Good pharmacy practice should be reflected in lower reported error rates, but there may be an "honesty tax" for the conscientious and thorough error reporting reflected in higher error rates.

PERFORMANCE MEASURES AND MEASUREMENT

Are Medication Error Rates Useful as Comparative Measures of Organizational Performance?

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Health care providers are faced with increasing demand for accountability and information. A wide variety of organizations are currently developing indicators and other performance measures for purposes of both internal quality improvement and comparison of performance across providers.* Patients/consumers, employers, and payers expect to compare institutions based on these indicators. During the past few years, health care providers have reluctantly begun to accept this inquiring eye into previously sacred internal affairs.

At first glance, medication error rates seem ideal comparative measures for the public, who obviously want to be treated at facilities in which the fewest errors occur. However, because there are so many factors that can affect reported error rates, there is some question as to whether the public is well served by using error rates as a barometer of quality.

Adverse events in health care are significant,[1,2] disruptive social problems with both personal and

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Article-at-a-Glance

Background: Although medication error rates seem a plausible indicator, it is not a foregone conclusion that error rates are good barometers of quality.

Methodology: This article is based on a multisite, nationwide study of one contributor to medication errors: pharmacy dispensing errors. Using questionnaires, directors of pharmacy at 157 member hospitals of a national health care management firm reported their average daily medication dispensing loads and the number of dispensing errors per 100 patient days during one quarter. Stepwise discriminant analysis was used to seek characteristics of high versus low reported error rates, as well as characteristics that could distinguish hospitals that reported no errors from those that reported errors.

Discussion: Results show that currently measured error rates represent a process within an organization and can range from no or few errors to substantial errors, with the variation reflecting a variety of scenarios. Hospitals that do not measure error rates obviously report no errors. Inattention or a lack of clear methods to collect and define errors can also result in no reported errors or low error rates. In contrast, a hospital that standardizes and implements a measurement scheme may have high reported error rates. Progressive experimentation with systemwide error prevention and process improvement will result in varying error rates. Logically, if hospitals are punished for reporting high error rates, they will start reporting lower error rates regardless of the true rates. Finally, successful management practices will be reflected in low error rates.

Conclusion: The focus on measuring medication error rates is important for improving quality within organizations because drug-related errors are an important cause of adverse events. However, the variances in error-reporting rates and the variables associated with those variances documented in this study raise serious questions about the usefulness of comparing error rates between hospitals based on voluntary reports. Interorganizational comparisons of rates are not likely to be meaningful and may be counterproductive.

societal costs. Medication use is one of the seven major areas for which the Joint Commission on Accreditation of Healthcare Organizations is developing and implementing indicators[3]; a medication error rate is one of the indicators still being tested. The Harvard Medical Practice Study found that drug complications were the most common type of adverse event in patient care (19.4%).[4]

Current literature and research concerning adverse events and medication errors emphasize the investigation of error activity *within* institutions, including analysis of causes and prevention of errors.[5-7] However, if medication error rates are to be used as comparative indicators of institutional quality, then these rates must be ascertained as reliable to make any comparisons meaningful. One avenue of determining this reliability is to examine certain characteristics about the institutions and relate them to reported error rates.

The medication administration process begins with the manufacturer who creates the drugs and ends with the patient who takes them; in between are the physician, pharmacist, and nurse (Figure 1, p 194). Errors can occur anywhere in the process. Traditionally, prevention of medication errors, including detection and monitoring, has been considered a department-level responsibility, usually involving pharmacy, nursing, and medicine. Today's analysts, however, realize that prevention is a systemwide problem requiring a multidisciplinary solution. Although the director of pharmacy is just one member of that multidisciplinary group, he or she is most likely to have the understanding and skills to drive a process that will lead to a successful system for preventing medication administration errors.[8]

Methods

This article is based on a multisite, nationwide study of one aspect of medication errors: pharmacy dispensing errors. The unit of analysis is the hospital, and the primary outcome is the

