

Study of Outcome Variation Among an Elective Total Knee Arthroplasty Cohort using Statistical Process Control

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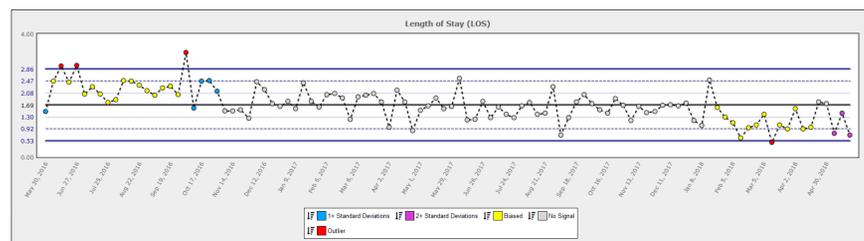
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Background

When we apply Peak Software’s risk-, severity-, and volume-adjusted Statistical Process Control (SPC) algorithm to a cohort of elective Total Knee Arthroplasty (TKA) encounters, we see a decrease overall in the weekly average Length of Stay (LOS) values over a two-year span as we move to an outpatient model for these surgeries. When conducting an SPC analysis with outcome measures, it is important to not only consider average measure values, but also the variability between the weekly values. We are only seeing common cause and special cause variation in the run charts because Peak’s adjustments account for external (non-actionable) variation.



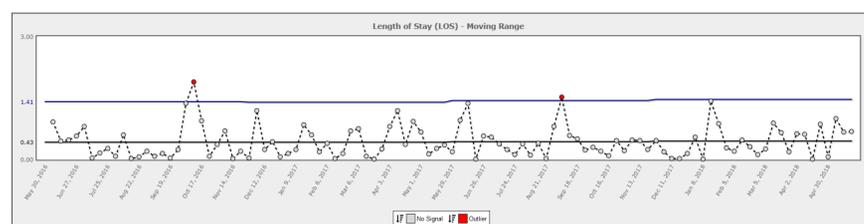
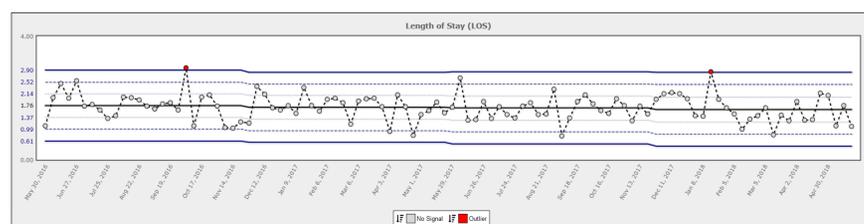
Upon visual inspection of this risk-, severity- and volume-adjusted run chart, it looks like the average weekly LOS value is decreasing.

Aim

We conduct a comprehensive study of variation to determine if the decreased LOS is statistically significant, quantify the variability in the LOS values, and assess a balanced set of outcomes for these patients. In particular, we test each 6-month interval to determine if there is a statistically significant change in mean and standard deviation of several measure values during that period.

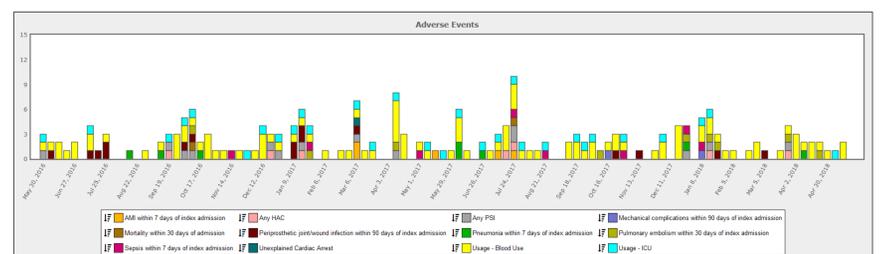
Investigation

When we apply the mean shift algorithm to the LOS run chart, we see that there is a significant decrease in average LOS over the two-year period. However, based on the Moving Range chart, we see that there was also an increase in the variability of the weekly average LOS values.



When we add a mean shift analysis to the run chart, we see a statistically significant decrease in the average weekly LOS over time. However, the Moving Range chart indicates an increase in the week-over-week variability, which is concerning in an SPC analysis.

Morbidities can be another indicator of inconsistent processes. In Peak’s Adverse Events bar chart, we can see all unanticipated incidents for each week, corresponding to the weeks displayed in the run chart. Here, we see several instances of ICU stays and blood utilization, which should be avoided with TKA patients.



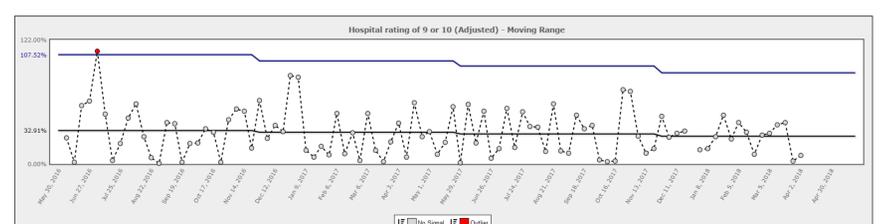
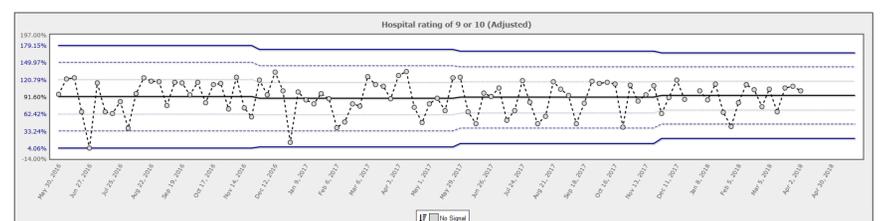
Adverse Events, or morbidities, are contributing factors to increased LOS of any patient. In particular, we may want to focus on decreasing the blood utilization for TKA procedures.

Application

While the decreased LOS is likely desirable, consistency is priority with any SPC analysis. First, we want to see consistency in our process over time, as indicated by our outcome measures and morbidities. Then, we can enact additional interventions to support our overall long-term outcome goals, such as transitioning all TKA procedures to the outpatient setting. The variability in the LOS outcomes indicate that we do not have consistency in our treatment processes for TKA patients, which is also shown in the high number of adverse events displayed.

Next Steps

Moving forward, we want to ensure a balanced set of outcomes by investigating other related measures. For example, using a Peak SPC run chart with the Adjusted HCAHPS Hospital Rating measure, we can see that the weekly average adjusted survey response values are increasing. Moreover, the associated Moving Range chart indicates that the week-over-week variability is decreasing, which is necessary in successful Statistical Process Control initiatives. By leveraging the power of Peak, we eliminate external variation, so we can focus on common and special causes in our variation-reduction efforts and easily identify the fastest path to actionable change for our patients.



Not only do we see an increase in the Adjusted HCAHPS Hospital Rating values over time, there is a decrease in the variability between weeks, which is necessary for process control.