The Diffusion of Decision Support Systems in Healthcare: Are We There Yet?

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EXECUTIVE SUMMARY

Clinical decision support (CDS) systems, with the potential to minimize practice variation and improve patient care, have begun to surface throughout the healthcare industry. This study reviews historic patterns of information technology (IT) in healthcare, analyzes barriers and enabling factors, and draws three lessons. First, the widespread adoption of clinical IT, including CDS systems, depends on having the right organizational and individual financial incentives in place. Second, although CDS systems and clinical IT in general are powerful tools that can be used to support the practice of medicine, they alone cannot redefine the workflow or processes within the profession. Healthcare managers counting on technology to restructure or monitor clinicians' work patterns are likely to encounter substantial resistance to CDS systems, even those that generate valuable information. Third, while the pace of implementing IT systems in healthcare has lagged behind that of other industries, many of the obstacles are gradually diminishing. However, several factors continue to inhibit their widespread diffusion, including the organizational turmoil created by large numbers of mergers and acquisitions, and the lack of uniform data standards.

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INTRODUCTION

The technological advances of the past few decades in virtually all of our daily activities have revolutionized the ways in which we can both access and spend money. These advances range anywhere from the advent of automatic teller machines to the use of wireless hand-held devices in restaurants and ballparks to place food orders. Similarly, progress in information technology (IT) has opened the way for enhanced capabilities to communicate within offices, across town, and around the world.

Despite these seemingly ubiquitous improvements, parts of the healthcare industry appear almost untouched by advances in IT. Medical technologies, such as MRIs and CAT scans are now widespread, and computerized systems for billing and financial transactions have become common among providers and insurers alike; however, these changes do not seem to be paralleled in clinical IT. Paper medical records in hospitals and physician offices remain the norm. Although some instances of electronic ordering of laboratory tests and prescriptions exist, most ordering is still done by hand and on paper. In this respect, medicine is still being practiced much the same way it was a half century ago.

As part of its mission to describe changes in the healthcare system and their effect on communities, the Center for Studying Health System Change undertook a study of the changing role of information technology in healthcare and its effect on the delivery of healthcare. The focus was on clinical decision support (CDS) systems, and the extent to which these have been incorporated into the practice of medicine, their effect, and their potential.

METHODS

This study included interviews with key industry informants,[1] a review of information from both trade and scientific literature, and site visits to several facilities with cutting-edge applications of CDS systems. The Center conducted telephone interviews with a range of industry representatives, including clinicians/system users, IT specialists in hospitals and academia, consultants, and vendors. We visited several institutions with recognized centers of excellence in medical informatics research and development: Beth Israel/Deaconess Medical Center, Brigham and Women's Hospital, Children's Hospital, and Massachusetts General Hospital in Boston; and Columbia-Presbyterian Medical Center in New York. In addition, we made a site visit to Toledo Hospital, which is implementing a CDS system involving a commercial adaptation of an earlier prototype. Lastly, the Center assembled a small group of industry experts—which included chief information officers, vendors, system users, and researchers—to participate in a roundtable discussion on IT issues.[2]

WHERE WE ARE TODAY, AND WHY

Many examples of automation and information systems exist throughout the healthcare industry, but most focus on the financial and administrative aspects of the practice of medicine. Much less on the clinical side is automated. One recent survey conducted for *Modern Healthcare* (Morrissey 1997)

focused on the prevalence of clinical information systems. Of the respondents, 3 percent reported having expert systems in place to assist with patient care (i.e., those that use patient data to generate case-specific advice); 9 percent reported having point-of-care data collection/retrieval systems operational (i.e., the ability to seek and receive information while treating patients); and 28 percent had network-wide access to patient information online.

In fact, panelists in our roundtable discussion noted widespread disagreement about reports of the prevalence of IT in healthcare. Part of the problem lies in the lack of clear definitions of terms used in many surveys: one hospital's understanding of an "expert" system may not be matched elsewhere. Another issue is the varying degree of rigor applied in measurement. For example, two facilities may report having in place an IT application such as bedside terminals; however, one may have hundreds of terminals operational while the other has only one. Lastly, survey results may be skewed by respondents' lack of objectivity and their desire to appear to be on the cutting edge, even if they are not.

