Optimizing the medication use process

Proceedings from the April 2008 Interdisciplinary Conference

Improving clinical, operational and financial performance

CareFusion

Executive summary

Patient and medication safety is federally mandated and must be a priority for everyone.[1-3]

The requirements of the Centers for Medicaid and Medicare Services (CMS)[2] and the National Quality Forum (NQF)-endorsed report "Safe Practices for Better Health Care" thrust governance leaders into a major new role in which they are vulnerable and accountable to identify and mitigate patient safety risks and hazards.[3] A single-minded focus on safety and quality can also generate extraordinary financial results.[4-6] To help hospitals achieve these goals, an invitational conference brought together nationally recognized experts to focus on "optimizing the medication use process."[7]

Presentations included the following key points:

- Drug distribution—how a medication gets to a patient unit, then to a nurse and ultimately to a patient—needs to be a critical focus of a hospital's strategic plan. Drug distribution models need to be developed that will bridge the gaps, stop the fragmentation that frustrates nurses every day and provide efficiency, safety and effectiveness for both pharmaceutical and nursing care.
- At the University of Pittsburgh Medical Center (UPMC) a medication-safety strategic plan includes evidence-based drug-use initiatives; controlling drug availability or access; new or revised protocols and procedures; a unit-based pharmacist model; technology such as barcodes, automated dispensing cabinets (ADCs) and intelligent infusion systems (smart pumps); staff education; a web-based error reporting system; standard preprinted order sets/protocols; computer alerts and electronic documentation. The position of medication safety pharmacist was established to focus initiatives and resources for significant improvements in patient safety outcomes.
- At Brigham and Women's Hospital (BWH) the ideal standard for technology includes computerized prescriber order entry (CPOE), ADCs, smart pumps, electronic medication administration records (eMAR), barcoding, a robust pharmacy information system and a pervasive wireless environment so that all clinicians can access real-time information they can act on immediately.
- In 2007, more than 94% of larger hospitals used automated dispensing cabinets (ADCs) as a primary dispensing model or as part of a hybrid model in which some doses are stocked in ADCs and some in patient-specific cassettes filled by central pharmacy and dispensed to patient care areas.[8] The biggest advantage of ADCs is that pharmacist-reviewed orders are immediately available. A five-year forecast indicates that hybrid model use will grow perhaps 16% to 17%, especially among larger hospitals.[8]
- Nurses who have good, safe medication practice find that medication safety technologies supplement their workflow.
- Knowledge management—providing the right data, information, knowledge and executive- and clinical-decision support—is essential to optimize not only medication safety but also efficiency, costs and consistency of care.
- Optimizing the medication use process requires a hospital environment that promotes safe practice and safe care; a well-defined, well-documented strategic plan for safety technologies; support from senior executive, medical staff, pharmacy and nursing leadership; strong nursing-pharmacy collaboration and a strong partnership with the information systems department.
- Collaboration with industry partners, who have more data than academic organizations and can see emerging patterns, will allow the development of next-generation devices and technologies.
- Technology needs to be driven by ideal practice and will never replace clinicians' critical thinking skills. Continuous improvement and data management are ongoing. The allocation of sufficient resources is critical to maintaining an optimized system.

Hospital governance, chief executive officers and senior leadership

Patient and medication safety is an increasingly important issue that affects not only patients but also hospital trustees, chief executive officers (CEOs) and senior leadership. Government agencies, the media, the public and payers increasingly scrutinize hospital performance. The Centers for Medicare and Medicaid Services (CMS) have established Conditions of Participation (CoP) and Conditions for Coverage (CfC) as minimum standards that providers and suppliers must meet to become Medicare and Medicaid certified[1] and have identified hospital-acquired conditions such as poor glycemic control and deep vein thrombosis for which hospitals will not be paid.[2] The updated National Quality Forum (NQF)-endorsed "Safe Practices for Better Health Care"[3] can be used as measures by any agency and thus constitute a federal mandate for hospitals. In an era of pay-for-performance (P4P), ensuring patient safety is not only the right thing to do—it is the right thing to do to get paid.

The NQF-endorsed report thrusts governance leaders into a major new role in which they are vulnerable and accountable to identify and mitigate risks and hazards (Practice 1).[3] Governance and senior leadership need to become aware of performance gaps, be directly and personally accountable for them and invest resources and capacity to take explicit actions to close those gaps. Pharmacy, nursing and safety leaders, including a dedicated patient or medication safety officer, can become a hospital's "Chief Revenue Preservation Officers."

