

The Current State of Lean Implementation in Health Care: Literature Review

Bozena Poksinska, PhD

Purpose: The purpose of this article is to discuss the current state of implementation of Lean production in health care. The study focuses on the definition of Lean in health care and implementation process, barriers, challenges, enablers, and outcomes of implementing Lean production methods in health care. **Design/Methodology/Approach:** A comprehensive search of the literature concerning the implementation of Lean production in health care was used to generate a synthesis of the literature around the chosen research questions.

Findings: Lean production in health care is mostly used as a process improvement approach and focuses on 3 main areas: (1) defining value from the patient point of view, (2) mapping value streams, and (3) eliminating waste in an attempt to create continuous flow. Value stream mapping is the most frequently applied Lean tool in health care. The usual implementation steps include conducting Lean training, initiating pilot projects, and implementing improvements using interdisciplinary teams. One of the barriers is lack of educators and consultants who have their roots in the health care sector and can provide support by sharing experience and giving examples from real-life applications of Lean in health care. The enablers of Lean in health care seem not to be different from the enablers of any other change initiative. The outcomes can be divided into 2 broad areas: the performance of the health care system and the development of employees and work environment.

Health care organizations are under strong pressure to improve. Society is aging and the demand for health care services is increasing, but financial conditions for health care systems are not improving or even worsening. In this millennium, health care systems are challenged to be as affordable, accessible, safe, thorough, efficient, and cost effective as possible. There is a need to look for new and more efficient ways of providing care. Many health care organizations adopt the Toyota Production System as the performance improvement approach, often called the *Lean health care management system*. The Lean approach seeks improvements within the framework of an organization's existing processes. Lean production does not focus on substantial reorganization requiring large-scale investments, but it gives health care organizations an alternative methodology for achieving improvements without high investments.¹

There are many views of what constitutes Lean thinking. It is undeniable that Lean has its roots in the Toyota Production System.^{2,3} The first descriptions of Toyota Production System appeared in the late 1970s,⁴ but the book *The Machine That Changed the World* by Womack et al⁵ first popularized the approach under the name "Lean production." Nowadays, Lean production is applied in various types of organizations all over the world. There has been considerable development of the concept over time and there is no consistent definition of the approach.^{6,7} Different authors have different opinions on which characteristics should be associated with the approach.⁶

Author Affiliation: Division of Quality Technology and Management, Linköping University, Linköping, Sweden.

Correspondence: Bozena Poksinska, PhD, Division of Quality Technology and Management, Linköping University, 58183 Linköping, Sweden (bozena.poksinska@liu.se).

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Womack and Jones⁸ were among the first authors to propose how Lean techniques could be applied to services and specifically to health care. They argued that the first step in implementing Lean thinking in health care is to put the patient in the foreground and include time and comfort as key performance measures of the system. The Lean principles as multiskilled teams taking care of the patient and an active involvement of the patient in the care process were emphasized. Since then, many applications of Lean in health care have been published in academic journals.^{9,10-17}

Young et al¹⁷ argue that an obvious application of Lean thinking in health care lies in eliminating waiting times, repeat visits, errors, and inappropriate procedures. Spear¹⁶ emphasizes empowerment of employees by providing them with the necessary tools to improve processes in their area of work. This means that all health care staff become focused not only on taking care of the patient but also on finding better ways to take care of patients. Lean enhances process steps that are valuable and essential for patient care, while eliminating those that fail to add value. As a result, staff members feel empowered to improve care processes and are more satisfied with their jobs.¹⁶

Based on the literature review, this article aims to present the current state of Lean implementation in health care. The study focuses on the definition of Lean in health care and implementation process, barriers, challenges, enablers, and outcomes of implementing Lean production methods in health care.

