QI Project Graphing

For the majority of users, it is much easier to understand data, especially numerical data, through pictures rather than tables. "A picture is worth a thousand words" is a well-known adage that applies as easily to performance data as it does to the world in general. Taking this adage one step further in terms of "performance data", we should add "but only if it is the RIGHT picture".

How do I Access Graphing?

Click on the **Graphing** link which is found on the "Reports/Graphs" menu from the main product tabs.

The steps in this guide provide an orientation to the chart types and how to create them. Refer to the Data Analysis Guide and on-demand webinar sessions for details on interpreting graphs. Graphing is also supported by in-product HELP that provides guidance and explanations of graphing elements, charts and tables.

What Graphs are Available?

The three types of charts available in the QI Project® graphing function are control charts, comparison charts, and other graphs (a simple line chart). Each chart is always accompanied by a table of values that summarizes the values on which the chart was based. All charts and tables created in the graphing feature are created using SAS, one of the most sophisticated and powerful statistical programs currently available. The charts and tables created can be saved but cannot be modified in any way. For example, you cannot change font size, colors or marker types. The default chart for performance improvement is always the Control Chart.

Common graphing elements display default values that are pre-programmed. For example, the default start month and year is always the earliest month and year that data were collected by your facility for a measure. The default end month and year is always the current month and year.

To make the most efficient use of your time, each graphing selection you make when creating a chart is "sticky". This means that you do not have to re-select each element or re-enter date values if you decide to create the same chart type for more than one measure or if you decide to create a different chart type for the same period.

Control Charts

The default chart choice is always the control chart since this chart best displays your facility's process of care, the processes' control limits and relevant types of special cause variation. A control chart is particularly useful in identifying special cause variation in your facility's data. Special cause variation occurs when something external to your process influences performance for that process of care. Special cause variation must always be identified and eliminated from processes to insure the best possible outcomes.

SAS will identify three common types of special cause variation and automatically flag them in the graphs and accompanying tables. Refer to the table below for the four types of Statistical Process Control (SPC) tests identified.

Identifying Special Cause Variation		
SPC Test	**Special Cause Type**	**Description of Special Cause**
Test 1	Outlier	*Any data point beyond <u>the identified</u> sigma limits*
Test 2	Shift in the process	*Nine or more consecutive data points on the same side of the Centerline (CL)*
Test 3	Trend	*Six or more consecutive data points whose values steadily increase or decrease*
Test 4	Data oscillations (Zig-Zag or saw-tooth)	*14 or more points in a row alternating up or down*

SAS automatically creates the correct control chart for a measure's data type. The two data types are discrete data (found in CMC, OPC and Psych Insights) and continuous data (found only in CMC and OPC).

- *Discrete data* (which are things we count)
  - SAS creates
    - **p-chart** for proportion measures
    - **u-chart** for ratio measures
- *Continuous data* (which are things we measure),
  - SAS always creates an **I-chart** which is the preferred analysis tool for these measures.
    - Depending on the number of data values for the period in your graph, in addition to the I-chart, SAS may also permit you to create an aggregate chart.
      - An **X-bar and s chart**, that averages the individual values for each month and then plots the monthly average in the topmost of two charts and each month's standard deviation value on the lower chart, or
      - An **M-chart** that plots the median value for each month in the topmost of two charts and the range for each month on the lower chart.

A word of warning is in order about data aggregation. Aggregating data can actually hide special cause variation and lull you into a false sense that all is well with your process. Aggregation should always be approached with caution and individual values must always be analyzed first before any aggregation is attempted.

Comparison Charts

The second chart type available to you from the drop-down list on the graphing link is a Comparison Chart. A comparison chart is a special chart that compares your facility's monthly performance values for a measure to the aggregate performance of all other QI Project facilities for the same measure.

The QI Project® creates two types of comparison charts, each tailored to the type of data type collected by the measure. Factors that influence the comparison chart type are whether the data are discrete or continuous, and, if discrete data, whether the measures are proportions or ratios. Because health care data are not normally distributed and population sizes for a measure may be small, further adjustments are made to the calculations for the expected performance interval using the values for the QI Project-wide comparison group's weighted mean rate, the facility's rate, and the facility's population.

SAS automatically creates the correct comparison chart for the measure's data type.

- *Discrete data* (or things that we count)
  - The comparison chart calculations generally produce upper and lower limits of the expected performance interval of unequal size. When the facility rate is less than 50, the lower interval will be larger than the upper interval. Conversely, when the facility's rate is greater than 50, the upper interval will be larger than the lower interval. Should the facility rate be exactly 50, the upper and lower range intervals will be of equal size.

- *Continuous data* (or things that we measure)
  - There is no adjustment for the facility's rate or population and the upper and lower parts of the range interval will always be equal.

