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IMPACT OF LEAN SIX SIGMA ON HEALTHCARE INSTITUTIONS IN LEBANON

A dissertation submitted in partial fulfillment of the requirements for the Master's Degree in Political and Administrative Sciences, Planning and Management Division

By

Rabih Haidar Chmayssani

Members of Jury

Dr. Marwan Kotob	**Supervisor**	**President**
Dr. Haissam Fadlallah	**Assistant Professor**	**Member**
Dr. Khalil Khairallah	**Assistant Professor**	**Member**

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Dedication

This thesis is dedicated to my father’s soul who has been a source of encouragement and inspiration to me. I am also grateful for my loved ones who endured this long process with me and trusted my efforts while offering assistance and love.

Acknowledgment

I would like to thank my respectful advisor Dr. Marwan Kotob for the direction, and motivation he provided to me throughout the whole period of my master's degree in general and my thesis in specific. I would like also to acknowledge and thank the committee members: Dr. Hayssam Fadlallah, Dr. Khalil Khayrallah, who accepted to read my work. Finally, I would like to thank the administration and staff of the N.B.G.U. hospital for their help and contribution to my study.

ABSTRACT

Impact of Lean Six sigma on health care institutions in Lebanon

Healthcare is a complex business that must continuously balance the need for medical care together with an attention to financial constraints. Although demonstrating advances in technology and treatment, the healthcare institutions in Lebanon are still full of inefficiencies. Lean Six Sigma is a business improvement methodology that aims to improve quality, speed, customer satisfaction, and costs: it achieves this by merging tools and principles from both Lean and Six Sigma. Lean Six Sigma principles are well suited to the healthcare sector due to their potential for reducing medical errors improving clinical processes while eliminating waste and increasing quality, safety and efficiency. This paper examines quality concepts in general and focuses on the Lean Six Sigma approach and its application in healthcare. It also focuses on the implementation of some Lean Six Sigma techniques in a Lebanese governmental hospital. This research falls under the quasi experimental design which is a form of experimental research in which the researcher does not have control over assignments of participants, but uses already established groups to implement an experiment[(1)]. The instruments that I used to conduct this study are observations and interviews. I examined some existing quality problems and offered ways to improve the efficiency and effectiveness of the quality process through some Lean Six sigma techniques. Results showed substantial improvement compared to the initial application. Benefits were clearly shown in operational efficiency and higher process quality. It is also good to mention that the Lean Six Sigma techniques were applied with little disruption to the hospital and within its current budget with no additional cost.

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(1) Lodico M.G, Methods in Educational Research : from Theory to Practice (2nd ed.), New York : Jossey – Bass, 2010 .

Introduction

Background of the study

The health sector is characterized by diversity despite its singularity. There are many professions associated with this sector (e.g. doctors, nurses, nursing attendants, managers, suppliers etc.) This kind of diversity has resulted in an enormous increase of health costs which lead hospitals into using business techniques to reduce costs.

The health care sector in Lebanon falls more under the private sector. Lebanon has a total of one hundred thirsty hospitals spread throughout the country of which one hundred and five hospitals fall under the private sector and twenty under the public sector.[1] The challenge in the Lebanese healthcare industries is how to balance between quality and accessibility to the health care. The service quality and patients satisfaction are getting considerable attentions and these issues are considered in their strategic planning process. Patients' perceptions about the services provided by particular health care organizations affect the image and profitability of the hospital and they also significantly affect the patients' behavior in terms of their loyalty.

Increased patients' expectations about the service quality had pushed the healthcare service providers to identify the most important factors that are necessary to improve healthcare services that achieve patient's satisfaction and yet also help the service providers to reduce time and money involved in handling patient's complaints.

[1] Health Care Sector in Lebanon: Syndicate of Private Hospitals, Interview, Beirut, 2012 .

Quality has become a major societal concern; healthcare organizations have been looking for ways to improve the bottom line and the quality of patient care. Quality management is a very wide discipline that covers different essential concepts. Of these concepts are ISO, Accreditation, Quality Control, Six Sigma and Lean Six Sigma.

This study will present a historical overview of healthcare quality control management in general and will elaborate in details on Lean Six Sigma as being the leading approach in the quality management domain nowadays.

Statement of purpose

The Lebanese healthcare sector is facing the inability to maintain sustained development in healthcare systems. This is due to problems arising at the level of implementation of quality management techniques. The purpose of the study is to address the capability of sustaining adequate healthcare management through the adoption of Lean Six Sigma in a Lebanese governmental hospital.

Questions of the study

The study will attempt to answer the following main question:

1) To what extent the Lean six sigma approach is applied in the Lebanese healthcare sector and whether its application is able to maintain sustained healthcare development?

The study will further focus on the following secondary questions:

- How the quality management concepts evolve over time?

- What differences exist in a Lebanese governmental hospital that starts recently to implement some of the Lean Six Sigma techniques in its daily routines?

Definition of terms

The definitions of the key terms in this paper are:

Six Sigma

It is a quality improvement program originating from industry, characterized by its customer driven approach, based on systematic and statistical processes that increase quality by decreasing variation, defects, and costs.

Lean Six Sigma

Lean Six Sigma adds tools that increase speed and reduce waste and process complexity, while employing processes to improve quality and focus on the voice of the customer [(1)]

Significance of the study

The significance of the study lies in providing Lebanese hospitals with the leading approach in the quality management represented by the Six Sigma principles as a way of promoting and developing their current use of quality health care.

[(1)] Brett, C and Queen, Streamlining Entreprise Records Management with Lean Six Sigma. Information Management Journal, 2005, 36 (6), p.10, 58-62.

Division of the study

The study is divided to two parts in addition to an introduction and a conclusion. Part one contains chapter one, two and three and part two contains chapters four, five and six. Part one deals with the theoretical part of the study and part two deals with application and implementation. Chapter one presents an overview of the quality management concepts including Lean Six Sigma, chapter two describes the International Organization for Standardization (ISO), chapter three focuses on Accreditation, chapter four presents Lean Six Sigma for Hospitals, Chapter 5 presents the Implementing and Improving Lean Six Sigma in Hospitals and Chapter six discusses The Nabih Berri Governmental University Hospital (N.B.G.U.H.) as sample of the study.

Methodology

In this study, I used the quasi experimental design. Quasi-experimental research is a form of experimental research in which the researcher does not have control over assignments of participants, but uses already established groups to implement an experiment[(1)]. In my case, I used already existing hospital departments and I implemented an intervention which is the Lean Six Sigma techniques.

This paper focuses on how quality management works in Lebanon on ground, the impact of Lean Six Sigma on healthcare institutions and will help suggest better ways to enhance the development and sustainability of quality management in Lebanese governmental hospital through the adoption of Lean Six Sigma. At another level, this study uses a comparative

[(1)] Lodico, M.G, Methods in Educational Research : From Theory to Practice, New York : Jossey – Bass, 2010 .

methodology to show similarities and contrasts among different quality management approaches.

Limitations of the study

The limitations of this study start with the scarcity of primary resources available about the application of Lean Six Sigma in Lebanon. Moreover, the collection of data from Lebanese public servants faces noticeable difficulties.

PART 1: QUALITY MANAGEMENT CONCEPTS

With the rapid changes, enhancements and improvements of technology, the perception of quality related to health care has been changed and challenged. The concept of quality has existed for many years, throughout which its meaning has changed and evolved over time. In the early twentieth century, quality management meant inspecting products to ensure that they met specifications. Later on, during World War 2, it adapted a more statistical nature, where sampling techniques and quality control charts were applied to observe production or service processes. Then in the 1960s, the so-called "quality gurus" concept took over and quality began to be viewed as a concept that affected the entire organization, where all functions were considered to be involved and responsible for either high or poor quality outcomes[(1)]. Since the 1970s, quality has grown in importance and in turn became of tremendous interest, concern and enthusiasm. Competition was the main reason behind it; it became obvious that companies or organizations that do not meet certain standards would not survive.

When quality is met according to the definition of the customer, this is called customer-defined quality. Of course, the definition of the term quality depends on the perspective of the person defining it. There is a difference between defining quality from a perspective of a manufacturing company, than from that of a services company. The health care community produces

[(1)] Reid, R.D, and Senders, N.R. Operations Management 5th Edition, Hoboken : John Wiley & Sons, 2013, P.138.

products that are intangible, and is therefore categorized as services organizations, which makes defining quality more difficult, especially taking into account that it depends on the experience with the service given, which in turn can be highly subjective perception.

The revolution of quality in healthcare is putting the patient in the center and let care revolve around it. With every advancement in the health care sector, it is vital to meet the correct quality requirements. As mentioned in the introduction, quality has become a major societal concern; healthcare organizations have been looking for ways to improve the bottom line and the quality of patient care. But in a sector that is so wide and so evolving, how is quality measured? There is not only quality of care, but quality of life. Are our old measures of quality to maintain and improve health, meaningless now? Then again, from whose perspective should quality be measured – the patients' or the healthcare professionals'?.

When talking about quality, there is a wide range that includes Total Quality Management, critical paths, benchmarking, improvement thinking, learning organizations, outcomes measurements, and practice guidelines. All of these are based on concepts and models, examples, case studies and practical methods [(6)]. Information is gathered by addressing perspectives of patients, physicians, and staff for implementation. The following are the most essential questions that should be asked in order to be able to redefine quality of care, health and even life[(1)]:

- What is health, and how to measure its quality?
- What is quality of life, and who has the right to determine this?
- How will quality of health and health care services be measured and judged?

[(1)] Nancy, O. Graham, Quality in Health care : Theory, Application, and Evolution, Gaithersburg, Md : Aspen, 1995, P.211.

- Who has the right to make judgments about quality – the patient, the family, the health care professional, the employer, the insurer or the public?
- Will patients become full partners in their health and health care?
- How widely will data be shared about the community, employers, health care institutions, health care providers, and individual patients?

In this study, “we will not focus on the ethics that is needed to answer these questions”, though it is impossible not to use it. In this part “we will review the literature of the quality management” and “we will study its different concepts”.

Chapter 1: Quality Management Basics

Quality Management is a wide discipline that includes various basic concepts some of which are, ISO, quality control, Accreditation, and Lean Six Sigma. Quality management concepts are a number of various sub-processes that all together form the base of Quality Management.

> "We will study each concept alone and this will help us compare it to the concepts of Lean and Six Sigma, and thereby be able to identify which would be more suitable to be used in the health care industry, in particularly the health care system in Lebanon".

Section 1: Quality Control and Assurance

According to ISO 9000:2005, Quality Control is a part of quality management focused on fulfilling quality requirements[(1)]." Quality Assurance: "A part of quality management focused on providing confidence that quality requirements will be fulfilled[(2)]." This shows us that quality control is rather the inspection process or part of quality management, whereas quality assurance relates to how the process is performed. Inspection refers to the process of examining, measuring, and testing characteristics of a product or service and comparing them to determine conformity. The results of these measurements or tests then identify the service being provided meets the requirements. The quality assurance function in a service organization may not include quality control of the service but rather the products used while providing the service. It is very

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(1) ISO 9000:2005, Quality Management Systems – Fundamentals and vocabulary, standard by International Organization for standarizaiton, 2005 .
(2) IBID.

necessary to control product quality in a services organization according to the requirements of the customers. One part of the quality assurance function is called auditing, which is used to ensure quality and comparing actual conditions with requirements and to report those results to management. In "The Quality Audit: A Management Evaluation Tool"[1] Charles Mill wrote that auditing and inspection are not interchangeable: "The auditor may use inspection techniques as an evaluation tool, but the audit should not be involved in carrying out any verification activities leading to the actual acceptance or rejection of a product or service. An audit should be involved with the evaluation of the process and controls covering the production and verification activities."

A quality system is a management system that describes the elements necessary to plan, implement, and assess the effectiveness of quality assurance and quality control activities. Functions like quality management policies and guidelines for the development of the organization, as well as project-specific quality plans; criteria to assessing quality of data; assessments to ascertain effectiveness of quality assurance/quality control implementation; and training-problems related to the latter. Data that is collected must lead to results with quality which meet a well-defined need, use, or purpose; comply with program requirements, and of course reflect consideration of economy and cost.

Health care organizations as well as private hospitals are striving to control operational costs, in order to meet the economic changes that are faced in the health care industry and continue to provide low cost high quality services at low costs. Costing should promote cost effectiveness of medical practice, maximize the resources available to the health care provider by

[1] Charles, A., Mills, The Quality Audit: A Management Evaluation Tool, New York : MCGraw – Hill, 1989, pp. 207-211.

managing the services offers to patients, and explore opportunities for further improvements[1]. Of course in health care services quality costing is more challenging, due to the complexity and high costs that the processes demand, most of which is hidden and intangible. It is not easy to define quality in relation to health care nowadays. Health care quality is described as having "uniquely, intangible, variable and inseparable characteristics.[2]".

Thus measuring patients satisfaction is more important but at the same time very complex. The non-technical aspects are more influential in patients' rating if quality than technical aspects. When intangible costs of quality are taken into consideration, it is difficult to measure and determine the agreed expectation of patients which are excessively identified in order to provide reasonable quality of care. To measure the cost of quality, only the cost paid by the hospital (or part of it) is taken into consideration. This excludes the cost to society, families and other agencies.

But there is another aspect that should be given high interest and importance, which is human cost. This is often underestimated when considering the financial cost the main concern for profit making organizations. Improving quality aims to virtually improve reduce the cost of services[3]. However, in health services in particular, it can be argued that efficiency of service can increase the throughput of patients by increasing the associated costs.

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[1] Balak Rishman, Theory and Problems of Combinatics, New York : McGraw – Hill, 1995, PP.192-201 .
[2] Valarie Zeithaml, A. Parasuraman, Leonard Berry, A conceptmal Model of service Quality and Its Implications for future customer perceptions and Expectations, New York : The Free Press, 1990 PP. 161-175.
[3] Wan Rashm'd, Kamaruzaman Jusoff, Service Quality in Health care setting, Maysra : International Journal of Health the care Q A, 2009 PP. 181-188.

Section 2: Continuous Quality Improvement

In the 1980s, the Americans began to lose out in the world of automobiles and others, in terms of quality and cost. This was due to the Japanese who began to compete with the American market by using concepts of American quality engineers. They even started developing their own embellishments and modifications following the work of Taguchi, Ishikawa, and others. This meant that the Americans had to improve efficiency focusing on just in-time manufacturing, lean manufacturing and total quality management[(1)]. By discovering what the Japanese did, which in fact was taken from American thinkers like Deming and Juran, they learned approaches that involved strategic commitments to quality improvement and driving out waste by reducing variation using a series of techniques, as well as employee empowerment to encourage the process to move ahead rapidly. The relative cost of their employees, was one area the Americans faced a competitive disadvantage in. In response to aggressive efforts at cost containment, quality of care became a concern, which asked for quality measurements throughout the system.

Consumerism in health care has peaked at the end of the twentieth century, and the demand of the new paradigm is rapidly forcing the health care delivery system to implement quality improvement methods to promote preventive care and improve access to appropriate services. Insurers, for example, can no longer simply serve as an intermediary that pays claims, but the exigencies in the marketplace request that insurers screen their network of doctors and hospitals for quality and access to care. After that, they initiate efforts to improve any deficiencies that they find. Improving quality means

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[(1)] Greg Bounds, Beyond Total Quality Management, New York : McGraw – Hill, 1994, P197.

to virtually reduce the cost of services. Looking at quality issues from the economic concept perspective of quality costing , may be not accepted from health organizations, according to Ovretveit, the following are the reasons[(2)]:

Clinicians are more concerned with clinical outcome without considering resources in their daily practice.

Some health care professionals think that quality programs add advance bureaucracy and diverges the focus from clinical care. Some clinicians are not interested in costs and view non-clinical issues not to be useful to them or their patients.

Some health care professionals might not be aware of the advantages and benefits of the quality improvement programs in providing better quality services and reducing costs.

Most clinicians or health care professionals are only trained in clinical specialty thus lacking experience in running costs and quality improvement programs.

Some health care professionals fear that spending cuts would lead to job cuts, thus becoming less supportive of costing procedures. Managers may become reluctant to introduce quality costing if it induces such fear among the staff.

Despite the advantages and disadvantages of this concept, it is worth sharing that it is still not very well-established in the sector of health organizations as it is in private sectors and industries.

[(2)] John Ovretveit, Total Quality Managemtn in European Helath care, Mayor : International Journal of Health care Quality Assurance, 2000, Vol. 13 (2), PP. 153 – 167 .

Section 3: Total Quality Management

Total Quality Management (TQM) is one of the progressively implemented systems by hospitals and health care organizations across the globe in order to reduce cost improve efficiency and provide high quality patient care. The concept targets improved customer satisfaction, also offers the prospect of great market share and profitability. TQM can be an important part of hospitals competitive strategy in quality of health care systems[(1)]. Hospitals often compete by trying to provide the better service quality. Thus, TQM which places a heavy emphasis on improvement in customer satisfaction index that offers the prospect of grater combines internal quality measures with value analysis ad conformance to specifications[(2)]. The buyer does not only pay for medical services such as medicines, diagnoses, surgeries, and treatments but also for the indirect services like administration and purchasing operations. It may also include Total Quality of performance that is directly related to health care safety, security, attitude of nursing and word boy, role of doctors in terms of time, like appointment, delay time, service time, timing with regards to medical treatment and surgery[(3)].

