

Research Paper ■

The CMIO—A New Leader for Health Systems

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Abstract Physician leadership is a critical success factor for health information technology initiatives, but best practices for structuring the role and skills required for such leadership remain undefined. The authors conducted structured interviews with five physician information technology leaders, or Chief Medical Information Officers (CMIOs), at health systems that broadly used health information technology. The study aimed to identify the individual skills and organizational structure necessary for a CMIO to be effective. The interviews found that the CMIOs had significant management experience prior to serving as a CMIO and were positioned and supported within each health system similar to other executive leaders; only one of the five CMIOs had formal informatics training. A review of the findings advocates for the CMIO to have a strong background and role as a physician executive supported by knowledge in informatics, as opposed to being a highly trained informaticist with secondary management expertise or support.

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Introduction

Health information technology holds promise for controlling costs and improving quality,¹ significant at a time when health care costs in the United States are currently almost fifteen percent of the U.S. Gross Domestic Product² and inadequate health care quality is frequently cited.³ Federal, state, and local efforts are broadening existing health care information technology initiatives and supporting new programs and projects. Examples include: the passage of the Wired for Health Care Quality Act of 2005 by the U.S. Senate in November 2005, promoting the use of information technology to enhance the quality of health care services,⁴ as well as a Pay-for-Performance program started by Blue Cross and Blue Shield of Rhode Island, promoting the use of information technology through provider reimbursement.⁵ The Center for Medicare and Medicaid Services (CMS) has also expanded its Doctor's Office Quality Information Technology (DOQ-IT) program from a four state pilot to a national initiative that promotes the use of electronic health records in primary care physicians' offices.⁶ Despite these programs and other examples of clinical sites implementing health care information technology, in particular Electronic Medical Records (EMRs) and Computerized Provider Order Entry (CPOE), widespread adoption and connectivity across the United States remains minimal, even within health systems that have initiated major information technology implementations. Less than 5% of hospitals in the United

States have implemented CPOE⁷ and of the hospitals with CPOE, almost 60% of them have physicians entering less than 10% of their orders.⁸

Information technology initiatives offer tremendous potential benefits, but also might be the riskiest undertakings for hospitals and health care provider organizations due to the large expense and high complexity of these projects. Across industries, information technology project failures abound—66% of major information technology projects fail, for reasons that include projects not meeting requirements, late completions, and budget overruns.⁹

Physician leadership of health care information technology projects has been identified as a key requirement for success. A 2003 *Journal of the American Medical Informatics Association* case study on the advanced clinical use of computers at several hospitals identified high level leadership as the single most important factor associated with a successful implementation, and that “all sites appointed people with clinical backgrounds to lead the move to computerization.”¹⁰

To identify and highlight best practices for future health care information technology initiatives, the study authors undertook structured interviews with physician information technology leaders, or Chief Medical Information Officers (CMIOs) at health systems that had broadly implemented information technology, including CPOE. This article presents an analysis of these five CMIOs, presenting compiled information on their skills, their experiences, their organizational positions, and the health systems in which they work.

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ⁱAdditional statistics include the following:

- Information technology projects average 43% in cost overruns
- Information technology projects average 82% in time overruns
- 48% of required features and functions never appear in the released information technology system

Background

The 1998 *Journal of the American Medical Informatics Association* article "How Should We Organize to Do Informatics?" discussed the "tension between the long-standing academic role of informatics groups within medical centers and the ever-expanding service role."¹¹ In the article Dr. Warner Slack of Harvard University was quoted as stating that "By the time doctors woke up to the potential of the computer in medicine, territorial imperatives were firmly established. The chief financial officer (CFO) or chief information officer (CIO) and his or her staff were in charge. And this is the situation in most hospitals today." Slack advocated that "clinical computing is a medical discipline," and therefore made the case, as presented by Dr. William Stead of Vanderbilt University, that "...[r]eal wins happen when a medical informatician has the skills and authority to use a system, identify what is needed, make the necessary operational changes on the fly, and redirect the research effort."¹¹