The heparin-related infant deaths in Indiana, California and Texas provide vivid examples of how lapses in patient safety, particularly high-risk medication errors, can have devastating impact on patients, families, staff and the reputation of a healthcare institution and its leadership.

Ultimately medication errors, lack of productivity and less-than-optimal care are the result not of individual error but of medication management system flaws. Hospital leadership owns the system.

A single-minded focus on safety and quality can also generate extraordinary financial results.[4-6] Safety and quality can be strategic differentiators and deliver to the bottom line. Optimizing the safety, efficacy and productivity of the medication use process is key to patient care and institutional sustainability.

To help hospitals achieve these goals, CareFusion hosted an invitational conference to bring together nationally recognized experts to focus on "optimizing the medication use process".[7] This document summarizes the following reports:

- A critical look at the often overlooked "gray" area between dispensing and administration.
- A case study of the University of Pittsburgh Medical Center (UPMC) medication safety strategy and infrastructure, including the newly created position of Pharmacy Manager, Medication Patient Safety.
- A case study of use of automation and technology at Brigham and Women's Hospital (BWH) to reduce medication errors and improve patient safety.
- A review of how information, knowledge and analytics can be used to help achieve continuous improvement of the medication use process.

More detailed information can be found in the Microsoft PowerPoint presentations available at carefusion.com/clinicalcenter.

Medication distribution systems

More than merely identifying errors, efforts to improve medication safety must focus on preventing harm. 38% of all medication errors occur during administration, 98% of which reach the patient and cause 51% of drug-related patient harm[9].

The need for greater safety at the point of care is obvious. Not as well understood is the need to address the gray area of drug distribution—how a medication gets to a patient unit, then to a nurse and ultimately to a patient. This is where processes fragment and efficiency suffers. Often there is no clear answer as to who is responsible.

Almost 27% of a nurse's time is spent giving medications.[10] To minimize time spent on non-value-added tasks, nurses basically need the following: a simplified process in which medications are readily available when needed and can be found in a single location, preferably as close to the patient as possible; patient-specific doses, so that medications do not

require further manipulation to obtain the final dose; and most importantly, a reliable, accurate distribution process that supports patient safety.

In the 1960s, typically one nurse was assigned to obtain and administer medications to patients, and drug distribution mostly meant floor stock. When team nursing and unit-dose dispensing began in the 1970s, a "medication nurse" was given a cart to fill with drugs and push to patients' rooms. When primary nursing began in the 1980s, nurses were asked to do much more decision-making at the bedside. A nurse now shared a cart with all the other nurses and used so-called "nurse servers," locked cabinets that stored medications and other supplies in each patient room. During the 1980s, ADCs were introduced. Over the next several decades, ADC safeguards were added, including clinical decision support, alerts, user reports and a profiling system that added another layer of safety checks.

Many of today's pharmacy graduates are clinical specialists and may divide their time between rounds in the clinical areas and traditional dispensing activities. More than a task, medication administration is viewed by nurses as an opportunity to assess a patient's response to the current ordered treatment and to evaluate a drug's clinical effectiveness. Drug distribution models have mainly been designed to meet pharmacy's needs and often are not congruent with nursing care delivery models. Historically, the nursing profession has not done a good job articulating which drug distribution model should be employed in order to maximize the safety, efficacy and efficiency of medication administration. Now, more than ever, it is important that drug distribution and nursing care delivery models be integrated to optimize the medication use process for pharmacists, nurses and patients.

The drug distribution models currently used are discussed below; advantages and disadvantages of each are summarized in Table 1.

- ***Centralized drug distribution.*** This model includes floor stock, medication cart fill and nurse servers. While reliance on floor stock has decreased over time, it is still found in places such as radiology, endoscopy and dialysis.
- ***Decentralized drug distribution.*** Satellite pharmacists were popular in the 1980s and 1990s, especially with pharmacists and nurses. However, they were resource-intensive and their use has declined. The percent of all hospitals using ADCs as their primary model has increased dramatically from 20% in 1999[8] to 56% in 2007[8] and 80% in 2008.[11] The biggest advantage of ADCs is that pharmacist-reviewed orders are immediately available, greatly reducing turnaround time.
- ***Hybrid drug distribution.*** This model combines cassettes filled by central pharmacies for patient-specific doses and ADCs for first doses, PRN drugs, narcotics, etc. Medication carts have returned with various additions such as a computer, barcode, locked drawers and patient-specific doses.

