

Research paper

Improving the quality of Emergency Department care by removing waste using Lean Value Stream mapping

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ABSTRACT

Lean Thinking was originally developed by Toyota in the 1950s as an improvement approach to reducing non-value-adding activity and improving flow within a system. Its use in healthcare is becoming increasingly common although there is little published information on its formal application to Emergency Departments in the UK. With increasing financial pressures, high service demand and target pressures, Lean offers a potential approach to maintaining a high-quality efficient clinical service for patients and staff. Using Value Stream mapping, a tool originally developed for manufacturing, we identified over 300 instances of waste and potential

improvements in processes within the major area of our department. This work allowed us to reduce the time to initial assessment and has highlighted a number of projects that are now being taken forward with directorate backing. With the support of healthcare leaders and managers who embrace the Lean philosophy, Lean Thinking offers huge potential for identifying waste and Value Streams leading to improvements in quality of care in the emergency department.

Keywords: Emergency Department, Lean Thinking, process mapping, Value Stream, waste

Introduction

With the NHS facing the prospect of having to operate within a constrained financial environment, it is essential to provide efficient high-quality care with minimal waste. Clearly, a favourable option is to reduce the time spent by staff engaged in inefficient processes by removing, where possible, steps that are non-value adding. These principles are encompassed within the 'NHS quality, innovation, productivity and prevention challenge' agenda launched by the Department of Health (2010) and expounded by the NHS Institute for Innovation and Improvement (2010) in their 'Productive

Ward' work, which concentrates on 'Releasing time to care'. At University Hospitals of Leicester NHS Trust, Lean techniques were felt to offer an opportunity to create a more productive Emergency Department.

This article describes how Value Stream mapping can be used in the initial stages of a Lean implementation project to identify waste in processes and generate ideas for improvements. We also explore the approach healthcare leaders and managers can take to facilitate the introduction of Lean Thinking principles in an Emergency Department based on our experience.

Background

Lean Thinking is a philosophy, management culture and set of tools for process improvement that focuses on reducing waste and improving flow within a system. It was initially developed by Taiichi Ohno at Toyota in Japan in the 1950s as the Toyota Production System and aims to reduce muda (non-value-adding work), muri (overburden) and mura (unevenness of flow).

In their work on Lean Thinking, Womack and Jones (2003) have identified the five key features of Lean as: understanding value, developing the Value Stream, improving flow, encouraging pull and pursuing perfection. Another important principle underlying Lean Thinking is that it is the customer, not the producer, who ultimately defines what is of value to them. Value is a complex interaction of experience, clinical quality and safety.

In his initial work, Ohno described seven basic wastes for manufacturing. Health examples have been described by Westwood *et al* (2006), and Bicheno (2008) subsequently described wastes for service industries.

Box 1 The seven 'WORMPIT' Lean wastes:

- W Waiting
- O Overproduction
- R Rework/defects
- M Motion
- P (Over) Processing
- I Inventory
- T Transportation

in the past, Lean Thinking has only been more formally introduced into healthcare systems within the last few years.

Although the similarities between healthcare and industry may not be immediately apparent, both involve multiple departments, long sequential complex processes with varying cycle times, queuing and the sharing of resources to produce an end product. Both sectors also typically have nine times more non-value-adding activity than work that actually meets the needs of the customer (Jones and Mitchell, 2006). It has therefore been estimated that 80% of Lean tools and mechanisms can be applied to healthcare (Ward, 2006).

When thinking about Value Streams, several authors in Lean Thinking have used the analogy of a motorway with slow-moving lorries travelling in both lanes reducing the overall flow of vehicles along the road (Figure 1) (Jones and Mitchell, 2006; Westwood and Silvester, 2007) and the benefits of active traffic management – a form of traffic streaming (Highways Agency, n.d.).

The same principle can be seen in the Emergency Department, where patients with similar Value Streams (or process steps with varying cycle times) are separated into minors, majors and resuscitation areas. A stream will contain groups of patients who have similar processes (e.g. simple assessment or routine investigations or complex evaluations). This differs from separating patients by clinical presentation, e.g. chest pain, as clinical groups can have different process steps and cycle times for different patients. Maintaining separate Value Streams has been shown to improve flow through the Emergency Department and reduce waiting times and overcrowding (Cooke *et al*, 2002; King *et al*, 2006).

