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Measuring and Improving Quality Using Information Systems

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Abstract

Information systems (IS) are increasingly important for measuring and improving quality. In this paper, we describe our integrated delivery system's plan for and experiences with measuring and improving quality using IS. Our approach is that for quality measurement to be practical, it must be integrated with the routine provision of care, and whenever possible should be done using IS. Thus, at one hospital, we now perform almost all quality measurement using IS. However, IS are not only useful for measuring care, but represent powerful tools for improving care using decision support. Specific areas in which IS has already been particularly effective include reducing the unnecessary use of laboratory testing, reporting important abnormalities to key providers rapidly, adverse drug event detection and prevention, initiatives to reduce the costs of drugs, and making critical pathways available to providers. The next wave of effort will be to promote widespread use of computerized guidelines, which is likely to prove more challenging. However, the advent of managed care in the U.S. has produced strong incentives to provide high quality care at low cost, and our perspective is that only with better IS than exist today will this be possible on a widespread basis. Such systems make feasible implementation of care improvement and cost reduction initiatives on a scale which could not previously be considered.

Keywords

Quality of Care, Measurement, Improvement, Decision Support, Integrated Delivery System

Introduction

Health care costs have continued to rise, and have now attracted sufficient attention that all parties involved: government, insurers, hospitals and patients, are now focussed on the issue. Measuring quality with non-automated tools is time-consuming and labor-intensive, yet the new focus on lowering costs while maintaining or improving quality demands much more quality measurement than has previously been routine. Interventions to reduce costs and improve quality may be most successful if they are focussed at the level of individual decisions, yet are non-intrusive, a difficult combination to achieve. Fortunately, information technologies can help both with quality measurement and quality improvement.

Several domains are particularly amenable to information-related approaches, specifically diagnostic testing and drug use. Diagnostic testing costs represent up to 25% of all hospital costs [1]. Test ordering is an area which physicians control and in which performance could be better. Studies of test-ordering[2-5] have found that as much as 50% of diagnostic tests in teaching hospitals may be unnecessary. Despite a growing information base about what represents unnecessary utilization, physician behavior with respect to test ordering has been remarkably resistant to change over the long term.

A number of interventions have been attempted to decrease utilization of tests [1-5]. The major types of intervention studied have been feedback, education (including providing information about clinical decision-making and cost issues), rationing, and financial incentives [6, 7]. Each of these strategies in the most successful studies have produced transient reductions of about 25% for targeted tests [7]. However, even the best-accepted interventions, those involving feedback and education, have had variable success [3, 8] and implementation has often been labor-intensive and costly [9]. The other major limitation for both types of intervention is that their effect tends to decay with time [7, 10] if the intervention program is not continued: the gains have not been held.

Thus, despite growing information about how better to use diagnostic tests [11], inappropriate use continues [12]. Why is this the case? The reasons can be divided into two primary categories: incentives and information. In the past, there were few direct incentives for physicians to modify behavior, but this is changing rapidly as a high percentage of patient care is now reimbursed under prepaid plans and hospitals are now focussing on the use of services. The reasons related to information can be further subdivided: 1) studies on the appropriate use of tests have been published in a wide array of sources, and have not been widely incorporated into medical curricula [7], 2) physicians have difficulty estimating risk, and might make better decisions if they were better at it [13-15], 3) the available interventions, such as review of utilization by senior physicians, have been time-consuming or difficult to incorporate in the long term [9, 10] and 4) feedback is often separated in time from decision-making [9].

Similar to the laboratory, pharmacy is both a high volume and high expense component of health care where there is considerable variability in practice patterns. Guidelines are prevalent regarding when to treat and which drugs are most cost-effective. However, the impact of these guidelines on physician behavior is limited in part by the reluctance of physicians to utilize these sources of information. Furthermore, formularies differ among insurance plans. Thus the most cost-effective drug for a given clinical situation for a patient in one insurance plan may represent inappropriate utilization under another plan. The need for immediate access to overlapping guideline and formulary information makes pharmacy management a natural arena for information systems solutions.