For these reasons, industry sources suggested that published data be taken with a grain of salt. Their own experiences suggest a much more modest estimate of the prevalence of clinical information systems, in line with a 1995 estimate of one percent of physicians using computerized patient records (Solomon and Dechter 1995).

What accounts for the slowness or reluctance with which such technologies are being adopted? Simplistic explanations often focus on the unique characteristics of the practice of medicine, seen as inherently different in complexity and content from banking or industry. Similarly, it is sometimes suggested that doctors themselves—because of age or mindset—view IT unfavorably. Panelists, however, noted that physicians of all ages can either champion or disparage information systems; younger physicians have no monopoly on enthusiasm for computer systems. They also disagreed with the frequent assumption that doctors, by virtue of their training and their desire for autonomy, will discount the value of computer-generated information. In fact, panelists unanimously agreed that physicians want more information and would be happy to receive it—as long as it is presented in a usable and timely format.

One factor contributing to the relative scarcity of information systems in healthcare is the industry's organizational structure. Because its traditional roots were as a cottage industry, perceived information needs were localized and relatively small. The more recent consolidation and commercialization of the industry have generated demands for better information systems, as has the increased complexity of care that requires additional coordination and information flow. A byproduct of the cottage industry characteristic was a lack of capital for IT investments. Developing appropriate information systems requires a substantial initial investment in time and money. Few individual providers could manage this financially, nor could they see a reasonable payoff for such efforts.

One key concept underlies all of the obstacles to more widespread diffusion of IT in healthcare—the lack of incentives for adopting such systems. Until recently, healthcare was not organized in such a way as to place a premium on sophisticated IT systems. Moreover, individual providers had no incentive to make the investment to develop an IT system because none of their competitors had one; in fact, there was every reason to wait to reap the benefits of someone else having made the investment.

Financial and business management information systems developed because there was a clear incentive to do so—collecting revenue required having adequate financial systems in place. Incentives to implement clinical information systems are few, and perhaps are even countered by disincentives. Under fee for service, no real financial driver induces providers to practice medicine more efficiently. Minimizing the use of resources to achieve a given outcome is not necessary if costs incurred are reimbursed; on the contrary, maximizing the health outcome from a given level of resources may lead to lower revenues. Similarly, most competition has been on price per episode per month rather than quality. As a result, investing in a sophisticated clinical information system has not been a high priority in fee-for-service systems. Not surprisingly, vendors suggest that in the most successful applications of clinical information systems payers shift financial risk to providers; thus providers have an incentive to practice as efficiently as possible. In these circumstances physicians have a financial incentive to be cost effective and to keep people healthy, and the benefits of a clinical information system that minimizes costs and maximizes quality outcomes can exceed the costs.

Thus, although several factors may have contributed to the slow adoption of IT in healthcare, the lack of appropriate incentives to demand and use clinical information is a common denominator. This suggests that no matter how perfectly given applications might perform, and no matter how enthusiastic physicians or other users may be, the widespread diffusion of clinical IT systems will probably not occur until the right incentives to use those systems are widely in place.

CLINICAL DECISION SUPPORT SYSTEMS

The most basic data systems provide a "dictionary" of health problems to clinicians, or display background information on specific patients—their function is primarily that of allowing clinicians to access information. More sophisticated systems, often referred to as "expert" or knowledge-based systems, can actively assist clinicians in the decision-making process. Our particular interest was in CDS systems that provide one or more of several functions (OTA 1995):

1. Assistance with diagnosing a patient's condition;
2. Assistance in determining proper drug dosage;
3. Reminders to administer preventive services to given patients at specific times; and

4. Assistance in carrying out diagnostic or therapeutic procedures, such as recommending specific treatments, reminders to perform procedures, alerts regarding potential adverse events, feedback based on previous orders, and prompts for testing or treatment options.