The Lean approach in healthcare

Lean Thinking has been used in the commercial sector since its inception at Toyota in the 1950s. Since this time, a number of manufacturing, service and retail industries have incorporated Lean Thinking into their work. Although elements have been seen in healthcare

Value Stream mapping in the Emergency Department

In autumn 2009, Leicester's Emergency Department secured the support of external Lean specialists in starting our journey into Lean Thinking. A Lean project

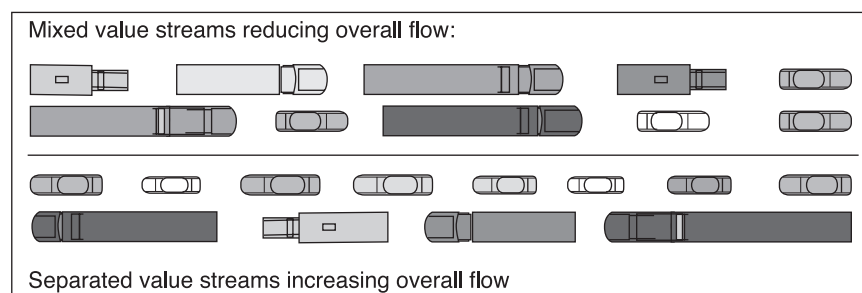


Figure 1 Value Streams on a motorway

team was established within the department comprising nursing, medical, managerial and academic staff. The project started with training in Lean principles, common improvement tools, such as Value Stream mapping (also known as process mapping), and types of waste for project team members. Elements of this training were then cascaded to other members of staff within the department.

Over the course of a week, members of the Lean team were assisted to build up a high-level Value Stream map (VSM) of the steps associated with a patient passing through the majors area of the department. The map was created by direct observation and timing of patient journeys through the department and supplemented by staff participation. Each step, movement,

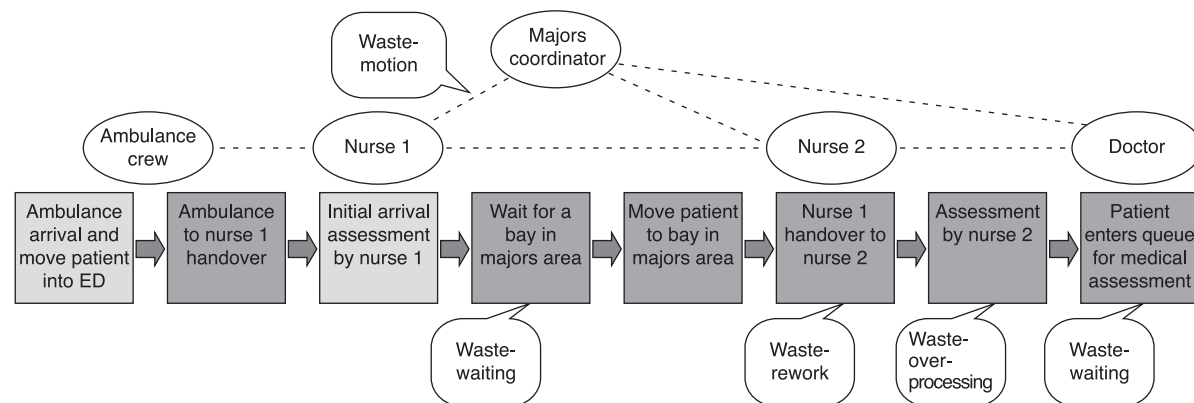
intervention, investigation, piece of documentation produced and staff contact was recorded and displayed visually on a map using Post-it® notes, with arrows to demonstrate push-and-pull forces and string to demonstrate communication lines. More detailed, low-level process maps were also created for nursing assessment, medical assessment, radiology processes and clerical support work, e.g. ward clerk. These VSMs were supplemented with observations of the Lean 'WORMPIT' wastes encountered and suggestions for possible improvements placed at the appropriate place along the VSM (Box 2).

Figure 2 illustrates a simple VSM that was created as a pilot in our Emergency Department prior to mapping the entire majors area.

Box 2 Examples of Lean wastes identified

W	Waiting	Patients waiting for assessment. Staff waiting for results.
O	Overproduction	Recording the same information multiple times.
R	Rework	Reassessment of patients by several members of staff.
M	Motion	Staff walking to reception and back to use the photocopier.
P	(Over) Processing	Staff ordering unnecessary investigations.
I	Inventory	Stock being unavailable when required or out of usable date.
T	Transportation	Untangling ECG cables.
		Patients going to CT scan which is distant to the Emergency Department.

Original majors arrival process:



Modified majors arrival process:

