

K. J. Leonard

Dept of Health Administration,
Faculty of Medicine, University of
Toronto, Toronto, ONT, Canada

Total Quality in Information Systems Management: Issues for the Health Care Industry

Abstract: Faced with rising costs, growing demand and declining funding, hospitals and others must either cut services or improve the efficiency and effectiveness of what they do. Neither solution can be implemented without adequate relevant information. Without understanding which services are providing the most value to its customers, sensible cutbacks will be difficult to make. Improving efficiency requires a knowledge of where there are inefficiencies, and improving effectiveness requires an understanding of what the outcomes of health care are. The solution, as many have documented, is to create, as a first step, a database containing detailed health care patient data. In this paper, we present continuous improvement techniques as a requirement for the design and development of this much needed database.

Keywords: Systems Design, Quality Management, Decision-Support Systems

1. Information Systems and Total Quality Management

In the field of information systems theory, much discussion is currently taking place regarding the principles of total quality management (TQM). Many believe that TQM, as it is commonly referred, is nothing more than common sense (outlining the simple truth that 'quality is better than non-quality'), and is only now getting recognized due to its "catchy" name. Others prescribe to the theory that TQM is a pervasive mindset composed of such philosophies as continuous improvement and process re-engineering that have only recently been adopted by organizational behaviorists. Whatever the consensus, it is becoming accepted that Information Systems (IS) theory and TQM are very much integrated.

For example, in the development of information systems, many TQM principles hold. Doing it right the first time is preached by leaders in both TQM and IS as a method of getting users/custom-

ers over the critical implementation period and in a position to willingly adopt the new technology. Clemmer, a noted TQM disciple, in a recent article on the argument of the benefits of process re-engineering versus improvement gives many examples of TQM in MIS (management information systems) [2]. Further, TQM principles often need an information system to become feasible, due to the overwhelming need to process a wealth of data almost instantly [1]. As a result, we consider a model called the TQMIS model - Total Quality in the Management of Information Systems. (For a more detailed presentation, see [7-9]). The emphasis of the model, simply, is on the application of continuous improvement principles throughout the information systems development life cycle (i. e., strategy to objectives, to design, to development, to implementation, to processing, management and measurement).

Practitioners, today, are constantly combing the literature for guidance on

such everyday IS issues as goal-setting, performance measurement, implementation, training and support, and on-going management and tracking of new development within information and computer systems. The actual transformation of *data into information*, while only a small component of IS theory, continues to receive a disproportionate percentage of the research attention. Progress and innovation, however, have brought about a real need to explore other aspects, such as *support and education issues*. This is where the application of TQM principles (training, continuous improvement, and benchmarking) become crucial. Firstly, training must be in place to efficiently affect change. Secondly, proper education and training to support the managers in the design of the reports and the development of insightful statistics reflecting the effectiveness of innovation will help ease the implementation process and foster an environment of continuous improvement. Finally, benchmarking further creates the necessary short and

w
in
sy
Ti
he
th
cu
ly,
pro
he
me
Da
inc
to t
the
org
uon
and
pro
ove
mer

3. I

II
able
using
what
five i

long term goals that are both realistic and achievable. In short, continuous improvement cannot take place without first developing an environment that promotes communication, education and training principles.

2. Hypothesis of TQMIS in Health Care

In the health care industry, the main promise of the TQMIS model is that increased effectiveness in information systems would streamline costs and increase efficiencies of delivery of service. Here, the specific IS questions are:

- how do we measure information system effectiveness?
- how do we measure increased efficiencies in health care?
- what data are useful?
- what data are required?
- what data are necessary to develop useful information and decision support?

The literature is currently flooded with research and commentary regarding the need to revise the information systems in health care [1, 3, 5, 11-17]. The call for applying new technology is heard throughout the industry. This then questions the very structure of the current state of Health IS. Consequently, as a first step in a long term research program, the majority of the emphasis here - due to the state of IS development in health - deals with IS Design. Database design issues cannot be examined in isolation, but rather, according to the TQMIS model, flow directly from the strategic objectives of health care organizations. By concentrating continuous improvement efforts on *database and system design*, a foundation will be properly created to establish long term overall system performance improvement.

3. Health Data Issues

Health care providers need to be able to measure what resources they are using to provide quality health care, at what cost, and to what end - how effective is that care [4, 17]? Unfortunately,

health data consist on many different types and levels of detail. Within a hospital, for example, there are many different levels of data required for many different audiences; as well, the technical sophistication varies substantial across the spectrum of potential users - from clinicians to patients. In addition, the scope of information utilized may range from a department level, functional focus, to a hospital-wide process focus.

