Decreasing the dispatch time of medical reports sent from hospital to primary care with Lean Six Sigma

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Abstract

Rationale, aims and objectives Timely communication is important to ensure high-quality health care. To facilitate this, the Gastro Intestinal Oncology Center Amsterdam (GIOCA) stipulated to dispatch medical reports on the day of the patient’s visit. However, with the increasing number of patients, administrative processes at GIOCA were under pressure, and this standard was not met for the majority of patients. The aim and objective of this study was to dispatch 90% of medical reports on the day of the patient’s visit by improving the logistic process.

Methods To assess the main causes for a prolonged dispatch time and to design improvements actions, the roadmap offered by Lean Six Sigma (LSS) was used, consisting of five phases: Define, Measure, Analyze, Improve and Control (DMAIC roadmap).

Results Initially, 12.3% of the reports were dispatched on the day of the patient’s visit. Three causes for a prolonged dispatch time were identified: (1) determining which doctors involved with treatment would compose the report; (2) the reports composed by a senior resident had to be reviewed by a medical specialist; and (3) a medical specialist had to authorize the administration to dispatch the reports. To circumvent these causes, a digital form was implemented in the electronic medical record that could be completed during the multidisciplinary team meeting. After implementation, 90.6% of the reports were dispatched on the day of the visit.

Conclusion The dispatch time of reports sent from hospital to primary care can be significantly reduced using Lean Six Sigma, improving the communication between hospital and primary care.

Introduction

With the growing complexity of cancer management, specialized multidisciplinary fast track outpatient cancer clinics are increasingly implemented [1,2]. Following this trend, a novel fast track outpatient clinic was initiated at the Academic Medical Center in Amsterdam, the Netherlands: Gastro Intestinal Oncology Center Amsterdam (GIOCA). The core of this clinic is formed by four tumour-specific multidisciplinary teams. Daily, multidisciplinary cancer team meetings (MDTM) are held to confirm diagnosis and staging of the disease and subsequently to formulate a treatment plan for all patients who visit GIOCA that day.

Multidisciplinary cancer teams focus on clinical (consensual) decision making, efficient interdisciplinary communication and adherence to clinical guidelines [3–5]. Several studies have shown that multidisciplinary teams can improve the quality of care by ensuring patients receive an accurate diagnosis. Indeed, multidisciplinary teams have been shown to rectify the diagnosis formulated by a single medical specialists and to improve survival [6–9]. Additionally, timely communication between the multidisciplinary clinic and the patients’ primary care physician (PCP) is important: delays in communication negatively influence the quality of health care [10]. In the Netherlands, PCPs have a coordinative role; they are responsible for the continuity of care and ensuring communication between medical specialists.
Communication between GIOCA and the PCPs consists mainly of medical reports. In 2012, GIOCA often dispatched these reports with delay. In our experience, after visiting GIOCA, many patients visit their PCP the subsequent day to discuss their diagnosis and treatment options. Therefore, it was important that the medical reports composed at GIOCA were dispatched on the day of the patient’s visit.

This article describes an improvement project aimed at decreasing the dispatch time. The project was set up according to the Lean Six Sigma (LSS) methodology. Lean Six Sigma, a combination of Lean Manufacturing and Six Sigma, is a trend in the quality improvement of the organization of health care [11–21]. Lean Manufacturing provides standard analysis tools and techniques with the intention of mapping out and removing inefficiencies, while Six Sigma offers a structured roadmap to reduce variation in organizational processes by analysing performance metrics and uncovering root causes [22].

The rising emphasis on improving quality and efficiency in health care is also subscribed by Porter who raised awareness to measure value in health care [23]. Two highly influential reports of the Institute of Medicine urged to use operational management methods to improve quality and efficiency in hospitals [24,25]. Lean Six Sigma is a method to this end.

The roadmap used in Six Sigma consists of five phases: Define, Measure, Analyze, Improve and Control, and is called the DMAIC roadmap. In current literature, numerous studies have described LSS projects in health care [26–29]. However, to our knowledge, these studies don’t focus on the communication between hospital and primary care. This study aimed to increase the proportion of reports dispatched the day of patients’ visit at GIOCA using Lean Six Sigma, thereby improving the communication between GIOCA and the PCPs.

**Methods**

This study was conducted at GIOCA in December 2012, in the Academic Medical Center in Amsterdam, the Netherlands. GIOCA was initiated in 2009. The study had a single centre uncontrolled before-after design [30]. This study was conducted following the DMAIC roadmap, the methodology offered in Lean Six Sigma. It prescribes five consecutive phases: Define, Measure, Analyze, Improve and Control. These five phases are detailed in (Table 1). In the following sections, each of the five DMAIC phases are described, as they were used to improve the speed of communication between GIOCA and the PCPs.

