EHR adoption has often lengthened documentation time (Baumann et al., 2018). Any new element in the framework, such as a minimum medication dataset or a cross-check, must replace existing effort or be delegated to appropriate support staff, as the scribe evidence suggests may be feasible (Gidwani et al., 2017; Mishra et al., 2018). Otherwise the intervention will add to the interruptions and fatigue that already drive error (Westbrook et al., 2018).

The framework must also be adapted to resource context. Emergency care systems differ widely in staffing and technology (Reynolds et al., 2017). Where emergency pharmacists are unavailable, trained nurses and standardized paper-based minimum datasets can carry the first and second pillars, with remote pharmacist review where possible. The stakes justify the effort: the economic burden of medication error is large (Elliott et al., 2021), and preventable medication harm is documented in all care settings (Hodkinson et al., 2020; Panagioti et al., 2019).

6.3 Research Priorities

Five priorities follow from the gaps identified. First, controlled evaluations of pharmacist-supported continuity models that begin in the ED and reach into pre-hospital practice. Second, trials of structured EMS-to-ED medication handoff that measure patient outcomes as well as information completeness. Third, evaluation of administrative support roles in emergency care with medication-related outcome measures, since current evidence is indirect. Fourth, pilot studies of linked pre-hospital and in-hospital surveillance, with validation of the candidate indicators proposed in Section 5.5. Fifth, implementation and economic evaluations that test whether the phased roadmap in Figure 3 is feasible across different resource settings.

6.4 Limitations

This review has limitations that readers should weigh. It is a narrative review with purposive source selection and no formal risk-of-bias assessment, so it may overrepresent studies that are prominent or that support a coherent story. The evidence base is drawn predominantly from high-income health systems. Evidence on medical secretarial support is indirect and comes from ambulatory care. Several quantitative findings, including the discharge summary error rates and the adverse event incidence per 100 ambulance missions, come from single studies in specific settings and should not be generalized without local data. The framework and indicators proposed here are conceptual and have not been empirically validated.

6.5 Conclusion

Medication safety in emergency care is a continuity problem as much as a prescribing or administration problem. Harm arises where information is created by one profession, transferred to another, and recorded in a system the next clinician cannot see. Pharmacy, EMS, nursing, and medical secretarial support each hold part of the solution, and epidemiological surveillance can connect those parts into a system that learns. The evidence is strongest at the hospital end and weakest in the pre-hospital and administrative links, where the opportunity is greatest. A phased, evidence-informed program that standardizes the medication dataset, protects administration, secures the record, and measures what happens across the whole continuum offers a realistic route to medication care that is safe and continuous from the first contact to the final discharge.

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