

# A "BACK TO BASICS" APPROACH TO REDUCE ED MEDICATION ERRORS

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**Introduction:** Medication error is the most frequently reported error in the emergency department. Nationally, 36% of medication errors occur in the administration phase. The purpose of this study is to reduce medication administration errors in the emergency department by reinforcing basic medication administration procedures.

**Methods:** This study examined a 3-month educational intervention using a nonrandomized, single group comparing pre-post outcome variables. The educational intervention, titled "Preventing Medication and IV Administration Errors," described current medication errors in the emergency department, and recommended practices for reducing medication administration errors. Of 127 nurses, 75% participated. Three measures used pre- and post-intervention were: a) knowledge of medication administration procedures assessed by tests; b) behaviors reflecting recommended medication practices assessed by surveys; and c) medication

administration errors, identified via chart review and voluntary error reports.

**Results:** In the post-test, 91% achieved perfect scores vs. 69% on the pre-test ( $P = .0001$ ). In the post-survey, the proportion responding that they follow recommended practice "all" or "most" of the time increased in 8 of the 10 survey questions, but the changes did not reach statistical significance ( $P = .98$ ). Reviews of charts (299 pre-test and 295 post-test) revealed little change in total medication errors: 25% vs. 24% ( $P = .78$ ). Voluntarily reported medication errors dropped from 1.28 to .99 errors/1000 patients.

**Discussion:** This educational intervention successfully improved knowledge of recommended medication administration practices. However, improved knowledge did not translate to a significant change in practice. More research is needed to identify interventions that can modify behavior in clinical settings.

**Key words:** Medication errors; 5 Rs in medication administration

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J Emerg Nurs 2011;37:141-7.

Available online 28 December 2009.

0099-1767/\$36.00

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doi: 10.1016/j.jen.2009.11.026

Medication errors happen frequently in the emergency department.<sup>1</sup> Several factors contribute to this high rate of medication errors, and the primary contributing factor is ED overcrowding, which is pushing hospital-based emergency care to the breaking point.<sup>2</sup> According to the 2007 National Hospital Ambulatory Medical Care Survey, there were 115.3 million ED visits in 2005 (the most current data available). Medication was prescribed and/or given in 76.7% of the total visits,<sup>3</sup> and in visits in which medication was given or prescribed, the average was 2.5 medications per visit.<sup>1</sup>

The sheer volume of medications given in the ED setting invites errors. Medication-related events were the largest single category of adverse events (19% of all adverse events in 2 landmark studies).<sup>4,5</sup> Fortunately, most ED medication errors (97%) do not result in patient harm,<sup>6</sup> but when they do, the impact from medication errors ranges from minor temporary effects to permanent injury or death. Other contributing factors to medication errors include the increasing number of complicated and chronically ill patients who take multiple medications; lack of detailed medical histories, making patients virtual strangers;



multiple patients being treated concurrently; frequent use of verbal orders; the wide range of drugs in use; time pressures; interruptions and distractions; and team communication problems.<sup>6,7</sup> In a cross-sectional study of all ED errors reported to MEDMARX (the anonymous national database for reporting medication errors) between 2000 and 2004, 13,932 medication errors were reported from 496 emergency departments. The error rate from the MEDMARX analysis was 78 reports per 100,000 visits. Estimates of medication error rates vary widely from 4% to 14%, and in pediatric ED settings, error rates as high as 39% have been reported.<sup>7</sup> An accurate error rate actually is not available because most systems for tracking medication errors (including MEDMARX) are voluntary and represent only the tip of the iceberg.

Reports detailing ED medication errors<sup>3,7,8</sup> are primarily descriptive, addressing factors contributing to errors, possible causes, and recommendations that may reduce medication errors. These recommendations address a wide range of issues; some address the blunt end of the problem, such as redesigning workflow within the emergency department to improve team communication, while others address the sharp end, such as requiring a double check for all high-alert medications. No reports described implementation and evaluation of specific interventions.

In our emergency department, 305 medication errors were voluntarily reported in 5 years. Nationally, 36% of medication errors occurred in the administration phase,<sup>5</sup> and this finding is confirmed by our local experience; therefore, we decided to focus our study on this phase of the medication process. Five years of medication errors in our setting demonstrated that medication administration errors occurred not because new drugs or sophisticated new technologies were used. Rather, medication errors occurred most often because nurses did not comply with basic medication practice—the lessons we were taught in fundamentals of nursing. Therefore, this intervention was designed to emphasize a “Back to Basic” approach to reduce ED medication errors. The purpose of this performance improvement project was to reduce ED medication errors by reinforcing basic procedures for safe medication administration.