Now, many publications have articulated the need for collaboration between physicians and information technology.¹¹⁻¹³ But what form should this collaboration take? Who should lead this collaboration...and who should participate? In early 2004, Dr. David Classen, Vice President of First Consulting Group, stated in an interview that "CPOE is probably the first IT initiative being led by people outside of IT," and that "Physicians are key leaders."¹⁴ Dr. Classen saw the "CMO [chief medical officer] emerging as the owner of this project using the medical informaticist and other physician champions as project leaders and advocates."¹⁵ Many industry and academic conference panels have supported Dr. Classen's recommended approach.¹⁶ A June 2003 California Health Care Foundation report "Computerized Physician Order Entry In Community Hospitals: Lessons from the Field" stressed having "physicians as leaders and decision-makers" with "visible, active roles for medical executives" as critical to the implementation of CPOE.¹⁷

The *Health Data Management Annual CIO Survey* in 2003¹⁸ and 2005¹⁹ shows, however, that there has been little increase in the role of clinicians in this process. In answer to the question "How involved are physicians in the CLINICAL information technology assessment and purchase process within your organization?" the CIOs reported the percentage of physicians who were involved or very involved as 50% in 2003, and 53% in 2005. Twenty percent of survey respondents in 2005 chose not to answer this particular question, which is an indicator of the ambiguous role of clinicians in the process (See Table 1 for a compilation of the survey results).

Often, hospitals that have achieved major progress implementing clinical information technology have developed physician leaders in the field, known as Chief Medical Information Officers, Directors of Medical Informatics, or other similar titles. Many job descriptions for these positions have been published in journals, by organizations, and in classified job listings at health informatics organization websites.²⁰ The roles and responsibilities vary slightly from position to position and from health care institution to institution, but the focus is similar—the person in the role must effectively lead the implementation of clinical information systems, including the use of such systems by physi-

Table 1 ■ Data compiled from the *Health Data Management Annual CIO Survey*—Response to the question: *How involved are physicians in the CLINICAL information technology assessment and purchase process within your organization?*

Year	2003 ²⁴	2005 ²⁵
Very Involved	20%	23%
Involved	30%	30%
Not Very Involved	40%	23%
Not at All Involved	8%	4%
Did Not Respond to this Question ^{viii}	2%	20%

^{viii}The data was reformatted to include the information on non-respondents reported by Health Data Management.

cians. Aside from cursory profiles of individual physician information technology leaders in both the lay press and health care information technology journals, little attention has focused on the skills necessary to be an effective physician leader in information systems and how a health system should enable such a leader to succeed.^{21,22}

This study was undertaken to identify, catalogue, and evaluate the skills and experiences that enabled five physicians to be effective leaders of clinical information systems, or CMIOs, at five diverse health systems: Rush University Medical Center in Chicago, IL; the multi-location Shriners International Hospitals for Children; The Queens Health Network in New York City, NY; Weill Cornell Physician Organization in New York City, NY; and William Beaumont Hospital in Royal Oak, MI. The health systems are all recognized leaders in health information technology implementation. Additionally, the study aimed to identify approaches the leadership at the five health systems took to position and support the respective CMIOs to effectively lead clinical information systems initiatives.

Methodology

The concept for the study, including the development of the 15 question instrument used during the structured interviews of the CMIO subjects, was created by Drs. Levis and Kremsdorf, based on their experiences as CMIOs at large health systems in the United States. This experience helped focus the interview questions on the skills, professional experience, authority, and resources that influenced their ability to serve effectively. Interview questions targeted the role of the CMIO in the health system, the professional experience of the subject physicians prior to becoming CMIOs, and how the health system positioned the CMIO within management. CPOE was a specific focus of questions due to its current importance in health information technology projects. The questionnaire appears in Figure 1, available as a JAMIA on-line supplement at www.jamia.org. The subjects for the interviews were identified by the authors as broadly representing different health systems in the United States, including: public, private, and charitable; academic and non-academic; and acute care, ambulatory care, and integrated delivery systems. The subjects were selected because of the known successes of their health systems' achievements in improving health care delivery with the

implementation of health information technology and the subjects' leadership contributions to these successes.ⁱⁱ

