

A tale of two hospitals: a sociotechnical appraisal of the introduction of computerized physician order entry in two Dutch hospitals

Jos Aarts, Marc Berg

Institute of Health Policy and Management, Erasmus University Medical Center, Rotterdam, The Netherlands

Abstract

We compared the implementation of computerized physician order entry (CPOE) in two Dutch hospitals, one being an academic medical center and the other a large regional non-academic hospital. Both implemented the TDS7000 system that was running on the same computer, located in the computing department of the academic medical center. The outcomes of the implementation were different. The introduction of CPOE in the university medical center failed, while it was a success in the non-academic hospital. An appraisal of the different outcomes is possible when we consider the implementation of information as a thorough social process in which the technical and the social are closely interrelated. Our findings suggest that organizational change associated with CPOE implementation should not focus on individual physician behavior but on medical work as a collaborative professional effort.

Keywords:

Hospital information systems; online systems; medical record systems, computerized; computerized physician order entry; qualitative research

Introduction

Computerized physician order entry gained prominence again after the publication of two reports by the Committee on Quality on Health Care in America on medical errors and improvement of the quality of the health system [1, 2]. The committee suggests that the wider introduction of CPOE would reduce the number of medical errors significantly and that therefore CPOE would improve the quality of care and patient outcomes. Indeed, studies such as by Bates have shown that CPOE can reduce medical errors and improve patient outcomes [3, 4].

The implementation of CPOE however, has been fraught with problems. Massaro described how residents in the University of Virginia Medical Center opposed the implementation of CPOE because they were required to use it and complained that they spent too much time on it [5]. Ash et al. found that in only 15% of the hospitals that had implemented CPOE physicians were using it [6]. Ash et al. later concluded from a cross-site study of CPOE in hospitals that implementation strategies for CPOE should be designed for its complex nature [7]. In a recent study of physician and public response to the medical error debate Blendon et al. found that physicians do not see themselves as

part of the problem and that they were less likely to adopt systemic approaches such as the use of information technology to reduce medical errors [8].

We have studied the implementation of CPOE in two Dutch hospitals over a longer period of time. During this time we collected data through interviews, observation of staff meetings and system use, and document analysis [9,10]. The implementation in one hospital ended in failure and in the other hospital CPOE was implemented successfully, but only was used by clerks and nurses. We have sought to understand our findings by taking the sociotechnical approach which addresses the interrelatedness of technical and social elements, and raise questions how CPOE might better fit in medical work practices [11].

A tale of two hospitals

The implementation of CPOE is not widespread in the Netherlands. A few hospitals have implemented some form of physician order entry that focuses on a single domain, such as medication [12]. A 953 bed university medical center (hereafter hospital A) and a large 1171 bed regional hospital (hereafter hospital B) have attempted to implement CPOE organization wide. The hospitals chose the TDS7000 system of TDS Healthcare Systems Corporation¹ and shared their computing resources. Hospital A wished to replace its IBM mainframe based home-grown hospital information system with a system that would be focused on supporting clinical work. Considerations for the selection of the order entry system were the wishes to be clinically oriented, of being advanced compared to other academic medical centers in the country and preserving the existing IBM infrastructure including the expertise of the ICT staff. Benefits listed were easier use and more readable and complete medical orders. Hospital B was more modest. It had no previous history of extensive use of computer systems, and felt it could move directly into support of clinical work. Hospital B was offered a deal by hospital A that it could use the IBM infrastructure by leasing broadband communication lines. This offer would save substantially on investments in an own infrastructure. On the other hand the earlier implementation of the order entry system in hospital B would provide the ICT staff in hospital A with a unique oppor-

1. Now Eclipsys Corporation. The system is also known as E7000.

tunity to gain experience with the development and the maintenance of the system. Hospital B signed the contract to implement the system in 1993 and hospital A in 1995. Both order entry systems were actually sitting on the same mainframe computer. In 1995 the system in hospital B went live and gradually its functionality was expanded to include CPOE in all clinical units. CPOE has not yet been implemented widely in the outpatient clinics.

