



GLOBAL JOURNAL OF MANAGEMENT AND BUSINESS RESEARCH: A  
ADMINISTRATION AND MANAGEMENT  
Volume 14 Issue 2 Version 1.0 Year 2014  
Type: Double Blind Peer Reviewed International Research Journal  
Publisher: Global Journals Inc. (USA)  
Online ISSN: 2249-4588 & Print ISSN: 0975-5853

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

By Kjeld H Aij, Guy Widdershoven & Merel Visse

*VU University Medical Center, Netherlands*

**Abstract- Objective:** 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.

**Keywords:** *Lean, oesophageal cancer, value-stream mapping, process improvement.*

**GJMBR-A Classification:** *JEL Code: M00*



*Strictly as per the compliance and regulations of:*



© 2014. Kjeld H Aij, Guy Widdershoven & Merel Visse. This is a research/review paper, distributed under the terms of the Creative Commons Attribution-Noncommercial 3.0 Unported License (<http://creativecommons.org/licenses/by-nc/3.0/>), permitting all non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

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

Kjeld H Aij <sup>α</sup>, Guy Widdershoven <sup>ο</sup> & Merel Visse <sup>ρ</sup>

**Abstract- Objective.** 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.

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

**Keywords:** Lean, oesophageal cancer, value-stream mapping, process improvement.

## 1. INTRODUCTION

Although the Netherlands has an excellent health-care system, Dutch hospitals still struggle to provide fully optimal patient care.<sup>1,2</sup> 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.<sup>3</sup> 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.<sup>4,5,6,7,8</sup> Lean is a quality-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).<sup>9</sup> 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,<sup>10</sup> 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.<sup>11</sup> 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.<sup>12,13,14,15</sup>

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.<sup>16</sup> 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 actually and validly improve health-care quality.<sup>17,18</sup>

To further investigate the benefits of Lean the Oncology Surgery Department at VU University Medical Center Amsterdam (VUmc) decided to introduce the process-improvement ideas of Lean thinking in an effort to improve the care process for oesophageal cancer patients. It is well known that the majority of patients with oesophageal cancer are not diagnosed until a relatively advanced stage,<sup>19</sup> and an internal audit showed that our department was no exception. There is ample evidence

Author α: VU University Medical Center Department of Anaesthesiology & Operative Care e-mail: k.aij@vumc.nl

Author ο: VU University Medical Center, EMGO+ Institute for Health and Care Research, Department of Medical Humanities e-mail: g.widdershoven@vumc.nl

Author ρ: University of Humanistic Studies. e-mail: m.visse@uvh.nl

that delays between diagnosis and surgery in oesophageal cancer result in higher overall rates of morbidity and mortality<sup>20</sup> so it is important, wherever possible, to direct efforts to reduce delays between the first outpatient visit, diagnosis and surgical treatment.<sup>21,22</sup> Because Lean approaches have had successful outcomes in earlier studies at VUmc,<sup>23</sup> and in other hospital settings,<sup>12,13,14,15</sup> the department chose to use a Lean approach to reduce the delay between point of diagnosis and treatment for patients with oesophageal cancer.

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

## II. METHODS

### a) Setting

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

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

### b) Team formation

Out of the participating departments involved in care for patients with oesophageal cancer – surgery, oncology, radiology, thoracic surgery, anaesthesiology, operating room (OR), intensive care, gastroenterology polyclinic and OR scheduling – a VSM review team was constructed, based on specialization and department, that consisted of 12 members. The team was headed by an executive member of the hospital leadership board, two value-stream experts (for training and coaching) and a care professional with the authority and responsibility to allocate the organization's resources (who could make decisions, arbitrate solutions, plan the project and select the processes that would be mapped; this person had a firm grasp of what achievement was being

targeted). The team also was complemented by two professionals from the oncology surgery and radiology departments, two facilitators and one coordinator. Finally, there were also representatives from the workforce 'on the floor' (medical staff, nurses, secretaries and radiotherapists).

