

# Managing Clinical Safety Software Data: Proceedings of an Expert Roundtable

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Moderator: *Beth Wilson*

- **Medication Technology and Its Impact on Medication Errors**

Speaker: *Linda Morgan, RN*  
Consultant

At the time of the Webcast, Director of Operations, Erlanger Health System, Chattanooga, Tennessee

- **Safety Software for Medication Devices**

Speaker: *Burnis D. Breland, MS, PharmD, FASHP*  
Director of Pharmacy, Columbus Regional Healthcare System, Columbus, Georgia; Adjunct Professor of Pharmacy Practice, Auburn University Harrison School of Pharmacy, Auburn, Alabama

- **Impact of Medication Technology at Union Hospital**

Speaker: *Megan O. Finch, RN-BC, MS*  
Staff Development Specialist, Patient Education Specialist, Union Hospital, Terre Haute, Indiana



## ACCREDITATION

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## A Supplement to *Hospital Pharmacy Journal* **Managing Clinical Safety Software Data**

The “Clinical Data Analysis Roundtable” held earlier this year provided an opportunity for participants to meet with an expert panel to discuss issues and concerns about the use of medication technology—including wireless technology—for improving patient care, avoiding adverse drug events, and ensuring patient safety. This presentation offered a business case for the use of “intelligent” technology, including wireless intravenous infusion devices and barcoded medication administration systems, as well as demonstrating how participants can take a proactive, multidisciplinary approach in the planning, selection, implementation, and diffusion of medication technology to address potential errors.

### EDUCATIONAL OBJECTIVES

Upon completion of this program, participants should be able to:

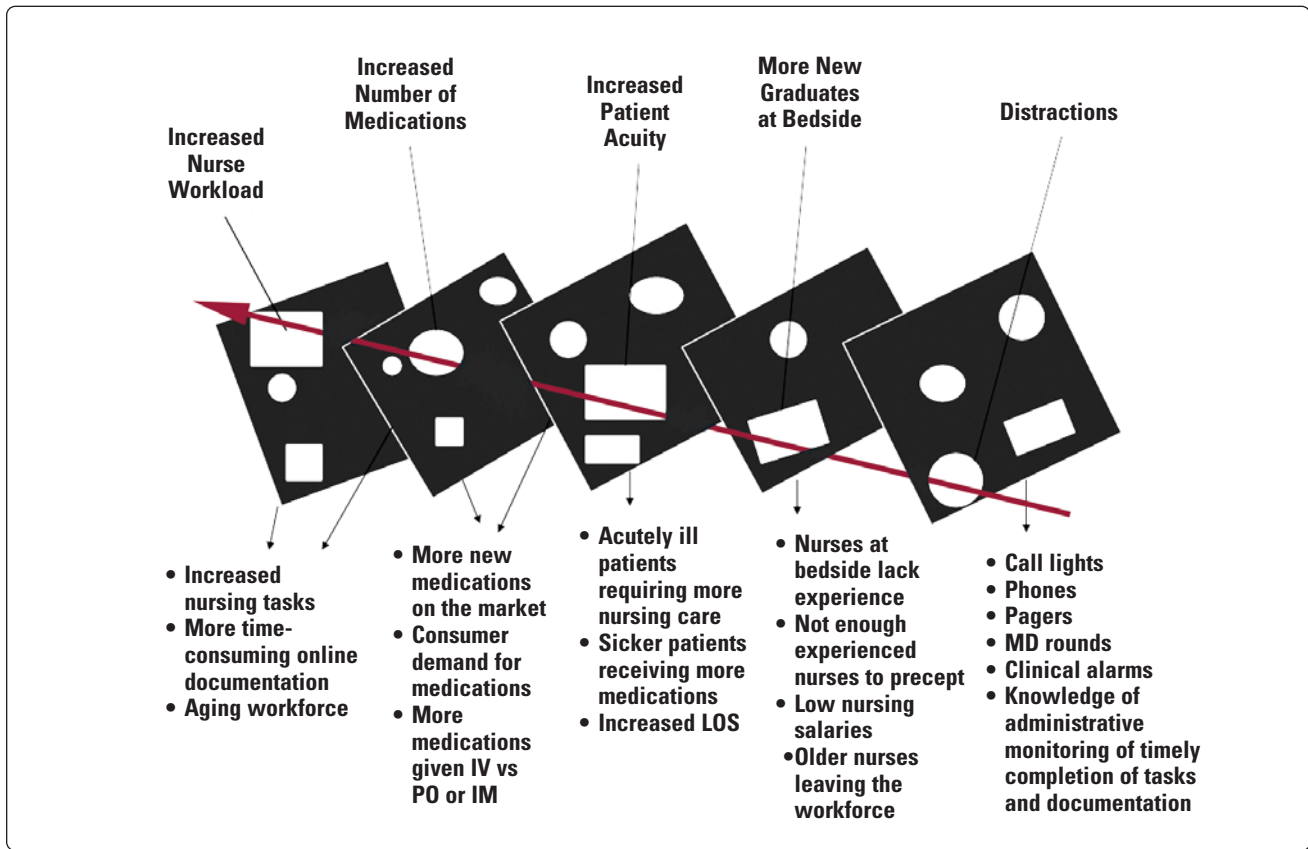
- Discuss how hospitals are using data to build a business case for high-technology devices that reflect a substantial return on investment based on cost savings and improved outcomes.
- Describe how hospitals are collecting real-time data that can provide clinicians with safety information on patients’ intravenous medication therapy.
- Develop a collaborative approach for implementation and maintenance of technology to improve patient care.

### MEDICATION TECHNOLOGY AND ITS IMPACT ON MEDICATION ERRORS

*Linda Morgan, RN*

#### Statistics

The Institute of Medicine (IOM) issued a report in 1999, *To Err is Human*, and the report showed that 44,000 to 98,000 deaths occur each year in the hospital environment and that this is the eighth leading cause of death—exceeding motor vehicle accidents, breast cancer, and acquired immunodeficiency syndrome (AIDS).<sup>1</sup> In addition to data given in this report, each year 770,000 patients are injured in a hospital environment<sup>2</sup>; there are at least 7,000 deaths<sup>2</sup>; and nearly 1 in every 5 drug doses administered in the typical hospital and skilled nursing facility results in a medication error.<sup>3</sup> Furthermore, a study by Barker et al. states that about 7% of the total errors made in the hospital environment will end in potential harm to the patient.<sup>4</sup>



**Figure 1.** The latent failure model of complex system failure: infusion errors. IM = intramuscular; IV = intravenous; LOS = length of stay; MD = physician; PO = oral.

Today's nurses work in a hectic environment. Nurses at the bedside are occupied with a tremendous number of duties, and they are surrounded by the sounds of alarms and the flashes of call lights. The nursing environment also is affected by an aging population, with sicker patients who require longer lengths of stay. Looking at this situation from a Reason's "Swiss cheese" standpoint (ie, when a series of factors line up and pass through "holes" in the process, an error will be made; see Figure 1)<sup>5</sup> leads to the conclusion that multiple factors contribute to medication errors in the hospital environment—errors that ultimately affect the patient. The technology discussed here can be likened to a small computer with built-in drug safety limits at each bedside, and those limits alert nurses if they are allowing practice outside their facility's defined safety limits. This technology is critical in supporting nurses in their error-prevention efforts as they deliver patient care.

