

Coherence of Lean and Six Sigma (LSS) in Health Care Industry

* Dr. Deepak Yaduvanshi, **Ashu Sharma

* Manipal Hospitals, Jaipur, India

** Narsee Monjee Institute of Management Studies, Mumbai, India

Abstract: Lean management principles have been used effectively in manufacturing companies for decades, particularly in Japan. The lean principles have been now successfully applied to the delivery of health care over the last few years. Lean thinking begins with driving out waste so that all work adds value and serves the customer's needs. Identifying value-added and non-value-added steps in every process is the beginning of the journey toward lean operations.

Influenced by the work of Womack and Jones, Lean in health care as "an organization's cultural commitment to applying the scientific method to designing, performing, and continuously improving the work delivered by teams of people, leading to measurably better value for patients and other stakeholders." In order for lean principles to take root, hospital must first work to create an organizational culture that is receptive to lean thinking. The commitment to lean must start at the very top of the organization, and all staff should be involved in helping to redesign processes to improve flow and reduce waste.

Lean is different from the other quality based models because of its value stream approach. Lean thinking is built on the plan-do-check-act cycle of CQI and transforms waste. There are similarities as well as differences of health care from manufacturing. As such, I believe lean principles when applied throughout an organization, can have a positive impact on productivity, cost, quality, and timely delivery of health care services.

Keywords- Lean, Six-Sigma, Health, Hospital, Quality

I. INTRODUCTION

Lean production is one such method which can be used for performance improvement.

A number of process improvement methodologies have been proposed as health care costs are continuously increasing. This would help in addressing the reported inefficiencies in health care delivery. Health care have also started using lean methods and significant improvement in systems have been observed.

The philosophy of lean thinking, derived from the Toyota Production System, is now being followed by health care, with a number of hospitals adopting lean production as their approach to improving quality and efficiency. In future, the application of lean principles and methods will bring a transformation in the way health care is delivered. In simple terms 'lean thinking' means using less to do more.

This paper presents a brief overview of lean management principles, and provides examples in health care organizations that lean can successfully streamline processes, reduce cost, and improve quality and timely delivery of products and services in hospitals.

II. LEAN FRAMEWORK

To understand application of lean production to improve the delivery of health care, the practice of lean must be understood.

1. The first step in lean improvement in health care is to understand value as defined by the patients, families, regulators, physicians, nurses and clerks.
2. The second step is to visit the workplace and observe how the process now operates. As the flow of the process from beginning to end is seen, delay, inefficiency, and waste that may exist can be observed.
3. A flowchart called a current-state value stream map (CS VSM) is created and all the individual steps are depicted which are necessary to complete the process from beginning to end.
4. Using the CS VSM, the team members can identify specific areas of waste, delay, causes of error, and inefficiency.
5. The team can then brainstorm ideas for improvement and propose how the process might be improved to transform waste into value.
6. A better process is designed and depicted on a flow map called the future-state value stream map (FS VSM) from the ideas generated by the team.
7. Once a FS VSM is devised and approved, the critical work of implementing the plan for reaching the future state begins.

Lean principles can have a significant impact on productivity, cost, and quality when applied throughout an entire organization. **Table 1** presents statistics that testify the power of lean thinking and the same effect can be realized in health care as well.

Validated Industry Averages*

| | |
|------------------------------------|--------|
| Direct Labor/Productivity Improved | 45–75% |
| Cost Reduced | 25–55% |
| Throughput/Flow Increased | 60–90% |
| Quality (Defects/Scrap) Reduced | 50–90% |
| Inventory Reduced | 60–90% |
| Space Reduced | 35–50% |
| Lead Time Reduced | 50–90% |

Table 1: The Impact of Lean Principles in Industry

Source: Virginia Mason Medical Center. According to Institute for Healthcare Improvement 2005 et al report .

III. EVOLUTION OF QUALITY IN HOSPITALS

Later, from the 1990s, the transformation has happened toward total quality systems. TQM then to six sigma and now lean. The Institute for Healthcare Improvement believes that adoption of lean practices can help health care organizations improve processes, reduce cost, better outcomes and increase satisfaction among internal and external customers.

The first documented events in the history of the assessment of the quality of care date to the second half of the 19th century, when Florence Nightingale studied the mortality rates of military hospital during the Crimean war.

Another in this field was Ernest Codman, confounder of the American College of Surgeons in 1918. Which specified the minimum standards that hospitals needed to fulfill and laid the foundation for the system of accreditation in the United States.

