Critical Review Form
Therapy

PGY-1

Applying lean: implementation of a rapid triage and treatment system. *West J Emerg Med*. 2011 May;12(2):184-91.

Objectives: **"to evaluate and discuss the application of Lean principles to our ED processes."**

Methods: **This retrospective, observational study was conducted at a non-trauma center ED in Sacramento, CA with annual census of 67,000 patients before and after implementation of a rapid triage and treatment (RTT) system using Lean principles. The RTT system was implemented on February 1, 2007; the study evaluated the six-month period prior to implementation (August 2006-January 2007) and the six-month period following implementation (March 2007-August 2007), excluding data from the first month of RTT (February 12007).**

Prior to Lean implementation, patients were met by an ED technician "greeter" who determined if the patient required immediate placement in the patient-care area. Non-critical patients were then seen by a nurse who performed a "medical screening examination," after which they were sent to a registration clerk. This triage process took 12-18 minutes, after which patients returned to the waiting room. When a bed became available, the patient would then be placed in a room and evaluated by a second nurse, and then assigned and seen by a physician. Patients of lower acuity were redirected to a "fast track" area where they would wait in a separate waiting room prior to being seen by a "fast-track" physician.

A Lean process improvement was then undertaken, involving the implementation of the RTT system. A RTT physician was placed in an area adjacent to the triage nurses to allow them to immediately address triage questions. High acuity patients (ESI 1,2, or 3) were immediately placed in exam rooms following nurse triage, while low acuity patients (ESI 4 or 5) were placed in the RTT area. The RTT physician was paired with one nurse and would treat and release patients directly from the RTT area, which was open from 8 AM to 2 PM.

Study data was extracted from the Kaiser Permanente Healthconnect system. ED census increased in the 6-month period after RTT implementation (30,981 vs.

33,926). Lower acuity patients (ESI 4 and 5) represented a statistically higher (though clinically similar) percent of patients after RTT implementation (42.1% vs. 43.2%, $X^2 < 0.004$); the percent of patients arriving by ambulance was similar before and after RTT implementation (12.8% vs. 12.4%; $X^2 < 0.101$). The hospital admission rate was higher in the period before RTT implementation compared to the period after implementation (12.9% vs. 11.6%, $X^2 < 0.001$).

Guide		Comments
I.	**Are the results valid?**	
A.	**Did experimental and control groups begin the study with a similar prognosis (answer the questions posed below)?**	
1.	Were patients randomized?	No. This was a before and after study in which the "control" group was the ED prior to implementation of the RTT system. No randomization occurred.
2.	Was randomization concealed (blinded)?	No. Randomization did not occur.
3.	Were patients analyzed in the groups to which they were randomized?	Yes. The analysis was between the ED in the 6 months prior to and following implementation of the RTT system.
4.	Were patients in the treatment and control groups similar with respect to known prognostic factors?	No. There was an increase in patient volume (30,981 vs. 33,926) and a higher percentage of lower acuity patients (ESI 4 and 5) after RTT implementation (42.1% vs. 43.2%, $X^2 < 0.004$). It is also possible that other interventions occurred in the ED or in the hospital during this study period that would have influenced the results. The percent of patients arriving by ambulance was similar before and after RTT implementation (12.8% vs. 12.4%; $X^2 < 0.101$).
B.	**Did experimental and control groups retain a similar prognosis after the study started (answer the questions posed below)?**	
1.	Were patients aware of group allocation?	Yes. There was no way to blind patients to triage processes and patient flow. It is unlikely that this would affect the outcomes described.
2.	Were clinicians aware of group allocation?	Yes. The providers (physicians, nurses, patient care technicians) were aware of and involved in the institution of changes in patient flow. The potential impact of the Hawthorne Effect needs to be considered when interpreting the results.
3.	Were outcome assessors aware of group allocation?	Yes. The outcome assessors were aware of the changes implemented, however the outcomes were objective and may not have been influenced by this fact.
4.	Was follow-up complete?	Yes. All patient visits were presumably included in the analysis given the use of an electronic medical record (Kaiser Permanente Healthconnect system).
II.	**What are the results (answer the questions posed below)?**	

<table>
<tr><td>1.</td><td>How large was the treatment effect?</td><td>In the 6 months following RTT system introduction, decreases were noted in mean ED length of stay (LOS), mean arrival to room time, mean arrival to MD start time, and the number of patients who left without being seen (LWBS).

