

Lean Process Mapping Techniques: Improving the Care Process for Patients with Oesophageal Cancer

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Abstract

This paper tests the hypothesis that the value-stream mapping (VSM) method, based on Lean thinking, could help streamline the care process for patients with oesophageal cancer. Design. Case study. Setting and participants: One of the largest tertiary referral centres for oesophageal cancer in The Netherlands. Interventions: We applied and evaluated the principles and tools of Lean thinking, especially VSM processes, to improve the process of delivering care to patients referred for oesophageal cancer. Results: Evaluation at the start of the project revealed that the care pathway was unsystematic and might introduce medical errors. Application of VSM principles in the Lean context improved the process by cutting the number of individual steps needed to begin treatment from 128 to 103 and minimized variability by applying standardization. The implementation of Lean techniques improved the delivery of clinical care to our patients with oesophageal cancer by reducing the time it took to start treatment by 3.5 weeks.

Index terms— Lean, oesophageal cancer, value-stream mapping, process improvement.

1 Introduction

Although the Netherlands has an excellent healthcare system, Dutch hospitals still struggle to provide fully optimal patient care. 1,2 This may be due to a combination of factors, such as increasing care intensity, difficulties with filling medical vacancies and the resulting heavy workloads for medical staff. 3 As these factors may underlie suboptimal delivery of patient care, hospitals face the challenge of improving these processes at an organizational level.

Studies have shown that processes and quality in health-care can be improved by applying Lean methods. 4, 5, 6, 7, 8 -improvement philosophy that aims to create more value with fewer resources. It seeks to identify and eliminate waste by using tools such as the value-stream map (VSM). 9 Creating a VSM can support in discovering and eliminating wastes, inefficiencies and errors that otherwise prevent the smooth flow of products or information through a system (the value stream). Practically this involves charting stakeholders, resources, activities and processes to allow the systematic identification, and elimination, of steps in a process that don't add value (non-value-adding activities, NVAs). In due course, the value stream consists of a refined series of value-adding steps that, depending on the context, delivers a valuable product or service to the customer, 10 or, in the case of health care, the patient. The Japanese Toyota Motor Corporation was the first organization to use VSM techniques and to implement Lean concepts and tools. 11 Since then, Lean methods such as VSM have spread from the manufacturing industry to service industries such as banking, insurance and hotel management, and they are increasingly being applied in health-care settings. 12,13,14,15 This increasing use of Lean tools in medical settings implies that Lean now forms an integral part of the quality management system in many Dutch hospitals. However, the Lean concept and its application in medicine are still poorly understood and literature on the subject is scarce. 16 Moreover, some researchers argue that there are significant gaps in the literature on health-care quality improvement with Lean, and that there is only scant evidence to show that Lean tools

44 actually and validly improve health-care quality. 17,18 To further investigate the benefits of Lean the Oncology
45 Surgery Department at VU University Medical Center Amsterdam (VUmc) decided to introduce the process-
46 improvement ideas of Lean thinking in an effort to improve the care process for oesophageal cancer patients. It is
47 well known that the majority of patients with oesophageal cancer are not diagnosed until a relatively A Design.
48 Case study. Setting and participants. One of the largest tertiary referral centres for oesophageal cancer in The
49 Netherlands.

50 Interventions. We applied and evaluated the principles and tools of Lean thinking, especially VSM processes,
51 to improve the process of delivering care to patients referred for oesophageal cancer.

52 Results. Evaluation at the start of the project revealed that the care pathway was unsystematic and might
53 introduce medical errors. Application of VSM principles in the Lean context improved the process by cutting
54 the number of individual steps needed to begin treatment from 128 to 103 and minimized variability by applying
55 standardization. The implementation of Lean techniques improved the delivery of clinical care to our patients
56 with oesophageal cancer by reducing the time it took to start treatment by 3.5 weeks.

57 Conclusions. Our results suggest that the VSM method, based on Lean thinking, can help to better arrange the
58 care processes for these patients. We believe that these principles can be applied to much of the care administered
59 in this setting and to other areas of health-care delivery.

60 department was no exception. There is ample evidence advanced stage, 19 and an internal audit showed that
61 our diagnosis and treatment for patients with oesophageal cancer.