Another event was the creation of the Joint Commission on the accreditation of Hospitals (JCAH) in 1951. Comprised of a consortium of American professional colleges, the JCAH first undertook to accredit those hospitals that voluntarily applied for accreditation and met pre-established standards of quality. For this reason, the organization changed its name and is currently called the Joint Commission on accreditation of Healthcare Organizations (JCAHO).

One important development in methodology in the 1950s was the formulation of the medical audit, a new method for evaluating quality, by Paul Lembcke of Johns Hopkins University School of Medicine.

Later, the establishment of MEDICARE and MEDICAID, federal programs to provide healthcare to the elderly and economically disadvantaged, in 1965 and 1966 and the stipulation that only hospitals with JCAHO accreditation would be recognized by these programs, represented another step forward.

Williamson in 1970s introduced a new methodology based on the concept of “achievable benefit not achieved” (ABNA),

which measures the difference between the standards of diagnosis and treatment considered desirable and that actually achieved.

However, R. Brook has had the greatest impact on the changes in perspective toward quality assurance. Brook established long term follow up of patients and showed the low correlation between the healthcare process and outcomes. Brook’s studies led to the development of methods to established the appropriateness of procedures.

This historical review would not be complete without mentioning Professor Avedis Donabedian, who has undertaken numerous studies and helped to rethink the concepts of quality in healthcare - from the classification of methods of quality assessment in structure, process and outcome in 1966 to reflection about the impact of the industrial model of quality on the healthcare model in 1992.

Like Donabedian, Heather Palmer has been instrumental in defining the dimensions of quality that have had a decisive influence on the conceptualization of this discipline.

IV. REVIEW OF LITERATURE

Quality improvement can be defined as the effort to improve the level of performance of key processes in the ICU [This et al. 1997]. According to Donabedian’s concept, overall quality comprises three areas:

1. Structure [i.e. organizational aspects] of the ICU.
2. Processes (medical and non-medical) in the ICU and
3. Outcome (mortality rate, length of stay, readmission rate, quality of life, utilization of resources etc.) [Donabedian 1988]

For each area distinct management tools to assess and control quality were suggested [Frutiger et al. 1998] (Table 2).

| | Standards | Guidelines | Indicators |
|------------------|-----------|------------|------------|
| Structures | XXX | XX | X |
| Processes | XX | XXX | XX |
| Results/Outcomes | X | XX | XXX |

Table 2: Quality areas and their corresponding management tools

Indicators of quality usually reflecting the overall efficacy of ICU treatment could be the incidence of nosocomial infections, the complication rates of invasive diagnostic procedures, the unplanned readmission rate 24h to 48h after discharge from the ICU, unplanned extubation or reintubation within 48h, the post-ventilator survival Table 2 Quality area and their corresponding management tools.

After ICU discharge of COPD patients, the use of blood products of expensive drugs. The effective cost per surviving patient, acute renal failure developing during the ICU stay and many others. Recommendations for ICU management have been published by a number of national and international critical care societies, for example by the ESICM and the SCCM[ef. ESICM 1998]. Some authors and organizations have furthermore developed systems for measuring performance and improving quality in the ICU. Among other SEMICYUC [SEMICYUC 2007] or the VHA Inc. [Pronovost and Berenholtz 2007].

“Every system is perfectly designed to achieve the results it achieves”, which summarizes all improvement. If we understand that the characteristics of the system determine how it performs, we understand that quality measures provide insight into systems rather than personal performance the authors continued. Already in 1967 Feinstein wrote. “When medical reports have been used in the past to note severity of illness, the main difficulty has not been the absence of suitable data, but the absence of the investigators” who considered only the demographic data and the Para clinical data of ‘disease’ while ignoring the clinical data of illness were unable to classify severity effectively – but then often concluded that the defect was in the data of the medical records rather than in the investigators’ concept of what data to analyze” [Feinstein 1967] People rather than data improve performance. If we want to improve, we must change the system in which we work and monitor our results. The purpose of quality measurement is to test and learn, not to judge[prono wost and Berenholtz 2007].

The NABH Standards for hospitals have been divided in two parts:

1. Access, Assessment and Continuity of Care (AAC)
2. Care of patients (COP)
3. Management of Medication (MOM)
4. Patient Rights and Education (PRE)
5. Hospital Infection Control (HIC)

Organization Centered Standards

6. Continuous Quality Improvement (CQI)
7. Responsibilities of Management (ROM)
8. Facility Management and Safety (FMS)
9. Human Resource Management (HRM)
10. Information Management System (IMS)

Illustration- ThedaCare, Inc.