The QI Project recommends that you view the entire chart carefully with an eye to examining your facility's overall performance within the context of other QI Project facilities. Placing your facility's overall rates in context with the comparison group's weighted mean can help you decide whether to celebrate a success or strategize on ways to improve performance.
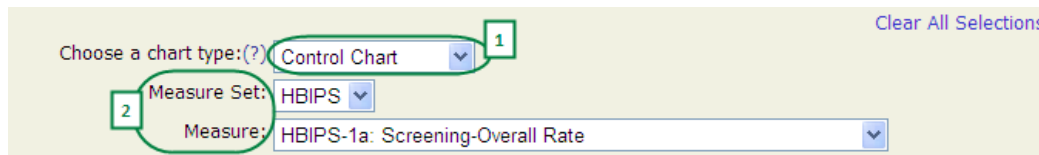
Other Graphs

The third chart available to you from the drop-down list on the graphing link is other graphs. This is a simple line chart that allows you to plot specific values: your facility's values, the QI Project-wide values or, if appropriate to your facility, the Sponsor values. These values can be displayed singly or in any combination with one another.
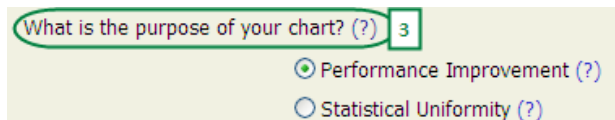
Creating Graphs: Control Charts

Discrete Data: the p-chart and u-chart

As noted above, there are two control chart types used for discrete data; the p-chart, which is used for proportions and the u-chart which is used for ratios. The following help text focuses on the **p-chart** as all CMC, OPC, and Psych Insights discrete measures are proportions with the exception of HBIPS-2 (Restraints) and HBIPS-3 (Seclusion) which are ratios. Note that the graphing elements and options for the **u-chart** are the same as those for a p-chart.

1. The chart type automatically defaults to **Control Chart**.

2. The first two graphing elements after selecting Control Chart—**Measure Set** and **Measure**—allow you to select the Measure Set and Measure for your control chart. Choose the Measure Set, then the Measure you would like to chart. Note that for Outpatient measures graphing, you actually choose a **Topic (Emergency Department** or **Surgery)** and then the **Measure.**

3. The next selection element is, "**What is the purpose of your chart?**" Select the response option based on what you intend to examine when looking at your chart.

   Your response to this question determines which special cause variation rules SAS will apply to the control chart.

   - If you choose **performance improvement (the most common reason for creating a control chart)**, SAS will apply all applicable special cause variation rules as it automatically analyzes the chart.
   - If you choose **statistical uniformity**, SAS applies only the outlier rule since your purpose is to check whether the data values for the period graphed are statistically uniform; or more simply, whether outlier or extreme values are present. If outlier values are present, the data are not statistically uniform.

4. **How would you like to plot your data?** This graphing element gives you two options based again on the data type.
   - For p-charts used for discrete data found in proportion measures, you can choose to graph either on a **Monthly** basis (recommended) or on a **Quarterly** basis. For quality

activities, it is always best to graph monthly rather than aggregate the data by quarter because quarterly graphing "flattens" the data. Aggregating data can actually hide special cause variation and lull you into a false impression that all is well with your processes of care when quite the opposite might be true. Remember that aggregating data moves your analysis further from actual patient experience.

5. Next you'll choose the **Date Range** you wish to plot in the control chart. For **Monthly** aggregate, you choose the *Month & Year* to start the graph and end the graph. For **Quarterly** aggregate, you choose the *Quarter & Year* to start the graph and end the graph. Any interval of months, quarters or years can be graphed.

6. After making all necessary selections to create your control chart, click on the **Generate Graph** button at the bottom of the selection page.
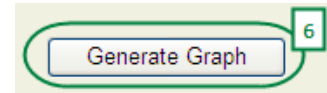
Format and Layout: p-chart and u-chart

The data table of values appears below the chart. The format and layout of the data table for the u-chart mirrors that of the p-chart. Click on the help links (?) to bring up the files that explain the specific calculations and variables included in the chart and table.

P Chart(?)

Click on Save Graph to save the graph to an image file.

Save Graph

P Chart for Performance Improvement
HBIPS-1a: Screening-Overall Rate

The light blue highlighted area demarcates the charts sigma control limits.

The facility's process of care is plotted as a blue line with each month's performance value indicated by a dot on the line.

Red dots indicate that special cause variation was identified. See the *SPC Test* column of the data table to see which test(s) were identified.

Subgroup Sizes   Min n = 106   Max n = 131

Click on Save Table to save the table to a csv file

P Chart Subgroup Size Table(?)
Save Table

Date	Num	Den	p value	SPC Test	Subgroup Small #	Power for Outliers	LCL p	Mean p
2008OCT	101	129	0.7829	1	N	Y	0.809	0.8913
2008NOV	102	124	0.8226		N	Y	0.8074	0.8913
2008DEC	92	123	0.748	1	N	Y	0.8071	0.8913

Continuous Data: the I-chart, X-bar and s chart and M-chart

For continuous data measures an I-chart is always produced. Depending on your data set, SAS may also allow you to create an X bar and s chart or an M-chart. The following help text focuses on the **I-chart** as it is always created for continuous measures.

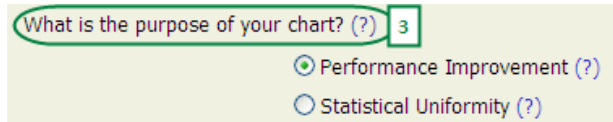1. The chart type automatically defaults to **Control Chart**.

