

Healthcare Information Systems: Analysis of Healthcare Software

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Abstract. The need to manage medical information in healthcare delivery requires that information technology be optimized in diagnosing diseases; in planning and administering treatment; and in monitoring patient outcomes, services, and costs. The goals of this article are twofold: (1) to identify healthcare-specific software that addresses specific parameters set forth by the World Health Organization (WHO) for healthcare information systems and (2) to identify issues that managers should keep in mind when choosing an integrated information systems software package. For our analysis, we gathered, through Internet research, information about more than 400 software products from more than 200 companies.

Key words: healthcare information systems, healthcare software

To operate successfully, healthcare organizations need to deliver low-cost, high-quality services and at the same time achieve the desired improvement in each patient's medical condition. Critical to such success is the application of integrated data to the healthcare delivery system. In an increasingly competitive and cost-conscious environment, a lack of unified electronic medical records and other electronic or digital healthcare data negatively affects quality and contributes to inefficiency and redundant efforts that, in turn, increase costs (Barber et al. 1994). Healthcare providers and decision makers such as physicians, nurses, and other practitioners, along with healthcare delivery organizations such as hos-

pitals and managed care systems, need access to more complete and better-integrated patient data. The involvement of all these different players necessitates a multidirectional flow of data.

An Integrated Information System

The interest of healthcare decision makers in having an integrated system has been increased because of knowledge-based, decision-support aids that provide immediate assistance, guidance, and feedback. With such standards and easily available information, users could readily obtain the information they need to make informed choices about treatments, providers, institutions, and health plans. The challenge is to coordinate the integrated system and software with healthcare (the healthcare industry being a very "visual" industry). Finding new ways to display data, using color and animation as well as digital imagery, is as important as delivering administrative and cost accounting information and reports. On the administrative side, the benefit of an integrated system involves the simplification and increased processing speed of routine and nonroutine administrative decisions within the health system—increased communication between all participants, increased inventory control, better allocation of costs, and a recruiting advantage over competitors, all of which lead to a competitive advantage for hospitals.

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In 1971, the World Health Organization (WHO) listed the basic requirements for a health information system. This article focuses on identifying viable companies and their software that meets the WHO criteria and other criteria identified in the research literature for addressing the demands and complexity of an integrated information system for a healthcare community network (Hartshorne 1990). Healthcare integrated information system software should incorporate the following criteria:

1. The system should be able to identify persons positively by name and place.

What to look for: Name, date of birth, race, gender, postal code

2. The system should avoid unnecessary agglomeration of data.

What to look for: Data redundancy minimization

The software should provide procedures and internal safeguards that do not restrict or prohibit the beneficial effects of the healthcare system. It should establish a single standardized numerical system that identifies each patient in the system to ensure that each patient has only one medical record in the system no matter how many different clinics the patient has been to or how many doctors the patient has seen within the healthcare system. Standards for information content, display, and exchange are a crucial element in the development of the integrated information system. To deal with the information explosion, a number of organizations have been working to standardize healthcare information and communication. These organizations include the Joint Working Group for a Common Data Model (JWG-CDM), the Health Level 7 (HL7) group, the Computerized Patient Record Institute (CPRI), and the Object Management Group (OMG; Forslund et al. 1996).

3. The system should be problem or trend oriented.

What to look for: Ability for research (by diagnosis related group [DRG])

4. The system should be goal oriented to assist monitoring evaluation.

What to look for: Evaluation ability

5. The system should employ functional and operational terms.

What to look for: Reporting features (custom, ad hoc, standard, standard terms, standard codes)

Healthcare providers should be able to use information effectively to serve the community, conserve resources, monitor costs and quality of care, and manage the system. Analyzing patient care data from communities and providing feedback about the findings to the caregivers and consumers can both reduce inappropriate care and increase beneficial care. Doing so can also improve continuous, lifelong learning for healthcare providers who have difficulty keeping up with the flood of biomedical literature and clinical practice guidelines.

6. The system should record all relevant data related to population groups, services rendered, resources allocated and expended, and outcome of health services.

