Addressing Medication Errors in Hospitals

Ten Tools

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Contents

Overview of the Tools

Regardless of whether an organization decides to implement new technologies or simply improve upon existing systems, it must first provide an environment in which there is heightened awareness about medication safety and a commitment from its leadership to address issues and processes related to the prevention of errors. Technology alone is not a solution to medication errors. Its use should be included as a part of the organization's overall strategy for creating a "culture of safety" in which there is:

- Adequate understanding of the medication use process within the organization (e.g., how medications are ordered, dispensed and administered in patient care areas)
- Appropriate safety processes in place to prevent medication errors (e.g., checking of patient wristbands, documenting allergy information)
- A baseline assessment of where there are opportunities for improvement (e.g., areas where medication errors occur most frequently)
- A plan for educating patients and staff members alike on medication safety

A number of health care organizations have prepared various support tools that can assist the hospital organization in creating an environment of increased awareness and establishing baseline process assessments. For example, such tools are easily accessible through the Web sites of the Institute for Safe Medication Practices (www.ismp.org) and the American Hospital Association (www.aha.org)

Hospitals can use these ten decision-support tools to:

- Conduct a baseline and follow-up assessment of organizational needs in order to provide direction in the selection of technological solutions;
- Prepare the hospital community for medication safety initiatives, including the use of technology;
- Assess technological needs, identifying gaps and deficiencies in the current information infrastructure and taking inventory of current systems and capabilities;
- Identify features and capabilities that the organization requires in order to support its medication safety strategies;
- Identify products and features that would be of value to the organization as part of a long-term IT strategy; and
- Create a list of questions that should be included in a RFP to vendors regarding company stability and experience, product capabilities, impact on the organization, and level of service and support provided.

Hospitals can customize these tools to meet their needs and use the tools in conjunction with other available resources to highlight specific medication safety issues.

List of Tools

Tool	Name	Purpose	How Used
1	An Assessment of Medication Use Processes	To guide the organization in assessing the processes involved in the delivery of medications and the need for support from technology	Can be used to understand current organizational processes with regard to ordering, dispersing, and administering medications. Needs assessment can also provide the initial basis for product selection.
2	Medication Error Tracking Form	To facilitate the collection of data on medication errors in the organization	Helps caregivers document relevant information about errors at the patient level.
3	Medication Error Reporting Form	To identify major sources of errors within and across departments	Allows the organization to quantify the types of errors that are occurring, determine priorities, and track progress over time. Can be adapted for use with the organization's risk management report forms.
4	A Checklist for Preparing the Organization	To outline overall implementation steps and record progress	Can be used and updated regularly by a multidisciplinary implementation team.
5	A Guide to Potential IT Solutions to Medication Errors	To help the organization identify the IT modules that are best suited to addressing its specific problem areas	Can help to generate an initial "wish list" and to rule out IT modules with limited value to the organization.
6	Pros and Cons of IT Options	To provide guidance in the evaluation and selection of technologies	Can serve as a basis for developing short- and long-term organizational strategies with regard to technology evaluation/selection.
7	Needs Assessment and Product Evaluation	To summarize and stratify technology features for purposes of assessing organizational needs and to facilitate comparisons of features among vendors post-RFP process	Can be used to elicit desired features and capabilities from staff and decision-makers and to evaluate vendors' offerings.
8	Request for Proposal (RFP) Template	To provide the user with a list of questions that should be included in a request for proposals (RFP) from IT vendors	Can be incorporated into the organization's RFP format and customized to specific technologies.
9	Estimated Cost Savings Worksheet	To provide a template for calculating potential savings associated with different technologies	Can help to determine which types of technologies offer the most value, both financially and in terms of medication safety.
10	An Example of the Implementation Process	To outline a series of steps for implementing technology	Can provide assistance in developing an implementation plan specific to the organization's needs and resources.

Tool #1

An Assessment of Medication Use Processes

This tool is intended to help the organization assess the various processes involved in the delivery of medications and identify areas that would benefit from technological support. It may be used by senior management and departmental leaders at each step of the organization's medication use process. Comprehensive self-assessment tools are also available on the Web sites of the ISMP (www.ismp.org), AHA (www.aha.org) and IHI (www.ihi.org).

Medication Use Process	Have	Need	Don't Need
Ordering			
Access to Drug Information			
Drug information resources are available to prescribers.	❑	❑	❑
Protocols are used for chemotherapeutic agents and other highly toxic drugs.	❑	❑	❑
Clinical pharmacist works on the hospital floors, actively reviewing patient records and orders, attending rounds, and easily accessible to interact with prescribers.	❑	❑	❑
A pharmacist is available as a consultant 24 hours a day.	❑	❑	❑
Other (describe):	❑	❑	❑
Access to Patient Information			
Allergy information is available on order sheets, the computer, and the pharmacy.	❑	❑	❑
Patient information (e.g., diagnosis, lab values, etc.) is available to the medical staff prior to ordering drugs.	❑	❑	❑
All orders are accompanied with basic information (i.e., patient's name, birth date and physician) printed on addressograph imprints or stickers, or sent electronically.	❑	❑	❑
Other (describe):	❑	❑	❑
Order Entry Tools			
Pre-printed order forms are available throughout the hospital.	❑	❑	❑
Prescriber ordering is performed on the computer.	❑	❑	❑
Clear guidelines and standards for writing medication orders have been established (e.g., eliminating the use of abbreviations).	❑	❑	❑

Medication Use Process	**Have**	**Need**	**Don't Need**
Ordering *(cont'd.)*			
Order Entry Tools *(cont'd.)*			
Other (describe):	❑	❑	❑
Pharmacy Order Entry/Verification			
The pharmacy computer system has a standardized set of checks (e.g., screening for patient allergies, duplicate drug therapies, potential drug/lab interactions, drug/drug interactions, dose ranges, etc.).	❑	❑	❑
The pharmacy computer system is interfaced with the laboratory system and has alert features.	❑	❑	❑
Orders cannot be entered into the pharmacy system until the patient's weight information has been entered.	❑	❑	❑
Orders cannot be entered into the pharmacy system until the patient allergy information has been entered.	❑	❑	❑
All medication orders (except) for emergency medications) must be verified by a pharmacist prior to administration.	❑	❑	❑
Other (describe):	❑	❑	❑
Dispensing			
Access to Information			
Drug information resources are available to pharmacists.	❑	❑	❑
Patient information (e.g., diagnosis, lab values, etc.) is available to pharmacy staff prior to dispensing.	❑	❑	❑
Allergy information is available to pharmacist.	❑	❑	❑
Other (describe):	❑	❑	❑
Distribution of Medications			
High-hazard medication are not kept on general patient care units.	❑	❑	❑
Unit-dose distribution systems are maintained.	❑	❑	❑
All intravenous medications are mixed in the pharmacy areas and are not mixed by nurses on the floor.	❑	❑	❑

Medication Use Process	**Have**	**Need**	**Don't Need**
Dispensing *(cont'd.)*			
Distribution of Medications *(cont'd.)*			
Other (describe):	❑	❑	❑
Administering			
Access to information			
Drug information resources are available in the patient care areas.	❑	❑	❑
Patient information (e.g., diagnosis, lab values, etc.) is available to patient caregivers prior to administering.	❑	❑	❑
Allergy information is available to the nurses.	❑	❑	❑
Other (describe):	❑	❑	❑
Standardization/Automation			
Administration times are standardized.	❑	❑	❑
Electronic or computer-generated medication records are available.	❑	❑	❑
Bar coding is used in the medication administration process.	❑	❑	❑
Other (describe):	❑	❑	❑
Monitoring			
A multidisciplinary team to address medication safety has been established.	❑	❑	❑
Medication errors are thoroughly evaluated in an open, non-punitive manner.	❑	❑	❑
A non-punitive, anonymous medication error reporting system has been established.	❑	❑	❑
Medication errors are monitored, tracked, and evaluated on a routine basis.	❑	❑	❑
The hospital has established a safety plan.	❑	❑	❑
Other (describe):	❑	❑	❑

Tool #2

Medication Error Tracking Form

This form supports the tracing and collection and systematic categorization of data on medication errors, which is the first step in quantifying the types of errors that occur, identifying potential solutions, and setting priorities. To ensure that medication errors are tracked and categorized in a uniform manner, the forms should be reviewed by an individual or individuals who understand the medication use process. Such individuals could be from the hospital's Risk Management, Quality Assurance, or Pharmacy and Therapeutics Committee, or can be delegated to the Pharmacy Department for the reporting of summary data to the appropriate oversight committee.