2. The first two graphing elements after selecting Control Chart—**Measure Set** and **Measure**—allow you to select the Measure Set and Measure for your control chart. Choose the Measure Set, then the Measure you would like to chart. Note that for Outpatient measures graphing, you actually choose a **Topic (Emergency Department** or **Surgery**) and then the **Measure.**
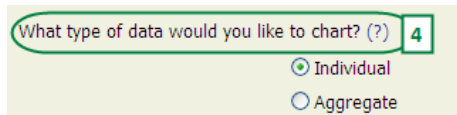

3. The next selection element is, "**What is the purpose of your chart?**" Select the response option based on what you intend to examine when looking at your chart.

    Your response to this question determines which special cause variation rules SAS will apply to the control chart.

    - If you choose **performance improvement**, SAS will apply all applicable special cause variation rules as it automatically analyzes the chart.

    - If you choose **statistical uniformity**, SAS applies only the outlier rule since your purpose is to check whether the data values for the period that is graphed are statistically uniform, or more simply, whether outlier or extreme values are present. If outlier values are present, the data are not statistically uniform.

4. The next selection element is, "**What type of data would you like to chart?**" Select the response option based on what you intend to examine when looking at your chart.

    The options provide the capability to plot either **Individual** values (the preferred approach) or to plot **Aggregate** values (always approached with caution).

    - **Individual** is the default choice because you analyze each case to evaluate the time it took from arrival to that measure's clinical intervention. Choosing the default creates an I-chart; where the "I" stands for "individual values".
    - Choosing the **Aggregate** option may produce an X bar and s chart or an M-chart in addition to the I-chart if the data set for the period graphed must meet specific population criteria for aggregate charting. Should the data set not meet these criteria, SAS will produce only an I-chart.

5. a. - If you select **Individual** values for the question, "**What is the purpose of your chart?**"

Define the time period for an I-chart by selecting the **Date Range** you wish to plotted in the control chart. Choose the *Month, Day and Year* to start the control chart and the Month, Day and Year to end the control chart. Any period of time for which you have data can be graphed.

5. b. - If you select **Aggregate** for the question, "**What is the purpose of your chart?**"
1. An additional graphing element will appear, "**How would you like to plot your data?"**

- Choose to graph either on a **Monthly** basis (recommended) or on a **Quarterly** basis. For quality activities, it is always best to graph monthly because quarterly graphing "flattens" the data. Aggregating data can actually hide special cause variation and lull you into a false impression that all is well with your processes of care when quite the opposite might be true. Remember that aggregating data moves your analysis further from actual patient experience.

2. Define the time period for the aggregate chart by selecting the **Date Range** you wish to plot in the control chart. For **Monthly** aggregate, you choose the *Month & Year* to start the control chart and the *Month & Year* to end the control chart. For **Quarterly** aggregate, you choose the *Quarter & Year* to begin the control chart and the *Quarter & Year* to end the control chart. Any interval of months, quarters or years can be graphed.

- If the data set for the period you wish to graph meets population requirements, either an X-bar and s chart or an M-chart may be created. Should the data not meet aggregation criteria, SAS produces only the I-chart.

6. After making all necessary selections to create your control chart, click on the **Generate Graph** button at the bottom of the selection page.