In 2007, 94% of larger hospitals used ADCs, either as a primary dispensing model or as part of a hybrid system. About 60% use medication carts. A five-year forecast indicates that the hybrid model will grow rapidly, perhaps a 16% to 17% increase, especially among larger hospitals.[8]

Strategic planning considerations

The gray area of drug distribution needs to be a critical focus in a hospital's strategic plan to bridge the gaps, stop the fragmentation that frustrates nurses every day and move to much broader thinking around the medication use process. For example:

- Does one distribution model better support the medication administration process? If so, which one(s)?
- Will the same model meet the needs for efficiency, safety and effectiveness for both pharmaceutical and nursing care?
- If not, what distribution model needs to be developed to support the nurse on the front line?

For any distribution model, medication administration and pharmacy dispensing models must be integrated. Executives, administrators and staff can no longer function in parallel silos. Nursing and pharmacy clearly impact one another in providing highest quality, safest and most effective and cost-effective care. Optimizing the medication use process must encompass and serve both disciplines.

Table 1. Advantages and disadvantages of drug distribution models

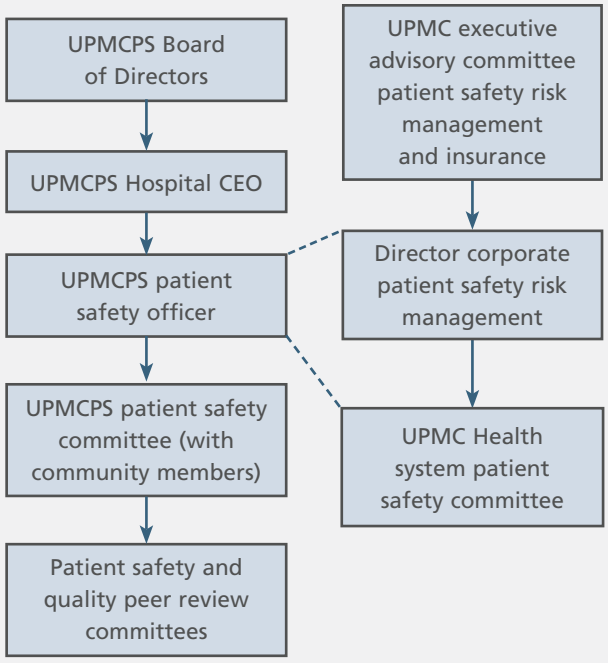
	Centralized distribution	Decentralized distribution	Hybrid
Advantages	• Capability to provide patient-specific medications • Capability to provide labeled patient cassettes • Potential to be closer to the point of care • Limited amount of medication available (reducing waste and error potential)	• Immediate availability of pharmacist-reviewed orders • Reduced turnaround time • Improved charge capture • Automatic inventory control (ADCs) • Potential to limit access • Fewer missing medications • Discontinued medications less available • Primary ADC distribution: – Improved drug security – Potential for segregation of product – Eliminate need to credit doses – Can be configured so practioners can have separate secure access – Borrowing less prevalent	• Dependent on the degree to which hybridization has occurred and how technology has been utilized to impact the system
Disadvantages	• Issues with drug turnaround time • Getting new medications to the unit and to the right cassette drawer • Missing medications (borrowed?) • Lack of medication segregation • Not all medications can be stored in the cart (refrigerated; large-volume IVs) • Patient drawer size • Nurses need to share access • Discontinued medications still available for administration (leads to "stashes") • Decreased drug security • Pharmacists needed to credit unused doses • Access by other practitioners	• Primary ADC distribution: – Many practitioners needing access to the same cabinet – Need for multiple cabinets in some locations – Cost – Need for duplicate inventories – Not all medications can be stored in the cabinet (refrigerated; large-volume infusions); selection – Potential drawer configuration – Less integrated into nursing workflow	• Could have the best (or worst) of both worlds

Medication safety: organizational infrastructure and strategy UPMC

UPMC is one of the largest non-profit organizations in the country. Twenty hospitals dispense almost 13 million medication doses a year. The UPMC culture of patient safety emphasizes collaborative clinical partnerships, so that physicians, nurses, pharmacists, other staff and patients will be able to communicate their issues or concerns. Error cases are used as educational tools and a blame-free culture promotes medication error reporting. The patient safety infrastructure at one of the UPMC hospitals is shown in Figure 1. The Board of Directors gives authority to the hospital CEO, and each of the health system hospitals has a patient safety officer.

