Jerry Lassa, MS Statistics

PHASE Data For Improvement Webinar: Taking the Pulse of Improvement Efforts Using Run Charts and Funnel Charts

July 18, 2018
**Zoom Webinar Housekeeping**

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2. You can chat in questions or raise your hand in the participant list to be unmuted.

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4. Please fill out our feedback survey at the end of the webinar.

5. Please participate in all polls during the webinar.
PHASE Data For Improvement Webinar
Taking the Pulse of Improvement Efforts
Using Run Charts and Funnel Charts

JERRY LASSA, MS STATISTICS
JULY 18, 2018
LEARNING OBJECTIVES

▪ Gain a deeper understanding of the data in your improvement efforts

▪ Learn how to use visual display and statistical analysis techniques that flag significant trends in data
  • Run Chart and Deming’s Rules
  • Testing of Means
  • Funnel Charts
Most importantly...

Learn to embrace, not fear, your data.
YOUR PHASE
MEASURE
PROGRESS
POLL #1

My role with PHASE data (can select more than one):

- Capture (e.g., see patients, document in EHR)
- Compile, analyze (e.g., pull data, create reports)
- Use for improvement (e.g., clinical, operational)
POLL #2

We compile and review our PHASE measures at least:
- Weekly
- Monthly
- Quarterly
POLL #3

Our top challenge(s) in making use of data for improvement is (can select more than one):

- Availability of the right data (frequency, granularity)
- Data quality (accuracy, reliability)
- Fully understanding and communicating the data we have (“data literacy”)
- Diligence and follow-through in acting on the data
- Other
DOGBERT CONSULTS

YOU NEED A DASHBOARD APPLICATION TO TRACK YOUR KEY METRICS.

THAT WAY YOU'LL HAVE MORE DATA TO IGNORE WHEN YOU MAKE YOUR DECISIONS BASED ON COMPANY POLITICS.

WILL THE DATA BE ACCURATE?

OKAY, LET'S PRETEND THAT MATTERS.
TREND CHARTS & DASHBOARDS
("DESCRIPTIVE ANALYSIS")

IMPORTANT TO HAVE REPORTS & DATA DISPLAYS THAT VISUALIZE WHAT’S HAPPENING WITH DATA “ON THE SURFACE”
ENSURE DATA QUALITY\(^1\)

Are the numbers right?
(Is there data integrity?)

- **Verifiable** – you get the same number when using different data sources
- **Accurate/Reliable** – numerator and denominator are correct; based on measure specs; get consistent results from same reporting tool
- **Retrievable** – desired data elements are documented in EHR in format that is possible to query (e.g., structured vs. un)
- **Complete** – all data elements, including repeat or re-analysis, are included

\(^1\) This checklist was developed as part of Million Hearts® work funded by the Centers for Disease Control and Prevention (CDC) and is © 2016 TMIT Consulting and NACHC; non-commercial use with attribution is permitted.
Two people in a focus group loved our product, so we're doubling our production.

The opinions of two people are not statistically useful...

...especially if you're one of the two people.

I knew those free sandwiches were too good to be true.
TECHNIQUES TO IDENTIFY IF VARIATION IS STATISTICALLY RELEVANT (“PREDICTIVE ANALYSIS”)

For an “early warning” of statistically relevant changes, use a run chart and Deming’s Rules

To statistically test for differences from period to period (e.g., month to month, quarter to quarter, year to year), use trend analysis

To statistically identify outliers (good and bad) for a single period of performance (e.g., one month, one quarter, one year), use a funnel chart
ARE YOUR PDSA'S WORKING?

When to use:
- When you lead teams through efforts using PDSA cycles and are testing and monitoring the impact of changes. For example, an effort focused on diabetic patient outreach and BP control. Has the effort resulted in meaningful change so far?

What the results will help you determine:
- Whether there is statistical evidence that improvement efforts may be leading to significant changes.

Potential Challenges:
- Sufficient data points for each period to ensure they are representative. Aim for 15-30 measurements.

For an “early warning” of statistically relevant changes, use a run chart and Deming’s Rules.
RUN CHARTS

DM BP Control (<140/90)

Q4 2015 | Q1 2016 | Q2 2016 | Q3 2016 | Q4 2016 | Q1 2017 | Q2 2017 | Q3 2017 | Q4 2017 | Q1 2018 | Q2 2018 | Q3 2018
--- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | ---
64% | 63% | 64% | 64% | 64% | 65% | 70% | 71% | 71% | 72% | 73% | 65%
Deming’s Rules for Run Charts

One or more broken rules is a signal of “special cause” variation.