The information-related reasons for inappropriate resource utilization can be addressed by combining a computerized order-entry system used by physicians with a computerized data review and "reminder" system that provides needed information at the time decisions are made, and gently challenges orders that fail to meet certain standards. Specifically, using the computer to provide feedback and reminders to doctors is reliable and inexpensive, compared to manual review of practices by senior physicians. Also, order-entry is immediately generalizable to all physicians, once in place requires little maintenance, and can be continued indefinitely. But most important, order-entry will allow **immediate** feedback to physicians **at the time they order tests.** To be optimally effective, an intervention should occur as close in time to the event as possible, and be constructive and non-judgmental [16]. Computerized feedback is ideal in both regards. Because physicians use their unique identification numbers to access the system, it is possible to track individual physician behavior before and after interventions designed to affect such behavior.

The goals of this paper are to describe changes which have already been made in one hospital in our new integrated delivery system, and further changes which can be expected to have an impact for measuring and improving quality as the system is developed.

Materials and Methods

The Partners network is an integrated delivery system including two large teaching hospitals, Brigham and Women's Hospital and the Massachusetts General Hospital, the Dana Farber Cancer Institute, as well as smaller community hospitals such as the North Shore Medical Center. It also contains a physician network, Partners Community HealthCare (PCHI) which includes over 700 physicians throughout the region.

The overall Partners IS plan calls for development of an information system that will be used across the network. At specific sites, such as Brigham and Women's Hospital and the Massachusetts General Hospital, a number of applications have already been built. Some of these applications which are functioning include an electronic outpatient record; for inpatients, computer order entry with outpatient order entry in development; an event monitor which scans the database for events of interest; and a sophisticated quality and resource utilization tracking system.

The network is currently developing applications to support the above types of functionality network-wide, including the Longitudinal Medical Record (LMR), which will serve as the medical record across the continuum of care for network patients; a master patient index; and a data warehouse which will track both quality measures and resource utilization in comparable ways across the delivery system.

Results

Quality Measurement

Historically, our institution measured quality by allowing each department to choose whatever measures it elected, and then to report periodically to the administration. This resulted in little standardization among departments, and quality reports were large stacks of paper which the administration found difficult to evaluate.

More recently, we completely retooled our quality measurement structure for the hospital. A central precept was to measure as much as possible using information systems. We began measuring a small number of parameters across the institution, including Maryland Hospital indicators such as mortality and readmission (Table 1) [17], HEDIS measures [18], and overall satisfaction with hospitalization. Departments were divided into clinical and non-clinical departments. The clinical departments were asked to choose measures falling within one of several categories: efficiency, critical variances and sentinel events. For example, the Department of Orthopedic Surgery chose as its efficiency measures average length of stay for total hip and total knee replacement; for critical variances, INR levels in patients on coumadin, deep venous thrombosis and wound infection rates, postoperative hip dislocation rates, and satisfaction with care; and for sentinel events, inpatient deaths.

Table 1 - Hospital-Wide Outcome Report

	FY 94	FY 95 Q1	Q2	Q3	YTD	YTD Var
DCs	45135	11294	11172	11543	34009	
28 - d Rdmt	6.4%	6.8%	6.9%	6.5%	6.7%	4.4%
Mort Rate	1.5%	1.6%	1.3%	1.2%	1.4%	-8.5%

Using an electronic record has significant advantages over billing data for many measures. For example, for Pap smears, the health maintenance section of an electronic record can provide much more accurate information about whether appropriate patients have received Pap smears than billingdata. If only claims data are used, the computer will search backwards through several years, and look for a claim for a Pap smear. Whether a woman has had a hysterectomy, has refused a Pap smear, has moved away or switched care to another primary care provider, or has another medical condition (such as terminal cancer) that makes Pap smear unnecessary, cannot readily be considered. Our computerized outpatient electronic record

deals with these issues by looking at the problem list to see whether hysterectomy is a coded problem (it is important to differentiate whether this was for benign or malignant disease). It looks at the health maintenance grid which providers maintain, and which allows them to designate whether one of the above conditions (patient refuses, has changed site of care, etc) is present. The electronic record can also help providers improve the rates at which patients have these measures by flagging such needs at individual visits, and by compiling lists of patients by doctor who are due for preventive services. These lists can be used by providers or by quality management to send letters to patients suggesting they come in for needed services.