### c) Rationale for choosing the oesophageal care pathway

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

### d) The present state

Once the team was formed, the team had to "go and see" (genchi genbutsu in Japanese): they went to the gemba, the place where work is actually done, to see what really happens. It took the team in total 100 h to capture enough reliable data to fully understand the process. As part of the process map they integrated findings from a time-motion assessment. Stopwatches were used to calculate the total time taken for one patient to go through the entire process, based on components including patient waiting time, processing time and walking time to and from all the relevant locations (e.g. car park, hospital entrance, front desk, polyclinic) that the typical patient would travel, and interviews were used to identify any efficiency problems. The VSM team additionally mapped the current process by hand. The team followed the value stream of oesophageal cancer treatment; that is, from when the patient enters the hospital to when the patient is discharged. At each stage the team captured the following data: 1] the lead time, 2] materials or inventory, 3] resources (e.g. staff), 4] current problems, 5] current key performance measures, 6] information stream and 7] possible waste. After the VSM was created (a paper wall chart with coloured post-it notes that showed the current value stream) the team critically reviewed it by reflecting upon and highlighting the observations and conclusions from their "gemba" (experience), sorted by observations in the clinic and the polyclinic. The team then addressed hazards and the risks in both the process design and the redesign in order to achieve acceptable risk levels. For each

process step in the value stream, the team identified non value adding steps (NVA) and/or barriers to improving the efficiency or safety of the surgical process. They then designed interventions that addressed the barriers to efficiency or safety. Figure 1 shows the VSM and Table 1 the various process steps.

#### e) *Mapping the future state*

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

### III. RESULTS

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

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

provides examples of barriers that were identified and the solutions implemented.

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

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

### IV. DISCUSSION

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



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 health-care quality.<sup>12, 14, 15</sup> We found VSM to be a focused and structured improvement tool that can lead to genuine and concrete care-process improvements in the delivery of patient care. Previous studies of the application of VSM have also shown that making a process visible by mapping, triggers critical thoughts that helps improving the process.<sup>24,25</sup> Both Emiliani (2003)<sup>26</sup> and Swank (2003)<sup>27</sup> argue that focusing employees' efforts on the value-creating activities desired by customers result in shorter lead times and fewer defects and errors. The introduction of the careful observational techniques of VSM may result in long-term, durable improvements and new knowledge about the care process. This knowledge may empower staff at every level to create solutions to improve the quality of patient experiences. This observation is supported by previous research into mapping processes; for example, Martin (2002)<sup>28</sup> found that during the mapping process insights develop, and, according to Teichgräber and de Bucourt (2011),<sup>12</sup> these insights are the most significant benefits of using process mapping techniques such as VSM. According to Teichgräber and de Bucourt (2011), "mapping does not only lead to better processes, but it also leads to a consensus that enables and enhances implementation".<sup>12</sup> Our study also showed that consensus was built, which contributed to the implementation of process improvements.

Although our results indicate that VSM enhances the care process of patients with oesophageal cancer, some challenges still remain. As with any new initiative there are a number of challenges and barriers that need to be addressed. Despite the goal of creating optimal collaboration between team members in the oncology surgery setting, and the finding that this was generally the case, one department was unable to/did not participate fully and actively. Furthermore, we identified that the management could have been more active in empowering and authorizing employees to make necessary changes. It has been argued that team members in a VSM should have a working knowledge of the VSM method.<sup>15</sup> In our case not every member was able to participate in the introductory training; the consequential lack of knowledge and confidence was reported by some group members to be a barrier to the success of the initiative. VSM – like any other Lean tool – is human-centred.<sup>14</sup> It therefore requires active participation of all parties involved. Constructive feedback and a non-judgemental attitude towards incremental process improvements can help teams to identify and eliminate waste. Practitioners of VSM should therefore jointly and iteratively pursue sources of waste in an attempt to reduce it, and team members should communicate their

achievements to other colleagues as a means of providing encouragement. There have been similar findings in other studies.<sup>29</sup>

This study has a number of limitations. It describes the application of a process mapping technique in one setting, which might not be necessarily comparable with other settings. While it supports the premise that VSM based on Lean thinking can help streamline the care process, it does not provide effects of the process mapping on patient care itself. To study effects on patient care, we suggest that future work should focus on outcome measures such as mortality, and length of hospital stay as a result of VSM techniques.

In conclusion, evaluation at the start of the project showed that the oesophageal cancer care process was highly fragmented, and involved variation entailing risks of medical errors. Application of VSM principles in the Lean context improved the process by cutting the number of individual steps needed to start treatment from 128 to 103 and minimizing the variability by applying standardization. VSM proved to be a valuable tool for improving the process of delivery of care to patients with oesophageal cancer. We expect these principles can be applied to other forms of care and other areas of health-care delivery.