Format and Layout: I-chart

A data table containing the values on which the chart(s) were based appears below the I-chart, X-bar and s chart or M-chart. Unlike the control charts for discrete data, a control chart for continuous data has two individual chart components. The upper chart plots each individual value for the period graphed. The lower chart plots the Moving Range. Clicking the help links (?) will bring up Help text that explains calculations and variables included in the chart and table.
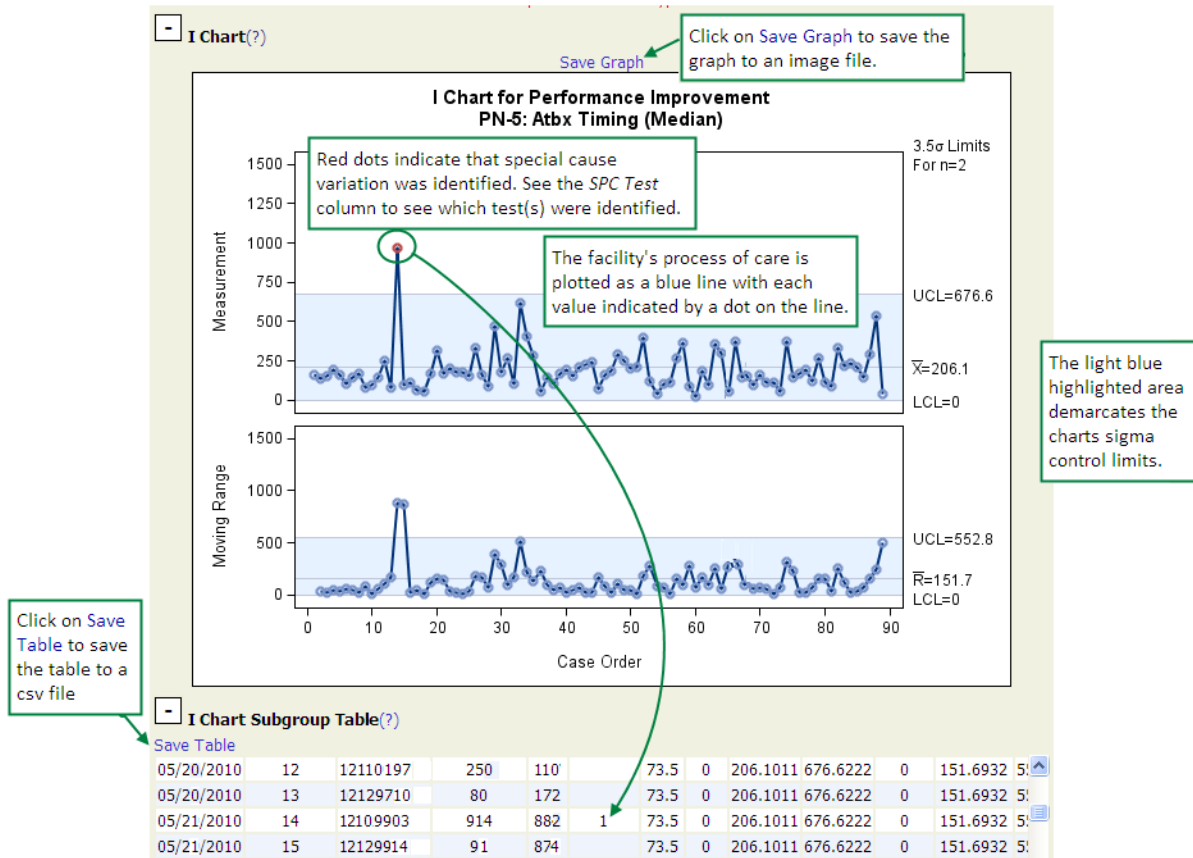
Core measures performance data are skewed. Although Statistical Process Control inherently adjusts for some degree of skewing, extreme skewing can adversely affect even Statistical Process Control analysis; specifically the ability to accurately identify a true outlier. A special graph—the probability plot—has been developed to visually help you determine the degree of skewing present in continuous data.
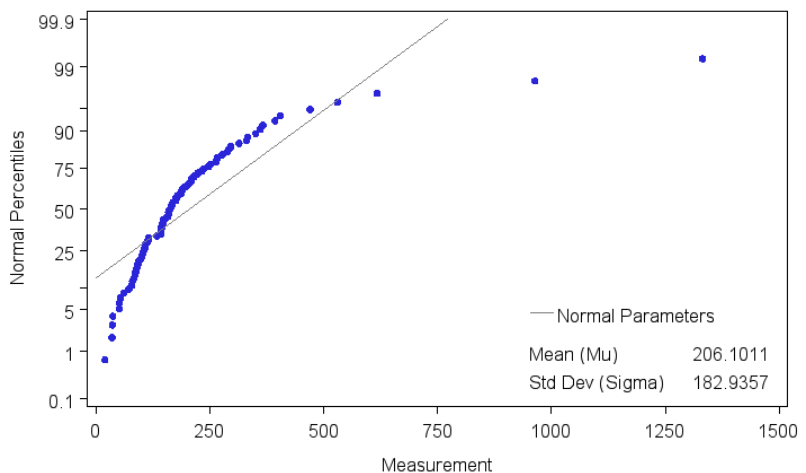
The Y or vertical axis of the probability plot has been created to perfectly mimic a bell-shaped curve. The data points in a data set that is normally distributed (data without any skewing whatsoever) will line up as a straight line on a probability plot. Data that are skewed produce a distorted line—the more distorted the line, the greater the degree of skewing. A simple test has been developed to screen a probability plot for extreme skewing—the "Fat Pen Test". If you can cover the majority of data points on a printed probability plot with a typically sized ball point pen, the data are not extremely skewed and subsequently pass the Fat Pen Test. If you cannot cover the majority of the data points, the data set fails the Fat Pen Test and extreme skewing is present. Minor skewing does not significantly affect your ability to identify outliers. Extreme skewing affects the ability to determine which, if any, data points in a distribution might actually be an outlier or extreme value. Click on the help link (?) to bring up the files that explain how to examine the probability plot.