## Methods

### STUDY DESIGN

This quasi-experimental study examined a 3-month educational intervention using a non-randomized, single group comparing pre-outcome and post-outcome variables. A 3-month intervention period was designed to provide adequate time for nurses to participate in the

TABLE 1

#### Summary of topics presented in “Back to Basics” educational intervention

- Orders should be legible (if not, verify them); do not accept verbal orders unless life/death situation; state, “Please write it on an order sheet,” or write it yourself and have the physician sign it
- Check 5 Rs 3 times: Right Time, Right Medication, Right Dose, Right Route, and Right Patient
- Check allergies on paper chart and electronic record and update as needed
- Bring order/chart to medication room
- Bring order and medications to bedside, label all syringes
- Identify patient: (1) ask patient to state his or her first/last name and date of birth; (2) check name band; (3) ask about allergies and check for allergy band; (4) tell patient the name and purpose of the medication; (5) ask patient if he or she has been medicated with the same medications before
- Chart medications as given in nursing notes at the bedside
- At shift change, give report with the chart; treat this as an opportunity to review orders and chart medications given, if they have not already been charted

intervention and complete the pre-tests and post-tests and surveys.

### SAMPLE AND SETTING

The study site is a 50-bed emergency department of an academic, tertiary care facility that serves as a level I trauma and pediatric referral center, with an annual census of more than 105,000 patient visits. All direct care registered nurses, both full time and part time, were invited to participate.

### HUMAN SUBJECTS PROTECTION

This study was approved by the hospital’s Institutional Review Board, and a waiver of consent was granted.

### EDUCATIONAL INTERVENTION

An analysis found that the majority of medication errors in our emergency department occurred because nurses did not comply with basic medication administration principles. Therefore, a senior nurse group composed of 4 direct-care ED nurses and an ED research nurse, who each had 10 to 25 years of nursing experience, developed an educational intervention designed to emphasize a “Back to Basic” approach to reduce ED medication administration errors.

### Test (Medication Administration)

1. What are the 5 Rs for medication administration?

- Right time
- Right medication
- Right Dose
- Right Route
- Right Patient

2. If an order is not legible, what should you do? Verify them

Verify

3. If a physician gives you a verbal order, what should you do?

Do not accept verbal orders

4. Please circle one: TRUE FALSE

It is necessary to bring the chart (or order sheet) with you to the med room when preparing medications.

5. Please circle one: TRUE FALSE

IV fluids and IV piggy backs need to have start and stop times documented in the nurse's notes.

6. Please circle one: TRUE FALSE

Our standards require that we use a Buretrol and an IV pump when giving IV fluids to a pediatric patient.

7. Please circle one: TRUE FALSE

Having the chart with you during shift report lets you review orders and gives you an opportunity to chart meds you forgot to chart.

8. Please circle one: TRUE FALSE

Pre-hospital treatment does not have to be documented because the information is already documented on the ambulance run sheet.

9. List 3 things to make sure you are giving the medication to the right patient

- Ask patient to state his/her first & last name & DOB
- Check name band
- Ask about allergy and check for allergy band
- Compare the up/bes no on the drug chart with the hand band

10. What does a red bracelet mean? Allergy (medical alert)

FIGURE 1

Pre-test and post-test (medication administration).



### SURVEY OF NURSING PROCESS FOR MED ADMINISTRATION

**This survey is about your current practice. Please respond to each statement with the corresponding number.**

(1)-All the time (2)-Most of the time (3)-Half the time (4)-Few times (5)-Not at all

- 1 1. When I see a written order that I can't read, I ask the doctor to clarify what he wrote.
- 1 2. When I see a written order that does not make sense to me, I ask the doctor to explain it to me.
- 1 3. When a doctor gives me a verbal order in a non-emergent situation, I ask the doctor to please write it down.
- 1 4. I take the chart/order with me to the med room while I prepare my patient's medication.
- 2 5. I ask patients their name and date of birth before I give them medications.
- 1 6. I check patients' allergies before I give them their medication.
- 1 7. I chart medications I give the patient at the bedside right after I give them.
- 1 8. I have the chart with me when I give report to the next shift.
- 1 9. I review all orders before the patient leaves the emergency department.
- 2 10. I review the chart before the patient leaves the emergency department to make sure my notes are complete.

FIGURE 2

Pre-survey and post-survey of medication administration practice.