Prevalence of CDS Systems

Two of the earliest and most frequently cited examples of CDS systems include the Health Evaluation through Logical Processing (HELP) System developed by Intermountain Health Care at Latter-Day Saints (LDS) Hospital in Salt Lake City and the Regenstrief Medical Record System (RMRS) at Indiana University. HELP involves a computerized medical record system that gives clinicians a comprehensive view of patient data, combined with decision support capabilities such as alerting systems for monitoring medications and lab results. RMRS, a longitudinal electronic patient record integrating inpatient and outpatient data, provides preventive care reminders and displays cost and effectiveness information when clinicians write orders.

HELP and RMRS were both developed in house over several decades; this suggests that the systems were not an overnight sensation and that significant resources were required for the investment. Much of the seminal work in CDS systems was done primarily in academic medical centers, where it may be easier to focus on the development process and the pedagogic benefits of such systems.

In recent years, commercial CDS systems modeled after prototypes developed in academic medical centers have become available. HELP and RMRS, along with the Brigham Integrated Computing System (BICS) at Brigham and Women's Hospital in Boston, are now being marketed through agreements with commercial vendors. Thus, although much of the foundation for CDS systems was laid over a long period in which little was disseminated beyond the institutions in which they were housed, the potential for the systems to proliferate is now substantially greater.

Despite this potential, use of CDS systems remains limited to date. Obtaining accurate figures on the popularity of CDS systems is difficult, given definitional and subjectivity errors. However, panelists at the roundtable suggested that the overall penetration of CDS systems is probably less than 5 percent of all healthcare facilities.

Incorporating CDS Systems into Clinicians' Work

A CDS system will need to save both time and money if clinicians are going to use it. Although in most cases time *is* money, salaried personnel in large hospitals, for example, may see little direct financial effect from CDS systems. Therefore, they might focus on the time-saving benefits from computerized ordering of drugs and relay of lab results. CDS systems can also contribute to improving the quality of care by reducing human errors or minimizing the effect of those that still occur. To encourage clinician use, a CDS system must be functionally integrated into the workflow process, rather than being

a stand-alone capability that requires a break from the routine.

Determining which workflow processes to automate and which ones to change presents a dilemma. Although certain procedures, such as the use of paper charts, have been followed for years, the actual process may not be the most efficient. Reorganization of the collection and display of information so that, for example, clinicians could see information on laboratory results grouped together rather than on separate pages by encounter may prove useful. However, changing the design of the paper chart would introduce a change to the way in which clinicians are used to working, which may create resistance to using a CDS system. As Robert Weaver (1991) suggests in his work on the diffusion of decision support technology, "if a technology is easily assimilated into the existing practice, it will be quickly embraced; if it disrupts everyday activities, the social organization, or status quo, it will not be."

An example of successful integration of a CDS system into existing workplace procedures is ProMedica Health System in Toledo, Ohio, which recently installed the 3M Healthcare Enterprise Management System (which evolved from the LDS HELP System). The CDS system provides access to data within and across facilities—clinicians can view patient information from various points within the hospital, from their ambulatory practices, or from home. ProMedica staff noted that the system's greatest strength is the fact that the decision support serves not as a watchdog but a "virtual house officer." Clinicians can request monitoring assistance from the CDS system (e.g., alerting them if a patient's vital signs fall outside of established parameters). Physicians have responded favorably to this type of backup support, whereas many react unfavorably to the concept of using CDS systems to monitor physician behavior or compliance with practice protocols.

BICS, developed at Brigham and Women's Hospital, includes an order-entry system that encourages cost-conscious care by suggesting less expensive alternatives to drugs ordered, and assists in determining appropriate drug dosages. BICS includes an alert system for drug allergies or interactions and abnormal lab results that warns physicians about critical events. The alert system has resulted in a drop from 2.1 to 0.7 hours in reaction time to adverse events. Physicians do not have to step aside from their "normal" tasks to use the system but have been able to both simplify their own tasks (ordering drugs from standard lists of default doses) and receive information on a more timely basis. More importantly, reductions in adverse events and in reaction times to those that do occur indicate important quality improvements for patients.