<table>
<thead>
<tr>
<th>#</th>
<th>Rule</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Shift - 6 or more consecutive points either all above or all below the median</td>
<td>There is evidence that the underlying process (e.g., care process) has systematically changed, resulting in sustained improvement or decline.</td>
</tr>
<tr>
<td>2</td>
<td>Trend - 5 points all going up or all going down</td>
<td>There is evidence that the underlying process is steadily improving or worsening.</td>
</tr>
<tr>
<td>3</td>
<td>Runs - a series of points in a row on one side of the median. (Total runs = n + 1, where n equals # times the line between data points crosses the median.)</td>
<td>There is evidence that the underlying process is erratic and may not be producing normal, or common cause, variability.</td>
</tr>
<tr>
<td>4</td>
<td>Astronomical Point - unusually large or small points</td>
<td>There is evidence the underlying process is producing suspect or outlier(s) results.</td>
</tr>
</tbody>
</table>
RUN CHARTS WITH DEMING’S RULES APPLIED

DM BP Control (<140/90)

Rule 1 triggered: Shift up
Rule 2 triggered: Trend up
RUN CHART IN EXCEL
DID YOUR MEASURE CHANGE SIGNIFICANTLY?

When to use:
- When presenting, for example, quarterly results on a measure to your leadership team and they want to know if they should take action on any of the trends occurring (up or down).

What the results will tell you determine:
- Whether there was a statistically significant change (improvement or decline) that warrants action (recognition or intervention).

Potential Challenges:
- Accuracy of numerator and denominator totals. Ensure data quality.
**TREND ANALYSES**

**USE TO DETERMINE IF MEASURE CHANGES ARE STATISTICALLY SIGNIFICANT**

Was your measure improvement or decline statistically significant?

You can use this approach:

Difference of Proportions Hypothesis Test:

H$_0$: $P_1 = P_2$

H$_1$: $P_1 \neq P_2$

$\alpha = 0.05$ testing level

(~2 standard deviation difference will be significant)

**Sample Test Statistics for Tests of Hypotheses for difference of proportions**

$$z = \frac{\hat{p}_1 - \hat{p}_2}{\sqrt{\frac{\bar{p} \bar{q}}{n_1} + \frac{\bar{p} \bar{q}}{n_2}}}$$

where $\bar{p} = \frac{r_1 + r_2}{n_1 + n_2}$ and $\bar{q} = 1 - \bar{p}$

$\hat{p}_1 = \frac{r_1}{n_1}; \hat{p}_2 = \frac{r_2}{n_2}$

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<table>
<thead>
<tr>
<th>Sample size (each period)</th>
<th>Significant Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>19%</td>
</tr>
<tr>
<td>40</td>
<td>17%</td>
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<tr>
<td>50</td>
<td>15%</td>
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<tr>
<td>60</td>
<td>14%</td>
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<tr>
<td>70</td>
<td>13%</td>
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<tr>
<td>90</td>
<td>12%</td>
</tr>
<tr>
<td>100</td>
<td>11%</td>
</tr>
<tr>
<td>200</td>
<td>8%</td>
</tr>
<tr>
<td>300</td>
<td>7%</td>
</tr>
<tr>
<td>500</td>
<td>6%</td>
</tr>
<tr>
<td>800</td>
<td>5%</td>
</tr>
<tr>
<td>1500</td>
<td>4%</td>
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<tr>
<td>1600</td>
<td>3%</td>
</tr>
<tr>
<td>3600</td>
<td>2%</td>
</tr>
<tr>
<td>15000</td>
<td>1%</td>
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</tbody>
</table>

"The UDS 70"
TREND ANALYSES
USE TO DETERMINE IF MEASURE CHANGES ARE STATISTICALLY SIGNIFICANT

Let’s use the easier approach!

Example: BP Control has improved from 55% last year to 58% this year in Q1.

Was the improvement statistically significant?

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<tr>
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</tbody>
</table>

Look up measure denominator in table to determine approximate difference required for significance

Since denominator for each period is ~5,000, a 1-2% change will be significant.

>> Increase of 3% is statistically significant. Celebrate!
WHICH PROVIDERS NEED HELP?

When to use:

- Use for priority measures where provider variability is high. For example, you may be trying to improve incentive payments from a health plan and want to identify providers that are performing significantly better or worse than all providers in total.