Format and Layout: X-bar and s chart

As was the case for previous control charts, there is a table of values and associated help files that explain the variables on which charts and associated table are based. An X-bar and s chart is a paired control chart that plots subgroup averages and the standard deviation of the subgroups. The X-bar graph appears above the s graph.
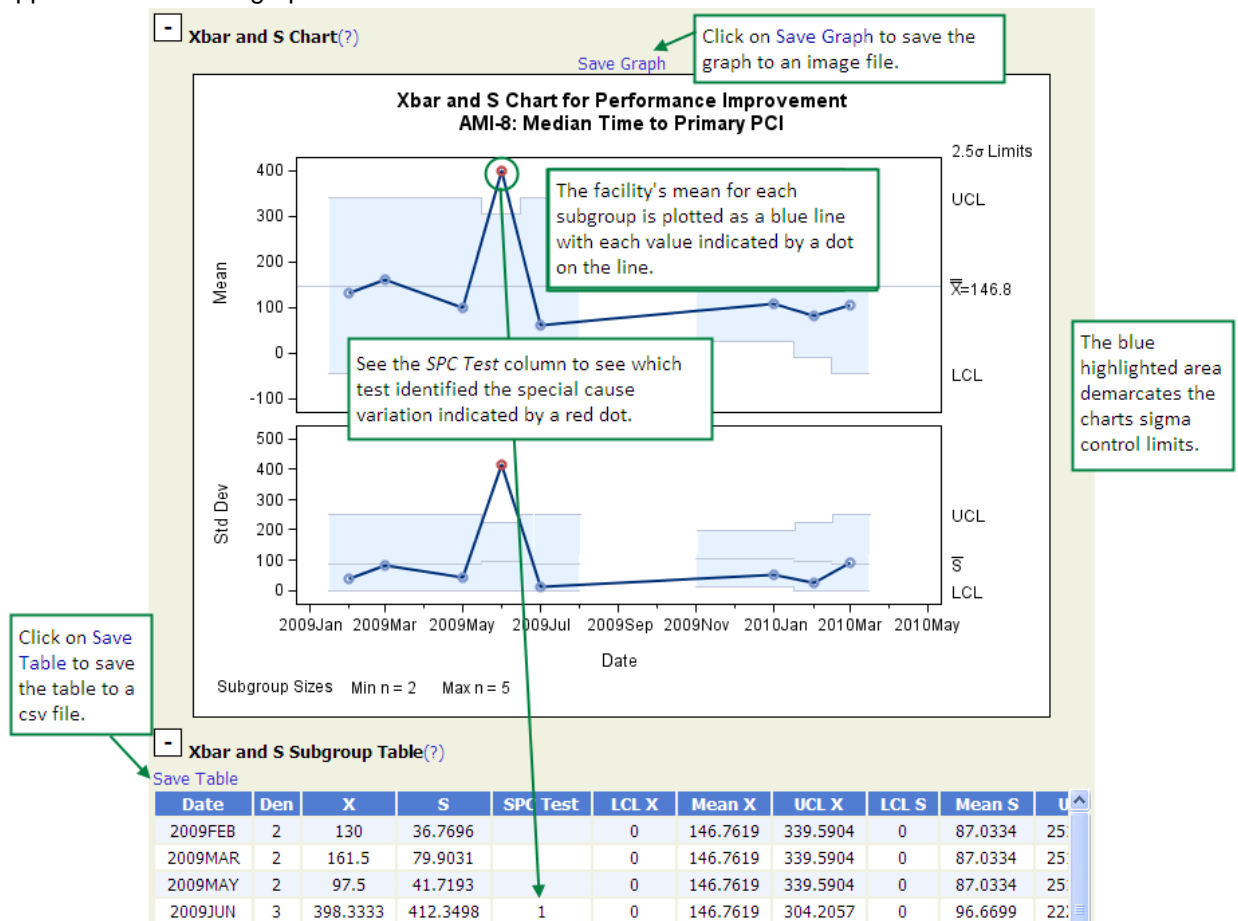
Note that gaps result when there is an absence of data for a particular month. This is not to be confused with a Phased control chart.

![Press Ganey logo] PRESS GANEY™
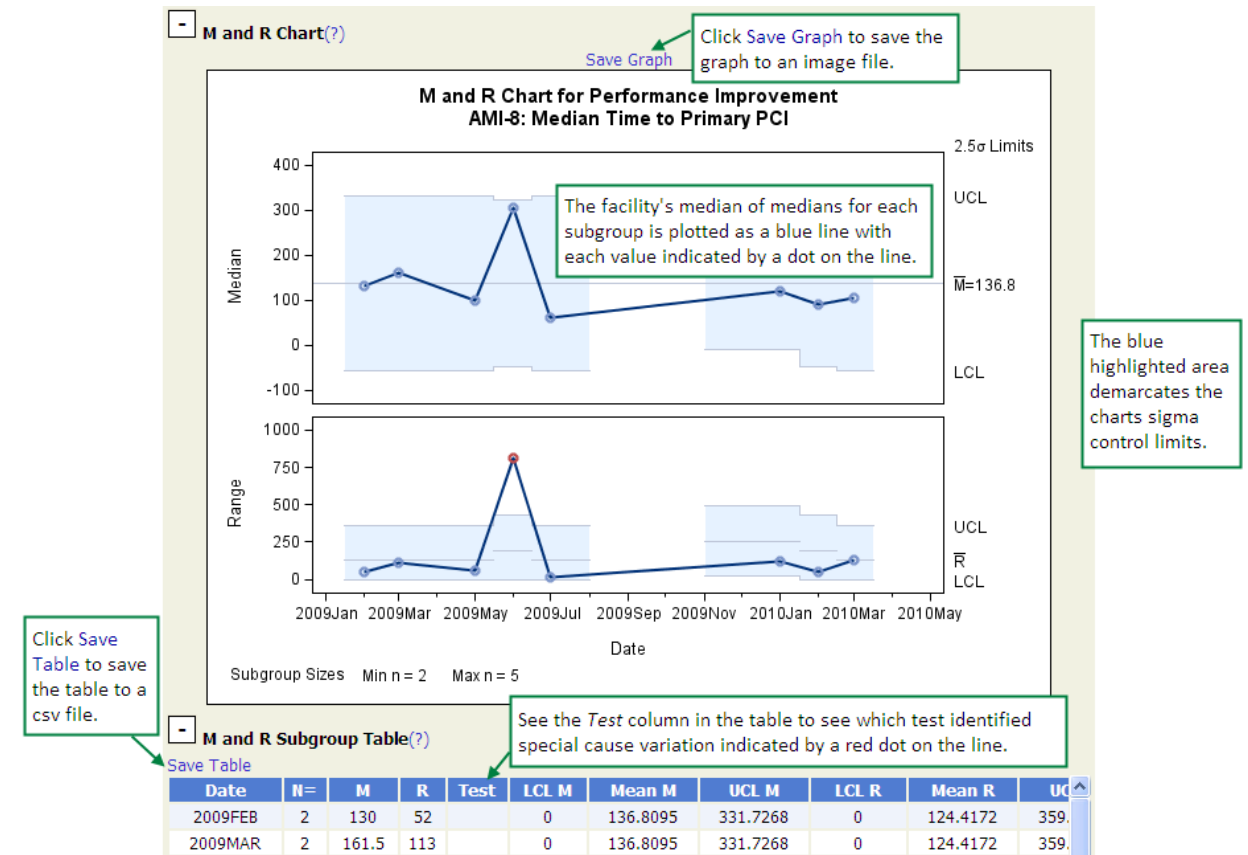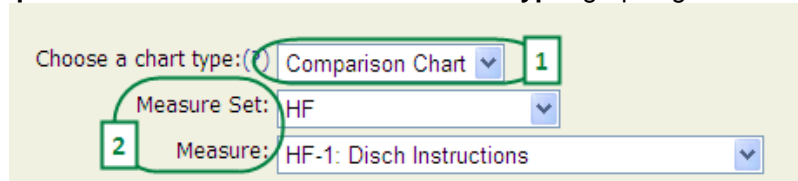Outcomes driven. Performance strong.