Erlanger Health System began developing a medication safety plan several years ago. The organization wanted to implement intelligent general infusion, intelligent patient-controlled analgesia (PCA), and barcoded medication administration, as well as robotic barcoding

of medications in the pharmacy. Furthermore, they sought placement of only intelligent syringe pumps in the pediatric environment. Currently, approximately half of the pumps are intelligent and the rest are "stupid" (*stupid* meaning that they are without safety limits). Erlanger plans to replace those, with the goal of implementing 100% smart technology to increase error prevention and improve medication safety.

When looking to improve medication administration safety from a dollars-and-cents standpoint, about 56% of all drug errors are infusion errors<sup>6</sup> and each preventable error that takes place in the hospital environment adds about \$8,750 to the cost of a hospital stay (based on 2006 dollars reported by the IOM).<sup>5</sup> That translates into a total annual cost of \$3.5 billion, assuming that 400,000 of these preventable events happen each year and excluding lost wages or productivity.

### **A Business Case for Investing in Medication Safety Technology**

When building a business case for this kind of investment, it is important to look at more than one area of an organization. For instance, 542 PCA infu-

sions were done at Erlanger in June 2008; of those, there were 95 attempts to override the hard limit. The definition of a *hard-limit attempt* is any attempt to enter a rate over or under what has been deemed absolutely acceptable within the facility-defined drug library rule set. Keep in mind that these devices have built-in limits and alerts for nursing staff. Nurses at Erlanger attempted to override the safety limits set within the pumps 95 times, which was about 17.5% of the total infusions that were programmed within the pumps. Assuming that all 95 of those attempts would have resulted in adverse drug events (at a cost of \$8,750 per event—the 2006 cost for an adverse drug event as reported by the IOM), the total cost for the month of June is \$831,250. Annualizing that number leads to a total of \$9,975,000 for the year.

Another example of this can be observed with intelligent infusion data. The nursing staff at Erlanger did 47,192 infusions in June 2008. In that same period, there were 516 hard-limit-override attempts, about 1.09% of the total programs that were entered within the pumps. Assuming that all 516 of those attempts would have resulted in adverse drug events, the total cost for June is \$4,515,000.

A business case also can be made for barcoded medication administration. The nursing staff at Erlanger made 241,130 total scans (or transactions within the barcoded medication administration system) in June 2008. Put into perspective, the nurses were making 8,038 scans a day, or 335 scans an hour. If smart technology is not helping the nursing staff at the bedside, then this creates many opportunities for errors to reach patients. Of the total scans made at Erlanger in June 2008, 0.28% resulted in system overrides and 664 were wrong-patient scans. (The definition of a *wrong-patient scan* is any time that the barcode on the medication, the barcode on the patient's armband, and the screen or the computer medication administration record [MAR] do not match.) Again, assuming that all 664 of those wrong-patient scans would have resulted in adverse drug events, the total cost for June is \$5,810,000. Annualized, the total is \$69,720,000.

When barcoded medication administration was first implemented at Erlanger, overrides were approximately 3%; they are now approximately 1.6%. *Override* means that the 5 rights of drug administration at the bedside were not done within the system. (Staff may have completed them manually.)

In August 2005, compliance at Erlanger was about 48% using the safety software. A higher compliance rate was expected from the nursing staff to obtain the greatest safety benefits for the patients. Over the peri-

od from 2005 until now, many new procedures and processes have been put into place to increase compliance. Staff at Erlanger have celebrated their successes, even those that were not related to money. Continuing education was, and is, vital. This technology cannot be implemented and then run on autopilot.

To summarize the business case for medication technology at Erlanger, there were 95 PCA interventions, 516 infusion interceptions, and 664 incorrect barcoded medication administration scans in June 2008. Assuming that all 1,275 of those interventions and incorrect scans would have resulted in adverse drug events (at a cost of \$8,750 per event), the total cost for the month of June is \$11,156,250. Using the Barker et al. study,<sup>4</sup> which states that approximately 7% of the total errors will have caused potential harm to the patient, there is an interception cost savings of \$780,938—annualized as \$9,371,250. This provides a very strong business case for the technology.

### Return on Investment for Intelligent Infusion

A simple formula can be used to calculate return on investment (ROI). For example, if calculating ROI for the infusion device, the cost of (or lease on) the pumps, the cost of the software, and any costs for staff education should be plotted against what errors have been intercepted using that particular infusion device. Looking at this from Erlanger's perspective and using real data, the cost of the devices can be recouped in less than 3 months. Again, that is assuming that 7% of those total interceptions would have resulted in patient harm. The same formula can be used for PCA. Plotting the cost of the pumps, the software, the firmware for the wireless technology, and education against what has been saved intercepting potential errors, Erlanger data shows that costs for PCA devices can be recouped in approximately 8.5 months. Vendor and consultant fees and staff education costs (4 hours for nurses and 2.5 hours for respiratory therapists, using the average rate of pay) were included when calculating the ROI for barcoded medication administration at Erlanger. Calculations show that Erlanger can recoup the cost of its barcoded medication administration devices in less than 2 months.

### Summary

Medication safety technology reduces variation at the bedside or at the point of care, thus decreasing the chance for error; patients will undoubtedly be safer because of this technology.

Registered nurses (RNs), licensed practical nurses (LPNs), and respiratory therapists can and will adapt to using this technology, and they will wel-

come the hard and soft limits. For some time, nursing staff at Erlanger questioned data that they were given from the new technology, but wireless collection allows for objective, real-time data analysis that does not involve human error. The data must be shared with front-line staff, and it must be understandable and consistent. The technology can serve as a regular source of performance measurement for a future generation of nurses who want to know how they are performing. Furthermore, because of the benefits it offers nursing staff and considering the current shortage of nurses, this technology can be a valuable recruiting tool.

To facilitate nurses' understanding of this technology, Erlanger placed an intelligent infusion pump in its nursing schools. This gave incoming nursing students an opportunity to use the pump in the lab before entering the health system environment, which is another benefit to the organization.

Medication safety technology is costly, and its purchase requires careful planning within an organization's budget. Current statistics must be used to calculate ROI, which—as demonstrated earlier—clearly exists for this technology. Successful implementation of this technology requires a multidisciplinary approach from staff in all departments (eg, information technology [IT], pharmacy, nursing, biomedical).

*Editor's Note:* Please go to [www.hospitalpharmacyjournal.com](http://www.hospitalpharmacyjournal.com) to view the Webcast, which contains video of a visit with Linda Morgan at Erlanger Health System, as well as a visit with Florence Chang, chief information officer at MultiCare Health System in Tacoma, Washington. They discuss the important role that leaders play when investing in medication technology for patient safety.