**Define**

The aim of the Define phase was to select and define a project and formulate its target. With the increasing number of patients, administrative processes at GIOCA were under pressure: the number of patients who visit GIOCA has steadily increased from 378 in 2009 to 1039 patients in 2012. The reports to the PCPs were often dispatched with a delay of more than 1 day, resulting in a lower quality of care.

For patients, a visit at GIOCA lasts an entire day and consists of a morning consultation, followed by additional imaging if necessary, and one or more afternoon consultations. Patients have consultations with both senior residents and medical specialists due to the academic nature of the hospital. Furthermore, these doctors have different disciplines, due to the multidisciplinary nature of GIOCA. A week at GIOCA is organized by tumour specific days and each day is managed by a different tumour-specific multidisciplinary team. Therefore, all patients with (suspected) hepatocellular carcinoma (HCC) visit solely on Mondays while patients with colorectal cancer (CRC) visit on Tuesdays, patients with oesophageal and gastric cancer (ESOGAS) on Wednesdays, and patients with pancreatic and biliary cancer (PB) on Thursdays.

At noon, the doctors meet to discuss all patients who visited that day. During this multidisciplinary team meeting (MDTM), the diagnosis and staging of the disease, each patient was referred with, are confirmed or changed and a treatment plan is formulated. One of the doctors who attended the MDTM and is involved with the treatment of a patient writes a summarized medical report. This doctor is either a senior resident or a medical specialist. However, a medical report written by a senior resident must always be reviewed by a medical specialist. The medical specialist must remember to authorize the administration to dispatch the finalized report to the PCP. This process causes many reports to be dispatched after 2 days or more.

In November 2012, a project team was formed consisting of doctors and nurses working at GIOCA at the time. The project team was led by a LSS black belt, a project leader in LSS terms. The project leader formulated the objective to dispatch 90% of the reports on the day of the patient’s visit, that is, a dispatch time of 0 days. Dispatch time was defined as the number of working days between a patient’s visit at GIOCA and the day the report was dispatched to the patient’s PCP. The project was initiated in December 2012 and was planned to be completed within 6 months, in June 2013 (Fig. 1).

**Measure**

The aim of the Measure phase was to quantify the problem and to measure the current process performance. To quantify the

<table>
<thead>
<tr>
<th>DMAIC cycle</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Define</td>
<td>Select and define the project and project leader (black belt or green belt), establish project objectives, and describe the current process.</td>
</tr>
<tr>
<td>Measure</td>
<td>Quantify the problem by selecting the appropriate measurable characteristics, the critical to quality (CTQ) indicators. Measure the process performance and validate the measurement procedure.</td>
</tr>
<tr>
<td>Analyze</td>
<td>Analyse the current process performance, make a data-based-diagnosis, and identify potential influence factors.</td>
</tr>
<tr>
<td>Improve</td>
<td>Establish effect of the influence factors on the CTQs. Improve the process by designing and implementing evidence-based improvement actions.</td>
</tr>
<tr>
<td>Control</td>
<td>Control the improved process performance and close the project.</td>
</tr>
</tbody>
</table>
problem, critical to quality (CTQs) characteristics were selected. For this project, ‘dispatch time’ was the selected CTQ characteristic.

To measure the current process performance, data on 195 medical reports were collected and evaluated between December 2012 and February 2013. Only initial presentations at GIOCA were included to avoid bias and exclude other possible contextual dependencies of dispatch time. For each report, the number of days between the date of the patient’s visit and the date of dispatch was calculated. The Electronic Medical Record (EMR) was hand searched to identify possible reasons for delays in dispatch time. These reasons were documented. Furthermore, patient characteristics (age, gender and tumour-specific MDTM) were recorded to evaluate any differences between the measurements.

**Analyze**

The aim of the Analyze phase was to analyse the CTQ and to compose a list of possible causes prolonging the dispatch time. The LSS black belt analysed the CTQ dispatch time for all reports. It was found that only 12.3% of the reports were dispatched on the same day. A more detailed analysis is provided below in the results section. To determine whether differences in dispatch time existed between the different tumour-specific MDTMs, the dispatch times were compared with a $\chi^2$ test. To determine differences, the proportion of reports dispatched on the day of the visit between the different measurements, a Kruskal–Wallis-test was employed. Subsequently, the LSS black belt organized a brainstorm session to discuss process inefficiencies. Three major process inefficiencies were identified as the main causes of accumulation of waiting time before the report was dispatched: (1) determining which doctors involved with treatment would compose the report was unclear at times; (2) the reports composed by a senior resident had to be reviewed by a medical specialist; and (3) a medical specialist had to authorize the administration to dispatch the reports (Fig. 2).