The recorded interviews were conducted during five successive conference telephone calls from the fall of 2003 through the spring of 2004. All three authors were present for all five interviews. Each candidate was interviewed separately in a similarly structured manner using the survey instrument; candidates were allowed to respond to questions in an open-ended manner as long as the response included an answer to the question asked; no candidate was provided any information about the results of the prior interviews by the authors. Dr. Leviss served as the primary interviewer and Dr. Kremsdorf and Ms. Mohaideen contributed follow-up questions to all candidates to clarify responses. Dr. Kremsdorf documented the interview with outline notes in addition to a taped recording made of all interviews. All responses have been de-identified where possible at the request of the study subjects. Responses were aggregated according to the pertinent question by Dr. Leviss and Ms. Mohaideen and then analyzed in a qualitative manner by all three authors. A literature review of the topic was performed to identify supporting and contrasting material. Finally, the study subjects each reviewed the written report and consented via email correspondence to the submission of the report for peer-reviewed publication.

Results

Interviewees: The following five physician informaticists were identified and agreed to be interviewed for the study. All five were the lead physician informaticists, or CMIOs, at their respective organizations. A brief description of the CMIO's health system follows each person's name and title.

John Brill, MD: Associate Vice President, Chief Medical Information Officer, and Associate CIO, Rush University Medical Center, Chicago, IL, and the Director, Section of Medical Informatics, Department of Internal Medicine, Rush Medical College.ⁱⁱⁱ Rush University Medical Center is part of an academic integrated health care system serving the Chicago metropolitan area and is the primary teaching hospital for Rush Medical College. The CPOE implementation of the Siemens Invision[®] software began in the mid-1990s and by 2001 had been implemented across almost all inpatient services, including diagnostic test orders, patient treatment orders, and medication orders.

Curtis Cole, MD: Director of Information Services, Weill Cornell Physician Organization, Weill Medical College of Cornell University, NY, and Assistant Professor of Medicine, Cornell University. Weill Cornell Physician Organization has over 600 affiliated physicians, in a faculty practice of primary and specialty care. Physicians use the EpicCare[®]

Ambulatory EMR software by Epic, including CPOE for diagnostic test orders, patient treatment orders, and medication orders.

Steven Luxenberg, MD: Medical Director of Informatics, Beaumont Hospitals, Royal Oak and Troy, MI.^{iv} Beaumont Hospital includes two acute care hospitals in Troy and Royal Oak and is a regional medical center and tertiary care hospital providing inpatient and ambulatory primary and specialty care. In 2002, Beaumont completed a CPOE implementation for diagnostic test orders using the Misys CPR[™] software.

Alastair MacGregor, MB, ChB, MRCP: Associate Medical Director of Informatics, Shriners International Hospitals for Children, International Headquarters, and Director and Consulting Physician Executive for Cerner Corporation.^v Shriners International Hospitals for Children is a network of pediatric specialty hospitals throughout North America providing orthopedic, burn, and spinal cord injury care free of charge to patients under the age of 18. Shriners Hospitals is implementing CPOE using the Cerner Millennium[®] software across all hospitals, with 17 out of 20 US hospitals completing CPOE implementations by 2004 for medication orders.

Glenn Martin, MD: Director, Medical Informatics, The Queens Health Network, New York, NY, and Associate Dean of Research of the Mt. Sinai School of Medicine, New York, NY. The Queens Health Network (QHN) is part of the New York City Health and Hospitals Corporation and is the largest health care provider in the borough of Queens in New York City. QHN received the 2002 Nicholas E. Davies award, presented by the Health Information and Management Systems Society, for its computer-based patient record implementation of Misys CPR[™] software, including clinical documentation by physicians and nurses, and CPOE for diagnostic test orders, ancillary orders, and ambulatory and inpatient medication orders.

Role of the CMIO

The interviewees were the first CMIOs in all five organizations studied. All CMIOs viewed themselves as both information technology and clinical executives, as opposed to operations executives. All five were responsible for leading clinical information technology initiatives, including: Electronic Medical Record and Clinical Information Systems implementations, data warehouse initiatives, and other ad hoc information technology projects such as physician websites, physician e-mail, and network security. Four of the five CMIO roles were structured for the individuals to continue to serve as an attending physician: three spent 20% of work time providing direct patient care; and one spent 50% of work time providing direct patient care. The fifth CMIO did not provide direct patient care.

