Actionable Patient Safety Solution (APSS) #3A: MEDICATION ERRORS

Executive Summary Checklist

Medication errors (wrong drug, wrong dose, wrong patient or route of administration) are a major cause of inpatient morbidity and mortality. An effective program to reduce medication errors will require an implementation plan to complete the following actionable steps:

- Hospital leadership must understand the medication safety gaps in their own system, and be committed to a comprehensive approach to close those gaps.

- Create a multidisciplinary team, including physicians, nurses, pharmacists, and information technology personnel to lead the project.

- Implement systematic protocols for medication administration, featuring checklists for writing and filling prescriptions, drug administration, and during patient transitions of care, as well as other quality assurance tools. These tools will include:
  - Installing the latest safety technology to prevent medication errors, such as the BD Intelliport™ Medication Management System and First Databank FDB MedKnowledge™ system or other drug dosing solutions for individual or categories of medications such as Monarch Medical Technologies solution for calculating IV & SubQ insulin doses.
  - Use barcoding for drug identification in the medication administration process.
  - Check patient’s allergy profile before prescribing medication.
  - Ensure appropriate training and safe operation of automated infusion technologies.
  - Distinguish “look-alike, sound-alike” medications by labeling design and storage.
  - Implement a system for patient follow-up to ensure medication adherence.

- Implement technology that standardizes Computerized Physician Order Entry (CPOE), reporting systems and quality assurance reports to audit compliance with safe drug administration practices.

- Practice the Five Patient Rights on Medications: right patient, right drug, right dose, right route, and right time of administration. All care providers should use this simple checklist.

- Provide education of all hospital personnel in the principles above. Monitor the effectiveness of this education at regular intervals.

- Review monitoring/reporting results at medical staff meetings and educational sessions as a part of Continuous Quality Improvement (CQI).
The Performance Gap

Medical errors are defined as preventable adverse events or effects of care and are a major cause of death in the United States. 1 in 20 perioperative medication administrations, or every second operation, resulted in a medication error and/or an adverse drug event.¹ Healthcare leadership must be made fully aware of the significant improvements in quality and safety of healthcare, as well as cost savings, that can be realized by actively addressing medical errors.

Medical errors include inaccurate or incomplete diagnosis or treatment, as well as instances of an appropriate method of care being executed incorrectly.² The vast majority of medical errors result from faulty systems and poorly designed processes, rather than poor practices or incompetent practitioners.³

Medication errors are a form of medical error and a significant cause of adverse events. Medication errors can be categorized as: 1) wrong drug, 2) wrong dose, 3) wrong route, 4) wrong frequency and 5) wrong patient. For example, drug infusion pump errors related to programming and operation are common and may have catastrophic complications. These pumps are complex to operate and poorly designed user interfaces can lead to programming errors. Patients receiving infused medications are often critically ill and receiving multiple medications, which further increases the probability of error. Perioperative medication administration has challenges due to a lack of computerized order entry, pharmacy approval or oversight by a second person prior to administration. These challenges coupled with a high stress environment has higher rates of medication errors resulting in a higher severity level.⁴ A variety of approaches are now available, to reduce these types of errors, including automated infusion and IV injectable technologies, integration of electronic medical records, continuous patient monitoring, predictive algorithms, checklists, and process of care advances.

Closing the performance gap will require hospitals and healthcare systems to commit to action in the form of specific leadership, practice, and technology plans.

Leadership Plan

Hospital governance, senior administrative leadership, and clinical/safety leadership must close their own performance gaps by implementing a comprehensive patient and medication safety approach. The process must include the fundamentals of change outlined in the National Quality Forum (NQF) safe practices.⁵ Specifically, the plan must:

● have strong evidence that they are effective and reducing preventable deaths;
● are generalizable and may be applied in multiple care settings and for multiple patient types;
● are likely to have a significant impact on reducing preventable deaths if fully implemented; and
● provide knowledge that can be used to educate and empower patients, healthcare professionals, researchers, and insurers.
● be designed so that leadership and all healthcare professionals fully understand the performance gaps in their own area of care;
● include a firm target date for the implementation of the corrective plan, with measurable quality indicators and milestones. “Some is not a number. Soon is not a time”⁶;

---

budget allocations for the corrective plan should be evaluated by governance boards and/or senior administrative leaders;
be endorsed by clinical/safety leadership to ensure implementation across all providers and systems; and
include a standardized system for feedback so that work plans remain flexible and may be fine-tuned as implementation progresses.

