Improving patient satisfaction using lean manufacturing tools. Case studies from Italy

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Abstract

Purpose. The main purpose of this research is to investigate how to improve performances such as patient transportation and waiting times inside a unit of a public hospital from the emergency department. The public health care system is particularly complex and sometimes health services are provided by large hospitals in which thousands of patients are treated every day. Once a patient is inside a hospital he or she often has to travel long distances from one department to another.

Methodology. Though an active research, the logistic flow of patients inside an hospital unit has been analysed, the kind of operations rationalised using group technology and then a 'cell' inside the hospital has been designed.

Findings. The transportation cost of patients inside one of the largest Italian public hospitals has been reduced. Consequently, the patient's satisfaction due to transportation times and a loss of comfort has been improved.

Practical implications. Findings can be very useful for practitioners who are thinking about implementing Lean in the healthcare context.

Originality/value. The cost savings have been achieved using particular tools derived from Lean Thinking, such as 'spaghetti chart or diagram', the activity worksheet as well as Group Technology.

1. Introduction to Lean tools

The spaghetti chart or diagram is a visual way to trace the flow of a product, a patient, or a document through processes in a diagrammatic form. A spaghetti flow is a simple way of showing what happens to this virtual ‘spaghetti’ while the patient moves through each process, department, ward or building. It is called a spaghetti chart because the result typically looks like a dish of spaghetti. The spaghetti chart helps identify waste that is not seen in other ways, for instance walking to and from a department that is located too far from the patient using it. It helps to calculate the flow and distance that people and material travel inside a hospital.

Group Technology is a typical manufacturing layout in which functionally-grouped processes (services or products with similar characteristics) are organized into cells to improve led time and reduce wastes such as transportations and motions. Sometimes a U-shape design is related to Group Technology in order to reduce transportations and motions.

2. Review of the literature

The literature presents many articles dedicated to the implementation of models such as TQM, Six Sigma and Lean in the health care industry (Van De Heuvel et al., 2006; Van Der Wiele et al., 2006; Dey et al., 2007; Cauchick and Andrietta, 2009; Lagrosen et al., 2010; Salah et al., 2010; Sin et al., 2010; Talib et al., 2011; Portioli-Staudacher and Tantardini, 2012). Several authors discussed the general advantages of Lean in the health care. Brandao de Souza (2009) reviewed the existing literature on lean healthcare, classifying over 90 papers. As a result it seems to exist an agreement about benefits of lean healthcare, even if it remains a challenge to better understand how principles and tools have evolved over the years.

Papadopolous (2011) discussed how lean is related to continuous improvement principles and these latter are linked to dynamic actor associations.

However few authors have dealt with the use of specific Lean tools, such as VSM and especially Group Technology inside healthcare.

Ben-Tovim et al. (2004) described the generic application of Lean thinking inside healthcare in order to redesign care at the Flinder Medical Centre in Australia.

Filingham (2008) wrote a book dedicated to explaining how to improve a patient’s experience in healthcare. The book is a collection of Lean tools rather than a discussion on their applications in healthcare. VSM and Group Technology are just quoted as tools to improve processes.

Graban (2009) wrote a book for practitioners concerning the use of Lean thinking in hospitals. By the means of case studies in a chemotherapy centre and a surgical department he described how to apply a spaghetti diagram to the tracing of walking patterns (Graban, 2009, pp. 69–70). The examples given are general and do not delve into how to calculate distances and reduce them.