Results/Effects of CDS Systems

Information on the results of CDS systems is limited. A recent meta-analysis reviewed studies of the effect of using CDS systems to determine drug dosage, diagnose, remind clinicians about preventive care, and assist in active medical care decisions. These studies involved methodologies such as

having control group patients managed by clinicians without the aid of computers, or withholding CDS-generated output from clinicians in the control group. Fifteen of twenty-four studies demonstrated a significant difference favoring CDS systems in improving clinician performance; and three of ten studies indicated significantly positive effects on patient outcomes (Johnston et al. 1994).

Much of the published information on results comes from the early systems developed at Regenstrief and LDS Hospital. In a controlled trial, RMRS provided cost and cost-effectiveness information on diagnostic tests to one group of clinicians while a control group received no information on charges. Doctors in the intervention group ordered 14 percent fewer tests and charges were 13 percent less for outpatients, averaging savings of $7 per patient visit, with no adverse outcomes (Tierney, Miller, and MacDonald 1990).

The HELP system at LDS Hospital generated reminders for perioperative antibiotic use, identifying patients who would benefit from antibiotics, and improving the timing of their use. The CDS system improved clinician prescribing habits and led to a decline in the postoperative wound infection rate from 1.8 to 0.9 percent of surgical patients (Larsen et al. 1989).

Although some calculations of the financial effect of CDS systems have been done, potential purchasers do not have concrete return-on-investment (ROI) data. There have been some determinations of financial results, such as the Regenstrief demonstration of 12.7 percent lower charges ($887) per admission resulting from the provision of cost-effectiveness information for inpatient orders (Tierney et al. 1993). Attempts to calculate ROI have focused primarily on savings in administrative costs (record keeping and clerical staff). However, these estimates do not accurately capture the potential benefits of CDS systems, and most purchase decisions are ultimately made on the basis of less tangible factors, such as a belief that a strategy of early investing in IT will someday pay off.

Issues to Be Resolved

Although many examples of CDS systems have demonstrated favorable results, they are not problem free. The implementation process is long and slow, and requires much more than the simple installation of computer systems. The stumbling block is seldom the technology itself, but the people who use it, for whom change may not be easy. Other concerns about CDS systems focus on the potential for information overload, and the possibility that immediate availability of "too much" data will distract a clinician from focusing on critical aspects.

Given the complexities of the practice of medicine and the sheer amount of information that clinicians can both remember and forget, automation should be an ideal means of both communicating data and suggesting treatments. However, a CDS system is only a tool—it alone cannot change workflow processes, organizational structures, or the practice of medicine. In that sense, getting doctors to adhere to guidelines, whether automated or not, can be difficult. There is resistance

to guidelines not developed locally, as well as difficulty in applying disease-specific guidelines when patients may suffer from multiple health problems. Many vendors are reluctant to incorporate substantive content into their CDS systems, preferring to delegate this task to individual purchasers. Although vendors could in principle take good ideas from their clients, build them into their CDS systems, and provide broader exposure among other users, in doing so they run the risk of disseminating poorly researched information or exposing themselves to the threat of malpractice suits.

Two additional issues exist with respect to the development and automation of practice protocols. Some CDS system clients have developed useful guidelines, but refused to share them on the grounds that they were proprietary assets of a delivery system. Panelists expressed concern that although this practice may preserve intellectual property rights, it also reflects a growing trend of competitive advantage taking priority over advances in healthcare. Another issue is the fine line between using CDS systems and protocols to provide helpful advice as opposed to having them direct the practice of care. Once CDS systems move into the latter realm without the involvement of "competent human intervention before any impact on human health occurs . . . e.g., clinical judgment and experience . . . to check and interpret a system's output" (OTA 1995), they become subject to Food and Drug Administration regulation as medical devices. This suggests that both vendors and clinicians will continue to tread carefully in the design and application of CDS systems.