Practice Plan

- Formally assess opportunities to reduce medication errors with a comprehensive self-assessment process.\(^6\)
- Create a multidisciplinary team which includes physicians, nurses, pharmacists, and information technology personnel.
- Develop education on medication error and patient safety updates. Frequency can be monthly or quarterly. Systematize patient allergy and drug-drug interaction checks on every patient, CPOE, medication barcoding, as well as patient education and adherence tools for correct and timely medication administration.\(^7\) This should include the use of checklists and other quality assurance tools.
- Universal checklist for drug administration must include: patient, drug, dose, route, frequency.
- Implement standardized order sets where possible.\(^8\)
- Implement the Institute for Safe Medication Processes (ISMP) guidelines for training and safe operation of intravenous infusion pumps.\(^9\)
- Implement Institute for Safe Medication Processes (ISMP) guidelines for the multidisciplinary use of medication dispensing cabinets.\(^10\)
- Implement Institute for Safe Medication Processes (ISMP) guidelines for Adult IV Push Medications.
- Review medication labels and redesign as needed.\(^11\)
- Implement a standardized process for compounding sterile medications.\(^12\)
- Adhere to the Patient Safety Movement Actionable Patient Safety Solution guidelines for continuous monitoring of all patients who are receiving parenteral narcotics or other sedative drugs.\(^13\)
- Implement CDC Guidelines for single use injections, one solution, one patient, one syringe.

---


Technology Plan

To be successful in implementing this Actionable Patient Safety Solution, one should rely on implanting a technology plan using the following systems. Other specific strategies will be developed or become apparent as the above are implemented. This action plan will include careful observation of the consequences of each new strategy, which will in turn lead to additional novel ideas for further improvement in medication administration safety.

*Suggested practices and technologies are limited to those proven to show benefit or are the only known technologies with a particular capability. As other options may exist, please send information on any additional technologies, along with appropriate evidence, to info@patientsafetymovement.org.*

<table>
<thead>
<tr>
<th>System or Practice</th>
<th>Available Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>All Settings</strong></td>
<td></td>
</tr>
</tbody>
</table>
| **ONC Meaningful Use Certified EHR system**             | The following EHR vendors have signed the Patient Safety Movement Open Data Pledge: 
- Cerner
- GE Healthcare |
| Electronic Health Record (EHR) System with the following capabilities: |                                                                                                                                                      |
| ● Computerized Physician Order Entry (CPOE)            |                                                                                                                                                      |
| ● Drug-drug interaction check                          |                                                                                                                                                      |
| ● Drug-allergy interaction check                        |                                                                                                                                                      |
| ● Electronic Prescribing (eRx)                         |                                                                                                                                                      |
| ● Electronic Prior Authorization (ePA)                 |                                                                                                                                                      |
| **Electronic Medication Administration Record (eMAR) system with pharmacy and bedside barcoding capabilities** | First Databank FDB MedKnowledge system  
- First Databank FDB MedKnowledge system
- Monarch Medical Technologies Endotool® Solutions for insulin |
| **FDA approved clinical decision support solution for medication therapy recommendation.**    | Monarch Medical Technologies Endotool® Solutions for insulin |
| **Infusion pumps that wirelessly communicate data back to the electronic eMAR**               | Alaris®, Baxter®, Hospira®, Fresenius®, B.Braun® I.V. pumps.                                         |
| **Patient and Medication barcoding system**           | Codonics® Safety Labeling System; or
- BD Intelliport™ Labeler; or
- Single Use Injection Vials and Kits                  |

