

Research Paper ■

The Extent and Importance of Unintended Consequences Related to Computerized Provider Order Entry

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quences are predicted or detected, their management can knowingly involve tradeoffs. An example CPOE-related tradeoff is the degree to which the extra time physicians must exert to use CPOE (an undesirable consequence), is offset by the increased information physicians find available at the point of care via CPOE—making patient visits more effective.³⁰ The ability to maintain control over consequences may give hospital decision makers more confidence when making the determination to implement CPOE.

Recent descriptions in the literature of the unintended consequences of patient care information systems include a taxonomy of kinds of errors,³¹ a list of kinds of errors related to CPOE,¹⁸ a hierarchical model of unintended consequences of CPOE,³⁰ and a more general summary of the unintended consequences of patient care information systems.¹⁹ In addition, the authors of the current study previously described in detail a typology of unintended adverse consequences of CPOE.³² However, none of the previous studies provided a comprehensive, semi-quantitative description of the extent and importance of unintended consequences in hospitals across the nation. We therefore transformed our descriptions of types of unintended consequences into survey questions to discover how widespread and important the consequences are. We tested and, using short telephone interviews, administered the resulting instrument to representatives of 561 U.S. hospitals that have reported that they have installed CPOE systems, out of a

tory of a entry fields changes the power structure of organizations. Often the power or autonomy of physicians is reduced, while the power of the nursing staff, information technology specialists, and administration is increased.

Overdependence on Technology: As hospitals become more dependent on these systems, system failures can wreak havoc when paper backup systems are not readily available.³⁹

Methods

Survey Development

We developed an interview script, which included a short description of the purpose of the survey, five questions about the kind of CPOE system in place, and eight questions about possible unintended consequences. The five questions about the system were designed to collect descriptive information about the degree to which the system is infused into the institution. Infusion of technology is defined as the extent to which an organization uses an innovation in a complete and sophisticated manner,⁴⁰⁻⁴¹ and it occurs as information technology applications become more deeply embedded within the organization's work systems.⁴²

Though we had previously discovered nine types of unintended adverse consequences, we decided not to ask interviewees about one of them, paper persistence, because as the role of paper has changed from a long-term storage medium to a temporary memory aid and disposable display device, its persistence should not now be considered adverse. The unintended consequences typology developed from the qualitative study was therefore transformed into eight survey questions, which were pilot tested (see Table 1). The questions were designed to be as neutral as possible to avoid bias. We prefaced the questions by stating that the study concerned "what organizations have learned about CPOE." We asked about surprises, "things that happened that you didn't expect," so the focus was on both unintended and unanticipated consequences; responses might then involve either desirable (beneficial) or undesirable (adverse) effects.

The questions were asked first as yes/no queries to determine if the respondent thought the unintended consequence existed at that site (0 = No). If the answer was yes, the importance was determined on a 1 to 5-point Likert scale ranging from 1 for "not at all important" to 5 for "very important." We received institutional review board approval from Oregon Health & Science University and Kaiser Permanente Northwest to conduct the survey.

Survey Administration

We attempted to contact the entire population of U.S. hospitals using CPOE, instead of a sub-population from which we would make statistical inferences, because we wanted to gain insight into the nature of unintended consequences related to CPOE from organizations beyond those we visited. We selected acute care hospitals from the 2004 HIMSS AnalyticsTM Database that reported having CPOE in place ($N= 448$). Since that database did not include U.S. Veterans Affairs hospitals, which the authors believed to constitute important models of CPOE use, we also surveyed them ($N= 113$). We contacted hospital staff listed as appropriate contacts via electronic mail and then made phone appointments for the 10 to 20 minute survey. Follow-up included multiple phone calls until a knowledgeable informant was found. Each question asked the interviewee to respond on a 5-point Likert scale about the extent of the problem; researchers took notes on anything that was volunteered beyond

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Survey unintuitive

Survey

time CPOE has been in place and the extent to which unintended consequences were present. Using bed size and ownership as established proxies for “other important organizational characteristics in studies of hospital organizational issues,”⁴³ as well as geographic location and teaching status, we compared respondents to non-respondents using logistic regression.

