
PHARMACY PRACTICE



Analysis of Problems in a Medication Distribution System

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INTRODUCTION

Medication distribution systems are designed to maximize the accuracy of the process beginning when medication orders are written and ending when the patient receives medications correctly. Failure of the system may result in problems ranging from caregiver inconvenience to medication errors. Each such error is important in itself, but often the rate of occurrence of errors is of particular concern. In fact, "the error rate is generally considered one of the best indicators of the effectiveness or quality of a drug distribution system".¹ Unfortunately, analysis of errors involves certain difficulties. These include the definition of medication errors and the accurate measurement of their rate of occurrence. The CSHP "Guidelines for Medication Incident and Medication Discrepancy Reporting"² are of assistance in defining events by providing a classification scheme and listing possible contributing factors. These guidelines underscore the complexity of drug distribution and the many points at which a drug distribution system may fail. The many variables influencing medication distribution quality can be divided into broad groups:

- 1) Transcription related
- 2) Dispensing related
- 3) Administration related

Assessment of a drug distribution system using, for example, medication error reports as a marker of quality

involves two types of analysis. First is **case analysis**, or the review of individual reports or groups of reports to determine what went wrong and what factors contributed. A limitation is that error reports show only the endpoint of system breakdown, not necessarily where or how the breakdown occurred. Second is **overall analysis**, where the error rate is used to estimate the quality of the system as a whole (i.e., how well it operates compared to how well it could operate). For overall analysis to be valid, markers used must provide a sufficient sample. If the markers represent only a small portion of possible cases, accurate assessment is less likely. Therefore, it is significant that studies reveal that techniques used to report errors affect the apparent incidence.^{3,4,5,6} Basically, direct observations yield much higher rates than do spontaneous reports. Lack of awareness by caregivers that errors have occurred is not uncommon and "as a result, there is a risk of gross under-reporting".¹ For example, one study compared 36 reported errors in one year to a figure, extrapolated from observation, of 51,200 possible errors.³ However, while direct observation is a superior method, it is logistically difficult and may be prohibitively expensive as an ongoing quality assurance tool.

Of value in better assessing the quality of drug distribution would be a method of identifying directly the

points at which the system breaks down, and accurately measuring these.

Medication Administration Record Correction Notifications

In September 1993, Kelowna General Hospital completed conversion from a traditional to a unit-dose medication distribution system. The system combined dispensing of a 24-hour supply of unit-dose medications with the use of computer generated Medication Administration Records (MARs). MARs added a double-check into the system in that nurses checked the accuracy of all new pharmacy medication computer entries against the physician's orders. Consequent to this, an improved method of Nursing to Pharmacy communication was required to minimize time spent communicating discrepancies detected. To accomplish this, the use of MAR Correction Notifications (MARCNs) was initiated. Communication occurred via the computer or by completion of a form available on each medication cart.

MARCNs reflect the detailed medication-related communication between Nursing and Pharmacy, thereby providing information about breakdowns in medication distribution. MARCNs directly show the points at which breakdowns occur whether or not these result, in the worst case, in medication errors. Thus, they can facilitate system alterations to eliminate factors that may

contribute to future errors. This is important, as "system changes are needed for effective reduction of error[s]".¹

METHODS

Data Collection

MARCNs were collected and analyzed for the period of January 1 to June 30, 1994. Data collection began several months after implementation of unit dose to allow staff to become familiar with the system and for initial adjustments to be completed. Six months was chosen to allow for variations in workload and to identify trends.

To place the number of MARCNs in perspective, workload data were used to determine both the number of medication order entries and the number of doses dispensed. For comparative purposes, the number of medication errors reported during the collection period was ascertained.

Organization of Data

Categorization, general enough to facilitate analysis yet preserving sufficient detail to allow identification of contributing factors, was necessary due to the large number of MARCNs involved. Each MARCN was reviewed and assigned to one of six categories. Subcategories of these are outlined in Table I.

1. Medication Order Related
2. Order Processing Related
3. Dispensing Related
4. Interdepartmental Communication
5. Extraneous Notification
6. Interpretational

Data Analysis

Cumulative tallies for each category and subcategory were analyzed to identify the major points of breakdown. In addition, monthly tallies for each category and subcategory were tracked. Unanticipated monthly fluctuations were analyzed against the work environment to determine causative factors.

