Medications and Their Harms to Patients: A Comprehensive Guide to Safe Use, Recognizing Adverse Effects, Proper Administration, and Responsible Prescription Practices

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Accepted: 2025/7/15 **Published**: 2025/8/20

Abstract
Medications are central to modern healthcare, bringing enormous benefits in prevention, symptom control, and cure. Yet medicines also cause harm when used incorrectly, when interactions occur, or when system failures lead to errors. This comprehensive guide synthesizes evidence and practical principles to help clinicians, pharmacists, nurses, patients and health system leaders reduce medication-related harm. We review the nature and magnitude of medication problems, common sources of harm (including administration errors, drug–drug interactions and system failures), and special considerations for vulnerable groups (children, older adults, people with mental illness and patients with chronic noncommunicable diseases). Practical sections cover safe prescribing principles, medication reconciliation, patient-centred counselling and education, correct administration and monitoring, and use of digital tools to support adherence and safety. The guide highlights the critical role of patient participation and shared decision-making in medication safety, and ends with recommended system-level strategies—teamwork, standardized processes, education, and continuous measurement—to implement evidence-based medication safety practices. Key recommendations are supported by contemporary systematic reviews, consensus statements and primary studies.

Keywords: medication safety, adverse drug events, medication errors, prescribing, administration, medication reconciliation, patient education, drug–drug interactions

1. Introduction

Medicines transform patient trajectories—averting strokes with antihypertensives, controlling diabetes, treating infections and enabling palliative symptom relief. However, medication use is not risk-free. Adverse drug events (ADEs), medication errors and inappropriate prescribing cause substantial avoidable morbidity, mortality and healthcare costs worldwide (Hodkinson et al., 2020). Improving medication safety requires a systems approach that spans safe prescribing, accurate dispensing and administration, vigilant monitoring, and meaningful patient engagement (Hughes & Blegen, 2008; Greenwald et al., 2010).

This guide synthesizes core principles and practical steps to reduce medication harms. It integrates foundational safety literature, recent syntheses of preventable harm, and contemporary studies addressing patient participation and vulnerable populations (Feng et al., 2024; Ayre et al., 2024). Our aim is pragmatic: to equip clinicians and healthcare teams with evidence-informed practices and to empower patients to participate safely in medication decisions.

2. Scope and magnitude of medication-related harm

2.1 Types of medication problems

Medication-related harms include:

- Adverse drug reactions (ADRs): unintended, harmful responses at normal doses.
- Medication errors: preventable events in prescribing, transcribing, dispensing, administering or monitoring that may lead to harm.
- Drug–drug and drug–disease interactions that produce unexpected outcomes.
- Medication-related problems (MRPs): inappropriate drug choice, subtherapeutic dosing, duplication, nonadherence, or untreated indications.

2.2 Global burden and preventability

Systematic reviews indicate that a substantial fraction of ADEs across care settings are preventable (Hodkinson et al., 2020). Hodkinson and colleagues' meta-analysis showed preventable medication harm occurs across primary, secondary and aged care, highlighting system vulnerabilities at transitions and in community settings. In paediatrics, medication problems remain prevalent, with contextually specific drivers (e.g., dosing by weight) and notable preventable harm (Kidie et al., 2026). Drug–drug interactions account for a considerable share of harm in hospitalized patients (Zheng et al., 2018), illustrating the complexity of polypharmacy and the heightened risk in multi-morbidity.

3. Common causes of medication harm

3.1 Human factors and process failures

Medication administration errors are often rooted in busy clinical environments, interruptions, inadequate staffing and poor communication (Hughes & Blegen, 2008). Errors can occur at any step: illegible prescriptions, transcription mistakes, dispensing errors, wrong-time or wrong-route administration, or failure to monitor laboratory values.

3.2 Transitions of care

Transitions (admission, discharge, transfer) are high-risk moments. Absence of accurate medication lists and poor reconciliation processes cause omissions, duplications and dosing mistakes (Greenwald et al., 2010). Incomplete communication between inpatient teams, primary care, pharmacists and patients perpetuates risk.

3.3 Polypharmacy and drug interactions

Polypharmacy, particularly in older adults and patients with chronic conditions, increases the probability of clinically significant drug–drug and drug–disease interactions (Zheng et al., 2018). Additive pharmacodynamic effects (e.g., multiple sedatives causing falls) and pharmacokinetic interactions (altered metabolism leading to toxicity) are common mechanisms.

3.4 Vulnerable populations

Children require weight-based dosing, which introduces calculation errors (Kidie et al., 2026). People with mental illness may face fragmented care and unique medication safety challenges in primary care (Ayre et al., 2024). Patients with NCDs taking long-term therapies may experience complacency, misunderstanding about side effects or gaps in monitoring—areas where patient participation is crucial (Feng et al., 2024).

4. Recognizing adverse effects: vigilance and patterns

4.1 Common and high-risk ADEs

Certain drug classes carry predictable risk profiles:

- Anticoagulants: bleeding.
- Opioids: respiratory depression, sedation, GI effects.
- Insulins and oral hypoglycemics: hypoglycaemia.
- Psychotropics: metabolic effects, QT prolongation, extrapyramidal symptoms.
- Antibiotics: allergic reactions and C. difficile infection.