METHODOLOGY

The starting point for the analysis was an extensive search in several databases, for example, Emerald, PubMed, ScienceDirect, Wiley, and Interscience. Effort was made to review medical journals and the journals from several areas such as quality management, health care management, and operations management. The search criteria included key words such as “lean health care,” “lean hospital,” “Toyota Production System,” “lean management,” and “health care.” A systematic review of the references cited in

the articles found was also made. This broad search strategy was necessary because the articles on Lean health care have been published in a wide range of journals in many subject areas. An initial search for the key words mentioned earlier resulted in more than 200 hits. However, a careful analysis of the content limited the number of identified articles to around 60. The primary problem was that the mentioned key words were used in a wider context and did not contain enough in-depth information for the analysis. The second review of articles, based on specific areas of interest such as Lean health care characteristics, Lean implementation, barriers, challenges, enablers, and outcomes limited the number of articles included in this literature review to around 30 relevant works.

LITERATURE REVIEW

Overview of Lean health care characteristics

Table 1 presents the most frequently mentioned principles, methods, and tools in the reviewed articles on Lean health care. The analysis and the chosen characteristics were inspired by Pettersen.⁶ The table is organized on the basis of frequency of appearance. Characteristics discussed by less than 3 authors were excluded from the table. The other reviewed principles, tools, and methods may be found at the bottom of the table. In the left column of the table, under the reviewed characteristic, a number of articles are listed, which discussed the specific Lean principle, method, or tool in the context of health care.

The reviewed articles can be categorized into 2 sets: theoretical studies and case studies, as suggested by de Souza.¹⁸ The first set refers to articles that discuss the application of Lean in health care based on general examples and the knowledge and experience of the authors in health care settings. The second set of articles is based on case studies or other empirical evidence collected in research projects. Both types of articles were included in the analysis. The criteria for including the references in the table were that the Lean characteristic was either used by case organization or discussed in the context of health care. To be included, it was not enough that the Lean principle,

Table 1

OVERVIEW OF LEAN HEALTH CARE CHARACTERISTICS

Lean Characteristic	References
Process improvement (28 articles)	1, 9, 11, 13, 16, 21-23, 25, 26, 28, 29, 32-36, 38-40, 44, 46, 53-57
Continuous flow (23 articles)	1, 9, 11, 13, 21, 23, 25-27, 29, 32-36, 38, 39, 46, 47, 53, 54, 56, 57
Value stream mapping including more traditional process mapping (22 articles)	9, 11, 13, 21, 25-27, 32-36, 38, 40, 44, 46-48, 53-56
Waste elimination (22 articles)	1, 9, 11, 13, 16, 21, 22, 25-27, 34-36, 38, 39, 44, 46, 47, 54-57
Teamwork (22 articles)	1, 9, 11, 13, 16, 21-23, 25, 26, 28, 29, 32, 34-36, 38, 39, 41, 47, 48, 53
Lead time reduction (20 articles)	1, 11, 13, 16, 22, 23, 25, 27, 32-35, 39, 40, 53-57
Kaizen/continuous improvement (15 articles)	1, 13, 21, 23, 25, 26, 28, 29, 38, 39, 41, 44, 48, 56, 57
Education/cross training (15 articles)	1, 9, 11, 23, 25, 28, 33, 38-41, 44, 48, 55, 56
Value from patient's point of view (14 articles)	9, 13, 21, 22, 25-27, 33, 34, 36, 39, 44, 46, 47
Standardized work (14 articles)	9, 13, 22, 23, 25, 26, 28, 33, 38, 40, 44, 47, 54, 57
Patient pathway/journey/flow (10 articles)	9, 11, 22, 23, 32, 33, 36, 39, 40, 46
5S (10 articles)	9, 23, 33, 34, 38, 41, 44, 48, 54, 57
Pull system (7 articles)	9, 13, 33, 34, 38, 39, 46, 54
Root cause analysis (6 articles)	1, 11, 22, 27, 28, 33
Just in time (5 articles)	23, 32, 35, 38, 54
Visual management (5 articles)	9, 36, 38, 47, 54
Poka yoke, error proofing (3 articles)	13, 38, 54
One-piece flow (3 articles)	35, 56, 57
Other reviewed Lean principles and tools are policy deployment/hoshin kanri, layout adjustments, production leveling/heijunka, andon, takt production, total productive maintenance/preventive maintenance, autonomation/jidoka, and kanban (less than three hits).	

method, or tool was mentioned in the article text, for example, in the literature review.