One can define quality as either superiority of excellence, or as the lack of defects in quality care and services, but according to Crosby quality is 'conformance to requirements' (zero defects)[(4)]. The American National Standards Institutes (ANSI) and American Society Quality (ASQ) define quality as "The totality of features and characterizes of a care or service that

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(1) GunJan Patel, Total Quality Management in Health Care, India : The MIDAS Journal, 2009, PP. 118-129.
(2) IBID, P. 121
(3) IBID, P. 123
(4) IBID, PP. 128-129

bears on its ability to satisfy given needs." The view of quality as the satisfaction of customer needs is often called fitness for use[1].

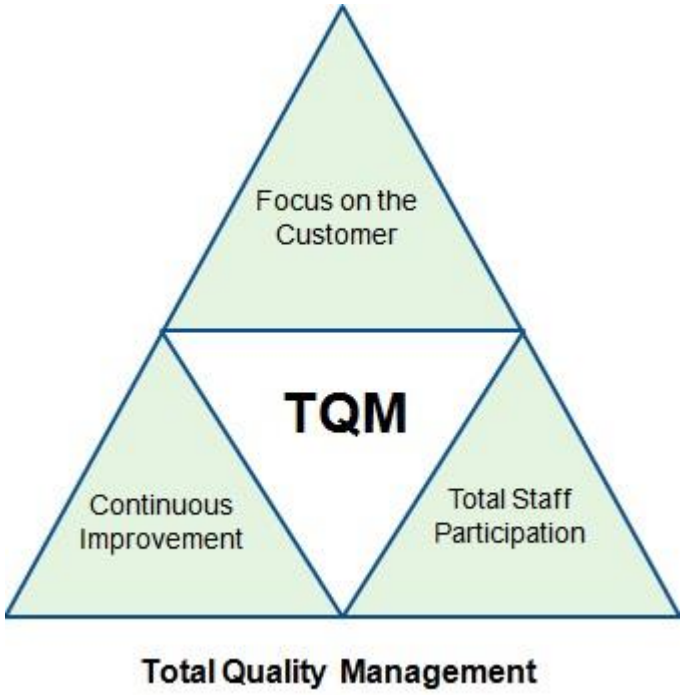

Figure 1: TQM Structure

There are 8 QM principles that should be used by carrying out the basic concept of TQM in order to satisfy the intent of the quality standards in the health care management system (Table 1)[2].

[1] Gunjan Patel, 2009, PP. 118 – 129 .
[2] IBID

1	Customer Focused Organized	Organizations depend on their customers and therefore should understand current and future customer needs, should meet customer requirements and strive to exceed customer expectations.
2	Leadership	Leaders establish unity of purpose and direction. They should create and maintain the internal environment in which people can become fully involved in achieving the organization's objectives.
3	Involvement of People	People of all levels are the essence of an organization and their full involvement enables their abilities to be used for the organization's benefits.
4	Process approach	A desired result is achieved more efficiently when activities and related resources are managed as a process.
5	System approach to management	Identifying, understanding and managing a system of interrelated processes as a system contributes to the organization's effectiveness and efficiency in achieving its objectives.
6	Continual improvement	Continual improvement of the organization's overall performance should be a permanent objective of the organization.
7	Factual approach to decision making	Effective decisions are based on the analysis of data and information.
8	Mutually beneficial supplier relationships	An organization and its suppliers are interdependent and a mutually beneficial relationship enhances the ability of both to create value.

Table 1: TQM Principles

TQM is people focused management system that aims to continue increases in customer satisfaction at continually lower real cost [(1)]. It works horizontally across all departments and functions. It involves all employees, and even extends to include sully chain and customer chain.

Section 4: Quality Improvement Plan (QIP)

A quality improvement plan is a commitment that is done by a health care organization towards its clients/staff/patients/residents, staff and community. The goal is to improve quality through focused targets and actions. It assists in delivering quality programs and services and is a way of focusing its efforts on key quality improvement priorities. The QIP centers its purposes on improving the outcomes of care, measuring improvement and surveying for patient satisfaction. It is a legislation that requires health service providers from all sectors to develop an annual Quality Improvement Plan for the following fiscal year and make that plan available to the public. 11 indicators have been selected for the 2017/2018 Quality Improvement Plan (Halton Healthcare):

1. Patients received enough information at discharge.
2. Readmissions to hospital (Patients with Congestive Heart Failure).
3. Readmissions to hospital (patients with Chronic Obstructive Pulmonary Disease).
4. Readmissions to hospital (patients with Mental Illness).
5. Palliative patients discharged home with home supports.
6. Alternate level of care.
7. Patient Satisfaction, Inpatient Care.
8. Patient Satisfaction, Emergency Care.

[(1)] GunJan Patel, 2009, PP. 118 – 129 .

9. Medication Reconciliation on Admission.
10. Medication Reconciliation at Discharge.
11. Emergency Department Wait Times for Complex Patients.

For example, the Health Care Financing Administration (HCFA) has embarked on a new program to ensure the quality of care provided to Medicare and Medicaid beneficiaries[1]. The Health Care Quality Improvement Program (HCQIP) has a mission and is still evolving, though there are 5 main goals that remain in constant focus[2] :

1. Improving outcomes.
2. Promoting quality measurement.
3. Informing and educating providers and promoting practice guidelines.
4. Informing and educating beneficiaries.
5. Establishing and enforcing health and safety standards.

The main reasons that made HCFA reinvent its QA programs are the rapid changing of the health care system, the growing agreement in the health care community that the quality of care can be defined and measured, data systems have changed immensely, and of course the Total Quality movement incorporation of the concepts of customer satisfaction, Continuous Quality Improvement and the presence of employee empowerment in all sectors of the economy.

[1] Barbara Gagel, Health care Financing Administrative, Washington DC : Pub med, 1995, PP. 82 – 97 .
[2] IBID

Section 5: Lean and Six Sigma

Six Sigma is a quality improvement initiative that has evolved over 25 years. It was developed by Bill Smith and first applied by Motorola Corporation in 1986[1].

Six Sigma has been implemented by many large, multinational companies world-wide, and has gained considerable popularity over the years. The Six Sigma program has been widely accepted to be one of the most successful process improvement systems available to businesses[2]. It has been applied in a wide range of business areas, including manufacturing and service settings, and expanded recently to financial institutions, education, hospitality, and health care organizations.

Moreover, Six Sigma has been successfully introduced into many other special business functions such as human resources management, research and development (R&D), supply chain management (SCM) and e-business[3]. Firms adopting Six Sigma have reported significant financial gains from their deployment efforts. For example, in 1999 General Electric reported $2 billion of net income benefits.

According to Eckes (2001), Six Sigma is the most popular quality improvement

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[1] Tennant, G. Six Sigma : SPC and TQM in Manufacturing and Services, Hampshire : Gower Publishing Company, 2001, P 211.
[2] Ronald Snee, Roger Hoerl, leading Six Sigma, A step – by – step Guide, New Jersy : Financial Times Prentice Hall, 2003, PP. 44 – 46 .
[3] IBID

methodology in history. Antony (2006) considers it as a business strategy known as an imperative for operations and business excellence. Its structured framework for controlling processes and measuring results with a financial aspect and with the use of quantitative techniques and tools has drawn the attention from academics and practitioners. In many cases its business performance achievements are remarkable. Six Sigma complement traditional quality management to enhance business performance. Moreover, Six Sigma, is defined as a systematic and statistically-based process to reveal defects in performance, driven by customer specifications. Six Sigma methodologies aim to reduce the variation in clinical and business processes which give rise to long cycle times, high cost and poor outcomes. A process that operates at true "six sigma" levels is producing acceptable quality over 99.99% of the time.

Lean Six Sigma is the application of Lean techniques to increase speed and reduce waste and process complexity, while employing processes to improve quality and focus on the voice of the customer"[(1)]. Lean Six Sigma, is at one point about the speed and the relationship between steps in a process, aiming to eliminate non-value added elements, creating a "one-piece" flow. "Lean Production" also known as "Toyota Production System (TPS)", was invented by Toyota, according to Jeffrey Liker, whose profits in March 2003 were higher than GM, Ford, and Chrysler combined. Byrne, G., Lubowe, D. and Blitz, A. (2007) provide a definition and suggest that both methodologies are more or less equivalent in importance. However, their definition arguably places too much emphasis on the individual

[(1)] Brett C and Queen, Streamlining Entreprise Records Management with Lean Six Sigma. Information Management Journal, 2005, Vol39, 155 (6) PP. 58 – 62 .

characteristics of the two methodologies rather than defining Lean Six Sigma as a synthesis of something that is new.

Lean Six Sigma builds on the knowledge, methods and tools derived from decades of operational improvement research and implementation. Lean approaches focus on reducing cost through process optimization. Six Sigma is about meeting customer requirements and stakeholder expectations, and improving quality by measuring and eliminating defects. The Lean Six Sigma approach draws on the philosophies, principles and tools of both. However, Lean Six Sigma's goal is growth, not just cost-cutting. Its aim is effectiveness, not just efficiency."[(1)]

While Brett and Queen (2005) and Proudlove, N., Moxham, C. and Boaden, R. (2008) favor the description about Lean Six Sigma that Lean practices embed within Six Sigma method, Hoerl, R. (2004) prefers describing Lean Six Sigma as an inclusion of Six-Sigma projects into a Lean context. However, Hoerl (2004) suggests that since it is providing an overall deployment and problem solving methodology, Six Sigma is an overarching main major program containing Lean existing in subordination.

Similarly, Bendell (2006) reports that Six-sigma is based on systematic and statistical processes that reveal defects in performance driven by customer specifications. The aim of the methodologies is to reduce the variation and non-value added activity in clinical and business process which create long cycle times, high costs and poor outcomes. A process that operates at true Six Sigma levels is producing acceptable quality levels over 99.9996% of

[(1)] George Bryne, Dave Lubowe, Amy Blitz, Using a Lean Six Sigma approach to drive innovation. Strategy and Leadership, New York : Pearson Prendic Hall, 2007, Vol 35 (2), PP. 5-10 .

the time. By using the Six Sigma processes performance, most processes are improved. A project that moves from “2 sigma” to “3 sigma” has been improved by about 450%. Typical projects that have delivered substantial gains to organizations sponsoring Six Sigma Projects in the health care industry are: Emergency Department patient flow and cycle time; Operating room patient flow and cycle time; Laboratory and Radiology cycle time; billing, coding & reimbursement; Supply chain management; Referral authorization; antibiotic administration. Mckensson, Standard Register, General Electric, Motorola, and Honeywell have all made significant commitment to Six Sigma and have reported impressive gains.

The importance and success of the use of Six Sigma is now very promising in the health care industry, where recently many providers and payers have adopted the principles. So as Six Sigma provides an integrated improvement approach that increases quality by decreasing variation, defects, and costs, Lean adds tools that increase process throughout by eliminating waste. In health care fast means rapid access and waiting time, while reducing defects means less complication. Hence, Lean Six Sigma is an excellent tool to tackle present-day health care challenges[(1)].

5.1 Lean Methodologies

The rapid increase of Lean Manufacturing in the Western World started in 1990 with the publication of a seminal work on Lean Manufacturing called “The Machine that Changed the World”[(2)]. As mentioned previously, Lean

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(1) Van Den Heuvel, Lean Six Sigma in a Hospital Amesterdam : International Journal, 2006, Vol 2 (4) PP. 377 – 389.

(2) James Womack, Daniel Jones, Daniel Ross, The Machine that change The world, New York : Macmillan, 1990, PP. 323 – 342 .

Manufacturing is an outgrow of the Toyota Production System[1]. Toyota and other Japanese companies invented a manufacturing paradigm that was not only more advanced but of higher quality than the paradigm of the West, which was based on employing economies of scale.

The Japanese had broken with dogmas like[2]:

- A strong separation of thinking and doing of the job is most effective.
- Defects are unavoidable by-products of production processes.
- Organizations should be designed as a hierarchical chain of command.
- Inventories are necessary evils, used to buffer fluctuations in production speed and customer demand.

The main focus of Lean is reducing waste, managing variability and synchronizing flows. It offers a framework for the analysis of process within an organization. The core element in this framework is the distinction between value-adding and non value-adding activities[3]. Value-added activities are those that contribute to what the customer wants of the product or service and that they would be willing to pay for. The primary analysis tool of Lean is the value stream map, which is a process flowchart extended with information of the speed, continuity of flow, Work In Process (WIP) etc. This way it points out which steps add value and which do not. It is used to focus on improvement activities; helps identify bottlenecks by stretching the entire value chain, providing a holistic picture of companies' processes.

Because lean focuses on process throughput the Lead Time is an important variable. It tells how long any item of work will take to be completed. According to Little's Law the Lead Time equals the amount of work in process divided by the average completion rate:

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(1) Taiichi Ohno, Just – In – Time for Today and Tomorrow, New York : Basic, 1988, P. 236 .
(2) IBID.
(3) Van Den Heuvel, Lean Six Sigma in a Hospital, 2006, PP. 337 – 338 .

$$\text{Lead Time} = \frac{\text{Amount of Work in Process}}{\text{Average Completion Rate}}$$

This equation shows that one can increase the process speed either by reducing the amount of work in process or by increasing the average completion rate.

5.2 Principles of Lean

The principles of Lean can be summed up in 5 general techniques (Lean enterprise Institute):

1. Specify value from the standpoint of the end customer by product family. Understand customer values thoroughly and create products, processes or methods that satisfy their needs. Create tangible methods to identify and measure customer value.

2. Identify all the steps in the value stream for each product family, eliminating whenever possible those steps that do not create value. Manage, measure and improve through value streams and address end-to-end processes.

3. Make the value-creating steps occur in tight sequence so the product will flow smoothly toward the customer. Eliminate obstacles like time, overuse, misuse and underuse, and unneeded processes.

4. As flow is introduced, let customers pull value from the next upstream activity. Train everyone in the organization in root causes and problem solving, this empowers people for lean improvement every day and aligns their job to customer value and company prosperity.

5. As value is specified, value streams are identified, wasted steps are removed, and flow and pull are introduced, begin the process again and continue until a state of perfection is reached in which perfect value is created with no waste. This is the pursuit of perfection, where you plan, do, check and act according to the scientific method of problem solving and improvement.

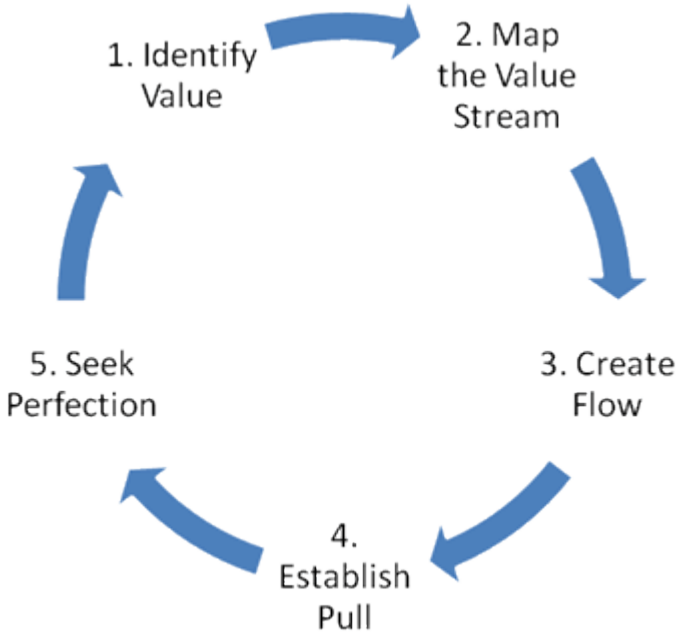

Figure 2 : Lean Principles

5.3 Six Sigma Méthodologies

Six Sigma is a philosophy for companywide quality improvement. It was popularized by General Electric in the late Nineties. It is characterized by its focus on the customer, emphasis on decision-making based on quantitative data and its priority on saving money. Six sigma literally means six times sigma, and in statistical terminology the Greek letter σ indicates the standard deviation of a random variable. Motorola developed a methodology of 4

steps that included: measure, analyze, improve and control (MAIC). Later on, General Electric added a step prior to all the other steps, which is 'define', becoming DMAIC. It is a closed loop that eliminates unproductive steps, often focuses on measurements and applies technology for continuous improvement[(1)].

The following are the steps of the DMAIC process:

- Define – in which the products or processes that need a priority intervention through Six Sigma projects are identified. Variables to which to refer in order to prioritize possible projects are:
  - Define requirements and expectations of the customer
  - Define project boundaries.
  - Define processes by mapping the business flow.

The execution of this phase should include benchmarking with other international competitors in order to highlight the key product/process features.

- Measure – first of all the selection of some characteristics of the chosen product/process ('response' variables) will be done, as well as the resources that influence ('input' variables) these characteristics. These are the ones that are most important to the customers ('CTO – Critical to Quality characteristics). This is best done by using the 'QFT - Quality Function Deployment' technique. After that, sampling techniques, measurement intervals, operational modalities for data recording, roles etc. will be done for data collection. The data is now

[(1)] Young Hoon Kwak, Frank Anbari, Benefits, Obstacles, and Future of Six Sigma Approach, Washington DC : Technovation, 2006, vol. 26, PP. 708 – 715 .

of definite purpose and provides necessary information for decision-making in terms of changes to the product/process.

The main activities include:

- Measure the process to identify customer needs.
- Develop a data collection plan.
- Collect and compare data to determine issues and shortfalls.