This senior nurse group created a 20-page educational flip chart and slide show presentation entitled "Preventing Medication and IV Administration Errors." This content was tailored to address specific errors identified in the safety reports and chart reviews from our emergency department. The content included:

- A list of the most common medication errors in our emergency department
- The 5 Rs of medication administration process (right patient, right medication, right dose, right time, right route)

- The correct method of documenting medications and intravenous lines, including medications given by pre-hospital personnel
- Recommendations for reducing errors at each step of medication administration
- Recommendations on how to prevent errors (Table 1)

#### PROCEDURE

All nurses were invited to participate via memos posted in the communications books for all 3 shifts. Participation was encouraged but was strictly voluntary and confidential. Multiple copies of the educational materials were made

TABLE 2  
Summary of study results

Outcome measures	Pre-intervention	Post-intervention	Test and level of significance
Knowledge test: No. and % of nurses who obtained 10 correct responses out of 10 items (Paired sample) n = 84	59/84 (69%)	77/84 (92%)	Sign test $P = .0001$
Behavioral survey: rank sum of mean score Unpaired, unequal groups: (pre) n = 81 (post) n = 73	6285.5	5649.5	Wilcoxon rank sum test $P = .9768$
Medication errors: No. and % and detected through chart reviews (pre) n = 287 charts (post) n = 296 charts	126/287 (44%)	102/296 (34%)	2-sided Fisher exact test $P = .78$
Medication error rate detected through voluntary safety reporting	1.28/1000 patients	.99/1000 patients	Voluntary reports ↓

available in the break room for a period of 3 months. The nurses read the material and completed the survey and tests on their own time. The pre-survey and pre-test were completed immediately prior to reading the material. The nurses then read the material, and afterward immediately completed the post-test. Completed tests and surveys were dropped in a locked box next to the educational materials. These materials were collected and the results were entered in a Microsoft Excel spreadsheet (version 2003) by a research intern. The post-survey was administered on the fourth month to see if there was any self-reported sustained change in behavior.

#### DATA ANALYSIS

Pre-tests and post-tests were scored and differences were compared using the 2-sided sign test. For the surveys, which had categorical variables and unpaired responses, the non-parametric Wilcoxon rank sum test was used to test for significance. Analysis of medication errors identified via chart reviews was completed by using the Fisher 2-sided exact test and non-parametric procedures. All tests of significance were conducted at a critical level of  $P \leq .05$ . Analyses were done using Stata (version 10.1, StataCorp, College Station, TX).

#### OUTCOME MEASURES

The following measures were compared before and after intervention to assess effectiveness:

1. Written test: A test consisting of 10 questions based on the materials contained in the educational booklet was given to measure the nurses' knowledge of recommended medication administration practices (Figure 1).

2. Survey: The survey used 10 of the nursing medication administration practices recommended in the educational intervention as the basis for the survey questions. Nurses were asked to respond with the frequency they practiced recommended guidelines using a 5-point Likert-type scale (Figure 2). The surveys were confidential.
3. The number of medication administration errors, identified via review of charts and voluntary safety reports, to determine if the intervention had any effect on errors.

By consensus, the senior nurse group established the definitions and criteria used for chart selection. The chart review was limited to admitted patients only and to patients with medications ordered in the emergency department. The reviewers used a standardized data collection form for the chart reviews. All 4 nurses were trained to review charts. During the training, 60 charts were reviewed by all 4 reviewers to establish inter-rater agreement. An inter-rater agreement of 90% was reached prior to proceeding with the actual chart reviews to evaluate study outcomes. A sample size of 580 charts (290 pre-intervention and 290 post-intervention) was selected to provide precision for estimates of selected attributes. For example, assuming a chart error prevalence of 30% in the pre-intervention phase, a sample of 290 charts would provide a confidence interval of about  $\pm 5$  percentage points for the prevalence estimate. Further, for hypothesis testing of pre-post change due to the intervention, a sample size of 580 charts would provide more than 80% power to detect a 27% reduction in the error prevalence (ie, 30% to 19%) using a  $\chi^2$  test at a critical level of 5%. Based on our admission rate of approximately 1700



patients per month, the nurses reviewed a randomized sample of 287 charts before the intervention and 296 charts after the intervention.

## Results

Of a total of 127 nurses, 95 (75%) participated in the educational program. All completed the pre-test, but only 84 completed both pre-tests and post-tests. Only 81 completed the pre-survey; and 73 completed the post-survey. Because this activity is voluntary, we cannot mandate that the nurses complete all the instruments. The pre-test and post-test is a paired, equal group because they were administered at the same seating. The pre-survey and post-survey, because of the 4-month separation and the attrition, is an unpaired, unequal group and was analyzed as such. Attrition for the post-survey was attributed to the time lag and the voluntary nature of the project (Table 2). Some of the post-survey participants did not write their names on their responses, hence we were not able to identify and pair their responses with the pre-survey. The 95 nurses who initially participated (nurses who read the educational intervention and completed at least one instrument) is characterized as 85% female, 62% full time, and 78% level II nurses (level II nurses have more than 3 years' experience).

### PRE-INTERVENTION AND POST-INTERVENTION TEST

After reviewing the educational material, the percentage of nurses who obtained a perfect score increased by 21% (18/84) in the post-test.