As well, the impact of alterations made to the medication distribution system was assessed.

MARCNs were also used to gauge the overall accuracy of the system, analogous to measuring the medication error reporting rate. When used in this fashion, it was necessary to obtain objective criteria for comparison. This was done by comparing the number received to the number that could have been received. Problems related to order processing and entry belonged to categories 1, 2, or 6. For these, the number of entries

was a useful denominator. Breakdowns stemming from dispensing related activities belonged to categories 3, 4, and 5. For these, each dose represented a potential MARCN and; therefore, the number of doses dispensed was most important.

RESULTS

A total of 1,823 MARCNs were received in the six-month period. The totals for each category and subcategory are shown in Table I. The relationship between MARCNs and workload are shown in Table II. Not

Table I: Six-Month Data by Category of MARCN

Category of MARCN	# MARCN	% MARCN
1. MEDICATION ORDER RELATED		2.3%*
a. Ambiguous order	23	
b. Order changed after processing	8	
c. Order written on wrong patient's chart	1	
d. Failure to note allergy	0	
e. Illegible order	10	
2. ORDER PROCESSING RELATED		34.2%
a. Incorrect addressograph	6	
b. Missed documented allergy	2	
c. Failure to clarify order	13	
d. Order missed (Pharmacy)	184	
e. No copy received (order missed - Nursing)	209	
f. Inaccurate MAR order entry	154	
g. Order entered on wrong patient's profile	17	
h. Calculation error	0	
i. Missing drug entry (i.e., stopped in error)	39	
3. DISPENSING RELATED		4.3%
a. Incorrect drug dispensed	15	
b. Incorrect dosage strength dispensed	28	
c. Incorrect dosage form dispensed	6	
d. Incorrect dosage interval	14	
e. Incorrect labelling of package	2	
f. Faulty packaging	13	
4. INTERDEPARTMENTAL COMMUNICATION		26.7%
a. Changed status of conditional order	54	
b. Dose time change request	66	
c. Refill prn / Replace missing dose	248	
d. Request for addition to comments line	20	
e. Miscellaneous	99	
5. EXTRANEOUS NOTIFICATION		12.0%
a. Request to delete order already deleted	73	
b. Request to add order already added	68	
c. Inappropriate request (i.e., to add non-MAR item)	46	
d. Request to add order awaiting clarification	14	
e. Miscellaneous	17	
6. INTERPRETATIONAL		20.5%
a. Discontinue order "implied"	374	

* indicates the percentage that each major category contributes to the total number of MARCNs received

Table II: Relationship Between MARCNs and Workload

Total number of medication order entries	42,400
Total number of doses dispensed	294,000
Total number of MARCNs received	1,823
Entry related (categories 1,2,6)	1,040
Dispensing related, all (categories 3,4,5)	783
Dispensing related, significant (categories 3, 4c only)	326
MARCNs received (as percentage of number possible)	
Entry related (denominator = entries)	2.5%
Dispensing related, all (denominator = doses)	0.3%
Dispensing related, significant (denominator = doses)	0.1%

all categories possess equal potential to result in medication errors. To make analysis more meaningful, those with greater risk potential were highlighted. Table II; therefore, also lists the categories included as **significant MARCNs**. The number of medication errors reported during this six-month period was 118.

DISCUSSION

MARCNs provided much information about the distribution system that was unavailable from error report review alone. The larger number of MARCNs as compared to error reports (15 fold difference) validated use of this method for system analysis. Comparison against suitable denominators provided a measure of overall quality, while analysis by categories and subcategories allowed for identification of particular points of system breakdown.

Monthly data, of which space does not allow a detailed summary, showed trends toward a decreased number of MARCNs related to many order processing subcategories. MARCNs may have provided automatic feedback, as the same group that entered the orders also processed MARCNs and made corrections. However, systematic documentation of contributing factors and feedback to the groups involved would provide more feedback more quickly.

The category "Medication Order Related" contributed 2.3% of all MARCNs. The data by no means

reflected the total number of incomplete or poorly written medication orders. The majority were resolved at or before the time of order entry. Rather, these data reflected only instances contributing to errors.