- Analyze – in this phase the following will be done: evaluation of data collected in the 'Measure' phase; assessing through statistical methods; evaluating the process centering and variation; the process stability; the trend of product/process performance, as well as making evaluations by using the DPMO (defects per million opportunities). Usually a gap analysis is also done at this stage in order to identify the common factors that determine best performance. The execution of this phase should also include a benchmarking on the performance of response variables for similar product/process of competing best-in-class organizations. This can provide an important basis for setting improvement targets.

  Some of the activities include:

  - Analyze the causes of defects and sources of variation
  - Prioritize the opportunities for future improvement

- Improve – in this phase decisions about the characteristics of which to intervene is made. The ones chosen are the ones that through improvement make us achieve the target set. A set of simple tools called '7QC tools' of improvement measure is established, which allow one to verify the presence of special causes of variation, from which an activity from their elimination or reduction should follow. However, if there is no presence of special causes of variation, then

the design of experiments will be adopted, by voluntarily introducing variations in the process and analyzing their effect.

The main activities consist of:

- Improve the process to eliminate variation.
- Develop creative alternatives and implement enhanced solutions.

- Control – by using statistical process control tools, in particular the control charts, the actual improvement in terms of values of the response variables, is ascertained. Control charts monitor and provide evidence of the results arising from the new process conditions. One can also 'institutionalize' the achieved results by either updating the flow-chart, or through an estimate of annual savings. For example in terms of costs due to the implemented improvement. Finally, it is essential to disseminate the results of Six Sigma within the organization. This can be done by the production of short reports about the case study.

The main activities done are:

- Control process variations to meet requirements.
- Develop a strategy to monitor and control the improved processes.
- Implement the improvements of systems and structures.

Section 6: Differences between TQM and Six Sigma

It must be understood that quality is based on what customers want and not what managers think they want, thus must be based on data collected from

customers[1]. The importance lies in exceeding customers' expectations, it is necessary to exceed their expectations and not only to provide competitiveness. This is exactly the target of the Six Sigma concept, to achieve and continuously improve quality in order to ensure customers' satisfaction and consequently customers' loyalty. The Six Sigma concept is based on the disciplined improvement of quality, where the accent is on quality of process, in terms of increasing quality and reducing costs of their implementation, by reducing variation and defects . The most important differences between the Six Sigma and Total Quality Management, or what most believe makes it the successor of the latter are :

- Identification, reduction and prevention of defects and variations within the defined specifications,
- Existence of experts for the implementation of the Six Sigma projects and precisely defined roles of employees,
- Promotion of the Six Sigma business culture,
- Continuous improvement of relationship with customers.

Other differences are[2]:

In the TQM framework quality is not sufficiently connected with the strategy and performances, the team that is responsible for quality improvement is autonomous and separated from both, the top managers and the process executives. While in Six Sigma projects, the process management, process improvement and measurement, are daily responsibilities of all employees. This enables that the quality and cost become an integral part of work of each employee.

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[1] Christopher Ahoy, Customer – Driven Operations Alipning Quality Tools and Business Processes for customer Excellence, New York : McGraw – Hill, 2009, PP. 108 – 111 .
[2] Andelkovic Pesic, Vinko lepojevic, Vladimir Zlatic, Six Sigma Vs. Total Quality Management, Serbia : University of Nis, 2011, Vol 8 (2) PP. 221 – 233 .

For TQM, quality leaders are committed to quality improvement, advocate for quality improvement and take measures to raise the quality to the next level. However if the top management support is missing, ideas of leaders remain only ideas with no possibility for implementation. The Six Sigma concept considers leadership as a predecessor, where ideas of leaders are only the introduction to quality improvement process. The top management is aware of the importance and necessity of change and quality improvement. This way, ideas of leaders and other employees become reality.

The goal of TQM is primarily to stabilize the level of quality and not to improve it. Whereas the message Six Sigma promotes is continuous quality improvement, focusing on customers, process management and process improvement.

The goal that is promoted by TQM is usually expressed as “achieving or surpassing customers’ requirements” which in turn are always subject to change, and using this approach makes it difficult to meet requirements that might change from one day to another. Six sigma therefore defines the following as their goal “providing zero defects”. It is very clear being defined in terms of defects rate or correctness rates which should be around 99.99966%.

TQM teams create a “quality policy” which is defined without consulting the direct executives of the processes but are forced to comply it. Six Sigma on the other hand, always involves the expertise of employees for performing certain activities. Employees are given the authority to perform work in a way they think is best but must always keep in mind that the outcomes do not only reflect themselves but the whole enterprise.

This implies that the main differences between TQM and Six Sigma lie in the attitude about defects, the relationship with customers, leadership and

business culture. According[1] to the results of organizations that have implemented Six Sigma projects testify the superiority over TQM.

Section 7: Synthesis of Lean And Six Sigma

For the synthesis of Lean and Six Sigma, Lean may use the management structures that Six Sigma offers: Six Sigma's project-by-project approach provides an effective embedding framework to apply Lean principles[2]. Lean has no methods for diagnosis and only a few for analysis, therefore lacks to analyze economic performance indicators of a process to indicate where the points of improvement are. It rather focuses on inefficiencies in the process flow, which not always includes the points of improvements. Lean is one-sidedly focusing on problems with the process throughput which are solved with a set of standards[3].

Certain Six Sigma methods, like the DMAIC, offers a thorough roadmap for analysis and diagnosis, driven by powerful tools and techniques. Since Six Sigma is a general problem solving framework, it can benefit from the standard solutions that Lean offers, especially when it comes to projects pursuing process efficiency improvement and speed. The synthesis of Lean and Six Sigma leads to an integration of both, and the key to a successful integration is to regard Six Sigma's project management and its DMAIC roadmap as a general framework for problem solving and process improvement. Lean's standard solutions and mindset find their place within this exact framework. Several hospitals have started to work with Lean Six

[1] Andelkovic Pesic, Vinko Lepjevic, Vladimir Zlatic, SS VS TQM, 2011 – PP 221 – 233.
[2] Van Den Heuvel, Lean Sing Sigma in a Hospital, 2006, PP. 377 – 388 .
[3] IBID

Sigma[1]. Georges (2003) explains what exactly Lean Six Sigma is for services[2]. It is a business improvement methodology that maximizes shareholder value by achieving the fastest rate of improvement in customer satisfaction, quality, process speed, cost, and invested capital. The synthesis of Lean and Six Sigma is required because Lean alone cannot bring a process under statistical control and Six Sigma alone cannot dramatically improve process speed or reduce invested capital. Moreover, both enable the reduction of the cost complexity. According to[3] the following is an overview of the differences between Six Sigma and Lean:

Six Sigma emphasizes the need to recognize opportunities and eliminate defects as defined by customer. It recognizes that variation hinders our ability to reliably deliver high-quality services. It requires data-driven decisions and incorporates a comprehensive set of quality tools under a powerful framework for effective problem solving. Six sigma provides a highly prescriptive cultural infrastructure effective in obtaining sustainable results and when implemented correctly, it promises and delivers $500,000+ of improved operating profit per Black Belt per year. Lean focuses on maximizing process velocity, provides tools for analyzing process flow and delay times at each activity in a process. It centers on the separation of 'value-added' from 'non-value-added' work with tools that eliminate the root causes of non-value-add activities and their cost. It provides a means for quantifying and eliminating the cost of complexity. The two methodologies therefore interact and reinforce one another and are therefore complementary.

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[1] Michael George, Lean Six Sigma for Service How to Use lean speed and six sigma Quality to Improve Services, New York : MCGraw – Hill, 2003, PP. 178 – 184 .
[2] IBID
[3] IBID

One of the most expensive aspects of medical care is hospital stays which puts providers in a quandary: how to reduce costs but still provide high-quality care. In the cardiac unit of Stanford hospitals and Clinics, an analysis of process flow found a capacity constraint in the "step-down unit", used for post-operative patients who no longer required intensive care. Limited capacity in that unit resulted in patients staying longer in more expensive intensive care than necessary. Rather than simply hiring more nurses or assigning more beds to increase capacity, a team examined the protocols used in the step-down unit, studied guidelines for determining discharge readiness, and evaluated factors that contributed to longer stays to determine if there was anything the hospital could do to mitigate or avoid those issues (such as changing guidelines for using certain drugs). A number of changes were instituted, all of which resulted in increased capacity in the step-down unit without major investment[(1)].

The following is an example of the application of Lean Six Sigma in the Canisius Wilhelmina Hospital[(2)]:

The Canisius Wilhelmina Hospital is located in Nijmegen, the Netherlands, and has 650 beds and a budget of 145 million euros. At the beginning of 2005 the Canisius Wilhelmina Hospital started to implement Lean Six Sigma. This was done by the same team that was responsible for the implementation in the Red Cross Hospital. In 2005 two teams of 20 Green Belts were trained. This time the training also included the key principles of Lean. An exercise was added in which the participants could experience directly the powerful effects of Lean tools. In 2006," we started to train another team of Green Belts and we plan to start two more groups". Employees are very enthusiastic about the training especially, because they

(1) Micheal George, Lean Sik Sigma for Service, 2003, PP. 178 – 184 .
(2) Van Den Heuvel, Lean Six Sigma in a Hospital, 2006, PP. 377 – 388 .

are given the means and tools to solve problems in their own department, which they faced for a long time. Since the Canisius Wilhelmina Hospital is twice as big as the Red Cross Hospital, we also trained more than 60 Yellow Belts to make more employees familiar with Lean Six Sigma and to support the Green Belts in their projects. Furthermore, we did an additional Lean training of one day for all the managing medical specialists and the directors. In April 2006, we did a large survey among employees to evaluate the organizational structure. A large number of flaws in our structure are mentioned by our employees. However, Lean Six Sigma was appreciated as a very useful instrument. In the next paragraph," we will demonstrate one project in a hospital that has been conducted in the Emergency Room".

This project illustrates very well the power of Lean Six Sigma in a hospital. In Table 1 we find some examples of Six Sigma, Lean and Common tools.

In 2000, the management of Red Cross Hospital, Netherlands implemented the Quality Improvement (QI) approach to improve their quality performance in the healthcare services; however, they could not succeed due to some problems[(1)]. These problems included the following: projects that were not strategically relevant; projects did not always have a significant business case; lack of a systematic project-tracking system; lack of uniform method for project management and control; and too many projects that were not completed[(2)]

At the end of 2001, the top management of Red Cross Hospital introduced the LSS methodology and solved these problems[(3)]. At the beginning of the LSS program, the project champion identified some problems in the measure

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(1) Henk de korning, Lean Six Sigma in Health Care, 2006, Journal for Helth care Quality, 2006, vol 28 (2) PP. 4-11.
(2) IBID
(3) IBID, PP. 4-11

phase. These included the following: the signature of the department head was missing; monitoring of the hours worked was not done; breaks were not registered; there were errors in the reported hours worked and time for travel; there was no check on the number of the temporary worker's years of experience; and the hourly wage was incorrectly stated on the invoice.

Based on the LSS approach, the management was able to solve these problems and save €36,000 per year from unnecessary costs and waste[(1)]. However, during the analysis phase of LSS, the Green Belt team discovered several issues that affected the starting time. These included the following: patients were not administered the prescribed medication; patients were brought in late by the referring department; the operation theater had insufficient manpower; specialists had to make rounds prior to performing procedures in the operation theater; and anesthesiologists and other specialists were late[(2)]. After identifying these problems, the LSS Green Belt team found that these problems were occurring due to the poorly defined process of the performance. To overcome these, the management developed a new admissions process based on the following principles: – patients must be present at the operation theater facility before 7:35 am; – before arriving at the operation theater, patients must receive preoperative preparation; and – the referring department and the anesthesiologists must be informed about the planned operation theatre treatment for the patient 1 day in advance of the procedure date[(3)]. The Green Belt team also identified other problems that led to excessive time spent in completing the target project within deadline. They discovered that the hospital maintenance department did not have standard operating procedures, and as such, malfunctions were handled

[(1)] Van Den Heuve ! lean Six Sigma in a Hospital, 2006, PP. 377 – 388 .
[(2)] Henk de koning, Lean Six Sigma in Health care, 2006, vol 28 (2) PP. 4-11.
[(3)] IBID

in an ad hoc fashion with no accounting for urgency or priority[1]. To solve these problems, they took some initiatives, such as turning the lights off at night to extend the life of light bulbs, dividing project problems into levels of urgency based on the importance of the task, and establishing and monitoring working performance for fixing standard malfunctions, as handled by the top management of Red Cross Hospital. Once the management succeeded in solving these problems, the Hospital was able to reduce the number of wastes and costs in the performance process. As a result, the hospital managed to save approximately €200,000 in 2004 just by implementing the LSS approach[2] .

[1] Henk de koning, Lean Six Sigma in Health care, 2006, vol 28 (2) PP. 4-11.
[2] IBID

Chapter 2: International Organization for Standardization (ISO)

Other than the TQM and Six Sigma assessment models there are other external assessment models such as the International Organization for Standardization, and Accreditation and Standards. The International Organization for Standardization (ISO) is an independent, non-governmental international organization with a membership of 162 national standards bodies. Standards give world-class specifications for products, services and systems, to ensure safety, quality and efficiency. They cover almost every industry from technology to food safety, to agriculture and healthcare.

Accreditation is defined by the international Society for Quality in Healthcare as a "self-assessment and external peer assessment process used by health care organization to accurately assess their level of performance in relation to established standards and to implement ways to continuously improve the health care system.[(1)]". The accreditation movement is flourishing worldwide as a result of the global change in the exchange of health services.

[(1)] Assaf Al Assaf, Seval Akgun, Health care Quality, Oklahom : University of Oklahoma, 2009, PP. 338 – 342.

Section 1: Concepts and purpose of ISO

As mentioned before, the ISO is independent, non-governmental international organizations that ensure quality, safety and efficiency in all eras Technology, healthcare, food safety, etc . The ISO story began in 1946 when delegates from 25 countries met at the Institute of Civil Engineers in London and decided to create a new international organization that 'facilitates the international coordination and unification of industrial standards'. On 23 February 1946 they officially began operations. Since then, 21919 International Standards covering almost all aspects of technology and manufacturing have been published.

Starting with obvious things like weight and measures, they have developed into a family of standards that cover everything from the shoes you stand in, to the Wi-Fi networks. The purpose of ISO is that providers can have confidence that their products are safe, reliable and of good quality. In other words, the main purpose is to make the world a better place. Regulators and governments count on ISO standards to help develop better regulation.

Standards help businesses increase productivity while minimizing errors and waste.

Section 2: The ISO standards

ISO standards are many and depend on the family or industry they belong to. The ISO list is long and starts by ISO 1 till ISO 99999. The ISO 9000 family of quality management system standards for example is designed to help organizations ensure that they meet the needs of the customers and other stakeholders while meeting statutory and regulatory requirements related to

a product or program. It deals with the fundamentals of quality management systems. It is based on seven quality management principles. ISO 9000 is the set of international standards on quality management and quality assurance developed to help companies effectively document the quality system elements to be implemented to maintain an efficient quality system. They are not specific to anyone industry and can be applied to organizations of any size. It helps companies satisfy its customers, meet regulatory requirements, and achieve continual improvement. However, it should be never considered a complete step but only the first. ISO 9000 is a series, or family of standards, whereas ISO 9001 is a standard within the family. ISO 9001 deals with the requirements that must be fulfilled by organizations in order to meet the standards. It lays out the fundamentals and vocabulary of quality management systems (QMS). Third-party certification bodies provide independent information that organizations meet the requirements of ISO 9001. ISO 9001 is the most widely used management tools in the world today since over one million organizations worldwide are independently certified.

The ISO 9000 family contains the following standards:

- **ISO 9001:2015 :** Quality Management Systems – Requirements
- **ISO 9000:2015:** Quality Management Systems – Fundamentals and Vocabulary (definitions)
- **ISO 9004:2009:** Quality Management Systems – Managing for the sustained success of an organization (continuous improvement)
- **ISO 19011:2011**: Guidelines for auditing management systems

Organizations can only certify to ISO 9001. The ISO 9000:2015 and ISO 9001:2015 standards are based on seven quality management principles. Senior management can apply for them for organizational improvement. The seven quality management principles are: customer focus, leadership,

engagement of people, process approach, improvement, evidence-based decision making and relationship management.

1- Customer focus

This principle focuses on understanding the needs of existing and future customers, aligning organizational objectives with customer needs and expectations, meeting customer requirements, measuring customer satisfaction, managing customer relationships and aiming to exceed customer expectations.

2- Leadership

This principle focuses on establishing a vision and direction for the organization, setting challenging goals, modeling organizational values, establishing trust, equipping, empowering employees and recognizing their contributions.

3- Engagement of people

This principle focuses on ensuring that people's abilities are used and valued, making people accountable, enabling participation in continual improvement, evaluating individual performance, enabling learning and knowledge sharing and open discussion of problems and constraints.

4- Process Approach

This principle focuses on managing activities as processes, measuring the capabilities of activities, identifying linkages between activities, prioritizing improvement opportunities and deploying resources effectively.

5- Improvement

This principle focuses on improving organizational performance and capabilities, aligning improvement activities, empowering people to make

improvements, measuring improvement consistently and celebrating improvements.

6- Evidence-based decision making

This principle focuses on ensuring the accessibility of accurate and reliable data, using appropriate methods to analyze data, making decisions based on analysis and balancing data analysis with practical experience.

7- Relationship management

This principle focuses on identifying and selecting suppliers to manage costs, optimize resources, and create value. It also deals with establishing relationships considering both the short and long term, sharing expertise, resources, information and plans with partners, collaborating on improvement and development activities and recognizing supplier successes.