After the hospital has implemented interventions to prevent medication errors, it can use the data collected through this form to measure the impact of those interventions. By making the tracking of medication errors an ongoing process that is part of a hospital's Performance Improvement or Continuous Quality Improvement initiatives, the organization will be better equipped to monitor errors and identify new opportunities to prevent them.

Directions for Use

Section 1: Patient Information

This section will allow the reviewer to access the patient's medical records if additional information is necessary.

Section 2: Medication Order Information

This section describes the medication error in terms of the medication involved and the outcome of the error.

Section 3: Medication Error Categorization (can be hospital-specific)

This section can be completed by the individual reporting the error or by the reviewer of the report.

1. **Medication Class Involved**

   To enable the hospital to identify the types of medications most frequently involved in medication errors, please check the therapeutic class for the medication involved in the error. For reference, see the American Hospital Formulary Service (AHFS) Pharmacologic-Therapeutic Classification System© used to classify drugs by class. You may need to customize the selection of therapeutic classes to include those that apply to your organization.

2. **Categorization of Medication Error**

   Classify whether the medication error was the result of an error in prescribing/ordering, transcribing/order verification, dispensing, medication administration, or medication

monitoring. Also note if the error was "intercepted" before the medication reached the patient.

a. Prescribing/Ordering Error: An error that originated from the written medication order

b. Transcription/Verification Error: An error that originated during transcription of the original physician order and/or transmission of the physician order to the pharmacy or nursing staff

c. Dispensing Error: An error originating from the point that medication was dispensed from the pharmacy (either as a patient-specific medication, such as that sent to the nursing unit for placement in a patient's medication cassette/supply; or as "floor-stock" [non-patient specific] medication, such as that stocked by the pharmacy in automated dispensing cabinets or in a medication room). Dispensing errors include incorrect admixtures of medications within the pharmacy and dispensed to the floor for administration of the dose.

d. Administration Error: An error originating during the processes directly associated with medication administration at the nursing unit. These errors include selection of the wrong medication from a patient's medication cassette or from a dispensing cabinet, or incorrect admixture of a drug at the nursing unit.

e. Monitoring Error: An error originating from a lack of necessary monitoring or lack of interpretation/appropriate action for selected drugs (e.g., drug level monitoring for certain antibiotics, antiarrhythmics, anticoagulants, anticonvulsants, etc.).

3. Possible Cause of Medication Error

This section will enable you to identify the most common causes for medication errors and can be used in quality improvement efforts.

a. Patient Knowledge Deficiency

b. Medication Knowledge Deficiency

c. Non-adherence to Policies and Procedures

d. Miscellaneous

Medication Error Tracking Form

Section 1: Patient Information

Patient Name:	Patient Hospital ID:
Date of Report:	Name of Reporter:
Patient Location at Time of Error:	Date and Time of Error:

Section 2: Medication Order Information

Name of medication:
How was order written?
Did patient receive the medication? ❑ Yes (If *yes*, what did patient receive [drug, dose, route, time of administration]?) ❑ No (If *no*, how was error intercepted?)
What was the outcome? ❑ Adverse drug event occurred. Describe injury that occurred and actions taken to minimize injury. ❑ Adverse drug event did not occur (no apparent patient injury or ill effect noted).
To enable a complete assessment of the medication error, please describe, in detailed narrative, the occurrence of the error. Provide any suggestions or recommendations regarding how to prevent future occurrences of this type of error.

Medication Error Tracking Form

Section 3. Medication Error Categorization

1. Medication Class Involved *(check one box; AHFS classification is provided for reference)*

- ❑ Antihistamine (4:00)
- ❑ Antiinfective (8:00)
- ❑ Antineoplastic or Immunosuppressive (10:00)
- ❑ Autonomic (12:00)
- ❑ Blood or Blood Formation Coag (16:00, 20:00)
- ❑ Cardiovascular (24:00)
- ❑ Central Nervous System (28:00)
- ❑ Diagnostic or Radioactive Agent (36:00, 78:00)
- ❑ Electrolytic, Caloric, and Water Balance (40:00)
- ❑ Eyes, Ears, Nose, Throat Preps (52:00)
- ❑ Gastrointestinal (56:00)
- ❑ Hormone (68:00)
- ❑ Other:

2. Categorization of Medication Error

A1. Prescribing/Ordering *(check all that apply)*

- ❑ Order written on wrong patient
- ❑ Order written for wrong drug
  - ❑ Drug not appropriate for indication
  - ❑ Patient with allergy to drug
  - ❑ Drug-drug or drug-disease interaction
- ❑ Order written for wrong dose/dose not adjusted
- ❑ Order written for wrong dosing schedule
- ❑ Order written for wrong route
- ❑ Other:

A2. Was error intercepted before reaching patient?

- ❑ Yes, during transcription/verification
- ❑ Yes, during dispensing
- ❑ Yes, during administration
- ❑ No
- ❑ Other comments:

B1. Transcription/Verification *(check all that apply)*

- ❑ Order transcribed on wrong patient
- ❑ Order transcribed for wrong drug
- ❑ Order transcribed for wrong dose
- ❑ Order transcribed for wrong dosing schedule
- ❑ Order transcribed for wrong route
- ❑ Other:

B2. Was error intercepted before reaching patient?

- ❑ Yes, during dispensing
- ❑ Yes, during administration
- ❑ No
- ❑ Other comments:

Medication Error Tracking Form

Section 3. Medication Error Categorization *(cont'd.)*

***2. Categorization of Medication Error** (cont'd.)*

C1. Transcription/Verification *(check all that apply)*

- ❑ Medication dispensed to wrong patient
- ❑ Wrong medication dispensed
- ❑ Wrong dose dispensed
- ❑ Medication dispensed at wrong time (late)
- ❑ Wrong dosage form (route) dispensed
- ❑ Other:

C2. Was error intercepted before reaching patient?

- ❑ Yes, during dispensing
- ❑ Yes, during administration
- ❑ No
- ❑ Other comments:

D1. Administration *(check all that apply)*

- ❑ Medication administered to wrong patient
- ❑ Wrong medication administered to patient
- ❑ Wrong dose administered
- ❑ Medication administered at wrong time
- ❑ Medication administered via wrong route
- ❑ Other:

D2. Was error intercepted before reaching patient?

