USP Medication Safety Forum

The Impact of Abbreviations on Patient Safety

Luigi Brunetti, Pharm.D.
John P. Santell, M.S., R.Ph.
Rodney W. Hicks, Ph.D., A.R.N.P.

Department Editor: James G. Stevenson, Pharm.D., College of Pharmacy, University of Michigan, and University of Michigan Hospitals. This department features medication error issues based on data collected by the United States Pharmacopeia (USP).

Within the past decade medication errors have emerged as a significant patient safety concern and have been shown to account for up to 7,000 deaths per year.[1] One intervention aimed at reducing the incidence of medication errors is improving written or electronic communications, particularly in patient medical charts. In 2004 The Joint Commission introduced the "Do Not Use" list of abbreviations[2] as part of the requirements for meeting National Patient Safety Goal 2, which addresses the effectiveness of communication among caregivers. Goal 2B requires health care organizations to maintain a standardized list of abbreviations, acronyms, and symbols that are not to be used.[3]

In addition to the "Do Not Use" list, the organization is required to develop additional restrictions pertaining to the use of abbreviations. In May 2005, the Joint Commission's required "Do Not Use" list was reaffirmed[4,5] (Table 1, page 578). Despite the list's availability since 2004, noncompliance remains a frequent finding (23%) during Joint Commission surveys. Furthermore, annual Joint Commission survey results have shown a decreasing trend (from 75.2% to 64.2%) in compliance in hospitals from 2004 to 2006.[6]

Communication failures are the most common root cause of sentinel events, accounting for more than 60% of events from 2002 through 2006.[7] Frequently, communication lapses are the result of using abbreviations when conveying medication orders. Staff responsible for reading, interpretation, and processing medication orders may not recognize or may misconstrue an abbreviation, resulting in the alteration of the intended meaning. An example commonly reported is the misinterpretation of the letter "U" intended to represent the word "units" being frequently interpreted as a 0 (that is, "10U" is misread as "100" units). If not caught, this error would likely result in the administration of an inappropriate dose, potentially harming patients.[8] To our knowledge, however, the deleterious effect of using abbreviations has not been previously quantified. The purpose of this study was to provide further evidence about patient safety risks that result from using abbreviations.

The United States Pharmacopeia (USP) MEDMARX® program is a national medication error reporting program that allows subscribing facilities (hospitals and their related health systems) to report and track medication errors in a standardized format. MEDMARX uses the National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP) Index for Categorizing Medication Errors to measure error outcomes, in which Categories E through I indicate patient harm.[9,10] The validity of this instrument was recently reaffirmed.[11] The characteristics and impact of abbreviation use are summarized and analyzed in this article on the basis of error records submitted to MEDMARX between 2004 and 2006.

Methods

All error records submitted during the study period that contained "Abbreviation" as one of the causes of error were