Most important role in CPOE: All five CMIOs stated that they advocated for CPOE and articulated its business case at their health system. Additionally, all CMIOs stated that they

ⁱⁱAll five CMIOs were from hospitals that had successfully implemented CPOE, which for the purposes of this article has been defined as one hundred percent physician use of a clinical information system for at least one complete category of orders in a clinical care setting—e.g., all laboratory test orders on a service. Information about the CPOE implementations was either reported by a 3rd party, such as published report, or was directly communicated by the subjects to the authors.

ⁱⁱⁱBy the time of publication of this article, Dr. Brill had left the position to become the Vice President and Chief Medical Officer at Dearborn Advisors, LLC.

^{iv}At the time of the interview, Dr. Luxenberg had left the position to become Physician Informaticist at the Department of Clinical Research Informatics at the National Institutes of Health, Clinical Center, Bethesda, Maryland.

^vBy the time of publication of this article, Dr. MacGregor had left his position at Shriners International Hospitals for Children to work solely as a Physician Executive for the Cerner Corporation.

created physician ownership of the CPOE project and committed physician participation and support. This was accomplished through several activities of the CMIOs:

- Set project expectations (i.e., created and executed the information technology strategic plan)^{vi}
- Set the cultural tone for the project (i.e., mandated e-mail communication about CPOE and banned paper communication for CPOE committees)
- Led the vendor selection process
- Created and managed the clinical IT department
 - Recruited physician champions for CPOE project
- Led communication efforts with physicians and nurses
- Led physician and other clinician design meetings
- Created CPOE implementation plans and training modules
- Directed training and go-live support (i.e., remained on-call 24 hours per day, seven days per week for clinicians with questions or problems during go-live)
- Developed and led multi-disciplinary process redesign efforts

All CMIOs reported functioning as key in-house information technology consultants on health system initiatives that did not solely focus on information technology. All CMIOs presented about clinical information systems initiatives to different groups within the health system, both on a regular basis to different committees and in an ad hoc manner.

Health system leadership: CMIO involvement in health system committees was extensive for all five persons interviewed. Each of the CMIOs chaired at least one senior health system committee: four CMIOs chaired information technology committees, including CPOE and enterprise master patient index (EMPI) committees; and two chaired non-information technology committees, including the pharmacy and therapeutics (P&T) Committee and a health system standards committee for equipment and services. Additionally, four CMIOs served on the health system medical executive or medical leadership committee and three served on the health system quality assurance committee. All CMIOs served on additional committees such as a residency review committee, a Health Insurance Portability and Accountability Act (HIPAA) Committee, and a Security Committee.

Health system policymaking: Only one CMIO possessed direct authority to change or create health system policy during the implementation of clinical information technology (e.g., new data entry requirements when physicians ordered medications). The remaining four CMIOs functioned as key advisors to the health system executives and committees that changed and created such policies. With respect to changing or creating health system operations and procedures, one CMIO possessed direct authority to do so during the implementation of clinical information technology (e.g., new processes for creating laboratory specimen labels).

Budget authority: All CMIOs stated that they were able to influence health system budget decisions through indirect channels, including personal and professional relationships. Four CMIOs had direct influence as well: two had budget authority within a project after a budget had been approved;

one CMIO was a member of the health system budget committee; and one had a supplemental discretionary budget.

Support staff: The CMIOs had varied staff sizes: two had over 20 directly reporting FTEs; one CMIO had an administrative assistant and a project analyst; one had only an administrative assistant; and one CMIO only had staff support through a matrix reporting structure where individuals reported to the CMIO depending on the specific project. The CMIOs without large staffs stated that all initiatives required collaborative work efforts from individuals across departments, whereas the CMIOs with staff could perform some functions independently.