4.2 Early recognition techniques

Clinicians should maintain a high index of suspicion when new symptoms arise after medication changes, when laboratory abnormalities are unexplained, or when drug adherence changes. Use of symptom checklists, routine monitoring protocols (e.g., INR for warfarin, renal function for renally cleared drugs) and active patient questioning about side effects are essential.

4.3 Reporting and learning

All suspected ADEs should be reported to pharmacovigilance systems and internally documented for analysis. Reporting fosters signal detection and system learning. Encourage non-punitive reporting cultures and regular review of incidents to identify system fixes.

5. Principles of safe prescribing

5.1 Patient-centred prescribing

Prescribers should practice evidence-based therapeutic choice that is individualized to patient values, comorbidities, renal/hepatic function and polypharmacy risks. Shared decision-making improves adherence and safety: discussion should include benefits, likely side effects, monitoring requirements and alternative options (Greenwald et al., 2010).

5.2 "Start low, go slow" and deprescribing

For older adults and frail patients, begin at lower doses and titrate cautiously. Regularly reassess the ongoing need for each drug. Deprescribing (structured withdrawal of inappropriate medications) can reduce polypharmacy risks and prevent interactions.

5.3 Choose simplest effective regimens
Once daily dosing, fixed-dose combinations when appropriate, and minimizing complex timing reduce errors and improve adherence. Consider patient ability to self-manage, vision, cognition and social supports.

5.4 Consideration of interactions and comorbidity
Prescribers must review the full medication list—including OTCs and complementary medicines—and consider potential interactions. Use updated interaction checking tools and consult pharmacists for complex regimens.

6. Medication reconciliation: a cornerstone of safety
6.1 Why reconciliation matters
Greenwald et al. (2010) outline the necessity of patient-centred, clinically relevant, and implementable reconciliation at transitions. Reconciliation prevents inadvertent discontinuations, duplications and dosing errors.

6.2 Practical reconciliation steps
- Obtain best possible medication history (BPMH) using multiple sources: patient/family report, prior records, pharmacy dispensing records.
- Reconcile discrepancies at admission, transfer and discharge.
- Communicate reconciled list to next care provider and to the patient with clear counselling and written instructions.
- Document rationale for changes and follow-up plans.

6.3 Barriers and solutions
Time constraints, fragmented records and communication silos impede reconciliation. Solutions include use of standardized forms, delegation to pharmacists or trained nurses, integration of electronic medication records and patient-held medication lists.

7. Safe administration: nursing and pharmacy practices
7.1 The “five rights” and systems approaches
Traditional “five rights” (right patient, drug, dose, route, time) remain foundational (Hughes & Blegen, 2008) but must be complemented by systems strategies: barcode medication administration, independent double checks for high-risk drugs, minimizing interruptions during medication rounds, and smart infusion pumps.

7.2 High-risk medications and safeguards
Medications with narrow therapeutic windows (e.g., insulin, anticoagulants, chemotherapy, opioids) require additional safeguards: standardized dosing protocols, pre-printed order sets, pharmacist review, and patient monitoring plans. Use of concentration standardization and ready-to-use formulations reduces compounding errors.

7.3 Role of pharmacy
Pharmacists play critical roles in prospective review of orders, detecting interactions, dose adjustment for renal/hepatic function, counseling patients, and leading medication reconciliation. Community and clinical pharmacists can be integrated into care teams for long-term safety monitoring (Feng et al., 2024).

8. Drug–drug interactions: identification and management
8.1 Scope and clinical impact
Zheng et al. (2018) found that drug–drug interactions are common and can produce clinically significant harm in hospitalized patients. The risk increases with the number of medications and presence of organ dysfunction.

8.2 Practical strategies
- At prescribing: use interaction-checking software but interpret alerts clinically to avoid alert fatigue.
- Review cumulative anticholinergic, sedative and QT-prolonging burdens.
- When interactions are unavoidable, implement monitoring (e.g., drug levels, ECG, INR) and educate patients to report symptoms.
- Coordinate with pharmacy for alternative regimens with lower interaction risk.

9. Patients as partners in medication safety
9.1 Rationale for patient participation
Patients are central actors in medication safety—administering drugs at home, reporting side effects and adhering to regimens. Empowerment reduces errors and detects early warning signs (Feng et al., 2024; WHO “5 Moments for Medication Safety”).

9.2 Practical engagement strategies

- Provide clear, staged education: indication, dose, timing, route, storage, likely side effects, what to do if a dose is missed.
- Use teach-back to verify understanding.
- Offer written medication lists and reconcile them during each visit.
- Encourage patients to bring medicines and OTCs to appointments ("brown bag" review).
- Use digital reminders, medication apps and, where feasible, electronic adherence monitoring—balanced by attention to accessibility and data quality.

9.3 Barriers to participation

Feng et al. (2024) highlighted barriers: low awareness of medication safety roles, limited time in consultations, variable digital literacy, and misinformation online. Clinicians should actively invite questions, foster mutual trust, and signpost reliable information.