Methodology

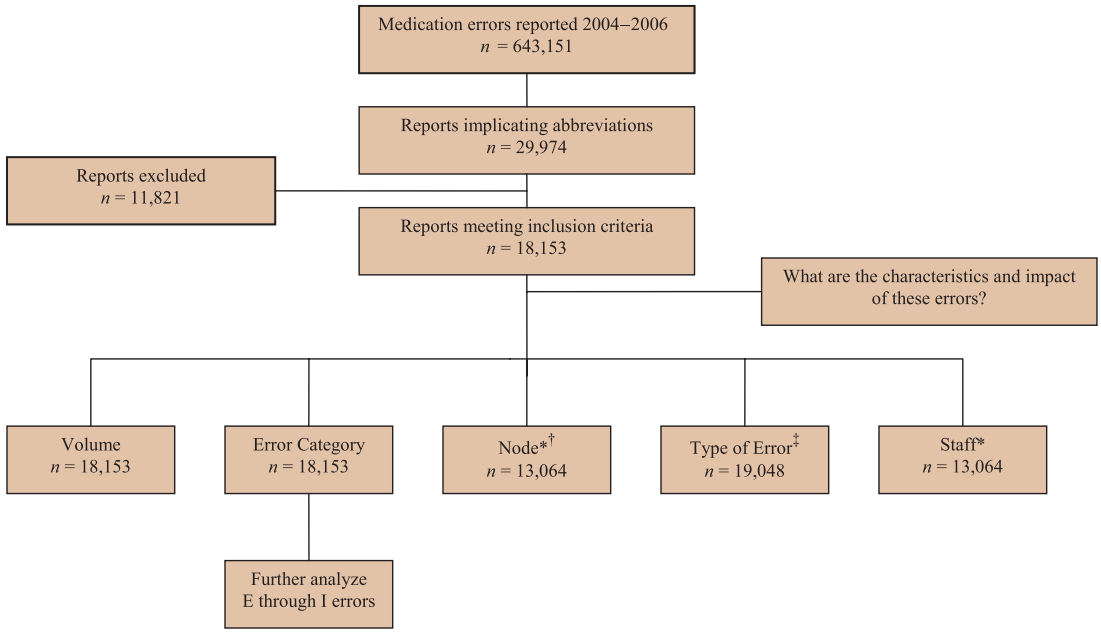

Figure 1. *The study's methodology is outlined.*

identified and exported to a worksheet format. Machine reading of the records was done using keywords (from the "Do Not Use" list and previous USP publications[12,13]) in filter mode. Figure 1 (above) outlines the methodology of the study. The researchers also read any record that could not be machine read, looking for evidence of any abbreviation that was involved in the errors. Any record that could not be associated with a particular abbreviation was discarded from the sample.

Each record that remained in the final data set was evaluated, using the Index for Categorizing Medication Errors, for the node (or phase in the medication use process), the level of staff associated with making the error, and the type of error that resulted. When records were assessed for the types of error involved in the event, the number of times a type of error was selected rather than the number of records containing that error type was used for calculations because each error record may have contained more than one type of error. Errors were also examined by discipline (medicine, pharmacy, or nursing) involved in the event. All data were analyzed using descriptive statistics.

Findings

Sample

From 2004 through 2006 a total of 643,151 medication errors were reported to the MEDMARX program from 682 facilities. Of these errors, 29,974 (4.7%) were attributable to abbreviation use. Through machine and staff reading, records were grouped into themes or discarded. Approximately 39.4% (n = 11,821) of the abbreviation errors were excluded due to lack of information provided from the reporter in the error description to allow classification of the abbreviation. The final sample size consisted of 18,153 medication error reports. These reports were distributed into the appropriate recurring themes, hereafter referred to as abbreviation groups.

The primary variables measured included (1) volume or

Table 1. The Joint Commission's "Do Not Use" Abbreviation List*

Do Not Use	Potential Problem	Use Instead
U (unit)	Mistaken for "0" (zero), the number "4" (four), or "cc"	Write "unit"
IU (International Unit)	Mistaken for "IV" (intravenous) or the number "10" (ten)	Write "International Unit"
Q.D., QD, q.d., qd (daily) Q.O.D., QOD, q.o.d., qod (every other day)	Mistaken for each other; period after the "Q" mistaken for "I" and the "O" mistaken for "I"	Write "daily" Write "every other day"
Trailing zero (X.0 mg)† Lack of leading zero (.X mg)	Decimal point is missed	Write "X mg" Write "0.X mg"
MS MSO4 and MgSO4	Can mean morphine sulfate or magnesium sulfate; confused for one another	Write "morphine sulfate" Write "magnesium sulfate"

* Applies to all orders and all medication-related documentation that is handwritten (including free-text computer entry) or on preprinted forms.
† Exception: A "trailing zero" may be used only where required to demonstrate the level of precision of the value being reported, such as for laboratory results, imaging studies that report size of lesions, or catheter/tube sizes. It may not be used in medication orders or other medication-related documentation.

distribution of reports in each abbreviation group, (2) the error outcome using the NCC MERP Index, (3) node where error originated, (4) staff involved, and (5) type of error.

Abbreviation Groups

The frequency of abbreviation groups involved in medication errors is summarized in Table 2 (page 579). The most common abbreviation resulting in a medication error was the use of "QD" in place of "once daily," accounting for 43.1% of all errors, followed by "U" for units (13.1%), "cc" for "mL" (12.6%), "MSO4" or "MS" for "morphine sulfate" (9.7%), and decimal errors (3.7%). Drug name abbreviations other than MSO4 (morphine sulfate) or MgSO4 (magnesium sulfate) were represented by the abbreviation group "drug name." Abbreviations for drug names using the stem (for example, nitro = nitroglycerin) were placed in the abbreviation group "stem."

