Hindawi Publishing Corporation
Conference Papers in Medicine
Volume 2013, Article ID 143985, 6 pages
http://dx.doi.org/10.1155/2013/143985

Conference Paper

POCT in Emergency Rooms: One Key Factor for Process Streamlining with Lean Management

Verena Lindenau-Stockfisch,[1] Julia Searle,[2] and Martin Möckel[2]

[1] *Paul Gerhardt Stift Hospital, 06886 Lutherstadt Wittenberg, Germany*
[2] *Department of Cardiology Campus Virchow Klinikum (CVK) and Division of Emergency Medicine CVK and Charité Campus Mitte (CCM), Charité University Medicine Berlin, 13353 Berlin, Germany*

Correspondence should be addressed to Julia Searle; julia.searle@charite.de

Received 16 January 2013; Accepted 2 April 2013

Academic Editors: A. Bellou, E. Giannitsis, and C. Hamm

This Conference Paper is based on a presentation given by Verena Lindenau-Stockfisch at "Clinical Decisions in Acute Patients: ACS–POCT–Hypertension and Biomarkers" held from 19 October 2012 to 20 October 2012 in Berlin, Germany.

Overcrowding is a common problem in Emergency Departments (ED) worldwide and has a negative impact on patient satisfaction and, more importantly, patient safety. So, the Emergency Department of the secondary-care hospital Paul Gerhardt Stift in Wittenberg, Germany, was faced with increasing numbers of patients. Lean management was introduced to analyse, optimise, and standardise ED processes. Consequently, a project group concentrated on "cycling muda" which is to identify waste and cost drivers along a representative patient path using one suitable Lean tool: mapping the current state in a value stream. As a result, it became clear that both patients and staff suffered from immense waiting times that lead to risky patient care and employee frustration. By subsequently eliminating the waste drivers and designing a high-quality patient flow process creating standards supported by state-of-the-art technology, the hospital's ED turned into a streamlined department with reduced waiting times offering employees a satisfactory and modern workplace where patients benefit from first-class care.

1. Introduction

In the past years, emergency rooms (ER) all over Germany, especially those of maximum care hospitals, have been faced with an increasing number of patients which is caused by a variety of factors including demographic changes, inflexible ambulant services, and an overreaching demand for healthcare services. ER overcrowding causes immensely high waiting times with a negative impact on patient and staff satisfaction and, even more importantly, patient safety [1]. Thus, a process-oriented view with speedy diagnostic work up, ideally integrated on-site, is indispensable for appropriate patient care. At the same time, medical ethics and economic principles should not correlate negatively with each other. Among various quality management methods, Lean management is one methodology that may help hospitals to achieve these goals. Originally, Lean is a management methodology that goes back to production processes with the main aim to increase output by reducing input. The lean philosophy has its origin in the Japanese manufacturing industry and is strongly bound to the Toyota Production System (TPS). Toyota introduced this system in the 1990s with the intention to become one of the largest car manufacturers worldwide [2].

This paper describes an ongoing project at the hospital Paul Gerhardt Stift in Lutherstadt Wittenberg to exemplify how processes were analysed, optimised, and standardised with Lean management tools to regain process stability both as an important indicator for patient safety and process quality and as a driving force for employee satisfaction.