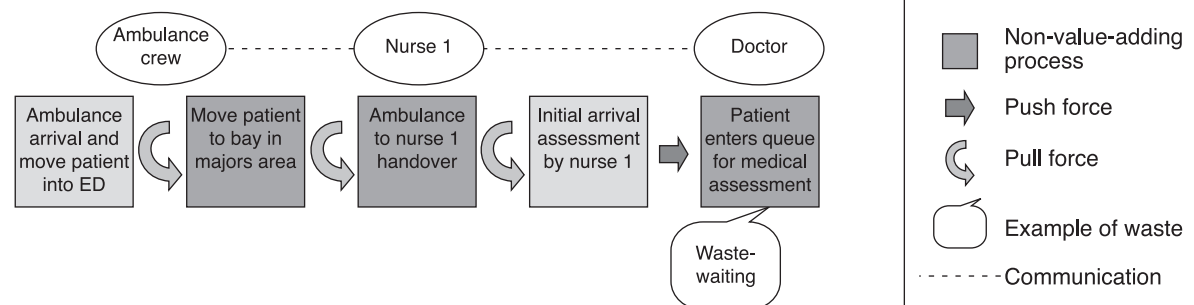


Figure 2 An example Value Streams map – Majors arrival process

Outcome

During a week-long period of Value Stream mapping at Leicester's Emergency Department, over 300 observations of waste and suggestions for improvements were identified, with all staff groups contributing, including porters, security, clerical and managerial, medical and nursing staff of all grades. All staff on duty during the week were able to contribute to the development of the map (Figure 3).

At the end of the Value Stream mapping week, a list of potential projects was identified and divided into quick easy wins, medium-term projects and more long-term issues. It was also acknowledged that not all of the non-value-adding wastes identified could be eliminated from the overall majors process.

The high-level majors area VSM document was presented to the senior medical directorate management team to get 'buy-in' to the project and facilitate cross-directorate working within the trust. In addition, it was important to obtain agreement for potential short-term reductions in performance while projects were initiated to create long-term improvements.

An early example of the results of introducing Lean Thinking at Leicester has come from modifying our majors arrival process (illustrated in Figure 2). A retrospective audit, comparing 100 randomly selected

patient notes from one week before and one week four months after this modification, demonstrated a mean reduction of 20 minutes from Emergency Department arrival to initial nurse assessment.

Discussion

The majors Value Stream mapping exercise was a simple but effective way of demonstrating different Value Streams and identifying waste within emergency department processes. Although this tool was originally developed in an industrial setting, we found that its use in healthcare did not require any major adjustments.

We found that developing the VSM was not difficult, but did require us to step back from the clinical situation and make notes about what we saw. The high level of staff acceptance of our presence and involvement in helping us develop the map was not only pleasing, but was also felt to be crucial to our success in identifying so much process waste.

Involving healthcare leaders and managers when initiating a Lean project such as ours is critical to its success. Initially, staff need to feel both reassured about the project's motives and empowered to openly



Figure 3 Finished high-level majors VSM (value stream map)

challenge the status quo and make suggestions for improvement. In our department, we did this by educating staff during handover meetings and by the project team explaining their work during the mapping exercise.

Leaders also need to facilitate staff to step back from the clinical coalface and learn about Lean Thinking so that they can make observations about their working environment. Projects developed as a result of the Value Stream mapping exercise will need to be supported and facilitated by healthcare leaders, particularly across departments and directorates, where they have a potential impact on performance. Negotiating approval for short-term potential dips in performance in order to achieve long-term efficiency improvements was a key Emergency Department requirement, particularly given the pressure to deliver against targets.

A specific focus for those healthcare leaders and managers working at directorate and trust level should be to introduce pull systems upstream from the Emergency Department. Flinders Medical Centre in Australia developed specialty-based pull systems from their Emergency Department and dismantled their 'take' system, which they found led to inpatient team workload variability. These interventions reduced patient outlying and length of stay, in addition to improving patient flow within their Emergency Department (Ben-Tovim *et al*, 2008).

Finally, healthcare leaders should focus on developing a Lean Thinking philosophy within their organisations. Embracing Lean as a philosophy, empowering staff, delegating decision making, communicating a clear vision, employing multiple Lean tools, viewing Lean as a long-term journey (rather than a short-term initiative) and looking for continuous improvement would overcome many of the reasons for failure identified in the literature (Bhasin and Burcher, 2006; Randor *et al*, 2006).

Further plans

Aside from the other benefits of Lean Thinking mentioned above, the Value Stream mapping exercise has generated a number of project ideas which the department can now take forward. Staff involvement in the mapping work and waste reduction has generated enthusiasm for change and identified people to take projects forward. The Value Stream mapping work is only the start of a continuous drive to make the emergency department more Lean, and significant improvements are expected over the coming months and years.

Summary

Value Stream mapping is a simple and effective way of starting to apply Lean Thinking, which can help identify clinical Value Streams and waste in processes within the Emergency Department. Clinicians wishing to use this Lean tool in healthcare must learn to think in terms of process groups, and differentiate these from clinical groups to maximise the benefit from Value Stream mapping.

The role of healthcare leaders in Lean Thinking is largely one of support to staff within departments and bridging silos within the complex healthcare system of the NHS. Importantly, healthcare leaders should focus on developing and sustaining a Lean philosophy and avoid using Lean as an initiative for short-term 'fire-fighting', particularly in times of economic constraint.

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CONFLICTS OF INTEREST

The authors declare that they have no conflict of interests in relation to this article. Ethics committee

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