FROM THE FIELD

Overcoming Barriers To Adopting And Implementing Computerized Physician Order Entry Systems In U.S. Hospitals

A survey of senior managers suggests that efforts to diffuse this patient-safety technology must focus on rallying physicians' support.

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ABSTRACT: Few U.S. hospitals have implemented computerized physician order entry (CPOE) in spite of its effectiveness at preventing serious medication errors. We interviewed senior management at twenty-six hospitals to identify ways to overcome barriers to adopting and implementing CPOE. Within the hospital, strong leadership and high-quality technology were critical. Hospitals that placed a high priority on patient safety could more easily justify the cost of CPOE. Outside the hospital, financial incentives and public pressures encouraged CPOE adoption. Dissemination of data standards would accelerate the maturation of vendors and lower CPOE costs. These findings highlight several policy levers to speed the adoption of this important patient safety technology.

THE 98,000 DEATHS per year and many more injuries resulting from medical errors have made patient safety a top priority in U.S. health care.[1] Many medication errors—the most common cause of preventable injuries in hospitals—can be prevented by computerized physician order entry (CPOE) systems.[2] These systems reduce the incidence of serious medication errors by 55 percent.[3] This collective evidence has prompted the LeapFrog Group, a national consortium of Fortune 500 companies, to designate CPOE deployment by hospitals as one of three patient-safety goals.[4]

Despite the apparent efficacy of CPOE systems, only 10–15 percent of hospitals use them.[5] While previous case studies have described some of the challenges to CPOE implementation in selected U.S. hospitals, it is unclear how these challenges can be overcome.[6] To provide more insight into this subject, we conducted in-depth interviews with top management officials from U.S. hospitals that are at various stages of CPOE implementation.

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Data And Methods

■ **Sampling framework.** We defined CPOE as an electronic application with which physicians directly enter orders for medications, diagnostic tests, and ancillary services. To categorize the degree of implementation for each hospital, we considered the percentage of all physician orders written with CPOE and the hospital's level of commitment toward full implementation. *Full implementation* was defined as having more than half of all physician orders written with CPOE. We divided hospitals into five categories: (1) CPOE fully implemented; (2) hospital committed to full implementation: full implementation not achieved, but budget and personnel committed to it; (3) hospital considering full implementation: full implementation not achieved, no resources committed to that goal, but planning to do so; (4) hospital attempted but abandoned: full implementation attempted, but not achieved and no longer under consideration; and (5) hospital never considered implementation.

Using a local panel of experts and their national contacts, we established a database of seventy-two hospitals and preclassified each hospital into one of these five categories. We randomly contacted hospitals in each category to set up half-hour telephone interviews with up to three senior managers for five hospitals in each category.

■ **Identifying informants.** We first contacted the chief information officers (CIOs), because they were likely to be familiar with CPOE implementation. If the CIO refused to participate in an interview, we contacted the next hospital in the same category. If the CIO consented, we interviewed up to two other senior managers at that institution. Fifty-two interviews were conducted at twenty-six hospitals during February–July 2002.

■ **Interview instrument.** We developed a semistructured interview instrument to delineate the barriers to and facilitators of CPOE adoption and implementation. We included domains identified by previous work and developed new ones.[7] We asked informants about the status of CPOE implementation and plans for its further development. We next discussed the perceived benefits of CPOE and, when relevant, how the decision to adopt CPOE was made. We then asked about barriers to adopting and implementing CPOE, ways to overcome these barriers, and history of sizable delays in or failed attempts at implementation. We concluded by asking about policy options that might influence the widespread adoption of CPOE in U.S. hospitals. We also asked each interviewee to name the top three barriers and facilitators.

■ **Code list.** We used the grounded-theory approach to analyze the interview transcripts.[8] The two investigators who conducted the interviews met regularly with senior investigators to discuss the emerging themes. Through iterative readings of a subset of transcripts, we developed a code list to characterize the factors that influenced CPOE adoption and implementation. Using this code list, three investigators coded all fifty-two transcripts; they continued to modify and organize the code list to further delineate the relationships among the emerging themes.

The top three barriers and facilitators were also coded. In the 58 percent of cases where that question was not directly asked, the coder inferred the top three barriers and facilitators from the interview transcript.

Study Results

■ **Hospital demographics.** Among the fifty-two officials interviewed, 46 percent were CIOs, 21 percent were chief financial officers (CFOs), 21 percent were chief medical officers (CMOs), and 12 percent were other management officials. Demographics of institutions and their stages of CPOE implementation appear in Exhibit 1. Despite multiple attempts, we failed to recruit hospitals that were not considering implementing CPOE.