62 The aim of this study was to investigate whether the use of Lean techniques, in particular VSM, can improve
63 the care process for oesophageal cancer patients by shortening the time between diagnosis and start of treatment.

64 **2 II.**

65 **3 Methods**

66 **4 a) Setting**

67 VUmc Amsterdam, the Netherlands, is a tertiary referral centre for patients with oesophageal cancer. After
68 the diagnosis of oesophageal cancer in a referring hospital, almost 95% of patients (approximately 120 patients
69 per year) in The Netherlands are referred to the VUmc outpatient clinic for surgical assessment and surgery.
70 VUmc has two departments with 30 beds each for oncology and gastroenteral surgery patients and, due to cuts
71 in government spending, VUmc is expected to need to double the number of treatments for oesophageal cancer
72 in the future.

73 VUmc introduced a Lean management qualityimprovement project in February 2012, one component of which
74 was to specifically use VSM to improve the efficiency of the oesophageal cancer care pathway. As already
75 discussed, VSM has proven worthwhile in other hospital processes by creating capacities that can be used
76 to optimize patient monitoring and improve patient safety and quality. By helping to redefine processes and
77 eliminating NVA activities, our target was to reduce throughput time, which was also expected to increase levels
78 of patient satisfaction.

79 **5 b) Team formation**

80 Out of the participating departments involved in care for patients with oesophageal cancer -surgery, oncology,
81 radiology, thoracic surgery, anaesthesiology, polyclinic and OR scheduling -a VSM review team was constructed,
82 based on specialization and department, that consisted of 12 members. The team was headed by an executive
83 member of the hospital leadership board, two value-stream experts (for training and coaching) and a care
84 professional with the authority and responsibility to allocate the organization's resources (who could make
85 decisions, arbitrate solutions, plan the project and select the processes that would be mapped; this person had
86 a firm grasp of what achievement was being targeted). The team also was complemented by two professionals
87 from the oncology surgery and radiology departments, two facilitators and one coordinator. Finally, there were
88 also representatives from the workforce 'on the floor'(medical staff, nurses, secretaries and radiotherapists). c)
89 Rationale for choosing the oesophageal care pathway

90 The VSM system was applied to the care program for patients with oesophageal cancer based on the following
91 anticipated advantages: the treatment planning and delivery procedures have a standard that is well accepted
92 by the department faculty and staff; the input information necessary to initiate therapy is not always available;
93 and departmental leadership made the choice for this patient group. The treatment of patients with oesophageal
94 cancer is highly demanding for both patients and hospital staff and therefore any unnecessary burden needs to
95 be eliminated. The treatment planning and delivery procedures are complex and involve many care professionals
96 from different disciplines. Furthermore, cancelling surgical procedures has consequences for organization and OR
97 capacity.

98 **6 d) The present state**

99 Once the team was formed, the team had to "go and see" (genchi genbutsu in Japanese): they went to the
100 gemba, the place where work is actually done, to see what really happens. It took the team in total 100 h to

101 capture enough reliable data to fully understand the process. As part of the process map they integrated were
102 used to calculate the total time taken for one patient to go through the entire process, based on components
103 including patient waiting time, processing time and walking time to and from all the relevant locations (e.g. car
104 park, hospital entrance, front desk, polyclinic) that the typical patient would travel, and interviews were used to
105 identify any efficiency problems. The VSM team additionally mapped the current process by hand. The team
106 followed the value stream of oesophageal cancer treatment; that is, from when the patient enters the hospital
107 to when the patient is discharged. At each stage the team captured the following data: 1] the lead time, 2]
108 materials or inventory, 3] resources (e.g. staff), 4] current problems, 5] current key performance measures, 6]
109 information stream and 7] possible waste. After the VSM was created (a paper wall chart with coloured post-it
110 notes that showed the current value stream) the team critically reviewed it by reflecting upon and highlighting
111 the observations and conclusions from their "gemba" (experience), sorted by observations in the clinic and the
112 polyclinic. The team then addressed hazards and the risks in both the process design and the redesign in order
113 to achieve acceptable risk levels. For each e) Mapping the future state

114 The team designed a future-state VSM, which is an often radically different series of process steps that allows
115 the delivery of value to the patient faster, with fewer defects, using fewer resources. A future-state value stream
116 was constructed by determining whether any of the steps in the process could be executed with less waste or
117 whether they could be eliminated altogether. After designing the future state, the team created a detailed work
118 plan for implementing the process improvements to make that proposed process a reality. Members of the team
119 were assigned to specific tasks with timelines to drive the implementation of the process with optimal efficiency.
120 Evaluation of the success of VSM has been carried out by measuring the reduction of NVA steps. Subsequently,
121 improvements were made by elimination of identified waste and errors from the care pathway.