The results of the analysis were the foundation for the discussion of different aspects of applying Lean in health care presented in the next sections.

WHAT IS LEAN HEALTH CARE?

There is little evidence of the complete Lean philosophy being applied in the health care system.^{19,20} When reviewing literature on Lean Health Care, one underlying theme becomes apparent: Lean is often perceived as a set of tools and techniques for improving processes (Table 1). The words “process,” “value stream,” and “continuous flow” appear in almost all articles that discuss the application of Lean in health

care. Lean health care is about simplifying processes by understanding what adds value and eliminating waste.^{9,11,21-25} It is often emphasized that current health care systems consist of fragmented processes that require a shift in how the flow of patient care delivery is perceived and organized.²⁶

The care processes in large health care organizations simply evolve over time and are seldom a result of conscious planning and action.^{9,26} The health care processes are organized with a focus on the doctors, nurses, and other clinical staff and are often not optimized for patients.^{1,25} The care is organized in departmental silos and often the only person who sees the whole of the patient journey is the patient himself or herself.^{1,9} In such systems, a patient can typically spend hours in hospitals for only some 10 minutes of value-added time. Applying Lean

thinking, specifically value stream and continuous flow, has the potential to help break down the silo mentality, enabling changes to occur across functional boundaries.¹ Much of the work that is performed within the health care setting does not directly add value from the patient's point of view.⁹ It is rarely clearly specified how processes should ideally work in health care operations. The consequence is inconsistency in care, unreliable access to resources and processes, and constant interruptions, which in turn implies inefficiencies, long waiting times, increased potential for errors, and worker frustration.¹¹

As stated before, Lean health care is mostly about how to manage and improve processes, but what does it actually mean in practice?

First, the health care units recognized the patient as the primary customer and as a critical factor to be taken into consideration when designing processes and delivering care.^{9,21,22,25-29} Many articles discussed the value from the patient's point of view (Table 1). To improve processes, it is necessary to have a clear view of the customer and what is value added as opposed to non-value added from the customers' point of view.

The second step is learning to see the processes as they are performed with all problems and shortcomings.⁹ It is necessary to categorize the huge variety of patients with different conditions into groups with similar needs and value streams and see the different patient flows through the health care system.³⁰ One of the frequently discussed and used principles in Lean health care is patient pathway/journey/flow. The patient flows through a series of different processes in the patient pathway/journey. The point is to follow the route through which a patient needs to travel from the demand for care to the completion of treatment as he or she experiences it. All the steps in a patient's pathway can be visualized with the help of value stream mapping (VSM). According to the analysis in Table 1, VSM is the most popular Lean tool applied in health care. With VSM, staff can quickly come to understand that all work is a process and all processes can be improved.⁹ The focus also lies on improving the whole process and not just optimizing individual parts.²⁶

Third, process improvement in health care implies specifying how work is expected to be conducted and removing waste in the form of waiting time, rework due to poor procedures, workarounds, interruptions, etc.²⁴ In this respect, the most commonly mentioned Lean principles and methods are standardized work, waste reduction, and continuous flow. As can be seen in Table 1, continuous flow is the second most frequently discussed principle in articles on Lean health care. Creating continuous flow is the goal of process improvement. The idea is that the patient should flow between health care units and staff groups without interruptions. Ideally, patients should move from one step in their care to the next without delay. To achieve continuous flow, staff need to gain an understanding about processes, identify waste and bottlenecks, and find out root causes of problems. This added perspective is valuable because studies show that when health care staff experiences an interruption, problem, or other distraction in routine, they work around the problem without bringing attention to it. They are focused on getting the job done but whatever caused their problem remains uninvestigated.³¹ Continuous flow also implies increasing cooperation and breaking down barriers between multiple operating units.²⁵ Optimizing the performance of an individual area is insufficient, and it is necessary to integrate the single processes owned by different health care units in one value flow to enhance the comprehensiveness and continuity of patient care.^{1,26,32}

All 3 steps require an interdisciplinary team approach, which is an explanation for the frequent occurrence of the Lean principle "teamwork" in the reviewed articles.