## V. ACKNOWLEDGMENTS

The authors acknowledge all the staff of the Department of Anesthesiology and Operative Care, VU Medical Centre, Amsterdam, who helped with this project allowing us to shadow their daily work and sharing insight and thoughts for improving the care process for oesophageal cancer patients. We also acknowledge Marlou van Beneden and Marjolein Jungman for their assistance in mapping the processes. We also would like to thank Steven Bradshaw of Emedits Global Ltd for professional medical writing services. KA is the principal researcher and was responsible for the design of the study, conducted the data collection and was responsible for the data analysis. MV and GW supervised the study. All authors contributed to the writing of this paper and approved the final manuscript.

### *Funding*

This work was supported by LIDZ: a Dutch network for lean healthcare.

## REFERENCES

1. Spear SJ. Fixing health care from the inside, today. *Harvard Bus Rev* 2005; 83(9): 78.
2. Weinstock D. Lean healthcare. *J Med Pract Manage* 2008; 23(6): 339–341.
3. Rogers AE, Hwang WT, Scott LD, Aiken LH, Dinges DF. The working hours of hospital staff nurses and patient safety. *Health Aff* 2004; 23(4): 202–212.

4. Graban M. *Lean Hospitals: Improving Quality, Patient Safety, and Employee Engagement*. Boca Raton, FL: CRC Press, 2011.
5. de Bucourt M, Busse R, Güttler F, Reinhold T, Vollnberg B, Kenterich M et al. Process mapping of PTA and stent placement in a university hospital interventional radiology department. *Insights Imaging* 2012; 3(4): 329–336.
6. Brown T, Duthé R. Getting 'Lean': hardwiring process excellence into Northeast Health. *J Healthc Inf Manag* 2009; 23(1): 34–38.
7. Melanson SE, Goonan EM, Lobo MM, Baum JM, Paredes JD, Santos KS et al. Applying Lean/Toyota production system principles to improve phlebotomy patient satisfaction and workflow. *Am J Clin Pathol* 2009; 132(6): 914–919.
8. Rutledge J, Xu M, Simpson J. Application of the Toyota Production System improves core laboratory operations. *Am J Clin Pathol* 2010; 133(1): 24–31.
9. Van den Heuvel J, Does RJ, De Koning H. Lean Six Sigma in a hospital. *Int J Six Sigma Competitive Advantage* 2006; 2(4): 377–388.
10. Kim CS, Hayman JA, Billi JE, Lash K, Lawrence TS. The application of lean thinking to the care of patients with bone and brain metastasis with radiation therapy. *J Oncol Pract* 2007; 3(4): 189–193.
11. Uker JK. *The Toyota Way*. Madison, WI: McGraw-Hill, 2004.
12. Teichgräber UK, de Bucourt M. Applying value-stream mapping techniques to eliminate non-value-added waste for the procurement of endovascular stents. *Eur J Radiol* 2012; 81(1): e47–e52.
13. Grove AL, Meredith JO, Macintyre M, Angelis J, Neailey K. UK health visiting: challenges faced during lean implementation. *Leadership Health Serv* 2010; 23(3): 204–218.
14. Serrano Lasa I, Castro RD, Laburu CO. Extent of the use of Lean concepts proposed for a value-stream mapping application. *Prod Plan Cont* 2009; 20(1): 82–98.
15. Singh Gill P. Application of value-stream mapping to eliminate waste in an emergency room. *Glob J Med Res* 2012; 12(6). Available at: <http://medicalresearchjournal.org/index.php/GJMR/article/view/282> [Accessed 18 December 2013].
16. Yousri TA, Khan Z, Chakrabarti D, Fernandes R, Wahab K. Lean thinking: can it improve the outcome of fracture neck of femur patients in a district general hospital? *Injury* 2011; 42(11): 1234–1237.
17. DelliFraine JL, Langabeer JR, Nembhard IM. Assessing the evidence of Six Sigma and Lean in the health care industry. *Qual Manag Healthc* 2010; 19(3): 211–225.
18. Joosten T, Bongers I, Janssen R. Application of lean thinking to health care: issues and observations. *International Journal for Quality in Health Care*; 21(5): 341–347.
19. Lang GD, Konda VJ. Early diagnosis and management of esophageal and gastric cancer. *Minerva Gastroenterol Dietol* 2013; 59(4): 357–376.
20. Grotenhuis BA, Wijnhoven BP, Grüne F, Van Bommel J, Tilanus HW, Van Lanschot JJB. Preoperative risk assessment and prevention of complications in patients with esophageal cancer. *J Surg Oncol* 2010; 101(3): 270–278.
21. Sikkema M, De Jonge PJ, Steyerberg EW, Kuipers EJ. Risk of esophageal adenocarcinoma and mortality in patients with Barrett's esophagus: a systematic review and meta-analysis. *Clin Gastroenterol Hepatol* 2010; 8(3): 235–244.
22. Spahos T, Hindmarsh A, Cameron E, Tighe MR, Igal L, Pearson D et al. Endoscopy waiting times and impact of the two week wait scheme on diagnosis and outcome of upper gastrointestinal cancer. *Postgrad Med J* 2005; 81(961): 728–730.
23. Aij KH, Simons FE, Widdershoven GA, Visse M. Experiences of leaders in the implementation of Lean in a teaching hospital—barriers and facilitators in clinical practices: a qualitative study. *BMJ Open* 2013; 3: e003605.
24. Platchek T, Kim C. Lean health care for the hospitalist. *Hospital Medicine Clinics* 2012; 1(1): e148–e160.
25. Kim CS, Hayman JA, Billi JE, Lash K, Lawrence TS. The application of lean thinking to the care of patients with bone and brain metastasis with radiation therapy. *Journal of Oncology Practice* 2007; 3(4): 189–193.
26. Emiliani ML. Linking leaders' beliefs to their behaviors and competencies. *Manag Decis* 2003; 41(9): 893–910.
27. Swank CK. The lean service machine. *Harvard Bus Rev* 2003; 81(10): 123–130.
28. Martin J. *Organizational culture: Mapping the terrain* 2002. Sage.
29. Yamamoto Y, Bellgran M. Fundamental mindset that drives improvements towards lean production. *Assembly Autom* 2010; 30: 124–130.