**Improve**

The aim of the Improve phase was to design and implement improvement actions. The improvement actions were discussed and devised under supervision of the black belt in brainstorm sessions. To solve all three main process inefficiencies, it was proposed that the report had to be completed digitally during the MDTM. This ensured no doctor had to be appointed to compose a report and all doctors in attendance at the meeting could consent to the report, rendering revisions by medical specialists irrelevant. Furthermore, the digitally completed form simplified and expedited the authorization of the administration. To facilitate completion of the report during the MDTM, a comprehensive digital report form was developed and included in the EMR. This form was projected on to a screen during the MDTM. One senior resident was appointed to document all decisions made by the multidisciplinary team during each meeting.
Development of the MDTM-form

The development of the new MDTM form was carried out in three phases. During the first phase, the form was designed, in the second phase, the report was tested, and in the third phase, the report form was modified and implemented. In phase I, the pilot form was developed. Lamb et al. identified key-aspects that should be discussed during the MDTMs to ensure a high quality of care: patient history; patient wishes; presence or absence of key medical specialists; diagnosis and TNM staging; treatment plan; and primary treating doctor [5]. Furthermore, these key-aspects are in line with the guidelines formulated by the (Dutch) Health Care Inspectorate. The pilot form consisted of three different sections comprising several text fields. Section 1 consisted of specified text fields regarding patient information. These text fields had to be filled in as preparation for the MDTM, during the morning consultation. The text fields in sections 2 and 3 were filled in during the MDTM. In phase II, the pilot MDTM form was tested for user friendliness. In the period April 2013 to May 2013, two researchers (YLB; TR) measured which of the six aforementioned key-aspects were filled out in 47 forms (Table 2).

To reveal the most prominent causes for the incomplete forms, several doctors from the multidisciplinary team were interviewed. The medical specialists suggested the many fields caused them to lose the overview of the form and took too much time to complete. In phase III, the form was adapted and implemented based on the phase II test results: some text fields were omitted and others were combined or reformulated. Figure 3 shows the final MDTM form. All doctors were given an introductory course to the new form, after which the new form was implemented in June 2013.

Subsequently, the six key-aspects were assessed again in the adapted digital MDTM form. The IT department set up a link between the consultation form and the MDTM form. This ensured that in all forms, the key-aspect ‘patient history’ was automatically transferred from the consultation form to the MDTM form. In the second measurement, all key-aspects were more often filled out, compared to the first measurement (Table 2).

Control

The aim of the Control phase was to measure and maintain the targeted CTQ dispatch time and close the project. The CTQ dispatch time was measured again after implementation of the MDTM form with a second data set. Data were prospectively collected from June 6 to September 23 2013. For each report, the same variables that were measured in the first measurement were measured again. Subsequently, the number of days between the date of the patient’s visit and the date of dispatch were calculated. The percentage of reports dispatched on the same day as the patient’s visit was compared before and after the intervention, using a Kruskal–Wallis test. Findings are discussed below. To ascertain no differences existed between the patient group before and after implementation of the digital MDTM form, age and gender of the patient were documented and compared between the two groups. In order to maintain the targeted CTQ dispatch time,
Figure 3  Final MDTM form. Above: screenshot of form as it is used daily; below: schematic view of screenshot, translated.
the newly designed form was incorporated in the MDTM and had become the standard method of working.

To confirm that the proportion of dispatched reports on the same day as the patient’s visit remained at 90%, or higher, a new observation was made from January 2015 to April 2015. For each report, the number of days between the date of the patient’s visit and the date of dispatch was calculated and the number of filled in text fields containing the key-aspects was determined.

**Results**

At the start of the project from December 2012 to February 2013, the dispatch times for 195 reports were calculated. Only the reports composed after the initial visit were included. Of the analysed reports, 12.3% were dispatched on the same day as the patient’s visit, 37.9% were dispatched the day after the visit, 45.1% were dispatched after more than 1 day after the visit and 4.5% were not dispatched at all (Table 3). The dispatch time differed significantly between the individual tumour-specific MDTMs: the CRC and ESOGAS MDTMs had significantly longer dispatch times than the HCC and PB MDTMs ($P < 0.0001$; Table 4).