Qualitative data in the form of notes taken during the interviews were analyzed using QSR N6. This analysis simply entailed grouping comments with the questions to which they related, each representing a type of unintended consequence.

Results

We were able to establish contact with 265 of the 561 hospitals and discovered that 89 of those listed in the HIMSS AnalyticsTM database did not actually have CPOE, so they were dropped from further consideration. We therefore conducted 176 full interviews. Thirty-four additional institutions had

Table 3 ■ Comments from Respondents

Type of Unintended Consequence	Respondent Comments
More work and New work	<ul style="list-style-type: none"> • Needs additional educational effort and surveillance by nursing and pharmacy to prevent ADE's • Orders are more labor intensive; repeat orders are timesaving with the system, though • Most examples of new work that come to mind really are not new, but only new to the person doing it • Prescribers are now responsible for much of the ordering and documenting that used to be done by support staff • People expect the computer to save them time, but there is a learning curve while trying to get to know the system and that creates work • More data can mean that there is more to manage and how to do that effectively becomes an issue. CPOE has made some things definitely faster • Upfront work takes more time which is the downside, but information is there and clearly available for everyone • Time saved overall, but individually some see more work than others
Workflow	<ul style="list-style-type: none"> • Has different effects on different jobs and people • Especially the physicians • Sequence of workflow is often required to be changed; new steps are added • Same work, different groups performing the tasks • Establishing remote access, many doctors have already checked their labs and work online before coming to work or doing rounds, which makes their floor practices easier
System demands	<ul style="list-style-type: none"> • It takes an army to help build and maintain X system, assuming you have not hired the vendor to do this work. There are about 50 people who support the X system directly in our IT department and it still is not enough to keep up with the demand • The need for constantly upgrading old computer equipment is a huge issue. It is a constant tug-of-war between the cost of new equipment and the cost of user time and frustration having to use equipment that is slow or in need of repair • Huge undertaking, a lot on the software side, there were cultural issues as well • Demand from the organization exceeding our supply so getting priorities sorted out once you establish the mandatory maintenance allocation is critical • Training and maintenance have been huge • Order sets are the biggest challenge and modification of them once in the working system is very intensive • Weren't aware that so much support resources would be needed; we way under forecasted • Do not do this unless you can support it! • We've tackled the beast with 6 full time workers, each specializing in a particular area
Communication	<ul style="list-style-type: none"> • People seem to forget how to communicate, even for the most basic, routine matters. They expect the computer to tell them what to do, every step of the way • I think there is less face-to-face communication between providers • It's always a challenge in a complex environment because the computer makes things invisible; we should educate everyone in what the system can and can't do to uncover misconceptions and silent communication patterns • People began to assume the system had it so they did not need to tell someone • Initially, they didn't think they had to talk any more and that isn't the case! It is much improved over time • Improvement because patient records accessible anywhere
Emotions	<ul style="list-style-type: none"> • Computer phobics had a hard time; they identified each additional minute the physicians spent because of the system • There have been both strong advocates and strong opponents of the system • Doctors mostly see CPOE as a good tool and beneficial for others • In the beginning, resistance, now no • At first, everyone was upset. But now residents rely on it; they don't know how to use the paper system • Pick your favorite terms of praise or profanity. They are all used • It's an inanimate object, so easier to express it toward system than toward a human; people expect computers to be working all the time and when they don't people are angry • A small but vocal minority hate it • Generational, but mostly favorable • Many reactions on both sides of the fence. Some doctors were upset because they felt like they were being asked to be typists. Others are happy because they can navigate the computer to find the information they need quickly • Some love it and other keep hoping that it will just go away • Most have been willing to adapt and have had positive responses. There was one case where a doctor told the implementation staff that they were ruining his life • Doctors don't like feeling dumb so when they don't know how to use the system, they get frustrated and angry

Workflow: We asked if CPOE altered workflow and to what extent. 87% of respondents said that it is a moderate to very important issue. Many commented that CPOE increased efficiency, which is genera8.m(efficien4791r8008.4324177.3839anm(to)TjETBT9009256.896177.3839xpectation(CPOE)TjETB

Beliefs

based on the survey taxonomy being derived from a prior study of adverse consequences.

Responding sites tended to differ from non-respondents by management type, with VA hospitals the most

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