ThedaCare, Inc., is a health delivery system with three hospitals, 27 physician clinics, and 300,000-member health plan, based in northeast Wisconsin. Nationally recognized for its quality performance results, ThedaCare is also among the nation’s “most wired,” or computer-savvy, health care institutions. With 5,000 employees, it is northeast Wisconsin’s

second largest employer.

Though some of the details differ, the “lean story” at ThedaCare is very similar to Virginia Mason’s. While it is helpful to see the principles in use, it is not necessary to visit a Japanese company to gain a clear understanding of lean thinking; manufacturing companies in the US are using lean principles as well. ThedaCare leaders consulted with a nearby Wisconsin-based business, Ariens Outdoor Power Equipment Company, that has very successfully employed lean management for several years.

ThedaCare leaders set ambitious and specific goals to kindle a culture change: Improve quality to “world-class” levels (95th percentile or greater); become the health care employer of choice, making the *Fortune 100* list of best employers; and lower costs in order to lower the price paid for services, gaining \$10 million a year through cost savings and increased productivity. The patient is at the center of these goals.

ThedaCare leaders and staff are working to create is one in which constant improvement is seen as a never-ending journey, relying on the organization’s most important attribute: the brain-power of its staff. ThedaCare leaders recognize that a great deal of waste is the result of time the staff spend “putting out fires,” and that designing processes that work better reduces waste and enables staff to better meet the needs of patients. Like Virginia Mason, ThedaCare engages staff in intensive process improvement efforts, which they call Event Weeks. Participation in at least one Event Week is mandatory for all staff members (staff can choose from six different Event Week topics each week).

The groups that come together for Event Weeks use the ThedaCare Improvement System, which includes three tenets for change, as a framework for their work. These tenets are respect for people, teaching through experience and focus on world-class performance.

The details of these tenets are spelled out so that leaders and staff can use them in their process improvement work. For example, Table 3 shows how the organization defines the first tenet.

| What It Is: | What It Isn't: |
|--|--|
| Error-free practice | Long wait times |
| Timely service | Creating/doing non-value-added work |
| No waste | Wasted time |
| No-layoff philosophy | Wasted materials |
| Professionals who work together to improve performance | People focused on tasks rather than patient outcomes |

Table 3 :ThedaCare’s First Tenet for Change: Respect for People
Source: ThedaCare, Inc.

The three goals of the ThedaCare Improvement System are improved staff morale, improved quality (reduction of defects) and improved productivity. Every Event Week must focus specifically on these three goals.

ThedaCare leaders have acknowledged to staff that the new culture of lean will feel counter-intuitive for a while, with its emphasis on reducing waste and non-value-added work, as opposed to adding technology, buildings, or manpower. Lean also has a penchant for redeploying the *best* employees when productivity improves, not the poor or marginal performers; moving an accomplished lean thinker to a new department is an effective way to spread change.

The new culture requires new behaviors, including the use of smaller, "right-sized" groups of workers or technologies in "cells" rather than large, cumbersome processes; strong, sometimes directive leadership, augmenting more traditional team approaches; and less batching of work in favor of "right now" real-time action.

The new culture of lean also means that some roles change. For example, managers become teachers, mentors, and facilitators rather than simply directors or controllers.

Results at ThedaCare

On a monthly basis, ThedaCare tracks a range of outcomes related to lean management, including number of Event Weeks, number of employees who have participated in at least one Event Week, significant quality improvements, and financial measures.

With about six rapid improvement Event Week topics every week, by the end of 2004 ThedaCare had involved more than 600 employees directly in learning about lean thinking.

Examples of results at ThedaCare include the following:

- \$3.3 million in savings in 2004
- Saved \$154,000 in the Catheterization Lab supply procurement processes
- In 2004, reduced accounts receivable from 56 to 44 days equating to about \$12 million in cash flow
- Redeployed staff in several areas saving the equivalent of 33 FTEs

V. METHODOLOGY

1. CONTINUOUS PROCESS IMPROVEMENT IN LEAN METHODOLOGY

Continuous process improvement is designed to utilize the resources of the organization to achieve a quality-driven culture. Individuals must think, act, and speak quality. An organization attempts to reach a single-minded link between

quality and work execution by education its constituents to "continuously" analyze and improve their own work, the processes, and their work group. Process refers to business and production activities of an organization. Business processes such as purchasing, engineering, accounting, and marketing are areas where nonconformance can represent an opportunity for substantial improvement.