After implementation of the adapted MDTM form, the dispatch time was calculated for 191 reports from June 2013 to September 2013. Only the reports composed after the initial visit were included. Of the analysed reports, 12.8% were dispatched on the same day as the patient’s visit, 90.6% were dispatched the day after the visit, 33.0% were dispatched >1 day after the visit and 20.5% ($n = 41$) were not dispatched at all (Table 3). A further study of these 41 reports was dispatched on the day of the visit, 7 the day after the visit and 10 more than 1 day after the visit. Only one report was never dispatched. These are not included in this table.
reports showed that for 40 of these patients, an alternative medical report, which was not generated from the MDTM form, was dispatched to the PCP. Of these 40 medical reports, 56.1% was dispatched on the same day as the patient’s visit, 17.1% was dispatched the day after the visit and 24.4% was dispatched 1 day after the visit. Interestingly, although the differences between the different tumour-specific days remained present, the distribution was different: the reports composed at the HCC MDTM, were dispatched most often, followed by reports from the PB-MDT, CRC-MDT and lastly the ESOGAS-MDT (Table 6). For the 200 reports from the third measurement, the text fields containing six key-aspects were also assessed (Table 2).

### Table 4 Differences in dispatch time before implementation of the MDTM form

<table>
<thead>
<tr>
<th>Variable</th>
<th>n</th>
<th>Dispatch time Median** (IQR)</th>
<th>Reports dispatched Day of visit (%)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tumour-specific MDTM*</td>
<td></td>
<td></td>
<td></td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>HCC</td>
<td>11</td>
<td>1.0 (0.3–2.0)</td>
<td>36.4</td>
<td></td>
</tr>
<tr>
<td>CRC</td>
<td>24</td>
<td>2.0 (1.0–4.0)</td>
<td>12.5</td>
<td></td>
</tr>
<tr>
<td>ESOGAS</td>
<td>55</td>
<td>2.0 (2.0–4.0)</td>
<td>5.5</td>
<td></td>
</tr>
<tr>
<td>PB</td>
<td>105</td>
<td>1.0 (1.0–2.0)</td>
<td>13.3</td>
<td></td>
</tr>
</tbody>
</table>

Differences in dispatch time between different tumour-specific multidisciplinary team meetings (MDTM) in days, before implementation. P value is obtained by analysing the data with Kruskal–Wallis.

*HCC, hepatocellular carcinoma; CRC, colorectal cancer; ESOGAS, oesophageal and gastric cancer; PB, pancreatic and biliary cancer.

**Interquartile range.

### Table 5 Differences in dispatch time after implementation of the MDTM form

<table>
<thead>
<tr>
<th>Variable</th>
<th>n</th>
<th>Dispatch time Median** (IQR)</th>
<th>Reports dispatched Day of visit (%)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tumour-specific MDTM*</td>
<td></td>
<td></td>
<td></td>
<td>0.007</td>
</tr>
<tr>
<td>HCC</td>
<td>7</td>
<td>0 (0–1.0)</td>
<td>57</td>
<td></td>
</tr>
<tr>
<td>CRC</td>
<td>38</td>
<td>0 (0–0)</td>
<td>86</td>
<td></td>
</tr>
<tr>
<td>ESOGAS</td>
<td>45</td>
<td>0 (0–0)</td>
<td>89</td>
<td></td>
</tr>
<tr>
<td>PB</td>
<td>101</td>
<td>0 (0–0)</td>
<td>95</td>
<td></td>
</tr>
</tbody>
</table>

Differences in dispatch time between different tumour-specific multidisciplinary team meetings (MDTM), shortly after implementation. P value is obtained by analysing the data Kruskal–Wallis.

*MDTM, multidisciplinary team meeting; HCC, hepatocellular carcinoma; CRC, colorectal cancer; ESOGAS, oesophageal and gastric cancer; PB, pancreatic and biliary cancer.

**Interquartile range.

### Table 6 Differences in dispatch time 16 months after implementation of the MDTM form

<table>
<thead>
<tr>
<th>Variable</th>
<th>n</th>
<th>Dispatch time Median** (IQR)</th>
<th>Reports dispatched Day of visit (%)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tumour-specific MDTM*</td>
<td></td>
<td></td>
<td></td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>HCC</td>
<td>9</td>
<td>2.0 (0–1.0)</td>
<td>36.4</td>
<td></td>
</tr>
<tr>
<td>CRC</td>
<td>57</td>
<td>1.0 (0–1.0)</td>
<td>12.5</td>
<td></td>
</tr>
<tr>
<td>ESOGAS</td>
<td>49</td>
<td>2.0 (1.0–2.0)</td>
<td>5.5</td>
<td></td>
</tr>
<tr>
<td>PB</td>
<td>85</td>
<td>0 (0–2.0)</td>
<td>13.3</td>
<td></td>
</tr>
</tbody>
</table>

Differences in dispatch time between different tumour-specific multidisciplinary team meetings (MDTM), 16 months after implementation. P value is obtained by analysing the data Kruskal–Wallis.