What to look for: Hospital features (population groups, services rendered, resources, outcome), any clinical modules (radiology, pharmacy, respiratory, surgery), business modules (financial, payroll, scheduling, material management)

Clinicians need timely access to both patients' medical images and alphanumeric data, which are typically provided by hospital information systems. The use of computers and an integrated system could make the task of data input easy, given the value of single-point entry for easy update and multiple utility. The system must be capable of guaranteeing that each user is executing the proper program, with the proper user interface displayed, and is accessing the proper database, in the proper fashion, for every transaction in a secure manner. "National and community networks that allow consumers to obtain information about their own health care conditions and to obtain professional medical advice in their homes can empower patients to take better care of themselves" (Benefits of Using NII Applications to Improve Health Care 1998).

7. The system should express information briefly, unambiguously, and imaginatively.

What to look for: Ease of use for input and ease of use for output

8. The system should provide for feedback and appropriate sharing of data.

What to look for: Security provisions, interdepartmental collaboration, and Internet capability

No matter how good a system, healthcare professionals will ultimately be the ones who determine whether the new system is acceptable. The healthcare user must be able to find where information resides; thus, being familiar with the system through training and data input is an important function. Within the professional field, administrators and information technology (IT) personnel often encounter a variety of reactions, ranging from enthusiasm and acceptance, to reluctance, to all-out resistance. It is mission-critical to establish physician acceptance at the conception and planning stages of the project. Research has provided few insights into why different attitudes exist and how best to address them so that system implementation will go smoothly (Valenta and Wigger 1996).

In addition, the healthcare administrator should realize that the hospital management, along with the IT department, should instigate long-range, strategic plans for monitoring, upgrading, and incorporating emerging technology. And because of the large volume of healthcare information, high bandwidth capacity will be necessary to integrate Internet capability, digitally transfer patient records, and give ordinary citizens the ability to access their medical records at any time and any place.

Software

We obtained a list of companies for healthcare information systems and their associated Web site addresses from the Internet. More than 200 companies were listed. Our research focused only on the marketing information that was given out by the companies' Web sites. We made the assumption that the Internet is used as a tool for companies to do an initial investigation and contact. Therefore, companies' Web sites must be informational to the extent that general knowledge about their products—which is sufficient for this research project—is described. Few of the companies' products completely cover all aspects of administration, business, and clinical modules. Therefore, each criterion is not 100 percent available and some form of interfacing between a company's software modules and existing software must be considered when implementing an integrated system. Even with the advent of eXtensible Markup Language (XML), this interfacing is by no means an easy undertaking. Many problems remain, and continue as systems are upgraded.

For each feature, we linked and checked specif-

TABLE 1
Viable Companies That Meet
Integrated Healthcare Information
System Software Criteria

Company	Viable?	No. of criteria met
CPSI	Yes	36
McKesson	Yes	36
Cerner Corporation	Yes	35
HEALTHvision Corporation	Yes	35
Siemens Medical Solutions	Yes	35
CostFlex Systems, Inc.	Yes	34
CSC Health Services	Yes	34
InfoSys, Inc.	Yes	34
3M Health Information Systems	Yes	33
Health Management Systems, Inc.	Yes	33

ic fields as we reviewed the companies' information on their Web sites. In addition, we revisited sites to see whether the companies were still viable. Of the original 207 companies listed that had more than 400 products, 46 companies no longer had the URL address listed, 66 companies on the list did not actually have products but instead resembled consulting firms, and 7 companies were bought out over the course of this research. Out of the original 207 companies on the list, only 80 were viable. Of those 80 viable companies, we have listed those companies that meet the criteria for an integrated healthcare information system software (see table 1).

Conclusion

In this article, we focused on discovering the most viable healthcare-specific, integrated information system software based on criteria established by WHO and other research. Eighty companies were identified as having software systems that meet at least some of these criteria. Finding a company that has a truly integrated information system is a difficult feat. Hospitals should carefully investigate companies and their products and match their needs with the capabilities of the software. The appendix lists all of the companies that were reviewed and the ways in which they meet the identified criteria.