In addition to having measurable input and output, a process must have value-added activities and repeatability. It must be effective, efficient, under control, and adaptable. In addition, it must adhere to certain conditions imposed by policies and constraints or regulations.

All processes have at least one owner. In some cases, the owner is obvious, because there is only one person performing the activity. However, frequently the process will cross multiple organizational boundaries, and supporting sub-process will be owned by individuals within each of the organizations. Thus, ownership should be part of the process improvement initiatives.

2. CONTINUOUS QUALITY IMPROVEMENT (CQI)

Quality Improvement is an ongoing process which results in reduction of risks to patients and staff. All quality initiatives need to be leadership driven, requiring designing or redesigning managerial processes, monitoring results, analyzing & choosing the best alternative, implementing changes and in the process deliver desired outcomes and be safe. The quality program should be documented and should involve all areas of the organization it should be known and understood by all staff members. The organization should collect performance data on the quality initiatives and benchmark with the best practices in the industry. The quality program of the diagnostic services, infection control and patient safety should be integrated into the quality plan of the organization. The organization should define its sentinel events and intensively investigate when such events occur.

Quality improvement needs to be continuous and involves taking corrective steps towards desired outcomes so as to achieve organizational goals. It should be adequately supported by the management.

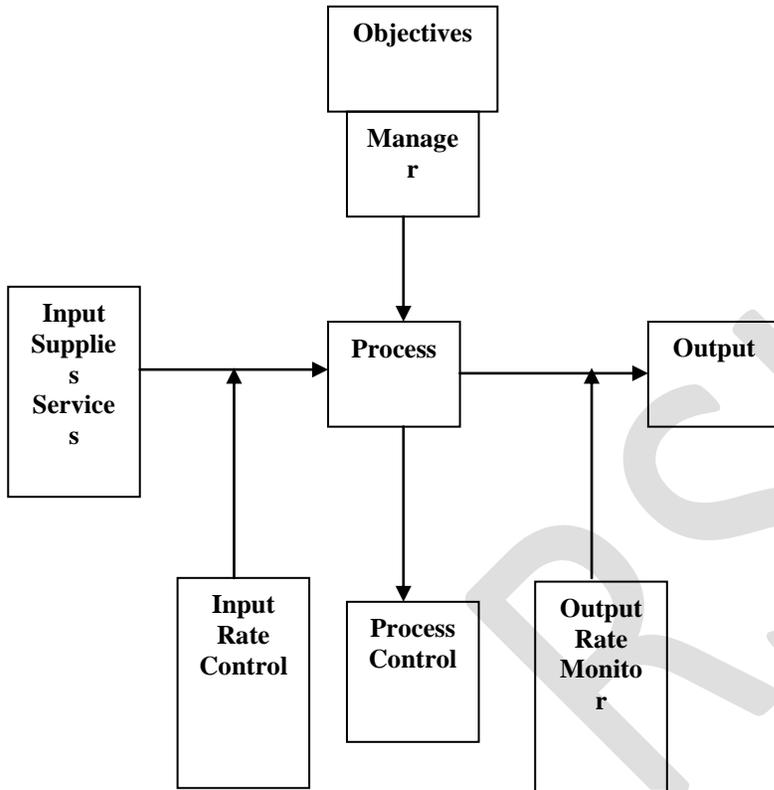
3. HOSPITAL AS SYSTEM

The hospital system as its external environment and linkages. Therefore, to understand the hospital system one has to look at the hospital as an open system. A general hospital, within the immediate environment of health care organization and the larger environment of the community are interdependent. The hospital services have to be considered as a socio-technical system within the health care system that copes with the constraints from both the internal and external environment.

A system has been defined in the Oxford English Dictionary as simply "a set or assemblage of things, connected, or

interdependent, so as to form a complex unity; a whole composed of parts in orderly arrangement according to some scheme or plan." To be more precise a system is a hierarchical chain of systems and sub-systems, interconnected and interdependent, having clear objectives at each level of the system or subsystem, obtains enough inputs from its environment to offset its output, and operates with varying processes or methods to achieve the ultimate objective of the system. As per Katz and Khan social systems are anchored in the attitudes, perceptions, beliefs, motivations, habits and expectations of human beings.