Prior Professional Experience and Skills of the CMIO

Professional background: The professional backgrounds of the five CMIOs varied, but similar qualifications were apparent. All were board-certified in their field of medical specialty, including three internists, one family practitioner, and one psychiatrist. Three CMIOs received academic honors in medical school. Prior to being appointed CMIO, all five physicians were involved in a clinical information technology project at a hospital or ambulatory care center (four of the five CMIOs had this involvement at the same health system where they became the CMIO). Each of the CMIOs reported one of the following experiences: serving as a hospital CIO; serving on a clinical information technology vendor advisory committee; being a self-described 'amateur techie' and building and configuring personal computers and other technology devices; serving as a medical informatics liaison to public sector initiatives (i.e., public health project outside of the hospital); and serving as a consultant on health care informatics. Formal medical informatics training, however, was not common: only one CMIO completed a full-time medical informatics training program^{vii} and one CMIO completed a one month medical informatics elective in medical school. One CMIO had two years of experience as a clinical investigator in medical informatics.

Leadership skills: All five CMIOs had general executive leadership skills and experience. Four CMIOs had clinical transformation leadership experience prior to becoming the CMIO. These CMIOs cited a variety of clinical transformation projects that they had led or co-led, including the redesign of nursing operations, patient registration, and physician care processes, and other hospital business improvement initiatives. Four CMIOs held management positions prior to becoming the CMIO, including: director of a clinical department, manager of a physician practice (ambulatory and hospitalist), manager of government initiatives, manager of staff at a health care technology vendor, hospital CIO, and manager of research staff. Three CMIOs had been responsible for managing and reporting budgets prior to becoming CMIO—one as a clinical department director, one as a CIO, and one as a manager of grant-funded projects.

Negotiation and conflict resolution skills: Three CMIOs received formal negotiation and conflict resolution training during prior experiences, including a psychiatry residency, a Bach-

^{vi}The examples in parentheses illustrate the approaches of individual CMIO interviewees.

^{vii}The training was provided through a National Library of Medicine (NLM) supported Medical Informatics Fellowship.

elors and a Masters degree in psychology, an executive training program at a top-20 U.S. business school, and a training program of the American College of Physician Executives. Additionally a fourth CMIO described significant prior work experience in negotiation and conflict resolution during the interview.

Management training: Two CMIOs were provided with formal skills updating and executive management training upon appointment as CMIO. One CMIO was provided formal management training by a large health care IT vendor and one CMIO was provided the opportunity to attend an executive management program at a business school.

Informal networks: All CMIOs used informal channels to influence health system projects and health system leadership. Three CMIOs had lengthy pre-CMIO careers at their health systems during which strong professional and personal relationships and networks were developed—two CMIOs were at their health system more than 20 years prior to becoming the CMIO and one CMIO was at the health system for 10 years prior to becoming CMIO. The three cited these relationships as important in their ability to lead major clinical information system initiatives.

Position within Health System Management

The selection process for the CMIOs, their positions in management hierarchy, their resources (e.g., staff, budget) and their organizational authority were typical of senior hospital executives.

Appointment decision: The health system CEO, CMO, and CIO all had a direct influence in the selection of the CMIOs. Three CMIOs were direct appointments by the CEO or CAO (Chief Administrative Officer) and one was appointed by a panel on which the CEO sat. The health system Medical Director or Chief Medical Officer had a direct influence in the selection of the four CMIOs who worked at acute care hospitals. The CIO either interviewed the CMIO or participated in the selection committee at all five health systems.

Reporting structure: Two CMIOs reported directly to the health system CEO, one to the CAO, one to the Chief Medical Officer, and one to the Associate Chief Medical Officer. Where the CMIO did not report directly to the health system CEO, the CMIO's direct supervisor did. None of the CMIOs reported to the health system CIO.

CPOE initiation: The CPOE implementations were initiated by different groups at each health system, including:

- CIO and Nursing Leadership (collaboratively)
- CEO and Ambulatory Care Director
- CEO, CIO, and CMO (collaboratively)
- Medical Leadership and CMIO (collaboratively)

Organizational shortfalls: All five CMIOs reported that additional CMIO resources or authority would have improved the outcome of the CPOE implementation. Three stated that additional resources (staff, funding, or both) would have accelerated the time table for CPOE project completion. Four CMIOs stated that if they possessed increased authority across the health system, it would have allowed a re-prioritization of the project steps in CPOE and either shortened the implementation time line or improved the outcome.