- ❑ No
- ❑ Other comments:

E. Monitoring *(check all that apply)*

- ❑ Necessary monitoring not ordered
- ❑ Necessary monitoring not performed
- ❑ Monitoring result not noted/acted upon
- ❑ Other:

Medication Error Tracking Form

Section 3. Medication Error Categorization *(cont'd.)*

3. Possible Cause of Medication Error *(check all that apply)*

A. Patient Knowledge Deficiency

- ❑ Allergy information not available/noted
- ❑ Concomitant medication(s) not available/noted
- ❑ Concomitant condition(s) not available/noted
- ❑ Lab values/clinical information not available/noted

B. Medication Knowledge Deficiency

- ❑ Indications for medication use
- ❑ Available dosage forms
- ❑ Appropriate dosing/dosing guidelines
- ❑ Appropriate routes for administration
- ❑ Drug compatibility

C. Non-adherence to Policies and Procedures

- ❑ Use of abbreviations in medication ordering
- ❑ Incomplete medication order processed
- ❑ Established treatment protocol deviation
- ❑ Established pharmacy policy deviation
- ❑ Drug delivery problem (dispensing delay)
- ❑ Non-standard dosing schedule used
- ❑ Medication "borrowed" from another patient
- ❑ Patient identification not checked
- ❑ Established nursing policy deviation
- ❑ Drug preparation error
- ❑ Other:

D. Miscellaneous

- ❑ Illegible physician handwriting
- ❑ Memory lapse
- ❑ Drug stocking problem (drug not available)
- ❑ Equipment failure (e.g., IV pump failure)
- ❑ Other:

Tool #3

Medication Error Reporting Form

Hospital personnel should report all medication errors, regardless of whether the error results in an adverse drug event (ADE). The reporting of all medication errors allows the hospital to assess opportunities to improve its medication use processes so as to reduce the risk of such errors.

This form is a vehicle for aggregating the data collected in Tool #2, the Medication Error Tracking Form. Hospitals can use it as a stand-alone form for reporting purposes, or may want to adapt or streamline it for use on existing hospital Risk Management Report forms. The results are intended to be entered into a database or otherwise tabulated to provide a quantitative report of the types and causes of medication errors.

Table 1. Types of Medication Involved in the Medication Errors

	Number of Errors	% of All Errors	Change in % from Previous
Antihistamine (4:00)			
Antiinfective (8:00)			
Antineoplastic or Immunosuppressive (10:00)			
Autonomic (12:00)			
Blood or Blood Formation Coag (16:00, 20:00)			
Cardiovascular (24:00)			
Central Nervous System (28:00)			
Diagnostic or Radioactive Agent (36:00, 78:00)			
Electrolytic, Caloric, and Water Balance (40:00)			
Eyes, Ears, Nose, Throat Preps (52:00)			
Gastrointestinal (56:00)			
Hormone (68:00)			
Other:			

Table 2. Categorization of Medication Errors

	Number (%) of Errors	Change in % from Previous	% Intercepted	Number (%) Causing ADE	Change in % from Previous
Prescribing/Ordering Errors	**# (%)**	**+/- %**	**%**	**# (%)**	**+/- %**
Wrong patient					
Wrong drug – indication					
Wrong drug – allergy					
Wrong drug – drug interaction					
Wrong dose/dose not adjusted					
Wrong dosing schedule					
Wrong route					
Other					
Transcription/Verification Errors					
Wrong patient					
Wrong drug					
Wrong dose					
Wrong dosing schedule					
Wrong route					
Other					
Dispensing Forms					
Wrong patient					
Wrong drug					
Wrong dose					
Wrong time (dose dispensed late)					
Wrong dosage form (inappropriate for route)					
Other					
Administration Errors					
Wrong patient					
Wrong drug					
Wrong dose					
Wrong time					
Wrong route					
Other					
Monitoring Errors					
Monitoring not ordered					
Monitoring not performed					
Monitoring result not acted upon					
Other					
Total	**# (100%)**	**+/- %**	**%**	**# (100%)**	**+/- %**

Table 3A. Possible Causes of Medication Errors – By Medication Use Process

	Number (%) of Errors	Change in % from Previous	% Intercepted	Number (%) Causing ADE	Change in % from Previous
Prescribing/Ordering Errors	**# (%)**	**+/- %**	**%**	**# (%)**	**+/- %**
Patient Knowledge Deficiency					
Medication Knowledge Deficiency					
Non-Adherence to P&P					
Miscellaneous					
Other					
Transcription/Verification Errors					
Patient Knowledge Deficiency					
Medication Knowledge Deficiency					
Non-Adherence to P&P					
Miscellaneous					
Other					
Dispensing Errors					
Patient Knowledge Deficiency					
Medication Knowledge Deficiency					
Non-Adherence to P&P					
Miscellaneous					
Other					
Administration Errors					
Patient Knowledge Deficiency					
Medication Knowledge Deficiency					
Non-Adherence to P&P					
Miscellaneous					
Other					
Monitoring Errors					
Patient Knowledge Deficiency					
Medication Knowledge Deficiency					
Non-Adherence to P&P					
Miscellaneous					
Other					
Total	**# (100%)**	**+/- %**	**%**	**# (100%)**	**+/- %**

Table 3B. Possible Causes of Medication Errors – By Cause of Error

	Number (%) of Errors	Change in % from Previous	% Intercepted	Number (%) Causing ADE	Change in % from Previous
Patient Knowledge Deficiency	**# (%)**	**+/- %**	**%**	**# (%)**	**+/- %**
Prescribing					
Transcribing/Verification					
Dispensing					
Administration					
Monitoring					
Medication Knowledge Deficiency					
Prescribing					
Transcribing/Verification					
Dispensing					
Administration					
Monitoring					
Non-Adherence to P&P					
Prescribing					
Transcribing/Verification					
Dispensing					
Administration					
Monitoring					
Miscellaneous					
Prescribing					
Transcribing/Verification					
Dispensing					
Administration					
Monitoring					
Total	**# (100%)**	**+/- %**	**%**	**# (100%)**	**+/- %**

Summary

Top Three Drug Classes Involved in Medication Errors:
Top Three Types of Medication Errors and Patterns of Recurrence (i.e., is current trend better or worse than previous assessments?):
Top Three Causes Medication Errors (by Medication Use Process Step) and Patterns of Recurrence (i.e., is current trend better or worse than previous assessments?):
Top Three Causes of Medication Errors and Patterns of Recurrence (i.e., is current trend better or worse than previous assessments?):
Recommendations for Quality Improvement (describe non-technological or technological solutions for major identified medication error problem areas):

Tool #4

A Checklist for Preparing the Organization

The purpose of this checklist is to help the hospital plan for the implementation of new technologies and record its progress over time. It is meant to be used initially by senior management and departmental leaders, and then updated regularly by a multidisciplinary implementation team.