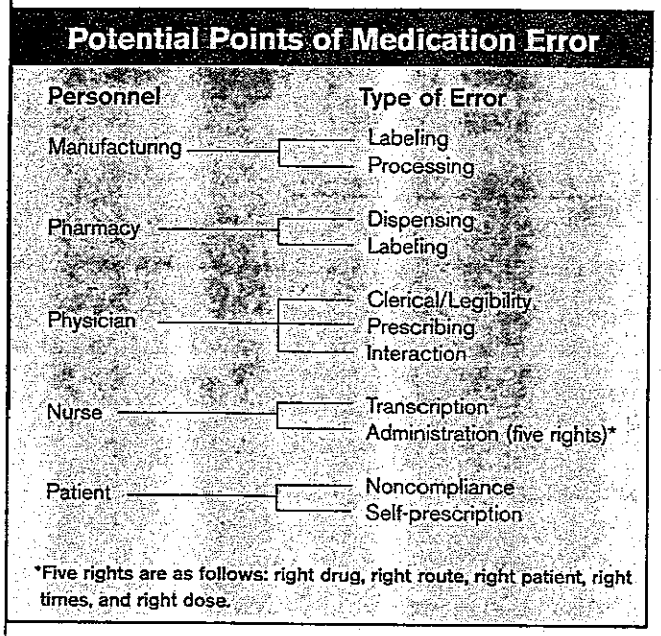

Figure 1. *The medication administration process begins with the manufacturer creating drugs and ends with the patient taking them.*

reported dispensing error rate. We sought to determine operational aspects of a hospital and its pharmacy that could predict pharmacy dispensing error rates. Additionally, we attempted to discern whether the pharmacy dispensing error rate is a valid measure of the quality of service rendered by the pharmacy.

A national health care management firm collaborated on the study, and survey questionnaires were sent to the directors of pharmacy at 227 hospitals associated with the management firm. A total of 165 (73%) hospitals responded, and 157 surveys (69%)—all from hospitals associated with the health care management firm for at least three months—were completed.

A comparison between surveyed hospitals and all hospitals in the United States showed that surveyed hospitals were smaller (for example, 11% had more than 200 beds versus 38% for all hospitals), offered fewer intensive services, were more likely to be for-profit, and were more likely to be clustered in the south-central states (Arkansas, Louisiana, Oklahoma, Texas) rather than New England. Despite these differences, the surveyed hospitals offered a national cross section of pharmacies and pharmacy practices.

Ninety percent of the hospitals had average lengths of stay of fewer than ten days. The average daily medication dispensing load ranged from 75 to 10,000 doses per day (mean = 1,000; SD = 1,472).

The dependent variable is pharmacy dispensing error rates, the number of errors per 100 patient days for the fourth quarter of 1992. Reported error rates ranged from zero to 3.975 (mean = 0.168 and median = 0.083). Excluding the zero responses, the mean was 0.21 and the median was 0.105.

Theoretically, this database of 227 hospital pharmacies used a consistent definition of dispensing error. The health care management company defined pharmacy dispensing errors as those discovered after the drug leaves the pharmacy, as well as (1) prescribed drugs not dispensed, (2) drugs not available at the nurse's scheduled administration time, and (3) drugs dispensed after the order had been discontinued. To test the effects of possible internal variation in error definitions, independent variables of error definition were included in the study.