2. Methods

2.1. Lean Emergency Management in the PGS Wittenberg. The Protestant hospital Paul Gerhardt Stift (PGS) in Wittenberg,

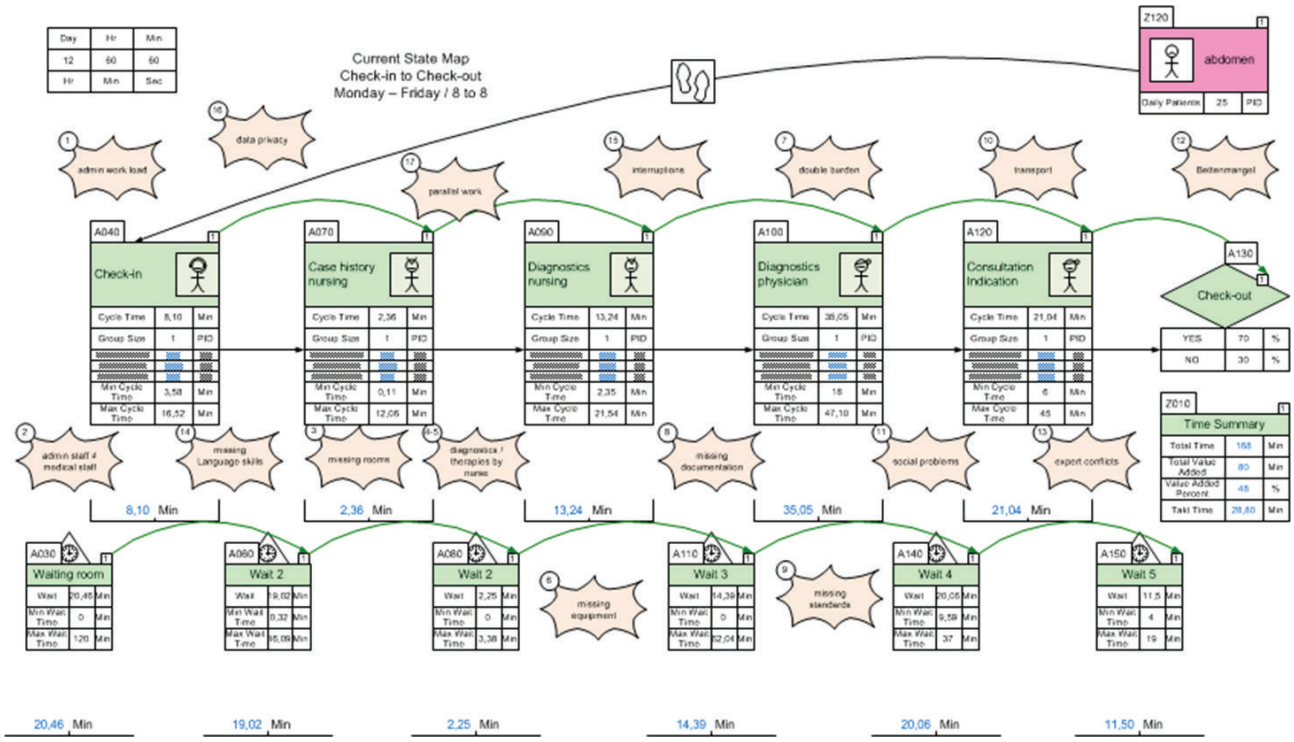

Figure 1: The so-called value stream map (current state) created to reflect the clinical process on patients with abdominal pain.

located between Berlin and Leipzig, is provided with 437 beds and belongs to a private hospital chain of the Paul Gerhardt Diakonie Group (PGD) with hospitals and special-care homes mainly in Berlin and its surroundings. Due to its various disciplines, it belongs to the so-called multicare hospitals and additionally has strategic alliances with regional neurologic and cardiologic specialist clinics. In 2011 and 2012, the Emergency Department had to cope with about 23,000 patients, with an increase of 10% in comparison to 2010.

Throughout the holding, Lean management was introduced with the following targets [3]:

(i) to reduce long waiting times for patients,

(ii) to increase patient safety, and

(iii) to design a flexible organisation structure.

After a basic information course for all employees, such as nursing staff, ancillary staff, and physicians, with a participation of about 70%, the hospital management decided on starting the initial Lean project in the Emergency Department.

Consequently, a smaller project group consisting of employees of all careers, disciplines, and hierarchies working in the Emergency Department was founded, who received a detailed training about Lean methods such as value stream mapping, a Lean tool to compare current and future state of processes by focusing on waste drivers, mainly time.

Relevant process owners created the current state map with the target to show the actual process and to analyse main problems. To illustrate the complexity and need for speedy diagnostics, the project group agreed on mapping patients with abdominal pain.

The following 6 process boxes were mapped (Figure 1):

(i) administrative checkin;

(ii) primary case history taken by nursing staff;

(iii) diagnostics taken by nursing staff;

(iv) medical history taken by physician;

(v) interdisciplinary consultation;

(vi) checkout.

Already at this moment, first correlations between problems and causes or rather waste drivers became obvious, since problems were analysed by the project members in an open-minded, neutral atmosphere without blaming each other.

2.2. Waste Drivers

(1) Administrative staff is unable to work efficiently due to too many parallel activities that do not comply with the core scope of duties;

(2) administrative staff defines further treatment/transfer to discipline although not being medically skilled;

(3) missing treatment rooms;

(4) nursing staff decides on diagnosis and even therapies;

(5) missing medical equipment;

(6) double burden for physicians (on-call duty);

(7) missing availability of laboratory parameters;

(8) missing standards/SOPs;

(9) transport and walking distances (patient, laboratory);

(10) medical debates, especially between internists and surgeons;

(11) delayed checkout due to limited patient care capacities (crowding effects);

(12) insufficient language skills;

(13) interruptions;

(14) inadequate data privacy.