Figure : The system as defined



4. DESIGN THE INDICATORS AND ESTABLISH STANDARDS

The quality indicator is a quantitative measure used as a guide to control and evaluate the quality of the most important aspects of care. Table 4 provides a brief description of these aspects.

| SECTION | DEFINITION |
|----------------------|--|
| Dimension | Important aspect of care assessed by the indicator |
| Justification | Usefulness of the indicator as a measurement of quality, related to its validity, i.e. does what we aim to measure make sense? |
| Formula | Mathematical expression |
| Explanation of terms | Definition of the terms in the formula that might be ambiguous |

| | |
|----------------|---|
| Population | Identification of the unit of study |
| Type | Structure, process, or outcome |
| Source of data | Origin and sequence of data obtainment |
| Standard | Desired level of fulfillment of the indicator |
| Commentaries | Includes reflections concerning validity and bibliographic references |

Table 4: Quality Indicator

VI. CONCLUSION

Lean management is used in manufacturing industry since long, but it is new to health care. Toyota Production System and other lean tools therefore can be applied to the processes of health care. For acceptance of lean thinking it is most important to create a suitable organizational culture. Also, many other such operations and quality tools can be applied to health care for increasing the efficiency of the systems.

Results from health care organizations substantiate that utilizing lean methods can lead to improvements in the quality and efficiency of health care. The magnitude of success in manufacturing and health care sector can be determined by testing and evaluating the impact of lean on health care. The hospitals can adapt the lean techniques and can lead the change in health care industry at large.

REFERENCES

- [1]. Bowers, M. R., J. E. Swan, and W. F. Koehler. 1994. "What Attributes Determine Quality and Satisfaction with Health Care Delivery?" *Health Care Management Review* 19 (4): 49-55.
- [2]. Chassin MR, Brook RH, Park RE, et al. Variations in the use of medical and surgical services by the Medicare population. *N Engl J Med.* 1986;314(5):285-290.
- [3]. Chong, Y., N. Unklesbay, and R. Dowdy. 2000. "Clinical Nutrition and Foodservice Personnel in Teaching Hospitals Have Different Perceptions of Total Quality Management Performance." *Journal of American Dietetic Association* 100 (9): 1044.
- [4]. Cole, D. A. 1999. "Creating Outcomes with Redesign Efforts." *AORN Journal* 70 (3): 406.
- [5]. Committee on Quality Health Care in America, Institute of Medicine. *Crossing the Quality Chasm: a New Health System for the 21st Century.* Washington, DC: National Academy Press; 2001.
- [6]. Dowd, S. B., and E. Tilson. 1996. "The Benefits of Using CQI/TQM Data (Continuous Quality Improvement/Total Quality Management)." *Radiologic Technology* 67 (6): 533-37.
- [7]. Fiume O, Cunningham JE. *Real Numbers: Management Accounting in a Lean Organization.* Managing Times Press, 2003.
- [8]. <http://www.qualitydigest.com/feb01/html/sixsigma.html>
- [9]. Institute for Healthcare Improvement. *Going Lean in Health Care.* White Paper. Boston, MA: Institute for Healthcare Improvement; January and February 2005.
- [10]. Institute of Medicine. 2001. *Crossing the Quality Chasm: A New Health System for the 21st Century.* Washington, DC: National Academies Press.
- [11]. Jimmerson C, Weber D, Sobek DK 2nd. *Reducing waste and*