Hospital data are used to determine medication error causes and assess severity. Safety improvement efforts concentrate on eliminating root causes of medication errors with greater levels of or potential for severity or patient harm.

Figure 1. UPMC Presbyterian Shadyside* patient safety infrastructure



* One of the UPMC hospitals

Interventions are monitored and lessons learned shared with the appropriate leaders and committees and communicated throughout the organization. The position of medication safety pharmacist was established in 2001 to address the organization's need for direct pharmacist involvement in patient safety.

A multidisciplinary team identifies solutions to minimize or eliminate recognized risks and develops a medication safety strategic plan with specific proposals and time line. The plan is used to guide decisions, set the vision for the coming years and integrate ways to improve medication safety. Interventions include evidence-based drug-use initiatives, new or revised protocols and procedures, a unit-based pharmacist model, technology such as barcodes, automated dispensing cabinets (ADCs) and smart pumps, staff education, a web-based error reporting system, standard preprinted order sets/protocols, computer alerts, controlling drug availability or access and electronic documentation.

Lessons learned

- A systematic, strategic and collaborative approach to preventing medication errors must be an organizational imperative.
- A successful strategic plan for medication safety must incorporate effective use of hospital and department data, be supported by a more-than-adequate safety infrastructure and embrace a culture of "no blame" in reporting and analyzing medication errors.
- Staff must feel comfortable in questioning unsafe orders or situations.
- A pharmacy director plays a key role in the development and implementation of a strategic plan by providing expert advice on medication errors and by supporting an open environment in a pharmacy department.
- A pharmacist position dedicated to medication safety can provide focus and resources to make significant improvements in the organization's patient safety outcomes and ensure that pharmacists are considered key safety leaders in the organization.

Brigham and Women's Hospital (BWH): using automation and technology to reduce medication errors and improve patient safety

BWH is a 755-bed, academic, tertiary-care medical center with 45,000 admissions annually, 2,500 nurses and 85 full-time equivalent (FTE) pharmacists. Approximately 6 million doses are dispensed annually. Optimization of the medication use process began with the development of a strategic plan focused on safe medication administration. The goal is to reduce medication errors and increase patient safety by enabling care providers to make more informed decisions during the medication use process.

Re-engineering the entire medication use process required software, hardware and "peopleware." Technology does not replace the critical thinking skills of clinicians. Education, teamwork training, user feedback, a robust medication safety improvement team, pharmacists on nursing units and a dedicated medication safety officer (MSO) pharmacist are key elements in the BWH system. The BWH Medication Safety Committee, co-chaired by a pharmacist and nurse and staffed by the MSO, does surveillance and tracking, investigates every adverse drug event (ADE) and medication error, evaluates data trending and reviews high-risk medications and utilization of Institute for Safe Medication Practices (ISMP) alerts.

Feedback on "good catches," e.g., an insulin infusion inadvertently programmed for 505 units/hr instead of the intended 5.5 units/hr, can convince staff of the importance of using the safety technologies.

Nurses who have good, safe medication practice find that medication safety technology supplements their workflow. Nurses who take shortcuts and do not follow good practice find technology burdensome because it forces them to take the required steps.

