Optimizing MRI logistics: prospective analysis of performance, efficiency and patient throughput

By Dr K Beker & Dr KJ Mortele

From the patient 's point of view, MRI departments are frequently characterized by long waiting periods, while from the hospital's point of view, the actual use of the MR imaging system itself in the overall process cycle. is often sub-optimal

This article summarizes the results of a recent paper describing the application of "Lean" analysis techniques to MRI logistics. ("Lean" analyses were first developed for the analysis of Japanese car production processes in the late 1980s).

The results show that this approach can significantly aid in streamlining patient throughput and imaging volume.

One of the biggest burdens affecting healthcare based service industries these days, especially radiology, is patient throughput. Determining how to avoid long wait times is crucial in managing an efficient workflow. Waiting rooms and long wait periods have been common practice in medicine, but since the implementation of new patient center process improvements, they are no longer acceptable. Both the patients and the providers stand to benefit from focused process improvements which should be continuously implemented in all service areas where time is crucial in maintaining effectiveness.

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Our institution —the Beth Israel Deaconess Medical Center, within the Harvard Medical Center — is well acquainted with the "Lean" philosophy. The Lean approach consists of a set of principles and tools for streamlining workflow in service industries. It was originally implemented by Japanese automotive manufacturers in the late 1980s but is still used to this day [1].

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Lean philosophy focuses on identifying and eliminating waste in the work environment through passive observation and use of a set of distinct measuring and productivity tools. These tools aid process analysis through the identification and elimination of productivity and efficiency issues while embracing continuous transformation [2]. Application of the lean philosophy is crucial in industries that rely on customer flow and equipment function, revealing opportunities to reduce clinical and technical errors and mistakes, reduce patient and reporting waiting time, improve patient outcomes, increase staff productivity, decrease cost, and improve employee and customer satisfaction [3]. This can be achieved by effectively applying continuous improvement measures perfected in the service industry and quality assurance science [3–6].

MRI tend generally to have longer scanning times, severe delays, and increased patient wait times compared with other imaging modalities. Therefore, our team decided to embark on a Lean process analysis in our outpatient MRI scanning department where patient throughput could experience the maximum amount of improvement.

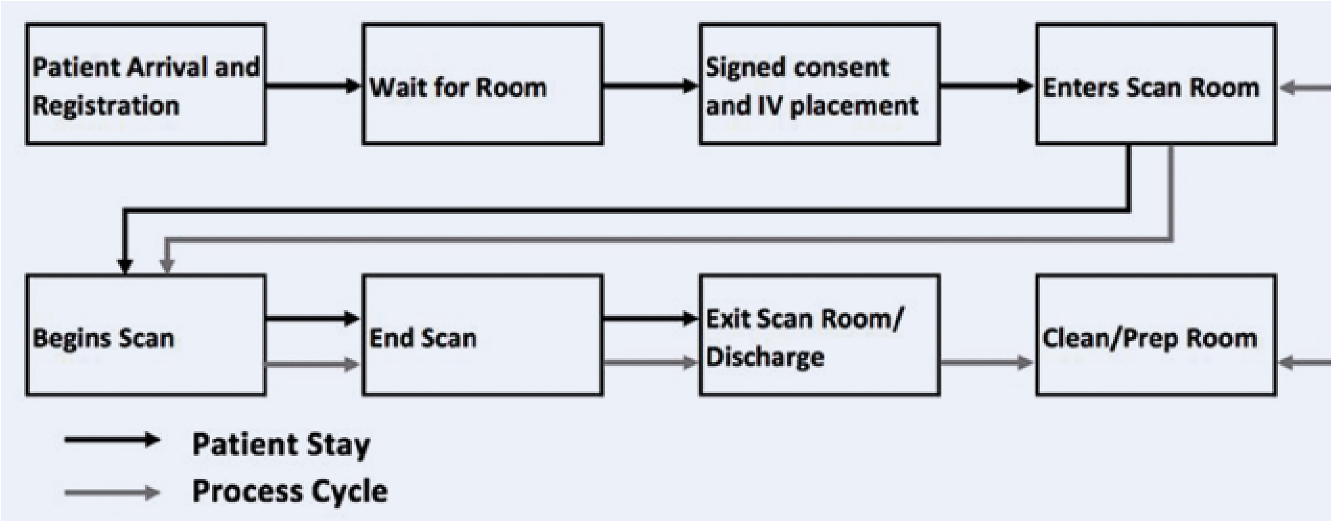

Figure 1. MRI Process flowchart of the steps necessary for the acquistion of each MR image.