In hospital A the system went live late in 1997. Applications such as patient administration and scheduling were activated, but CPOE was never implemented. Physician resistance grew after it became apparent that administrative users were not happy using the system. To complete a transaction, such as scheduling a patient, a secretary had to page through many screens and the Windows emulation of the TDS screen was not intuitive in use. It became manifest that these characteristics of the system slowed down the users and physicians started to realize that using the system would cost them much time [10]. Through formal and informal channels the physicians mustered enough support to halt the further deployment of the system. The hospital is still using the system for administrative purposes, awaiting decisions about the future direction of the role of ICT.

In hospital B only clerks and nurses were using CPOE. In the beginning the nursing use of CPOE had been made difficult by inserting authorization screens in which the nurse had to fill in detailed information about the physician responsible for the medical orders. Later on this 'agent for' construction was simplified when it became clear that physicians would never use the system [9]. Medication orders proved to be problematic in this hospital. Nurses would enter medication orders and it was agreed that physicians would authorize these orders through the system or signing paper medication sheets. In reality about 60% of the medication orders were not authorized. Our interviews revealed a difficult relationship between physicians and the pharmacy because of different opinions about the responsibility for medication quality. A similar finding was reported in a study by Carpenter and Gorman [13].

Research methodology

Qualitative research methods are most appropriate to study systems in practice [14]. We collected data for this study through open interviews, document studies and observing systems in use, and staff meetings in both hospitals, starting in 1997 and ending in 2002. In both hospitals we interviewed project leaders, clinical members of the implementation staff, staff and resident physicians, nurses and technical and administrative staff. The interviews were transcribed and submitted to the interviewees to correct for factual errors. In total 25 interviews were conducted.

We examined documents pertaining to the selection and the use of the system, the outcome of pilots in hospital A and the evaluation by external consultancy firms.

We transcribed also the observations of the systems in use and staff meetings. During the observation of people using the system we would occasionally ask them to explain what they were doing. In the staff meetings we focused on how the participants

were behaving and what they were saying. Both interviews and observation transcripts were coded for relevant keywords.

A sociotechnical appraisal

The most interesting question is not why the introduction of CPOE failed in one hospital and did not in the other, but whether and under what conditions CPOE can be implemented and appropriately used. We argue that existing technological and organizational arrangements are important factors that determine the introduction of new technologies, such as CPOE. The combination of technical considerations (the pre-existing IBM infrastructure) and organizational considerations such as 'costs containment', 'being clinically oriented' and 'being a leading university medical center' together determined the choice for the TDS system in hospital A. In hospital B organizational issues determined the choice, mainly because there was no history of a technical infrastructure that was strong enough to influence the choice. The hospital was lured into this choice because of the favorable conditions offered by hospital A and TDS, wishing as a vendor to enter the Dutch market. We observed that, contrary to hospital A, administrative practices in hospital B had a chance to become well integrated with the system. We suggest that this difference can be explained by the fact that clerks in hospital A were already familiar with information systems and that administrative work in hospital B was mainly paper based. It was much more difficult for users in hospital A to adapt to new working conditions, especially in the light of promises that functionality would not change and use would be easier. Clerks in hospital B found using the system superior to their paper based work practices, and were able to adopt the new technology and change their work routines without being hindered by established practices of computer use. The experience of administrative personnel with and attitude towards the system in hospital A influenced the opinion of the physicians. They feared that using the system would cost them too much time and started to oppose the introduction of the physician order entry functionality. The opposition was powerful enough to abort the implementation. In hospital B the physicians were equally opposed to CPOE, but they did not object if nurses and unit secretaries would enter their written or verbal orders, as long they would not have to do it themselves.