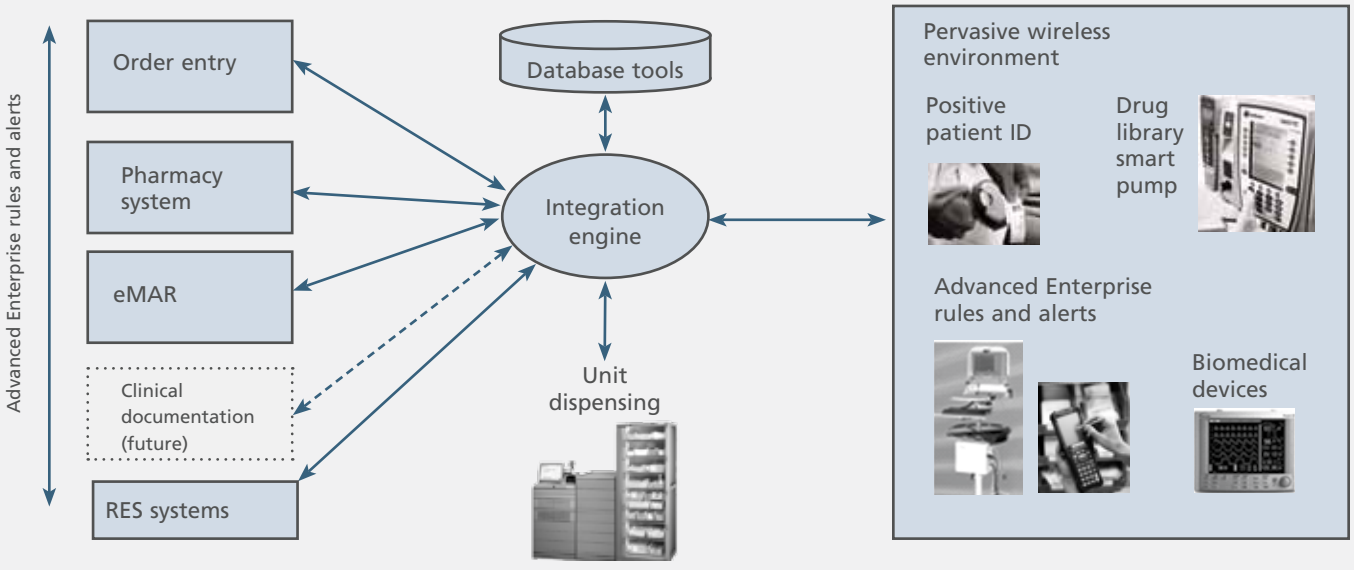
Ideal standard

The ideal standard for technology includes computerized prescriber order entry (CPOE), ADCs, smart pumps, electronic medication administration records (eMAR), barcoding and a robust pharmacy information system. Each of these technologies has its positive impacts and areas of concern (see carefusion.com/clinicalcenter for details). No technology can be the only tool necessary. For example, CPOE may not solve problems that may exist in other processes such as dispensing, administering and monitoring.

A long-term goal at BWH is to create the pervasive wireless environment illustrated in Figure 2, so that all clinicians can access real-time information they can act on immediately. Connectivity is also essential for technology integration, common data sets and models, intuitive outputs, mobility and enterprise-wide clinical-decision support.

Figure 2. Pervasive wireless environment

Integration, common date sets and models, intuitive outputs, mobility and enterprise–wide clinical–decision support are all key components to a successful medication administration process.



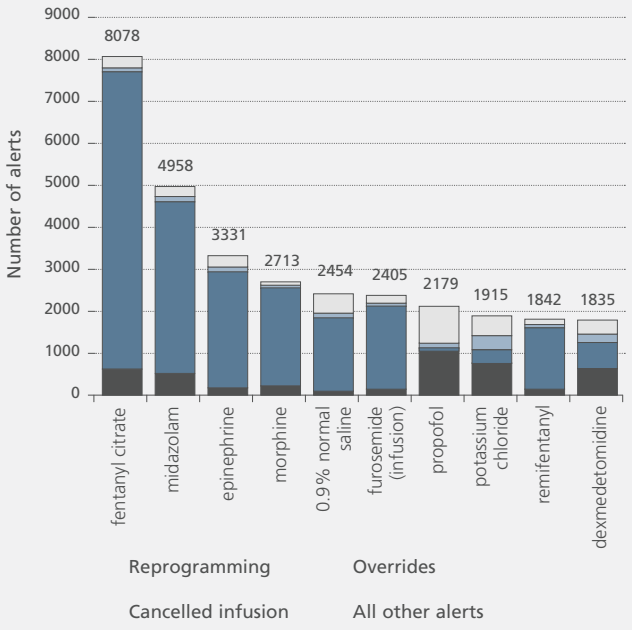
Multiple systems help prevent errors. For example, an incorrect chemotherapy order goes through the order review process without the pharmacist or the nurse picking up the error. The product is prepared, sent to the patient care unit and programmed into the smart pump for delivery to the patient. The smart pump drug library averts the error. In this example two verification processes failed and the third system check caught the error.