CMIO Observations and Recommendations

Four of the five CMIOs identified failed clinical information system initiatives in which they had been involved at their health system. The failures included personal data assistant (PDA)-EMR initiatives, clinical data repository and data mining projects, ancillary services, and pharmacy information system initiatives. The initiatives failed due to either a lack of health system executive support for the initiative (beyond that of the CMIO), lack of health system funds for the initiative, and/or the lack of staff to successfully complete the initiative. Most failed initiatives were actually projects that were aborted prior to completion, after the health system leadership (including the CMIO) recognized that a successful project was not possible due to the above constraints. The fifth CMIO felt that his lack of involvement with failed initiatives reflected on his short tenure (approximately two years) as CMIO as opposed to infallible expertise.

The five CMIOs had several recommendations for hospitals and health systems that are considering appointing a physician as CMIO, including:

- The CMIO should be
 - credible as a good clinician and not be viewed as a "techie doctor" who is only knowledgeable about computers
 - an effective communicator across services and disciplines
 - an effective consensus builder
 - knowledgeable of hospital operations
- The hospital CEO and Executive Leadership must be engaged in the projects involving the CMIO
 - "Can't do CPOE without a CMIO, but the person shouldn't be the driver"
- The CMIO should become a senior member of the physician executive leadership team
 - If the health system organization is large, the CMIO should have budget and operational authority as necessary to support clinical information system initiatives
- Continuous professional development should be provided to the CMIO

Commentary

There has been a lack of definition of the role of the CMIO in health systems, and a lack of understanding of the importance of such a position in the implementation of health care information technology projects. Through the common lessons learned from the interviews of these five CMIOs, the CMIO position's usefulness in an organization has been clarified and justified as the newest addition to health system Chief Officer positions. The interviews with these individuals indicate that executive leadership skills are more valuable to a CMIO than formally trained informatics expertise—for all but one CMIO, leadership experience and training strongly outweighed formal informatics training. "It's not what you know any more. It's what you do with what you know that really makes the difference," observed Wolfgang Grulke, a noted futurist and the CEO and founder of FutureWorld.²³ The CMIOs surveyed have leveraged their leadership and informatics expertise to effect broad health system change and to accomplish health system

goals, rather than relying solely on technical backgrounds to build information systems. Recruiting and empowering effective CMIOs will enable a health system to best meet the challenging tasks of technology-enabled transformation.

Lastly, medical informatics training programs should emphasize education in management and executive leadership in order to prepare the next generation of CMIOs to effectively lead health systems. Another approach would be for more health care management training programs, including MBA and MPH degree programs, to include courses on medical informatics. Identifying which areas of additional medical informatics expertise would be most valuable to CMIOs, such as outcomes assessment or patient safety, is worthy of further investigation as the numbers of CMIOs increase and health care informatics and management training programs evolve to prepare them. As more physician leaders develop expertise using information technology to effect change and improvement in our health care system, the current CMIO and CMO positions might converge into one role. Regardless of the future title, physician leadership in health care technology will only continue to grow in importance.