Beyond these implementation issues lie two technical problems yet to be resolved. One is the absence of standard vocabularies across systems (the fact that different CDS systems use different terminology). The second is the need to protect the privacy of medical records. Although the first issue has received much attention for many years, industry representatives expressed dismay at the absence of measurable progress, and felt that the lack of standards is a major stumbling block to the effective adoption of automated medical records. On the issue of privacy, many noted that fears about the potential for unauthorized access to confidential medical record information were justified, but also discouraged providers from implementing clinical information systems. Legislative efforts to protect the privacy of medical records have had limited impact to date, but are likely to intensify. Nevertheless, many within as well as outside the healthcare industry remain concerned about the need to balance privacy issues with legitimate and valuable access to information and the potential for improved health outcomes.

PROSPECTS AND FUTURE DIRECTIONS

Interviews with industry representatives and the discussion at the roundtable session suggest that interest in and enthusiasm for CDS systems will continue and grow. Changes in healthcare organization, including a greater emphasis on ambulatory care and the integration of larger systems, will lead to a greater

demand for simpler ways to communicate information. Moreover, shifting risk to providers will create financial incentives for clinicians to have access to more and better information.

The prospects for broader adoption of CDS systems depend on one additional factor besides the appropriate incentives: the role of medical education. Panelists suggested that medical school training would have to reinforce among students the importance of demanding good information within an environment where they bear risk. The panelists lamented, however, that much of the continuing emphasis within medical school curriculum is on the myriad options for treating a particular condition, rather than concentrating on the best way to achieve the desired outcome.

Our assessment of historic patterns of adoption of clinical IT in healthcare and the factors underlying those patterns gives rise to both optimism and concern for the future. On the positive side, the past decade has seen marked improvements in the capabilities of CDS systems. Although technical issues remain, the consensus within the industry is that these are solvable. Factors that have inhibited the adoption of clinical IT in healthcare, such as a lack of capital and appropriate incentives, are dwindling. Many organizations have recognized that healthcare is fundamentally an information business and are beginning to devote commensurate resources to IT solutions. Similarly, with changing financing mechanisms and organizational structures within the industry, the incentives for providers to demand and use IT to improve efficiency and quality of care are becoming more widespread.

Yet some countervailing factors temper this optimism. New incentives to encourage greater prevalence of IT in healthcare are accompanied by a great deal of organizational turmoil within the industry, exemplified by a large number of mergers. Neither executives nor clinicians can focus on information systems within this environment, as they have more immediate and bigger concerns.

In addition, the spread of managed care may be a necessary but insufficient condition for the diffusion of IT. Although financial incentives are changing, it is still eminently feasible to make money in healthcare without having CDS systems in place, and many managed care payers have been slow to delegate risk to providers. Only after the healthcare market's many inefficiencies have been eliminated and risk has been shifted to providers will there be a clear competitive advantage for those providers using a clinical IT system. Thus, although the foundation is being laid for expansion of IT and CDS systems, it is unlikely that this will happen until after much of the healthcare industry evolves and stabilizes.

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Notes

1. Interviews were held in 1997 with representatives of: abaton.com, Blue

Shield of California, Columbia-Presbyterian Medical Center, The Computer Patient Records Institute, Group Health Cooperative of Puget Sound, Kaiser-Foundation Health Plan, Southern California, MedicaLogic, Inc., The Medical Quality Commission, Oacis Healthcare Systems, 3M Health Information Systems, and VHA's Information Technology Solutions Program.

2. Participants in the 1997 roundtable session were: Jim Bradley, abaton.com; Edna Bruehl, West Virginia University Hospitals; Mary Sue Galvin, Group Health Cooperative of Puget Sound; Susan Horn, Institute for Clinical Outcomes Research; Robert Jenders, Columbia Presbyterian Medical Center; Charles Kennedy, Blue Shield of California; Jim McCord, Oacis Healthcare Systems; Alan Zwerner, The Medical Quality Commission; and Holly Wong, Center for Studying Health System Change.