■ **Barriers and strategies to overcome them.** *Barrier 1: physician and organizational resistance.* Resistance to CPOE adoption by physicians featured prominently in our interviews, which our informants attributed to the perceived negative impact on physicians' workflow. For example, one hospital reported "a 20 percent loss of efficiency, in some cases closer

EXHIBIT 1
Characteristics Of Hospitals Participating In Survey Of Computerized Physician Order Entry (CPOE), 2002

Characteristic	Fully implemented CPOE (n = 5)	Committed to implementing CPOE (n = 12)	Considering implementing CPOE (n = 6)	Attempted but abandoned full implementation (n = 3)
Average number of licensed beds	538	405	330	532
Teaching hospital (major or minor)	3	8	1	1
Urban location	5	10	4	1
Geographic location				
East Coast	1	4	1	2
West Coast	1	3	1	0
Other	3	5	4	1

SOURCE: Authors' analysis of study data.

NOTES: We attempted contact with forty-six hospitals; twenty-six hospitals participated (for a response rate of 57 percent).

to 30 percent to 40 percent." Physicians often felt that traditional paper-based ordering was faster. While training would help, some physicians' low computer literacy level made training challenging. Often, it was difficult to train community-based physicians who spent little time in the hospital and were not motivated to learn to use CPOE efficiently.

Resistance among physicians sometimes escalated to the point of a "physician rebellion" that could derail the entire implementation process. Given the negative publicity these breakdowns would entail, the fear of physician rebellion could prevent institutions from committing to CPOE adoption.[9] Community hospitals, which did not employ most of their physicians, were concerned that their physicians might admit patients to other local hospitals that did not require CPOE use. Several informants from institutions with prior unsuccessful attempts at CPOE implementation attributed their difficulties to the lack of user involvement in the implementation process. Repeated attempts were difficult, because previous failures made the organization and user groups less tolerant of risk.

Overcoming resistance. We identified four strategies to overcome this barrier:

(1) Strong leadership: Leadership was a recurring theme in almost all interviews. As one official stated, "Leadership is as important as the quality of the technology." Hospital leaders had to be firm believers in the benefits of CPOE and had to demonstrate visibly a commitment to the implementation project. They needed to be facile at managing changes that inevitably came with CPOE implementation. They also had to feel empowered to mandate CPOE use within the hospital. Some managers led by example and were among the first to adopt CPOE.

During uncertainties and setbacks, hospital leadership needed to maintain and aggressively communicate a common vision to the hospital staff. This vision must describe not only how CPOE would improve patient safety, quality, and efficiency, but also how it would strengthen the hospital's core mission and consolidate its leadership position within the local market.

(2) Identifying physician champions: Physician champions, typically well-respected clinicians, were key to successful CPOE implementation. Their intimate knowledge of physicians' workflow enabled them to facilitate the selection and customization of vendors. During the rollout of CPOE, champions would remind the general users of its downstream benefits, encouraging them to see beyond their immediate frustrations. Champions

would also relay users' concerns to the implementation team and the vendors.

(3) Addressing workflow concerns: Few vendor products to date can be used "out of the box" by hospitals without extensive customization to fit clinicians' workflow. The frustration that came with learning to use a new ordering system often was mitigated by the visible presence of support staff. This "help at the elbow" also sent a strong message to users that the hospital was committed to making CPOE work.[10] Several informants noted that many physicians, once they had overcome the initial training barrier, "wondered how they ever did it the other way."

(4) Leveraging house staff or hospitalists: Our informants often discussed the role of house staff in the implementation process. One noted that these young physicians "do not look at [CPOE] as something that they have to do— they almost look at it as an entitlement." These younger physicians were comfortable with information technology (IT), because many had been exposed to CPOE as medical students. Since they used CPOE every day, they were motivated to learn all of its features to make their workflow more efficient. These physicians-in-training often provided valuable feedback on how to improve the CPOE product. Several informants mentioned that hospital-employed hospitalists also served as facilitators of CPOE adoption.

Barrier 2: high CPOE cost and lack of capital. Estimates from prior studies for the cost of CPOE have ranged from $3 million to $10 million, depending on hospital size and level of existing IT infrastructure.[11] As one CIO stated, CPOE was "the most expensive project I had ever done in my twenty-nine years of doing hospital software." Several informants, particularly those in institutions that had not committed to implementing CPOE, had difficulties obtaining resources to fund this high-cost project. Even informants who were successful at this effort were concerned their colleagues at other hospitals would not succeed.