MATERIALS AND METHODS

Initially, two physicians observed the process as it occurs, identifying all the steps and stakeholders in each step. We initially stratified all time intervals required for the successful imaging of each patient followed by the measurement length of each interval overa period of two weeks. To include all possible time intervals when "non-value added time" was present, we separately observed two time intervals. One time interval focused on pure MRI utilization, where the total process cycle was to fully assess the time when the scan room was idle (as "non-value added time") with differentiation between gradient time versus non-gradient time. The other time interval focused on the patient's complete length of stay, identifying any patient wait time as "non-value added" time [Figure 1] .

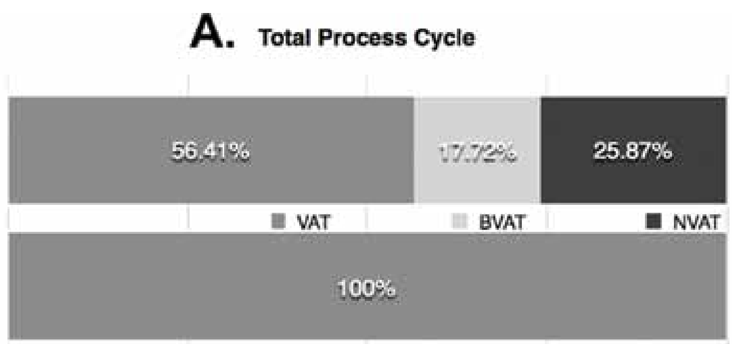

Figure 2. MRI utilization. The diagram shows representation and relations of the total MRI process cycle, gradient MRI time (value-added time,VAT) and non-gradient MRI (divided into business VAT and non-value-added time [NVAT]. The graph shows the total MRI process cycle data from two adjacent 1.5T MRI scanners (Magnetom Aera, Siemens Helathcare and Signa Twinspeed, GE Healthcare).

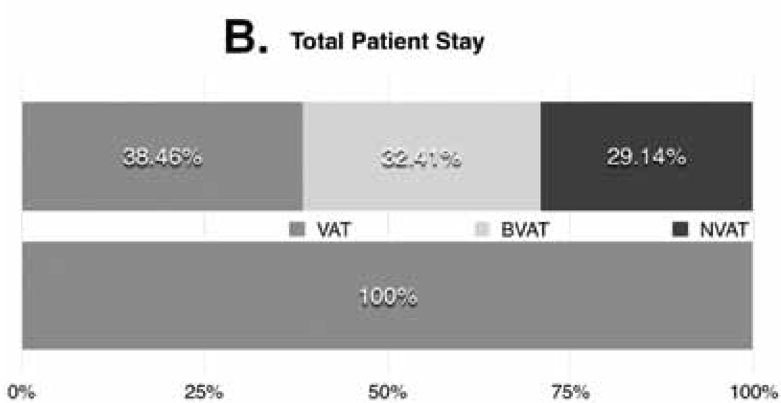

Figure 3. Breakdown of patient stay. The graph shows time values of total patient stay. VAT = value added time, NVAT = non-value added time.

By observation and feedback from the active MRI personnel, we classified multiple sources of delays and measured their influence on the total patient length of stay. We identified the specific delays when continuous improvement could have the greatest impact in decreasing wasted time.

RESULTS

A third of the total overall patient length of stay and MRI process time resulted in non-value added time. Most service industries tend to have high amounts of waste if process evaluations aren't done continuously. This is especially true when dealing with MRI scanners. Identifying and measuring the delays aided in focusing our improvement solutions to areas where the highest amounts of waste could decrease [Figure 2, 3]

Our results attributed the delay source with the highest frequency to be issues with IV port placement where a specialized nurse had to be summoned, and the