Routinely obtaining such data will be an important challenge. One promising approach is to place computer terminals in examination rooms, and have patients have a computer interaction before seeing the physician. This may be an effective strategy for increasing the use of health maintenance measures, and also for specific problems. For obtaining satisfaction data, it promises to be particularly effective. In addition, we will probably begin to develop materials which patients can view from home over the Internet.

Another challenge will be developing a quality measurement structure across the network. The planned approach is similar to that described above. A unifying theme will be to measure as much as possible using information systems, during the process of routine care. For comparisons to be meaningful, it will be necessary to get the members of the network to agree about how they are compiling individual measures. Significant work will be required even for measures such as readmission, and measuring satisfaction comparably for example will require more coordination. Short-term goals are to be able to measure the Maryland Hospital measures for hospitals and the HEDIS criteria for outpatients across the network, as well as severity-adjusted prospective expenditures in a variety of resource categories by physician for patient subsets. Among the longer-term goals are to be able to measure quality and resource utilization by episode within specific disease categories across the network.

Quality Improvement

For diagnostic tests, we have already implemented and evaluated a number of decision support measures, though many remain. For example, we conducted a randomized trial in which we displayed reminders for potentially redundant tests (Figure 1), and found that about 70% of such tests were canceled [19]. In another series of trials, we are evaluating the impact of structured ordering--asking providers for their ordering tests, with appropriate counter-detailing for improving the use of such tests as antiepileptic drug levels, digoxin levels, thyroid tests and abdominal radiographs [20-23]. Systems can also be used to rapidly communicate markedly abnormal results to providers. We have developed an approach in which the information system is directly interfaced with the paging system, and another application identifies the clinician responsible for each patient at any given time, which makes it possible to rapidly inform the appropriate clinician about important results [24].

For drugs, drug injuries can be prevented, and direct medication costs can be reduced using decision support. Computerized order entry can make drug ordering safer by showing clinicians default dosages, putting in place dose ceilings, eliminating transcription, and requiring complete orders. But perhaps most important, a number of checks can be made in the background, to look for drug allergies, drug-drug interactions, and drug-laboratory problems. Guided dose algorithms should make it possible to more appropriately dose agents such as aminoglycosides, and heparin.