LEAN HEALTH CARE AND FIVE LEAN PRINCIPLES

Womack and Jones⁸ defined a 5-step process for guiding the implementation of Lean techniques:

1. Specify value from the standpoint of the end customer
2. Map the value stream
3. Create flow

4. Establish pull
5. Seek perfection

There are relatively few articles referring explicitly to the 5 principles, but one may notice that the 3 steps emerging in the Lean Health Care articles have a good coverage with the 3 steps as defined by Womack and Jones.⁸ This coverage is, however, difficult to see with step 4 “establish pull” and step 5 “seek perfection.” Only 7 articles discussed the application of the pull system in health care. The discussions were short and undeveloped and the examples rather poor. In fact, only 2 case-based examples of the application of the pull principle in health care setting were found.^{33,34}

The fifth principle (“seek perfection”) is about striving for perfection through continuous improvement. An organization should constantly evaluate itself, learn from its mistakes, and continuously improve the value stream.⁸ Although at first sight it looks like “continuous improvement” (Table 1) is not poorly represented in Lean health care articles, the situation is far from what can be characterized as “seeking perfection.” Continuous improvement is a broad concept that refers to a wide range of activities. An example of an activity identified as “continuous improvement” but not what Womack and Jones⁸ exactly mean by “seek perfection” is *kaizen blitz* (sometimes referred to as *rapid improvement events*). Kaizen blitz is a focused, intense, short-term project to improve a process.^{1,25,35,36} “Seeking perfection” is more about developing a continuous improvement culture, where employees are continuously focused on the goal of eliminating waste and encouraged to develop ideas to improve their work, and where improvement activities become a part of the everyday work.^{8,25} Spear¹⁶ argues that Lean health care is about turning employees into problem solvers by teaching them to stop going around problems and instead fix them right away.

The fact that the steps “establish pull” and “seek perfection” are not well represented in the Lean health care articles may indicate that health care organizations implementing Lean have not achieved this level of maturity. Several authors are concerned about one-sided focus on “process improvement” in Lean health care applications.^{23,25} They state that “*Lean*

implementers sometimes lose their perspective on the fact that for any process to perform better the people who compose the process need to be better at what they do.” An important element of Lean is developing people and creating continuous improvement culture rather than applying Lean tools to every process.²³ The application of tools provides good results, but these improvements are rarely sustained. The real challenge is to go beyond the simple application of Lean tools and to develop a Lean culture of continuous questioning and improvement.²⁶ Several authors argue that the success of Lean implementation lies in the understanding that Lean is a system, not simply a toolbox.^{13,23,37} The application of Lean tools is also important, however, because the tools embody the Lean principles and support the development of the Lean culture.¹¹

HOW IS LEAN IMPLEMENTED IN HEALTH CARE?

The literature was reviewed in search of implementation patterns for Lean health care. The following key steps were identified^{1,9,11,22,24,25,29,35,38-43}:

- Conducting Lean training
- Initiating pilot projects
- Implementing the changes

The first step usually included training days in which the basic Lean principles, methods, and tools were introduced. The basic idea was to facilitate widespread use of Lean tools and create a base for initial practical work. The target groups for training differed between cases. The training was intended either for all staff members or only for leaders or Lean facilitators who would be responsible for the Lean initiative in an organization. In the second case, leaders or Lean facilitators then received the responsibility to train a group of their peers. This approach assumes that those trained in Lean will train others and that learning will gradually disseminate across the organization.^{11,22} Several authors stressed the importance of training their own Lean facilitators recruited from the health care organizations instead of employing external consultants.^{23,39,44} People’s knowledge,

creativity, and commitment seem to be important for building a sustainable Lean organization. Lean implementation should not rely on consultants who tell how it should be done; instead, employees should be trained in all Lean aspects to initiate and drive the improvement work.