Section 3: The power of standards

Standards make everyday life work. They establish the size, shape or a capacity of a product or system. They specify performance of products, processes, or personnel. They also define terms so that there is no misunderstanding among those using the standard. Standards ensure that a phone call can be interconnected anywhere in the world, that batteries for electrical appliances are safe, and that a plane that takes off from London can be refueled in Los Angeles. With standards in place, our homes, workplaces, and daily lives are safer and more convenient. In the U.S. alone there are more than 100,000 standards at work across all industry sectors. These include:

- Product-based standards (ex.: car airbags, washing machines, banking cards)

- Performance-based standards (ex.: toy safety, greenhouse gas emissions, food safety)
- Management System Standards (ex.: ISO 9000 Quality and ISO 14000 Environmental Management Systems)
- Personnel Certification Standards (ex.: cyber-risk technicians, food handlers, crane operators)
- Construction Standards for buildings and systems in the built environment (ex.: building, electrical, and plumbing codes)

Standards are developed by technical experts that work together to meet a common marketplace need. The term "voluntary consensus standard" describes a document developed through a process where all views and objections are considered and where affected parties (including government, consumers and business) have reached consensus on its contents. The creation of these standards is done by hundreds of Standard Developing Organizations (SDOs) and consortia. There is a vital link between standards that define characteristics of products and products themselves, this link is called conformity assessment. It verifies whether a certain product or service meets a given level of quality or safety. It can also provide information about the consistency of the characteristics of a product, their consistency, and the performance of this product. Most of the times, product problems are not due to inadequacy of the standard, but rather the conformance to the standard. Testing, inspection and auditing of products as well as management systems is as important as the standard in ensuring that the product or system is safe and performs as expected. The task to assess compliance may rest with the manufacturer or a third party like an auditor or testing lab. It may also be specified by an official like a building code inspector.

Section 4: ISO Tools and Techniques

In order to develop certain standards, different tools or techniques are used. One of them is the auditing techniques, it comprises of records, statements of fact, or other information relevant. This audit evidence may be quantitative or qualitative[(1)]. Guidelines for auditing management systems, is the comprehensive standard for auditing. Systems provide guidance on auditing management systems that include the following[(2)]:

- Principles of auditing
- Managing an audit program
- Conducting management system audits
- The evaluation of competence of individuals involved in the audit process, including:
  - The person managing the audit program;
  - Auditors;
  - And audit teams.

An audit is a systematic, independent, and documented process for obtaining audit evidence and evaluating it objectively to determine the extent to which the criteria are fulfilled. The criteria are obtained in procedures, policies and requirements adopted by an organization and may even include applicable laws, regulations, policies, procedures, standards, management system requirements, contractual requirements or industry/business sector codes of conduct. Audit criteria are used as a reference against which conformity is determined. It comprises of records, statements of fact or other information

(1) ISO 19011:2011
(2) ISO – Annex 4

relevant to the audit criteria and which are verifiable[1] is the comprehensive standard for auditing[2]. Conformity assessment – Requirements for bodies providing audit and certification of management systems, augments this guidance when the auditing being performed is undertaken by an independent third-party certification/registration body. Internal audits (first-party audits) are conducted by the organization itself.

This may be done for management review and other internal purposes; it may form the basis for an organization's declaration of conformity. Second – or third-party audits are external audits. The difference between them is that the second-party audits are conducted by parties having an interest in the organization, ex.: customers. Whereas third-party audits are conducted by external, independent auditing organizations, such as those providing registration or certification of conformity to the requirements of[3].

Combined audits are called so when a quality management system and an environmental management system are audited together. When two or more auditing organizations cooperate to audit a single organization it is called a joint audit[4]. Is applicable to all organizations that need to conduct internal or external audits of management systems or manage an audit program. Audits are recognized as one management tool to monitor and verify the effective implementation of organizations policies and objectives.

ISO/TR 10017:2003 provides guidance on the selection of appropriate statistical techniques that may be useful to an organization in developing, implementing, maintaining, and improving a quality management system in compliance with ISO 9001[5]. This is done by following these steps:

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[1] ISO 19011:2011
[2] ISO/IEC 17021:2011
[3] ISO 9001 or ISO 14001
[4] ISO – Standard Catalogue
[5] IBID.

examining requirements of ISO 9001 that include the use of quantitative data, identifying and describing the statistical techniques that can be useful when applied to such data. Furthermore, it is not intended for contractual, regulatory or certification/registration purposes. Neither is it intended to be used as a mandatory checklist for compliance with ISO 9001:2000 requirements. The justification for using statistical techniques is that their application would help to improve the effectiveness of the quality management system.

Section 5: ISO's certified hospitals in Lebanon

Lebanon's superior position as Healthcare provider renders the country as a regional healthcare destination[(1)]. In an interview conducted by the executive magazine, International patients account for roughly 20 percent of the total number of patients in the hospitals. Patients are drawn to the highly specialized healthcare services. Lebanon's hospitals are especially reputable in the fields of oncology and digestive, cardiac and brain surgeries. Cosmetic surgery is a major component of medical tourism in Lebanon. Most of the foreign patients come for routine operations like plastic surgery, dental or eye care. Lebanon's hospitals are also capable of performing specialized procedures such as internal bypass surgery and other technical treatments. Its top clinics and hospitals are equipped to handle the full range of surgical procedures. ISO certified hospitals are among the leaders in servicing foreign patients. With costs significantly lower than in most developed countries and plenty of highly-skilled surgeons and physicians, health care in Lebanon is an attractive prospect. However, with conflicts in the Middle

[(1)] Databank – Hospital Industry Report June 2013, P.14

East and worsening political situation in Lebanon and neighboring Syria, independent medical travelers will be more cautious to visit Lebanon. In efforts for the government to promote its reputation as a Healthcare destination, Caretaker Minister of Tourism Fadi Abboud launched the Eighth Conference on medical tourism to be held in Beirut from November 15 till 17, 2013 assuring that the conference's main objective was to promote Lebanon as a destination on the map of medical tourism, health and beauty, and to shed light on Lebanon's best characteristics.

For example, Al Makassed General Hospital has established their Performance Improvement Department in 1981(Makassed General Hospital – makassedhospital.org). The goal of establishing this department was and still is, to continuously improve hospital processes, evaluate patient-care activities, promote patients' safety and prevent risks. The Hospital has adopted policies which translates into hospital-wide quality improvement goals. In turn, these goals are broken down into attainable individual quality objectives. Measurement of improvement is achieved by a set of Key Performance Indicators.

Hospital committees enhance this effort by assessing the qualitative dimension of hospital processes.

Every effort is made to discover hazards before they pose risks to patients, visitors or employees, responding proactively to implement policies which will have a positive impact on patient satisfaction and safety.

- The hospital received ISO 9001:2000 certification in 2004 that was renewed on 2007, 2011 and 2014.

- In August 2016, the hospital earned the ISO 9001:2015 certification.
- The hospital was accredited in 2005 and rated “A”, then re-accredited on 2011 without any reservation by the Lebanese Ministry of Public Health.
- MGH received the HACCP certification for its dietary department in June 2014.
- MGH is preparing for JACIE (European) accreditation for the Bone Marrow Transplantation Unit.

In 2002, as Dr. Rizk Clinic, LAU Medical Center – Rizk Hospital was the first hospital in Lebanon awarded ISO 9001:2000 certification (LAU Medical Center-Rizk Hospital – laumcrh.com). This achievement was testimony to the hospital's commitment and usage of an innovative management system that emphasized quality.

Since 2002, the hospital has continued on the quality path evidence by successive ISO recertification during the next two certification periods—2005 and 2008. Today, the hospital is ISO 9001:2008 certified.

Chapter 3: Accreditation

In general, certification, licensure and accreditation are all methods of evaluation and are also methods of assessing and rewarding organizations (and individuals) for quality[1]. Accreditation is the only method however that requires a health care organization to follow a rigorous set of performance standards and be subject to a comprehensive process of self-assessment in addition to external evaluation. Accreditation is applied primarily to organizations rather than individuals, departments or units. Accreditation is a rigorous and comprehensive evaluation process through which an external accrediting body assesses the quality of the key systems and processes that make up a health care organization. Accreditation also includes an assessment of the care and service health care organizations are delivering in important areas such as preventive services and client satisfaction. Accreditation was developed in response to the need for standardized, objective information about the quality of health care organizations. Almost all accreditation programs are voluntary. Organizations seek accreditation for different reasons but most do so in an effort to increase market share and to win customer satisfaction and professional reputation. In all cases accreditation is voluntary. The International Society of Quality in Health Care (1998) defines accreditation as:

…a self-assessment and external peer review process used by health care organizations to accurately assess their level of performance in relation to established standards and to implement ways to continuously improve the

[1] Assaf Al Assaf, Seval Akgun, Health care Quality, Oklahoma : University of Oklahoma, 2009, PP.338-342

health care system. Quality standards and the external peer review process are directed by nationally recognized autonomous, independent accrediting agencies with a commitment to improve the quality of health care for the public.

The Canadian Council on Health Services Accreditation (CCHSA) describes accreditation as one of the few and most effective measures that health service organizations can use to accurately assess their level of performance. It is a peer review and a self-assessment process that focuses on ways to continuously improve the health care system. Each health service organization's performance is assessed against a set of national standards set by the accrediting organization in collaboration with key players in the health care system and related stakeholders. The assessment is designed to address processes; outcomes and structures, with the focus on continuous improvement within the health service delivery system.

Section 1: Concepts and purpose of Accreditation

Accreditation offers quantitative as well as intangible benefits to a health care organization besides public recognition. Accreditation can actually enhance the organization's strategic management decision-making process[(1)].

The purpose of accreditation can be summarized into the following categories[(2)] :

- Demand of the customer

[(1)] Accreditation Association of Ambulatory Health Care, 1999 .
[(2)] Assaf Al Assaf, seval Akgun – Health were Quality, 2009 – PP 338- 342.

- A forum for measuring performance
- Standardization and variance control
- Benchmarking
- Report cards
- Quality improvement
- Positive competition
- Reward and recognition
- Efficiency

Health care consumers are becoming increasingly aware of the different requirements a health care organization must meet in order to be considered a quality organization. They are also becoming interested in learning about the status of care provided by an organization judged by its peers or professional experts. Accreditation provides for a mechanism for an objective unbiased peer review of a health organization. It provides the consumer a set of measures by which they can judge a health care organization in comparison with similar organizations.

Accreditation standards are developed to be as quantifiable as possible. These standards follow the various functions and units health care organizations perform and possess. Standards are developed and are updated annually by a group of experts that are related directly to the process of care and to the structure of services rendered by the health care organization. These standards are therefore developed to measure the performance of the health care organization in the aspects of care and services it claims to provide.

One of the main activities of accreditation is to set standards that a health care organization must meet[1] . Experts usually develop these standards

[1] Assaf Al Assaf, Seval Akgun, Health care Quality, 2009, 338 – 342.

rigorously. It is with these standards that the accreditation agency is able to measure the quality of the health care organization they want to evaluate for accreditation. Therefore, these standards soon become the yardsticks by which performance is measured and accreditation is achieved. Standardization is important in order that objectivity can be assured in the evaluation process. It is also a mechanism for controlling outcomes and comparing performances. Meeting certain standards will render the health care organization "accredit able" and will decrease variation between its current performance and the desired one. Standardization is also useful in controlling cost by controlling expectations, predicting outcomes and facilitating effective budgeting.

Accreditation provides a mechanism for comparison between health care organizations. Those organizations that have achieved accreditation, especially "commendation" or "excellent" status, will have a positive image and will use that distinction to market their services accordingly.

Section 2: The power of Accreditation Standards

As explained in the previous paragraph, Accreditation provides a mechanism for comparison between health care organizations. Those organizations that have achieved accreditation, especially "commendation" or "excellent" status, will have a positive image and will use that distinction to market their services accordingly. Accreditation can therefore be used as a tool for positive marketing and as a tool that enhances positive competition between health care organizations. Competition can be based on price or other factors. Competition based on quality as exemplified by the attainment of accreditation is a form of nonprime competition and is a form of positive

competition. This type of accreditation is in contrast with the type of competition exhibited by and between political candidates where they each try to find weaknesses in each other performance or character to attack. Positive competition on the other hand encourages benchmarking and identifying the positive attributes of your competitor in order for you to achieve even a better level of these attributes in your organization. It is a process of continuous search for excellence and a mechanism for emulating that excellence in one's own systems. Accreditation facilitates this process and encourages it.

Receiving accreditation is equivalent to receiving the seal of approval on the quality of one's own organization[1]. This recognition certificate is usually worthy of announcement and heavy marketing to promote it. It is both rewarding and beneficial to an organization and its employees. Accreditation can also be used as the mechanism for rewarding individuals who have worked hard in order for the organization to achieve it. It is also a method of recognition among peer organizations and proof of quality. Quality has many dimensions. Two of these dimensions are related to the ability of an organization to attain its objectives in a timely and cost- beneficial manner. Therefore the ability of an organization to use its resources in the optimum way is one of the important dimensions of quality. Similarly, an organization that can demonstrate its ability to achieve its goals and objectives in a timely manner is considered an effective organization and therefore has met another dimension of quality. Accreditation is somewhat similar to what quality is all about. Accreditation requires an organization to be effective and to use its resources most efficiently. In order for the health care organization to achieve accreditation it has to demonstrate its effectiveness and its efficiency through completed projects related to their mission, their objectives and their

[1] Assaf Al Assaf, seral Akgun, Health care Quality 2009, PP 338 – 342.

goals. Efficiency and effectiveness must be practiced and proof must be documented in order for an organization to receive accreditation organization. [1]

Section 3: The Accreditation process

Such a system must have credibility, and this is usually attained through an upper management structure such as a board of directors or a governing board. The board most probably will consist of representatives of all of the major players in the health care system. For example, representatives from both the government and the private sector would be represented on the board. Professional organizations and societies may also be included on such a board. Certainly, this board would act as the top decision-making entity in the system of accreditation. It is responsible for evaluating survey reports for health care facilities and would render the final decision regarding eligibility for accreditation. Therefore this board is responsible for:

- Evaluation of surveyors' recommendations
- Verification of information
- The accreditation decision
- The appeal process
- Re-evaluation and periodic surveys
- Re-accreditation
- Accreditation violations/abrogation

[1] Assaf Al Assaf, seral Akgun, Health care Quality 2009, PP 338 – 342.

The accrediting organization will have an administration. This component will have a number of activities and functions that are supportive and somewhat facilitative in nature. This component is usually responsible for providing leadership and administrative insight to the accreditation process. Specific functions include:

- Facilitating the application process
- Collecting of the application and survey fees
- Scheduling of the on-site survey
- Identification and contact of surveyors
- Travel arrangements of surveyors
- Secretarial and clerical support
- Help desk/customer service, etc…

The accreditation process consists of a "desktop review" of the application and a site visit. Through this process, applicant organizations submit evidence of compliance with accreditation standards, which is then verified by an accreditation reviewer. Once the desktop review is complete, the organization may be asked to submit additional information and/or revisions to the application. After receipt and review of the additional documentation, an on-site visit will be scheduled. Applicants refer to a specific interpretation guide to prepare for the on-site verification. The processing time for an application, that is the time an application is received at an accrediting organization until the time the accreditation is granted, is approximately four to six months. The actual time frame will vary according to the type of accreditation applied for, the number of standards that are met versus not met upon desktop and on-site review, the number of applicant sites, and the number of applicants in the queue for accreditation, among other factors. During the on-site visit, a team of surveyors meets with many representative groups from various parts of the health care organization to discuss the

processes of care and support function within the organization, as well as, the quality improvement initiatives related to them. The survey team meets with the health care facility's board of directors, senior administration, care teams and other supporting teams, such as human resources, environment and information management. Most important, the surveyors meet with clients and their families, who are interviewed about their understanding of the care received, their feelings about the quality of care/service, and their level of understanding of their role in the care and treatment process. In addition, the survey team reviews documentation (for example, policies and procedures, minutes, care plans and clinical records) and visits key work areas to support their observations. In summary, the survey team is invited by the organization to review the quality of care and services provided against nationally developed standards. After the survey team completes its verification process a report including the accreditation recommendation is prepared and submitted to the accrediting organization for decision-making. The accrediting organization in turn analyses the report and discusses the recommendation, thus making its final decision regarding accreditation. The decision is verified by the accreditation organization's governing board and is provided to the health care facility. If the decision is a denial for accreditation or any adverse decision, then the facility has the right to appeal that decision.

Section 4: Accreditation Standards and QIP

Accreditation standards not only grew in quantity but also in focus, setting and quality. When first developed, these standards were primarily structure standards—standards related to either the physical structure of a hospital or

to its human resources. More process-oriented standards were introduced to manual and later outcome-related standards were also added. The current list includes more process standards than structure and has over the years included such areas as patients' rights and responsibilities leadership and ethics, therefore moving away from distinct "departments" to functions.