The next phase of our research is to investigate a community hospital that is using one of these software systems. In the summer of 2001, we began a case analysis of an alpha site for an implementation

APPENDIX A—continued

Company	Name	Date of birth	Race	Gender	Postal code	History	Data redundancy min.	Research-DRG	Research-race	Research-gender	Research-demographics	Evaluations	Reporting-custom	Reporting-adhoc	Reporting-standard	Standard-terms	Standard-codes	Ease fuse-input	Ease fuse-output	Hospital-population groups	Hospital-services rendered	Hospital-resources	Hospital-outcome	Clinical module	Financial module	Payroll module	Scheduling module	Materials management module	Radiology labs module	Pharmacy module	Respiratory care module	Surgery module	Security provisions	Interdepartmental collaboration	Internet capability	Variable?	Number of criteria met	
Trizetto & Erisco	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	25	
EXCEL CARE Inc.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	20	
FLEXserv Health	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	11	
Care Systems Inc.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	11	
First Consulting Group	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	7		
Genesys	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	35		
Siemens Medical Solutions Health Services Corp.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	29		
Health Care Systems	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	26		
Health Cost Consultants Inc.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	34		
InfoSys, Inc.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	33		
3M Health Information Systems	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	33		
Health Management Systems Inc.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	33		
HJ Morgan Inc.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	15		
Hospital Computer Systems (HCS)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	26	
Infinity Medical	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	13	
Systems, Inc.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	10		
Infor*Med Corporation	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	16	
IRP, Inc.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	2	
InterSystems Corporation	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	10	
ChartMaker (Medical Information Systems)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	31	
Keane Inc.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	5	
Kronos Incorporated	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	21
LanVision Inc.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	21

(appendix continues)

APPENDIX A—continued

Company	Name	Date of birth	Race	Gender	Postal code	History	Data redundancy min.	Research-DRG	Research-race	Research-gender	Research-demographics	Evaluations	Reporting-custom	Reporting-adhoc	Reporting-standard	Standard-terms	Standard-codes	Ease fuse-input	Ease fuse-output	Hospital-population groups	Hospital-services rendered	Hospital-resources	Hospital-outcome	Clinical module	Financial module	Payroll module	Scheduling module	Materials management module	Radiology labs module	Pharmacy module	Respiratory care module	Surgery module	Security provisions	Interdepartmental collaboration	Internet capability	Viable?	Number of criteria met				
QuadraMed Corporation	X	X	X	X	X	X	X	X							X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	19		
Technology for Healthcare	X	X	X	X	X	X									X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	16	
Solucient	X	X	X	X	X	X		X	X						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	14
SAP America Inc.	X	X	X	X	X	X				X					X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	12	
SeeBeyond Technologies Corporation (STC)	X	X	X	X	X	X						X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	10	
SoftWatch Inc.	X	X	X	X	X	X									X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	9	
Surgical Information Systems	X	X	X	X	X	X							X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	8	
Symmetry Health Data Systems	X	X	X	X	X	X		X								X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	11
Medical Manager Health Systems	X	X	X	X	X	X									X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	12
SYSWARE Healthcare	X	X	X	X	X	X									X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	12
Systems Inc.	X	X	X	X	X	X									X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	16
Tech-Time Inc.	X	X	X	X	X	X									X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	8
Tempus Software, Incorporated	X	X	X	X	X	X									X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	10
Click4Care Inc.	X	X	X	X	X	X									X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	9
Wellsoft Corporation	X	X	X	X	X	X									X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	9
Number of X's	64	64	64	64	64	64	33	28	25	23	23	25	20	12	54	35	38	47	47	20	33	27	34	35	43	25	23	25	21	28	15	19	39	45	42	80	80	80	80	80	

of a software system from one of the viable companies. That case analysis incorporates four clinics and a small community hospital, along with the surrounding community with a population of approximately 50,000. Future articles will describe the clinics' and hospital's experiences in implementing this system.

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