The second step included testing ideas and initiating some pilot projects using Lean tools and methods. The pilot projects were sometimes part of the education program or were initiated in direct connection to training days. The idea was to let people try the ideas in organizations and create some quick results. The pilot projects usually included VSM. The health care staff was organized in cross-functional teams and performed analysis of patient flow, assessed the time required to perform process steps, and identified value-added versus non-value-added activities.^{22,25,26,36,41} The overall objectives included reduction of lead time and elimination of waste in processes. The primary focus of pilot projects was to engage frontline staff in identifying problems and to involve them in the improvement work. The outcome of this step was an action plan for change.

The third step is about driving the change processes with the full involvement of the employees. There are only a very limited number of cases, however, describing the practices.^{24,25,35} This step is a problem-solving process and may include the use of different Lean tools and techniques. A team of 5 to 10 members, often including all professions and different organizational levels, analyzes causes of a problem, generates and selects some solutions, plans for actions, and evaluates results. This problem-solving process is referred to in some cases as *rapid improvement event*,³⁶ *kaizen event*,²⁵ or *rapid process improvement workshop*.³⁵

There is no single correct way of implementing Lean in health care. The articles showed that different health care units require different approaches. Several authors stressed that Lean is not a one-time change of work processes, but a new way of thinking and working. There is little chance to succeed if Lean is implemented top down as a fully defined and complete concept for reducing costs and improving performance. It is difficult to take ideas from one culture and apply them in another, especially if these

ideas involve people, behaviors, practices, and ways of thinking. An appropriate implementation strategy is an adaptation-oriented approach with focus on finding ways that are consistent with the specific conditions and suit a health care culture.³⁰ Health care units implementing Lean need to make a critical review of how the principles, methods, and tools can be used in their own organization and adapt the concept to fit their context. The active choices concerning values, methods, and tools can improve the chances of achieving long-term sustainable improvements.^{9,25,30}

BARRIERS AND CHALLENGES TO LEAN IMPLEMENTATION

The first barrier that needs to be overcome in Lean implementation is to convince staff that Lean can work in a health care setting.^{9,26,27,39,43} When talking about Lean in health care, the usual reaction is that patients are not cars and health care organizations have completely different organizational settings than the automotive industry. However, when training is provided, the staff gradually understands that there is a great amount of waste in the processes and applying Lean principles could provide great benefits.³⁰

The training itself is a challenge, however. There are few people in health care who have a well-founded knowledge of and experience in principles, methods, and tools of Lean production. There is a lack of qualified people inside health care to teach about Lean.^{25,29} Educators need to be hired from the manufacturing sector, but they often talk manufacturing language and lack relevant examples from the health care sector.⁴⁵ This makes it more difficult for health care staff to accept the ideas and requires longer assimilation periods.^{24,36}

Another problem is lack of clear focus on the customer. One of the basic Lean principles is to understand value as defined by the customer. The term *customer* in health care is not straightforward, however. The primary customer in health care is the patient, but the patient is not a customer from the market economy perspective. The patient usually does not pay directly for the service. Other customers, such as

family members, caregivers, decision makers, local communities, and taxpayers, also need to be considered. To understand what is value added, there needs to be a clear view of the customer without confusion of conflicting requirements and priorities from different stakeholders. The ambiguous notion of the patient as customer and the dynamics between the different stakeholders are seen as a barrier in the process of Lean implementation.^{21,46,47}

Another factor perceived as inhibiting Lean implementation was the organizational structure of health care. Professional knowledge is organizational power. The health care structure is still very hierarchical, with physicians as the dominant decision makers. Physicians are highly trained individuals and they have been trained to act with autonomy. Lean culture requires teamwork, collaboration, and good communication skills that traditionally have not been emphasized in physicians' professional training.^{23,27}

Several authors reported difficulties related to cooperation with other departments.^{36,41,48} Health care is a complex system with many interdependent units. One of the challenges is to improve the entire system, not just optimize the performance of individual departments. Improving value streams may require involvement of several health care units, which are not always ready to recognize, understand, and *acknowledge changes* or simply lack the necessary prerequisites to perform the change. The risk is also that an improvement activity may fix some problems at one unit, but cause other problems at another unit. It is therefore important to take the holistic approach and consider the impact of the actions on other units, and not just shift the problems to other areas.²³

CHANGE ENABLERS

The enablers for Lean health care discussed in the literature seem not to be different from enablers of any other change initiative. Three key factors that contribute to the success of Lean implementation in health care are recurring in several articles.