Format and Layout: M-chart

As was the case for previous control charts, there is a table of values and associated help files that explain the variables on which charts and associated table are based. The upper or M-chart plots the median of all values for each month while the lower R chart plots the range values for each month.

- **M and R Chart**(?)

Save Graph

Click Save Graph to save the graph to an image file.

**M and R Chart for Performance Improvement
AMI-8: Median Time to Primary PCI**

2.5σ Limits

Median

400
300 — UCL
200
100 — M̄=136.8
0
-100 — LCL

The facility's median of medians for each subgroup is plotted as a blue line with each value indicated by a dot on the line.

The blue highlighted area demarcates the charts sigma control limits.

Range

1000
750
500 — UCL
250 — R̄
0 — LCL

2009Jan 2009Mar 2009May 2009Jul 2009Sep 2009Nov 2010Jan 2010Mar 2010May

Date

Subgroup Sizes   Min n = 2   Max n = 5

Click Save Table to save the table to a csv file.

- **M and R Subgroup Table**(?)

Save Table

See the *Test* column in the table to see which test identified special cause variation indicated by a red dot on the line.

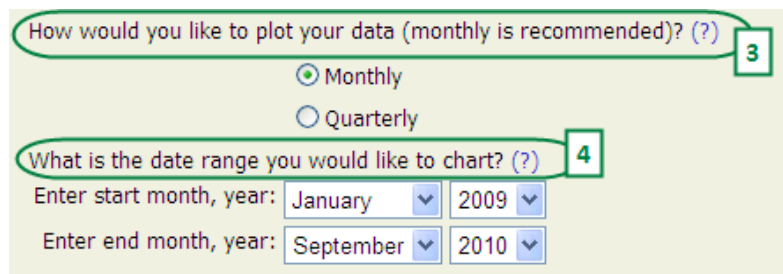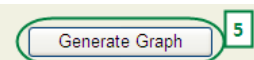| Date	N=	M	R	Test	LCL M	Mean M	UCL M	LCL R	Mean R	UC
2009FEB	2	130	52		0	136.8095	331.7268	0	124.4172	359.
2009MAR	2	161.5	113		0	136.8095	331.7268	0	124.4172	359.

Creating Graphs: Comparison Charts

1.   Choose **Comparison Chart** from the "**Choose a chart type**" graphing element drop-down list.

2. The first two graphing elements after selecting Comparison Chart - **Measure Set** and **Measure -** allow you to select the Measure Set and Measure for your comparison chart. Choose the Measure Set, then the Measure you would like to chart. Note that for Outpatient measures graphing, you actually choose a **Topic (Emergency Department** or **Surgery)** and then the **Measure.**