TABLES

Table 1 : Procedural steps of the current-state VSM

<p><b>Identify key process steps for delivering product/service to patient</b></p> <ul style="list-style-type: none"> <li>Utilize information from “go and see” (<i>genchi genbutsu</i>)</li> <li>Include key metrics with each step</li> <li>Include lead time and cycle time data</li> <li>Identify undesirable parts of the process</li> <li>Determine data gaps that need to be collected</li> </ul>
<p><b>Identify flow of information from end user to beginning of process</b></p> <ul style="list-style-type: none"> <li>Include systems that provide information</li> <li>Record the frequency and type of information</li> <li>If information is your “product”, can you identify the origin of information?</li> </ul>
<p><b>Determine whether the value-stream steps add value or do not add value</b></p>
<p><b>Analyse waste and determine improvements</b></p>
<p><b>Develop an action plan to make improvements</b></p>

Table 2 : Objectives of work streams, findings and process improvements

Work stream	Objectives	Process improvements
Streamlining the preoperative process	To design scheduling processes that support improved OR use	<ul style="list-style-type: none"> <li>Creating defined process-step milestones based on historical preoperative process times</li> <li>Finishing isolated administrative functions and designed administrative preoperative tasks before the day of surgery</li> <li>Redesigning admission processes to ensure appropriate prioritization</li> <li>Consolidating and streamlining OR nursing assessment documentation</li> </ul>
Reducing collection of redundant information	To reduce redundancy in the capture, entry and reporting of patient information	<ul style="list-style-type: none"> <li>Analysis of every data element captured or viewed across the entire perioperative process</li> </ul>
Employee engagement	To improve employee engagement and satisfaction across all surgical service departments	<ul style="list-style-type: none"> <li>Preprocedure checklist implemented</li> <li>OR briefings implemented</li> </ul>
Reducing non operative time	To improve the efficiency of the non-operative processes and patient flow	<ul style="list-style-type: none"> <li>Mapping of existing processes to identify redundancies and waste</li> <li>Standardizing preoperative nursing activities</li> <li>Redefining roles and responsibilities to facilitate patient flow</li> </ul>

Table 3 : A comparison between the results of the measures: pre-Lean and post-Lean application