The first is commitment and participation of health care staff in the improvement processes. Employ-

ees are considered experts at performing their work and their full involvement enables their professional knowledge, skill, and experience to be used for the organization's improvement.^{11,39} Empowered staff are more eager to realize their ideas as opposed to a reluctant staff feeling forced to carry out top-down process improvements.^{25,44} It is therefore crucial that health care staff own and drive the improvement work.^{1,21,28,47}

The second is to focus on developing people before developing organization. It is essential to provide training and give responsibility to employees, so that they will be able to take initiative to make improvements on their own.^{23,24,39,49} Developing is not only about teaching Lean tools and methods but also about learning a new approach to thinking where employees feel that they can make use of their skills and creativity, take initiatives, and cause things to happen.^{28,44,45,49}

The third is support from managers at all levels. For top-level managers, it is vital to show a genuine interest in the Lean implementation work, pay attention to the results that are being delivered, and provide necessary resources.^{1,9,39,41} Nelson-Peterson and Leppa³⁵ mention daily presence of top management on the unit as a necessary condition for success of Lean implementation. Managers at lower levels who lead health care units implementing Lean need to take ownership of the change and actively support their employees in the improvement process.^{1,11,41,42} Dickson et al²⁵ tell about management taking a subordinate role in the improvement process, where empowered staff identified problems and implemented their own solutions.

WHAT ARE THE OUTCOMES FROM LEAN HEALTH CARE?

There is a lack of rigorous research on the outcomes from Lean health care. Several studies report results from the Lean initiatives, but methodologically these studies are not comparative and include mostly self-reporting results.⁵⁰

The outcomes from the Lean initiatives can be divided into 2 broad areas: one area relates to the performance of the health care system, while the other

Table 2

OUTCOMES FROM LEAN HEALTH CARE RELATED TO PERFORMANCE OF HEALTH CARE SYSTEMS

Performance Measure	References
Decreased overall time that patients spent on care	1, 22, 26, 27, 29, 39-41
Increased number of patients who can be handled (patient throughput)	1, 22, 25, 29, 39
Reduced number of errors and incidents	11, 23, 24, 29, 39, 41, 44
Reduced waiting times	27, 39, 40, 44
Increased patient satisfaction	11, 25, 35, 41, 44
Increased employee satisfaction	11, 29, 35, 41, 44
Reduction of overtime hours	11, 29
Decreased inventory costs	29, 39
Reduction in travel time/walking distance for patient and staff	1, 29, 41

relates to the development of employees and work environment. These areas are consistent with the categories discussed by Porras and Robertson⁵¹ in their organizational development model.

The outcomes reported on the performance of health care system are measurable and often stated in numbers or given as improvement rates. A summary of improvements on performance measures discussed in the health care literature is presented in Table 2.

The results in the Table 2 mostly relate to the improvement of patient outcomes. Better outcomes for patients usually imply more accessible care with shortened treatment time and reduced waiting. As can also be seen in the Table 1, lead time reduction was a frequently discussed goal with Lean implementation and was found in 20 reviewed articles.

The second set of outcomes has a mostly qualitative character and concerns the influence of Lean implementation on employees and work environment. One of the most frequently mentioned outcomes in this set is increased attention of employees to *waste* and their more proactive attitude to *problem solving*. Staff

stop assuming that waste is part of their work and do not accept workarounds and firefighting anymore, but instead take initiative to resolve problems.^{11,38,44} Lean health care offers employees more responsibility, greater involvement, and a sense of ownership in their work.^{35,39}

Another outcome is a much calmer and more organized work environment.^{23,25,27,40} Lean focuses on eliminating non-value-adding activities and removing wasted time from processes. The work becomes more orderly and predictable and thereby less stressful. As a result, health care staff are more focused on their assignments and, consequently, far more receptive to patient demands.²³

CONCLUSIONS

This study showed that Lean is mostly used in health care as a process improvement approach. Value stream mapping is the most frequently applied Lean tool in health care. The process orientation is crucial, but still weak in health care organizations.⁵² However, many current problems of health care can be solved by applying process improvement approaches. Using VSM, all steps in the patient journeys are analyzed as a whole from start to end: from diagnosis, through treatment, to discharge. This allows for reducing waiting times and duplicate work and ensuring that the interrelated steps connect. Many health care units work in silos and are not aware of the effects of their efforts outside their own departments. Problems and difficulties frequently appear in the crossings between different units.