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PRACTITIONER APPLICATION

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This article does an excellent job of exploring the challenges, opportunities, and current status of clinical decision support (CDS) systems in healthcare. My experiences as chief medical officer of multiple HMOs and as president of a practice management company are consistent with the authors' conclusion that CDS systems are in limited use today. I agree that for significant advances and wide diffusion to occur, a number of barriers must be overcome. I also agree that their

potential to improve healthcare is very real and exciting. The authors' examples of success cited in their review of the literature prove that point. I congratulate the authors on producing a valuable summary article on this important area. I can add little to their fine description and analysis, except as it relates to the barriers to diffusion. On that topic, I think it critically important that we acknowledge a hierarchy of barriers, with financial incentives at the top of the list.

COST BARRIERS TO DIFFUSION

The high cost of information technology (IT), of which CDS systems are a subset, is often cited as a major barrier to diffusion in healthcare. But in an industry that routinely invests millions of dollars in redundant high-tech equipment and facilities, we cannot blame costs alone for barring diffusion. The financial barriers to IT diffusion have more to do with incentives. Simply stated, expensive scanners and surgery suites are revenue centers, whereas IT is a cost center. That fact is the major driver in IT investment decisions.

Because IT is a cost center, IT investments must be justified by improving revenue or margin. To increase revenue, providers will invest willingly in office-based billing and collecting systems. For health plans, the same cost center incentives have motivated heavy investment in client billing, claims payment, and eligibility management systems. As insurers took on more risk for managing care, these claims administration systems were modified to capture and report on basic clinical information as well, incorporating coded diagnostic and procedure information from evolving standardized hospital and physician billing forms.

In general, health plans have little incentive to finance collecting chart-level clinical information on all patients, especially because such data are not typically available electronically. Unless a physician's practice is exclusively with a single health plan, it is hard for the plan to justify helping that physician's office finance an electronic medical record and CDS system. Likewise, most providers' offices have little incentive to finance electronic collection of detailed clinical data. Such data are not necessary to collect fee-for-service revenue, and gathering the data would involve costly changes in work procedure, staffing, and systems.

Once CDS systems become critically important in generating revenue or margin, then provider groups, health plans, management organizations, and outsourcing shops will quickly fill the need. That connection will happen when groups of providers are routinely delegated significant financial risk for managing defined populations, or are given strong incentives to produce desired population-based clinical outcomes.

CULTURAL BARRIERS TO DIFFUSION

Much of healthcare is still viewed as art practiced by members of an elite guild. Although each physician member of that guild has learned to depend on his or her own favored list of reference materials, from textbooks to treatment guidelines and summary articles, they resist the idea of algorithm-driven "cookbook medicine."

In my experience, this cultural resistance to algorithms and management systems among physicians is not absolute, but varies based on the form and use of these tools. Physicians like having more information and are interested in "best practices" and expert guidelines. They appreciate any labor-saving device, especially if it can also help improve care or office effectiveness. The critical issues for acceptance by physicians seem to be the ease of gaining the information, its relevance to their situation, the concern with being judged inappropriately, and the desire to retain clinical autonomy. If those issues are managed well and locally respected physicians are included in the process, clinical guidelines and algorithms can be implemented successfully.

I also think physicians have less resistance to computers than is often suggested. I have seen the practitioners comply and outcomes improve when a computer-supported disease management system is implemented by physicians in their local practice setting. Likewise, I have seen physicians successfully integrate a decision support system gradually into their real-time electronic medical record system. In short, my experience agrees with the authors' general comment that the key to CDS system success is the involvement of (and relevance to) practicing physicians, and the degree to which the system improves workflow and outcomes.

Many early practice guidelines and clinical CDS systems failed these tests. They required extensive offline effort or work arounds, involved double data entry, and focused on retrospective review of behavior rather than real-time workflow improvement. As successful systems evolve to better support the average physician's day-to-day practice settings, these "cultural" barriers will gradually dissolve.

SCALE AS A BARRIER TO DIFFUSION

The cottage industry structure of healthcare is often given as a reason why CDS systems have been slow to develop. Certainly, individual doctor's offices and small group practices cannot justify large hardware and software investments. But the scale issues have not precluded these same practices from having access to efficient PC-based billing and collecting systems. And, to the extent scale was a barrier to acquiring more sophisticated applications, a large outsourcing service industry has developed to support billing and collecting for a wide range of practice settings. Something other than scale is involved.