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## **SAFETY SOFTWARE FOR MEDICATION DEVICES**

*Burnis D. Breland, MS, PharmD, FASHP*

New pumps have many capabilities and features that the older, “dumb” pumps do not. Smart pumps, or intelligent infusion devices, offer tools like “Tallman” lettering that allow setting of dosage limits for individual infusion lines so that concurrent infusions can run with safety limits in place. Drug libraries can be customized for meeting individual patient-care-area needs, and institutions can set up to 18 different clinical-care-area or patient-care-area libraries so that they can address individual patient populations, as well as meet the needs of individual staff. The user defines the limits for each medication, so the institution sets the soft and hard limits. The soft limits can be overridden but the hard limits

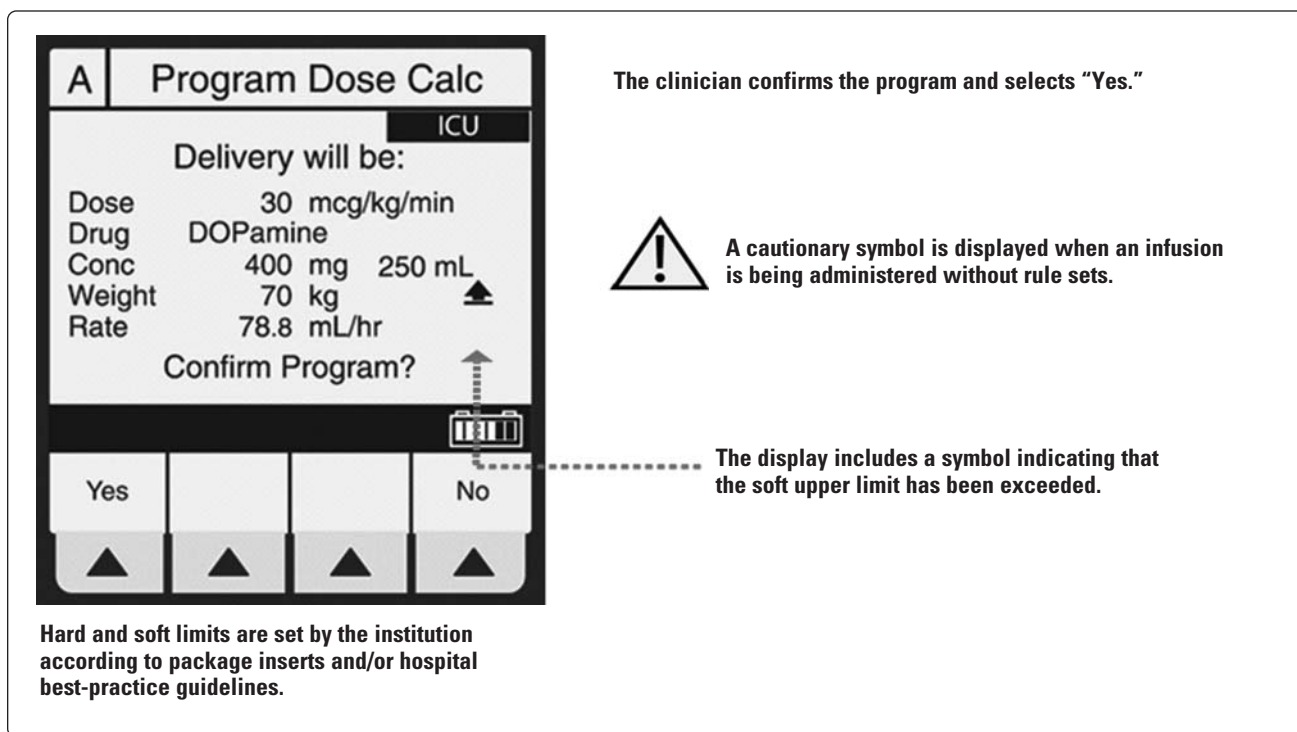
cannot, so the soft limits enable staff to know when practitioners need to override some of the limits.

As they look at the screen on a pump, clinicians are asked to select the right drug, the right dose, and the right infusion rate, and then they confirm that the entry is the correct medication and the correct rate (see Figure 2). The pump gives other information as well. Technology and equipment are not always programmed correctly, but if that is the case with this system, then an icon appears on the screen that indicates that the pump is operating outside the facility-defined safety limits. The screen may also display a symbol that indicates if the clinician is using the software above—or if the drug is being infused above—the soft upper limit. The hard and soft limits are set by the institution based on the medical literature, as well as the individual practices of the institution. Each organization and individual areas within each organization have different methods for programming, but the library can be set based on protocols that are used in individual areas or by looking at overall safety parameters and setting what is needed or standardizing as needed across the institution.

## **The Drug Library**

Understanding the options for building the drug library is very important. The library is designed so that an institution can assign full limit sets for each individual drug or so that they can do partial limit sets (or limited sets). If a relatively safe medication (eg, cefazolin) is given by intravenous infusion, it can be designated as having no limits but still should be labeled within the safety software. Defining the clinical care areas, as well as developing the library, is crucial. Institutions can use consolidated groupings, which Columbus Regional Healthcare System initially used when common medications were given. They also may use common medication practices or common medical/surgical areas, or they can tailor their libraries to individual patient care areas. The staff at Columbus moved from groupings to individual areas, which gave them the ability to customize libraries to those individual areas and to collect data that were unique to those areas. These data affect pharmacy and nursing departments, so they should be reviewed and used from the both the nursing perspective at front-line administration and the pharmacy perspective of what are, or what should be, the medication administration practices at the institution.

The library is the core intelligence base of the infusion device. It is extremely important that the library be built as thoughtfully, carefully, and precisely as possible, but improving the quality of the library is an ongoing process. Essential steps in



**Figure 2.** Delivery final confirmation screen as shown on a pump.

building the library include getting a template and consulting with other institutions about their safety limits. Another crucial step is getting an infusion device, using it, and understanding it. This will create an understanding of what front-line users will face as they try entering drugs that have a full rule set based on dosage, rather than just flow rates.

Understanding dose-versus-volume parameters is also vital. These can be set up in the system as doses over time (such as vancomycin 1 g over an hour), or they can be set up as flow rates for which standard concentrations are used for administration (such as levofloxacin over a 30-minute period). Institutions can customize these devices, but they must review the literature and determine and confirm the safety limits for individual drugs. Awareness of individual hospital practices that determine how drugs are being administered according to different protocols within the institution is essential.

Another point that pharmacy departments must keep in mind is recognizing how pharmacy practices will affect a nurse's ability to set a pump. For example, a loading dose of phenytoin is routinely administered. A staff member might load 1 g (1,000 mg) in 100 mL of normal saline, and the pharmacy may put a message on the label or the MAR that says to infuse over 20 to 30 minutes. However, if the soft upper limit is set at 25 mg/min, then that 20- to 30-minute infu-

sion will actually exceed the soft safety limit. Reviewing safety limits and pharmacy labels to make sure consistent practices are in place is important so that nurses are not confused. Getting input from all staff who are using or infusing medications—physicians, nurses, clinical pharmacists—in the patient care areas is crucial, but it is also important to recognize the protocols that might dictate administration practices. Staff and managers must recognize that building the drug library is an ongoing process that requires time spent checking and rechecking the system.

Maintaining the library should be viewed as a continuous quality improvement process. The pharmacy must routinely monitor the reports and review how drugs are being used in the institution. Medical, pharmacy, and nursing staff should want to improve the accuracy of the safety limits. Although they do not want to allow infusion of drugs that might cause patient harm, they also do not want inefficient, incorrectly set limits that require overrides. As mentioned earlier, nursing staff must have confidence in these devices, but they also should always use good clinical judgment in recognizing that a certain protocol does, or does not, make sense for a particular patient and condition. Because the safety limits cannot be perfectly set for each patient, the more time spent reviewing how drugs are used and reviewing the frequency of overrides, the better the limits will be.