The third component is related to the setting and continuous updating of the accreditation standards and the scoring guidelines for measuring compliance to the standards. Specifically, this component will be responsible for:

- Organizing the domains (see below)/sections for the standards manual
- Developing and setting the accreditation standards and sub-standards
- Identifying the documentation requirements for evaluating compliance
- Establishing scoring guidelines
- Organizing and updating the standards manuals

Accreditation is the formal evaluation of any organization (health related or not) according to accepted criteria or standards. A professional society, a non-governmental body, or a governmental agency may do it. Accreditation is the process by which a facility becomes officially certified as providing services of a reasonably good quality, increasing the public trust in the quality of its delivered services. This chapter discusses different aspects of accreditation standards: setting the standards; accreditation scoring system; quality improvement, infection control and other accreditation related plans; the NCQA guide for school based health centers and the URAC accreditation standards are also reported. The reader will be exposed to different accreditation standards setting scenarios, and will witness the tailoring of accreditation standards accordingly with the unique and different backgrounds in which they originated.

Section 5: Accreditation standards in Lebanese hospitals

Quality care is the ultimate goal for the patient, the provider, the organizational leader and the policy maker. Ensuring this quality of care can be achieved through accreditation which measures conformity to standard provides educative and consultative information to help reduce the system's inefficiencies and achieve optimal use of resources. Quality of care has recently become a major concern for policy makers in Lebanon and improving quality of care involves improvement in all the components of delivery including structure, process, and outcome of health. The accreditation system adopted by the MOPH in Lebanon passed into four phases which are:

Phase one: Developing and Pilot – Testing Standards & Procedures (2000-2001)
Phase two: First National Survey (2001-2002)
Phase three: Follow-up Audit and Standards Revision (2002-2003)
Phase four: Second National survey (2004-2005)

With the intention to improve the quality of care, control health expenditures and protect consumers in Lebanon, the ministry of public health (MOPH) developed and implemented new hospital accreditation policy in Lebanon in collaboration with the Word Bank through the health sector rehabilitation project (HSRP) to replace the old Alpha-Star rating system. With the assistance of an Australian company, Overseas Project Corporation of Victoria (OPCV), the MOPH developed an accreditation manual for

hospitals in Lebanon. The MOPH manual put standards for all departments that are found in a hospital; these standards comprehensive and covered all the components including structure, process, and outcome of health. I will list below the MOPH standards that are related to Lebanese hospital departments.

The departments that can found in hospitals are the following: Anesthetics, Biomedical Department, Blood collection and distribution, Buildings, Cardiac Cath Laboratory, Chemotherapy Department, Central Sterile Supply Department, Children's Department, Clinical Nursing, Credentialing Medical, Dietetics and Nutrition, Emergency Room Services, Engineering Maintenance, Environmental Services, Fire Safety, Governing Body and Management, Human Resources, Infection Control, Information Technology, Laboratory Department, Laundry Services, Medical Administration, Medical Imaging, Medical Record, Content Management, Medical Services, Nursing Administration, Obstetrics, Occupational Health and Safety, Organized Medical Staff, Operating Room,

Pharmacy, Physical Therapy, Procurement, Psychiatry, Quality Systems, Renal Dialysis, Special care Units/Tertiary Services/NICU, Waste Management. Each of these departments has its own standards. I chose some of these departments to speak about their accreditation standards.

5.1 Department: Buildings

This department refers to the physical structures of the hospital facility, its maintenance and its components. The architectural design and structure, plumbing, electrical supply, sewage systems, all fall under the auspices of buildings. This department has seventeen standards that I will summarize as follows: The hospital administration should apply for and retain all the necessary governmental building permits and licenses and must meet all

governmental guidelines and regulations. Appropriate heating and cooling facilities should be provided for all staff and patient areas. Generator backup for electricity supply should be available for the entire hospital with a lag time that is less than 10 second on international standard and UPS backup must be present in all critical cases. For safety of patients and employees, finishing should ensure that there is no exposed electric wiring. The water supply of the hospital should be filtered with adequate records of chemical treatment and all bacteriologic testing. Drinking water as well should be periodically tested. To ensure safety, the fire system should include smoke sensors, fire hoses and fire alarms in all hospital areas and a no smoking policy should be enforced. Hospital signs and symbol should well written and lit for patients to identify the services they need. Adequate storage space should be available for each department like hospital stores, biomedical stores, dirty utility room, janitor stores, kitchen stores etc….Ideally each patient's room should contain a bathroom and the door of the bathroom should open outwards to prevent patient entrapment.

5.2 Department: Emergency Room Services

This department has twenty two standards that I will summarize as follows:

The emergency room should be under the direction of a qualified physician trained in emergency medicine supported by similarly qualified nursing staff. The emergency room is a vital department within the hospital as it is often the first point of contact for patients prior to admission. Therefore, the emergency room should be clearly identifiable from the outside of the hospital, having a separate entrance. The department should have all the necessary equipment for emergency patients. There should be a documented and operational triage system. Separate areas should also be available for resuscitation with all the necessary equipment for children and

adults, general physical examination rooms, plaster room etc…Security management is an integral part of the emergency room. It should include the availability of security staff either permanently on duty within the department or readily available. An alarm system with call bells in each section should be available. Easy access to the resuscitation room from the entrance with minimal time delay is mandatory. Sufficient space around each cubicle is necessary to allow for efficiency both for staff and for ready access to equipment and supplies. Each treatment area/cubicle should ideally have piped oxygen, suction, anti-static flooring and a full monitoring system along with all emergency supplies. Patients' privacy must be maintained at all times either by having separate walls or curtain dividers. The waiting facilities should be at a sufficient distance from treatment cubicles to prevent overcrowding during emergencies. The ideal layout should have a central staffing console surrounded by treatment cubicles for easy monitoring and access. The department must be large enough for the rapid transfer of equipment from one area to the other. The department needs at least one defibrillator on a fully stocked crash cart, checked every shift. Documentation in the emergency room must be detailed. All patients despite their duration of stay in the emergency room and /or transfer within the hospital or discharge should have a completed medial record established. The medical record should be able to meet future audit criteria. A standardized form is frequently used internationally to facilitate this process. A major part of quality improvement activities are regular attendance by staff at education sessions and proof of competency testing. All staff would be expected to have completed annual CPR training.

5.3 Department: Radiology/Medical Imaging

The medical imaging department should be under the direction of a qualified radiologist and a chief technician experienced by training and education. A schedule of all radiology/medical imaging staff should be visible within the department. The imagining department should have enough space to allow for toilet and changing facilities for patients. The imagining department environment should be such that all activities are carried out in a safe manner for both patients and staff. The dark room should have an extractor fan and outlet hoses from the film processor sealed at the point of entry to disposal containers. MRI facilities (where applicable) must meet the requirements for the operation of powerful magnetic fields. Requests for imaging are written on standardized forms and should include relevant clinical information. Ideally, the register information would be computerized to facilitate statistical analysis. Data should also be collected as to which technician performed the imaging procedure and the amount of film used.

The radiologist in charge should be actively involved in budget preparation and receive monthly financial reports from the accounting department. Staff is to maintain annual training in cardiopulmonary resuscitation and evidence of this training should be documented within the department and within each employees personnel file. It is imperative that all staff consistently wear radiation safety badges that monitor cumulative exposure. Staffs are to have occupational health and safety education. Imaging Departments are expected to provide an advisory service to clinical staff. Private changing rooms for patients are available within the department. A quality improvement plan should be in place for the department. The plan is to include audits of relevant activities both clinical and non-clinical. Deficits elicited from audits should undergo corrective action and re-evaluation.

A policy and procedure manual should exist which describes radiology department management and clinical services at this hospital where policies and procedures are to be identified. Department has an appropriately equipped crash cart such as defibrillator, emergency drugs, cardiac monitor etc… Appropriate written information is given to all patients prior to performance of procedures. A consent form should be evident for all patients undergoing procedures that carry risk or are invasive. Radiology reports are completed, reviewed, and signed by a radiologist within 72 hours of the examination. All mammograms are read and reports countersigned by two radiologists.

5.4 Department: Quality System

Quality systems are a vital component for the effective management of a hospital. A quality improvement program considers all stakeholders as customers and is premised on the fact that appropriate and effective customer service and satisfaction is paramount to successful management. Providing an effective service must also include the provision to openly acknowledge errors as a way of identifying areas for improvement. Invariably this requires a cultural shift. This cultural shift is where staff at all levels move away from a punitive and closed atmosphere to a transparent and educative environment; one where mistakes are openly reviewed in order to improve the service. The cultural shift, a commitment to quality improvement is required, commencing at the senior management level and must be communicated to staff at all levels. Smaller hospitals may have one committee that drives the quality program; larger hospitals may have committees formed that are allocated responsibility for each department. Quality improvement plans must have very clear, precise objectives using

key performance indicators as the measurement tools. It is against these statements that the outcomes are measured. These indicators can be established using the S.M.A.R.T. principles which are clearly Specific, Measurable, Achievable, Realistic and Time-bound. An annual hospital quality improvement plan exists which includes sections for: management, finance, medical services, nursing services, and general services.

A quality improvement system demands that all activities are clearly documented, and progress is monitored. Satisfaction questionnaires, surveys, complaints are all invaluable methods of collecting data which should be analyzed into meaningful statistics and then planned interventions executed in response to any deficits identified. If an established process for ordering supplies is not working effectively then this would be documented on the improvement log.

The quality coordinator would then initiate investigations; the data would then be analyzed and deficits identified. This activity would be followed by planned and introduced interventions and the quality loop completed as outlined above. The feedback should go back to the department / staff where the improvement log was initiated and documented, preferably on the improvement log to allow for ease of tracking. A documented policy and procedure for complaints exists for patients, staff and visitors. Investigation and resulting actions from complaints are documented.

PART 2: IMPLEMENTATION OF LEAN SIX SIGMA IN HOSPITALS

The implementation process of Lean Six Sigma can be considered as a highly important factor for the success of the methodology within an organization.

Management must put large efforts in the planning and design of the program and its implementation. A top-down approach is recommended to fully prepare all layers of the firm to work with Lean Six Sigma's methods and tools. This means that the organization's strategy should be assessed, cross-functional teams should be set up, improvement tools should be selected, awareness should be created throughout the firm and a detailed implementation plan should be made before the actual implementation can be initiated.

Implementation of the Lean Six Sigma methodology can cause an organization's culture to change significantly; management should therefore carefully evaluate the organizational culture in order to reveal any possible discrepancies that can occur when managing the operational Lean Six Sigma program. The objective for managers is to create an environment where continuous improvement is encouraged and employees are intrinsically motivated to improve their own work outcomes and ultimately positively develop the organizational performance.

Chapter 1: Lean Six Sigma for Hospitals

Hospitals today face major challenges. On one hand we have patients that demand quality of care to be improved continuously, and on the other hand we have health insurance companies that demand the lowest possible prices. These conflicted goals can be achieved by using the Lean Six Sigma program.

Lean Six Sigma is an integration of Six Sigma and Lean Manufacturing, both quality improvement programs originating from industry. Lean and Six Sigma are highly complementary. Six Sigma provides an integrated improvement approach that increases quality by reducing variation, defects, and costs. Lean adds tools that increase process by eliminating waste. In healthcare faster means rapid access and no waiting times, while reducing defects means less complication. Increasing speed and reducing defects both lead to lower costs. Hence, Lean Six Sigma is an excellent tool to tackle present-day healthcare challenges.

There are many benefits of Lean Six Sigma in hospitals. The following section focuses on efficiency and effectiveness goals of Lean Six Sigma application in hospitals.

Section 1: Efficiency goals of Lean Six Sigma in hospitals

When using Lean Six Sigma methodology, more efficiency is achieved, through increasing efficiency, decreasing costs, increasing revenues, and performance improvement outcome.

1.1 Increasing efficiency

Lean and Six Sigma have a complementary relationship with each other in improving the quality of services by reducing costs and wastes. The Lean method uses a management structure based on the Six Sigma approach. The Six Sigma method provides an effective embedding framework according to the project-by-project approach of applying Lean principles. On the one hand, the Lean approach does not analyze the financial performance indicators of a process, and the main objective is to improve organizational performance by reducing unnecessary costs. On the other hand, the Six Sigma's DMAIC approach provides a roadmap by which to analyze and diagnose the organizational performance. This approach can specifically identify the problems/errors in the process and is driven by powerful tools and techniques. The Six Sigma method, however, is a general problem-solving framework that may suffer from process inefficiencies; for those who are after process efficiency improvement and speed, this drawback can be solved by the Lean approach[(1)]. Thus, Lean and Six Sigma should be integrated to achieve high organizational performance through continuous improvement.

[(1)] Van Den Heuvel, Lean Six Sigma in a Hospital, 2006, PP 377 – 388 .

In 2008, one of the private hospitals in Taiwan "Hospital X (name is assumed)" began to implement LSS methodology to improve medical service quality by reducing mortality and medical costs[1]. At the beginning of the LSS project, the team discovered that there were several problems that prevented Hospital X from providing medical services to the patients. These are as follows[2]:

- Patients who are always queuing;
- Inexperienced physician in the ER;
- Too much time waiting for the diagnosis;
- Delay in receiving medicine;
- Shortage of nurses in the ER
- overcrowding at the hospital corridor, and
- Too many operation materials that are not necessary.

After implementing the LSS applications at Hospital X, it was observed that non-value-added time was reduced by 70.7%. It also improved the medical process and workforce efficiency to provide better service quality for the patients. Moreover, this approach helped Hospital X to save NT$ 4.42 million (1 US$=29.42 NT$) per year from unnecessary costs and waste.

1.2 Decreasing costs

The Lean Six Sigma (LSS) approach improves service quality and customer satisfaction by reducing the cost of operation and increasing business revenue. Healthcare organizations have embraced the LSS concept after it was fully developed, tested, and verified by many firms in the manufacturing sector such as Motorola, Allied Signal, Toyota, and General Electric[3]. The

[1] Van Den Heuvel, Lean Six Sigma in a Hospital, 2006, PP 377 – 388 .
[2] IBID.
[3] IBID.

application of LSS ensures the success of the healthcare center by reducing the number of defeats, such as patient waiting time, delivery of medical reports, unnecessary medical costs, and so on. It also helps the healthcare center achieve continuous improvements in the healthcare service by ensuring accurate results in a timely fashion. Providing accurate results to the healthcare providers enables them to diagnose and treat patients with a higher quality of care. The health sector is characterized by diversity due to its singularity but also the many professions associated with it (doctors, nurses, nursing attendants, managers, suppliers etc). This kind of diversity has resulted in a dramatic increase of health costs leading hospitals into using business techniques to reduce costs. Purpose: The purpose of the present review was to explore the possibility of operating hospital standards of operational policy.

Material and Method: The methodology followed is based on searching and reviewing research studies and scientific articles abstracted from an international database (Scopus) and from the Greek and international literature between the years 1996 to 2012, using keywords such as: hospital, business, health expenditure, supplies, and total quality management.

Results: The review of literature shows that hospitals suffered from mismanagement, excessive expenses and insufficient health care services. The application of Lean Six Sigma methodologies and TQM helped to reduce costs, the continuous control problems encountered in raising the level of benefits.

Conclusions: The hospital cannot be associated with a business, because the hospital is meant to care for the public in general as opposed to businesses that aim at increasing their profits. However, adopting techniques of the business field, the hospitals have the ability to control operating costs and curb costs, therefore, the modern hospital can function as an ‘idiosyncratic’

form of business. Lean is a way to continuously improve quality and performance of products and processes, as well as reducing costs and streamline the development of innovations[1].

On a supply chain level, long-term relationships with suppliers and customers regarding integration of information and physical flows are also incorporated into the Lean philosophy[2].

The use of either Lean or Six Sigma can cause firms to put incorrect priority on certain improvement initiatives, while Lean Six Sigma can solve such a problem because: "The activities that cause the customer's critical-to-quality issues and create the longest time delays in any process offer the greatest opportunity for improvement in cost, quality, capital, and lead time[3].". Hence, a synergy should be obtained which results in better overall performances rather than individual approaches to process improvement[4]. Lean Six Sigma decreases organization's costs by:

- Removing "Waste" from a process. Waste is any activity within a process that isn't required to manufacture a product or provide a service that is up to specification.
- Solving problems caused by a process. Problems are defects in a product or service that cost the organization money.
- Basically, Lean Six Sigma enables to fix processes that cost the organization valuable resources.

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[1] Naveen Gautan, Nouna Sipgh, Lean Product Development, International Journal of Production Economics, 2008, 114 (1), PP 313 – 332.
[2] Raffaella Cagliano, Federico Caniato, Gianluca Spina, Lean, Agile and Traditional supply, Italy : journal of Purchasring & Supply Management, 2004, PP 151 – 164 .
[3] Michael George, Lean Six Sygma For service, 2003 , PP 178 – 184 .
[4] Brett & Queen, Streaming Enterprise Records Management With Lean Six Sigma, Information Management Journal , 2005,VOL. 39 (6) PP. 58 – 62 .

1.3 Increasing revenue

Lean Six Sigma increases organization’s revenue by streamlining processes. Streamlined processes result in products or services that are completed faster and more efficiently at no cost to quality.

Simply put, Lean Six Sigma increases revenue by enabling an organization to do more with less – Sell, manufacture and provide more products or services using fewer resources.

One of Mount Carmel's first Six Sigma projects was focused on a simple, common problem: timely and accurate reimbursement. They discovered that their Medicare Choice product was writing off huge amounts as uncollectable due to HCFA denials. The organization did not expect the business line to be extremely profitable, leading to a certain ambivalence toward the uncollectable amounts. However, a Six Sigma process revealed that the problem lie simply in the coding of reports submitted to HCFA, more specifically around the status of patients classified as "working aged." Since the status of these patients often changed during the treatment process (with regard to work status), HCFA either rejected claims or did not reimburse fully for the care. Original estimates from fixing the problem: a $300,000 gain in net income. Actual "realized" amount: $857,000. It appears that as a result of improving the coding process around one parameter, the organization improved reporting among many other parameters as well, dramatically boosting revenue collection.