Secondly, with regard to data availability, technology will have a profound impact on data collection. Advances in such technologies as hand writing and voice recognition will facilitate data capture for physicians and other care givers providing a more comprehensive database. Researchers have indicated that a continuous, life-time, personal medical record could allow better assessment of the cost-effectiveness of many preventive, diagnostic, and therapeutic activities [3, 5, 6, 12, 18]. Such a record would also benefit the patient by ensuring consistent, integrated care, and ease of transition between health care institutions and providers - a need that definitely exists [10, 12, 13]. An effort is needed to create standardized comparisons of significant criteria which could then provide important insights for a hospital's quality improvement efforts.

4. Strategic Objectives

Ultimately, the core of this research focuses on the development of a framework for an *electronic patient health record*. If health administrators and care givers (across all providers in a community) knew *which* of their activities were having a positive impact on the quality of their patients' lives, if they knew *how* their activities were impacting that quality and by *how much*, then those administrators and care givers would be able to reallocate current resources to achieve more. Or perhaps they could maintain the current level of service with fewer resources. In addition, incorporating a collaborative attitude toward information management throughout the community could affect increased efficiencies and improve quality of care. All of these resulting

possibilities stem from a first step of the creation of a comprehensive medical computerized record within a database of health indicators.

In some detail, hospitals, as an example, need information but they need to first determine *what* information. Data needs are difficult for managers to assess, and even more difficult without a clear understanding of what the objectives of the hospital should be and how it defines quality. We must seek to address these initial questions and to ultimately develop a methodology for data collection and transformation into useful information.

Therefore, the strategic objectives are to ultimately establish a comprehensive database of health care data - including both *cost* and *health* performance measures. Ideally, patients should be able to move seamlessly between various health care providers without the need to spend valuable time providing the same demographic and historical data at each stop. The first step is to design such a system. The next step is to have hospitals validate this methodology and to contribute to the initial data pool. This validation process will include both the development of measurements and the creation of feasible standards or benchmarks. Finally, once the validation by hospitals is completed, it is hoped that the database will be expanded through the inclusion of data from interested hospitals and health care centers across Canada.

5. Database Design: The Issues Concerning an Electronic Patient Record

As stated, the first stage in this process is the design and development of a database of *patient care data*. Health care pertains to providing care to patients and, as such, the database must begin there. After the successful implementation of such a database, efforts can then begin on a more comprehensive dataset - which will include financial, organizational, physician and patient focused data. If we attempt to develop all aspects of a comprehensive database at once, we will risk diffusion of effort and early mistakes - which may

be impossible to overcome in later stages. Some of the specific issues relating to database design are discussed below.

5.1 Centralized versus other configurations

Must a patient health repository be centralized to be effective? Or can a virtual centralized database be sufficient?

Certainly, an effective health information system consisting of health data from many sources must be integrated at some level. Otherwise, the disjointedness, redundancy and fragmentation that exists today would continue except that it would be electronic (and access time to incomplete data would be reduced). However, the only time a complete, efficient database is needed is during a treatment episode or inquiry. At that time, a virtual centralized record can be constructed, almost instantly, with immediate subsequent computerized inquiries to the multiple sites involved. With the appropriate software and algorithm, redundancies can be removed and a comprehensive record provided within seconds.

In short, either format suggested above can be effective - there is no one optimal configuration. It should be noted that much of the decision choice will rely on the cooperation and technology available to the partners in the network. Agreeing with the philosophy of a comprehensive, electronic patient record is more critical than the actual data location.

5.2 Data capture

As physicians are paid a fee per item of service, there is no financial incentive for them to participate on quality improvement teams, or to promote data collection activities. However, the patient medical record is the primary source of information for diagnoses and treatments, and the physician is primarily responsible for the quality of information contained in the patient record. Therefore, the motivation must be created to ensure accurate and complete data capture. The technology itself also has a profound impact on data collection. Ease of data entry will impact the volume of information

collected, and advances in such technologies as hand writing and voice recognition will facilitate data capture for clinicians and other care givers.

5.3 Standardization and comparability of information

The MIS Guidelines being developed by the CIHI (Canadian Institute for Health Information) are making great strides toward standardization of hospital data collection activities. By specifying what to measure as well as how to measure it, the CIHI is ensuring that the numbers are comparable and can thus provide useful information (benchmarks) to managers. Hospital administrators have been very frustrated in the past with comparisons that were made based on the historical numbers collected with little or no attention paid to consistency of capture or analysis.