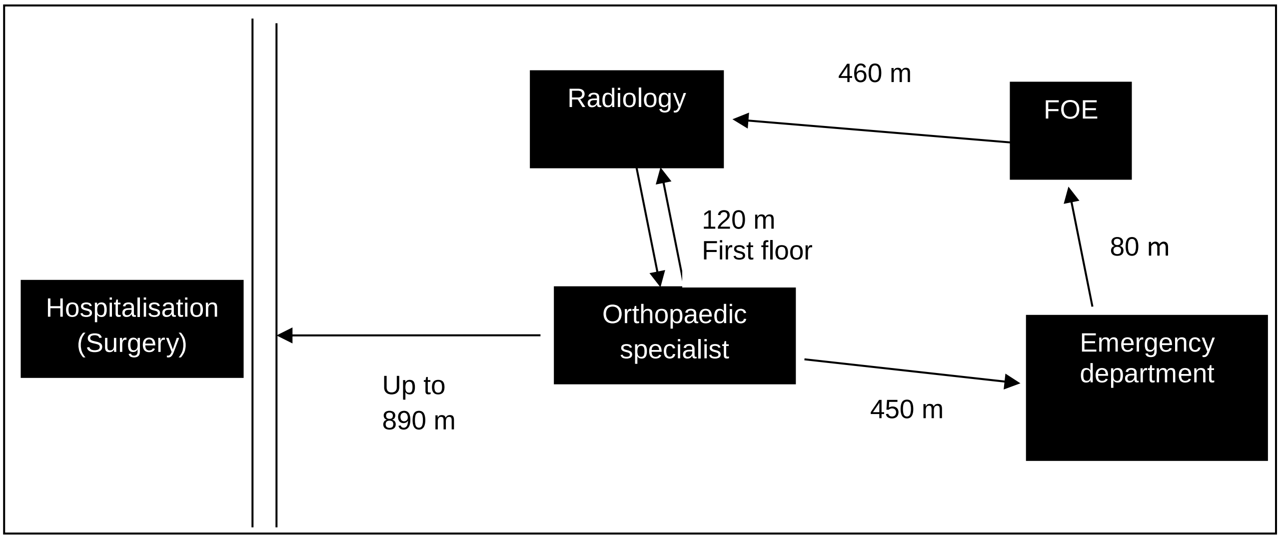
Al-Araidah et al. (2010) discussed the possibility of reducing lead time, especially in a pharmacy department, using Lean tools such as 5S and Kanban.
Other authors have dealt with the subject of Lean thinking inside healthcare, however, they analysed and discussed different tools and different objectives.

3. Discussion of the case study and the active research

The research has been carried out using a qualitative inquiry. The case study took place in a large Italian public hospital and doctors and nurses were interviewed on the patient path in case of trauma with suspected fractures from the emergency department to patient discharge or hospitalisation. On average the emergency department of this hospital manages about 100 cases per day. Of these, 25 patients need transportation by the means of a wheelchair or a stretcher. The analysis and the calculations about distances and costs were undertaken with a team dedicated to lean and logistical aspects inside the hospital.

First, the team used a spaghetti chart in order to visualise the patient track inside the hospital. Figure 1 shows a patient's track using a spaghetti chart. The patient arrives at the emergency department, a triage is assigned to the patient and then the patient travels 80 metres to a ward for the first orthopaedic examination (FOE) that is managed by a doctor. After having had this examination the patient moves 460 metres to radiology. From radiology the patient goes to the orthopaedic specialist with an X-ray report using a lift in this case because the doctor's office is on an upper floor. The specialist decides whether the patient should be hospitalised or discharged. If the patient is discharged, then he or she has to go back to the emergency department just to close the case and give all the clinical documents to a nurse. In case of hospitalisation the transportation towards surgery has been taken into account.

Figure 1 – Spaghetti chart of a patient



FOE = first orthopaedic examination. Radiology

Between the emergency department and FOE, and between FOE and radiology, as well as between radiology and the specialist's examination, the patient has to wait because of queues.

To better summarise all the times including transportations and waiting times the team has completed an 'activity worksheet diagram'. Average times have been taken by the team for the patient flow (see Figure 2).

Figure 2 – Activity worksheet for the entire patient flow

Activity worksheet

Area: Hospital 1	Code: Trauma flow
Process: T147	Kaizen Team: n°2 (Logistic improvement)
Before (date):	After (date):

Work	Movement	Transport	Waiting	Inspection	Activity	Time	Distance	Work	Movement	Transport	Waiting	Inspection	Activity	Time	Distance
○	**○**	●	▼	◈	Access to emergency department	1h	N.A.	○	**○**	●	▼	◈	Access to emergency department	1h	N.A.
○	**○**	●	▼	◈	Triage	20'		○	**○**	●	▼	◈	Triage and FOE	15'	
○	**○**	●	▼	◈	Transport towards FOE	5'	80m	○	**○**	●	▼	◈	Transport from FOE to Radiology	30'	460 m
○	**○**	●	▼	◈	Access to FOE	30'		○	**○**	●	▼	◈	Access to Radiology	40'	
○	**○**	●	▼	◈	FOE	15'		○	**○**	●	▼	◈	Radiology	20'	
○	**○**	●	▼	◈	Transport from FOE to Radiology	30'	460m	○	**○**	●	▼	◈	Orthopaedic specialist examination	30'	
○	**○**	●	▼	◈	Access to Radiology	40'		○	**○**	●	▼	◈	Movement towards emergency department or Straight exit	30' 5'	450 m 100 m
○	**○**	●	▼	◈	Radiology	20'		○	**○**	●	▼	◈			
○	**○**	●	▼	◈	Transport towards orthopaedic specialist examination	30'	120m	○	**○**	●	▼	◈			
○	**○**	●	▼	◈	Access to orthopaedic specialist	20'		○	**○**	●	▼	◈			
○	**○**	●	▼	◈	Orthopaedic specialist examination	30'		○	**○**	●	▼	◈			
○	**○**	●	▼	◈	Movement towards emergency department	30'	450m	○	**○**	●	▼	◈			
						***330'**	**1.11 km**							***230' 200'**	**560 m**