*MDTM, multidisciplinary team meeting; HCC, hepatocellular carcinoma; CRC, colorectal cancer; ESOGAS, oesophageal and gastric cancer; PB, pancreatic and biliary cancer.

**Interquartile range.

Discussion

The quality and frequency of communication between hospital and primary care can influence health care quality [10]. Therefore, this study aimed to investigate whether the proportion of reports dispatched from GIOCA to the PCP within 1 day could be increased to 90%, using the Lean Six Sigma methodology. To achieve this, a
A digital MDTM form was developed and included in the EMR. During the MDTM, this form is simultaneously projected onto a screen and filled out ‘real-time’ by a designated senior resident. Furthermore, a report is generated from the form and immediately dispatched to the PCP by the administration. The implementation of the new form ensures the proportion of reports dispatched on the same day as the patient’s visit, increases dramatically, initially from 12.8% to 90.6%.

This study was designed with an uncontrolled before-after design, which can possibly overestimate the results of quality improvement interventions, since other causes of improvement are difficult to exclude [30]. However, although we feel confident, the second measurement shows a representative improvement due to the implementation of the MDTM form, the third measurement shows that only 29.0% of the reports were dispatched on the day of the visit. Still, the implementation of the digital MDTM form can be described as a structural change. During the third measurement, ‘regular’ reports, not generated from the MDTM form, were also dispatched to the PCP. When also considering these reports, 50.5% of the reports were dispatched on the same day as the visit. This does indicate that although a structural change has been implemented, the process must be continually monitored to ensure no new causes for delays in dispatch time occur.

This study also assessed the use of the key-aspects in the MDTM form. The first measurement of these key-aspects was performed with the pilot MDTM form. The results from this measurement were incorporated in the adapted MDTM form. The second measurement of the key-aspects was performed with the adapted MDTM form, immediately after implementation and the third measurement was performed 16 months after implementation. These different measurements show that the text fields containing the key-aspects were increasingly more filled out. This is important since the communication between health care workers must not only be timely, but also contain the necessary information to ensure quality care.

Before implementation of the MDTM form, a significant difference in dispatch time between the different tumour-specific MDTMs was observed. Interestingly, after implementation of the new report form, the significant difference in dispatch time was still present; the dispatch time of reports sent by the HCC MDTM was significantly longer than the dispatch time of the other MDTMs. However, at the HCC MDTM, a significantly smaller number of patients (n = 7) was discussed, leading to a smaller number of reports formulated at the HCC MDTM, during the second observation period. Since only three reports were dispatched with a delay, the difference is not clinically relevant. Furthermore, in the third measurement, the dispatch time of the reports composed at the HCC MDTM was actually shorter, with more reports dispatched at the day of the visit compared to the other MDTMs.

Currently, various hospitals have incorporated Six Sigma, Lean Management or Lean Six Sigma in their organization and have published several cases describing improvement projects [13,14,18,26,28,31–33]. Like the current study, these studies mostly implement LSS for singular improvement projects [12,14,17,26–29]. This is both an advantage and a disadvantage of LSS. However, for most of these studies, it is unclear whether the results from the improvement projects are sustained over time and whether these results can be transferred to other problems or other health care organizations [12,34]. The structured DMAIC roadmap is an excellent tool when employed to improve routing tasks, since it forces researchers to focus on the selected CTQs [22].

LSS is an appropriate strategy when facing recurring problems or crises in routine tasks; in the current study, three major process inefficiencies of a routine task were identified. These inefficiencies caused an extended dispatch time for the medical reports. Improving these inefficiencies provides an excellent opportunity to enhance the quality of patient care by ensuring the PCP has all relevant information to coordinate care. In this study, we have shown that the tools provided by LSS can contribute to an important improvement in the communication process of a hospital. However, both the tools and processes, in this case the MDTM form, need to be more regularly evaluated in order to maintain the goal of >90% of the MDTM reports dispatched on the same day as the patient’s visit. With the implementation of the digital MDTM form within the EMR, we believe a solution has been created that is transferable to both other departments within the AMC as well as other health care organizations, especially organizations working with multidisciplinary teams.

Acknowledgement

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References