Data generated by medication safety technologies are used to measure results of safety improvement initiatives and target areas for further efforts. Annual results for various technologies at BWH are shown in Table 2 and Figures 3 and 4.[12]

Table 2. Brigham and Women's Hospital: eMAR Error prevention data

February 2008	
Total patients	4,617
Total administrations	398,504
Wrong drug intercepted	5,824
Wrong patient intercepted	137
Expired medications intercepted	314

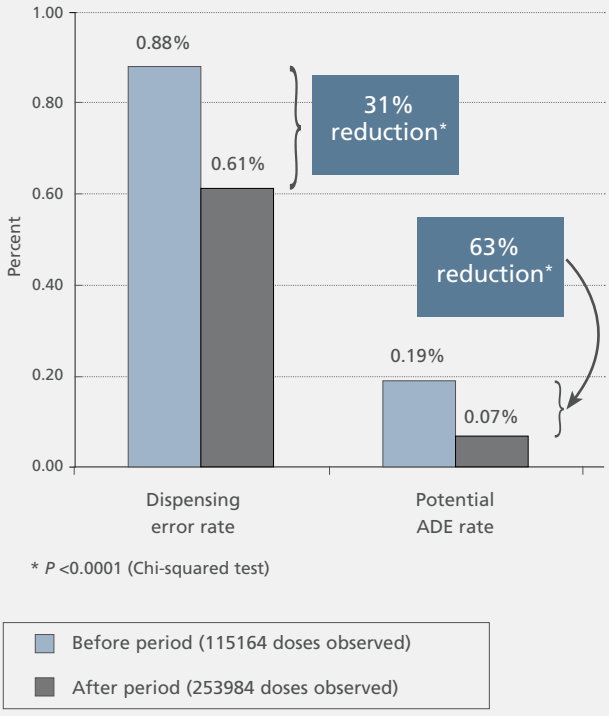
Figure 3. Smart pump CQI data—actions taken on alerts



It is important to remember that no one intervention (barcode, eMAR, CPOE, automation, etc.) will solve all problems in the medication administration system. A multi-faceted approach is needed to address all levels of the system.

Technology needs to be driven by ideal practice. Everyone needs to understand that technology will never replace clinicians' critical thinking skills. Human factors play a key role in acceptance, and end-user feedback is essential to design, implement and maintain technology. Most of all, the work never ends; continuous improvement and data management are ongoing. Finally, the allocation of sufficient resources is critical to maintaining an optimized system.

Figure 4. Dispensing errors and potential ADEs: Before and after barcode technology implementation[12]



Projected errors prevented per year:

- **>13,500 medication dispensing errors**
- **> 6,000 potential ADEs**

Data, information and analytics for executive– and clinical–decision support

Medication safety technologies generate huge amounts of data. Turning those data into information and then into knowledge that C-suite executives, clinicians, risk managers and CQI teams can use easily and efficiently is critically important. Trustees need to hold the leadership of an organization accountable for producing the kind of data that are necessary to answer questions about patient safety.

Hospital information systems need to analyze and present data to quickly answer a user's critical questions and not cause "data overload." There should be easy access to key performance indicators (KPIs) focused on performance and outcomes. Clinicians need the right information at the right time for the right patient at the right place in the workflow without "alert fatigue."

Maintaining and updating the various information systems is challenging but essential to improving patient safety, the top issue for hospitals in 2008![13] Improving medication safety is key to achieving that goal. Knowledge management—providing the right data, information, knowledge and executive- and clinical-decision support—is essential to optimize not only medication safety but also efficiency, costs and consistency of care.

Knowledge management

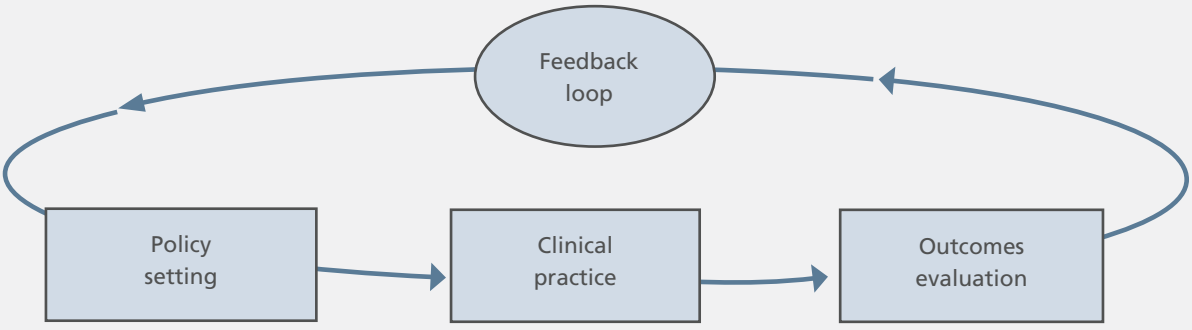
Figure 5 shows a knowledge management model that most hospitals are trying to use. It is recommended that a multidisciplinary team is created to review the process and that this should include a patient—a stakeholder often missing from the process. Establishing baseline performance can show how day-to-day workflow may deviate from best practice.