Then, the project group prioritised and clustered the problems, relevant process owners met in individual meetings for detailed analysis of the single-process boxes, subprocesses were mapped, and solution approaches were elaborated step by step, that were realised in test or rather pilot phases. Time measurements were carried out to complete the current state map (time level) and to distinguish value-creating activities from waste and nonvalue adding activities. After successful testing, some adjustments, and final evaluation of the test results, standards were elaborated.

3. Results

3.1. Reorganisation of Administrative Processes and Tasks. Less complex problems, such as insufficient language skills, could be quickly solved by immediate actions such as creating a new admitting form in various languages. Furthermore, administrative staff was discharged from work that does not belong to the core activities of administrative checkin in ER (e.g., hospital telephone cards now available at the information desk). The hospital IT department modified the admitting programme and customised the documentation to the needs of the administrative work.

3.2. Manchester Triage System. Complex problems asked for complex solutions.

The Manchester Triage System (MTS, Table 1) was introduced. Intuitive nursing experience yielded a structured instrument to assess patients' needs for treatment considering individual pains and complaints by using a validated system.

Furthermore, MTS serves for

(i) quality control,

(ii) risk management,

(iii) initiating the treatment process,

(iv) legal protection, and

(v) staff calculation

and includes the delegation of medical activities to the assisting personnel [4]. The necessary triage room was provided within short time, medical equipment was purchased, and nursing staff number was increased by 3 employees in full time. After comprehensive training of the complete ER team, the testing period was accompanied by intensive practical support. In cooperation with the coordination centre of EMS a standard for patient handoff was elaborated to avoid negative correlations with the emergency medical assistants' expert report. Once per month, unclear or controversial cases were discussed in an open-minded and neutral atmosphere between nurses and physicians.

Table 1: Manchester Triage Scale.

UK National Triage Scale		
1-red	Immediate resuscitation	Patient in need of immediate treatment for preservation of life
2-orange	Very urgent	Seriously ill or injured patients whose lives are not in immediate danger
3-yellow	Urgent	Patients with serious problems, but apparently stable condition
4-green	Standard	Standard cases without immediate danger or distress
5-blue	Nonurgent	Patients whose conditions are not true accidents or emergencies

Source: Netzwerk Ersteinschätzung.

3.3. Introduction of POCT. The problematic transport of blood samples to the laboratory called for a more precise analysis which was carried out with a classic A3 solution method, a powerful tool for a structured problem solving approach and root cause analysis to push ahead with standardisation of problem solutions, to increase their frequencies and regularity, to generate profound knowledge in a team.

In fact, measurements showed that it took already 37 minutes to carry blood samples from the ER to the laboratory, whereas first laboratory results were available after 71 minutes (average). However, these results were not complete or rather relevant to further decision making. Doctors had to wait at least 30 minutes for first data and 90 minutes to initiate further steps.

With the equipment of POCT and the combination of laboratory and performance standards, physicians now receive relevant data after 2 minutes for blood gas analysis (especially electrolytes, haemoglobin, and metabolic parameters) and important data from the AQT devices after 15–20 minutes. This means immense improvement of patient safety and staff satisfaction. These standards have been integrated in the order-entry system of the hospital and serve as general guidelines for the whole organisation.

The purchase of the two analysis devices was suggested from both medical and process views.

3.4. Argumentation from Medical View. Two main aspects have to be considered: first of all, the increase of medical quality and secondly the improvement of medical effectiveness [5].