What the results will tell you determine:

- The Funnel Chart compares results for a single measure across all providers on a single chart and displays a confidence interval (an upper and lower bound on the measure) for each provider. It identifies which providers are performing significantly better or worse than all other providers on that measure.

Potential Challenges:

- Transparency. All should agree to sharing. Otherwise results should be masked or coded.
FUNNEL CHARTS
USE TO STATISTICALLY IDENTIFY OUTLIERS (GOOD AND POOR) FOR A SINGLE PERIOD OF PERFORMANCE

What is the Margin of Error on results for individual providers?

You can use this approach:

95% Confidence Interval for a single population proportion:

\[ \hat{p} - E < p < \hat{p} + E \]

where \(E = z_c \sqrt{\frac{\hat{p}(1 - \hat{p})}{n}}\)

\[ \hat{p} = \frac{r}{n} \]

z_c = 1.96 critical value

(~2 standard deviation Margin of Error)

Or you can use this approach:

<table>
<thead>
<tr>
<th>Provider</th>
<th>Num</th>
<th>Den</th>
<th>BP Control</th>
<th>MOE</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>55</td>
<td>90</td>
<td>61%</td>
<td>10%</td>
</tr>
<tr>
<td>J</td>
<td>85</td>
<td>130</td>
<td>65%</td>
<td>8%</td>
</tr>
<tr>
<td>Q</td>
<td>180</td>
<td>250</td>
<td>72%</td>
<td>6%</td>
</tr>
</tbody>
</table>

Enter in provider level numerators and denominators and let Excel compute the Margin of Error!

Margin of Error (“MOE“ or just “E“) is used to compute the +/- range (Confidence Interval) for the “true” measure value. The more data points (patients) you have, the smaller MOE will be.
FUNNEL CHARTS
USE TO IDENTIFY STATistically
SIGNIFICANT PRACTICE VARIATION

BP Control (<140/90)

Upper Control Limit for each provider

Lower Control Limit for each provider
FUNNEL CHARTS
USE TO IDENTIFY STATISTICALLY SIGNIFICANT PRACTICE VARIATION

BP Control (<140/90)

Significantly better than all providers

Significantly worse
FUNNEL CHART IN EXCEL
PRESENTING & DISCUSSING RESULTS
FAMILY HEALTH CENTER EXAMPLE

1) Run Chart

<table>
<thead>
<tr>
<th>January</th>
<th>October</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Numerator</td>
<td>647</td>
<td>1,827</td>
</tr>
<tr>
<td>Denominator</td>
<td>1,105</td>
<td>3,011</td>
</tr>
<tr>
<td>HTN BP Control</td>
<td>59%</td>
<td>61%</td>
</tr>
</tbody>
</table>

2) Trend Analysis

<table>
<thead>
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<td>3600</td>
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3) Funnel Chart by Provider

- High performing provider
- These providers need help
- Close to a significant improvement from Jan to Oct
HELPING HANDS HEALTH CENTER

1) Run Chart

<table>
<thead>
<tr>
<th></th>
<th>Jan</th>
<th>Oct</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Numerator</td>
<td>1,022</td>
<td>1,717</td>
<td></td>
</tr>
<tr>
<td>Denominator</td>
<td>1,776</td>
<td>2,744</td>
<td></td>
</tr>
<tr>
<td>DM BP Control</td>
<td>58%</td>
<td>63%</td>
<td>5.0%</td>
</tr>
</tbody>
</table>

Trend up

2) Trend Analysis

<table>
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<td>2%</td>
</tr>
</tbody>
</table>

3) Funnel Chart

Site D needs help

Significant improvement from Jan to Oct
Understanding the Source of Significant Changes in the Data (if any)

Be sure you have a good understanding of the underlying source of change so you can aim improvement efforts accordingly:

- Was there a change in measurement?
- Change in HIT?
- Change in reporting?
- Change in staffing?
- Change in practice?
In Conclusion

• Have trend charts and dashboard in place to monitor measures “descriptively.”

• Use advanced analysis techniques such as run charts with Deming’s Rules, trend analysis, and run charts to monitor measures “predictively” and gain deeper insights.

• Use these techniques to create a shared language about interpreting results and whether action should be taken.

• No surprise discussions with results! Be sure to meet with data stakeholders prior to meetings to share approach and findings. Encourage data owners to present findings.
CONTACT INFO

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Accessing the template

Slides & Template will be posted to the PHASE support portal:

- [careinnovations.org/phasessupport](http://careinnovations.org/phasessupport)
- Go to Resource Hub
- Scroll down to Latest PHASE Convening & Webinar Resources