Two general categories of error identification seem prevalent in the literature: self-reporting and direct observation. Self-reporting can be done anonymously or through incident reports. The anonymous self-report allows the person committing (or witnessing) the error to report the mistake without being associated with it. This low-risk method enables staff to identify errors with relatively little fear of receiving disciplinary action.[9] Its primary disadvantage is that errors will not be reported unless discovered, thereby making self-reported error rates almost invariably low. In the direct observation technique, an observer witnesses the administration of each dose and later compares that with the actual physician order. In the disguised observation variation of this method, the person giving medications is unaware of the observer, while in the undisguised variation, the observer accompanies the person giving medications. An error is recorded when any discrepancy is found.[10] Advantages of this technique include the ability to detect more errors than any other system and the use of an objective observer. Disadvantages

include observer fatigue, influence of the observer on the subjects, mistaken inference of the observer in analyzing the process, and high cost.[11]

Gross underreporting of errors through incident reports has been documented. In one study, 36 errors were reported via incident reports for one year, although results of a direct observation sample suggested that 51,200 errors (or 1,422 times as many) may have occurred during the same year.[9] A later study detected a mean error rate of 9.6% with the direct observation method and 0.2% with the incident reporting method.[12]

Additional results raise questions about the reliability of self-reported errors. For example, what are the implications of the fact that 21% of hospitals in our survey reported zero errors? Were zero errors possible? Did zero errors have an implication beyond just being the low end of a continuous variable? One might think that using a narrow technical definition of dispensing error would contribute to a report of zero errors. In fact, 40% of the zero-reporting hospitals in our study used very broad definitions of error. Another possibility was that small hospitals might be more likely to report zero errors. Yet, bed size was not a contributing factor. Additionally, the average daily dispensing load was not a factor in distinguishing zero-reporting hospitals, which had medication dispensing loads ranging from 86 to 5,800 doses per day.

Clearly, a zero error response that was possibly inaccurate was a unique phenomenon. Therefore, zero was not treated as a number, but as the opposite of *any* response other than zero. In effect, a new question was asked, "Why are errors reported or not reported?"

Four clusters of possible factors affecting dispensing error rates other than error definition can be identified: hospital characteristics, pharmacy features, pharmacists' perceptions, and error prevention activities[5, 7, 8, 11, 13-15] (Table 1, p 196).

Stepwise discriminant analysis was used to analyze the data. The first discriminant analysis omitted the middle third of the distribution (0.10–0.14), seeking characteristics of high versus low reported error rates without the zero-reporting hospitals. The second analysis sought characteristics of those hospitals reporting no errors versus those reporting any errors.

Results and Discussion

Discriminant analysis revealed that five variables in combination explained 19.1% of the variance between hospitals reporting low and high error rates. The variables that characterized hospitals with the lowest pharmacy dispensing error rate are shown in Table 2 (p 197).

Teaching hospitals appeared to have lower reported error rates than nonteaching hospitals in our study, a finding that seemingly contradicts other reports. Brennan et al, for example, have suggested that teaching hospitals had a higher percentage of adverse events than nonteaching hospitals.[13] Evidently, the incidence of adverse events cannot be equated with identifying and reporting dispensing errors. A reported error is not necessarily an adverse event. Alternate explanations include (1) student work may be more closely supervised and, therefore, more accurate, or (2) student errors are not counted in hospital reporting systems.

Pharmacists who enjoy open communication with physicians are more likely to report lower error rates. Open lines of communication can optimize therapeutic appropriateness and enable medication to be prescribed, dispensed, and administered in a timely and accurate fashion. On the other hand, pharmacists could be ignoring certain errors because of the close relationships. Error prevention is repeatedly reported as a system issue.[14] Although this study loosely classified communication as a perception variable, communication is also a systemwide error-prevention activity. Poor communication could be a symptom of either poor management, defensive management, inadequate computer information systems, or feelings of blame.