Task	Completed	In Progress – Anticipated Completion Date
Steps to Implement a Successful Information Technology Program		
Develop an information technology strategic plan. This plan should be integrated with the organization's strategic plan.	❑	
Create an information technology team to assess the current state of the organization (i.e., personnel, finances, etc.) and the organization's technology and to evaluate potential vendors and systems.	❑	
Once the IT decision has been made, assign an implementation team to develop a project plan. This team should identify the equipment, personnel, training costs, and other ancillary costs involved in implementing the technology.	❑	
Establish a rollout plan or implementation timeline.	❑	
Establish a training process.	❑	
Establish a continuous process to review the implementation of the new technology, evaluate systems changes to improve the process, and implement the changes.	❑	
Other (describe):	❑	
Medication Safety		
Educate health care professionals on the importance of participating in the medication error reduction process and understand the importance of reporting medication errors. All health care professionals are dedicated to improving medication safety.	❑	
Educate health care professionals about the importance (and potential pitfalls) of technology in improving medication safety.	❑	
Identify clinical champion(s) committed to improving medication safety within the hospital.	❑	
Establish a multidisciplinary team to address medication safety.	❑	
Establish a process for thorough evaluations of medication errors in an open, non-punitive manner.	❑	
Establish a non-punitive, anonymous medication error reporting system.	❑	
Monitor, track, and evaluate medication errors on a routine basis.	❑	
Establish a safety plan.	❑	
Other (describe):	❑	

Tool #5

A Guide to Potential IT Solutions to Medication Errors

Based on reports of medication errors in the organization (see Tool #3, Medication Error Reporting Form), the hospital can determine where the majority of serious medication errors occur and the potential for preventing such errors. It can then assess its priorities for implementing technological interventions or programs to prevent medication errors. The purpose of this tool is to help hospitals identify the technological modules best suited to addressing specific types of errors.

Note that the same technology can address several different types of medication errors. The following table places the potential technological solution at the point of the originating error; that is, while a prescribing error should be intercepted along the medication continuum (e.g., pharmacist check, nursing check), the table presents the potential technological solution under the prescribing error section as the point of the "original" error.

Medication Class

Table 1 in Tool #3 categorizes medication errors by the types of medication involved. If particular medication classes are associated with the majority of medication errors, the hospital may want to consider implementing protocols or practice guidelines for the use of those medications. A focused review of all medication errors occurring within the medication class will allow the hospital to determine the breadth and depth of such protocols. For example, if numerous medication errors occur with antiinfectives, and an analysis of antiinfective medication errors finds that most errors result from the prescribing of a wrong dose, then the most appropriate intervention may be a technology that gives physicians access to dosing information at the point of prescribing.

Categorization of Medication Errors: Potential Technological Solution

Medication Error	Potential Technology or Technological Feature to Address
Prescribing/Ordering Errors	For more "global" prescribing/ordering medication errors (a specific type of error within prescribing/order is not apparent, but rather appears to be multi-factorial) CPOE – Pre-defined order sets (e.g., medical problem-based order sets to match an approved patient care protocol). Order sets may include orders for labs, radiology, medications, nursing care, respiratory care, etc.
Wrong patient	CPOE – require patient verification before order entry
Wrong drug – indication	CPOE or Pharmacy System* – access to drug information: Drug monographs CPOE or Pharmacy System* – interactive clinical rules: Drug alerts for specified drugs (e.g., common "sound-alike" drugs)
Wrong drug – allergy	CPOE or Pharmacy System* – require presence of allergy information prior to entry of medication orders CPOE or Pharmacy System* – interactive clinical rules: Allergy Check
Wrong drug – drug interaction	CPOE or Pharmacy System* or Nursing System* – interactive clinical rules: Drug/Drug Interaction Check (including IV incompatibilities) CPOE or Pharmacy System* – interactive clinical rules: Contraindications for Drugs (including pregnancy and lactation warnings) CPOE or Pharmacy System* – interactive clinical rules: Duplicate Therapy Check CPOE or Pharmacy System* – access to patient information: Concomitant Disease States CPOE or Pharmacy System* – access to drug information: Alerts regarding Medication Label "Black Box" Warnings CPOE or Pharmacy System* or Nursing System*- access to drug information: Alerts regarding drug-food interactions
Wrong dose/dose not adjusted	CPOE or Pharmacy System* – interactive clinical rules: Care Protocols CPOE or Pharmacy System* – interactive clinical rules: Lab Value Access/Alerts CPOE or Pharmacy System* – interactive clinical rules: Dosing Range Limitations (i.e., cannot routinely enter dose under or over a certain range or cumulative dose) CPOE or Pharmacy System* – access to drug information: Drug Dosing Guidelines for Organ System Impairment or Age (e.g., pediatric, adult, elderly dosing guidelines) CPOE or Pharmacy System* – body surface area calculation for entered height and weight

Medication Error	Potential Technology or Technological Feature to Address
Prescribing/Ordering Errors *(cont'd.)*	
Wrong dosing schedule	CPOE or Pharmacy System* – interactive clinical rules: Care Protocols CPOE or Pharmacy System* – interactive clinical rules: Lab Value Access/Alerts CPOE or Pharmacy System* – interactive clinical rules: Dosing Range Limitations (i.e., cannot routinely enter frequency of administration under or over a certain range) CPOE or Pharmacy System* – interactive clinical rules: Automatic Stop Orders CPOE or Pharmacy System* – access to drug information: Drug Dosing Guidelines
Wrong route	CPOE or Pharmacy System* – interactive clinical rules: Care Protocols CPOE or Pharmacy System* – interactive clinical rules: Lab Value Access/Alerts (e.g., no intramuscular injections if prothrombin time is elevated) CPOE or Pharmacy System* – access to drug information: Drug Dosage Form Availability
Transcription/Verification Errors	These errors are usually caused by "human error" due to physician handwriting illegibility or lack of training in order interpretation. Hence, a potential global solution for transcription errors, regardless of subtype of error, is based upon eliminating transcription. CPOE – process that allows direct transmission of order into pharmacy and nursing systems Electronic document management – process allows transmission of actual physician order (not transcribed order) to the pharmacy, with or without imaging enhancement technology
Wrong drug	Pharmacy System* or Nursing System* – access to drug information: Drug Monographs Pharmacy System* or Nursing System* – interactive clinical rules: Drug Alerts for Specified Drugs (e.g., common "sound-alike" drugs)
Wrong dose	Pharmacy System* or Nursing System – interactive clinical rules: Dosing Range Limitations
Wrong dosing schedule	Pharmacy System* or Nursing System* – interactive clinical rules: Care Protocols Pharmacy System* or Nursing System* – interactive clinical rules: Standardized Dosing Schedules Pharmacy System* or Nursing System* – access to drug information: Drug Dosing Guidelines

Medication Error	**Potential Technology or Technological Feature to Address**
Transcription/Verification Errors *(cont'd.)*	
Wrong route	Pharmacy System* or Nursing System* – interactive clinical rules: Care Protocols Pharmacy System* or Nursing System* – interactive clinical rules: Lab Value Access/Alerts (e.g., no intramuscular injections if prothrombin time is elevated) Pharmacy System* or Nursing System* – access to drug information: Drug Dosage Form Availability
Dispensing Errors	
Wrong patient	Pharmacy System – process to use automated "drug picking" or dispensing devices Nursing System* - process, such as bar coding, to check medication to be administered against physician order or medication kardex for specified patient
Wrong drug	Pharmacy System – process to use automated "drug picking" or dispensing devices Nursing System* – process, such as bar-coding, to check medication to be administered against physician order or medication kardex for specified patient
Wrong dose	Pharmacy System – process to use automated "drug picking" or dispensing devices Pharmacy System – process to maintain and update inventory levels (i.e., ensure necessary stock is on hand for medication orders) Nursing System* – process, such as bar coding, to check medication to be administered against physician order or medication kardex for specified patient
Wrong time (dose dispensed late)	CPOE or Electronic document management – process that allows direct transmission of order into pharmacy (eliminate time delay for order transmission) Pharmacy System – interactive clinical rules: Standardized dosing schedules
Wrong dosage form (inappropriate for route)	Pharmacy System – process to use automated "drug picking" or dispensing devices Nursing System* – process, such as bar coding, to check medication to be administered against physician order or medication kardex for specified patient