Error Outcome

The majority of errors were associated with an NCC MERP categorization of A, B, or C (28%, 67.2%, and 3.8%, respectively). Using the sample size available for evaluation as the denominator (n = 18,153); 0.3% of errors resulted in patient harm (NCC MERP Categories E through I). The most common abbreviations resulting in patient harm are summarized in Table 3 (page 580).

Node where Error Originated

Eighty-one percent of the errors occurred at the prescribing node of the medication process, while errors occurring at the transcribing and dispensing nodes occurred with much less frequency, representing only 14% and 2.9% of errors, respectively. Administration, monitoring, and procurement combined represented less than 2% of errors.

Staff Involved

Abbreviation errors originated more often from medical staff (78.5%) in comparison to nursing (15.1%), pharmacy (4.2%), other health care providers (1.3%), and non–health care providers (0.9%). As shown in Table 4 (page 581), the abbreviations with the greatest incidence differed among staff. For example, the top abbreviation errors among medical staff were "sc" (90.4%; 319/353 occurrences), "HS" (87.8%; 424/483), and "cc" (83.7%; 1705/2036), while the top abbreviations among nursing staff were "IU" (46.2%; 6/13), "stem"drug names, (29.4%; 5/17 incidents), and "TID" (27.8%; 20/72). The use of "BID" (21.2%; 35/165), "µg" (20.9%; 14/67 occurrences), and "d/c" (20.3%; 25/123) were identified as the abbreviation errors with the greatest incidence within the pharmacy staff.

Table 2. Frequency of Selected Abbreviations Associated with Errors*

Abbreviation Group	Error Number	Error %
QD = once daily	7,827	43.1%
U = units	2,378	13.1%
cc = mL	2,281	12.6%
MSO4, MS = morphine sulfate	1,768	9.7%
decimal error (i.e., X.0 mg or .X mg)	666	3.7%
HS = at bedtime	541	3%
MgSO4, Mag, Mg = magnesium sulfate	459	2.5%
sc or sq = subcutaneous	375	2.1%
QOD = every other day	305	1.7%
1/2	277	1.5%
x d (i.e., x 3 d; days or doses?)	216	1.2%
QID = four times daily	211	1.2%
d/c or dc (discharge or discontinue?)	200	1.1%
BID = twice daily	180	1%
Drug name (i.e., HCTZ, T3, ARA-C)	153	0.8%
µg = mcg	84	0.5%
< or >	84	0.5%
TID = three times daily	78	0.4%
Stem (i.e., "nitro," "IV vanc")	29	0.2%
IU = international units	24	0.1%
os, od, ou = left eye, right eye, or both eyes	16	0.1%

* Based on percentage of 18,153 reports.

Types of Error

Errors involving abbreviations were also examined by the types of error associated with the event. A total of 19,048 error type selections were reported in 18,153 records and sorted to their respective abbreviation groups. Overall, the three most common types of error resulting from abbreviation use were prescribing (67.5%), improper dose/quantity (20.7%), and incorrectly prepared medication (3.9%). When evaluating the frequency of types of error by the five most frequently reported abbreviations (QD, u, cc, MSO4 or MS, and decimal—the inappropriate use of leading or trailing zeros), the error-type incidence was very similar, with prescribing (68.8%) as the most common type of error, followed by improper dose/quantity (21.9%) and incorrectly prepared medication (3.5%). Furthermore, if the top five abbreviations were removed from the data pool (decreasing the data pool to n = 3474), the incidence of error type would still be greatest among prescribing (61.8%) and improper dose quantity (15.4%).

Abbreviations and Miscommunication: Case Examples

Case 1

A 62-year-old patient on hemodialysis was treated for a viral infection with acyclovir. The order for acyclovir was written as "acyclovir (unknown dose) with HD." The order was misinterpreted as TID (three times daily). Intravenous acyclovir should be adjusted for renal impairment and given after hemodialysis once daily. The patient received three doses daily during a two-day period, resulting in a rapid mental decline, delirium, and subsequent death.

Case 2

A hydromorphone epidural was prescribed for a patient and written as "2 µg/mL." The pharmacist incorrectly entered the order as "500 mg in 250 mL" and prepared and labeled the medication as "2 mg/mL." The error was perpetuated when the nurse incorrectly interpreted the labeled medication and administered a 1,000-fold dose variance. The patient developed marked respiratory depression requiring intubation and mechanical ventilation, in addition to compromised cardiac function requiring chest compressions and pharmacological intervention. The epidural was removed and naloxone was administered as a continuous infusion to antagonize the effects.

