Critical Review Form
Therapy

Applying the Lean principles of the Toyota Production System to reduce wait times in the emergency department. *CJEM*. 2010 Jan;12(1):50-7.

Objectives: **To determine if the application of Lean techniques to the care of dischargeable patients in the Emergency Department (ED) "would improve ED efficiency and productivity, and ultimately reduce ED wait times and improve patient satisfaction." (p. 51)**

Methods: **This observational study was conducted in the ED of the Hotel-Dieu Grace Hospital in Windsor, Ontario, a regional trauma center with an annual census of 55,000 patient visits. Lean techniques were applied to the population of Canadian Triage and Acuity Scale (CTAS)-2 to -5 patients deemed by the triage nurse to be dischargeable. Patients presenting by ambulance, and those with primarily psychiatric complaints were excluded.**

The intervention began with a 3-day kaizen workshop in September 2005 that involved participants from all aspects of ED patient care. The first day focused on current-state value stream mapping, in which a view of the current process steps involved in the care of dischargeable patients was created. Once these steps were mapped, participants were asked to identify 3 key "bottlenecks" in the value stream. Day 2 of the workshop involved the creation of a future-state value-stream map. The final day involved project planning, with the focus on 3 general priorities: workplace organization, creation of standard work, and communication of Lean concepts and projects to the ED staff.

All departmental metrics were compiles manually using the hospital health records. These metrics and outcomes included mean time to see a physician, mean length of stay (LOS) for dischargeable patients, mean LOS for all ED patients, the proportion of patients who left without seeing a physician (LWBS), the patient satisfaction score (based on the NRC Picker survey), overall ED volumes, and the number of patients admitted and awaiting an inpatient bed at 6:00 AM.

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 Lean process improvements. 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 and no. The **kaizen** event occurred in September 2005. Mean wait times, mean LOS, and patient satisfaction scores were analyzed from April 2005 to September 2005 (pre-Lean process improvement); analysis was again performed from October 2005 to March 2006, and then again from April 2006 to March 2007. The mean number of admitted patients awaiting bed placement was analyzed by calendar year in 2004, 2005, 2006, and 2007.
4.	Were patients in the treatment and control groups similar with respect to known prognostic factors?	No. In March of 2006, a project was undertaken involving the reorganization of the ED into areas based on likelihood of admission. The effects seen following this time may have been at least partly the result of this intervention rather than the Lean process. It is possible that other interventions occurred in the ED or in the hospital during this study period that would have influenced the results.
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?	Unknown. There is no mention of whether or not those assessing outcomes were blinded to the Lean process improvements.
4.	Was follow-up complete?	Yes. It is highly likely that all patient visits were included in the analysis.
II.	**What are the results (answer the questions posed**	

<table>
<tr><td></td><td>below)?</td><td></td></tr>
<tr><td>1.</td><td>How large was the treatment effect?</td><td>The triage nurses were able to predict which patients would be discharged with a sensitivity of 86%.

<table><tr><td></td><td>4/2005-9/2005</td><td>10/2005-3/2006</td><td>4/2006-3/2007</td></tr><tr><td>Mean time to see MD (min)</td><td>111</td><td>89</td><td>78</td></tr><tr><td>Mean LOS (discharged patients) (hours)</td><td>3.6</td><td>3.3</td><td>2.8</td></tr><tr><td>Mean LOS (CTAS 1-3)</td><td>4.7</td><td>5.0</td><td>4.6</td></tr><tr><td>Mean LOS (CTAS 4-5</td><td>3.1</td><td>3.0</td><td>2.3</td></tr><tr><td>LWBS</td><td>7.1%</td><td>5.0%</td><td>4.3%</td></tr><tr><td>Mean monthly patient satisfaction score</td><td>79.8%</td><td>82%</td><td>83.1%</td></tr></table>
The mean number of admitted patients waiting for beds at 6:00 am daily was 1.3 in 2004, 1.8 in 2005, 4.1 in 2006 and 6.1 between January and March 2007.

P-values were not provided for any of the data, and insufficient data was provided to calculate them.</td></tr>
<tr><td>2.</td><td>How precise was the estimate of the treatment effect?</td><td>Unsure. 95% confidence intervals were not provided, and insufficient detail was provided to calculate these.</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 study was performed in a smaller (55,000 annual census vs. ~100,000 in our institution) Canadian ED in a smaller city (population ~216,000) with no associated Emergency Medicine Residency Program.</td></tr>
<tr><td>2.</td><td>Were all clinically important outcomes considered?</td><td>Yes. The authors included length of stay, mean wait times to be seen by a physician, LWBS rates, and patient satisfaction. While other outcomes such as patient safety measures could have been included, their assessment would be much more difficult.</td></tr>
<tr><td>3.</td><td>Are the likely treatment benefits worth the potential harm and costs?</td><td>Uncertain. While Lean process improvements are relatively inexpensive, the extent of the benefit is unclear from this study. No p-values were provided for the differences in the outcomes over time. Additionally, other interventions occurred during the study period, and it is difficult to know the extent to which any changes in outcome measures can be attributed to the Lean</td></tr>
</table>

		process improvements.

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) **Very few details are provided regarding the process changes implemented.**

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

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

5) **No attempt was made to control for confounders.**

6) **Estimates of precision not reported.**

7) **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.**

8) **Outcomes were measure for 5 months prior to and following process changes, with no mention of how this duration was chosen or whether the duration was chosen *a priori*.**

Bottom Line:

A series of Lean process improvements led to decreases in the mean time to see a doctor, LOS, and LWBS rate, with an increase in patient satisfaction in the 5 months following implementation. These trends continued through the following year. The study suffered from many methodological flaws that make interpretation difficult, including failure to identify a primary outcome, failure to account for other potential confounders, and failure to provide *a priori* timeframes for outcome analysis.