Institutions should solicit recommendations from staff for library changes. At times nursing staff may tolerate the fact that the library is not set exactly as it should be, and they might not communicate that to the appropriate party. This information is needed so that the institution can address any concerns correctly. As changes are made to the library, the library has to be rolled out to the entire hospital. As mentioned earlier, the wireless system is the best option because within this system, all the pumps can be updated with library upgrades at once and in less than 10 minutes. Columbus updates their libraries about once a quarter. Oftentimes, new drugs come in or institutions may switch from one product to another, so maintaining the library and continually improving it is a necessary, ongoing process.

### **Reporting Function and Clinical Quality Reports**

There is a wealth of information in the clinical quality reports, so they must be reviewed and understood. The reports are an integral component of the patient safety program, and they can be used for identifying therapeutic trends—as found at Columbus when staff realized that they were often using nicardipine infusions in neurology patients. This revealed a whole new area of therapeutics of which they were previously unaware: the use of nicardipine as a preferred agent for acute blood pressure control in stroke patients. The reports can drive quality improvement initiatives; they can be used for standardizing infusion rates. Standardizing some medication (ie, potassium chloride) levels across patient safety areas is also a challenge because of safety concerns and the uniqueness of the infusion. It might be that staff are trying to standardize potassium infusion rates throughout the institution, which is very important because running a potassium infusion too fast may harm or even cause death to patients. Staff can monitor and measure the work they are completing with the changes that were made, then determine whether the changes were effective or if they caused other problems. The reports can also be used for monitoring compliance and improving the safety, as well as the operational efficiency, of the pumps.

There are several standard reports available. At Columbus, there are approximately 18 standard reports that are used, and different versions of those are pulled at different times. The Asset Tracker Report is useful for reviewing the number of pumps, which of those pumps are running, which library version is used by those pumps, if the pumps have the latest library version or not, and so on. Information regarding pump locations and where

pumps last were used also is available. However, the real heart of the clinical side of the process is using the report called the Override Variance (or Override Variance Detail) Report, which shows every time a safety limit was overridden, either lower or higher. That report gives the user knowledge of what really happens in the patient care areas. The Edit Variance Detail Report is also extremely important because it details critical catches made by the system. If staff wonder whether these devices truly make a difference, then this report can show them a situation in which someone entered “100 mL/h” but the entry should have been “10.” This reinforces how the technology is helping staff make a difference.

### **Improvement Through Data Analysis and Review**

The staff at Columbus want to improve patient safety outcomes by having a better-quality library. They want therapeutically accurate safety limits, but they also want operational efficiency with the limits set by the institution. Furthermore, they want to make sure that the process is working for front-line users, which encourages those users to use the technology to the best of its ability. There may be limits in the system set too low or too high, causing frequent overrides. At Columbus, prior to routine intravenous (IV)-pump use, staff frequently used the to-keep-open (TKO) rate to keep a vein open with minimum fluid volume, which might have been 40 mL/h. The new infusion devices are accurate down to very low flow rates, and nurses may decide that they only want to run keep-vein-open (KVO) infusions at 10 mL/h. Having an artificial soft limit at 40 mL/h does not make a difference, and it creates additional work for nurses, so Columbus recently changed that setting in their system.

In addition, the limits on an antibiotic that can be pushed (eg, cefazolin) may not need restriction, which may create an opportunity for a limited or unrestricted set. It should be noted that inappropriate safety limits can be very harmful; they may cause adverse reactions, toxicity, or underdosing issues. All health care professionals are familiar with how painful phenytoin can be, and it also can cause arrhythmias. Staff should not infuse more than 50 mg/min because doing so may cause harm. In the case of this product, an appropriate upper hard limit is necessary.

A good example of under- or overdosing can be observed with heparin infusion. If it is too low, the patient may not experience an anticoagulant effect; it may extend a blood clot or result in a pulmonary embolus. Going over the limit may result in a bleed. Thus, there is a therapeutic range that must be maintained. Another example that may be surprising is levofloxacin.

CCA: 8ICU		Override Variance Detail			
Medication/Concentration	Alert Date/Time	Limit	Limit Violated	Initial Dose	Final Dose
Nicardipine 25 mg/250 mL	04/13/2008 00:16:46	10 mg/h	↑ UPPER SOFT	12	12
Nicardipine 25 mg/250 mL	04/13/2008 00:39:21	10 mg/h	↑ UPPER SOFT	12	12
Nicardipine 25 mg/250 mL	04/13/2008 00:39:25	10 mg/h	↑ UPPER SOFT	12	12
Nicardipine 25 mg/250 mL	04/13/2008 00:39:43	10 mg/h	↑ UPPER SOFT	12	12
Nicardipine 25 mg/250 mL	04/13/2008 00:39:55	10 mg/h	↑ UPPER SOFT	15	15
Norepinephrine 8 mg/250 mL	04/09/2008 14:15:31	16 mcg/min	↑ UPPER SOFT	30	30
Norepinephrine 8 mg/250 mL	04/09/2008 14:28:09	16 mcg/min	↑ UPPER SOFT	40	40
Pip/Tazo (Zosyn) 3.375 g	04/10/2008 06:12:58	100 mL/h	↑ UPPER SOFT	150	150

**Figure 3. Override Variance Detail Report from Columbus Regional Healthcare System. CCA = clinical care area; ICU = intensive care unit; Pip/Tazo = piperacillin/tazobactam.**

This is an antibiotic that has a concentration-dependent effect rather than a time-dependent effect, so if the minimum serum concentration of the organism is not exceeded, then an antimicrobial effect will not be achieved. If infused too slowly, then peak levels will not be high enough and the needed effect may not be reached. At Columbus, rates are set at 250 mg of levofloxacin in 50 mL at 100 mL/h, 500 mg in 100 mL at 100 mL/h, and 750 mg in 150 mL at 100 mL/h so that it is not administered too quickly, which may create potential problems. However, the drug is kept within a defined time frame that will give the maximum therapeutic effect.

If infused too quickly, vancomycin can lead to Red Man syndrome. This drug may be set based on volume (if using a standard concentration) or set on dose. At Columbus, it is set on dose as 1 g/h, so it extends automatically depending on what dose is entered. This is an excellent example of a drug for which the safety limit must be set because of its significant clinical effect.

Another example of a drug that could cause an overdose if limits are not set appropriately is propofol. At Columbus, the upper soft limit was set at 100 mcg/kg/min, and there was no upper hard limit because staff were unsure of what it should be. The anesthesia department gave a ruling that said the upper hard limit would be 250 mcg/kg/min. When possible, it is imperative to place limits that protect patients, but deciding what those limits should be may take some time.

Figure 3 is an Override Variance Detail Report from one of Columbus's adult intensive care units. It shows drugs frequently overridden, demonstrating that sometimes it is correct to override. With a drug like nicardipine, which has a very narrow therapeutic window, the infusion may start at 10 mg/h but the maximum rate may be 15 mg/h. (Patients requiring infusion rates greater than 10 mg/h are not uncommon, but staff elected to keep the soft upper limit at 10 mg/h as a safety warning.) This leads staff

to wonder where limits can be set. At times it is necessary to exceed the limit—for example, with a patient on norepinephrine. The soft upper limit for this drug went from 16 to 20 mcg/min at Columbus. That does not mean the limit must be changed so as not to create more work. Staff must recognize that at times they may need to go over the soft upper limit.