Case 3

A 53-year old male patient whose chief complaint was mid-sternal chest pain was evaluated by a cardiologist. On evaluation the physician believed that the pain was not cardiac in nature, but rather of gastrointestinal origin. An order for "MDX/GI" cocktail was written. Pharmacy prepared the compound, which is composed of Mylanta® (aluminum hydroxide, magnesium hydroxide, and simethicone), diclomine, and Xylocaine® (lidocaine). On administration, the patient experienced difficulty breathing, followed by respiratory distress. A code was called and

Table 3. Top Five Abbreviation Groups Associated with Patient Harm*

Abbreviation Group	Total Errors	Category					Totals	Percentage
		E	F	G	H	I		
U	2,378	28	1	0	1	0	30	1.26%
Drug name	152	2	1	0	0	0	3	1.97%
Stem	31	0	0	0	2	0	2	6.45%
TID	78	0	0	0	0	1	1	1.28%
mcg	84	0	0	0	1	0	1	1.19%
Totals	*2,723*	*30*	*2*	*0*	*4*	*1*	*37**	*1.36%*

* The top 5 abbreviations associated with patient harm account for 69% (37 of 54) of all errors resulting in patient harm.

administration of epinephrine resolved symptoms. The patient had a well-documented allergy history to lidocaine. Both nursing staff and physician were unaware that MDX/GI cocktail contained lidocaine.

Discussion

Medication errors are often associated with illegible handwriting of orders, which often include abbreviations. With the increased adoption of information technology, the use of abbreviations in drug data libraries and computer-entry screens will continue to pose a threat to patient safety. The results of this study provide further evidence that abbreviation use remains prevalent and can result in patient harm despite the introduction of the National Patient Safety Goal to improve communication and restrict the use of abbreviations. Few studies have quantified the extent of such errors in terms of volume or error severity. Since the adoption of The Joint Commission list of prohibited abbreviations, it appears that awareness has led to increased reporting of medication errors stemming from abbreviation use. In addition, the reporting of abbreviations as a cause of medication errors before the introduction of the Joint Commission National Patient Safety Goals in 2002 represented 1% of all reported medication errors, compared with an average of 4.5% since (2003-2006).[14] Continued reporting of errors associated with abbreviations is critical in the identification of error-prone practices and the improvement of patient safety.

Although the incidence of patient harm is low, any incidence which can be avoided is a target toward which everyone should strive. A simple risk-versus-benefit analysis of abbreviation use versus prohibition will reveal that whereas using abbreviations may save minutes, prohibiting abbreviations may save lives.

Abbreviation errors originated at the prescribing node more often than all other nodes combined. One may argue that errors originating at this node are less problematic because the pathway between prescribing and patient receipt of the order is designed to intercept errors; however, they do present unnecessary risk. Fundamentally, removal of the originating causes of the error (that is, abbreviations) is more sensible than relying on quality control measures to intercept the error before it reaches the patient.

A study performed by Bates et al.[15] revealed that approximately 30% of all handwritten prescriptions required clarification and correction by a pharmacist to prevent an error. Pharmacy and nursing are often charged with contacting the prescriber when abbreviations confound orders. This often causes conflict between the health care professions, further deteriorating communication. Potential solutions to this dilemma include engagement of medical staff leadership, accountability for habitual offenders, rewards for nonusage, and education.

The identification of which staff members contribute to the medication errors associated with individual abbreviations highlights areas for further staff development. Education targeted at illustrating the dangers of abbreviation use is essential. If data and illustrative case reports (perhaps organization-specific) are presented, awareness of the perils of abbreviation use will be heightened. Identifying by discipline the most common abbreviations that resulted in errors may be of value for designing interventions aimed at various health professionals. For example, physician education initiatives should include limiting the use of "sc," "hs," and "cc"—the most common infractions. A similar approach may be taken for pharmacy and nursing.