1.4 Performance improvement out come

Lean Six Sigma develops effective employees within any organization by:

- Involving employees in the improvement process. This promotes active participation and results in an engaged, accountable team.

- Building trust. Transparency throughout all levels of the organization promotes a shared understanding of how each person is important to the organization's success.

Basically, Lean Six Sigma develops a sense of ownership and accountability for the employees. This increases their effectiveness at delivering results for any improvement project they are involved in. Quite often, this benefit is overlooked by organizations who implement Lean Six Sigma, but it's underlying advantages dramatically increase the chances of continued success of Lean Six Sigma, and the business.

Going back to the history of Lean Six Sigma, In the early 1950s, Taiichi Ohno introduced a concept of "lean production or lean thinking" to reduce muda (waste) from the production processing. The concept was first implemented by the Toyota Motor Corporation (hereafter referred to as Toyota) to reduce unnecessary waste in the production and improve the quality of activities in the plant[(1)]. This concept was widely known as the Japanese Toyota Production System and later became known as "lean production" and "lean thinking"[(2)]. In 1947, Eiji Toyoda went to the US to learn how automobile cars were manufactured efficiently and effectively in the world's largest plant. In the meantime, Ford's Rough plant was producing 7000 cars per day, which was like a dream compared with Toyota's 13-year production of 2685 cars[(3)]. While Eiji was studying in the US, he wrote a letter back to the headquarters in Japan that he thought there were possibilities by which to improve the production system in manufacturing new Toyota cars. However, the application of Ford's mass production system did not work in Japan due to the cultural and

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(1) Jens J. Dahlaard, Su M : Dahlgaard – Park, Lean Production, Six Sigma Quality, TQM and Company Culture, The TQM Magazine, 2006, vol 18 (3), PP 263 – 281 .
(2) J. womak, D. Jones, D. Roos, The Machine that change the world, 1990, PP. 323 – 342 .
(3) IBID, P. 324

environmental differences[1]. They then realized that there was too much waste everywhere, i.e., waste in manpower, production, transportation, and facilities. They also realized that they were operating on limited human and material resources and that they were unable to adopt and implement the production system being used in the US at that time[2]. Therefore, Ohno returned to Japan and motivated his employees to work together under the best performance operation concept, followed by the so-called "five S" activities. Ohno introduced another famous system to reduce waste, which he called just in time (JIT) or Kanban system. This helped the company identify how much waste was involved in the mass production system. The JIT system enabled the company to reduce waste in the following three ways: not requiring a large space, in which to house a large number of parts; only the needing quantity of parts was produced; and defects were immediately discovered to prevent many others from being produced[3].

Section 2: Effectiveness goals of Lean Six Sigma in hospitals

When using Lean Six Sigma methodology, effectiveness is achieved through innovation, quality improvement and service management.

[1] J. womak, D. Jones, D. Roos, The Machine that change the world, 1990, PP. 323 – 342 .
[2] IBID, PP. 329-342
[3] Jens , J. Dahlgaard, Lean Production, Six Sipma Quality, TQM & Company culture, 2006, Vol 18 (3), PP 263 – 281.

2.1 Innovation

The descriptions given so far leads to a highlight of a unique relationship between innovation and Six Sigma projects and, more generally, the philosophy of Six Sigma. The philosophy of Six Sigma is imbued with principles which underpin the innovative ability of an organization, and encourages the organization to innovate through the minimization of the variability in processes and products. "We can therefore say that the positive results achieved by a Six Sigma project" (for example, the solution of a chronic problem of quality would permanently reduce the defect rate in a process) is always an innovation[(1)]. However, the opposite is not true, in the sense that innovation can be sought through routes that do not necessarily pass through the study of variation in product and processes.

Healthcare, as with any other service operation, requires systematic innovation efforts to remain competitive, cost efficient, and up-to-date. The principles of Lean Thinking and Six Sigma can be combined to provide an effective framework for producing systematic innovation efforts in healthcare. Controlling healthcare cost increases, improving quality, and providing better healthcare are some of the benefits of this approach.

2.2 Quality improvement

Quality improvement (QI) consists of systematic and continuous actions that lead to measurable improvement in health care services and the health status of targeted patient groups. The Institute of Medicine (IOM) is a leader and advisor on improving the Nation's health care. The IOM defines Quality in health care as a correlation between the level of improved health services

[(1)] Jens , J. Dahlgaard, Lean Production, Six Sipma Quality, TQM & Company culture, 2006, Vol 18 (3), PP 263 – 281.

and the desired health outcomes of individuals and populations[1]. When quality is considered from the IOM's perspective, then an organization's current system is defined as how things are done now, whereas health care performance is defined by an organization's efficiency and outcome of care, and level of patient satisfaction. Quality is directly linked to an organization's service delivery approach or underlying systems of care. To achieve a different level of performance and improve quality, an organization's current system needs to change. While each QI program may appear different, a successful program always incorporates the following four key principles[2]:

- QI work as systems and principles
- Focus on patients
- Focus on being part of the team
- Focus on use of the data

The leader's role in promoting and developing QI begins with creating and sustaining a personal and organizational focus on the needs of internal and external customers. Through actions, a leader demonstrates a clear commitment to the organizational mission, values, goals, and expectations that promote quality and performance excellence. The customer-oriented mission, vision, values, and goals of an organization are best integrated into all aspects of management through effective leadership nipples[3]. An organization that experiences success in the development and implementation of its QI program understands that the organization's chief officer or senior leader creates energy, synergy, and focused leadership for

[1] The Institute of Medicine of the National Academics
[2] Quality Improvement, HRSA, 2011
[3] IBID

the QI program. Under his or her leadership, all other managers or leaders work together to[1]:

- Set the direction for QI by creating a strong patient focus
- Create clear statements that define the organization's mission and values, and identify operational objectives, and short- and long-term expectations
- Demonstrate continuous commitment to achieving the organization's QI goals

Achieving high levels of performance re quires that an organization’s leaders develop a strategic quality plan to fulfill the mission of integrating QI into their organization. A strategic quality plan provides guidance for delivering safe and quality care. The plan is often updated annually by clinical, administrative, and executive leadership to ensure the organization is continuously making improvements to meet the needs of its patients and families. The strategic quality plan[2]:

- Identifies clear goals that define expected outcomes of the overall QI effort
- Is fact-based using indicators to measure progress
- Includes systematic cycles of planning, execution, and evaluation
- Concentrates on key processes as the route to better results
- Focuses on patients and other stakeholders

[1] Quality Improvement, HRSA, 2011
[2] IBID

2.3 Service management

Service management is any activity or benefit that one party can offer to another that is essentially intangible and does not result in the ownership of anything [1]. There has been a surge of interest in all aspects of service management in recent times. Many books, articles, and research papers on services and service management have appeared in popular and academic business literature starting in the 1980s and continue to be published today. The impetus for this phenomenon can be traced back to two major developments in recent history. First, the quality movement that started in the 1980s had brought most consumers, news media, and academicians to the realization that the overall quality of services in the United States was not ideal, acceptable, or competitive in the international markets. Second, the fact that services no longer formed the least important (tertiary) sector of the economy became obvious. Contrary to the once widely held view among economists, services in the second half of the twentieth century had increasingly played a significant role in the economic life in the United States and in all industrialized countries. The material gains of a society are achieved by adding value to natural resources. In advanced societies, there are many organizations that extract raw materials, add value through processing them, and transform intermediate materials and components into finished products. There are, however, other organizations that facilitate the production and distribution of goods, and organizations that add value to lives through a variety of intangibles they provide. Outputs of this latter group are called services. Services can be defined as economic activities that produce time, place, form, or psychological utilities. Services are acts, deeds, or performances; they are intangible. A maid service saves the consumer

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([1]) Philip Kotler, Marketing Management, Analysis, Planning, Implementation, and control, New Jersy : Prentice Hall, 1997, PP 51 – 67.

time from doing household chores. Department stores and grocery stores provide many commodities for sale in one convenient place. A database service puts together information in a form more usable for the manager. A "night out" at a restaurant or movie provides psychological refreshment in the middle of a busy workweek. Services also can be defined in contrast to goods. A good is a tangible object that can be created and sold or used later. A service is intangible and perishable. It is created and consumed simultaneously. Although these definitions may seem straightforward, the distinction between goods and services is not always clear-cut. For example, "when we purchase a car, are we purchasing a good or the service of transportation? A television set is a manufactured good, but what use is it without the service of television broadcasting? When we go to a fast-food restaurant, are we buying the service of having our food prepared for us or are we buying goods that happen to be ready-to-eat food items? In reality, almost all purchases of goods are accompanied by facilitating services, and almost every service purchase is accompanied by facilitating goods". Thus, the key to understanding the difference between goods and services lies in the realization that these items are not completely distinct, but rather are two poles on a continuum.

Six Sigma provides an integrated improvement approach that increases quality by reducing variation, defects, and costs. Lean adds tools that increases process throughput by eliminating waste. In healthcare faster means rapid access and no waiting times, while reducing defects means less complication. Increasing speed and reducing defects both lead to lower costs. Hence, Lean Six Sigma is an excellent tool to tackle present-day healthcare challenges. One of the basic Six Sigma tools and techniques are reducing defects by reducing variation. Others are focusing on a disciplined approach for reducing defects and producing measurable financial results,

providing an organization with a very specific measurable target for quality, providing a data-driven methodology for defect reduction. Six sigma refers to the standard deviation of a process that also describes the variation of the process. Standard deviation is the spread of process performance and the dispersion of all data points from the mean average. Lean and Six Sigma Methodologies focuses and fixes different areas of a process. It has the ability to maximize shareholder value by achieving an extremely fast rate of improvement in the following areas:

- Cost reduction
- Productivity
- Increased throughput
- Defect reduction
- Customer satisfaction and retention
- Market growth

Chapter 2: Implementing and Improving Lean Six Sigma in Hospitals

All over the world healthcare is facing serious quality problems while costs are exploding. Care processes are poorly designed and characterized by unnecessary duplication of services, long waiting time and delay. Costs are exploding and waste is identified as an important contributor to the increase in healthcare expenditures.

Healthcare consistently does not succeed in meeting patient's needs. Implementing Six Sigma combined with Lean principles can help hospitals to enhance quality and reduce costs. Six Sigma combined with Lean Manufacturing, better known as Lean Six Sigma, is such a powerful tool in healthcare.

Section 1: Implementing Lean Six Sigma

The implementation process can be seen as one of the most important factors which influence the success of the Lean Six Sigma program within the organization. A top-down approach to the implementation is recommended to structurally distribute the philosophy throughout the organization and develop the required resources. Organizations must be aware that the implementation of Lean Six Sigma has a large impact on the existing organizational culture.

1.1 Development of framework

According to Amar and Davis (2008)[1], there are two approaches for the designing of Six Sigma implementation frameworks. One is called the Critical Success Factor (CSF). A common approach used in developing Six Sigma, Lean Six Sigma or other Quality improvement framework is to identify elements or factors that are believed to be critical to the successful implementation of these concepts. For example, top management support is included on the list of CSFs for an improvement initiative. Rogers' diffusion of innovations theory has been refined over many years and its application extended from focusing on adoption of new ideas by individuals to adoption of new ideas by organizations[2].

In order to understand how such a framework is developed "we will give an example of the Escuela Superior Politecnica del Litoral (ESPOL)", whose social responsibility is considered one of their strategic goals. Given that ESPOL strategy for social responsibility is addressing major local problems, the Industrial Engineering (IE) department proposed a long-term project within an Ecuadorian Children Hospital (ECH) to achieve a world-class status[3]. The hospital is a private non-profit organization dedicated to help the community since 1906. Initially, the hospital was a small outpatient health facility, financially supported by a group of philanthropists. Nowadays, the hospital has a capacity of 160 care beds, 5 operating rooms, a unit of intensive care, laboratory, pharmacy and a physical therapy unit. Hospital occupancy is 160 patients on an average day, outpatient service is required by 140 patients on an average day. During the initial phase of the project, a group of IE students and professors started a preliminary

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[1] Kifayah Amar, Douglas Davis, A Review of six Segma implementation frame works, Sydny : Enginering University, 2008 , PP 7-8 .
[2] Evertt Rogers, Diffusion of Innovations Theory, New York : Free Press, 2003, P 19 .
[3] Marcos Buestan, Cinthia Perez, Edwin Desintonio, A proposed Framework of Implementing lean six sigma, Costa Rica : San Jose : 2016, P5.

evaluation of the ECH processes, with the goal of identifying QI opportunities that later, will be addressed as improvement projects. The projects were evaluated using an impact-effort matrix that revealed which projects might be considered as a priority for the hospital. In most of the cases, the problems were related to a deficient patient flow and a lack of processes standardization. Given the numerous successful experiences related to the application of LSS in a healthcare environment, and the characteristics of the problems in the ECH, the hospital managers, and the university's consulting group decided to implement LSS. An important aspect was discovering the right path for the implementation of LSS at the Hospital. "We selected an incremental improvement approach. Starting with small steps, instead of implementing a very complex continuous improvement system that could require a deep level of support and a significant use of resources". The selected approach starts with few projects that focused directly on solving problems to improve primary key performance indicators (KPI). The proposed approach considers the suggestion of authors such as Curatolo and Lamouri et al[(1)].

That recommend starting a Lean implementation on a micro level. Hence, Lean should be applied to specific operational processes previous the deployment of the Lean principles to the entire organization. Based on the previous observations, an incremental approach will help to create the confidence in applying the LSS methodology inside the hospital. Additionally, this approach promotes a culture that is comfortable with changes, reducing the resistance to the implementation of new solutions significantly. Lean and Six Sigma are combined in only one initiative. Depending on the expected output, each tool is assigned to different phases.

[(1)] Niccolo Curatolo, Samir Lamouri, A Critical Analysis of lean approach in Hospitals, Paris : Business Process Management Journal, 2014, Vol 20 (3), PP. 433 – 454 .

Although DMAIC is maintained as the framework for the inclusion of Lean and Six Sigma tools, our proposed approach presents an alternative framework related to the five Lean principles proposed by Womack and Jones[1] in the classic book "Lean Thinking" namely:

- Identify Value
- Map Value Stream
- Create Flow
- Establish Pull
- Pursue Perfection

The proposed approach presented offers a clear combination of both methodologies. The approach has been developed considering the recommendations offered by Clegg, Pepper, et al.[2] that states four guides during the construction of a Lean Six Sigma approach namely:

- Strategic and process focused
- Balance between the two philosophies
- Balance between complexity and sustainability
- Designed considering the kind of problems experienced

1.2 Wrong way to implement Lean Six Sigma

There are some possible drawbacks to the lean Six Sigma methodology. One of the most significant is that both lean and Six Sigma involve major changes to the workplace. For example, most lean implementations are not successful

[1] James womak, Daniel Jones, Lean Thinking, New York : Simon & schnster, 2010, PP. 183 – 198 .
[2] Ben Clegg, Mathew Pepper, Asystem Approach to customing Lean six sigma Implementations, International Journal of Quality & Reliability Management, 2010, Vol, 27 , PP 138 – 155 .

because management underestimates the amount of time and effort required to implement and maintain lean.

In his book "Changing with Lean Six Sigma," A. Aruleswaran[1] writes, "The most significant challenge is to change people and their mindsets."

It is not unusual for it to take more than two years to make the changes required just to implement lean. Implementing both lean and Six Sigma together means even greater complexity. If sufficient time and resources are not provided, the likelihood of failure is high.

1.3 Better way to implement Lean Six Sigma

At times, lean and Six Sigma may give conflicting answers. A system must be in place to resolve differences and address situations in which conflicting "solutions" are championed. Babe Ruth's famous words apply when combining lean and Six Sigma: "The way a team plays as a whole determines its success. You may have the greatest bunch of individual stars in the world, but if they don't play together, the club won't be worth a dime."

In addition, lean Six Sigma methodology can result in using the wrong method for the problem being addressed. For example, Six Sigma is not appropriate for solving small problems that do not involve a significant number of variables. Lean techniques are much more efficient for solving these types of problems. Of course, this is also an advantage of lean Six Sigma methodology because both methods are available, and the best one or a combination of both can be used.

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[1] Aruleswaran, A., Changing With Lean Six Sigma, Selongor: LSS-Academy, 2010, PP. 785 – 805 .

1.4 Set of tools and techniques

It’s easy to hire consultants and pour resources into lean Six Sigma methodologies, thinking you'll ensure success that way. While adequate resources must be allocated, the objective is not to spend a lot of money and waste resources. For example, Dr. Kaoru Ishikawa taught that 90 percent of all problems can be solved using simple graphical techniques he called the "seven tools of quality:"

1. Cause-and-effects diagrams (fishbone diagram)
2. Histograms
3. Check sheets
4. Pareto charts
5. Stratification (flow charts)
6. Control charts
7. Scatter diagrams

Achieving the right balance to economically implement lean Six Sigma methodologies is a difficult challenge.

Section 2: Improving the Lean Six Sigma

There are important ways to improve Lean Six Sigma in hospitals and make it more successful by paying attention to critical quality indicators as well as saving time and reducing cost. The following section discusses ways of improving LSS.

2.1 Critical-to-Quality Indicators (CTQs)

CTQs are the internal critical quality parameters that relate to the wants and needs of the customer. They are not the same as CTCs (Critical to Customer), and the two are often confused.