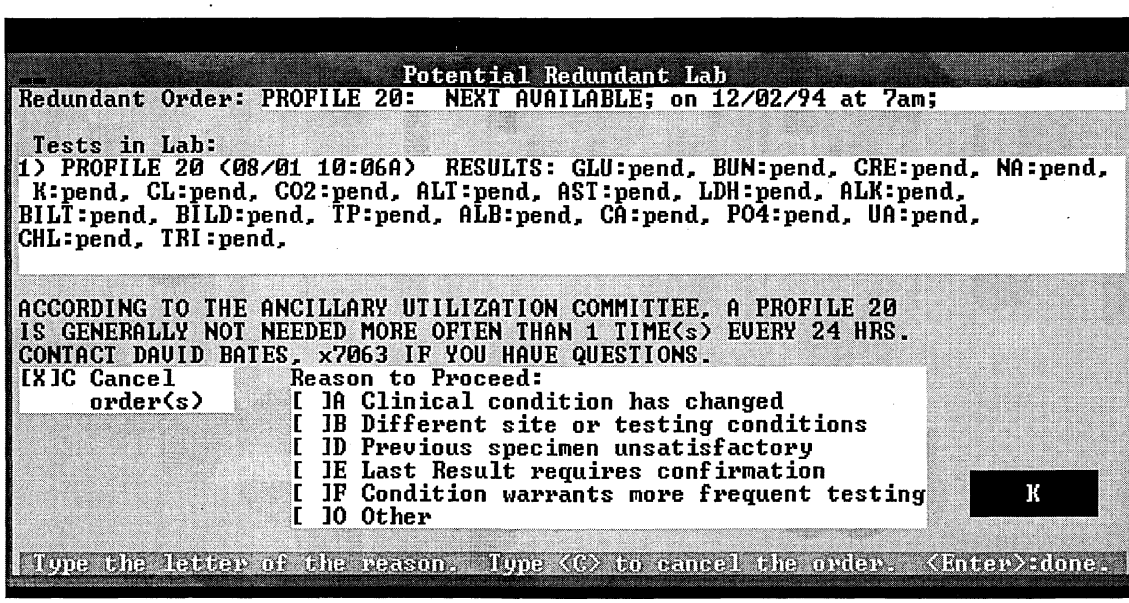

Figure 1 - Sample Reminder for a Redundant Test

Furthermore, efficiency can be improved by making suggestions about dose, frequency, route and drug changes. For drug-drug substitutions within classes, which have therapeutically equivalent alternatives, displaying guidelines about which drug to use within a class has been very effective, resulting in almost exclusive use of suggested alternatives. Agents without a therapeutic alternative can also be approached, although this is more difficult. For example, we recently found that display of a guideline for vancomycin decreased vancomycin days per provider by 37% [25]. Frequency suggestions have been very successful; for example, we have found that simply changing the default dosing frequency from twice a day to once a day for an expensive antibiotic, ceftriaxone, resulted in a switch in use from 85% twice a day to 85% once a day, almost overnight.

Critical paths are another tool which have been used to improve quality. Our hospital has developed approximately 20 critical pathways, which specify expected occurrences and care plans for a specific condition, such as coronary artery bypass surgery. These have significantly decreased costs for the conditions involved, while improving patient satisfaction. Information systems are important for pathways in several ways. First, many paths are essentially sequential sets of orders, so that they relate extremely well to physician order entry, and it is easier to write order sets using order entry than on paper. Second, paths rely on determining when something specific occurred (such as removal of the Foley catheter) at serial times, and much of this can be automated instead of having research assistants collect these data. Third, a significant problem in implementing paths is making providers aware they are available for a given condition. For example for the stroke pathway at our institution, only about a third of patients are enrolled. To deal with this issue, in several months we will begin requiring providers to enter the admitting diagnoses in coded form at the time the patient is admitted, and we will direct them to any available paths.

Discussion

In the U.S., the rising expense of health care has prompted unprecedented focus on costs, and at the same time at measuring quality because of fears that quality will decline as costs are reduced. While it is clear that putting in place financial incentives for providers can reduce costs, this represents a blunt sword. In contrast, information systems can be used to specifically target areas where additional care is needed, and other areas which represent marginal or unnecessary utilization. Although we now know much more about what care is indicated, study after study demonstrates huge gaps between current best practices according to guidelines and actual performance. Thus, we believe that there are enormous challenges not simply in knowing what to do, but in actually getting it done, and computers represent a powerful but underutilized tool for meeting these challenges. The interventions on which we are focussing are targeted at practices that will directly affect quality of care and patient outcomes. Furthermore, we will be able to use population-based approaches to target patients who have not come in, and may thus benefit most from some of these measures.

Information systems will have their main impact in three ways. First, they can be used to directly improve quality, by getting providers the information and decision support they need, when they directly interact with the information system in real time. Second, efficiency and quality can be further improved by using event monitors to look for asynchronous events and communicate them to providers. Third, it will be possible to perform quality measurement using information systems in ways which will be less expensive yet more comprehensive and reliable than previous methods.

Conclusions

The costs of care continue to rise, and as more technological advances become available this trend will continue. To use technology appropriately, better decision support is essential; this will involve both information display and guidelines. Information systems offer the best opportunity to bring decision support to the point of care and ensure guidelines are used. All this will take place within the context of integrated delivery systems, which will ensure that redundancy is minimized and will provide large quantities of data for quality measurement and improvement. Further optimization of care will depend heavily on routine quality measurement. In the future, almost all quality measurement will be done using information systems, and will be seamlessly integrated into the process of routine care. Not only will health care providers use these systems, but patients will use computers in waiting rooms and from home.

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