Lean health care applied as a process improvement approach focuses on 3 main areas: (1) defining value from the patient point of view, (2) mapping value streams, and (3) eliminating waste with the effort to create continuous flow. Although the 5 Lean principles as defined by Womack and Jones⁸ are not widely discussed in Lean health care literature, an analogy can be seen between how Lean is currently applied in health care and the 5 Lean principles. Health care organizations seem to pursue only the first 3 steps. The steps “establish pull” and “seek perfection” are poorly discussed in the Lean health care

literature, and there is little evidence of their application. This fact may indicate that health care organizations implementing Lean have not achieved this level of maturity or have problems moving beyond a simple application of Lean tools. Several authors state that Lean is more than just tools and that to achieve long-term sustainable results it is necessary to change the organizational culture.^{23,37} The question of “How to ensure that Lean becomes more than another set of tools but becomes a sustainable way of working” is crucial, but could not be answered by reviewing the current literature on Lean health care.

There is no single correct way of implementing Lean in health care. The evidence indicates that the approach has been adapted rather than simply adopted. However, in respect to the differences between health care and the manufacturing sector, Lean cannot simply be copied into health care settings. Lean implementation in health care requires adaptation and development of the approach to fit the specific context and allows health care staff to own the approach. The usual implementation steps include conducting Lean training, initiating pilot projects, and implementing improvements using interdisciplinary teams.

There are some challenges that face the implementation of Lean in the health care:

- Health care staff do not like care services being compared to car assembly lines. They believe that their organizational settings and problems are unique and cannot be simply solved by methods coming from the manufacturing industry. It takes time before staff understand how Lean works, and begin to realize the potential benefits.
- There is a lack of educators and consultants who have their roots in the health care sector and can provide support by sharing experience and giving examples from *real*-life applications of Lean in health care. Educators and consultants are usually hired from the manufacturing sector, which makes it more difficult for health care staff to accept Lean.
- The key principle in Lean production is to understand value as seen by the customer. The

term *customer* in health care is not straightforward, however. Health care organizations may have multiple customers including patients, family members, caregivers, decision makers, local communities, and taxpayers.

- The health care structure is hierarchical with physicians being in the one profession that possesses the highest rank and the most power within the organization. Lean, however, requires teamwork that builds on collaboration and open communication.
- Health care is a complex system with many interdependent units. The challenge is to improve the entire value stream, not just optimize the performance of individual departments.

The change enablers for Lean health care do not seem to be different from enablers of any other change initiative. A successful Lean transformation in health care relies on the involvement of all professional groups. Staff need to be trained to understand Lean principles and techniques and take an active role in the implementation work. Managers need to motivate and engage employees and provide necessary support and resources.

The literature review shows that there have been some significant tangible and intangible outcomes in organizations that have adopted Lean principles. The outcomes can be divided into 2 broad areas: one area relates to the performance of the health care system, while the second relates to the development of employees and work environment. The first area includes results such as increased patient throughput and reduced waiting times. The second area is related to the change of employees' role from a passive to an active role in improving and developing health care processes and organization. The second area also includes improvements in work environment such as more predictable and calmer working days.

It is crucial that the knowledge about how Lean can be applied in health care settings be shared and that organizations learn from others' mistakes and successes. Lean health care is a widely debated subject; however, the available articles in the area present only a limited view of the potential advantages and disadvantages of Lean in health care. In fact, no

articles were found criticizing the application of Lean in health care. Many articles found in the area have a speculative character and are not based on empirical evidence. More rigorous and holistic research is required to evaluate the real impact and to understand more about underlying factors influencing the success and sustainability of Lean in health care.

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