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

FIGURES

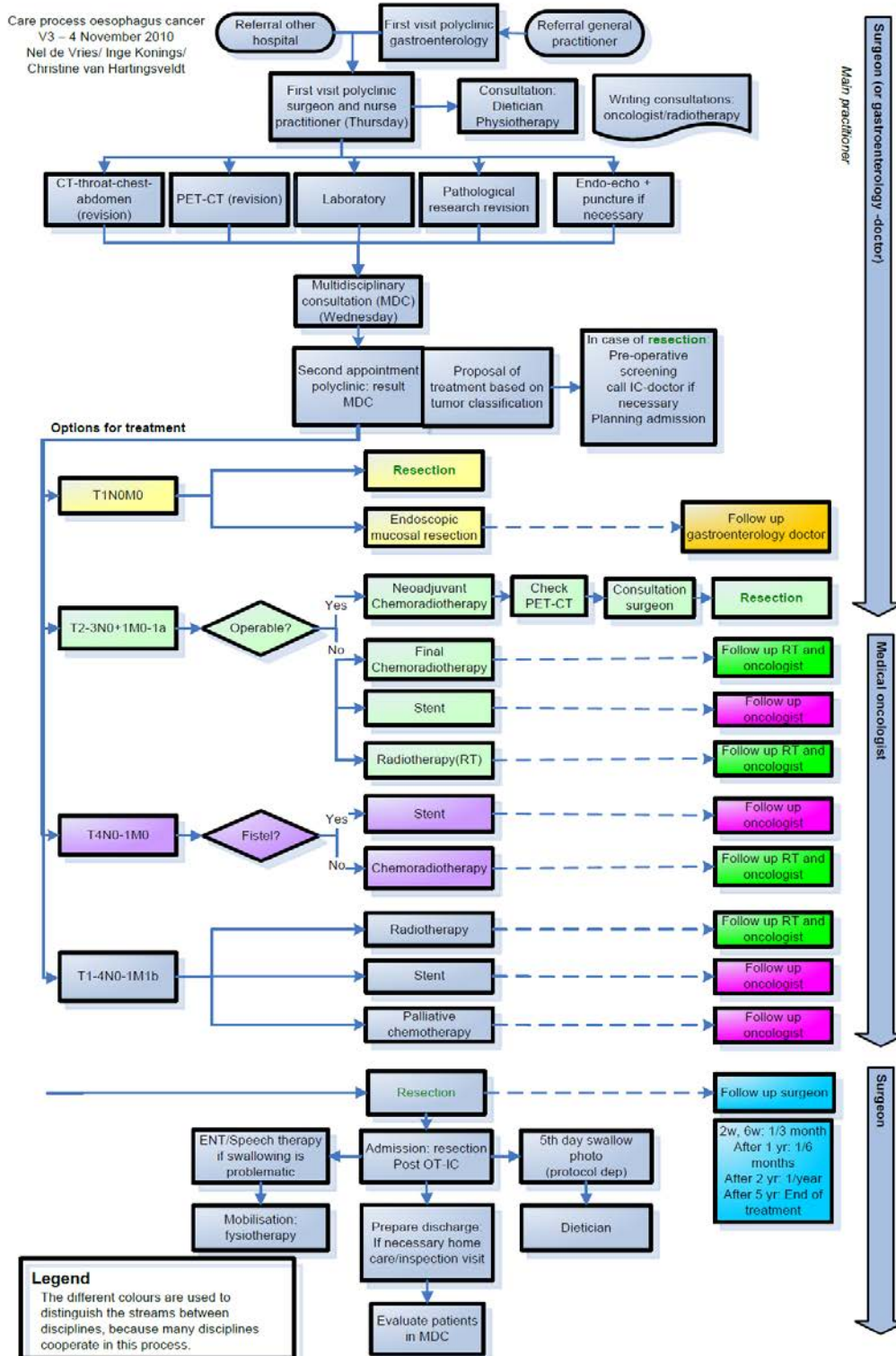


Figure 1 : The oesophageal cancer care pathway



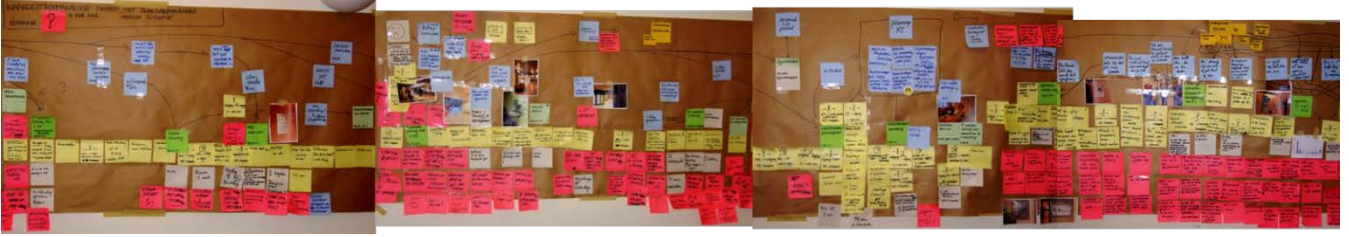


Figure 2 : The VSM chart