Following are some specific examples from Columbus. These critical catches help reinforce use of this technology, as well as reinforcing to the staff the importance of the technology.

- In the emergency department (ED), there was an instance in which heparin was being dosed at a low rate. This occurred frequently within a narrow time frame, which prompted staff to take another look at what was happening. The issue was with neurology patients being seen in the ED; some were being started on only 600 or 700 units/h, which is very low and would normally be subtherapeutic. This demonstrates that what is found on these reports may actually cause staff to call into question the therapeutic practices in a certain area to make sure that they are appropriate.
- Propofol was initially entered as 500 mcg/kg/min when it was supposed to be 50 mcg/kg/min. The pump recognized this critical catch, and the clinician changed the dose.
- In the children's area, a potassium chloride infusion initially was entered as 200 mL/h, but it was supposed to be 20 mL/h. This was another catch made by the pump.
- In the critical care area at Columbus, heparin is used in 25,000 units per 250 mL, so it is 1,000 units/mL. In this case, the pump was originally set at 12. The user thought the rate was being set at 12 mL/h, which would have been correct, but in reality the parameters were set in units per hour. Thus, the user needed to enter 1,200 units rather than 12. When an alert sounded, the user saw the discrepancy and was able to correct it.
- When the technology was first implemented, there was not a lower limit set for heparin at Columbus, but eventually 700 units was selected. Prior to setting the lower limit, doses would be entered as 12.5 units/h, and nurses would think they were entering 12.5 mL/hr. Still, the error was not caught because a lower safety limit had not been defined. A lower soft limit, as well as a lower hard limit, was created to alert the user. This is another example of what can be learned from the reports.
- In the labor and delivery department, a pump was programmed for oxytocin administration at 56 mL/h when it should have been 6 mL/h.

Again, staff found that they needed to set a soft upper limit and a hard upper limit for oxytocin that were different than the limits set for oxytocin in the post-labor and delivery obstetrics unit.

Many institutions do not put in limits; perhaps they are not sure how to set them because they know there is wide variation. This should never be a reason for *not* trying to set limits. A user can always override the system by choosing “No Drug Selected” in an emergency situation, but limits should be set that encourage use of the pumps to their fullest capacity.

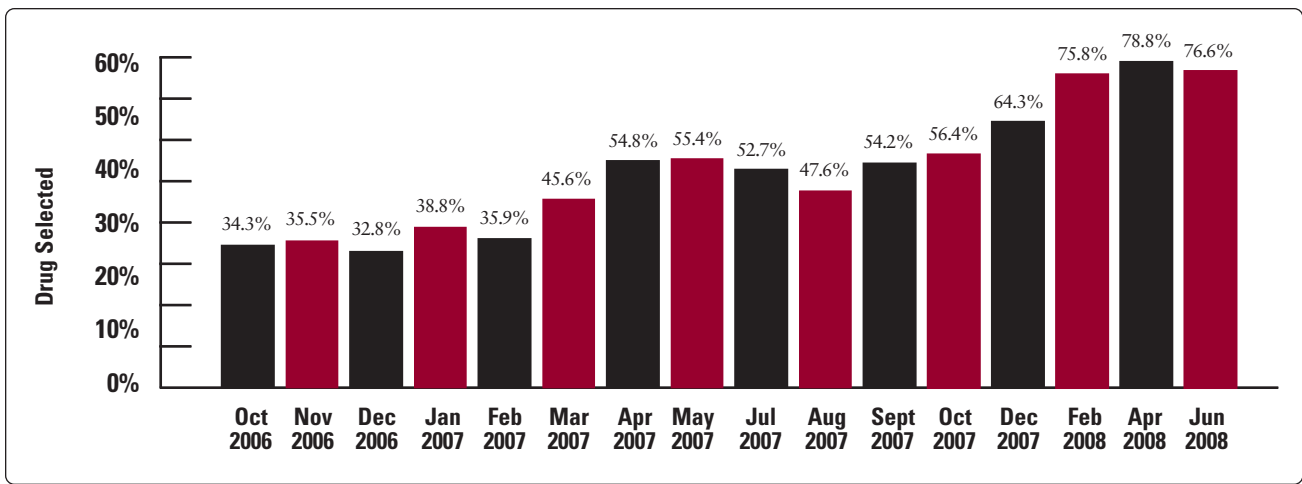
At Columbus, data from reports are transferred onto an *Excel* spreadsheet. When an issue is found that needs attention, staff with expertise in that area are asked to give feedback. This can lead to some serious, as well as practical, academic discussions as to what those limits should be. However, making a tool, as done with the spreadsheets, and using that tool will help an organization step through the process of improving their drug library.

### **Trend Reports and Drug Library Compliance**

Columbus has seen dramatic improvement in compliance. It started at approximately 34%, and Figure 4 shows that during that first year it moved up to approximately 54%. By the second year, staff had learned how to improve compliance, and currently it is at approximately 80%. Compliance within individual patient care areas was also reviewed, and the cancer center now has a 92% compliance rate, which is almost perfect for that area. The adult critical care areas have moved up to approximately 80% compliance. At times, a drug is not available from the library, and staff have to pick “No Drug Selected.” Use of that override method does affect these data. One hundred percent compliance may not be achievable, but reaching the 80% to 90% range is excellent.

There are several ways that Columbus achieved improvement. One was increasing the quality of the drug library. The library must be well maintained, or staff will not use it or they will use it inappropriately. Much time, hard work, and continued efforts are vital for improving the library. Beyond that, Columbus focused on high-risk medications and took a closer look at pumps that infused heparin, insulin, and so on, to drive compliance. Staff have also done rounding. They look at every pump that is infusing in a particular area to see which pumps are operating within the safety limits and which are not.

Columbus gives real-time feedback to their practitioners through audits. For example, Figure 5 shows a report given to nurses that breaks down which pump, which patient, which nurse, and what was going on. The real-time feedback helps drive healthy



**Figure 4. Drug library compliance at Columbus Regional Healthcare System, October 2006 to June 2008.**

competition, as well as confidence, so dramatic improvements have been observed within many different areas. Ultimately, the feedback leads to a collaborative approach and gets staff involved in the process.

**Summary**

This is valuable safety technology. If fiscal limitations have been set for select projects, I highly advocate using available resources on intelligent infusion devices. These devices make critical, lifesaving catches, and the difference that they can make has been observed at Columbus. These devices can improve the overall quality of the medication administration process through standardization. This technology improves the safety of the medication administration process when medications are administered via the most dangerous route (ie, IV directly into the bloodstream, bypassing all the natural barriers of the body), so focusing on the area that has the greatest impact on patients makes sense. These devices also allow for monitoring of the therapeutic use of drugs, especially the highest risk drugs; thus, staff can learn a lot about themselves by looking at reports generated from the system. Often it is difficult to monitor what occurs in an institution with regard to medication practices, and this technology helps staff see the process from a global and well-defined patient care area.

**IMPACT OF MEDICATION TECHNOLOGY AT UNION HOSPITAL**

*Megan O. Finch, RN-BC, MS*

Union Hospital is in the process of adding a large expansion, and we are continually evaluating our technology. Although the hospital had

been using smart-pump technology for 2 years, it upgraded to wireless technology in the Fall of 2006. We thought we were doing well because we had been using smart-pump technology for some time and our audits were at 90% compliance. However, our first electronic report in October 2006 showed only 34% compliance.