Education is often not enough; enforcement is required to ensure that abbreviations are not used.[16] This may be done by holding health care professionals accountable for infractions. Medical staff leadership must be engaged to

Table 4. Staff Involved with Various Abbreviation Groups*

Abbreviation Group	Total Errors Reported†	Staff				
		Medicine (%)‡	Pharmacy (%)‡	Nursing (%)‡	Other HCP (%)‡	Non-HCP (%)‡
QD = once daily	5,493	4,469 (81.4)	171 (3.1)	750 (13.7)	71 (1.3)	32 (0.6)
cc = mL	2,036	1,705 (83.7)	43 (2.1)	271 (13.3)	5 (0.2)	12 (0.6)
U = units	1,606	1,176 (73.2)	58 (3.6)	323 (20.1)	35 (2.2)	14 (0.9)
MSO4, MS = morphine sulfate	1,044	752 (72)	38 (3.6)	235 (22.5)	14 (1.3)	5 (0.5)
HS = at bedtime	483	424 (87.8)	23 (4.8)	25 (5.2)	5 (1)	6 (1.2)
decimal error (i.e., X.0 mg or .X mg)	480	376 (78.3)	13 (2.7)	74 (15.4)	3 (0.6)	14 (2.9)
sc or sq = subcutaneous	353	319 (90.4)	7 (2)	25 (7.1)	0 (0)	2 (0.6)
MgSO4, Mag, Mg = magnesium sulfate	243	186 (76.5)	4 (1.6)	50 (20.6)	2 (0.8)	1 (0.4)
½	225	150 (66.7)	30 (13.3)	32 (14.2)	11 (4.9)	2 (0.9)
QOD = every other day	188	118 (62.8)	24 (12.8)	34 (18.1)	7 (3.7)	5 (2.7)
BID = twice daily	165	106 (64.2)	35 (21.2)	12 (7.3)	7 (4.2)	5 (3)
x d (i.e., x 3 d; days or doses?)	149	110 (73.8)	8 (5.4)	25 (16.8)	4 (2.7)	2 (1.3)
d/c or dc (discharge or discontinue?)	123	69 (56.1)	25 (20.3)	24 (19.5)	1 (0.8)	4 (3.3)
QID = four times daily	119	90 (75.6)	12 (10.1)	11 (9.2)	3 (2.5)	3 (2.5)
Drug name (i.e., HCTZ, T3, ARA-C)	109	74 (67.9)	9 (8.3)	21 (19.3)	3 (2.8)	2 (1.8)
TID = three times daily	72	34 (47.2)	14 (19.4)	20 (27.8)	2 (2.8)	2 (2.8)
µg = mcg	67	33 (49.3)	14 (20.9)	18 (26.9)	1 (1.5)	1 (1.5)
< or >	64	38 (59.4)	12 (18.8)	14 (21.9)	0 (0)	0 (0)
Stem (i.e., "nitro," "IV vanc")	17	10 (58.8)	2 (11.8)	5 (29.4)	0 (0)	0 (0)
os, od, ou = left eye, right eye, or both eyes	15	9 (60)	3 (20)	2 (13.3)	0 (0)	1 (6.7)
IU = international units	13	7 (53.8)	0 (0)	6 (46.2)	0 (0)	0 (0)
Totals	13,064	10,255 (78.5)	545 (4.2)	1,977(15.1)	174 (1.3)	113 (0.9)

* HCP, health care provider.

† Totals based only on reports identifying staff implicated in abbreviation error.

‡ Percentages of errors by staff within each abbreviation group.

exert peer pressure and support for the policy. Likewise, an endorsement from the pharmacy and therapeutics committee may also be a good source for awareness and enforcement policy for pharmacy departments. Senior nursing leaders share a similar responsibility for eliminating the use of inappropriate abbreviations by nursing staff. Peer-initiated programs tend to have better staff acceptance. Therefore, the identification of key leadership figures respective to each discipline responsible for implementing peer accountability is a crucial element for success.

Several negative outcomes may develop as a result of lapses in communication originating from commonly used, error-prone abbreviations. For example, prescribing errors have the propensity to be perpetuated and result in patient harm when abbreviated drug names are confused with other products, scheduling instructions are unclear, or units of measure are ambiguous. Improper dosages that are excessive may lead to medication toxicity. Conversely, improper dosages that underdose may lead to subtherapeutic drug levels, which could contribute to increased hospital stays, treatment failures, and in the case of antibiotics, drug resistance. Improper medication preparation results in unnecessary drug expenditure and waste, in addition to potentially exposing patients to unnecessary pharmacologic agents.