Discriminant analysis revealed that seven variables in combination explained 36.7% of the variance between hospitals reporting zero errors and those reporting more than zero errors. The variables that characterized hospitals reporting

Table 1. **Independent Variables for Dispensing Error Rates**

Hospital Characteristics
1. Teaching status
2. Length of time managed by pharmacy management firm
3. Scope of services: Pediatrics and/or psychiatry
4. Operating surplus/loss last fiscal year
5. Occupancy rate

Pharmacy Features
6. Use of pick stations
7. Pharmacist-to-technician ratio
8. Daily Computerized Medication Administration Records
9. Twenty-four hour pharmacist coverage
10. Computerized order entry
11. In-house training topics (for example, recognition of potential administration errors, similar sounding name drugs, drugs that are patient/age-specific, duplicate therapeutic agents)

Pharmacists' Perceptions
12. Error rates used as measure of effectiveness
13. Error rates are a good measure of effectiveness
14. Communications between pharmacist and physician

Error Prevention Activities
15. Standard abbreviations required
16 Mandate lead zero for decimals
17. Use of *qd* (*quaque die*, "every day") abbreviation not permitted
18. Routine double-check of dispensed medications when the pharmacist is the primary dispenser
19. Tracking of returned medications

Error Definition
20. Technical errors (for example, wrong dose/wrong drug, labeling error)
21. Cognitive errors (dispensing a contraindicated drug or drug to which the patient has a known allergy)
22. Potential error (for example, orders not filled in time for scheduled administration, orders filled but not delivered to patient care areas)

zero pharmacy dispensing errors are shown in Table 3 (p 197).

Most of the variables associated with hospitals reporting zero errors are characteristic of low-occupancy–rate hospitals with less-extensive pharmacy practices: narrow error definitions, minimal or no error-prevention education, less than optimal use of pick stations, and no daily computerized medication administration records (MARs). Daily computerized MARs are especially important because they provide a means to survey medication delivery from pharmacy to patient and allow sorting and identification of types, location, and sources of errors.

Pharmacists who perceive that error rates are used to measure their pharmacy's performance are more likely to report zero errors and lower error rates. As Deming stated, those who feel fear will try to protect themselves rather than strive to improve.[15] Pharmacists who fear that error reporting will lead to embarrassment or reprimand may not be diligent in data collection and may report fewer errors. Managers who work in an environment that does not view errors as opportunities for improvement are more likely to be blind to errors or to underreport them.

High occupancy rates (frequently used measures of system efficiency) were associated with the reporting of any errors. If error prevention requires attention to system efficiency,[13] hospitals may be successful because they have systems to evaluate quality data and then use those data to further improve the system.

Comprehensive education and broad error definitions were associated with improved reporting systems (more than zero errors reported), and

Table 2. Variables That Characterize Hospitals with the Lowest Pharmacy Dispensing Error Rates

- Communication between pharmacists and physicians perceived to be very good
- Potential errors (delivery or delay errors) not used in the error definition
- Pharmacist reports that errors are used to measure the pharmacy's performance
- Fewer pharmacists than technicians
- A teaching hospital

Table 3. Variables That Characterized Hospitals Reporting Zero Pharmacy Dispensing Errors

- Offering fewer continuing education courses to dispensers during the past year
- Low occupancy rate
- No daily computerized medication administration records
- Less than a 1:1 ratio of pharmacists to technicians
- Association with the health care management company for fewer than 2.5 years or more than 5 years
- Not using cognitive errors (allergy and contraindication errors) in the error definition
- No pick stations or allowing multiple dispensers at one pick station

broad definition also was associated with reporting higher error rates. If pharmacists receive education about possible errors and use liberal definitions of error, they become vigilant of specific types of errors. This alertness leads to increased likelihood of finding and reporting errors.

Length of time associated with the national management firm is another example of the association of less-extensive pharmacy practice with error reporting. Hospitals managed from 2.5 to 5 years were more likely to report errors. The health care management company has been developing its standardized quality assurance program during the past 6–7 years. Only during the past few years have new directors of pharmacy been required to attend an orientation on the quality assurance program before beginning their new assignments. Possibly, many veteran directors of pharmacy did not appreciate or fully use the new system, and new directors may not have had the opportunity to implement the new system.

The pharmacist-to-technician ratio was associated with both error reporting and error variance. Hospitals with more pharmacists than technicians had higher error rates, which is consistent with previous findings.[16] All pharmacies double-checked a technician's work, but only 5.1% of the pharmacies surveyed reported that dispensed medications were double-checked when pharmacists were the primary dispensers. The absence of this well-documented error-prevention activity could have led to higher error rates in hospitals with more pharmacists than technicians.