Scale becomes a significantly lower barrier when we collectively prescribe standardized data definitions, standard templates for interface and exchange of information, and appropriate incentives. As proof, look again at the history of billing and collecting standards. The health insurance industry, including hospitals, physicians, insurers, and Medicare, had a strong incentive to agree on standard billing forms and data elements. Good standards can improve revenue, margin, and cash flow for everyone; therefore these standards have become universal, have expanded in scope, and have adapted for electronic commerce.

Little such standardization exists for CDS systems. Much of the development, as the authors point out, is proprietary. Some IT developers in healthcare excel in

administrative systems, others in financial or clinical management, and still others in electronic medical records. Many of these systems do not interface well with the others, and no clear industry leader has emerged to set a market-based standard, as IBM did for the PC. Competitive standard-setting organizations have begun to work on the problem. If we solve these data and system interface standards issues, entrepreneurial information services vendors will rapidly solve the scale problems, given the right incentives.

The fact that hospitals and academic medical centers are ahead of physicians in CDS systems implementation is often cited as evidence of the importance of scale as a barrier. Certainly the budgets of these institutions can better support IT staff and development, including purchasing expensive hardware and software systems, setting internal data standards, and building workable interfaces between the various subsystems that support the institution. But much of this IT effort is focused on administrative systems to help manage these complex multilayered organizations, not on clinical IT or CDS systems. In my opinion, support for clinically related IT is based more on financial incentives than scale.

Only after hospitals were subject to diagnostic-related grouping (DRG), case rates, and capitation payment incentives were their IT capabilities expanded beyond administrative and financial management to include some elements of clinical management. Only when revenue and margin became more dependent on effectively managing resources through an entire episode of care, including the risk of extended stays and complications, did significant investment begin in clinically related IT. Only the more advanced of these organizations have developed actual CDS systems capability.

This is not to say those hospitals and academic medical centers did not invest in clinically related IT simply to improve patient outcomes. Some certainly did. However, the fact that we see CDS systems investment most clearly in clinical areas frequently subject to case rates or subject to wide variance in DRG resource utilization (e.g., cardiac care) is no accident. Neither is the fact that important areas for research funding at academic medical centers are often the areas with the most aggressive CDS systems development (e.g., cancer and diabetes).

CONCLUSION

The authors do a very good job of summarizing the current state of affairs and issues involved in the diffusion of CDS systems. I agree that the absence of industry-wide standards for data and system interface poses a major barrier to development in this area, as does the general organizational instability in the healthcare industry. Lacking standards, the small scale of most physician practices is also a barrier. Cultural barriers can be attacked by expanding medical education to include clinically related IT and by making such systems more user friendly and better integrated into daily work flow. But the most important determinant of diffusion is the expansion of incentives that reward those organizational structures

and behaviors that successfully manage population care (be it disease cohorts or plan membership), rather than units of service.

Sustained investment in CDS systems will require evidence that such investment furthers an organization's mission. In today's marketplace, that usually translates into revenue, margin, or competitive advantage. Supporting a mission of improved patient care alone is not enough. As a Catholic not-for-profit hospital system leader once quoted: "no margin, no mission." Whether payment is through global capitation, a large subcapitation, or a strong incentive to produce desired outcomes, the existence of these population-level financial incentives will go a long way to ensuring sustained investment in CDS systems.

I believe that tomorrow's healthcare system ultimately must and will foster and reward high-quality, cost-effective local accountable delivery systems. The strength of that belief makes me optimistic about the future of CDS systems. To the extent we allow fear of providers assuming financial risk or demand for wide-access insurance products to decrease the incentives that support development of these delivery systems, we will also slow the development of CDS systems. That would be tragic. Improved clinically related IT and CDS systems, and the clinical guidelines to support them, are our best hope for systematically improving healthcare quality and cost effectiveness in America.