Medication Error	**Potential Technology or Technological Feature to Address**
Administration Errors	
Wrong patient	Pharmacy Dispensing System – process by which medications in nursing unit-based dispensing devices cannot be accessed unless an "active" order exists within the pharmacy system for the patient (i.e., controlled access to medications via an automated pharmacy "double check") Nursing System – process, such as bar coding, to check medication to be administered against physician order or medication kardex for specified patient
Wrong drug	Pharmacy Dispensing System – process by which medications in nursing unit-based dispensing devices cannot be accessed unless an "active" order exists within the pharmacy system for the patient (i.e., nurse can only access the medication if ordered) Nursing System – process, such as bar coding, to check medication to be administered against physician order or medication kardex for specified patient
Wrong dose	Pharmacy Dispensing System – process by which medications in nursing unit-based dispensing devices cannot be accessed unless an "active" order exists within the pharmacy system for the patient (i.e., nurse can only access the medication dose that was ordered) Nursing System – process, such as bar coding, to check medication to be administered against physician order or medication kardex for specified patient Nursing System – access to drug information: Drug Use Guidelines or Monographs Nursing System – access to drug information: Drug Preparation Guidelines or Standards
Wrong time	Pharmacy Dispensing System – process by which medications in nursing unit-based dispensing devices cannot be accessed unless an "active" order exists within the pharmacy system for the patient (i.e., nurse can only access the medication within a designated time interval) Nursing System – process, such as bar coding, to check medication to be administered against physician order or medication kardex for specified patient Pharmacy System or Nursing System – interactive clinical rules: Assignment of Standardized Medication Administration Times Nursing System – access to drug information: Drug Compatibility Guidelines

Medication Error	Potential Technology or Technological Feature to Address
Administration Errors *(cont'd.)*	
Wrong route	Pharmacy Dispensing System – process by which medications in nursing unit-based dispensing devices cannot be accessed unless an "active" order exists within the pharmacy system for the patient (i.e., nurse can only access the medication dosage form consistent with the prescribed route of administration) Nursing System – process, such as bar coding, to check medication to be administered against physician order or medication kardex for specified patient
Monitoring Errors	
Monitoring not ordered	CPOE – interactive clinical rules: Order sets that link medication orders and lab/radiology orders (i.e., prompt to remind physicians to order labs or other monitoring tests appropriate for the medication)
Monitoring not performed	CPOE – interactive clinical rules: Reminder alerts to check on monitoring parameters
Monitoring result not acted upon	CPOE – interactive clinical rules: Reminder alerts to check on monitoring parameters CPOE – access to drug information: Protocols for dosage adjustments CPOE – interactive clinical rules: Drug order sets that incorporate "hold parameters" for drug administration (e.g., hold blood pressure medications if blood pressure is < 100/60; hold potassium supplement if serum potassium is > 5)

* "Indirect Prevention" by enhancing medication error interception

Tool #6

Pros and Cons of IT Options

Technology	Medication Errors Prevented (% of Errors)	How Medication Safety Is Promoted	Success Factors	Barriers to Implementation	Recommendations
1. CPOE	Prescribing and transcription (51%)	▪ Affects the medication use step at which most errors occur ▪ Increases efficiencies at each of the medication use steps downstream	▪ Physicians enlisted as champions from the onset ▪ Physicians employed by the hospital can be mandated to use the system ▪ Physician time was "bought" to manage implementation ▪ Prior exposure to using computers (looking up labs results) ▪ One-on-one support during training ▪ Efficient workstation arrangements (no lines), quick responses (no log-in delays or slow screens)	▪ Most costly of technologies (development and design, training, implementation) ▪ Physician resistance (acceptance, training) ▪ Maximum effectiveness achieved only if linked to other information systems (lab, pharmacy)	Because of significant financial and manpower resources required to adopt and support this technology, CPOE would not be recommended as a "first step."
2. Order document management system	Transcribing (12%)	▪ Enhances visual quality of a written order through reverse imaging, enlargement (scanning) ▪ Reduces errors associated	▪ Used in conjunction with pharmacy information system	▪ Value to hospital difficult to quantify and therefore difficult to justify expense	▪ This technology can reduce errors by improving workflow efficiencies. ▪ An order document management system would

Technology	Medication Errors Prevented (% of Errors)	How Medication Safety Is Promoted	Success Factors	Barriers to Implementation	Recommendations
2. Order document manage-ment system *(cont'd.)*		with delays in turnaround time (electronic transmission) ▪ Reduces disruptions in medication delivery processes due to decreased phone calls regarding status and location of orders			not be recommended as a primary solution, but one that can enhance the functionality of a pharmacy information system. It can be viewed as an interim step towards CPOE.
3. Pharmacy information system	Prescribing (order processing and verification), transcribing (51%)	▪ Verifies prescribed orders for accuracy and appropriatene ss during the order entry process ▪ Applies checks against these orders for patient allergies, potential drug-drug interactions, dose ranges, and duplicate therapies ▪ Can alert clinicians to potential adverse drug events ▪ Can drive data used by other applications (nursing point-of-care,	▪ Extensive experience with its use ▪ Commonly found in hospital pharmacies ▪ Pharmacy users are familiar with using technology for day-to-day operations	▪ Many systems are used primarily for patient charge capture, with clinical functionality taking a back seat. ▪ Replacement of pharmacy systems may be the only solution to improving clinical functionality. ▪ Critical patient information fields (allergies, height, weight) frequently are not completed due to inaccessibility or unavail-ability of information, thus reducing	▪ A "first step" is to implement a pharmacy system with clinical checks and alerts if such a system is lacking. ▪ Those with system should upgrade as needed to achieve optimal clinical functionality (could be as easy as "turning on" an alert function). ▪ It is also useful to interface or link pharmacy and laboratory information systems to improve access to information

Technology	Medication Errors Prevented (% of Errors)	How Medication Safety Is Promoted	Success Factors	Barriers to Implementation	Recommendations
3. Pharmacy information system *(cont'd.)*		automated dispensing devices, electronic MARs)		the effective-ness of these systems.	critical to assessing dosing ap-propriateness.
4. Robots, automated carts and cabinets, bar coding	Dispensing (11%)	▪ Robots can reduce errors associated with dispensing, especially in high-volume settings. ▪ Automated dispensing devices (carts, cabinets) can restrict access to medications on a patient-specific basis and only upon order verification by the pharmacist. ▪ Bar coding technology is used in conjunction with the above devices to help ensure correct drug is dispensed to correct patient.	▪ Appropriate checks are in place to ensure that additional errors are not introduced through the use of automation. ▪ Access to medications in automated dispensing devices is also regulated to conform with recognized safety procedures (e.g., look-alike and sound-alike drugs, "high-risk" drugs).	▪ Devices are expensive to purchase or lease. ▪ They require adequate space. ▪ Without proper checks, they can actually introduce medication errors. ▪ These technologies, including the use of bar coding, are susceptible to "workarounds" and overrides. ▪ Automated dispensing devices can be accessed without a pharmacy-verified order (through an override). ▪ The majority of unit-dose packaged drugs are not bar coded.	▪ Robots rely upon the use of bar coding technology and therefore cannot be recommended as a first step due to the resources required to create that technology for a hospital pharmacy. ▪ Automated dispensing devices are most effective if linked to a pharmacy information system that regulates access to the medications based upon a verified order. In the absence of that link, these devices have primarily been used to prevent drug diversion. ▪ Automated carts and cabinets are best reserved as a modular step to a pharmacy information system if appropriately restricted.