3. **How would you like to plot your data?** is a graphing element that gives you two options.
   - You can choose to either graph on a **Monthly** basis (recommended) or on a **Quarterly** basis. For quality activities, it is always best to graph monthly rather than aggregate the data by quarter because quarterly graphing "flattens" the data. Remember that aggregating data moves your analysis further from actual patient experience.
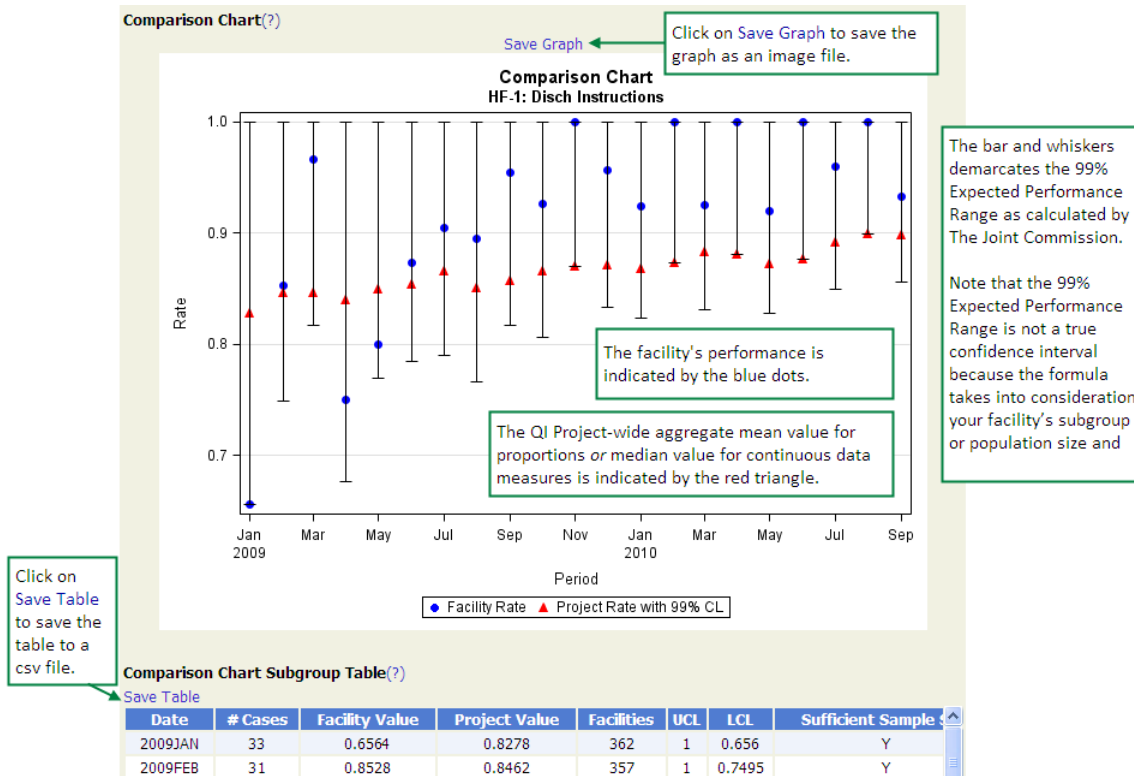

4. You next choose the **Date Range** you wish to plot in the comparison chart. For **Monthly** aggregate, choose the *Month & Year* to start the graph and end the graph. For **Quarterly** aggregate, choose the *Quarter & Year* to start the graph and end the graph. Any interval of months, quarters or years can be graphed.

5. Once you have made the desired selections to create your chart, click on the **Generate Graph** button at the bottom of the selection page.

Format and Layout: Comparison Chart

The comparison charts provide a comparison of facility performance to QI Project-wide performance. The data table of values appears below the chart. The format and layout for discrete and continuous measures are the same. Click on the help links (?) to bring up the files that explain the specific calculations and variables included in the chart and table.

Comparison Chart(?)

Click on Save Graph to save the graph as an image file.

Save Graph

Comparison Chart
HF-1: Disch Instructions

The bar and whiskers demarcates the 99% Expected Performance Range as calculated by The Joint Commission.

Note that the 99% Expected Performance Range is not a true confidence interval because the formula takes into consideration your facility's subgroup or population size and

The facility's performance is indicated by the blue dots.

The QI Project-wide aggregate mean value for proportions *or* median value for continuous data measures is indicated by the red triangle.

● Facility Rate ▲ Project Rate with 99% CL

Click on Save Table to save the table to a csv file.

Comparison Chart Subgroup Table(?)
Save Table

Date	# Cases	Facility Value	Project Value	Facilities	UCL	LCL	Sufficient Sample
2009JAN	33	0.6564	0.8278	362	1	0.656	Y
2009FEB	31	0.8528	0.8462	357	1	0.7495	Y

Creating Graphs: Other Graphs

Other graphs are simple line charts that plot any combination of three values, (1) the facility rate, (2) the QI Project-wide aggregate rate, and if appropriate to the facility, (3) the Sponsor mean rate.

1. Choose **Other Graphs** from the "**Choose a chart type**" graphing element drop-down list.

2. The first two graphing elements after selecting Other Graphs—**Measure Set** and **Measure**— allow you to select the Measure Set and Measure for your chart. Choose the Measure Set, then the Measure you would like to chart. Note that for Outpatient measures graphing, you actually choose a **Topic (Emergency Department** or **Surgery**) and then the **Measure.**
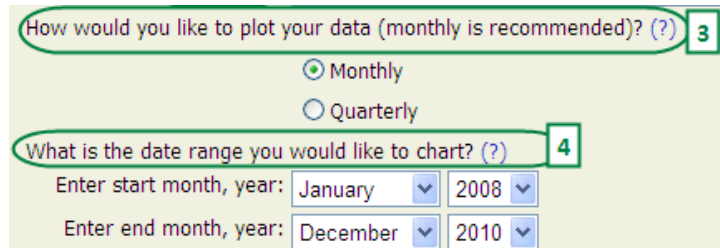

3. **How would you like to plot your data?** This graphing element gives you two options.
    ▪ You can choose to either graph on a **Monthly** basis (recommended) or on a **Quarterly** basis. For quality activities, it is always best to graph monthly rather than
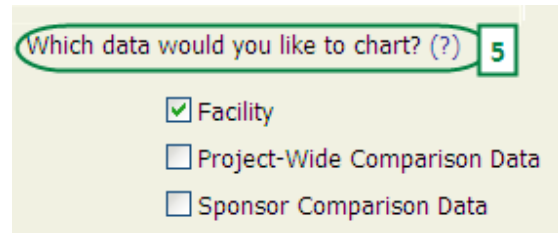
aggregate the data by quarter because quarterly graphing "flattens" the data. Remember that aggregating data moves your analysis further from actual patient experience.
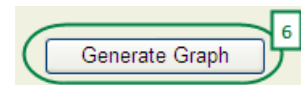

4. Choose the **Date Range** you wish to plot in the Line Graph. For **Monthly** aggregate, you choose the *Month & Year* to start the graph and end the graph. For **Quarterly** aggregate, you choose the *Quarter & Year* to start the graph and end the graph. Any interval of months, quarters or years can be graphed.