Limitations

Several limitations were evident during analysis of the

Table 5. Recommendations for Improving Communications Through Minimization of Abbreviation Use

- Initiate a campaign to eradicate the use of abbreviations in clinical practice; an interdisciplinary approach is essential.
  - –Use "Dear Doctor" letters
  - –Post prohibited abbreviation lists on hospital identification badges, in patient charts, newsletters, an intranet site, computer screen savers, and announcement boards.
  - –Use peer-initiated accountability.
  - –Give rewards for non-usage.
- Educate staff on the harmful effects of abbreviations.
- Minimize the use of abbreviations; write out the drug name, schedule, unit of measure.
  - –Prohibit use in patient charts, preprinted order forms, computer programs.
- Clarify intent to avoid misinterpretation if abbreviations are found.
- Introduce computerized physician order entry (CPOE) in a manner that minimizes the use of abbreviations.
- Review all computer-entry software for potential abbreviation issues.
- Prohibit the use of abbreviations in all facility publications (e.g., newsletters).
- Include industry, organizational, educational, and professional bodies in error-prone abbreviation awareness and avoidance, as the multifaceted nature of health care requires a global approach.

data. Reporter bias or inexperience may have contributed to conservative categorization of errors. This was seen particularly in the "U," "MSO4," and "MgSO4" groups because reporters tended to be more conservative in assigning the error to an NCC MERP Index category. Furthermore, reporting may be biased to find only those errors that are associated with abbreviations from The Joint Commission's "Do Not Use" abbreviation list, resulting in a higher ranking for those abbreviations than others. In addition, the incidence of patient harm associated with abbreviation use was based on a small sample size in several of the top five abbreviations associated with patient harm. Another limitation, which is discussed in greater depth in the Conclusion and Recommendations, is the large number of records (39.4%) excluded because of the lack of error description and subsequent identification of the error causing abbreviation. This decreased the viable sample size and thus eliminated records with the potential to identify additional error-prone abbreviations or to strengthen data supporting prohibition of error-prone abbreviations.

Conclusion and Recommendations

Nearly 5% of all errors reported to MEDMARX from 2004 through 2006 were attributable to abbreviations. Armed with the understanding that communication is the leading cause of sentinel events and that abbreviation use hinders communication, limiting abbreviation use improves patient safety and patient care. In addition, error-prone abbreviations are preventable and therefore are a logical area for improvement. Although the use of abbreviations may be more time efficient, it comes at the expense of creating barriers to communication, which is detrimental to patient safety. This study provides further support to the "Do Not Use" list.

This analysis of nearly 30,000 medication error reports involving abbreviations suggests that health care organizations should examine other additions to the "Do Not Use" list. Some atypical abbreviations resulted in patient harm and are worthy of consideration for inclusion in facility-specific lists. Good candidates for incorporation into such lists include drug name abbreviations (for example, PCN, DCN, TCN), stem abbreviations (amps, nitro, succs), µg (mcg), cc (mL), and dose scheduling (BID, TID, QID).*

As previously stated, 39.4% of the 29,794 errors in which abbreviations were identified as the cause of error could not be used in data analysis because of insufficient error descriptions, meaning that the exact abbreviation was unidentified. This is of concern because these data have the potential to benefit clinical practice through illustration of potential harm associated with these abbreviations. When reporting medication errors, it is essential for the reporter to include the key points that adequately

* Drug name abbreviations, cc, and µg (mcg) are among the additional abbreviations, acronyms, and symbols suggested for possible future inclusion in the official "Do Not Use" List. The Joint Commission: *Official "Do Not Use" List.* http://www.jointcommission.org/NR/rdonlyres/2329F8F5-6EC5-4E21-B932-54B2B7D53F00/0/06_dnu_list.pdf (last accessed Jun. 11, 2007).

describe the error—cause of the error, brief description of the cause (in the case of abbreviations, what abbreviation), the contributing factors, the outcome, staff involved, and the point in the medication process where the error occurred.

Recommendations for improving communications through minimization of abbreviation use are provided in Table 5 (page 582). J

Luigi Brunetti, Pharm.D., formerly Specialty Resident in Drug Information, Drug Information Service, Ernest Mario School of Pharmacy, Rutgers, the State University of New Jersey, and Robert Wood Johnson University Hospital, New Brunswick, New Jersey, is a Clinical Assistant Professor, Ernest Mario School of Pharmacy. **John P. Santell, M.S., R.Ph.,** is Director of Practitioner Programs and Services, Department of Healthcare Quality and Information, United States Pharmacopeia, Rockville, Maryland. **Rodney W. Hicks, Ph.D., A.R.N.P.,** is Manager, Patient Safety Research. Please send reprint requests to Luigi Brunetti, brunetti@rci.rutgers.edu.

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