Table 3 shows key steps involved in the implementation of knowledge management. The need to include governance refers to the pharmacy and therapeutics (P&T) committee and to broader governance at the hospital level.

Table 3. Key technology implementation steps

- Identify stakeholders in the medication usage process early on
  - Multidisciplinary team
- Examine sources of information that you have
- Establish your processes
  - What is your baseline performance?
- Think about governance
  - Who and what?
- Where do you want to be
  - Key goals? CPOE? Knowledge management tool for all assets? Barcoding?

Figure 5. Knowledge management model



- Define performance metrics to monitor
- Set standards
  - Formulary
  - Alerts
  - Guidelines

- Prompt
- Decision support
- Critique and alert

- Compliance review
- Utilization review
- Performance evaluation

Focus: Safety, efficacy, costs, resources, consistency of care.

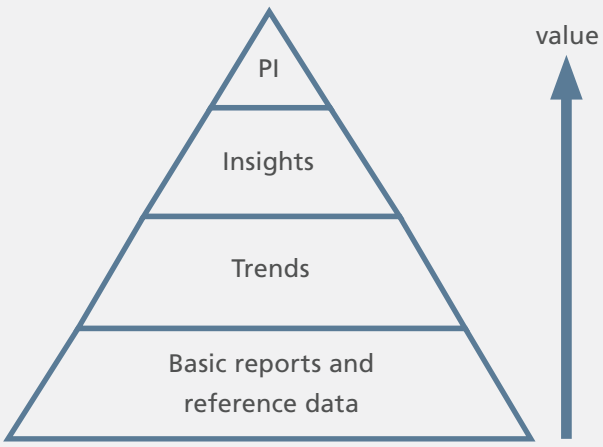
After the development of key goals, prioritization is one of the hardest steps. Based on experience at various institutions, the team recommended narrowing efforts to no more than five key priorities. Getting buy-in from all stakeholders is essential. Testing the feedback loop is important during roll-out.

Clinicians do not browse through information when they need it at the point of care. They have a question, and they go into the information to find the answer. To meet this need, drug information resource icons were put on eMAR screens. If a patient needs a certain drug, a nurse can click on the icon and be launched directly to that drug's dosing and administration information. Nurses quickly realized that they could get information at their fingertips. The right information was available at the right time for the right patient at the right place in the workflow.

The knowledge pyramid

To make information most useful, it needs to be pushed up the "knowledge pyramid" (Figure 6).

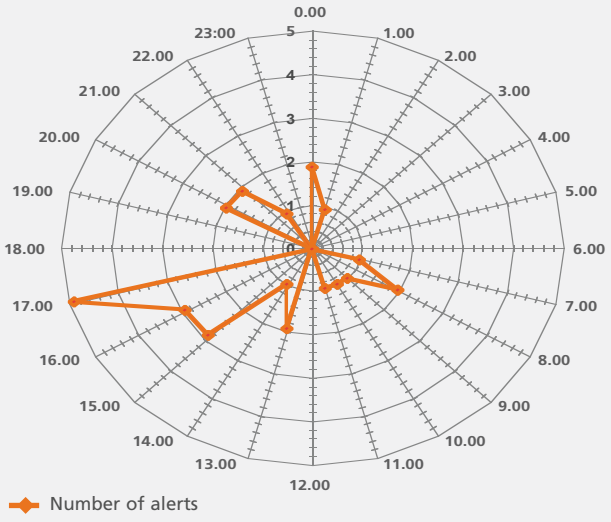
Figure 6. The knowledge pyramid



The top level of the knowledge pyramid enables performance improvement (PI) throughout the hospital. Basic reference information is combined with patient data, laboratory and testing results. That information is combined with order sets, rules and reminders within the workflow that prompt, advise and critique clinicians. Reaching this level requires integration of information from multiple systems from multiple vendors.