Technology	Medication Errors Prevented (% of Errors)	How Medication Safety Is Promoted	Success Factors	Barriers to Implementation	Recommendations
5. Electronic MAR, electronic clinical documentation, and bar coding scanners	Medication administration (38%)	▪ Provides nurses with access to medication information at the bedside or at the time a medication is selected from an automated dispensing device. ▪ Records medication administration times and clinical documentation electronically, making it easily accessible to clinicians. ▪ Uses bar coding technology to check accuracy of patient, drug, dose, route, and administration time.	▪ Extensive staff training on all shifts ▪ Developed in-house expertise on use of technology ▪ Provided computer classes to new computer users ▪ Conducted training as close to "go-live" date as possible to prevent memory decay ▪ During implementation phase, incorporated new technology with clinical processes	▪ Technology not widely implemented, even within hospital sites ▪ Same bar coding limitations as described above – workarounds, drug packaging. ▪ Hardware limitations – ease of use, visual "real estate" ▪ Requires radio frequency to be "real time" ▪ Medication safety enhanced only if connected downstream (in the medication use process) to a pharmacy information system or CPOE	▪ This technology is very promising and has the potential to impact another step of the medication use process at which errors occur frequently (and without the benefits of another check before the drug is administered). ▪ However, the technology has not been widely implemented and experience, although growing, is still somewhat limited. ▪ Hardware issues and limitations around bar coding suggest that this technology is best reserved as a "next step" for hospitals that have fully developed their pharmacy information systems.

Technology	Medication Errors Prevented (% of Errors)	How Medication Safety Is Promoted	Success Factors	Barriers to Implementation	Recommendations
6. Computer-ized ADE reporting	Addresses deficiencies in monitoring and reporting of events	▪ Efforts are being made by commercial vendors (software products) and hospital organizations (clinical data repositories) to capture this information in a single database. ▪ There is a movement towards sharing data rather than "building silos of information within organizations." For example, hospital systems are looking to benchmark data within individual hospitals and among multiple sites.	▪ "User friendly" reporting that encourages participation ▪ Standardized reporting format ▪ Capabilities for trending and analysis of data to facilitate system changes	▪ Underreporting (e.g., fear of punishment) ▪ Lack of standardiza-tion in the definition and reporting of errors	▪ At a minimum, hospitals should have a non-punitive, multi-disciplinary approach to collecting, reporting, and analyzing ADEs for purposes of identifying root cause and trends.

Tool #7

Needs Assessment and Product Evaluation

This table is intended to help the hospital assess its needs (i.e., features that are "must have" versus "nice to have") and evaluate the capabilities of competing products. It can be used by a medication error prevention implementation team that is charged with (1) determining the hospital's priorities for interventions to prevent medication errors and (2) selecting vendor products that can meet those needs.

This template should be used in conjunction with Tools 2 - 4, which are designed to help the hospital categorize and quantify its medication errors and establish its needs for a medication error prevention system.

Summary of Features

Based on a thorough assessment of the medication use process, check those features that are most important for addressing the high-priority needs of the hospital. Then use this summary of features to evaluate each vendor's products.

Features	Feature is Required	Feature is Optional	Rating (1-3)* 1 = meets needs 2 = partially meets needs 3 = will not meet needs		
			Available from Vendor 1	Available from Vendor 2	Available from Vendor 3
Computer Physician Order Entry System					
▪ ***General Operational Features***					
Allows interface with ADT system to autofill patient information fields (e.g., date of birth, hospital identification number)					
Requires physician identification check with password before allowing access to system					
Allows for preliminary order entry (e.g., by medical student, verbal order given to nurse or pharmacist) with co-signature ability					
Requires patient age/date of birth and gender before allowing medication order input					
Requires entry of allergies (or NKDA) before allowing medication order input					
Customizability of software (update of tables versus need for hard-coded changes)					
Allows interface with Pharmacy Systems					

Features	Feature is Required	Feature is Optional	Rating (1-3)* 1 = meets needs 2 = partially meets needs 3 = will not meet needs Available from Vendor 1	Available from Vendor 2	Available from Vendor 3
Computer Physician Order Entry System *(cont'd.)*					
▪ ***General Operational Features*** *(cont'd.)*					
Allows interface with Nursing Systems					
Allows interface with Lab Systems					
Allows interface with Radiology Systems					
Allows interface with hospital e-mail (to allow messaging to physicians from pharmacists, nurses)					
Wireless or remote access					
Customizability of software allows for maintenance at hospital site (i.e., basic changes do not require hard-programming)					
▪ ***Physician Order Entry Features***					
Calculates body surface area (BSA) based upon entered height, weight					
Structured individual medication order entry (requires entry of all medication order parameters necessary for a complete order)					
Allows pre-defined order entry (e.g., autofills field with hospital standards, such as concentrations of IV fluids)					
Structured order set order entry (e.g., allows defined order sets by physician, service, disease state, drug use protocol, etc.)					
Allows ordering of labs					
Allows ordering of radiology or other diagnostic tests					
Allows free text entries/comments area					

Features	Feature is Required	Feature is Optional	Rating (1-3)* 1 = meets needs 2 = partially meets needs 3 = will not meet needs Available from Vendor 1	Available from Vendor 2	Available from Vendor 3
Computer Physician Order Entry System *(cont'd.)*					
▪ ***Physician Order Entry Features*** *(cont'd.)*					
Allows interface to interactive clinical rules tables for display during order entry ▪ Drug specific alerts (e.g., "Black box" contraindications, pregnancy/lactation warnings, geriatric use warnings) ▪ Drug/lab (organ system impairment) checks/alerts ▪ Drug allergy checks/alerts ▪ Duplicate therapy checks/alerts ▪ Drug/disease or condition checks/alerts ▪ Drug/drug interaction checks/alerts ▪ Dose range (dose, frequency, duration, cumulative dose) checks/alerts ▪ Drug/ food interaction checks/alerts					
Simple ("one key") order renewal entry					
Simple ("one key stroke") order hold/ discontinuation entry					
▪ ***Information/Knowledge Features***					
Access to hospital's care protocols (e.g., clinical protocols by disease state, service, etc.)					
Access to drug monographs/drug use guidelines					
Transcription/Verification System					
▪ ***Process Features***					
Allows direct transmission of physician order to pharmacy (without re-copying order)					
Allows enhancement of transmitted order (e.g., technology allows enlargement of transmitted order)					

Features	Feature is Required	Feature is Optional	Rating (1-3)* 1 = meets needs 2 = partially meets needs 3 = will not meet needs		
			Available from Vendor 1	**Available from Vendor 2**	**Available from Vendor 3**
Transcription/Verification System *(cont'd.)*					
▪ ***Process Features*** *(cont'd.)*					
Allows direct transmission of physician order to nursing system (kardex or MAR) (without re-copying order)					
(see also Pharmacy Systems)					
Pharmacy Systems					
▪ ***Process Features***					
Allows interface with ADT system to autofill patient information fields (e.g., date of birth, hospital identification number)					
Requires pharmacist/technician identification check before allowing access to system					
Requires patient age/date of birth and gender before allowing medication order input					
Requires entry of allergies (or NKDA) before allowing medication order input					
Allows interface with CPOE System					
Allows interface with Nursing System					
Allows interface with Lab System					
Allows interface with Radiology System					
Allows interface with Hospital Finance/Cost Accounting Systems					
Allows interface with hospital e-mail (to allow messaging between pharmacists, physicians. and nurses)					
Wireless access (e.g., pharmacist can enter orders using handheld device)					
Generates hospital-defined labels (e.g., I.V. labels), medication "fill lists," and medication administration records					

