



Increase the Value of Smart Pump Technology **With Sophisticated Data Analysis**

A RELATIVELY NEW TECHNOLOGY, SMART PUMPS have been lauded as a viable means for ensuring patient safety during IV infusions. The determination to purchase smart pumps is generally based on the pumps' decision-support systems, which can prevent over- and under-dosing, and their bar coding capabilities, which can prevent wrong-drug medication errors. However, the devices are also capable of capturing and storing a significant amount of data, which, once analyzed, can help your institution further improve patient safety and increase user satisfaction. To get the most out of your smart pump purchase, it is imperative that you establish standard processes for collecting and analyzing your smart pumps' data.

Approaches to Data Collection

There are two different approaches to collecting continuous quality improvement (CQI) data from your smart pumps: the review of individual events and the in-depth analysis of data collected. Some facilities examine small, daily samples of individual events to reveal specific nurse practices, while others analyze aggregate data to identify practice variations. Depending on your goals, both of these methods can provide valuable information. Reviewing specific events can inform you of individual user practices and clarify the events surrounding a specific case, while a broader data analysis can identify processes for quality improvement opportunities.

For example, a daily review of infusions that have been programmed outside of predetermined safety limits can uncover individual programming events that require attention and may identify individual users that require additional education. At St. Joseph's/Candler Health System, our analysis of data over time helped us identify orders that were incomplete when written by the physician. Standardized order sets were then developed to include all of the necessary information and provide dosing and monitoring criteria.

When analyzing data on a broad scale, use monthly or quarterly batches to identify variation from standards and trends, such as a significant number of overrides related to one particular drug. You may find that the overrides are



Photo courtesy of Baxter Healthcare Corporation

Smart pump infusion data related to safety limit overrides and reprogramming events is useful in determining the effectiveness of the pump in reducing and eliminating medication errors.

clinically insignificant, and after evaluating your pumps' safety limits, you may decide to adjust the dosing ranges for that drug to avoid "false alarm" overrides. Long-term data analysis can also aid you in clarifying your data sets to aid nurse workflow, as well as identifying issues that require further system-wide staff education.

What Kind of Data Should You Collect?

In determining the types of smart pump data your facility should review, first establish your institution's priorities. For instance, after reviewing our initial data, we identified propofol as our first performance improvement priority due to the large number of alerts. No two institutions' smart pump data analysis needs will be exactly alike, but any facility can benefit from investigations in several key areas.

The name, concentration, and dose of the medication; the date and time of the event; the patient identification; the type of alert triggered; and the action taken by the nurse are all important data elements to collect. Smart pump infusion data related to safety limit overrides and reprogramming events is useful in determining the effectiveness of the pump in reducing and eliminating medication errors.

Smart pumps can be programmed with both "hard" and "soft" dosing limits. Hard limits will not allow a nurse to continue an infusion outside of certain parameters, whereas soft limits allow such overrides. Some systems also offer two-step limits, which allow the user to set a soft limit at one level, followed by a hard limit at another level. In some cases, a soft limit is set at the typical maximum dose, which may be lower than the absolute maximum. In certain rare clinical scenarios, it may be appropriate to exceed the soft limit, but not the higher absolute maximum, which is set as a hard limit. Collecting data related to nurse overrides of the smart pumps' soft limits helps the pharmacist determine if medications are used appropriately. Override data can be analyzed to determine what changes to infusion processes and data sets should be made to ensure safe medication use. In our initial analysis



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of override data, we found the lower limit of a number of vasoactive drips was set too high and did not allow the nurse to wean the patient off of the medication as slowly as needed without getting a warning. Our solution was to adjust the dataset to reduce the lower limit and avoid an unnecessary warning. Reviewing the data on an ongoing basis makes it easy to spot programming events that indicate nurse training may be needed. We have seen cases of multiple changes to programmed medications occurring within a short period of time. When the nurses were questioned, they acknowledged that they were confused about the order or the programming.

It is important to establish a benchmark for clinical significance in your data. By setting a range for standard deviation, you can eliminate some of the “noise” in your data and more effectively segregate issues that require your immediate attention, in terms of pump reprogramming and establishing new data sets.

Once you have reprogrammed your pumps based on your initial data analysis,



Photo courtesy of Cardinal Health

To get the most out of your review process, qualify the relevance of your data by the magnitude of its variation from your facility's established infusion safety limits.

the pumps' ability to prevent errors will become clear from the analysis the post-reprogramming data. You may also find it helpful to model further dataset changes after successful reprogramming events.