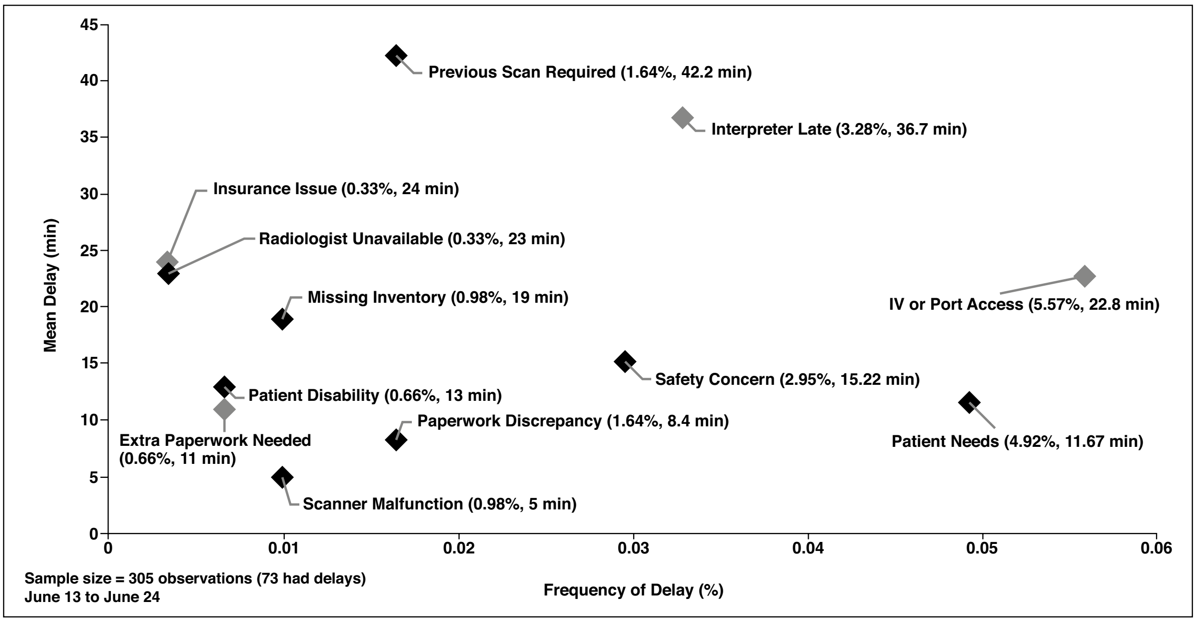

Figure 4. Frequency and Impact of delays. The diagram shows all measured delays and their mean length and frequency. Data shown in parentheses after each delay denote frequency expressed as percentage and length of delay expressed in minutes.

process had to halt until the arrival of the nurse to the preparation room for proper placement of the IV port access. On the other hand, the delay with the highest impact was attributed to MR arthrograms when a joint injection of contrast and confirmation with fluoroscopy was necessary but not accounted for in the schedule [Figure 4].

SIGNIFICANCE AND FUTURE DIRECTION

We proposed specific solutions targeting the underlying source of the delay, prioritizing the delays when overall impact and frequency were higher. As an example, our team proposed the implementation of an IV placement competency course. A course would increase the IV placement skills of all technologists and subsequently give the managers a chance to recognize the most capable technologists, providing the possibility to assure that each shift of technologists has at least one highly skilled worker who could potentially ease the IV placement in difficult to canalize patients. Thereby, resulting in a decrease in the overall IV placement delay as well as the need for an IV nurse.

Also, a department-wide initiative has taken place, focusing on the improvement of all potential delays perceived. This effort includes continuous education of staff on scheduling and booking processes, including a thorough review of all fluoroscopy and MRI scans for the identification and resolution of potential conflicts. Also, all patient scheduled are now reviewed three days in advance to identify potential issues (e.g., protocol, incorrect scanner booking, identification of claustrophobic patients, addressing patient needs, etc.).

Implant screening along with scheduling are now streamlined with the purchase of a new MR safety database that provides comprehensive and prompt implant safety information. The MRI manager is currently working alongside interpreters to successfully map the exact arrival and required time length for interpreters across all protocols, improving their overall time management, as well as implementing a three-way conversation line to aid in diminishing travel time and delays.

Since we were using tools that have assisted all service industries from automotive manufacturing to everything that is healthcare-related, our method for focused evaluation and improvement applies to all imaging departments as well as other healthcare related service departments. In fact, our team is currently in the early stages of evaluating all imaging modalities in a similar approach to identify and reduce waste across the radiology department.

CONCLUSION

Our study provides evidence on how systematic implementation of process analysis can significantly aid in streamlining patient throughput and imaging volume. Ongoing continuous improvement, if applied systematically, can potentially cut costs and increase efficiency and patient satisfaction.

REFERENCES:

1. Krafcik JF. Triumph of the lean production system. Sloan Manage Rev [Internet]. 1988;30(1):41. Available from: http://search.proquest.com/docview/224963951/abstract?accountid=10218
2. Cheung YY. No More Waits and Delays : Streamlining Workflow to Decrease Patient Time of Stay for Image-guided Musculoskeletal Procedures. Radiographics [Internet]. 2016;36(1):856–71. Available from: 10.1148/rg.2016150174
3. Kruskal JB, Reedy a., Pascal L, Rosen MP, Boiselle PM. Quality Initiatives: Lean Approach to Improving Performance and Efficiency in a Radiology Department. Radiographics. 2012; 32(2): 573–87.
4. Roth CJ, Boll DT, Wall LK, Merkle EM. Evaluation of MRI acquisition workflow with lean six sigma method: Case study of liver and knee examinations. Am J Roentgenol. 2010; 195(2): 150–6.
5. Zhang L, Hefke A, Figiel J, Schwarz U, Rominger M, Klose KJ. Enhancing same-day access to magnetic resonance imaging. J Am Coll Radiol [Internet]. 2011; 8(9): 649–56. Available from: http://dx.doi.org/10.1016/j.jacr.2011.04.001
6. Shah CJ, Sullivan JR, Gonyo MB, Wadhwa A, Dubois MS. Practice Policy and Quality Initiatives Using Lean Principles to Improve. Radiographics. 2013; 33(5): 1505–17.