122 7 III.

123 8 Results

124 The VSM visualization tool assisted the practitioners in better understanding and identifying what work was
125 carried out in the care process for patients with oesophageal cancer and how that work was performed. This, in
126 turn, enabled them to review that care process critically and improve it.

127 Evaluation of the existing process by the team revealed that the care pathway of patients with oesophageal
128 cancer was a rather disordered process. An assessment of the present-state VSM demonstrated that only 17 out
129 of 128 (13.3%) processes in the care pathway for patients with oesophageal cancer genuinely added value. Out of
130 the remaining 128 processes, seven were identified as unnecessary and 104 as being necessary but NVA activities.
131 Based on a clear futurestate analysis, the team was able to identify considerable improvements to the preoperative
132 process. The process improvements after observation of the present state were: to define process step milestones
133 based on historical preoperative process times, administrative functions and administrative preoperative tasks
134 to occur before the day of surgery, redesign of admission processes to ensure appropriate prioritization, and
135 consolidated and streamlined OR nursing assessment documentation. Regarding documentation, our VSM
136 evaluation highlighted that significant delays for patients were caused by the waiting time for the collection
137 and inspection of paperwork and medical records. Consequently, transition to the next step in the care process
138 could not occur until the medical records were ready. Table 2 provides examples of barriers that were identified
139 and the solutions implemented.

140 Subsequently, the process improvements were implemented. By making the processing of paperwork/medical
141 records more efficient the door-to-theatre-time could be reduced from 13.5 to 10 weeks and value-adding activities
142 increased by about 24%. As a result, the total duration of the care process was reduced considerably. Overall,
143 the team's future-state map revealed that the number of steps needed to initiate operating procedures could be
144 reduced to 103; the number of value-added steps could be increased from 17 to 21 while the 104 NVA steps could
145 be cut by over 23% to 80 steps. The identified potential safety risk was reduced by 71% and the information
146 errors were reduced by almost 92%. A summary of the results is shown in Table 3.

147 Overall, during the process improvements, active participation of team members was unfortunately not 100%;
148 in particular, one department did not participate completely, and team members who missed introductory
149 training/briefing sessions later reported that this caused them to lack some knowledge on how to apply and
150 confidence in the VSM method. There were also reports of some local barriers. For example on allowing
151 employees time away from their usual work to participate in the VSM process, and concerning suggestions
152 regarding changing existing practices. The team reported that management should have been more assertive and
153 supportive in bestowing employees with the authority and responsibility to attend the project meetings -especially
154 because employees familiar with the everyday work processes are those closest to the problem-and allowing them
155 make the necessary changes in a timely manner. Despite this, one key observation of our evaluation was that the
156 VSM approach generally did result in consensus between the participating team members and it is likely that this
157 buyin from a range of stakeholders enabled subsequent change to be implemented without too much resistance.

158 **9 IV.**159 **10 Discussion**

160 The purpose of this case study was to monitor and evaluate an example of Lean as a qualityimprovement tool in
161 practice. Our study at VUmc shows how Lean can be used to improve suboptimal care processes for patients with
162 oesophageal cancer. The application of Lean methods in the manufacturing sector has been highly successful; our
163 results indicate that VSM is a valuable tool in the health care setting too, and can be applied to a care process for
164 patients with oesophageal cancer, leading to significant improvements in hospital practice. The findings suggest
165 that VSM can help practitioners in learning to identify waste and visually see the process from beginning to end,
166 with the use of a dedicated team, by following the steps of the process.