Several hospital executives lamented the absence of a strong and objective business case for CPOE, and many did not trust those put forward by vendors. The high costs and uncertainties associated with implementing CPOE made it easy for hospital officials to focus on other competing and visible priorities, such as erecting a new hospital wing. The decision to invest in CPOE was often met with opposition from those who saw it as a drain on hospitals' resources. Hence, decision-making delays were common.

Overcoming the high cost of CPOE—hospital-centric approaches. Our informants identified several financial facilitators. (1) Realign the hospital's priorities to focus on patient safety: In an early interview, one CFO surprised us by proudly stating that "patient safety drove all of [their] decisions." Other informants echoed the sentiment that patient safety was a hospital mission and that hence CPOE was a mission-critical project. By making patient safety a top priority, some hospitals put other capital investment projects on hold and identified sufficient capital dollars for CPOE. Since the hospital board often included community leaders who were interested in reducing medical errors, board approval was far easier to win than support from hospital staff.

(2) Leverage external influence: The impact of the Institute of Medicine (IOM) report, *To Err Is Human,* and the Leapfrog Group should not be underestimated.[12] Public outcry against medical errors and the threat of market-share loss were often cited as the initial impetus or the final push to adopt CPOE. Our informants stated that hospitals needed to channel these external influences toward raising hospitals' awareness about patient safety.

(3) Measure CPOE's impact on hospital efficiency: Although the capital investment in CPOE was large, hospitals that had successfully implemented it benefited from improved hospital efficiency. CPOE systems reduced delays in patient care through better communication among departments and institution-wide standardization of procedures. The challenge for institutions, as one CIO commented, was to collect data early in the implementation process so that cost savings could be demonstrated. Similarly, benefits to the individual providers, such as reduced callbacks from

nurses and pharmacists and the ability to manage orders written on a panel of patients, needed to be measured and highlighted by hospital leaders and physician champions.

Overcoming the high cost of CPOE—external approaches. Although the typical hospital manager had little control over forces that drove the high cost of CPOE implementation, many commented on ways to make CPOE more affordable. Two themes emerged. (1) Improve system interoperability: Given the lack of standards among CPOE vendors, systems from different vendors often cannot communicate directly with each other. Since CPOE requires so many interfaces with other existing systems, managers often faced a difficult choice when they implemented CPOE: They could purchase CPOE from their primary IT vendor, even if its CPOE product did not meet their needs, or they could rebuild their entire IT infrastructure from scratch with a new vendor. Adoption of standards would mitigate this. Hospitals could build their IT infrastructure over time without worrying that the next component would make all existing components obsolete. Moreover, they might be able to choose from a larger variety of CPOE vendors. With improved system interoperability, the cost of CPOE implementation would decrease, allowing more hospitals to do it.

Our informants were divided about the government's role in improving interoperability. Many management officials, fresh from dealing with Health Insurance Portability and Accountability Act (HIPAA) compliance issues, lacked the appetite for further government legislation on "portability" in health care. However, others saw the government as the ideal agent to impose standards, given that decades of independent development by private industry had resulted in a myriad of proprietary vocabularies and communication protocols. Still others saw the purchasing power of the federal and state governments as a powerful leveraging tool to impose standards—if the government insists that all providers who care for Medicare and Medicaid patients submit claims and clinical data through a particular format, then hospitals and vendors will rapidly adopt that format.

(2) Provide third-party payer incentives for implementing CPOE: Some benefits of CPOE, most notably reduction in medical costs through prevention of adverse drug events, accrue to purchasers or third-party payers, whereas the costs of implementing CPOE are borne entirely by hospitals. Some hospital managers believed that financial incentives could correct this inequity. These incentives could come from either the government or private insurance companies and could include grants or loans to defray the capital cost, or increased reimbursement to hospitals that have met certain standards of CPOE use.

Barrier 3: product/vendor immaturity. Informants reported that many current vendor products did not fit the needs of their hospital, and extensive software modifications were required to accommodate workflow in the hospital. One CIO summarized the vendor market as follows:

> "[Company A] has a product that is now getting to be only two years [old]—and it still has a lot of work to do. [Company B] has a brand-new product out there from [University X], but boy, that's leading-edge brand-new software that now needs to be rewritten [to make it compatible with Company B's core product]. You wouldn't put eight or ten million dollars in one of [Company C's] old products for fear they'll disappear, so you put [your money] into their new product, and the paint's still wet on that. And that's less solid than [Company B's] basic product. [Company D], well, their forte is...considered to be outpatient systems. Now, I'm starting to run out of names of real solid companies."