An interesting aspect of this study is what we did not find: No error-prevention activities were significant in predicting variations in reported error rates, in part because many prevention activities were not being used. Only 8% of hospitals strictly enforced standardized abbreviations, 7% prohibited the abbreviation *qd* (*quaque die*, "every day"), and 7% had 24-hour pharmacist coverage—all are good markers of error-prevention efforts. The lack of correlation could be due to the method of error measurement. Any organization implementing prevention will have at least some method, most of which would be expected to increase the reported error rate.

Many of the significant variables suggest that reported error rates say more about pharmacy directors' personal attitudes or reporting environments than about the relative level of errors in their pharmacies. Theoretically, good pharmacy practice should be reflected in lower reported error rates, but there may be an "honesty tax" for the conscientious and thorough error reporting reflected in higher error rates.

This study was successful not only in identifying variables that had an impact upon pharmacy dispensing error rates, but in identifying variables that had an impact upon whether pharmacists reported *any* errors at all. These findings may be generalized beyond this group of commonly managed pharmacies to hospital pharmacies at large. They also may apply beyond the

pharmacy to the national health care issue of error rates as performance measures.

Error rates reveal a process within an organization. The variances in error rates may reflect a variety of scenarios. When a hospital does not measure error rates, obviously no errors will be reported. Inattention or a lack of clear methods and definitions will result in no reported errors or low error rates. Hospitals that establish a baseline, using standardized definitions and collection methods in an organized survey, may have high error rates. Progressive experimentation with systemwide error prevention will be reflected in varying error rates. If hospitals are punished because they report high error rates, they will start reporting lower error rates regardless of the true rates. Finally, successful management practices will be reflected in low error rates.

If this relationship between error rates and process within an organization exists, then it becomes difficult to compare institutional error rates.

Recommendations

Several recommendations can be made based on the results of this study. First, hospital administrators must be assured that any consistent, accurate system of error reporting exists in an open environment. Relevant stakeholders need to agree upon and clearly write error definitions. Open communication between professionals, explicitly stated data collection methods, and goals for the use of error rates will maximize data accuracy and minimize fear of repercussions. Consistent, ongoing vehicles for data collection should be established and supported. Daily computerized MARs provide an excellent procedure for locating and tracking errors. Although not all pharmacies will have access to this type of system, they should have some consistent procedure for error tracking.

Continuing education and frequent intradepartmental discussions about current problems, risks, and appropriate methods of error prevention could minimize errors. Reports of zero errors may be excellent flags of system problems.

Neither hospital administrators nor health care consumers should focus on individual error rates as markers of quality; rather, they should examine trends and other associated variables. High error rates may signify, on one hand, poor practice and a potential for disaster or, on the other hand, good detection and attention by professional personnel and an opportunity for improvement. Similarly, low error rates may signify successful error-prevention habits or increasing neglect. Identifying the action or practice (data elements) that may be contributing to changing error rates will be more useful than focusing only on the error rates themselves.

Administrators must be willing to use error rate trends to evaluate their institutions' error prevention activities. If those reporting to administrators sense a commitment to quality improvement at the top, the positive tone for error prevention can pervade the department or organization. If administrators make changes in the environment, they then can reassess outcomes (error rates) and evaluate the effectiveness of their actions. The next logical step is to test the effectiveness of specific dispensing error prevention issues, such as double-checking, pharmacy access, and tracking of returned medications.

Conclusion

The results of this study raise questions about the wisdom of comparing hospitals on the basis of voluntarily reported medication error rates. The focus on measuring error rates is important for improving quality within organizations because drug-related errors are an important cause of adverse events, but interorganizational comparisons of rates are not likely to be meaningful and may, in fact, be counterproductive.

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