How Is Data Collected?

Smart pump data can either be collected manually by downloading the data from each of your pumps to a computer via a cable, or by continuously transferring data via a wireless connection from the pumps to the server. Obviously, using a wireless connection makes the process much more efficient, but you should not let your lack of a wireless connection prohibit you from collecting and analyzing your smart pump data.

At St. Joseph's/Candler Health System, we initially collected CQI data from our pumps manually. One of our biomed techs went to each pump and connected it to a laptop to transfer the CQI information. This process was very time-consuming and forced us to delay complete data analyses to coincide with the time that we performed pump upgrades – about once a year.

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Now that we have a wireless server installed, CQI data downloads are continually available. The data transmitted is near real-time and allows us to analyze large amounts of data at any time. The communication from the pumps to the server is totally invisible to the user. Our wireless server also enables us to view the data sets in each pump. This helps us determine if the most current dataset has been uploaded into the pump itself, ensuring the most up-to-date safety limits are in use. Using the server, we can also see whether or not a pump is communicating properly with it, thus ensuring the accuracy and completeness of our data downloads.

Wireless Network Considerations

When using a wireless network to collect your smart pump data, the network's reliability is the key to ensuring timely downloads and a seamless process. Involve your IT department from the outset – upon your first discussion of using a wireless network for data collection. Once your wireless network is installed, test your access points to ensure they are effectively communicating with your pumps. One of the main factors impacting the communication of data is the location of the pump in relation to communication access points. Pumps located outside of an access point-covered area do not communicate with the server until moved within the coverage area, resulting in a data transfer delay. For example, if a patient spent several days in an area not covered by an access point, it is unlikely any of the CQI data would be communicated to the server. Overrides requiring review and action may not be communicated until after the patient is discharged. The better your system's wireless network the more current the data. Additionally, the reliability of your wireless network is essential to ensuring that programming updates to your pumps are made in a timely, almost immediate fashion, thereby guaranteeing that quality improvement measures, such as new data sets, are live at the bedside for the next infusion.

Even if your facility does not run a wireless network for its smart pumps, it is still important to collect and analyze your pumps' CQI data. At St. Joseph's/Candler, prior to installing a wireless network for our smart pumps, even the limited amount of data we manually downloaded proved helpful in our CQI efforts. It was with this initial CQI data that we identified a need to improve the

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processes of ordering, administering, and monitoring propofol. Some hospitals have chosen to download data when the pumps are sent to a central location for cleaning or redistribution. Manual downloads require a good deal more coordination than the wireless transfer of data, but there are learning experiences to be found in every set data, be it large or small.

Opportunities for Improvement

The data you analyze should be used to improve the safety of medication administration. Changes may be implemented in the infusion process, the ordering of appropriate doses, or by providing adequate monitoring parameters and standardized dosage adjustment. This will improve the quality of patient care and your nurses' workflow. The process changes also improve the safety of the working environment for our nurses and help protect them from career-ending errors. To get the most out of your review process, qualify the relevance of your data by the magnitude of its variation from your facility's established infusion safety limits.



Photo courtesy of Sigma International

Data analysis allows the opportunity to identify keypunch errors and prevent the incorrect dose from reaching the patient.

Also pay close attention to data surrounding high-risk medications, such as heparin. Reviewing the override and reprogramming data for heparin led us to realize that confusion existed about the difference between programming the loading dose versus the continuous dose of heparin. As a result, we totally revised our order form and administration documentation form. It also led us to establish a "hard" limit for heparin.

As mentioned above, our initial data led us to initiate a performance improvement project to significantly improve the processes of managing ventilator patients on propofol. This data revealed that propofol received the highest number of alerts during infusion programming. The first action we took was to establish safety limits for the administration of bolus doses. This also required intensive education to change the nurses' practice for administering a bolus dose, from simply increasing the rate until the desired effect is obtained, then turning the rate down, to a structured approach using safety limits for additional doses. Ultimately, we were able to evaluate the causes for these alerts and determine that there were tremendous variations in nurse practice for sedating patients in terms of how much drug they would actually administer. As a result, new order sets were developed that require the physician to establish a sedation goal for each patient. The parameters for dosing propofol infusions and bolus doses were established. The order set also provided guidelines for patient assessment and clear parameters for dosage adjustment. We discovered during this project that we could do a better job of managing



Following any changes to your pumps' programming, you should look at your data on a more frequent basis to determine what impact – if any – that change has made at the bedside.