The outcome of the implementation of CPOE in both hospitals was actually a thin line between failure and success. In both hospitals physicians were objecting CPOE. For the nurses and clerks in hospital B it meant an improvement of the quality of medical orders (legibility, reduction of errors) that they were doing anyway for the doctors. Both hospitals held the opinion that it was only legal and natural that medical orders would be initiated by physicians, and could not be delegated to other professionals. In both hospitals implementing CPOE was therefore not seen and planned for as organizational change. 'Technical' improvements were highlighted; the issue how medical work would or should change was not addressed.

What tipped the balance of accepting and rejecting CPOE was that in hospital A the 'memory' of using the old system influenced the course of events, while in hospital B the nurses and clerks started to 'own' the system. If physician use of CPOE

would be a measure of success then both implementations have to be considered a failure.

Discussion

From our findings we might conclude that we need to work harder to overcome physician resistance to CPOE. The 'communist opinion' is that writing medical orders is a professional responsibility of the physician and that it cannot be delegated to nursing or administrative staff. An editorial comment in the New York Times on the findings of Blendon et al. accused physicians of a retrograde behavior with respect to adopting technology to improve the quality of medical care [15]. We would challenge that position and the focus on individual physician behavior. In the past it has been proven very difficult to change physician behavior if they are not convinced of the benefits that such a change would bring [16]. The survey conducted by Ash et al. and our findings suggest that phrasing the benefits of CPOE in terms of making medical orders more legible and more complete are not sufficient to convince physicians [6,9]. In a white paper Bates points out that older CPOE systems might be error-prone and time-consuming, encouraging physicians to delegate the order entry process to other professionals such as nurses, pharmacists and secretaries [17]. In a review of the CPOE literature up to 1993 Sittig signals the need to change established medical practices and workflow routines for successful implementation of CPOE [18]. However, we would not like to downplay the issue of medication errors and the responsibility of physicians.

Rather than arrive at the conclusion to address individual physician behavior we would rather raise some questions about CPOE and suggest new directions for further research. Our observations show that many different professionals are involved in generating and entering medical orders, playing a role that is agreed upon or that has grown as a result of ad-hoc arrangements within a health care organization. Our observations including those about the problematic relationship between pharmacists and physicians are consistent with the findings of other CPOE researchers [13, 17-19]. Many decisions about patient care are negotiated between professionals, including even the patients [20]. Research suggests that delegating medical tasks to nurses with the help of decision support tools can actually improve the quality of medical care [20, 21]. Two questions arose from this study.

- How does CPOE fit in a model of delivering care as a collaborative professional effort in a continuum of care?
- What will be the effect on reducing errors and improve patient outcomes when pharmacists, nurses and clerks are considered essential as actors in CPOE?

We think that CPOE can be implemented successfully when standardized care paths and protocolized order sets are made part and parcel of working routines of collaborating health professionals, as suggested in studies by Sittig and Berg [18, 22]. Further research on CPOE should therefore focus on delivering care as a collaborative effort and perhaps related to the further development of workflows as novel ways to deliver medical care [23].

Conclusion

The implementation of CPOE in two Dutch hospitals proved to be very problematic. In one hospital CPOE never became functional, and in the other CPOE was only used by nursing and administrative staff. To a large extent sociotechnical issues influenced the implementation, such as the existence of local infrastructures and working arrangements. These are not easily changed as a result of new technologies. Research suggests that introducing new technologies that influence medical work practices and organizational arrangements should be carefully planned.

In our tale of two Dutch hospitals the introduction of CPOE was not planned as organizational change, and therefore measures to remedy organizational impacts were mainly defensive. Instead of focusing on individual physician behavior, organizational change should focus on CPOE as a collaborative effort. Unearthing the nature of collaborative delivery of care should be the focus of new CPOE research.

Acknowledgments

The authors acknowledge the staff of both hospitals to share their experiences with them. The authors thank their colleagues in RITHM (Research group on IT in health Care Management and Practice) for fruitful discussions about earlier drafts of this paper.