If implementing, or planning to implement, this technology, expectations may be that the initial scores with wireless reporting will mirror the scores calculated from looking at each pump individually and writing down the scores. Paper reporting is a snapshot in time. The biggest difference—and perhaps one of the strongest uses for this technology and these reports—is that data in the reports are in real time and shown over time, so they reflect complete practice. As of March 2008, Union is up to 82% compliance overall and continuing to improve. Keep in mind, this is the overall score, but reports are also run for each particular area. We have

**AUDIT**

**A random audit was conducted on Friday, March 28, 2008, at approximately 15:50 to determine compliance with the smart-pump drug library. The following infusion was found not utilizing the drug library:**

**Patient: XXXXXX**  
**Room 722-D**  
**Medication: TPN**  
**Nurse: John**

**Reason: Drug library was not set by the previous nurse (last name: Smith) before being passed off to him.**

**Figure 5. Random audit report from Columbus Regional Healthcare System showing real-time feedback. TPN = total parenteral nutrition solution.**

learned some things along the way that we wish we had known when we began this process. Perhaps our learning curve will help others who are just beginning to implement this technology.

### **Implementing New Technology**

When starting an implementation team, an organization must recognize that this truly is a collaborative process. There is no ownership of patient safety. The representatives who lead this project should be from IT, pharmacy, nursing, and education departments, and together they can set very clear and mutual expectations between those key groups. All departments must agree to meet those expectations and work together.

Patient safety is at the center of this process. Every staff member should see the reports and understand the importance of this technology, but this information is not just for the staff. The use of this technology should be shared and celebrated with patients, families, and the community so that they understand that their safety is of the highest importance when staff are employing these devices at the bedside. Furthermore, barriers to proper use must be identified, and they will come up continually. Anticipating everything that will happen when implementing new technology is impossible, so learn from each situation and move on. It is essential to plan interdisciplinary education as the institution moves into this multidimensional process so that members of nursing, pharmacy, materials management, and biomedical engineering are brought together for collaboration. Staff can learn from each other by sharing their experiences. Communication is key, as well as celebrating what is being done well.

To keep compliance moving forward at Union, we maintained our implementation team. In many cases, a team starts a project, hands it off, and disappears; and that is perfectly appropriate. However, in the case of this technology, the members of the implementation team are the key knowledge masters, and they have to stay involved. Union also acquired a number of staff nurses as resources because they see what is occurring at the bedside. We publish our reports house wide so that all staff members know what everybody else is doing, learning, and struggling with because that is how an organization improves. We also teach report reading as part of our orientation process for new employees in the involved departments. The smart-pump reports should not be understood only by management; these data also must be read and understood by staff who are using the equipment.

### **Areas of Improvement**

We have taken a few different steps in using this technology at Union. We are not just learning how to improve our library; we are also learning how to interface that with practice at the bedside. For instance, we track our high-risk medications. When evaluating insulin use at Union, a report was created that identified some unexpected patterns. Repeated instances were found of staff using a zero instead of a decimal point when programming or keying in the infusion rate. For example, if an infusion was meant to run at 7.2, the report showed “702” was the initial rate programmed before an edit. This was not isolated to one area, and the technology clearly prevented keystroke errors with insulin drips. As a result, we generated general insulin education, as well as remediation on programming the pumps. We also worked with the diabetes education team and used the report not just to create a snapshot of “What’s the pump doing?” but also “What can the pump tell us?” to improve the overall practice and knowledge at Union.

Another situation that we have addressed is one in which the drug needed was not in the library or could not be found. We wanted to engage the bedside staff in helping us improve the library, so an item called “Drug Not Listed,” which nurses could consciously select when they could not find what they were looking for, was added to the libraries. To make “Drug Not Listed” a tool rather than a crutch, it was required that the nurses communicate to their managers, the pharmacy leader, or the staff development specialist why they used that selection so that the following could be learned: Was the drug not there, and should it be added to the library? Or was the drug there and just not seen by the nurse? We have learned to use the data from the reports and to really look at what our nurses are doing as a means to educate them, learn from them, and expand the library based on that information. The “Drug Not Listed” entry has been a great help in improving the library, as well as an excellent educational tool.

With another report, Union reviews medications infused by clinical care area. This report allows tracking whether an area is starting to use a drug that is new to that area, which identifies an educational opportunity. We also look at medication selected by time of day, asking, “Do we have a pattern of edits, and how can we help with that?” These data are used to review practice, search for patterns, and create further educational opportunities.

Another important change was driven from Union’s staff level. The nurses at the bedside truly are the experts at comparing policies and processes

with what the drug library contains. The implementation team could sit around a table and say, “Oh, this makes sense,” but when staff nurses were asked about it, they would say, “Well, no, it doesn’t. We need to do *this*.” So we developed, at the encouragement of and with the ideas from our staff, a “Pump Patrol.” The Pump Patrol is very passionate about this technology. They have been selected by their managers, and they have taken on a role in identifying changes that can be made at Union to further improvements in practice that also improve safety.

The Pump Patrol identified a case in which the drug library listed a medication as a concentration for infusion in milliliters per hour, which did not match the weight-based routine order set. This prompted us to look at all of our routine order sets and compare them with the library, which is a good recommendation for an organization just starting out with this technology. This will save nursing staff time because an override will not be needed solely because of the way the library was constructed.

Another item that has been—and probably still is—a hot-button issue at Union is identifying a need for consistent practice when patients are transferred between clinical care areas. We asked, “Is your clinical care area a geographic location, or is it a patient-specific safety set?” and we decided what to do with the drug library if a patient was received to a unit. We also addressed situations in which patients were transferred between a medical/surgical area and critical care because the rule sets for critical care may allow for infusion of a drug at a higher rate than is allowed elsewhere. Keep in mind, this is a dynamic process—not just implementing and updating the library, but also use of the library. At Union, many of these decisions are made at the bedside-nurse level with manager approval. Our nursing staff decided that when they receive transfer patients, they want to review the infusions and change the clinical-care-area setting on receipt of the patient. That way the safety process automatically moves into their clinical care area.

We dealt with a similar situation in pediatrics. Union has a pediatric drug library and a clinical care area for pediatrics, but we were unsure of what to do if a child came into the ED. Do staff members place medications under “ED,” in which parameters are essentially for adults, or do they set them under “PEDS” because that suits the patient? The Pump Patrol evaluated the issue of clinical-care-area “geography” versus pediatric patient need. Now all pediatric patients, regardless of geography, have infusions evaluated against the pediatric drug library parameter.

Another issue that the Pump Patrol identified as

affecting nursing practice was that staff had to decide where starting the pump fits into the IV start policy. A difficult IV start may take several minutes, and nurses do not want to lose that line. Thus, some of our staff members would start the IV, start the pump, and then go back and program the library. Moving through the steps in this sequence allowed capture of a noncompliant program that affected overall scores but, in practice, was not incorrect. The policy was updated so that it included sequencing with pumps, and compliance was improved.

Any drug in the library that does not have limits shows as a noncompliant program and as not being in the drug library when reports are run, which is a concern that must be addressed. I strongly recommend limits of some type for every item in the library.