Photo courtesy of B. Braun Medical Inc.

pain in this patient population with analgesics and avoid deeper sedation. Guidelines for a "sedation vacation" were included in the order set prior to the initiative from IHI that outlines the benefits of waking ventilated patients daily. The data collected from your smart pumps may likewise uncover opportunities for organization-wide improvements.

Data analysis allows the opportunity to identify key-punch errors and prevent the incorrect dose from reaching the patient. It is important to know and communicate to the staff when the prescribed dose varies from the dose the nurse intended to program into the pump. You may find that your nurses are entering incorrect decimal points or extra zeros when using the pumps at the bedside. We have discovered events in which the zero was pressed instead of a decimal, for instance. This could result in a significant overdose. This event is more of a human factor issue and is very difficult to train staff not to do. With a smart pump, the technology prevents the errant key press and the resulting overdose.

Through data analysis, we have identified issues related to unclear labels and nurse misunderstandings of the concentration of the infusion dispensed. As a result, the concentration limit was established in the dataset so the nurse no longer sets the concentration. This automatic programming resulted in the elimination of dosing errors.

Recently one of our high-risk medications was unavailable from the manufacturer. The alternative product ordered is dosed at one-tenth the dose of our usual product. Using the wireless communication with the pumps, we were able to establish safety limits for the new product and avoid possible 10-fold overdoses.

Practice Recommendations for Data Review

Smart pump vendors provide "canned" reports that, for the most part, are very good for analyzing your pumps' data. At St. Joseph's/Candler, we also download the data to an Excel spreadsheet, and using pivot tables, we can comparatively analyze the data we want to see. With Excel, you have the freedom to customize your own charts and graphs based on any data points from the pumps.

I recommend analyzing individual events of your smart pump CQI data at least weekly. These can be performed quickly and provide actionable events to improve care. I also recommend performing an in-depth data set analysis either monthly or quarterly. The newer you are to smart pump data analysis, the more frequently you should perform this analysis. As your smart pumps program matures, your need for trend analysis will decrease, because you will have improved upon many of your processes and corrected programming along the way. However, following any changes to your pumps' programming, you should look at your data on a more frequent basis to determine what impact – if any – that change has made at the bedside.

Pharmacy's Role in Smart Pump Data Analysis

Pharmacy involvement in smart pump data analysis is essential. When reviewing the



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data, it is often possible for the pharmacists to calculate the dose entered and determine exactly what a nurse was trying to do when a programming error occurred. With their broad knowledge of drug dosing ranges and indications, pharmacists are well suited to this role. Also, because they are not the end-users of the pumps, pharmacists bring an objective approach to both analyzing what occurred at the bedside and providing solutions to rectify the situation going forward. In addition, pharmacists, on the whole, are detail-oriented and analytical by nature, and therefore, are valuable resources for determining methods for improving smart pump use in your institution. A designated person should be responsible for coordinating data analysis. A team approach for analysis should be employed to maximize improvements.

Communicating Quality Improvements and “Great Saves”

It is very important to immediately notify nurses of any quality improvements implemented to your smart pump systems, as these changes will affect their daily practices. Typically, a week before changing a dataset, we notify nurses via e-mail that changes will occur and what those changes are. We then notify them again when the changes have been uploaded and remind them to initiate the steps necessary to transfer the new data set to the pump.

“Great saves” should be shared with the nursing staff. We define great saves as potentially harmful events that a nurse reprograms to a safe dose after receiving a warning. Great saves appear in our CQI data “reprogramming” reports, and sharing them helps the staff understand the value of smart pump technology to patients and its ability to protect them from administering an incorrect dose of medication.

You can use e-mails to communicate instances in which your smart pumps prevented a medication error. This is a great way to promote the use of the software. You can also use reports, graphs, and slides in a number of different meetings, such as those for your performance improvement team, pharmacy and therapeutics committee, and nurse managers meetings.

It may also be helpful to communicate great saves on posters in areas accessible only to clinicians. Be careful to avoid placing these posters where patients may encounter them, as the information could be misinterpreted as a warn-

ing, rather than a success story.

Whatever your method for communicating great saves to your staff, keep it brief so it is easy to digest. Share the story in one- or two-sentence sound bites; do not give them three paragraphs to read.

Conclusion

The value of smart pumps in preventing IV medication errors is clearly recognized. Establishing processes to analyze the pumps’ CQI data will provide the opportunity to make even more significant advances in patient safety. While implementing smart pumps at your facility is a significant step towards providing safer care to your patients, performing CQI data analysis increases the sophistication of your use of these systems, as well as the value of your patient safety program. ■

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