167 **11 Global Journal of Management and Business Research**

168 Volume XIV Issue II Version I Year () A process step in the value stream, the team identified non value adding
169 steps (NVA) and/or barriers to improving the efficiency or safety of the surgical process. They then designed
170 interventions that addressed the barriers to efficiency or safety. Figure ?? shows the VSM and Table 1 the various
171 process steps. structured improvement tool that can lead to genuine and concrete care-process improvements
172 in the delivery of patient care. Previous studies of the application of VSM have also shown that making a
173 process visible by mapping, triggers critical thoughts that helps improving the process. 24,25 Both Emiliani
174 (2003) 26 and Swank (2003) 27 argue that focusing employees' efforts on the value-creating activities desired by
175 customers result in shorter lead times and fewer defects and errors. The introduction of the careful observational
176 techniques of VSM may result in long-term, durable improvements and new knowledge about the care process.
177 This knowledge may empower staff at every level to create solutions to improve the quality of patient experiences.
178 This observation is supported by previous research into mapping processes; for example, Martin (2002) 28 found
179 that during the mapping process insights develop, and, according to Teichgräber and de Bucourt (2011), 12
180 these insights are the most significant benefits of using process mapping techniques such as VSM. According
181 to Teichgräber and de Bucourt (2011), "mapping does not only lead to better processes, but it also leads to a
182 consensus that enables and enhances implementation". 12 Our study also showed that consensus was built, which
183 contributed to the implementation of process improvements.

184 Although our results indicate that VSM enhances the care process of patients with oesophageal cancer, some
185 challenges still remain. As with any new initiative there are a number of challenges and barriers that need to
186 be addressed. Despite the goal of creating optimal collaboration between team members in the oncology surgery
187 setting, and the finding that this was generally the case, one department was unable to/did not participate fully
188 and actively. Furthermore, we identified that the management could have been more active in empowering and
189 authorizing employees to make necessary changes. It has been argued that team members in a VSM should
190 have a working knowledge of the VSM method. 15 In our case not every member was able to participate in the
191 introductory training; the consequential lack of knowledge and confidence was reported by some group members
192 to be a barrier to the success of the initiative. VSM -like any other Lean tool -is humancentred. 14 It therefore
193 requires active participation of all parties involved. Constructive feedback and a nonjudgemental attitude towards
194 incremental process improvements can help teams to identify and eliminate waste. Practitioners of VSM should
195 therefore jointly and iteratively pursue sources of waste in an attempt to reduce it, and team members should
196 communicate their achievements to other colleagues as a means of providing encouragement. There have been
197 similar findings in other studies. 29 This study has a number of limitations. It describes the application of a
198 process mapping technique in one setting, which might not be necessarily comparable with other settings. While
199 it supports the premise that VSM based on Lean thinking can help streamline the care process, it does not
200 provide effects of the process mapping on patient care itself. To study effects on patient care, we suggest that
201 future work should focus on outcome measures such as mortality, and length of hospital stay as a result of VSM
202 techniques.

203 In conclusion, evaluation at the start of the project showed that the oesophageal cancer care process was highly
204 fragmented, and involved variation entailing risks of medical errors. Application of VSM principles in the Lean
205 context improved the process by cutting the number of individual steps needed to start treatment from 128 to
206 103 and minimizing the variability by applying standardization. VSM proved to be a valuable tool for improving
207 the process of delivery of care to patients with oesophageal cancer. We expect these principles can be applied
208 to other forms of care and other areas of health-care delivery. ? Determine data gaps that need to be collected
209 Identify flow of information from end user to beginning of process ? Include systems that provide information
210 ? Record the frequency and type of information ? If information is your "product", can you identify the origin
211 of information? Determine whether the value-stream steps add value or do not add value Analyse waste and
212 determine improvements Develop an action plan to make improvements

3

	Measures	Pre- Lean	Post- Lean
Door-to-theatre time (weeks)		13.5	10
Care process steps:		128	103
?	Value-added steps	17	21
?	NVA steps	104	80
?	Unnecessary steps	7	2
Identified potential patient safety risks		17	5
Identified information errors		12	1
Transfers		15	8
Lack of standardized protocol		9	3

[Note: figures Figure 1 : The oesophageal cancer care pathway]

Figure 3: Table 3 :

213 **12 TABLES**
 214 1 2

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²© 2014 Global Journals Inc. (US) In general, this study adds further evidence to the literature on quality improvement in health-care, by showing that VSM can actually and validly foster healthcare quality.^{12,14,15} We found VSM to be a focused and V.

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