### Summary

Building an educational clinical care area in the library is essential. Management will find that the ownership goes to the nurses at the bedside and in the units, and staff members will know that every program reflects on their compliance. Staff do not want others interfering with the system, so creation of an educational clinical care area is important. Staff members must be taught how to read the reports; this information should not be kept secret. At Union, we have taken an extra step. I have been working with our unit managers to run selective reports, so if they want to look at a 2-hour window of time and I am not available to run the reports for them, progress does not stop. There are many great improvements that can be made with this technology, and staff, patients, and patient families need to know it.

### CONCLUSION

Implementing technology into the processes of an institution is a great step forward, but it is a procedure that requires change and staff must be prepared for that change. Management must approach the process with full and ongoing knowledge of their staff’s needs. From a pharmacy perspective, this technology gives institutions an opportunity to examine how medications are being administered—at what rates and at what doses—on the front line in practice, rather than in theory. This presents a real chance to improve the quality of therapy for and the clinical outcomes of patients. Errors are part of human nature, but this technology can support staff and give them the help needed to keep patients safe.

This technology is young and continuously evolving. Clinicians have only used it for a short time, and vendors are regularly making significant product improvements. New pumps with enhanced aesthetics

and usability are being introduced, and more useful reports are regularly created. Staff provide vendors with input for making improvements that will lead to more efficient technology with improved safety. Bedside medication systems and smart pumps, for instance, already are available, and technology will continue to enhance medication safety moving forward.

*The following is from a question-and-answer session that took place during the Webcast.*

### **SUPPORT OF MEDICATION TECHNOLOGY FROM SENIOR MANAGEMENT**

Support from senior management is imperative when implementing new technology. Today, most members of senior management are supportive of technology, but that support must also be connected to the patient point-of-care environment. As discussed previously, showing staff the dollars-and-cents side of technology is vital. However, if senior management have  $x$  amount of dollars for building a tower that will add  $x$  amount of volume versus spending that money on patient safety technology, they will likely choose the tower. Thus, using statistics in creating an ROI is absolutely necessary to demonstrate to senior management the value in what is being done.

The 1999 IOM report highlighted medical errors—especially medication errors—putting a new emphasis on the situation, and at that time, organizations started developing their own medication safety strategies. Certainly, health care organizations must take advantage of the technology that is available now; they cannot afford *not* to. Acquisition and implementation of the technology will take time, and prioritizing is essential. Infusion technology is one of those areas that will be most affected. Some institutions may also decide to bring in a bedside medication verification system because there is much value in that area as well. Most importantly, there must be a strategy that senior management can believe in and use to hold the course over years as new technology is implemented.

An emerging medication safety concern is that insurance companies will not reimburse organizations for medication errors that affect patients. Therefore, error prevention is now even more vital, with the patient, as always, being first to benefit. Medication errors and adverse events are gaining publicity, so staff must prevent every error possible. There are also instances in which technology is being purchased by an organization and then not implemented to its full potential, which reduces an institution's opportunity for enhanced medication safety procedures.

Viewing new technology from safety and use perspectives and apprising senior management that the technology is being implemented and embraced builds a strong case for gaining their support.

### **CHALLENGES IN TECHNOLOGY IMPLEMENTATION AND DATA INTERPRETATION**

One of the biggest challenges for Columbus Regional Healthcare System was setting up the library. From a pharmacy perspective, the challenge was finding a starting point, and many hours were spent communicating with other institutions regarding the best methods for implementation. New users should expect to dedicate much time to building the library because there are no guidelines that map out the design for a predefined library. Because of individual protocols, practices, patient populations, and so on, institutions must build libraries themselves to a certain extent. Although building the library is a big undertaking, tasks like rolling it out, compliance, and educating staff can be just as great. As mentioned previously, education does not just happen once; it is a continual process. Turnover of staff, as well as staff working fewer days and longer hours, will also affect the education process. Nevertheless, a continual emphasis on how the pumps work and how to use the pumps, reinforcement, and reporting must remain constant.

A challenge experienced at Union Hospital that was unexpected—but is, perhaps, a natural occurrence—was the need to convince staff and managers that the reports received were correct and true. The reports reflect practice over time, and staff are more familiar with completing data collection retrospectively from charts. However, that data-collection method only shows snapshots in time, and the new reports show practice over time. The ability to explain the meaning of the reports is vital and valuable. For example, a staff member can come in at 10:00 AM and say, “All my pumps are set.” Then a manager can demonstrate that over the last week the pumps were not set. That creates a real understanding of the value of the reports, as well as a new mindset for staff.

### **GETTING DATA TO NURSE MANAGERS AND FRONT-LINE STAFF**

At Erlanger Health System, reports are sent out to the managers on a monthly basis. Then managers go over the reports at their staff meetings. At other times, nurse managers may call asking for data from “this day to this day, this time to this time.” Then those data are pulled and e-mailed to the managers.

Erlanger data are also posted on the nursing portal so that they are available to all staff members.

Furthermore, as mentioned previously, there is value in recognizing staff for doing a good job. It is important that those units that have an extremely high compliance are visited and that staff there are told what a good job they are doing and that they are making patients safer because of it.

At Union, managers and the Pump Patrol determine what reports they want and how often, and those reports are sent out approximately twice a week. This is not a time-consuming process, and it delivers real data. Reports are placed on the nursing portal at Union as well. Although they are widely distributed via e-mail, staff have to take an extra step when opening those messages. Thus, posting to the portal is more convenient. Furthermore, managers have been taught how to run any spur-of-the-moment reports that are needed.

Columbus provides global data on a monthly basis to all of their nursing leadership. Then the pharmacy and nursing departments review the data together. Staff also perform 2 audits a week in various areas that use different drugs, and the reports help direct staff to areas that may need attention. This creates a continuing collaboration process. Reviewing the reports and the therapeutic issues should be an ongoing process as well.

## REFERENCES

1. Kohn LT, Corrigan JM, Donaldson MS, eds. *To Err is Human: Building a Safer Health System*. Washington, DC: National Academy Press; 1999.
2. Improving Patient and Consumer Safety. US Food and Drug Administration Web site. [http://www.fda.gov/oc/mcclellan/strategic\\_safety.html](http://www.fda.gov/oc/mcclellan/strategic_safety.html). Accessed October 2, 2008.
3. Aspden P, Wolcott J, Bootman JL, Cronenwett LR, eds; Institute of Medicine Committee on Identifying and Preventing Medication Errors. *Preventing Medication Errors*. Washington, DC: National Academies Press; 2007.
4. Barker KN, Flynn EA, Pepper GA, Bates DW, Mikeal RL. Medication errors observed in 36 health care facilities. *Arch Intern Med*. 2002;162(16):1897-1903.
5. Reason J. *Human Error*. New York, NY: Cambridge University Press; 1990.
6. Medical malpractice verdicts, settlement and statistical analysis, jury verdict research. Referenced by Albert T. Liability insurance crisis: bigger awards just one factor. *amednews.com*. April 15, 2002. <http://www.ama-assn.org/amednews/2002/04/15/prl10415.htm>. Accessed October 16, 2008.