FOE = first orthopaedic examination; * average time per patient without hospitalisation.

4. Implementing Group Technology and U-Cell design

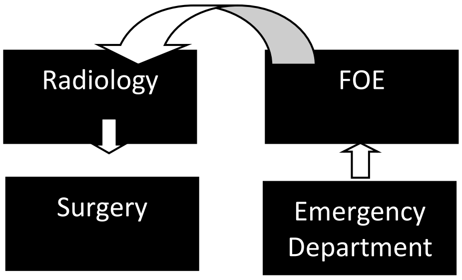
Using Group Technology, all the activities inside the flow have to be grouped. In order to reduce distances and times the team carried out the following logistic solutions:

1) Move the FOE department into the emergency department. In this way the patient's path is reduced by 80 meters and by 5 minutes of transportation. Furthermore the triage colour or revised trauma score is directly assigned to the patient by a doctor who at the same time can do the FOE. This enables a reduction of on average 5 minutes due to the fact that an orthopaedic doctor has more expertise than a generic nurse or doctor. Having moved the FOE doctor inside the emergency department the access time to the first examination has been reduced to zero.
2) The doctor who has the task to examine the patient after X-ray has been moved inside the radiology department. Indeed, this specialist is important because he or she decides whether

the patient is hospitalised or discharged. In this way the patient avoids 120 meters of path including the lift because previously the doctor's office was on an upper floor. These improvements have reduced transportation time by 30 minutes and eliminated the 20 minutes' waiting time to access the doctor's office.

3) It frequently happens that after the specialist's examination the patient is directly discharged with some minor treatment. In this case it does not make sense that the patient was supposed to return to the emergency department that is 450 meters walk away. In order to reduce times and distances, the specialist now keeps the clinical documents for the emergency department and the patient can directly leave the hospital using an exit situated about 100 meters from radiology.
4) In case of hospitalisation a closer surgery will be used.

Figure 3 shows the new U-Cell that groups all the activities.



The improvements have reduced the average lead time from 330 minutes to 200 in case of direct discharge of the patient and from 330 to 230 minutes in case of hospitalisation; this leads to an interesting cost reduction. Considering that 65% of the paths are made with a stretcher or with a wheelchair pushed by a nurse and that it happens on average 25 times per day, the saving per day is:

Saving per day = Daily cost before improvements – Daily cost after improvements
Daily cost before improvements = 330 × nurse's cost per minute × 25 =
330 × 0.26 × 25 = 2145 euros
Daily cost after improvements = 230 × nurse's cost per minute × 25 =
230 × 0.26 × 25 = 1495 euros
Saving per day = 650 euros

Considering 365 working days, the yearly saving is about 237,500 euros. These smarter logistic solutions have been carried out with little expense and without modifying the internal layout or rebuilding the spaces.

The improvements have also affected the likelihood of generating infections during the patient's path. In particular, the lift for getting to the specialist's doctor is considered a critical point for infections. Indeed the lift can sometimes be used by other patients and even visitors. With the new path the patients avoid the lift because the doctor is now at the radiology department.

5. Conclusions

This paper has demonstrated how a team inside a large hospital has cut down transportation costs using simple and smart logistic solutions; in particular, this was achieved by moving some offices and doctors from one place to another, grouping the activities by means of Group Technology and U-Cell design. In one year the hospital has saved about 237,500 euros in transportation costs in the trauma flow. The team at the moment is studying how to reduce transportation costs and eventually the hospital layout will be rebuilt. Furthermore, the reduction of the transportation path could also affect the likelihood of generating infections.

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