### PRE-INTERVENTION AND POST-INTERVENTION SURVEY

The percentage of nurses responding that they would do the recommended practice "all" or "most" of the time trended positively in 5 of the survey questions. The best improvement was in question 8 ("I have the chart with me when I give report to the next shift.") More nurses (71%, 52/73) said "all" or "most" of the time in the post-intervention survey versus only 60% (49/81) of nurses in the pre-intervention survey. However, these positive changes did not reach statistical significance ( $P = .98$ ).

### CHART REVIEWS

Although the total number of medication errors did not change from pre-intervention to post-intervention, 2 errors showed a significant drop. These errors were "IV fluids ordered but not given," which decreased from 4.9% (14/287) to 1.4% (4/296) post-intervention ( $P = .016$ ), and "Incomplete documentation" of medications, which

decreased from 14% (32/287) to 7.4% (22/296) ( $P < .01$ ). The reviewers identified 3 common medication errors: omission of medications and intravenous lines that were ordered; medications that were given and intravenous lines that were started with no written orders; and documentation errors.

### VOLUNTARILY REPORTED ERRORS

Medication administration errors dropped from 1.28/1000 patients (5 months pre-intervention) to .99/1000 patients (5 months post-intervention).

## Discussion

### PRE-TEST AND POST-TEST

The tests and the educational information included basic information that we believe every nurse should know to practice safely. This was confirmed by the high scores achieved by the participants even in the pre-test. The significant improvement in the scores in the post-test might reflect the success of the educational intervention in reinforcing basic knowledge of correct medication administration process. The following finding illustrates the difficulty of achieving desired outcomes with educational interventions: In the pre-test, 18 nurses said that given a verbal order, they would write it down and read back the order to the physician. This practice is not one we recommend to ED nurses. Our Clinical Operations Policy clearly states that "Verbal orders are reserved for emergency situations or when the Physician is actively involved in an invasive procedure." To prevent rampant use of verbal orders in the emergency department, we have interpreted this to mean "no verbal orders unless it is a true life/death situation." However, this interpretation has not been enforced in practice. Nurses carry out verbal orders given for reasons of convenience. The pre-test score showed that 22% of respondents in fact believed that taking routine verbal orders is acceptable as long as they write it on the order sheet. This response improved in the post-test, where 14 of 18 nurses changed their answers and stated that when given a verbal order, they would ask the physician to write the order unless it is a true life/death situation.

### PRE-SURVEY AND POST-SURVEY

Despite this increased recognition of the correct way of handling verbal orders, the behavioral survey of the same concept showed that behavior-wise, nurses did the opposite. Survey question 3 pertained to asking physicians to write their verbal orders; the percentage of nurses doing so either "all the time" or "most of the time" was down (92% [post-survey] vs 95% [pre-survey]). Even though this



difference was not significant, the direction is opposite of what we would expect from the results of the post-test. This contrary result suggests that knowledge alone is not a sufficient influencing factor in behavior.

#### CHART REVIEWS

Analysis revealed little pre-post change in total medication errors: 25% versus 24% ( $P = .78$ ). As a way of measuring the number of medication errors, chart review has limited value by itself, because it is highly dependent on conscientiousness to document what medications were given. However, it does measure well the documentation part of the process of medication administration. Even though overall result of the chart review showed that there was little pre-post change in the total number of medication errors, nevertheless it showed significant improvement in documentation of medications given (pre- vs. post-intervention).

#### VOLUNTARY ERROR REPORTS

The number of reports submitted is a small fraction of actual errors. No general conclusion can be made regarding the clinical significance of a drop in medication errors noted in this study, given the voluntary nature of this reporting system.

#### Limitations

This study has several limitations: The instruments used were designed by experienced nurses who can claim expertise in the medication administration process, but not in the field of instrument design. Therefore, we can only claim face validity for the instruments. A convenience sample was used with volunteers as participants; hence, a chance exists for self-selection bias. The results may have been skewed by 10% attrition in the post-survey participation, as 8 nurses did not complete the post-survey. Finally, the study was conducted in a single emergency department; therefore, the findings cannot be generalized.

#### Implications for Emergency Nurses

Medication administration ranks as one of the major nursing interventions. It also is the most frequent locus of errors in the chaotic environment of emergency departments. As advocates for patient safety, emergency nurses must continuously remind themselves that they cannot

be "too busy" to take the time to check the five "Rs" of medication administration. If we are to keep our patients safe, going "back to the basics" is imperative. Emergency nurses must slow down and use correct procedures when administering medications.

#### Conclusions

This study evaluated a simple intervention designed by ED nurses at the bedside. Although this attempt to improve the safety of medication administration had equivocal results, it provided valuable insights into our medication process. This educational intervention successfully reinforced knowledge of recommended medication administration practices. However, despite apparent success in improving knowledge, it did not produce a significant change in practice overall. More research is needed to identify interventions that can modify behavior in clinical settings.

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