Features	Feature is Required	Feature is Optional	Rating (1-3)* 1 = meets needs 2 = partially meets needs 3 = will not meet needs Available from Vendor 1	Available from Vendor 2	Available from Vendor 3
Pharmacy Systems *(cont'd.)*					
▪ ***Process Features*** *(cont'd.)*					
Updates inventory levels					
Generates drug utilization, revenue, and workload statistics					
"Clinical module": allows free text (e.g., as used to track clinical interventions, notes regarding patient clinical status, notes regarding ADEs, pharmacokinetics, etc.)					
Customizability of software (update of tables versus need for hard-coded changes)					
▪ ***Order Verification and Dispensing Features***					
Calculates body surface area (BSA) based upon entered height, weight					
Structured individual medication order entry (requires entry of all medication order parameters necessary to dispensing a medication)					
Allows pre-defined order entry (e.g., minimum keystrokes to autofill fields for common medication orders)					
Structured order set order entry (e.g., allows defined order sets by physician, service, disease state, drug use protocol, etc.)					
Allows viewing of key lab results without accessing separate system (i.e., do not need to exit pharmacy system to enter lab system)					
Provides dose calculation checks (e.g., IV drip rates based on drug concentration and prescribed dose)					
Allows interface to interactive clinical rules tables for display during order entry					
▪ Drug specific alerts (e.g., "Black box" contraindications, pregnancy/lactation warnings, geriatric use warnings)					

Features	Feature is Required	Feature is Optional	Rating (1-3)* 1 = meets needs 2 = partially meets needs 3 = will not meet needs Available from Vendor 1	Available from Vendor 2	Available from Vendor 3
Pharmacy Systems *(cont'd.)*					
▪ ***Order Verification and Dispensing Features*** *(cont'd.)*					
▪ Drug/lab (organ system impairment) checks/alerts					
▪ Drug allergy checks/alerts					
▪ Duplicate therapy checks/alerts					
▪ Drug/disease or condition checks/alerts					
▪ Drug/drug interaction or IV compatibility checks/alerts					
▪ Dose range (dose, frequency, duration, cumulative dose) checks/alerts					
▪ Drug/ food interaction checks/alerts					
▪ Drug standardization prompts/alerts (i.e., alerts pharmacists to approved "standards" for medication use)					
Simple ("one key") order renewal entry					
Simple ("one key stroke") order hold/discontinuation entry					
Interfaces to industry – leading automated dispensing devices ▪ Robotics/Drug Picking/Cart Fill ▪ Packaging/drug bar coding ▪ Automated dispensing devices (e.g., restricted access drug cabinets in nursing units)					
▪ ***Information/Knowledge Features***					
Access to hospital's care protocols (e.g., clinical protocols by disease state, service, etc.)					
Access to drug monographs/drug use guidelines					

Features	Feature is Required	Feature is Optional	Rating (1-3)* 1 = meets needs 2 = partially meets needs 3 = will not meet needs Available from Vendor 1	Available from Vendor 2	Available from Vendor 3
Pharmacy Systems *(cont'd.)*					
▪ ***Information/Knowledge Features*** *(cont'd.)*					
Access to patient education materials (for printing for medication counseling)					
Nursing Systems					
▪ ***Process Features***					
Allows interface with ADT system to autofill patient information fields (e.g., date of birth, hospital identification number)					
Requires nurse identification check before allowing access to system					
Allows interface with CPOE System					
Allows interface with Pharmacy System					
Allows interface with Lab System					
Allows interface with Radiology System					
Allows interface with Hospital Finance/Cost Accounting Systems					
Allows interface with hospital e-mail (to allow messaging between nurses and physicians, pharmacists, and other health care providers)					
Wireless access (e.g., nurse can enter data using handheld device)					
"Clinical module": allows free text for nursing notes and/or pre-defined notes based on service type (e.g., pediatrics, oncology, surgery, obstetrical care, etc.)					
"Workload module": allows for nurse-specific generation of "to do" lists, patient assignments					
Customizability of software (update of tables versus need for hard-coded changes)					

Features	Feature is Required	Feature is Optional	Rating (1-3)* 1 = meets needs 2 = partially meets needs 3 = will not meet needs Available from Vendor 1	Available from Vendor 2	Available from Vendor 3
Nursing Systems *(cont'd.)*					
▪ ***Medication Administration Features***					
Calculates body surface area (BSA) based upon entered height, weight (as needed for nursing "double checks" of selected medications, e.g., chemotherapy)					
Allows generation of medication administration records (usually from interface with pharmacy system and standardized hospital medication administration schedules); MAR must meet hospital and accreditation standards					
Allows viewing of key lab results without accessing separate system (i.e., do not need to exit nursing system to enter lab system to check on parameters before administering a medication)					
Provides dose calculation checks (e.g., IV drip rates based on drug concentration and prescribed dose)					
Allows interface to interactive clinical rules tables for display on "to do" lists or on medication administration record, etc.					
▪ Drug administration protocols (e.g., prompts for pre-medication with certain medications, other administration standards)					
▪ Drug specific alerts (e.g., "Black box" contraindications, pregnancy/lactation warnings, geriatric use warnings)					
▪ Drug/lab (organ system impairment) checks/alerts					
▪ Drug allergy checks/alerts					
▪ Duplicate therapy checks/alerts					
▪ Drug/disease or condition checks/alerts					

Features	Feature is Required	Feature is Optional	Rating (1-3)* 1 = meets needs 2 = partially meets needs 3 = will not meet needs Available from Vendor 1	Available from Vendor 2	Available from Vendor 3
Nursing Systems *(cont'd.)*					
▪ ***Medication Administration Features*** *(cont'd.)*					
▪ Drug/drug interaction or IV compatibility checks/alerts					
▪ Dose range (dose, frequency, duration, cumulative dose) checks/alerts					
▪ Drug/ food interaction checks/alerts					
▪ Missed dose prompts/alerts					
Allows electronic medication administration documentation					
▪ Interface with bar coded technologies (identify patient, drug, dose, route, time)					
▪ Allow comments regarding refused doses, administration parameters (e.g., vital signs) and PRN parameters					
▪ ***Information/Knowledge Features***					
Access to hospital's care protocols (e.g., clinical protocols by disease state, service, etc.)					
Access to drug monographs/drug use guidelines					
Access to "sound-alike" drug references					
Access to patient education materials (for printing for medication counseling)					
Medication Dispensing Devices					
▪ ***Process Features***					
Allows interface with CPOE System					
Allows interface with Pharmacy System					
Allows interface with Nursing System					
▪ ***Medication Access Features***					
Dispensing device is "fixed" (cannot be easily moved)					

Features	Feature is Required	Feature is Optional	Rating (1-3)* 1 = meets needs 2 = partially meets needs 3 = will not meet needs		
			Available from Vendor 1	**Available from Vendor 2**	**Available from Vendor 3**
Medication Dispensing Devices *(cont'd.)*					
▪ ***Medication Access Features*** *(cont'd.)*					
Dispensing device is "mobile" (can be easily moved)					
Dispensing device allows access to only one medication at a time (e.g., as needed for narcotic control)					
Dispensing device has a flexible divider system					
Dispensing device can be over-ridden without an order					
Dispensing device only allows access with an order					
Bar Code Technology Devices					
▪ ***Bar Coding Features***					
Has capabilities of providing the "5 Rights" checks					
Can generate bar codes/bar coded labels					
Can be easily programmed to read bar codes					
Has easily maintainable bar code library ("bar code specimen management")					

*Based upon vendor description and/or (preferably) demonstration of product

Tool #8

Request for Proposal (RFP) Template

Company Profile

(Information about the vendor to help you evaluate stability, experience, and service.)