Results can be reported in a variety of formats. For example, a chronogram (Figure 7) can help identify end-of-shift as a time associated with significantly more medication-error alerts. Staggering events so they did not all occur at shift change greatly reduced errors. Aggregated data from hospitals nationwide can be used to benchmark performance.

Figure 7. Chronogram of alerts by time of day



Integrating and managing data from multiple systems is often challenging. For an average 300-bed hospital, keeping the data up-to-date requires an estimated five full-time employees.[14] Since information goes out of date, finding ways to track updates, e.g., expiration dates and versioning, is critical. In addition to having basic information, it is also important to know where the trends are going—better or worse.

Future developments

Management of the large amount of data made available by ADCs is moving toward a "dashboard" approach that filters information to generate key performance indicators (KPI) metrics. Cost savings, safety, regulatory compliance and other KPIs can be accessed quickly to assess hospital performance in these areas. A "traffic light" approach can use green, yellow or red icons to identify areas such as inventory shrinkage that have problems. A click on a "trend" hyperlink shows results over time. Filters allow users to start with top-level, broad information and then drill down as desired.

"Crosswalking" allows clinicians to move rapidly from one database to another, e.g., to go from the National Drug Code (NDC) indication of which disease a drug can treat to Systematized Nomenclature of Medicine (SNOMED) information on how to treat that disease, to Logical Observation Identifiers Names and Codes (LOINC®), which provide the laboratory results needed to monitor the drug's effects. The development of such semantic ties among information sets has begun, but much work is needed to complete the vocabularies and make them usable in day-to-day care.

To help optimize the medication use process, hospital staff needs to work with industry partners, who have more data than academic organizations and can see emerging patterns. While conflicts of interest need to be controlled, such collaboration will allow the development of next-generation devices and technologies.

Conference summary/ key points

- Patient and medication safety is now a federal mandate[1-3] and must be a priority for everyone.
- The NQF-endorsed report "Safe Practices for Better Health Care" thrusts governance leaders into a major new role in which they are vulnerable and accountable to identify and mitigate patient safety risks and hazards (Practice 1).[3]
- Ultimately medication errors, lack of productivity and less-than-optimal care are the result not of individual error but of medication management system flaws. Hospital leadership owns the system.
- Active, involved leadership from board members, CEO and other C-suite executives is essential to improve patient and medication safety.
- Collaboration across disciplines is vital for successfully implementing change.
- In an era of increasing transparency and P4P, pharmacy, nursing and patient safety leaders must become "Chief Revenue Preservation Officers."
- The percent of hospitals using ADCs as their primary model has increased from 20% in 1999[8] to 56% in 2007[8] to 80% in 2008.[11]
- Technologies alone do not prevent errors in medication administration. The hospital environment must promote safe practice and safe care.
- Nurses who have good, safe medication practice find that safety technologies supplement their work flow; nurses who take shortcuts find technology burdensome because it forces them to take the required steps.
- Adding value to the medication administration system requires a multi-faceted approach; there is no single panacea.
- Necessary components for success include a well-defined, well-documented medication safety strategic plan, leadership buy-in and support and Nursing-Pharmacy collaboration.
- To make information the most useful, it has to be pushed up the "knowledge pyramid" so that basic reference information is combined with patient data, laboratory and testing results, order sets, rules and reminders within the workflow that prompt, advise and critique clinicians.
- Ideal practice needs to drive technology, which will never replace clinicians' critical thinking skills. End-user feedback is essential, and continuous improvement and data management are ongoing. The allocation of sufficient resources is critical to maintaining an optimized system.

Speakers:

Anne Bane, *RN, MSN*
Manager, Clinical Systems Innovations
Brigham and Women's Hospital
Boston, MA

William W. Churchill, *MS, RPh*
Executive Director of Pharmacy Services
Brigham and Women's Hospital
Boston, MA

Charles Denham, *MD*
Chairman
Texas Medical Institute of Technology
Austin, TX

Marcy Draves, *RN, MSN*
Clinical Director
CareFusion
San Diego, CA

Joanne Kowiatek, *RPh, MPM*
Pharmacy Manager,
Medication Patient Safety
UPMC Presbyterian
Pittsburgh, PA

Carol Leighton, *MRPharmS, MBA*
Vice President, Data Analytics
Cardinal Health
San Diego, CA

Susan F. Paparella, *RN, MSN*
Vice President
Institute for Safe Medication Practices
Huntingdon Valley, PA

Peter Skarzynski
CEO
Strategos
Chicago, IL

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