CTCs are what are important to the customer; CTQs are what's important to the quality of the process or service to ensure the things that are important to the customer.

A quality function deployment (QFD) or CTQ tree relates the CTQs to the CTCs. For instance, car door sound when closing might be a CTC, while the dimensional tolerances and cushioning needed to produce those conditions are CTQs for the auto maker.

2.2 Making Lean Six Sigma Successful

Six Sigma techniques are powerful in reducing process variation but are unable to significantly improve process speed. Lean tools and techniques are specifically designed to reduce wasted time in a process. Today, an increasing number of companies are implementing a combined Lean Six Sigma approach to business excellence.

Successful deployments are based on a "burning platform" – some major business challenge or risk that the company can overcome only through Lean Six Sigma. It could be a need to regain competitiveness in the market, a need to introduce new services, attract new customers, retain existing customers or simply improve profitability. Identifying a burning platform means all the company's business leaders are clear about why the company is adopting strategies based on Lean Six Sigma principles.

2.3 Getting a Faster, Better, Cheaper Hospital

For Lean Six Sigma to survive for a lifetime, organizations need to train their team members to be powerful change agents. Yellow Belt, Green Belt and Black Belt training, along with skilled mentors, can help increase organizational awareness. The employees identified for training should share the organization's vision.

Once resources and training are in place, a number of opportunities may present themselves. Organizations must make it a priority to:

- Listen to the customer
- Identify critical-to-quality criteria
- Ensure Lean Six Sigma efforts are linked to business goals

It is important to learn what to overlook and where to take risks. Activities must be assessed to ensure they are meeting the expectations of the organization's goals.

A proper governance structure can help a program sustain momentum. Poor governance or too much governance can lead to the vision falling apart. For instance, establishing a business quality council can help to clear any hurdles that may slow a project, allowing the project to adhere to timelines.

Proper governance also helps practitioners create a best practice sharing forum, which helps projects to be replicated and can highlight common challenges. Without regularly scheduled, productive meetings or review sessions, the program can veer off course and employees may lack guidance.

Chapter 3: The Nabih Berri Governmental University Hospital (N.B.G.U.H.)

In this chapter, I will study the impact of applying some techniques of the Lean Six Sigma in the N.B.G.U.H. but first I will introduce the hospital in general and its quality department in specific.

Section 1: Overview of the hospital

The Nabih Berri Governmental University Hospital (N.B.G.U.H.) is a Lebanese governmental hospital that was established in 1998 in Nabatieh, south Lebanon. Its name changed from Nabatieh Governmental Hospital (N.G.H.) to Nabih Berri Governmental University Hospital (N.B.G.U.H.) in 2012. The hospital was then transferred to a university hospital after signing up a contract with the faculty of medicine in the Lebanese university. This contract facilitated the work of medical students who started to study and train in the hospital.

The hospital contains 164 beds and employs 300 employees, among them are doctors, nurses, and administrative workers who work at a high competency level. Since its establishment, the hospital is working according to Lebanese and international standards and is increasing its scientific, technical and human capabilities.

1.1 Departments

The N.B.G.U.H. has the following departments or divisions: Internal medicine department (in all its specializations), Surgery department (in all its specializations), Quality department, Obstetrics department , Pediatrics and children's department, CCU, ICU, ICN, Operating room, Emergency, Renal Dialysis, Endoscopy, Physiotherapy, External clinics, Laboratory and blood, MRI and X-rays, PET-CT, Pharmacy, Dietetics & Nutrition, Oncology center, Eye surgery, Diagnosis, Burn center, Heart department, Radiotherapy for cancer patients, One Day Surgery and other complementary departments such as Reception, Cafeteria, Archive, Maintenance, Landry etc…

1.2 Mission

The N.B.G.U.H. motto is: "Health is the most precious blessing God gave to man." The N.B.G.U.H. mission is to provide basic and specialized health services with the safest and the highest quality technologies, supported by continuous education based on advanced medical and nursing machinery, to offer job opportunities and economic movement in the community, and to serve as many individuals as possible without distinction between social strata through effective leadership. It is different with its optimal use of resources and a hard working team to meet the needs of all the patients and their families.

1.3 Vision

The N.B.G.U.H. motto is: "Health care is not a privilege, it's a human right." This hospital strives to maintain the continuous development in order to reach its goal of becoming a distinguished institution in the community. It

does so by providing basic, specialized and distinctive health services, maintaining technical progress to keep up with the growing needs, as well as contributing to the scientific, health, and social development of the society.

1.4 Values

The N.B.G.U.H. has a set of values that govern its services and these values are: safety , care, excellence, equity, continuity, accountability, respect and confidentiality, non-discrimination, professionalism, environmental respect, education, quality improvement and care delivery.

Section 2: Access to the N.B.G.U.H.

In order to deal with the experimental part of my research, I had to study how the quality system works in the N.B.G.U.H. and to what extent the Lean six sigma approach is applied in the hospital. For that matter, I had to arrange some visits to the hospital.

As a sales and service engineer at GME, (General Medical Equipment is a company that sells medical equipment) I had easy access to the hospital, which is considered one of our customers. Nonetheless, I took the permission from the hospital manager to perform my study in the hospital working mostly and directly in the quality department.

2.1 Procedures

My visits to the hospital lasted seventy four days which covered the following procedures:

- First, I was introduced to the quality department manager and to all the staff working in the quality department who were informed about my research and frequent visits to the department.
- Second, I made observations and interviews in order to identify how the quality management works in the hospital, how it is interrelated in all departments, and how quality sustainability is achieved.
- Third, I did a training workshop for the staff who participated in the study in order to acquaint them with Lean Six Sigma approach and train them in the application of some techniques to achieve better quality improvements.

Section 3: Quality department at the N.B.G.U.H.

The N.B.G.U.H. quality department has its own structure, objectives and responsibilities. It is a vital department of the hospital because it communicates vertically and horizontally between all medical and administrative departments.

The quality department's mission is to improve health care quality in order to reach high level of satisfaction for patients and their families through its qualified staff. The quality department keeps on evaluating performance to have continuous improvement and better results. The quality department's vision is to spread and consolidate a quality culture at the hospital and to apply patient's safety rules and customer service. It also aims at creating a

common language of comprehensive quality in order to reach the best medical, technical and service practices.

The quality department at the N.B.G.U.H. is constituted of quality council and quality committee.

- The quality council is the highest authority assigned to create general policies for qualities, to approve quality annual plans and to follow their applications. The quality council has a CEO, quality manager, medical manager, nursing manager, and administrative and financial manager. The quality council meets periodically every three months, or when necessary upon a request from the quality manager.
- The quality committee represents the actual tool to execute policies and plans of the quality council. This committee supervises the application of the quality plans and programs. This committee has members from different departments like the medical, nursing, administrative and financial departments. This committee meets every three months upon an invitation from the quality manager to discuss Quality Improvement Plans (QIP) and study ways to overcome obstacles. The tasks of the quality committee includes: 1) To spread quality concepts and work on improving employees skills through training programs and continuous improvement. 2) To identify and improve quality plans and maintain its sustainability. 3) To apply accreditation standards and continuous evaluations. 4) To identify medical risks and try to decreases them. 5) To document and control quality records revising and modifying them continuously. 6) To review periodically the documented processes and check if they match the applied processes and identify the cases of nonconformity.

The responsibilities of head of the departments is to submit copies of Terms of Reference and Organizational Chart , QIP, minutes of monthly meetings, reports about applying quality programs etc…

"As we discussed before, the steps to achieving a high degree of quality pass through three steps. First the detection as in Quality Control is done, then prevention which is the Quality Assurance process, and then it is directed by Quality Management". In order to improve quality at every level in a certain organization, Total Quality Management (TQM) is integrated; this means that every member of the staff is committed to maintain high standards in every aspect of the hospital's operations.

The N.B.G.U.H. operates under an accreditation system where evaluations are done continuously. According to the 2015 N.B.G.U.H. annual report (1) the audit team from the GATES Company visited the hospital in order to evaluate and sort governmental hospitals. Gates reported strengths points as well as points that need to be improved. Among the strengthening points of the hospital: the existence of a general quality plan that cover all departments of the hospital, the existence of plans for training employees, the existence of an operating training center with the hospital offering good quality health care. The report also mentioned that the hospital is applying all previous audit recommendations. In addition to that, the N.B.G.U.H. opened new departments, like the Clinical Research Unit (NCRU), the Burn center, the Oncology center, etc…. in order to conduct research about infectious diseases, their prevention and early intervention and treatment. A committee was also established to control and monitor medical files. Its duty is to pick up haphazardly 50 files every 3 months and study these files in details and send written reports to the corresponding doctors informing them about their compliance or non-compliance with how to handle medical files.

Section 4: Applying some techniques of Lean Six Sigma at the N.B.G.U.H.

In this section, I will discuss the application of five techniques of the Lean Six Sigma methodology that I performed in different units of the N.B.G.U.H. The Lean Six Sigma offers a variety of techniques but I chose the ones that are appropriate to the particular context.

4.1 Accelerate the patient's experience in the N.B.G.U.H. Emergency Room

In this part I studied the experience of the patient from the time he/she enters the ER until his/her discharge and I offered solutions to improve the quality of the job. The emergency room is usually the most crowded division of any hospital where lots of delays occur. One of the key principles of Lean thinking is to eliminate delays. Over the years, the N.B.G.U.H. health care has made tremendous strides in reducing cycle time in various aspects of care. Outpatient surgeries are one example. Patients arrive in the morning and leave in the afternoon, no bed required. But there is still room for improvement. Lean thinking focuses on a key metric called “takt time”. Takt means rhythm. The Emergency Room (ER) handles 120 patients per day that would equate to 5 per hour or one every 12 minutes. But patients don't arrive in a rhythmic fashion, they arrive in waves. The biggest wave is between 2pm and 9pm due to rush hour traffic accidents. The smallest wave is usually 3am to 9am. So if patients arrive 2-3 per hour at off-peak times and 10 per hour at peak times. That's one every six minutes at peak times. Most ER patients at peak time have:

- Triage Nurse to evaluate walk-in patients by level of acuity, Takt Time needed is 6 minutes per patient.
- Registrars to handle insurance and hospital paperwork, Takt Time needed is : 6-12 minutes per patient.
- 2 M.D.s (one off-peak), Takt Time needed is 12 minutes per patient (some less, some more based on acuity) One trauma patient can completely consume one or both M.D.s.
- 1 Lab technician to collect blood samples (60% of patients require lab work), Tact Time needed is 10 minutes per patient.
- 1 Nurse for every two patients (sometimes with 1:1 nursing for traumas), Tact Time needed is 12 minutes per patient alternating Lab work often takes 45-60 minutes start to finish. Many of these patients will also need some sort of medical imaging (X-Ray, CT scan, etc.) which also takes 45-60 minutes. We can estimate that 25% of ER patients will be transferred to inpatients. That means 30/day or 5/unit. Traumas go to ICU. Chest pain patients go to telemetry. The rest go to medical/surgical beds. To admit a patient to an inpatient bed, it shouldn’t longer than 30 minutes although most hospitals run longer than this. This time is needed in order to sync up the ER and floor nurse to give "report" on the patient's condition and diagnosis. The solution I proposed is to fax or voice mail the report and transport the patient to the floor as soon as a bed is ready.

In order for patients to be transferred to the hospital bed, “we should consider the following. The hospital has one ICU (with 6 to 12 beds), one Telemetry unit for monitoring heart patients (with 12 to 20 beds), two Medical or Surgical unit (15 to 30 beds). The length of stay (e.g., tact time) in most of these units is 2-3 days. Patients also arrive from the operating room (3 to 5 patients per day) and direct admissions from local physician offices (3 to 5

patients per day). On a peak day, any unit can admit 10 or 12 patients and discharge 10 to 12. The sum of these two is called the "bed turn" rate (20-24). In order to discharge a patient once the order is written, Tact time needed is 2 to 6 hours. Delays happen for lab, radiology, oxygen, medical equipment, family or other transportation.) The target we put is 60 minutes and we reached the following solutions":

- Get physicians to discharge "pending" improved results 24 hours in advance. This allows nurses to do the paperwork and "teaching" required to prepare the patient for ongoing recovery at home.
- Prioritize discharge lab/radiology work ahead of other inpatients and after ED/OR.
- Set up home health requirements (e.g., oxygen, walker, etc.) in advance.
- Get at least two phone numbers of family members who can pick up the patient during the time when they are most likely to be discharged (when the doctors do their rounds).

After the patients leave the hospital, beds should be cleaned, Takt time needed for cleaning the bed is 20 to 30 minutes. However, with the delay in starting, it takes 15-90 minutes. All what is needed is to consider the peak time or rhythm of the hospital and assign more staff to clean the beds.

4.2 Using Five Concepts (5S) to manage the storage room

The storage room at the N.B.G.U.H. or any hospital in general, is a crowded area containing various hospital tools stored in one place. For this department, I used the 5S technique which is a method that uses a checklist of five Japanese concepts: *seiri, seiton, seiso, seiketsu,* and *shitsuke* (all beginning with the letter S and hence known as the 5S's). These concepts respectively refer to: sorting out the important from the unimportant,

arranging items in a logical order within the workspace, cleaning and sweeping the workspace, identifying items in a standardised fashion, and sustaining the new order. Before the project commenced the store was over-crowded with many items missing, redundant, or difficult to access resulting in wasted effort, delay and staff frustration.

The technique was implemented over a period of two weeks. I allowed one of the staff the staff to take a video movie of the storage room before and after process improvement took place. This video proved to be very effective in demonstrating the need for improvement in the store as well the need to sustain that improvement after arranging the store.

During the first stage all items in the store-room were examined. Those items that were no longer required or fit for use were removed. Indeed, several items were uncovered that had never been used.. At the end of this stage the store-room contained significantly fewer items and clutter was removed. During the second stage, items were re-arranged in the store and located in the most appropriate place. Items that tended to be used together were located together. At the end of this stage, items remaining in the store were arranged in a convenient and logical order. During the third stage a new arrangement was put in place for ongoing cleaning of the store-room. During the fourth stage a standard format was introduced: each category of items was labelled and colour-coded. These standards signified the importance of the item to the ward but also ensured that the item would continue to be stored in its allocated place. At the end of the four stages, items relevant to the work of the ward were easily accessible, clean and presentable, and easily identified using visual standards. The fifth stage requires that the new approach be sustained into the long run. There is always a danger that people become used to the new development and gradually take it for granted. At this stage people can become careless in their on-going implementation of

the new store procedures; the store then gradually regresses to where it had been. Developing the discipline to sustain the 5S stages will require ongoing communication within the personnel using this room.

Several steps were taken to ensure a successful implementation of the 5S project. Firstly the nurse, healthcare assistants, porters and other responsible staff were briefed on the nature of the project and introduced to the 5S framework. This strategy of regular communication and explanation was vital in getting all the staff on board and then keeping them on board.

The project resulted in a storeroom that was clean, neat, appropriately stocked and fit for purpose. Among the lessons learnt were that change is a socio-technical process and that correct management of human factors, for example identification of and communication with the staff is as important as correctly carrying out the technical elements of a project.

4.3 Using DMAIC to improve of medical records

Medical records hold important patient information and are regularly consulted during treatment. Ensuring that medical records are available at the required time and place is crucial to the effective running of hospitals. My project was to examine a persistent problem with medical records in the hospital. Medical records were not always available at the time and place of surgery leading to delay, search activity with no added value and sometimes cancellation of a procedure. In this process, I used a number of different improvement techniques at the same time in order to deal with this problem situation. The main methodology used was DMAIC from the six-sigma stable of techniques. DMAIC stands for Define-Measure-Analyse-Improve-Control which are the five structured steps of all Six Sigma projects needed to successfully achieve improvement in performance. I also used specific additional techniques during each of the DMAIC stages. For example, in the

Define stage, I used the theory of constraints to identify main blockages in the process. Indeed, problem itself resulted from the implicit identification of a major constraint that stops the surgery process which is the absence of a medical record for the patient. There were also other constraints on the process like late additions of patients to the surgery schedule. In the Measure stage, I also defined a process failure i.e. medical record not available at scheduled time of surgery. I estimated that the financial cost of defects was mainly due to professional time wasted. In the Analysis stage, I used logic trees to identify root causes for the unavailability of medical records and then cross-referenced these against effects using a cause-effect matrix. This stage identified additional key process input and output variables and allowed to produce a small number of 'critical to quality' statements. During the Improve stage, I devised checklists and follow-up procedures to ensure medical records were available when needed. Within the Control stage the new process was documented and ongoing monitoring, measurement, control and communications procedures were put in place in conjunction with the relevant personnel departments.

The Crucial factor of success was the identification of core issues relevant to the current process. Two core issues were identified: 1) human error and 2) the lack of a clear communication path between the relevant departments. Checklists were put in place to reduce the number of defects attributable to human error; these checklists facilitated dealing with the unexpected and identifying errors. Follow up procedures were designed and put in place to formalise communications between the medical records and surgical departments; in particular inter-departmental communication protocols for dealing with non-standard cases such as late additions to the surgery list.

The techniques used demonstrated clear improvements to the process that proved to be of direct benefit to both medical records and surgical

departments. Prior to implementation, defects were recorded at 19 out of 28 i.e. 19 medical records were unavailable at the scheduled time for surgery. Defects post-implementation were measured at 2 out of 28 i.e. only five medical records were unavailable when required at surgery. A key lesson learnt was that it is possible and indeed beneficial to use a variety of techniques in conjunction when carrying out a process of improvement in addition to the use of the guiding methodology, in this case DMAIC.