Standardized comparisons, today, are still not available on a widespread basis. It may not necessarily be true, however, that *all* information should be standardized across institutions. A manager could benchmark a department's current performance against past performance. In such a case the concern should be that the measure is appropriate, that it is important and indicative of quality of service provided. Further, it is not necessarily true that the measures outlined by the MIS Guidelines capture all of the information that a manager may want or need.

5.4 Sharing information

If a goal of the health care system of the future is to encourage more community involvement, then a mechanism for sharing information throughout the community is required. However, important barriers exist which hinder the achievement of open collaboration and information dissemination. Hospitals have historically been protective of their programs, and current efforts to regionalize services have pushed some hospitals to become even more guarded and protective of their programs from fear of losing them. Widespread understanding and acceptance of the gains to be realized through collaboration will

go a long way toward breaking down these barriers. Public concern for confidentiality and security of this information will also need to be met with counter arguments for improved care and reduced cost in an attempt to preserve the current health care system [6].

6. Examination of the Problems in Long Term Care: An Example

It must be reiterated that we stress that the initial goal for all health care providers must be to develop a patient care database which would promote exchange among all providers. As an illustration of the power of this solution, we present the problems in the Long Term Care (LTC) system. Once again, the information system *design* is of critical importance.

In September of 1995, a government report identified the major problems in the system as envisaged by the participants [10]. The problems are set out below:

1. Unclear Access Points
2. Inadequate Information
3. Inconsistency and Inequity of Services
4. Rigidity
5. Fragmentation
6. Multiple Assessments
7. Inadequate Accountability
8. Duplication
9. Provider Driven
10. Inadequate Complaints and Appeals Mechanism
11. Lack of Holistic Approach
12. Lack of Planning and Strong Linkages Between Institutional and Community Care
13. Special Needs Populations not Adequately Recognized
14. Information Technology Underutilized
15. Inadequate Staff Training
16. Lack of Focus on Independent Living
17. Shortage of Respite Care

In short, seventeen problems were identified within the existing long term care system. It is our contention that 10 of the problems can be directly related to the lack of a coordinated and com-

prehensive information system. Indirectly, aspects of 6 of the 7 remaining problems will also be resolved through an evolved integrated health information system within the community. Table 1 provides identification of the long term care problems which are resolved directly or indirectly through an information systems approach.

The long term care organization in our health system is a microcosm in a larger universe. Regional *health information partners* need to be set in place in order to meet the often complex needs of their clients in an efficient and timely way. The first step is to connect systems with partners and commit to the development of an electronic patient record (EPR). Integrated Delivery Systems is an evolving organizational design with more questions than answers – but the solutions will come from the organizational preparedness to design, act and constantly create new shared applications ultimately leading to the EPR.

7. Conclusion – Next Steps

The primary issues pertain to providing health care to patients. Consequently, there is a:

- need for a virtual centralized patient data registry,
- need to overcome ignorance concerning computers and IS,
- need to overcome resistance to change,
- need to address privacy and confidentiality concerns within a computerized health world.

The objectives in on-going research are to:

- determine which specific data variables are important in health care management,
- determine the relationship between these data elements and the information that is needed,
- determine how to implement this information into a format that is in the form of decision support and knowledge,
- determine what actions are and can be taken based on the information – “if you do nothing with the information, what is the use in generating it?”

Table 1 Long-term care problems helped by an information system [10].

Access and Coordination Problem	Impact of a Comprehensive Health Care Information System		
	Directly Enhances	Indirectly Enhances	Little or no Impact
Unclear Access Points		X	
Inadequate Information	X		
Inconsistency and Inequity of Services		X	
Rigidity	X		
Fragmentation	X		
Multiple Assessments	X		
Inadequate Accountability	X		
Duplication	X		
Provider Driven	X		
Inadequate Complaints and Appeal Mechanism		X	
Lack of Holistic Approach	X		
Lack of Planning and Strong Linkages Between Institutional and Community Care	X		
Special Needs Populations Not Adequately Recognized		X	
Information Technology Under Utilized	X		
Inadequate Staff Training		X	
Lack of Focus on Independent Living			X
Shortage of Respite Care			X

Current initiatives must first focus on identifying the strategic objectives of the health care provider or, perhaps, a community health information network. It is our belief that our goal should be to have patients, at one day, be able to move seamlessly between the various health care providers without the need to spend valuable time providing demographic and historical data at each stop. Once these objectives are clearly defined and agreed to, then – and only then – can an effective information system be designed and developed. This will include, as a first step, the database design structure. The next goal is to create the functionality to exchange information among government agencies, health care centers, educational institutions and private sector partners. Once a methodology for information exchange has been established in hospitals, a move to establish similar capabilities at the other health care services, such as long term care, must then be addressed.