---

15 Institute for Safe Medication Practices. Reporting a medication or vaccine error or hazard to ISMP. Retrieved from: https://www.ismp.org/errorReporting/reportErrorToISMP.aspx  
<table>
<thead>
<tr>
<th><strong>CPOE simulation tool to quantify the risk of serious ADEs with your current system</strong> CPOE</th>
<th>● Leapfrog CPOE Evaluation Tool¹⁹</th>
</tr>
</thead>
</table>
| **Drug Libraries** | ● Alaris®<sup>®</sup>  
● Baxter®<sup>®</sup>  
● Hospira®<sup>®</sup>  
● Fresenius®<sup>®</sup>  
● B.Braun® I.V. pumps  
● BD Intelliport™ Medication Management System for I.V. injectables, or comparable systems. |
| **Pharmacy Workflow Manager** | ● DoseEdge® from Baxter Healthcare<sup>®</sup> |
| **Perioperative Environment** | |
| **IV injectable doses, audible and visual feedback for each syringe attached with measurement of dose, allergy alerts and more accurate and timely documentation wireless to the anesthesia information system** | ● BD Intelliport™ Medication Management System. |
| **Continuous physiologic monitoring on patients receiving IV medications to provide an early indication of deterioration due to a medication error** | ● Masimo rainbow® Acoustic Monitoring²⁰  
● Side-stream end-tidal carbon dioxide monitoring  
○ Oridion®<sup>®</sup>  
○ Masimo®<sup>®</sup>  
○ Respironics®<sup>®</sup> |
| **Pharmacy Environment** | |
| **Pharmacy robots to reduce safety problems associated with providers drawing up their own medications, and risks associated with contamination from outsourced compounders.** | ● BAXA® Intellifil Robot. |


| Utilize Single Use Injection Kits or Pre-mixed sterile solutions | ● Asclemed USA Inc., Injection Kits  
● Nabratori RX, Pre-mixed sterile solutions |
| **Other Considerations** | “End-to-end” smart pump system, or other electronic pump systems |
Metrics

Topic:

**Adverse Drug Event**
Adverse drug event (ADE) with harm to patient (Category E or higher on NCC-MERP classification) that is preventable (i.e., not an unknown first-time reaction to a medication).

Outcome Measure Formula:
- **Numerator:** Number of reported adverse drug events with harm (as defined above) – by class or medication
- **Denominator:** Number of doses administered (by medication or class of medications)

*Rate is typically displayed as ADE with harm/1000 doses given*

Metric Recommendations:

**Indirect Impact (preventable rate):**
All patients benefit from efforts such as CPOE, medication reconciliation (upon admission and discharge from the hospital), monitoring of drugs with therapeutic indexed levels (e.g., digoxin, phenytoin, warfarin), conversion of IV to PO meds once patient can tolerate oral liquids, and antibiotic stewardship.

**Direct Impact (non-preventable rate):**
All patients prescribed medications

**Lives Spared Harm:**
\[ \text{Lives} = (\text{ADE Rate}_{\text{baseline}} - \text{ADE Rate}_{\text{measurement}}) \times \text{Doses} \div \text{Patient Days}_{\text{baseline}} \]

Notes:
**Top Medication Classes/Triggers:**
1. Opioids
2. Sedatives/Hypnotics (including propofol)
3. Anticoagulants
4. Antimicrobials (including antivirals and antifungals)
5. Anti-diabetic medications (including insulin, and other injectable and oral medications)
6. Injectable medications

Initial/Baseline measurement will show ability to capture ADE information, since most are voluntarily reported. Over time, decreases in this rate can show lives spared harm. To ensure that reductions are not due to decreased reporting, a control measure should also be measured:

**Control Rate Calculation:**
- **Numerator:** Number of ALL reported errors and adverse drug reactions (including harm and NOT causing harm or “near misses”)
- **Denominator:** Number of doses administered over time period

*Control ADE rate should be consistent or increase, with corresponding decrease in ADE with harm*
Data Collection:

ADE reporting information is dependent on volunteer reporting and accuracy of people verifying reports (preferably from pharmacy and a medication errors reporting program, MERP).