References ■

1. PricewaterhouseCoopers LLP. HealthCast 2020: Creating a Sustainable Future. New York: PricewaterhouseCoopers; 2005.
2. Heffler S, Smith S, Won G, Clemens MK, Keehan S, Zezza M. Health spending projections for 2001–2011: the latest outlook. *Health Aff.* 2002;21(2):207–18.
3. Committee on Quality of Health Care in America, Institute of Medicine. To Err is Human: Building a Safer Health System. Washington DC: National Academies Press; 2000.
4. A bill to enhance the adoption of a nationwide inter operable health information technology system and to improve the quality and reduce the costs of health care in the United States, S. 1418, 109th Cong., 1st sess., Congressional Record, 151, no.153-Book II, daily ed. 2005 November 17; S13260-77.
5. Higgins T. Blue Cross and Blue Shield of Rhode Island, e-Prescribing Past, Today and the Future [slide presentation]. Proceedings of the ePrescribing—What is it?, Why use it?, How is it used?, and Understanding the Players Conference; Providence, Rhode Island: New England Healthcare Information and Management Systems Society; 2005 May 6.
6. Miller J. Four-state pilot, now being expanded nationwide, shows doctors how it's done. *Government Computer News* 2005;Sep12;24(27).
7. Pedersen CA, Schneider PJ, Scheckelhoff DJ. ASHP national survey of pharmacy practice in hospital settings: Prescribing and transcribing—2004. *Am J Health Syst Pharm.* 2005;62(4):378–90.
8. Clinical Advisory Board. Computerized Physician Order Entry: Lessons from Pioneering Institutions. Washington, DC: The Advisory Board Company, 2001.
9. The Standish Group. CHAOS Chronicles 3.0; 2003.
10. Doolan DF, Bates DW, James BC. The use of computers for clinical care: a case series of advanced U.S. sites. *J Am Med Inform Assoc* 2003; 10(1):94–107.
11. Friedman CP, Frisse ME, Musen MA, Slack WV, Stead WW. How should we organize to do informatics? Report of the ACMI debate at the 1997 AMIA Fall Symposium. *J Am Med Inform Assoc* 1998;5(3):293–304.
12. Kovac, C. Towards a Digital Health-Care Ecosystem. *The Wall Street Journal.* 2005 Oct 25;B2.
13. Freudenheim M. Many Hospitals Resist Computerized Patient Care. *The New York Times.* 2004 Apr 6;C6.
14. Bria W, Rydell R. The Physician-Computer Conundrum: Get Over It! Health Information Management Systems Society; 2004.
15. Classen DC. Leading patient safety expert speaks on CPOE implementation strategy and success factors. Interview by Richard D. Lang *J Healthc Inf Manag* 2004 Winter;18(1):15–7.
16. Collins, J, moderator. Keynote Panel: The Convergence of New Content with Existing Clinical Information Systems in Order to Deliver New Diagnostic and Treatment Capability to Drive Down Cost and Improve Outcomes [slide presentation]. *Proc Emerg Technol Healthc Innov Congr.* Washington, DC; 2003; Sep 24
17. Metzger J, Fortin J. Computerized Physician Order Entry In Community Hospitals: Lessons from the Field. California Health Care Foundation and First Consulting Group; 2003.
18. Health Data Management's 2003 CIO Survey [online]. New York: Health Data Management and SourceMedia, Inc.; c2003-2005. Available at <http://www.healthdatamanagement.com/html/CIOSurvey.cfm/>. Accessed November 27, 2005.
19. Health Data Management's 2005 CIO Survey [online]. New York: Health Data Management and SourceMedia, Inc.; c2005. Available at <http://www.healthdatamanagement.com/html/HDMSurvey2005.cfm/>. Accessed November 27, 2005.
20. An example is available from The Informatics Review [online]. *The Informatics Review*; c1999. Available at <http://www.informatics-review.com/jobdesc/sample1.html/>. Accessed November 27, 2005.
21. Schiesel S. In the E.R., Learning to Love the PC. *The New York Times.* 2004 Oct 21;G1.
22. Hagland M, Van Beusekom M. Healthcare IT Innovators. *Healthcare Inform* 2005; Sept 22(9):25–32.
23. Grulke, W, Silber G. 10 Lessons From the Future: Tomorrow Is a Matter of Choice, Make It Yours. London: Financial Times Prentice Hall; 2000.
24. Health Data Management's 2003 CIO Survey [online]. New York: Health Data Management and SourceMedia, Inc.; c2003–2005 [Cited 2005 Nov 27]. Available from: <http://www.healthdatamanagement.com/html/CIOSurvey.cfm/>.
25. Health Data Management's 2005 CIO Survey [online]. New York: Health Data Management and SourceMedia, Inc.; c2005 [Cited 2005 Nov 27]. Available from: <http://www.healthdatamanagement.com/html/HDMSurvey2005.cfm/>.



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