The justified arguments follow increased medical-logistic demands in diagnostics and therapy of patients with highly acute or even life-threatening diseases. Here, one must

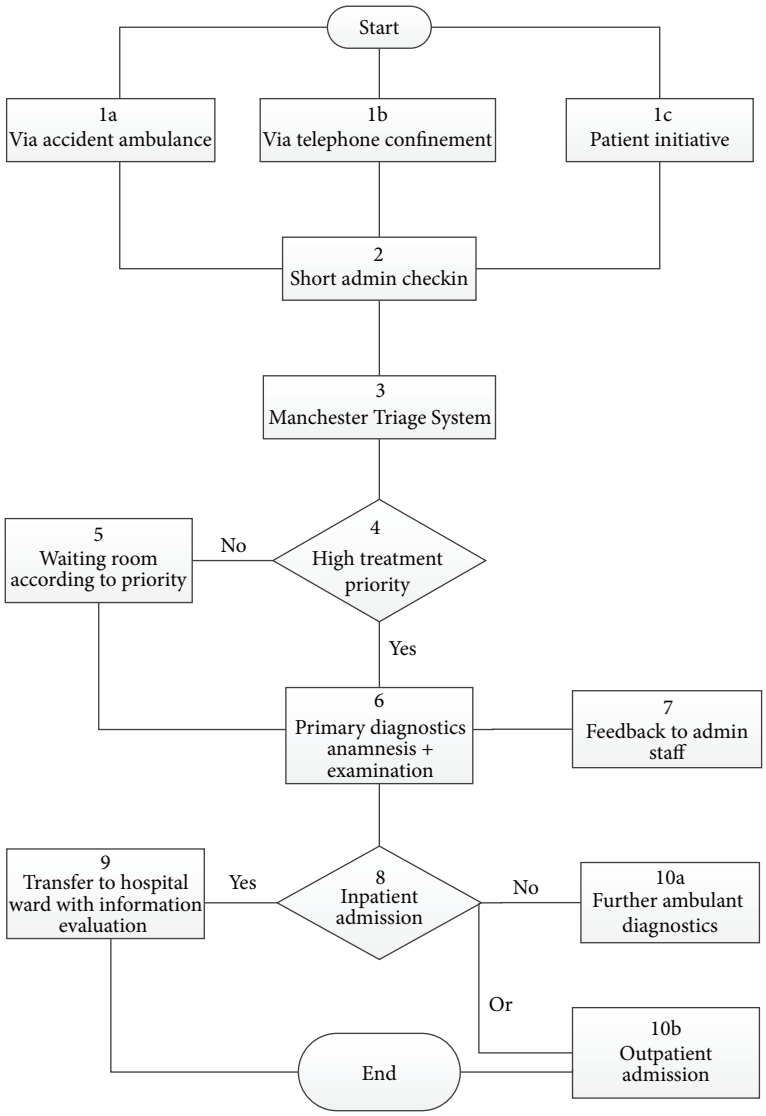

Figure 2: New patient path with integrated Manchester Triage system.

consider both demands resulting from modern medical expertise as well as SOPs in combination with optimised and efficient patients paths plus proximity conditions and processes that also focus on relatives requirements.

The blood gas device (ABL 800 series) delivers important acute parameters that play a decisive role in emergency medicine, since precise and valid results are available in time and on spot. Loop ways and external influences are omitted.

3.5. Argumentation from Process View. POCT equipment is regarded as a key factor for process streamlining with Lean methods, especially with regard to patient safety and employee satisfaction.

To increase process stability and quality, the project group elaborated the following future state map, consisting of 6 process boxes:

(i) administrative checkin,

(ii) initial assessment by nurse (Manchester Triage) in combination with diagnostics according to standards (laboratory and performances standards),

(iii) medical diagnostics or waiting area 1/2,

(iv) medical consultation/indication, and

(v) checkout.

The new patient path of the ER is illustrated in Figure 2.

Still, patients check in at the administration area but are then transferred immediately to the triage room. The nurse in charge determines the treatment priority according to the standardised presentation charts, examines vital signs, and decides on taking laboratory parameters at the POCT equipment according to the laboratory standards.

Table 2: Overview of triage patients with abdominal pain according to MTS, also showing delays caused by physicians.

Abdomen	ø total	ø red	ø orange	ø yellow	ø green	ø blue	Timeouts
		prompt	10 min	30 min	90 min	120 min	
Current map	**60,16**			*Admission—First View*			
January	30,33	5,00	12,00	21,56	43,14		12%
February	37,04		6,15	14,46	47,20		10%
March	29,32		8,30	13,23	33,14	51,40	12%
Future map	32,23						

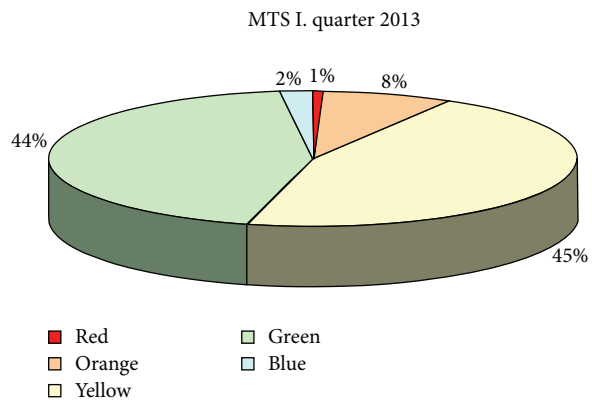

Figure 3: Graphic chart showing rated patients according to MTS priorities.