5. **Which data would you like to chart?** provides three options available to chart with Other Graphs. You may choose to plot one, two or all three of the options in any combination.

    ▪ **Facility** plots the facility values.
    ▪ **QI Project-wide Comparison Data** plots the QI Project-wide mean values.
    ▪ **Sponsor Comparison Data** plots the mean values for all facilities within the same sponsor group as the facility. Not all facilities belong to a Sponsor group.

6. Once you have made the desired selections to create your chart, click on the **Generate Graph** button at the bottom of the selection page.

Format and Layout: Other Graphs
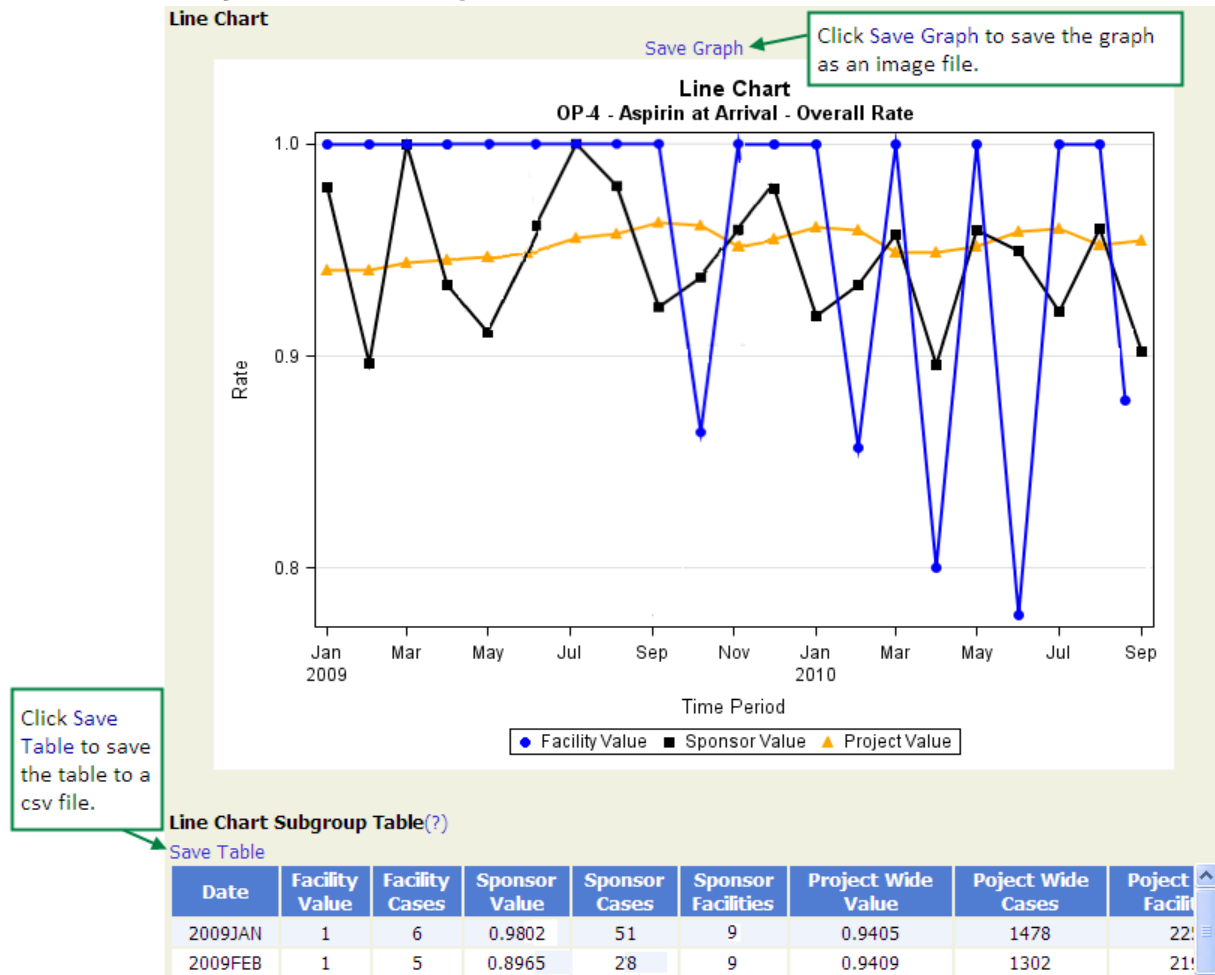
The data table of values appears below the chart. Click on the help link (?) to bring up the file that explains the specific variables included in the chart and table.