Medication usage information is usually collected from billing information rather than medication orders (more accurate if patient received the dose or not).

If medication usage information is not available, denominator could be per 1000 patient days. This can track over time, especially for all ADE reporting, however, will not adjust ADE rate for high or low utilization medications.

Scales:

- The Adverse Drug Reaction Probability Scale (Naranjo) determines the causality of an ADR or how likely is the drug the true cause of the ADE.\(^{21}\)

Mortality (will be calculated by the Patient Safety Movement Foundation):

The PSMF, when available, will use the mortality rates associated with Hospital Acquired Conditions targeted in the Partnership for Patients (PfP) grant funded Hospital Engagement Networks (HEN). The program targeted 10 hospital acquired conditions to reduce medical harm and costs of care. “At the outset of the Partnership for Patients initiative, HHS agencies contributed their expertise to developing a measurement strategy by which to track national progress in patient safety—both in general and specifically related to the preventable HACs being addressed by the PfP. In conjunction with CMS’s overall leadership of the PfP, AHRQ has helped coordinate development and use of the national measurement strategy. The results using this national measurement strategy have been referred to as the “AHRQ National Scorecard,” which provides summary data on the national HAC rate.”\(^{22}\) Adverse drug events was included in this work with published metric specifications. This is the most current and comprehensive study to date. *Based on these data the estimated additional inpatient mortality for Adverse Drug Events is 0.020 (20 per 1000 events).*


Workgroup

Co-Chairs:
Ron Jordan, RPh, FAPhA, Chapman University School of Pharmacy
Jerika Lam, PharmD, AAHIVP, FCSHP, Chapman University School of Pharmacy
Nat Sims, MD, Massachusetts General Hospital (MGH), Harvard Medical School

Members:
Steven Barker, PhD, MD, Patient Safety Movement Foundation, Masimo, University of Arizona
Laura Batz Townsend, Louise Batz Patient Safety Foundation
Thomas Corlett, Ehlers-Danlos Inspiration Community
Mitch Goldstein, MD, Loma Linda Children’s Hospital, National Coalition for Infant Health
Sarah Hanssen, Certadose
Helen Haskell, Mothers Against Medical Error (MAME)
Paul Jansen, Masimo
Chris Jerry, Emily Jerry Foundation
Stuart Long, Monarch Medtech
Ariana Longley, MPH, Patient Safety Movement Foundation
David Shane Lowry, PhD, MA, BS, Chicago Medical School, Rosalind Franklin University of Medicine and Science
Brendan Miney, Talis Clinical
Steve Mullenix, RPh, National Council for Prescription Drug Programs (NCPDP)
Robert Nickell, Enovachem
Celine Peters, Becton Dickinson (BD)
Rochelle Sandell, Patient Advocate
Robert Stein, Keck Graduate Institute
Jason Yamaki, PhD, PharmD, Chapman University School of Pharmacy
Coco Yang, PhD, RPh, Chapman University School of Pharmacy

Metrics Integrity:
Nathan Barton, Intermountain Healthcare
Robin Betts, RN, Intermountain Healthcare
Jan Orton, RN, MS, Intermountain Healthcare
## Revision History

<table>
<thead>
<tr>
<th>Version</th>
<th>Primary Author(s)</th>
<th>Description of Version</th>
<th>Date Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Version 1</td>
<td>Paul Jansen</td>
<td>Initial Release</td>
<td>January 2014</td>
</tr>
<tr>
<td>Version 3</td>
<td>Michael Ramsay, Steven Barker, Joe Kiani, Jim Bialick, Ariana Longley</td>
<td>Executive Review</td>
<td>April 2016</td>
</tr>
</tbody>
</table>