CIOs in hospitals with prior failed attempts at CPOE implementation recounted how poorly designed user interfaces and unacceptable processing speeds rendered early versions of CPOE unusable. While vendor products are definitely improving, few vendors have established a track record of successful implementation in more than a few hospitals. Several CIOs accused vendors of selling "vaporware," referring to software functionality that was promised but never delivered.

Overcoming vendor and product immaturity. Our informants offered several strategies for select-

ing vendors. (1) The vendor must be committed to the CPOE market. (2) The vendor must be ready to identify hospital workflow issues and adapt its product accordingly. (3) The vendor must commit to a long-term trusting relationship with the hospital, because successful CPOE implementation might take years. A standardized toolkit to evaluate product functionality and reports on vendors' track records would greatly assist hospital officials in their decision making. Since the benefits of CPOE also depend on the level of decision support, this toolkit should also provide a direct comparison of the medical knowledge supported by each product.

Discussion And Policy Implications

Using a qualitative approach, we identified three major barriers to implementing CPOE in various hospitals across the United States: physician and organizational resistance, the high cost of CPOE, and product and vendor immaturity. Although these barriers were significant for almost all hospitals in our study, our informants identified strategies to overcome them.

Although physician resistance has been reported in the literature, it was remarkable how often our informants cited this barrier as a greater impediment than cost. This finding should be interpreted with caution. Many of the institutions we interviewed were actively engaged in the implementation of CPOE, and this group might be more successful at overcoming financial barriers than the average hospital. However, even if this possible bias is true, our findings still strongly suggest that overcoming the financial barrier alone may not be sufficient to enable hospitals to adopt CPOE. Therefore, efforts to diffuse this patient-safety technology must focus on rallying physicians' support behind CPOE. Payers should also explore financial arrangements to reward hospitals for CPOE use, perhaps in the form of differential reimbursement that can be passed on to physicians. Other policy options include allowing and encouraging malpractice insurance companies to discount rates for physicians who use CPOE. Furthermore, govern-

ment or commercial payers that issue grants or loans to assist hospitals to implement CPOE should carefully assess these hospitals' capacity to manage change. Similarly, these programs should secure commitment from hospitals to share a portion of the implementation cost.[13]

Our findings also suggest that hospitals could mitigate the cost barrier by refocusing their priorities on patient safety. According to our informants, decisions to implement CPOE were driven by the mission of the hospital to provide safe and effective care, rather than return-on-investment considerations. Undoubtedly, some hospitals are in such dire financial condition that they cannot afford to adopt CPOE even if they truly consider patient safety a top priority. Nonetheless, our observation does imply that at least some U.S. hospitals might be able to afford CPOE implementation if their priorities could be realigned through some external or internal influence. Further research should therefore focus on ways to motivate organizations to raise the priority of patient safety.

Outside the hospital, many opportunities exist for policymakers to promote the adoption of CPOE. First, they must exert pressure on hospitals to improve patient safety. Our research suggests that hospitals respond to such pressures. Second, they should encourage public and private payers to provide financial incentives to institutions for adopting patient-safety measures such as CPOE. Such measures have been recently proposed by several legislative bodies.[14] Third, policymakers could provide access to capital through loans or grants to help hospitals overcome the initial cost barrier. Fourth, policymakers should improve the interoperability of CPOE systems by promoting the standardization of vocabulary and communication protocols. This would lower the cost of CPOE implementation and give hospitals access to a larger variety of CPOE vendors. A national repository of clinical knowledge for implementation by CPOE vendors should also help more organizations realize the technology's benefits. Fifth, research that addresses the barriers to the adoption of

CPOE should be supported.

This study has several limitations. First, the use of a relatively small pool of management officials as our informants may have biased our conclusions. In particular, we may not have adequately captured the issues faced by end users of CPOE, such as physicians and nurses. Second, we had great difficulty recruiting informants from hospitals that were not considering implementation, and our findings might underrepresent the financial barriers faced by hospitals that cannot see past this barrier. Nonetheless, we believe that the issues we identified will be applicable when these hospitals start considering CPOE implementation.

In summary, CPOE implementation is a difficult process, punctuated by uncertainties, risks, and organizational barriers. Strategies identified by our informants to overcome these barriers offer hope to hospitals that are willing to take on this challenge. Although widespread adoption will take time, we believe that policymakers have many opportunities to speed the nationwide adoption of this proven patient-safety intervention.

NOTES

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