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## QUESTIONS AND ANSWERS

1. **How did you create drug entries for items like antibiotics/chemotherapy regimens that have many dosing and volume variations?**  
We tried keeping with manufacturers' recommendations for the most part. However, we set many based on our standard drug concentrations, volumes, and administration practices.
2. **Can I assume the drug library or reports offer no assistance or visibility for drug titrations within the drug library safety limits that are programmed incorrectly?**  
The pump will require that nurses confirm the doses they are preparing to infuse. They cannot infuse anything outside the hard-limit rule set. The reports show hard-limit and soft-limit override attempts, as well as how many infusions have safety limits programmed and how many do not.
3. **The Joint Commission requires measurements when changing the medication management system. What measures did you use to evaluate the impact of the change when implementing barcoding?**  
We have many reports that are available in real time every day. The nursing managers get daily reports that show (1) overrides by unit and by nurse, (2) failure to follow up on as-needed medication, (3) second-nurse signature overrides, and (4) daily charting percentages.
4. **How difficult was it to establish upper hard limits (UHLs) for narcotic, patient-controlled analgesia regimens that allowed for cancer patients but protected other patients?**  
We have a separate oncology clinical care area with specifically high UHLs. This was established per oncologist recommendations.
5. **Do your smart pumps interface with an electronic medical record (EMR), and if so, how do you manage this operationally?**  
The pumps do not currently interface with our Siemens EMR, but it is my understanding that they will soon.

## **INTELLIGENT INFUSION TECHNOLOGY: ADVANCING TO THE NEXT GENERATION**

Institutional reports have made it abundantly clear that intelligent infusion technology can result in dramatic improvements in the safety of intravenous (IV) medication administration. Clinicians now have a reliable support system that helps prevent errors, and potential harm to patients has been avoided through alerts to nurses regarding inappropriate doses or concentrations or the wrong drugs.

More advances are on the horizon. Pump designers are turning to human factors studies—an examination of the way people interact with technology—to evaluate every factor that may influence safe and accurate use of intelligent pumps. They review user (ie, nurse) characteristics, including expectations, customary practices, and preferences, as well as the environment in which the pump will be used. The impact is significant. Research indicates that clinicians want easy-to-read and brighter LCD (liquid crystal display) screens with large fonts so that a patient's medication status can be read easily from across the room and from various angles. Visibility is crucial for preventing programming errors. Screen layouts also should be simpler, with easy-to-activate, touch-screen verification, which also allows for avoidance of potential programming errors. Doses should be displayed with 2 decimal places for increased flow accuracy. Variable-scrolling-speed options can give clinicians greater flexibility in navigation, and requiring that clinicians automatically enter into the drug library enhances safety software.

Human factors studies have also revealed the importance of implementing a distinct alarm mechanism that clearly identifies for users which device is alarming and that has different auditory levels. Audible alarms also should be supplemented with visual alerts that use color text and graphics.

The newest intelligent infusion software drug libraries hold up to 16,000 drugs and employ a greater number of care areas. This allows for better customization within the facility, as well as helping identify areas or issues that may lead to educational opportunities when addressing software compliance, overrides, and edits.

The latest pump design also increases versatility for the clinician by making available various modes of administration (eg, intermittent, delayed-start, and multistep infusions). Furthermore, as an added

safety measure, locking the pump screen (requiring that a password or key is used for access) is possible so that no unauthorized individuals can gain entry into the system and manipulate infusions.

Other factors that affect use of the device, such as how the device is attached to IV poles and patient beds, should be considered when designing next-generation pumps. Designs that reduce time and/or risk of repetitive stress injuries are important considerations.

Although it is not new, wireless connectivity is another issue that will factor into the next generation of intelligent infusion technology. Increased adoption of wireless devices by health care institutions can lead to greater safety and efficiency of an intelligent infusion system. For example, data-gathering speed improves because wireless connectivity allows direct communication between pumps and a hospital's information system and pharmacy information system. This allows near-real-time recognition of potential errors with the chance to intervene and prevent harm to the patient and also provides an opportunity for staff education.

Furthermore, wireless connectivity allows for easy and frequent production of reports to assess practice in a particular clinical care area or throughout the entire system. Analyzation of specific circumstances surrounding an infusion override or edit, evaluation of use of a particular drug across a clinical care area or areas, and review of compliance at the critical-care-area level or throughout an institution are made possible through use of wireless devices. These data may reveal the need for adjustments to the drug library, rule sets, or staff education. Easy data gathering supports implementation of continuous quality improvement initiatives. Moreover, unlike conventional interfaces, wireless connectivity provides for frequent library updates that can be managed remotely and easily—even across a system with several sites.

As the technology evolves, speed and flexibility of data transfer will increase. In addition, security measures that protect patient information—and comply with the HIPAA (Health Insurance Portability and Accountability) guidelines—will also improve with enhanced security (ie, encryption and authentication schemes).

Intravenous infusion technology does not stand still. It is a continually evolving process that promises an increasingly positive impact on patient safety, workflow efficiency, and overall quality of care.

# Continuing Education Quiz

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Continuing education (CE) for this program is processed solely through the ProCE online CE Center. To receive CE credit, please complete the program posttest and evaluation forms by clicking on the ProCE link at [www.hospitalpharmacyjournal.com](http://www.hospitalpharmacyjournal.com). Then go to the "Distance CE" section of the online catalog. With a passing grade of 70% or greater on the posttest, you can print your CE statement of credit online.

1. **Approximately what percentage of adverse drug events made in the hospital environment will potentially harm the patient?**
  - A. 1%
  - B. 4%
  - C. 7%
  - D. 20%
2. **Approximately what percentage of doses administered will result in a medication error?**
  - A. 5% (1 of 20)
  - B. 6.7% (1 of 15)
  - C. 15% (1 of 10)
  - D. 20% (1 of 5)
3. **Documented attempts to override established hard limits may be a component used in calculating return on investment (ROI).**
  - A. True
  - B. False
4. **Which of the following statements is true regarding soft and hard limits?**
  - A. Both soft and hard limits can be overridden.
  - B. Neither soft nor hard limits can be overridden.
  - C. Soft limits can be overridden, but hard limits cannot be overridden.
  - D. Hard limits can be overridden, but soft limits cannot be overridden.
5. **Which of the following is true regarding override and variance reporting?**
  - A. It may be used to identify areas of needed continuing education.
  - B. It may be used to identify overly strict hard limits.
  - C. It may be used to identify overly strict soft limits.
  - D. All of the above
6. **Prior to implementation of intelligent infusion technology, the implementing institution must catalog and create soft and hard limits for 100% of the IV medications stocked.**
  - A. True
  - B. False
7. **Which of the following statements is false regarding medication safety?**
  - A. Some insurance companies will not reimburse hospitals for medication errors that affect patients.
  - B. Medication safety interventions have reached their peak and no longer need to be a focal point of hospital management.
  - C. Medication errors and adverse events are getting a lot of publicity.
  - D. Some institutions are purchasing medication safety technology but are not implementing the technology to its full potential.
8. **Once intelligent pumps are implemented in an institution, the institution should:**
  - A. use clinical data reports in the institution's quality improvement initiatives.
  - B. continually educate staff on how to use the pumps.
  - C. continually provide reports to the staff on how intelligent pumps are being used in their clinical areas.
  - D. All of the above
9. **Intelligent infusion devices should *not* be used with specialty patient populations such as oncology or pediatrics.**
  - A. True
  - B. False
10. **All of the following should be used when creating drug entries in the library except:**
  - A. manufacturer label recommendations.
  - B. institution standard drug concentrations and volumes.
  - C. institution-specific administration practices.
  - D. All of the above

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