1. Stability

- Information on parent company and affiliations
- Years in operation, company headquarters, and other locations
- Financial statements for the past 2 years
- Business partners, alliances
- Plans for acquisitions or divestitures

2. Experience and performance

- Experience in health care and with the specific product(s)
- Number of sites (and number of users) in which specific product is implemented
- Current users and contact names, ability to conduct site visits
- Ratings information (e.g., KLAS IT performance ratings)
- Accreditation by professional organizations (e.g., NIDSEC, NCPDP)

3. Services

- Training support
  - Method (e.g., on-site, "train the trainer")
  - Materials – hard copy, on-line, videos
  - Trainers – who and how many
  - Duration of support
  - Expectation of hospital personnel involvement
- Implementation
  - Personnel involved and number
  - Location of personnel during implementation process, how accessed
  - Support documents (e.g., implementation guide, tools)
  - Assistance with preparing database (e.g., file building, data conversion)
  - Expectation of hospital personnel involvement
- Technical support
  - Internal versus outsourced
  - Average response time
  - Coverage and how accessed
  - Correlation of problem severity to service level
  - Documented service level agreements
  - Access to tracking reports for problems and updates
  - Expectation of hospital personnel involvement

3. **Services** *(cont'd.)*
   - Application services
     - Management: network, database, hardware, project
     - Hosting: remote, Internet and Intranet

4. **Costs**
   - Software license (e.g., fee schedule, fee determinations)
   - Hardware
   - Installation
   - Interfaces
   - Data conversions
   - Training/implementation/consulting

Product Technologies Evaluation

(Information about overall technological characteristics)

1. **Age**
   - Age of technology
   - Age of application code and relationship to technology

2. **Technological Platform**
   - Common, acquired, licensed, or interfaced
   - Configuration - fault tolerant, scalable, scale limitations

3. **Application Devices**
   - Device-dependency – handheld devices, terminals, laptops, printers
   - Ergonomic design
   - LCD legibility

4. **Networking**
   - Requirements, options (e.g., radio frequency)

5. **Data Storage**
   - Capacity
   - Conversions

6. **Modularity/Interfaces**
   - Product modularity
   - Product interface capabilities
     - Database interfaces
     - Data mapping
     - Impact on software functionality
     - Information sharing
   - Experience with writing interfaces with legacy systems and devices

7. System Integrity
- Responsiveness and performance
- Reliability and accuracy
- Flexibility
- Frequency of system outages
- HIPAA compliance
- HL7 compliance – degree
- Current claims standards compliance

8. Disaster Recovery
- Data storage redundancy (e.g., disk mirroring)
- Power redundancy
- Documented procedures for "manual" operation

9. Security/Patient Confidentiality
- User sign-on procedures – single or multiple
- Management of information to ensure patient confidentiality
- Safeguards for security
- Current and future methods for user verification (e.g., biometrics, voice recognition, retinal scans)

10. Customization
- Process for developing user-defined clinical rules (e.g., alerts, reminders, protocols, guidelines)
- Availability of "defaults" or vendor-developed clinical rules

11. Regulatory Compliance
- Standards with which compliance has been established
- Ability to produce required documentation

12. Upgrades
- Anticipated "next release"
- Support for upgrades (e.g., software, operating systems)

13. Physical Plant Requirements
- Site preparation and requirements (e.g., space, cabinetry, power, ventilation)

Tool #9

Estimated Cost Savings Worksheet

The purpose of this worksheet is to guide the hospital in calculating the potential savings resulting from the implementation of technology to reduce medication errors. The amount of savings will vary, depending on organizational characteristics and the technologies under consideration. Suggested users include senior management and department leaders involved with product evaluation, selection, and purchase.

The results of this worksheet can help to direct the hospital toward technologies that offer the most value for the organization in terms of medication safety and financial return. Sources of information would include the results of the organizational assessment and IT vendors. Sample calculations are provided as a guide for the user; please substitute organization-specific data as available.

Estimated Cost Savings Worksheet

A. Estimated Annual Hospital Costs Related to Preventable Adverse Drug Events (ADEs)		
	Example	**Actual**
1. Number of hospital admissions (per year)	10,000	
2. Estimated number of total preventable ADEs (per year)[i]	140	
3. Estimated hospital costs attributed to preventable ADEs (per event)[ii]	x $ 5,000	
4. Total annual costs related to preventable ADEs (A2 x A3):	$ 700,000	
B. Estimated Annual Costs for Technology		
1. Software license fee (perpetual license, one-time fee) [iii]		
2. Monthly support fees		
3. Hardware costs		
4. Installation fee (for hardware) [iii]		
5. Implementation/consulting costs for system configuration [iii]		
6. Training and implementation (staffing) [iii]	+	
7. Total costs for technology (sum B1 – B6)		

more >>>

[i] An ADE is defined as an injury resulting from medical intervention related to a drug. According to the National Coordinating Council for Medication Error Reporting and Prevention (NCCMERP), "a medication error is any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the health care professional, patient, or consumer." In other words, not every medication error results in an adverse outcome. In studies, incidence rates of ADEs have varied from 2 per 100 admissions to 7 per 100 admissions. Approximately 28% of ADEs are preventable (i.e., multiply total ADEs by a factor of 0.28). The sample calculation uses 5 ADEs per 100 admissions, so ([10,000÷100] x 5 x .28) = 140. (See: Bates D, Cullen D, Laird N. Incidence of adverse drug events and potential adverse drug events: implications for prevention. JAMA 1995;274:29-34.)

[ii] In a large tertiary care hospital in 1993, an average increased cost of $4,685 was attributed to preventable ADEs occurring after admission. Costs may be substantially different based upon patient acuity, region, hospital size, ADE type, etc. [See: Bates DW, Spell N, Cullen DJ, et al. The costs of adverse drug events in hospitalized patients. Adverse drug events prevention group. JAMA 1997;277:307-311.] The example was rounded up to $5,000.

[iii] These costs will be incurred within the first year and will need to be allocated over several years.

C. Estimated Annual Cost Avoidance Using Technology to Address Medication Errors		
	Example	**Actual**
1. Preventable ADEs due to prescribing and transcribing (e.g., CPOE, pharmacy information system) = (51%) x (A4)[iv]	$ 357,000	
a. Preventable ADEs due to transcribing (e.g., order management imaging system) = (12%) x (A4)[v]	$ 84,000	
2. Preventable ADEs due to dispensing (e.g., robotics, automated carts) = (11%) x (A4)[vi]	$ 77,000	
3. Preventable ADEs due to administration (e.g., nursing point-of-care systems) = (38%) x (A4)[vii]	$ 266,000	
4. Total cost savings (C1 + C2 + C3)[viii]	$ 700,000	
D. Estimated Cost Avoidance Using Technology to Address Medication Errors		
C4 – B7		

[iv] Cost avoidance based upon a combined 51% of errors occurring at the prescribing and transcribing steps of the medication use process.

[v] Cost avoidance based upon 12% of errors occurring at the transcribing step of the medication use process.

[vi] Cost avoidance based upon 11% of errors occurring at the dispensing step of the medication use process.

[vii] Cost avoidance based upon 38% of errors occurring at the administering step of the medication use process.

[viii] Cost savings and true financial impact on the organization will vary depending on terms of payments (e.g., capitated versus per diem rates), fixed costs, etc.

Tool #10

An Example of the Implementation Process