



Ensuring Patient Safety With Ambulatory Infusion Pumps

Douglas County Hospital is a 126-bed, county-owned general med/surg hospital. We do a significant amount of orthopedic surgery, hence the need for ambulatory infusion pumps, which we use both for PCA and epidural drug infusion. About four years ago, we had a potentially serious medication error as a result of an incorrectly programmed pump. The ambulatory infusion pumps we used at that time required the nurse to program all of the pertinent data for the infusion and an error was made. We immediately reviewed our entire process and determined human error caused the problem: a 1.0 milligram concentration was loaded as a 10 milligram concentration, and the missed decimal point resulted in the pump running at a rate ten times higher than it should have. Fortunately, we were able to avoid respiratory depression as the patient was already on a ventilator. While the patient was not harmed, it was very clear to us that the only way we could remove this risk from the system was to take the human element out of ambulatory pump programming. We decided to implement electronic infusion pumps with barcode driven software to restrict infusion parameters.

Pharmacy Driven Program

The key feature that drove our selection of the new ambulatory infusion pumps was restrictive programming. Pharmacy, as the primary user, establishes the pump programming via the drug library. Nursing, as the end-user, has very limited programming options. The nurses use a menu-driven program to see the strength and dosing parameters of the prescribed drug, which are pre-established in the drug library. The only time a nurse would alter the programming is in the event of a physician's change order. For example, if a patient is receiving one milligram of a drug every 15 minutes, but the order is written in a range of one to three milligrams, the nurse can use a code to override the original programming and increase the dose to two or three milligrams. This is the only programming change the end-user can make and a second nurse is required to double-check this process. We have significantly

narrowed the choices a nurse can make during the pump-programming phase to decrease the potential for medication errors.

To build the drug library, pharmacy worked with the medical staff to determine which drugs would be used with the ambulatory pumps. We chose four PCA drugs and two epidural infusions (Table 1). We then established the accepted concentrations and dosing parameters for each drug. We chose a single concentration for each drug with a 15-minute lockout pattern, so the patient could not receive more than one dose every 15 minutes.

Once the drug library was created in our database, pharmacy downloaded that data – not into each pump – but into each handheld PDA scanner used at the nursing station. Every medication used with the ambulatory pumps is bar coded. The bar code for each drug programs the pump with the proper drug, concentration, dosing interval and dosing volume. Because separate bar codes would be necessary for multiple concentrations of the same drugs, our present policy is to

allow only one concentration of each drug used with the bar code driven pumps.

After pulling the medication for administration, the nurse scans the bag with the handheld scanner, which is then plugged into the pump to load the protocol. The name of the drug, the concentration, the dosing interval and the lockout periods automatically load into the pump. With the bar code scanning option, even the end-user's step of choosing the right medication on the screen is eliminated. Once the drug is scanned, all of the pertinent fields in the pump are automatically populated. This way the nurse does not have to load any information into the pump itself and the pump does not contain more than one protocol at any given time.

Nurse Training

The nursing staff was very receptive to this new system as they appreciate the safety and peace of mind it offers. With our previous pumps, nursing was very cognizant of the risk involved with programming. Even with our double check processes, nursing was concerned that a mistake could result in serious con-



Nursing appreciates the safety and peace of mind offered by the bar code-driven software.

Photo courtesy of B. Braun Medical Inc.



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sequences for the patient. In addition, there were some nurses who rarely used the prior ambulatory pumps and thus were nervous about their lack of programming experience. The nurses appreciate the ease and speed of the process with the new pumps.

When we first implemented the new pumps, our biggest challenge was teaching the nurses how to use a bar code scanner. Although we have since implemented bedside scanning, this was our first foray into scanning and we were surprised by the volume of calls from nursing immediately following implementation. Once we demonstrated proper technique this problem was quickly resolved. However, I would recommend conducting training sessions on good scanning technique for any nurses who are new to bar code scanning prior to implementation. The only other challenge we have experienced is the occasional bar code that does not scan, so pharmacy currently checks all bar codes before sending them up to the floor to ensure the process will be smooth.

Patient Education

With our previous pumps, there was the potential for the patient to inadvertently alter the programming by pushing too many buttons on the pump even though it had a lockout feature. With our new pumps, not only is the lockout feature more effective, but also only one protocol is loaded into the system at any given time, eliminating the risk of inadvertent reprogramming. Furthermore, because of the simplicity of the system, the patient education process is very straightforward. Basically, we instruct patients to push the button when they are in pain.

Reports

The software for the pumps provides an array of quality report data, including whether any pumps are malfunctioning and tracking how many pumps are currently in use. We can also run reports on the total drug infused over time. While the nursing staff documents this information in the chart, it is much easier to pull the cumulative data from the devices. For example, at the request of the orthopedic group, we have pulled reports on the quantity of drug received by the patients. Interestingly, we have found that the patients using the ambulatory pumps are using fewer doses of narcotics, probably because they are ambulating more quickly and thus have a decreasing need for pain medication.

Conclusion

Once pharmacy completed the initial programming, the pumps were completely operational, so the implementation went very quickly. Because of the

plug-and-play approach to administering the drugs, the time saved by nursing has been dramatic. We have met our goal of decreasing the risk of an error by automating as much of the programming process as possible. ■



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Table 1. Ambulatory Infusion Pump Drug Library

PCA Drug Library

DRUG	CONCENTRATION	MAX DOSES/HR	DOSE RANGE
Morphine	1mg/ml	4	2mg to 4mg
Hydromorphone	1mg/ml	4	0.3mg to 0.6mg
Fentanyl	50mcg/ml	4	10mcg to 25mcg
Meperidine	50mg/ml	4	15mg to 20mg

Epidural Drug Library

DRUG	DOSE RANGE
Epidural Fentanyl 0.0005%/ Bupivacaine 0.125%	6-12ml/hr
Epidural Morphine 0.416mg/ml	5mg/day (0.5ml/hr)



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WHERE TO FIND:
Ambulatory Infusion Pumps

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Vendor	Reader Service Number
B. Braun Medical Inc.	1
Baxa Corporation	2
Baxter Healthcare Corp.	3
Curlin Medical, Inc.	4
Hospira, Inc.	5
I-Flow Corp.	6
Medi-Dose/EPS	7
Smiths Medical	8
WalkMed Infusion LLC	9
Williams Medical Company	10