

# Bar Code Scanning Can Reduce Pharmacy Errors

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VANCOUVER, B.C. – A series of interventions aimed at reducing human error dramatically reduced mistakes made in the formulation of intravenous medications and solutions for children at Duke University Medical Center, based on the results of a retrospective analysis.

The primary interventions included initiation of bar code scanning of medication vials and IV bags, improvement of work flow processes in the IV room, and elimination of manual order entry when producing complex IV solutions, and author Dr. Patrick Ethington said.

Before the interventions were fully implemented in December 2008, the hospital's electronic order entry system would generate an order by a physician that the

pharmacist had to manually transcribe into the computer system used in the IV room. The pharmacy technicians would prepare the recipe and place the drug vials and syringes in a basket to be checked by the pharmacist. Although a pharmacist still manually checks the volume of medications created, the system electronically generates orders and labels without the need for manual transcription, and freezes if a scanning error is detected, said Dr.

Ethington, a neonatology fellow at Duke University in Durham, N.C.

The impact of the interventions was evaluated by having pharmacy safety data for inpatient pediatric admissions recorded from March 3, 2007, to Sept. 24, 2009, and medication errors graded based on a severity index (SI) scored from 0 to 6. A score of 0 indicates the error never reached the patient and consequently caused no harm, 3 indicates the error reached the patient and caused transient adverse effects, and 6 indicates the error resulted in patient death.

There were no SI 3 or greater errors after the interventions, compared with a mean of 1.9 such errors per 100,000 doses created before the interventions (*P* value equals .04), Dr. Ethington said.

Scanning medication bar codes detected 2.7 errors per day; there was no way to score these errors for severity because they were not reported for SI

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#### Intended Use/Indications

Deflux<sup>®</sup> is indicated for treatment of children with vesicoureteral reflux (VUR) grades II-IV.

#### Contraindications

Deflux is contraindicated in patients with any of the following conditions:

- Non-functional kidney(s)
- Hutch diverticuli
- Ureterocele
- Active voiding dysfunction
- Ongoing urinary tract infection

#### Warnings

- Do not inject Deflux intravascularly. Injection of Deflux into blood vessels may cause vascular occlusion.

#### Precautions

- Deflux should only be administered by qualified physicians experienced in the use of a cystoscope and trained in subureteral injection procedures.
- The risks of infection and bleeding are associated with the cystoscopic procedure used to inject Deflux.
- The usual precautions associated with cystoscopy (e.g. sterile technique, proper dilation, etc.) should be followed.
- The safety and effectiveness of the use of more than 6 ml of Deflux (3 ml at each ureteral orifice) at the same treatment session have not been established.
- The safety and effectiveness of Deflux in the treatment of children under 1 year of age have not been established.

#### Adverse Events

List of treatment-related adverse events for 39 patients from a randomized study and 170 patients from nonrandomized studies. (Follow-up for studies was 12 months).

Adverse Event Category	Randomized Study (n=39 DEFLUX patients)	Nonrandomized Studies (n=170 DEFLUX patients)
UTI(i)	6 (15.4%) (ii, iii)	13 (7.6%) (ii, iii)
Ureteral dilation (iv)	1 (2.6%)	6 (3.5%)
Nausea/Vomiting/ Abdominal pain (v)	0 (0%)	2 (1.2%)

- Cases of UTI typically occurred in patients with persistent reflux.
- Patients in the nonrandomized studies received antibiotic prophylaxis until the 3-month VCUG. After that only those patients whose treatment had failed received further antibiotic prophylaxis. The patients in the randomized study received antibiotic prophylaxis 1 month post-treatment.
- All UTI cases were successfully treated with antibiotics.
- No case of ureteral dilation required intervention and most cases resolved spontaneously.
- Both cases of nausea/vomiting/abdominal pain were resolved.

Although vascular occlusion, ureteral obstruction, dysuria, hematuria/bleeding, urgency and urinary frequency have not been observed in any of the clinical studies, they are potential adverse events associated with subureteral injection procedures. Following approval, rare cases of post-operative dilation of the upper urinary tract with or without hydronephrosis leading to temporary placement of a ureteric stent have been reported.



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scoring. It was noted that it was not possible to verify that scanned medications were added to the IV bag or that the correct volume of scanned medication was placed in the IV bag. A long-term goal is to have automated volume verification.

The hospital focused on the preparation of IV medications and solutions because 20% of SI events originated at this step. Between 2007 and 2009, Duke Children's Services at the medical center treated 30,638 children, generating 338,657 orders, 869,997 doses, and 2,041 errors.

Factors that contribute to these errors include high volume, and stressful work that is somewhat repetitive and goes against the strengths of humans to think conceptually, he said. Only a small minority of medications has a characteristic color, leaving the bedside nurse to trust that the product is accurately labeled.

The medication production process is also set up for human error to occur in that different drugs are produced with similar-looking labels and similar size, color, and shaped vials, said Dr. Ethington, a former process engineer.

Although the current interventions reduced serious errors, they are no place to stop, said Dr. Ethington, who noted that roughly 25% of errors at Duke occur at the bedside. A recent study showed that bar code scanning on units significantly reduced timing errors in medication administration, but not potential adverse drug events associated with those errors (*N. Engl. J. Med.* 2010;362:1698-707).

Scanning at the bedside is difficult, but is a long-term goal of the hospital, he said in an interview. The researchers also plan to look at subtle differences between the day and night shifts. ■

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