4.4 Elimination of waste in the laboratory process

This intervention is related to the introduction of a lean approach to the laboratory activities. This is a busy unit of the hospital comprising 13 staff and receiving 350 samples daily. Laboratories provide a vital support service to clinicians and smooth running of laboratory processes is essential for effective support. The study concentrated on the elimination of waste and the primary technique used was the 'seven wastes'. Each type of waste was examined in turn, sometimes with the use of another supporting technique. For example, when examining defects, I used the DMAIC methodology from the Six Sigma stable to systematically measure variation and reduce waste due to defects in the laboratory testing process. My work concentrated in particular on the reduction of the number of tests that had invalid results. When examining the issue of excess inventory, I used just-in-time (JIT) as a basis for determining the supply of reagents used in laboratory testing; this resulted in a much smoother ordering cycle and significant reduction in the cost of ordering. However, as JIT requires smooth usage of materials, occasional stock-outs of reagent have occurred since the introduction of the new system. When examining waste due to un-necessary motions, I used the 5S approach to ensure that all equipment, vessels, tools, materials etc. required, were in place, that the place was clean, tidy and orderly, and that

formal procedures were in place and were followed. To reduce waste due to waiting, transport and un-necessary steps in processing, I used mapped processes, recorded the receipt of samples and I attempted to level workload so that work is more evenly across the day and week.

Two key success factors for the project were noted. Firstly, laboratory scientists must be involved in the process improvement project from the beginning. This did not happen in the case of this particular project and full benefits of the project were slower to be gained as a result. Secondly, project objectives need to be stated clearly from the outset. Again, this did not happen in the case of this particular project leading to suspicion among laboratory staff about the real motivation for the project. Whereas ostensibly the focus of the process improvement project was on cost reduction through elimination of waste, laboratory staff believed that staff reduction was an undeclared objective of the project. This led to slow engagement by laboratory staff in process improvement and delayed the gain of full benefit from the project.

4.5 Preventing patients from falling

This project aimed to examine the impact of a fall reduction that has been taking place in the hospital. The purpose is to reduce the number of patients falling in the hospital which was a recurring problem according to some staff of the N.B.G.U.H. Falls are serious incidents and can lead to fractures which are painful and distressing for the patient and costly for the hospital. The risk of a patient falling is greater in hospital than at home because the person may be unfamiliar with the environment, weak due to their illness, and in poor control of their balance due to medication. The hospital takes the issue of falls seriously and undertakes efforts to reduce the number of falls.

I adopted the technique of ‘mistake proofing’ as a basis for examining the effectiveness of the existing hospital falls prevention project. A criteria for good hospital mistake proofing designs are that they should be inexpensive, adaptable and easy to implement; they should also involve the patient’s family or carer.

A specific objective of the study was to identify high risk areas. To do this I used control charts to examine existing levels of falls in two wards that had higher than average incidences of falls. I had access to medical files and I examined monthly falls data over a two year period and used control charts to measure the variability of the process over time. I used the charts to determine when the process was out of control and attempted to determine the sources of ‘special cause’ variation. For example, one period of special variation coincided with the imposition of budgetary constraints that resulted in reduction in the availability of agency nursing staff.

One of the interventions introduced was to place an orange fall alert band on the wrist of patients who had already fallen or have a high likelihood of falling. This initiative is called a ‘mistake prevention’ technique with the purpose of making others aware that the patient may require assistance. The project team demonstrated that this mistake prevention device met Grout’s criteria: it was cheap, easy to implement, and provided a signal to the patient’s family as well as to hospital staff. This technique alerted hospital staff to the nature and purpose of specific fall prevention initiatives thereby increasing their impact. Mistake proofing, is a technique whereby an item is designed to be used in only one possible way. The purpose of this is to ensure that an item cannot be misused or miss-fitted. Mistake proofing supports a lean philosophy in that it seeks to reduce rework or poor work due to mistakes.

The key factors of success were the availability of data from the previous falls prevention project. Emphasis by higher management of the importance of falls prevention also helped ensure project success.

Assessment and prevention of patient falls has become an active part of best-practice nursing care in the hospital since implementation of the falls prevention project. The technique used provided a number of additional benefits for the hospital. It generated awareness in the hospital of the importance of 'mistake proofing' as an approach to falls prevention and an awareness of the four distinct elements of mistake proofing: mistake prevention, mistake detection, and error prevention. It also provided a theoretical grounding for falls prevention work that was already being carried out in the hospital for example, it pointed out that use of orange bands was a mistake-prevention technique. It demonstrated to hospital management the usefulness of control charts as an analytical tool and the important difference between the two sources of variation: common causes and special causes. The visual control charts clearly pointed out to management that keeping a process under control, in this case sustaining the reduction in the number of falls, remains a constant challenge. Finally the project made a number of practical recommendations to management including focusing fall reduction efforts on wards most at risk, and using control charts on a regular basis to review fall rates.

Section 5: Results and discussion

In my intervention at the N.B.G.U.H., I selected a main methodology of the Lean Six Sigma approach and used it as an anchor in a specific department of the hospital. This provided the work with a philosophy on which to base

change. This anchor methodology was supported by other specific techniques as a supplementary or subsidiary fashion to actually carry out the change and lead to better quality improvement.

The interventions demonstrated that Lean Six Sigma approach can yield considerable benefit even when implemented by new users or with staff that has been recently trained in Lean Six sigma approach. Benefits of the projects ranged from a reduction in hospital falls, to more complete medical records and to less waste time in emergency rooms. The interventions also demonstrated that Lean projects can be effectively applied in many different areas of a hospital and are useful in pursuing many different purposes.

The leadership of the hospital was also a key factor in improvement. The support of the quality manager at the N.B.G.U.H. was important for the successful implementation of the techniques. This support manifested itself also through the contribution of other departmental managers and personnel who trusted the work and participated in the improvement.

The study also demonstrated that even relatively simple but appropriately implemented lean six sigma projects can produce organizational benefits such as better operational efficiency, higher process quality, improved cost-effectiveness and better value for money. It is also good to mention that the Lean Six Sigma techniques were applied with little disruption to the hospital and within its current budget with no additional cost. They were actually simple and small techniques that provide the hospital with significant value in a variety of ways.

In addition to that, the staff and I came to realize that some of the work that was operating at the hospital prior to the intervention was very compatible with the Lean Six Sigma approach. The theoretical training and

implementation of the techniques defined the job in a more scientific and professional manner.

Early successes in simple projects may pave the way for tackling more complicated initiatives in the future initiating a positive cycle of improvement. Arguably a small intervention related to master's thesis is insufficient to bring about large-scale process change using Lean Six Sigma approach, but it is a start to a more sustained and continuous quality system.

Conclusion and Recommendations

Lean Manufacturing has been an important business philosophy and approach to production and operations management for the last decades. The methodology has, since its introduction to the U.S. in 1984, been subject to transformation on both an academic and managerial level[(1)]. Six Sigma has, just like Lean, become increasingly popular in the field of performance management[(2)]. Lean Six Sigma has been developed by combining the Lean Manufacturing and Six Sigma methodologies. The mixture of these two can lead to the best of both worlds: the waste eliminating and speed improving characteristics of Lean Manufacturing, and the statistically based and structured way of process improvement and redesign taken from Six Sigma. The integration of the Lean manufacturing and Six Sigma methodologies and concepts can improve the quality of care provided while at the same time reducing the cost as non-value added elements are being eliminated in the process.

Due to difficulties in implementing quality management techniques, the Lebanese healthcare sector is unable to sustain the development of healthcare systems. This is due to problems arising at the level of implementation of quality management techniques. The purpose of the study is to address the capability of sustaining adequate healthcare management through the adoption of Lean Six Sigma in a Lebanese governmental hospital (the N.B.G.U.H.) For that reason, I implemented five Lean Six Sigma techniques in some of the N.B.G.U.H. departments. I used the "takt time" in

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(1) Rachna Shah, Peter word, Defining and Developing measures of lean Production, New York : Elsevier, 2007, PP. 785 – 805 .

(2) Roger Schroeder, Revin Lindeman, Charles Liedtke, Adrian Choo, Six Sigma : Definition and underlying Theory, New York : Journal of Operations Management, 2008, Vol 26, PP. 536 – 554 .

order to accelerate the patient's experience in the emergency room. I also used the "5S" technique to manage the storage room, in addition to the DMAIC technique to improve the medical records, the elimination of waste in the laboratory department using "Seven Wastes" technique and finally the ‘mistake proofing’ technique to prevent patients from falling.

Results showed that the small projects applied in the N.B.G.U.H. demonstrated that Lean Six Sigma approach can yield considerable benefit even when implemented by new users or with staff that has been recently trained in Lean Six sigma approach. Benefits of the projects ranged from a reduction in hospital falls, to more complete medical records and to less waste time in emergency rooms. The interventions also demonstrated that Lean projects can be effectively applied in many different areas of a hospital and are useful in pursuing many different purposes.

The study also demonstrated that even relatively simple but appropriately implemented lean six sigma projects can produce organizational benefits such as better operational efficiency, higher process quality, improved cost-effectiveness and better value for money. The implementation of the LSS combined approach can in the same way cut unnecessary costs while boosting productivity and customer satisfaction.

High worker motivation is a valuable requirement for Lean Six Sigma programs to be successful. Management must not only invest in the specialist hierarchy structure which will mainly focus on improvement initiatives, but also put effort in creating awareness and understanding regarding Lean Six Sigma throughout the organization. This will allow the proper implementation of Lean Six Sigma and will in turn boost productivity and eliminate non-value added elements that might hinder productivity. Furthermore, the implantation of Lean Six Sigma will increase the revenue

of healthcare sector by streamlining products or services thus achieving more efficiency at no cost to quality.

As stated above, the Lebanese healthcare sector faces trouble implementing quality management techniques which is in many ways hindering its progress and decreasing its efficiency. By following the combined Lean Six Sigma approach and setting a clear plan of action in regards to innovation, quality improvement, and service management, "we can get a step closer to implementing these strategies". Using Lean Six Sigma techniques, Lebanese hospitals (precisely governmental hospitals) can train teams to focus on patients, be part of a team, utilize the data attained, and constantly reevaluate and implement strategies to boost productivity of the entire team, and all this can happen at minimal costs.

In summary, the proper implementation of the Lean Six Sigma combined approach can improve the quality of care provided at a healthcare institution while maximizing shareholder value and maintaining a steady process of increased productivity by: reducing costs through reevaluating current strategies and changing protocols as needed, eliminating non-value added elements, retaining customers by focusing on their needs and making sure they are satisfied with the services provided, and attaining a larger market share.

Implementing the Lean Six Sigma combined approach in Lebanon can be done but it will be a gradual process that will take time and will have some limitations in terms of tracking the progress and results. As mentioned in the limitations section, the collection of data from public servants at the N.B.G.U.H. or any other hospital is difficult in many ways and some institutions do not tend to voluntarily disclose information. Second some individuals in institutions might resist the implementation of such a system as they might be contempt with the way things are run and do not want any

form of regulation or they might not want their current routines or activities exposed. These limitations do not in any way change the fact that implementing the Lean Six Sigma approach in Lebanon can significantly improve the quality of care provided. Another aspect that Lebanese healthcare institutions need to focus on to reach their desired goals from implementing the Lean Six Sigma approach is listening to customers and modifying their goals to ensure customer satisfaction. To overcome the limitations, training programs and a clear timeline defining a stepwise approach to the implementation process must be set and gradually executed.

As discussed in Chapter six that is related to the N.B.G.U.H., strategy and process design, balance between complexity and sustainability, assessing limitations and designing plans to overcome them, training programs at all institutional levels must be conducted in order to move in the direction of the desired increased productivity. Furthermore, hospitals must have clear business goals to ensure that the implementation of the program helps them achieve their long and short-term goals while solving any problems that might hinder the progress on the way.

In conclusion, following the set of tools and techniques in the Lean Six Sigma approach and implementing the process of change in the Lebanese healthcare sector can boost customer satisfaction, eliminate unnecessary costs, increase the efficiency and productivity of the healthcare sector as well as provide service at better quality.

On the light of this work, further studies may explore new Lebanese governmental standards and regulations to reinforce and sustain the use of quality management concepts especially the Lean Six Sigma in health care institutions. The Lebanese government, being the official authority responsible of the private and public health institutions, may benefit from the experience of other countries that already adopted such standards and

held hospitals accountable for; hence maintaining and sustaining development while implementing quality management concepts.

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Appendix 1: Certified hospitals in Lebanon

The following is a list of certified hospitals in Lebanon (2014). The list is divided into five types of accreditations, according to the Ministry of Public Health of Lebanon.

Accreditation without reservation:

1. Abou Jaoudé Hosp.
2. Ain Wazein Hosp.
3. Al- Assi
4. Al- Bourj Hospital
5. Al- Hayat
6. Al- Koura
7. Al- Makassed Hosp.
8. Al Rassoul Al Aazam
9. Al Rayan
10. Al Salame- Hôpital de la Paix
11. Albert Haikal Hosp.
12. Alwatany
13. Al-Zahraa University
14. American University of Beirut
15. Bahman Hosp.
16. Becharry Governmental
17. Beit Chabab Hosp.
18. Bellevue Medical Center
19. Bint Jbeil (Islamic Health Society)
20. Bitar

21. Borgi
22.Centre Hospitalier Universitaire (Notre Dame de Secours)
23.Centre Hospitalier de Bhannès
24. Centre Hospitalier du Nord
25. Chahine
26. Charity Islamic Hosp.
27. Chtoura Hosp.
28. Clemenceau Medical Center
29. Clinique du Levant
30. Cortbawi (des sœurs des Saints-Cœur)
31. Dahr El- Bacheck Governmental
32. Dar Al- Amal
33. Dar Al Hikmeh
34. Dar Al-Chifae
35. Dr. Bahmad & El-Fakih Hosp.
36. Dr. Mohamad Khaled Social Foundations
37. Dr. S. Serhal
38. El- Batoul Hosp.
39. El Bekaa Hosp.
40. El- Hayek
41. El Youssef Hosp.
42. Eye & Ear Hosp.
43. Ghandour
44. Gharious/ Mount Lebanon
45. Hammoud (Hosp Univ. Medical Center)
46. Haroun
47. Hôpital Haddad (des sœurs du Rosaire)
48. Hôpital Libanais- Jeitaoui
49. Hôpital Notre Dame de la Paix (des Sœurs Antonines)

50. Hôpital Psychiatrique de la Croix
51. Hôpital Saint Georges (Centre Hospitalier Universitaire
52. Hôpital St. Joseph
53. Hotel Dieu de France
54. Ibn Sina
55. Islamic Health Institute (Sohmor)
56. Jabal Amel Hosp.
57. Labib Medical Center
58. Lebanese Canadian Hosp.
59. Libano Francais
60. Medical 2000 (Kamal Jounblat)
61. Middle East Institute of Health
62. Monla Hosp.
63. Monzer El Haj
64. Najjar Hosp.
65. New Mazloum Hosp.
66. Nini Hosp.
67. Notre Dame de Maritime
68. Raee Hosp.
69. Ragheb Harb
70. Rayak Hosp.
71. Rizk Hosp.
72. Sacré-Cœur Hosp.
73. Sahel General Hosp.
74. Saint Charles Hosp.
75. Saint Georges- Ajaltoun
76. Saint Georges- Hadath
77. Sainte Thérèse Hosp.
78. Saydet Zgharta

79. Shahhar El-Gharbi Governmental
80. St. Louis Hosp.
81. Taanayel General Hospital
82. Tannourine Governmental
83. Tatari Hosp.
84. Tel Chiha Hosp.
85. Trad Hosp.
86. Tripoli Governmental
87. Universal
88. El Ouyoun
89. Ousayran

Single Reserve Accreditation with Six-month follow up report:

1. Baakleen Medical Center
2. Clinique Dr. Georges Moarbes
3. Irfan
4. Khoury General Hosp.
5. Marjeoun Governmental

Single Reserve Accreditation with annual follow up report:

1. Akkar- Rahal Hosp.
2. Al- Bissar
3. Al- Iklim Health Foundation
4. Al Iman Hosp.
5. Al Jabal
6. Al- Murtada Hosp.
7. Alaeddine Hosp.
8. Al-Janoub Shuayb

9. Beirut General Hospital
10. Dalla'a General Hosp.
11. Dar Al-Ajaza Al-Islamia
12. Doctors' Hospital- Al Manara
13. Dr. Abdallah El-Rassi Governmental
14. Dr. Hamed Farhat Hosp.
15. El Arz
16. El- Kheir
17. Hanan Charity Hosp.
18. Hiram
19. Kassab Hosp.
20. Kharroubi General Hospital
21. Lebanese Italian Hosp.
22. Nabatieh Governmental
23. Notre Dame du Liban
24. Osman
25. RHUH (Rafic Hariri)
26. Saida Governmental
27. Secours Populaire Libanais- Hôpital Nabatieh
28. Sibline Governmental
29. Syr El-Dennieh Governmental

Accreditation with major reserve and re-auditing after 6 months:

1. Hikmeh (nabatiyeh)
2. Jezzine Governmental
3. Karantina Governmental
4. Rachaya Governmental

Accreditation with major reserve and re-auditing after 1 year:

1. Ehden Governmental.

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