REFERENCES

1. Hoyle W, Reinbold L. Surveys emerging trends in information technology. Health care Computing and Communications Canada, 1995; 9 (4): 56-8.
2. Cleamaci J. Process re-engineering and process improvement: not an either/or choice. CMA Magazine, June, 1988; 36-9.
3. Cross MA. CIOs tell CEOs how to make the most of their information systems. Healthcare Executive, 1996; 11 (2): 6-10.
4. Goodhue DL. Understanding user evaluations of information systems. Management Science, 1995; 41 (12): 1827-44.
5. Jirsch D. Patient-focused care: the systemic implications of change. Healthcare Management Forum, 1995; 6 (4): 27-32.
6. Leonard KJ, Newell Kelly C, LeBlanc J, Van Donsou J. A proposal for a centralized patient record database: the need to identify patient data elements to measure costs, clinical outcomes and benchmarking. International Journal of Technology Management – Special Issue on Health Care 1998; 15: 391-401.
7. Leonard KJ. A discussion on the relationship between information systems and total quality management in the credit scoring industry. Credit Research Digest, October, 1-4 (1994).

be:
Se:
d:

8. Leonard KJ. The development of credit scoring quality measures for credit applications. *International Journal of Quality and Reliability Management*, 1995; 12 (4): 79-85.
9. Leonard KJ. Information systems and benchmarking in the credit scoring industry. *International Journal of Benchmarking for Quality Management and Technology*, 1996; 3 (1): 36-42.
10. Marcei K, Reuch G, Leonard KJ. The missing piece of the long term care reform puzzle - the community health information network. *Health Law in Canada*, 1996; 16 (4): 114-20.
11. Masard WF. Protecting patient confidentiality. *Healthcare Executive*, 1996; 11 (2): 12-6.
12. A. Poljak. Role of a computer based patient record in outcomes research. 1995. Conference on Health Policy Research. Boston, Massachusetts, December 2-3 (1995).
13. Robinson D. Ownership of health data: principles for health information networks (part 2). *Healthcare Computing and Communications Canada*, 1995; 9 (3): 65-6.
14. Samuelson D. Diagnosing the real health care villain. *ORMS Today*, February, 20 (1995).
15. B. Senter. Health information: overcoming our insecurities. *Healthcare Computing and Communications Canada*, 1995; 9 (3): 53-5.
16. Skelton-Green J. The MIS guidelines: a critical analysis of their strengths and limitations (part II). *Healthcare Computing and Communications Canada*, 1995; 9 (4): 70-4.
17. Sulkens PL. The high performance team: healthcare's power shift - part VII. *Healthcare Computing and Communications Canada*, 1995; 9 (4): 12-5.
18. Sutherland RW, Fulton ML. Health care in Canada: A description and analysis of Canadian health services. Ottawa: Health Group (1988).

Address of the author:
Kevin J. Leonard,
Dept of Health Administration,
Faculty of Medicine,
University of Toronto,
12 Queen's Park Crescent West,
Toronto, ONT M5S 1A8
Canada

"Absolutely the best evidence ever"

Dr. Muir Gray, Head of Research & Development, NHS Executive, Oxford and Anglia Region

Schattauer

THE COCHRANE LIBRARY

The Cochrane Library is a regularly updated electronic library designed to give you the evidence you need for informed health care decision making. Launched in April 1995 under the name *The Cochrane Database of Systematic Reviews* it has now been renamed to reflect the inclusion of further important related databases, making it the most comprehensive source of evidence for all those with an interest in evidence based health care.

The Cochrane Library now contains four databases:

- ▶ The Cochrane Database of Systematic Reviews (CDSR)
- ▶ The York Database of Abstracts of Reviews of Effectiveness (DARE)
- ▶ The Cochrane Controlled Trials Register (CCTR)
- ▶ The Cochrane Review Methodology Database (CRMD)

The Cochrane Library is available in two formats:

CD ROM for Windows, and 3,5 inch disk for Windows

The Cochrane Library is updated quarterly, January, March, July, October. Subscription is annual and so gives updates of The Cochrane Library throughout the year.

Annual subscription (four updates):

Personal and single concurrent user: DM 498,-/US \$ 178.00

F.K. Schattauer Verlagsgesellschaft mbH
PO Box 10 45 43, D-70040 Stuttgart, Germany
distributes the publications of the **BMJ Publishing Group**,
London, exclusively in the following countries: Germany, Austria, Switzerland,
Czechian Republic, Slovakian Republic and Poland

09505 2/95: A 2000 en subsc: w drang: wdrang: rca