- errors: piloting lean principles at Intermountain Healthcare. *Jt Comm J Qual Patient Saf.* 2005;31(5):249-257.
- [12]. Johnstone, P. A. S., J. A. W. Hendrickson, A. J. Dernbach, A. R. Secord, J. C. Parker, M. A. Favata, and M. L. Puckett. 2003. "Ancillary Services in Health Care Industry: Is Six Sigma Reasonable?" *Quality Management in Health Care* 12 (1): 53-63.
- [13]. Keyte B, Locher D. *The Complete Lean Enterprise, Value Stream Mapping for Administrative and Office Processes.* New York, NY: Productivity Press; 2004.
- [14]. Kohn LT, Corrigan J, Donaldson MS, eds. *To Err Is human: Building a Safer Health System.* Washington, DC: National Academy Press; 2000.
- [15]. Lean Production at Park Nicollet. Available at <http://www.parknicollet.com/media/leanProduction.cfm>. Accessed March, 2005.
- [16]. Liker JK. *The Toyota Way.* Madison, Wisc: McGraw-Hill; 2004.
- [17]. Locock, L. 2003. "Healthcare Redesign: Meaning, Origins and Application." *Quality and Safety in Health Care* 12 (1): 53-57.
- [18]. Longest, B. B., S. Rakich, and K. Darr (eds.). 2000. *Managing Health Services Organizations and Systems*, 4th Edition. Baltimore, MD: Health Professions Press.
- [19]. Luck and J. W. Peabody. 2000. "Improving the Public Sector: Can Reengineering Identify How to Boost Efficiency and Effectiveness at a VA Medical Center?" *Health Care Management Review* 25 (2): 34.
- [20]. Luke, R. D., J. C. Krueger, and R. E. Modrow. 1983. *Organization and Change in Health Care Quality Assurance.* Rockville, MD: Aspen Systems Corporation.
- [21]. McClellan MB. *Testimony of Mark B. McClellan, MD, PhD, Administrator, before the House Ways and Means Subcommittee on Health on Value-Based Purchasing for Physicians under Medicare.* Washington, DC: Centers for Medicare & Medicaid Services; July 21, 2005.
- [22]. McConnell, P., and V. G. Ciotti. 1995. "Applying TQM/CQI Principles to Information Systems Selection." *Healthcare Financial Management* 49 (5): 48-52.
- [23]. McLaughlin, C. P., and A. D. Kaluzny. 1994. *Continuous Quality Improvement in Health Care.* Gaithersburg, MD: Aspen Systems Corporation.
- [24]. NAM. Getting started on the lean journey: first, take a walk! [NAM.org Web site]. Available at http://www.nam.org/s_nam/doc1.asp?CID 200253&DID 211562. Accessed Jan-uary 2000.
- [25]. NAM. How can we create a lean value stream? [NAM.org Web site]. Available at http://www.nam.org/s_nam/doc1.asp?CID 200253&DID 211566. Accessed June, 2000.
- [26]. NAM. Mapping your current state: the physical flow [NAM.org Web site]. Available at http://www.nam.org/s_nam/doc1.asp?CID 200253&DID 211564. Accessed March 2000.
- [27]. Overview of the Continuous Quality Improvement Program. 2005. Available at <http://www.med.umich.edu/i/exec/cqi/overview.htm>. Accessed 2005.
- [28]. Pyzdek, T. 2001. "Six Sigma and Beyond." *Quality Digest.* [Online article; retrieved 11/29/04.] Revere, L., and K. Black. 2003. "Integrating Six Sigma with Total Quality Management: A Case Example for Measuring Medication Errors." *Journal of Healthcare Management* 48 (6): 377-91.
- [29]. Richard P.wenzel: *Assessing the Quality of Health.*
- [30]. Rother M, Shook J, Womack JP, Jones DT. *Learning to See.* Boston: Lean Enterprise Institute; Version 1.3, 2003.
- [31]. Rother M, Shook J. *Learning to See, Value-Stream Mapping to Create Value and Eliminate Muda.* Brookline, Mass: The Lean Enterprise Institute, Inc; 2003.
- [32]. Rowell, P. 2004. "Appropriateness of Care: The Case for Changing the Focus of 'Quality' Measurement." *Quality Management in Health Care* 13 (3): 178-82.
- [33]. Samuels, D. L., and F. L. Adomitis. 2003. "Six Sigma Can Meet Your Revenue-Cycle Needs: Six Sigma Is Far from Being the Latest Quality Improvement Fad; It Is a Proven Technique Grounded in Principles that will Endure As Long As There Are Processes that Require Improvement." *Healthcare Financial Management* 57 (11): 70-75.
- [34]. Six Sigma—what is Six Sigma? Available at http://www.isix-sigma.com/sixsigma/six_sigma.asp. Accessed 2005.
- [35]. Spear S, Bowen HK. Decoding the DNA of the Toyota Production System. *Harv Bus Rev.* 1999;77(5):97-.
- [36]. Spear SJ. Fixing health care from the inside, today. *Harv Bus Rev.* 2005;83(9):78-91.
- [37]. Spear SJ. Learning to lead at Toyota. *Harvard Business Review.* 2004 May;82(5):78-86, 151.
- [38]. Spear SJ. The health factory. *New York Times.* August 29, 2005;sect 15.
- [39]. Swank CK. The lean service machine. *Harv Bus Rev.* 2003; 81(10):123-129, 38
- [40]. Vincent K. Omachonu.; Total Quality in Healthcare
- [41]. Walston, S. L., and R. J. Bogue. 1999. "The Effects of Reengineering: Fad or Competitive Factor?" *Journal of Healthcare Management* 44 (6): 456.
- [42]. Womack JP, Jones DT. *Lean Thinking: Banish Waste and Create Wealth in Your Corporation.* New York: Simon and Schuster, Inc.; 1996, Second Edition 2003.