10. Special populations and tailored safety considerations

10.1 Children

Pediatric dosing requires weight-based calculations and age-appropriate formulations. Double-checking, standardized concentration protocols, and pharmacist involvement minimize calculation and measurement errors (Kidie et al., 2026).

10.2 Older adults

Non-trivial prevalence of polypharmacy, altered pharmacokinetics, and multimorbidity make older adults susceptible to ADEs. Regular medication review, deprescribing where appropriate, renal dose adjustments and simplified regimens reduce harm.

10.3 Mental health patients

Ayre et al. (2024) emphasize primary care complexities for patients with mental illness—fragmentation, stigma and monitoring gaps for psychotropic side effects. Multimethod approaches combining clinician training, systematic review of medications and collaborative care models can improve safety.

10.4 Chronic NCDs and long-term therapy

Patients with NCDs often self-manage long term; patient education, periodic monitoring and involvement of community pharmacists are critical (Feng et al., 2024). Digital health can support adherence and early detection of problems but requires validation and governance.

11. Technology and medication safety

11.1 Electronic prescribing and decision support

Electronic health records and computerized physician order entry reduce transcription errors and can integrate clinical decision support for dosing, interactions and allergies. However, poor design and excessive alerts can create new risks—human factors design is essential.

11.2 Barcodes, smart pumps and infusion safety

Barcode medication administration reduces patient-drug mismatches. Smart infusion pumps limit dosing errors in IV therapies. Implementation must include training, maintenance and policy alignment.

11.3 Mobile apps and digital adherence tools

Digital adherence interventions (reminders, gamification, telehealth support) show promise but vary in effectiveness and usability (Sharma et al., 2024). Clinicians should recommend validated tools and integrate data streams into care workflows when feasible.

12. Education, team roles and culture

12.1 Interprofessional teamwork

Collaborative practice—physicians, nurses, pharmacists and allied health—increases redundancy, catches errors early and facilitates patient education. Ifrim et al. (JBI implementation studies) and Greenwald et al. (2010) stress team roles in reconciliation and shared responsibility.

12.2 Safety culture and reporting

A non-punitive culture that encourages reporting drives improvement. Regular morbidity and mortality reviews, medication safety huddles, and multidisciplinary root cause analyses disseminate learning.

12.3 Training and competency

Ongoing education for prescribers, nurses and pharmacists on safety practices, human factors, communication and shared decision-making is necessary. Simulation and case reviews reinforce safe behaviors.

13. Measurement and continuous improvement

13.1 Key metrics

Quality programs should track process measures (reconciliation completion rates, adherence to monitoring protocols), outcome measures (ADE incidence, readmissions for medication problems) and patient-reported measures (understanding, confidence, side effect reporting).

13.2 Audit and feedback

Routine audits, feedback loops and benchmarking promote adherence to best practice. Combining quantitative metrics with qualitative patient interviews (Feng et al., 2024) yields deeper insights.

13.3 Research gaps

High-quality randomized trials of multifaceted safety interventions, studies on implementation in low-resource settings, and better evidence on long-term digital tool effectiveness are priorities. Evaluations must include cost-effectiveness and equity analyses.

14. Practical checklists: bedside and outpatient

For clinicians (prescribing encounter):

- Confirm indication and necessity.
- Check allergies, renal/hepatic function and current medications (including OTC/herbal).
- Screen for drug–drug and drug–disease interactions.
- Choose simplest, lowest effective dose and schedule.
- Document indication, expected benefits, monitoring plan and stop/review date.
- Provide verbal and written instructions; use teach-back.
- Plan follow-up and monitoring.

For discharge and transition:

- Perform medication reconciliation with BPMH.
- Communicate reconciled list to patient and next clinician.
- Provide clear reasons for changes and monitoring requirements.
- Arrange follow-up and pharmacy support.

For patients:

- Keep an up-to-date medication list and bring it to appointments.
- Ask why each medication is prescribed, how to take it and what to expect.
- Report new symptoms, missed doses or concerns.
- Avoid purchasing medicines online without professional advice.
- Use reminders, pill boxes or pharmacy blister packs if helpful.

15. Policy and system recommendations

Health systems can accelerate safety by:

- Mandating and resourcing medication reconciliation at transitions.
- Embedding pharmacists in primary and inpatient teams.
- Standardizing high-risk medication protocols and concentrations.
- Implementing human factors design in EHRs and decision support.
- Promoting public education about medicines and reliable information sources.
- Funding research and national pharmacovigilance systems.

Conclusion

Medicines offer unparalleled therapeutic value but also carry the potential for harm. Reducing medication-related injury requires an integrated approach built on safe prescribing, robust reconciliation, careful administration, active monitoring and meaningful patient partnership. Technologies and team-based care can amplify safety gains but must be designed around users. Evidence shows that many medication harms are preventable (Hodkinson et al., 2020). Concerted action across clinicians, pharmacists, nurses, patients and health systems can translate into safer, more effective pharmacotherapy for all patients.

Acknowledgements

We acknowledge the researchers and authors whose work informed this guide, including systematic reviews and qualitative studies that illuminate the patient experience and system challenges.

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