The category "Order Processing Related" accounted for the largest percentage of MARCNs (34.2%). Three subcategories, *Order Missed (Pharmacy)*, *No Copy Received* and *Inaccurate MAR Order Entry* accounted for almost all of these. It should be noted that significant MARCNs were received on only 2.5% of all possible cases (i.e., the number of order entries). This context supports a view that order processing activities were quite accurate. However, as this category was associated with significant potential to result in medication errors, determination of contributing factors was important and could directly lead to improved quality of medication distribution. *Order Missed (Pharmacy)* pinpointed deficiencies in how medication order sheets were scanned at the time of order entry. *No Copy Received* highlighted deficiencies at the ward level in transmitting orders to Pharmacy. *Inaccurate MAR Order Entry* showed deficiencies or difficulties in order entry policies and procedures. The utility of MARCN review in assessing the impact of system changes was shown when delivery of written medication orders to Pharmacy, formerly done using a non-carbon copy, was changed to

facsimile transmission. Subjectively this was well received, but the MARCN data allowed objective assessment as well. The number of MARCNs received belonging to the subcategory *No Copy Received* decreased from approximately 17% of all MARCN received to approximately 8% as a result of this change.

"Dispensing Related" MARCNs were 4.3% of the total. Significant MARCNs were received on 0.1% of possible instances (i.e., all doses dispensed), which demonstrated a high degree of accuracy in this component of the distribution system.

The number of "Interdepartmental Communications" dealing with missing dose replacement requests increased by about 10% over the course of the collection period. Although missing doses were a relatively common problem, subjective evaluation by pharmacists indicated that no perceived increase in this category had occurred. Rather, this increase resulted from improved documentation by pharmacists of telephone requests received. Incomplete documentation was noted after the study had begun and documentation improved once this was drawn to staff members' attention. Methods of communication that circumvent MARCNs (i.e., telephoning) must be documented to provide reliable information.

SUGGESTIONS FOR IMPROVEMENT

Of the three general groups of variables that can influence the quality of medication distribution systems, the first two (Transcription related and Dispensing related) were thoroughly documented using MARCNs. The third variable was not significantly accounted for. This was Administration related, the portion involving all functions after medication has arrived in the patient care area. Methods such as investigating each dose replacement request and each instance that a dose

is returned in the medication cart may provide at least some of the needed information. However, such methods would require much time and effort.

Three differences in categorization would have allowed for improved data analysis. First, *Incorrect MAR Order Entries* should have been further subdivided into specific types to facilitate analysis. Second, within the category "Interdepartmental Communication", the subcategory *Refill prn/Replaced missing doses* should have been divided into two separate entities, allowing for better determination of the number of missing doses. Third, the category "Interpretational" should have been further subdivided into, for example: *Not Reordered Post Op, Patient No Longer Requiring, Order Precluded, PCA/Epidural Out*. This category accounted for over 20% of the total number of MARCNs

received and more detailed recording could have highlighted areas for improvement.

In conclusion, medication error rates reflect the quality of medication distribution systems but are grossly underestimated when gauged by the number of incidents documented in reports. As well, individual reports do not provide sufficient information regarding contributing factors. Evaluation of MARCNs, as a reflection of many aspects of the distribution system, provides a more valid estimation of overall quality. In addition, MARCNs (or groups of MARCNs) are useful tools for directly identifying points of breakdown within the system. Objective insight obtained by review of these breakdowns can then be used to alter the system, thereby improving quality and lessening the potential for medication errors. Finally, MARCNs

can also provide objective criteria to evaluate the impact of changes made to the distribution system. ☐

REFERENCES

1. Allan EL, Barker KN. Fundamentals of medication error research. *Am J Hosp Pharm* 1990; 47:555-71.
2. Anon. CSHP Standards, Guidelines, and Statements. Canadian Society of Hospital Pharmacists May 1991.
3. Barker KN, McConnell WE. The problems of detecting medication errors in hospitals. *Am J Hosp Pharm* 1962; 19:360-9.
4. Shannon RC, DeMuth JE. Comparison of medication-error detection methods in the long term care facility. *Consult Pharm* 1987; 2:148-51.
5. Barker KN, Kimbrough WW, Heller WM. A study of medication errors in a hospital. Fayetteville: University of Arkansas; 1966.
6. Tisdale JE. Justifying a pediatric critical-care satellite pharmacy by medication error reporting. *Am J Hosp Pharm* 1986; 43:368-71.