3.6. Laboratory and Performance Standards

(i) Profile A: chest pain/dyspnoea.

(ii) Profile B: abdominal pain, incl. gastrointestinal haemorrhage.

(iii) Profile C: pneumonia/sepsis.

(iv) Profile D: apoplexy/neurological deficit.

(v) Profile E: preoperation.

(vi) Profile F: Polytrauma.

All profiles include laboratory standards, vital signs, and medical orders. Due to that, variances are reduced, errors are minimised, physicians on duty receive credible diagnoses in a shorter time (no symptom based estimated diagnosis anymore), and postprocesses such as consultations, indications, and continuing therapies are accelerated. Beforehand, blood gas analysis parameters for emergency patients had to be taken from a POCT device at the ICU ward; rapid diagnostic for AQT parameters was not possible in proper style. Due to the use of POCT devices opportunity costs emerging from waiting times, transport, interruptions of workflow, and maintenance charges of the device at the ICU could be decreased or eliminated. Nursing staff in the ER is assigned to transport blood samples only once per hour to the central laboratory (except of medical orders), and the logistic team can be synchronised better.

3.7. First Evaluation. After a three-months pilot project with intensive practical guidance, first evaluation of the key data of the 3rd quarter 2012 and 1st quarter of 2013 was performed. The results of 150 MTS forms of the 1st quarter 2013 are displayed in Table 2 and Figure 3.

Since the ED is still suffering from crowding effects after physician's consultation due to long waiting times for interdisciplinary consultations and unsatisfactory bed allocation management no significant decline of the average total length of stay could be observed.

Analysis of the patient flow within the first four process steps (boxes admission to primary contact with physician) shows more meaningful results. Within this process steps, the length of stay decreased from average 60 minutes to 32 minutes (comparison 3rd quarter 2012 = 33 minutes) tantamount to 46% decrease of LOS in this period. Even more important is the differentiated analysis of the priorities according to MTS (Table 2 and Figure 4). Especially patients with acute symptoms benefit from the triage, since primary contact with the doctor comes along almost at the same time with the first laboratory results that are relevant to further decision making. Timeout figures suggest acceptance among physicians, since out of 150 completely filled in MTS forms only 17 timeouts are recorded (4 orange, 11 yellow, and 2 green).

4. Discussion

POCT equipment plays a key role in realising holistic solution concepts for streamlining processes and modern emergency departments are not imaginable without them anymore.

The combination of

(i) a triage system,

(ii) strategic operating standards,

(iii) symptom-based laboratory standards,

(iv) medical equipment, and

(v) a staff quality mix

allows for

(i) decrease of turn-around times and lengths of stay,

(ii) reduction of process costs (especially opportunity costs),

(iii) intelligent control of patient flow (avoidance of crowding effects),

(iv) increase of patient safety (risk prevention), and

(v) advanced employee satisfaction.

Figure 4: Future value stream map for the new patient path reflecting the clinical process on patients with abdominal pain. Source: own (project team work).

Within the following months, MTS will be integrated into the hospital's information system to further increase documentation quality for physicians in standby service, since this enables them to speed up access to all relevant data and to get an immediate overview about patient numbers and priorities no matter from which workplace in the hospital this information is needed. Due to the initial information about treatment priority given by the triage nurse combined with first vital signs and parameters from the POCT devices according to the standards, one can now consider a reorganisation of the previously inflexible processes dominated by the organisation into streamlined process working conditions that result in patient safety and employee satisfaction.

Future work will deal with the last 2 process boxes (consultation and checkout), since the hospital is still struggling with high waiting times that negatively influence the total value stream. Thus, the hospital management is thinking about establishing a central emergency ward with integrated first-aid post and ambulances for intelligent management of patient flow.

5. Conclusion

Lean management tools provide the opportunity to build more effective and safer clinical processes in the ED.

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