

# Reducing controlled substance prescription writing errors to virtually zero (“six sigma”) using a computer-based prescription writing program


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**Introduction:** Iatrogenic errors producing serious and often preventable injury occur frequently in hospitalized patients, particularly children (1-4). We previously demonstrated that discharge prescription errors for children requiring potent, narcotic analgesic drugs in the management of pain are common and may cause significant harm. We hypothesized that a computer-based controlled substances prescription (Rx) writing program that is linked to a hospital’s patient demographic database and contains weight-based dosing and decision management would significantly reduce the prescription error rate to less than 3.4 per million (“six sigma”).

**Methods:** Following institutional review board and pharmacy and therapeutic committee approval, a computer-based Rx writing program for controlled substances was developed and installed on a password-protected institutional intranet. This program was linked to the hospital’s patient demographic database. The prescribing health care provider was required to pick one of 14 controlled substances (e.g., acetaminophen with codeine, oxycodone, methadone, etc.) and to enter the patient’s weight in kg twice. The program had decision management logic and alerted the prescriber for allowable under and over dosing (50%) which generated “soft alerts” as well as unallowable overdosing which generated “hard alerts”. If a “hard” alert was generated a prescription would not be generated, although an override was available to the pediatric pain service. Examples of hard alerts include total acetaminophen daily dosing > 90 mg/kg (or 4,000 mg)/day or oxycodone dosing > 0.3 mg/kg/dose. This provided the prescriber with guidance and autonomy up to a degree. An electronic auditing trail was built into the program and all prescriptions were reviewed by one of the investigators (CUL). Primary outcome variables were the percent of prescriptions that contained at least one medication error or potential adverse drug event. Errors were defined using the Institute for Safe Medication Practices’ (ISMP) List of Error-Prone Abbreviations, Symbols, and Dose Designations (5), literature review, expert panel consensus, and the Johns Hopkins Department of Pharmacy hospital formulary.

**Results:** Over a 12 month period, 4,995 narcotic prescriptions were attempted by the faculty, house staff, and pediatric nurse practitioners using the computer-based Rx writer. Of these, 4,282 had no “soft” or “hard” alerts and 2,942 prescriptions were generated (Figure 1 is an example of a generated prescription). There were no errors in these prescriptions. Seven hundred and thirteen prescriptions had one or more alerts, (0-4 alerts per attempt, mean 1.4); of these, 173 were “hard” alerts and could not be over ridden. The remainder were “soft” alerts, of which 291 were for under dosing.

	The Johns Hopkins Hospital	Serial No.:1007353
600 North Wolfe Street * Baltimore, MD 21287-6180 * (410) 955-5000		10-09-2006
Hospital's Medical Assistance Number: 064-872-800		
Name: Daisy Duck	Age: 7 years	DOB: 02/03/1999
Address: _____		Weight: 22 kg
<b>Valid For Controlled Substances Only</b>		
Hydromorphone Liquid 1 mg per 1 mL Dispense: #30 mL ( thirty ) Sig: Take 1 mL (1 mg Hydromorphone) PO q 4 hours prn pain for 10 days (= 0.05 mg/kg/dose [Rounded by 9 %] ) Please dispense with measuring device. May substitute		
Refill: 0 ( zero ) Times		
Physician Signature: _____, MD		
Physician Print Name: Test Test, MD		J.H.H. Physician ID No.: N2412
DEA No.: BL3686930		
0039 (6/03) This prescription is NOT valid as a copy. Pharmacist please check for signature indentation/imprint.		

**Discussion:** We have developed, tested and implemented an effective error-prevention strategy utilizing a computer-based, controlled substances Rx writing program that is linked to our hospital's patient demographic database. It contains weight-based dosing and decision management support systems. This has reduced our error rate to virtually zero (approaching "six sigma" levels of quality with < 3.4 defects per million opportunities), and highlights the value of implementing industrial quality control systems ("six sigma" methodologies) into medical practice.

#### References:

1. Brennan TA et al., *NEJM*, 1991
2. Kohn LT et al., Institute of Medicine Report "*To Err is Human*", National Academy of Sciences, 1999
3. Kaushal R et al., *JAMA*, 2001
4. Wong IC et al., *Drug Saf*, 2004
5. ISMP (Institute of Safe Medication Practices), [www.ismp.org](http://www.ismp.org), 2006