
Administration of Emergency Medicine

APPLICATION OF LEAN MANUFACTURING TECHNIQUES IN THE EMERGENCY DEPARTMENT

Eric W. Dickson, MD, MHCM,* Sabi Singh, MS, MA,† Dickson S. Cheung, MD, MBA, MPH-C,‡
Christopher C. Wyatt, MD, MBA,* and Andrew S. Nugent, MD*

*Department of Emergency Medicine, University of Iowa Roy J. and Lucille A. Carver College of Medicine, Iowa City, Iowa, †Office for Operations Improvement, University of Iowa Hospitals and Clinics, Iowa City, Iowa, and ‡Department of Emergency Medicine, Johns Hopkins Medicine, Baltimore, Maryland

Reprint Address: Eric W. Dickson, MD, MHCM, Department of Emergency Medicine, University of Iowa Health Care, C43-GH, 200 Hawkins Drive, Iowa City, IA 52242

□ **Abstract—Background:** “Lean” is a set of principles and techniques that drive organizations to continually add value to the product they deliver by enhancing process steps that are necessary, relevant, and valuable while eliminating those that fail to add value. Lean has been used in manufacturing for decades and has been associated with enhanced product quality and overall corporate success. **Objectives:** To evaluate whether the adoption of Lean principles by an Emergency Department (ED) improves the value of emergency care delivered. **Methods:** Beginning in December 2005, we implemented a variety of Lean techniques in an effort to enhance patient and staff satisfaction. The implementation followed a six-step process of Lean education, ED observation, patient flow analysis, process redesign, new process testing, and full implementation. Process redesign focused on generating improvement ideas from frontline workers across all departmental units. Value-based and operational outcome measures, including patient satisfaction, expense per patient, ED length of stay (LOS), and patient volume were compared for calendar year 2005 (pre-Lean) and periodically after 2006 (post-Lean). **Results:** Patient visits increased by 9.23% in 2006. Despite this increase, LOS decreased slightly and patient satisfaction increased significantly without raising the inflation adjusted cost per patient. **Conclusions:** Lean improved the value of the care we delivered to our patients. Generating and instituting ideas from our frontline providers have been the key to the success of our Lean program. Although Lean represents a fundamental change in the way we think of delivering care, the specific process changes we employed

tended to be simple, small procedure modifications specific to our unique people, process, and place. We, therefore, believe that institutions or departments aspiring to adopt Lean should focus on the core principles of Lean rather than on emulating specific process changes made at other institutions. © 2009 Elsevier Inc.

□ **Keywords—Lean; health care; process change; frontline providers; patient satisfaction**

INTRODUCTION

In November of 1999, the Institute of Medicine’s (IOM) landmark report *To Err Is Human* showed that 44,000–98,000 patients die in the United States each year from medical errors (1). In a follow-up report, the IOM called for a fundamental redesigning of America’s health care system with focus on safety and quality (2). These reports did not escape the public’s attention, and since their release there has been a palpable tension between health care systems and purchasers of their services. Patients, third party payors, and the government are now demanding health care delivery systems to be safe, efficient, and quality-driven.

Informed consumers have forced change in a variety of industries, for example, in automobile manufacturing.

Information about automobile safety and quality began to spread in the mid-1960s after the publication of Ralph Nader's book *Unsafe at Any Speed*, which prompted consumers to demand safer, higher quality cars (3). The constant pressure from informed consumers drove the automobile industry toward improving safety, quality, and the overall value of their products, and is now driving health care in the same direction (4).

As a first step, medical centers that recognize the patient-oriented focus in health care must embrace transparent external reporting of quality and safety information to all interested parties. Next, they need to develop, implement, and sustain process management systems that welcome innovative and creative solutions to the health care delivery processes. These new systems must improve patient and worker safety while enhancing the quality of care and keeping costs down. For a number of institutions this means a re-engineering of their current process management system. According to the IOM, "innovations in industrial engineering that have swept through other sectors of the economy, from banking to air travel to manufacturing, have failed to take hold in health care delivery" (5) (p. 3).

We believe that operations improvement techniques, such as Lean Manufacturing and Six Sigma, which are used in other industries, are well suited to assist health care organizations committed to meeting the challenge (6).

Yet, why have they failed to take hold in health care delivery? First, process improvement techniques are considered core competencies in manufacturing; however, few people in the health care industry are trained and experienced in process improvement methodologies.

Second, there is a lack of goal congruence between physicians and hospitals due to the separation between hospital and physician payment (7,8).

And finally, despite the advances made in patient-driven health care delivery, hospitals fear that shifting the focus to the patient experience will be perceived as shifting the focus away from the physicians and lead to a swing in admissions to "physician-centered" hospitals.

These factors are particularly strong in community practices of primary care and surgery. However, they tend to be less powerful in emergency medicine and academic medical centers where the physician practice plan and the hospital are often owned by the same parent company, making them particularly good candidates for the application of Lean.

THE LEAN PRINCIPLES

"Lean" is a term adopted from Japanese manufacturing defining a philosophy that abhors waste in any form and relentlessly strives to eliminate defects. Waste is defined

as any action that does not add value to the product; in health care this refers to the patient experience. Arguably, current health care processes are designed with a focus on the clinicians and how to make them more efficient and minimize their waste. This approach is contradictory to Lean: it is like designing a process with a focus on the factory workers rather than the product they make.

The Lean process evaluates operations step by step to identify waste and inefficiency and then creates new solutions to improve operations, increase efficiency, and reduce expenses. Lean Manufacturing Principles, also referred to as Toyota Production System (TPS), are ubiquitous in the manufacturing environment, especially in the automotive industry. Two basic Lean concepts are: the relentless elimination of waste through standardization of processes and the involvement of all employees in process improvement (9). Empowerment of workers by providing them with the necessary tools to effect changes in their area of work is the cornerstone of the TPS. The two priority duties of the employee's job then become: a) making the product; and b) finding ways to make the product better by improving **quality** and **flow**. Transferred to health care, this means that all clinicians have two jobs: to take care of the patients and to find better ways to take care of patients.

An extremely useful first step in starting Lean is the mapping out of the process using a process map (Figure 1), then assessing the amount of waste in the system using a Value Stream Map (VSM, Figure 2) (10). The VSM documents the time for each process step and quantifies the amount of value-added and no value-added (waste) time in each step. This snapshot of the process helps the improvement team to step back and determine which steps in a process add value to the patient's experience and which steps take up resources and time and incur cost without adding value. Next, the team determines if each step in the VSM is indeed necessary. The goal is to redesign the process with a new process map that either minimizes or completely eliminates the uncovered waste.

At the center of Lean is product flow. In a Lean assembly line, the product continuously flows with no backlogs, even at the expense of having some downtime for the individual worker. Although the latter may seem like waste, in reality any downtime that occurs as pieces move from station to station is made up for by the reduction of waste in work-in-process inventory and additional movement of partially completed cars that would otherwise stack up. Think of all the extra work that is required for the patients waiting in a bed for an ancillary service, test results, or movement to the floor for admission.

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