References

- [1] Kohn LT, Corrigan JM, Donaldson MS, editors. *To err is human, building a safer health system*. Washington, D.C.: National Academy Press; 2000.
- [2] Committee on Quality of Health Care in America. *Crossing the quality chasm, a new health system for the 21st century*. Washington, D.C.: National Academy Press; 2001.
- [3] Bates DW, Leape LL, Cullen DJ, Laird N, Petersen LA, Teich JM, et al. Effect of computerized physician order entry and a team intervention on prevention of serious medication errors. *JAMA* 1998;280(15):1311-6.
- [4] Bates DW, Teich JM, Lee J, Seger D, Kuperman GJ, MaLuf N, et al. The impact of computerized physician order entry on medication error prevention. *J Am Med Inform Assoc* 1999;6(4):313-21.
- [5] Massaro TA. Introducing physician order entry at a major academic medical center: I. Impact on organizational culture and behavior. *Acad Med* 1993;68(1):20-5.
- [6] Ash JS, Gorman PN, Hersh WR. Physician order entry in U.S. hospitals. *Proc AMIA Symp* 1998:235-9.
- [7] Ash JS, Lyman J, Carpenter J, Fournier L. A diffusion of innovations model of physician order entry. *Proc AMIA Symp* 2001:22-6.
- [8] Blendon RJ, DesRoches CM, Brodie M, Benson JM, Rosen AB, Schneider E, et al. Views of practicing physicians and the public on medical errors. *N Engl J Med* 2002;347(24):1933-40.
- [9] Goorman EAM, Berg M. Modelling nursing activities: electronic patient records and their discontents. *Nurs Inq* 2000;7(1):3-9.

- [10]Aarts JECM, Doorewaard H, Berg M. Understanding implementation: the case of a computerized physician order entry system in a large Dutch university medical center. *J Am Med Inform Assoc* 2004;11(3): in press.
- [11]Berg M, Aarts J. van der Lei J. ICT in health care: socio-technical approaches. *Methods Inf Med* 2003;42(4):297-301.
- [12]Kalmeijer MD, Holtzer W, van Dongen R, Guchelaar HJ. Implementation of a computerized physician medication order entry system at the Academic Medical Centre in Amsterdam. *Pharm World Sci* 2003;25(3):88-93
- [13]Carpenter JD, Gorman PN. What's so special about medications: a pharmacist's observations from the POE study. *Proc AMIA Symp* 2001:95-9.
- [14]Crabtree BF, Miller WL, editors. *Doing qualitative research*. 2nd ed. Thousand Oaks: Sage Publications; 1999.
- [15]Editorial. Errors that kill medical patients. *New York Times* 2002 Dec 18.
- [16]Marco AP, Buchman D. Influencing physician performance. *Qual Manag Health Care* 2003;12(1):42-5.
- [17]Bates DW, Cohen M, Leape LL, Overhage JM, Shabot MM, Sheridan T. Reducing the frequency of errors in medicine using information technology. *J Am Med Inform Assoc* 2001;8(4):299-308.
- [18]Sittig DF, Stead WW. Computer-based physician order entry: the state of the art. *J Am Med Inform Assoc* 1994;1(2):108-23.
- [19]Ash JS, Gorman PN, Lavelle M, Payne TH, Massaro TA, Frantz GL, et al. A cross-site qualitative study of physician order entry. *J Am Med Inform Assoc* 2003;10(2):188-200.
- [20]Berg M. Medical work and the computer-based patient record: a sociological perspective. *Methods Inf Med* 1998;37(3):294-301.
- [21]New TD. Clinical decision support tools in A&E nursing: a preliminary study. *Nurs Stand* 2000;14(34):32-9.
- [22]Berg M. The search for synergy: interrelating medical work and patient care information systems 2003;42(4):337-44.
- [23]Stefanelli M. The role of methodologies to improve efficiency and effectiveness of care delivery processes for the year 2013. *Int J Med Inf* 2002;66(1-3):39-44.

Address for correspondence

Jos Aarts, MSc
 Institute of Health Policy and Management
 Erasmus University Medical Center
 P.O. Box 1738
 3000 DR Rotterdam
 The Netherlands
 E-mail: j.aarts@bmg.eur.nl