<table>
<tr><td></td><td>Pre-RTT</td><td>Post-RTT</td><td>Statistical Testing</td></tr>
<tr><td>Mean monthly boarder hours (95% CI)</td><td>349.2 (212.3-486.3)</td><td>312.6 (222.7-402.6)</td><td>P = 0.578</td></tr>
<tr><td>Mean ED LOS (hours) (95% CI)</td><td>4.2 (4.2-4.3)</td><td>3.6 (3.6-3.7)</td><td>P < 0.001</td></tr>
<tr><td>Mean arrival to room time (min) (95% CI)</td><td>46.7 (45.9-47.4)</td><td>25.4 (25.0-25.6)</td><td>P < 0.001</td></tr>
<tr><td>Mean arrival to MD start time (min) (95% CI)</td><td>62.2 (61.5-63.0)</td><td>41.9 (41.5-42.4)</td><td>P < 0.001</td></tr>
<tr><td>LWBS</td><td>1407</td><td>512</td><td>X^2 < 0.001</td></tr>
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</td></tr>
<tr><td>2.</td><td>How precise was the estimate of the treatment effect?</td><td>See above.</td></tr>
<tr><td>III.</td><td>How can I apply the results to patient care (answer the questions posed below)?</td><td></td></tr>
<tr><td>1.</td><td>Were the study patients similar to my patient?</td><td>No. This was a smaller hospital (110 beds vs. >900 beds) in a small city in California. The ED volume was lower than ours (67,000 vs. 100,000) and this was not a trauma center. While associated with an Emergency Medicine Residency Program, only typically had 0-3 residents in the department at any time, compared with at least 6 at all times in our ED.</td></tr>
<tr><td>2.</td><td>Were all clinically important outcomes considered?</td><td>No. Most of the commonly used surrogates of patient throughput were assessed, including mean length of stay, mean arrival to room time, mean time to be seen by a physician, and left without being seen rate. Patient safety outcomes such as mortality and sentinel event rates were not considered. Patient satisfaction was also not addressed in this study.</td></tr>
<tr><td>3.</td><td>Are the likely treatment benefits worth the potential harm and costs?</td><td>Uncertain. Value stream mapping and Lean process improvements are relatively inexpensive to institute. It would be helpful to know if the benefits seen in this study persisted beyond the study period. A repeat assessment of outcomes after a sufficient period would help in this regard.</td></tr>
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Limitations:

1) **Before and after study with no true control. It is possible that other interventions occurred during the study period that would influence the results.**

2) **Failure to identify *a priori* a primary outcome (Pocock 1997).**

3) **Failure to provide detailed chart review methods (Gilbert 1996, Worster 2004).**

4) **Outcomes were only assessed for the period 6 months after the Lean intervention. Early outcomes seen after process improvements may be short-lived as enthusiasm and diligence wane.**

5) **It is unclear if the ED staff was aware of the research being conducted. It is likely that the Hawthorne Effect had some influence on the outcomes.**

6) **The Lean improvements were primarily aimed at lower acuity patients. It is possible that the affect was limited to these patients with no impact on sicker patients.**

7) **The process changes implemented involved the addition of a triage nurse and provider, an improvement which does not rely on Lean methods for implementation, and which has been well studied (Rowe 2011-nursing, Rowe 2011-physician).**

Bottom Line:

A Lean process improvement involving the implementation of a rapid triage and treatment system resulted in improvements in mean ED LOS, mean arrival to room time, mean arrival to MD start time, and LWBS rates. Given the short timeframe (6 months) over which the outcomes were assessed, it is possible that these effects were short-lived. Re-assessment of the outcome measure during another 6-month period in the years following intervention would make the results more reliable. It is also possible that any improvements seen impacted low-acuity patients only, with no impact on the sicker patients.