

# Quality Improvement Basics: Data Display Methods

## Slide 1 Objectives

After completing this module, participants will be able to:

- Define the meaning and purpose of data visualization.
- Describe various data visualization options and determine when they should be used.

## Slide 2 What and Why of Data Visualization

Data visualization is the graphical representation of information and data using visual elements.

Experts in data visualization frequently use the term ‘storytelling’ to convey the idea that when done well, data visualization provides background, illustrates influential actions or variables, and unites the audience towards a common purpose. How you want to communicate your collected data observations will be your guide in selecting the appropriate method to display your data.

## Slide 3 Communicating the Data Story

As you think about telling your story with data, consider...

- Who is your audience, and what is the purpose of sharing the data?
  - Some audiences will require more background and a higher-level summary of outcomes, while others may need less background and more details about day-to-day performance and what they can do to help improve.
  - Along the way, display data with the end in mind - what goal are you trying to achieve by creating graphs, charts, and tables? Remember that you are turning data into information to communicate and tell a story.
  - Decide on an appropriate form of data that best portrays your data story (number, percent, precision, etc.)
- Choose a display method that best tells your story or is appropriate for your data type.

The data display examples in this module may help your team decide how to present your data to help guide decision-making.

## Slide 4 Tables

One of the simplest approaches to sharing your data is to compile and share it in a table format, showing numeric information in rows and columns, enabling the viewer to see the relationships between data points. If the data story you are trying to tell must relay specific values rather than larger trends, then a table would be an excellent choice to display your data. However, when using tables alone, your audience will likely immediately be drawn into the exercise of trying to interpret the data you are showing rather than understanding the bigger story you are trying to tell. Therefore, showing the actual values you have collected should only be done if discussing those values is needed. Consider a chart or graph as a preferred method to help your audience absorb the story faster or as an accompaniment to a table if you need to tell your story with numbers at a more detailed level.

If you need to present the actual values, decide how much or how little data to share and try not to overwhelm your audience with too much data with endless rows and columns. Defining the ‘story’ you want to tell will help you narrow that table to a subset of your data or perhaps an aggregated or summarized view.

Our example here shows the distribution of ethnic populations for a fictitious facility along with the percentages represented by each group, the percent diagnosed with hypertension, and the actual number of diagnosed patients by population. As you look at this table, consider how long it takes to make sense of this data. You’ll appreciate the difference it makes for your audience when using the appropriate data visualization tool.

### Slide 5 Graphs and Charts

Graphs and charts can be powerful tools to convey:

- Comparisons between variables
- Patterns, trends, or relationships
- Complex data relationships in a quick manner

Each type of data visualization serves a certain purpose and, if used appropriately, will aid you in telling your data story – whether that’s comparing data, trending, showing relationships or distributions, or demonstrating how different parts make up a whole.

Regardless of your tool, a good rule of thumb is to keep it simple and not overpopulate your graph, chart, or table with data. Your goal is to condense the data into a brief data story with some direct point or call to action for your audience. If you overpopulate your page with data, lines, legends, color etc....your audience will focus on interpretation, detracting from the point you’re trying to make. Less is often more when it comes to data visualization.

Let’s consider some options for graphical representations of data and when they are and are not useful.

### Slide 6 Histograms

A histogram is a graphical representation that displays data through bars to show the frequency of numerical data. For quality improvement, histograms are used to present the data distribution’s spread and shape. That is, where it is centered, how spread out it is, and whether it is symmetric or skewed in one direction.

In this example on the left, we have counts of patient-reported wait times in minutes stratified by Years. A histogram is useful in this instance because:

- The unit of “minutes” is a continuous variable.
- Viewing the data in this format allows us to see the distribution and spread of wait times year over year. For year 1, most patients reported a wait time of either 1-10 minutes or 40+ minutes, for Year 2, however, this shifted to having many more patients reporting lower wait times.

In the example on the right, we see a less useful histogram which may be better displayed with a different display method. This is because:

- The data categories are not continuous. The categories jump from 1-10 minutes up to 36–42 minutes, and there is overlap between the wait time categories.
- There is missing data for multiple years in multiple categories.
- Years 4 and 6 are not shown, which leads to an incomplete story of the data

### Slide 7 Bar Charts

Bar charts are used to compare categories of observed data. Bars can be reordered in bar charts but not histograms (recall that our histogram categories were sequential). Typically, the bars of bar charts have the same width as the focus is on the height or y axis. The height of the bar represents, in this case, the measure performance of each given category.

In the example on the left, the categories represent five separate facilities within a health system. The order in which you display the bars on a bar chart depends on the story you are telling your audience. You may choose to display the bars on a bar chart to show lowest to highest performance or vice versa. In this example, the bars are ordered based on the population size of each facility within the health system. Sun Hospital on the left has the largest patient population and clinic Mars on the right has the smallest patient population. While the patient population of the facilities isn't show in the graph, the audience interpreting this data likely has that context.

This bar chart tells us very quickly that Clinic Mars has the highest performance for this measure at 90%, and Sun Hospital has the lowest performance at 55%. This is much easier to conclude than from the bar chart on the right.

The bar chart on the right has many data points and lists the count of both the numerator and denominator for each measure rather than a percentage. Although this may be useful in some situations, it makes it difficult to interpret how each facility performs on this example measure.

Bar charts are not as useful when:

- You want to look at many data points with multiple categories.
- You want to show relationships between categories or activities.
- You want to look at many data points over time.

### Slide 8 Line Graphs

Line graphs, or line charts, are often used to display a change over time to identify trends, patterns, and exceptions.

Line graphs can show patterns in data clearly by showing the values over time. In many cases, the slope or trend of the line can be used to help make predictions beyond the data we've collected out into the future. Line graphs can easily display one or more continuous datasets. However, displaying more than five lines on the same graph can make the data difficult to interpret and a bit cluttered.

The line graph on the left shows measure performance as a percentage for five facilities over 6 years. This graph is successful in:

- Presenting continuous data to analyze trends, patterns, and anomalies over time.
- Displaying multiple sets of data

- Displaying trends that can be used to make educated guesses about future performance.

The line graph on the right also shows measure performance for five facilities over the course of 6 years. However, this graph shows a count on the left vertical axis and a rate on the right vertical axis. This graph is not as successful because:

- There are many missing data points in the dataset and timeline.
- The data is not in a consistent format. Having both rates and counts on separate axes makes it so you can't interpret the value of each data point.

### Slide 9 Pie Charts

An alternative to bar charts is pie charts. The primary strength of a pie chart is that it indicates a part-to-whole relationship. However, you want to be careful to limit the number of categories displayed. A maximum of 3 or 4 categories is an acceptable limit. Be aware that the visual comparison is difficult if the contribution to the whole is very small (for example, 1-5 % out of 100% is almost invisible in a pie chart).

In the example on the right, the pie chart has eight categories, which is too many, and comparing the categories is difficult. In the pie chart on the left, we have reached our maximum of 4 categories, and you can see that it is easier to make relative comparisons.

However, it is better to use histograms or bar charts as the viewer can more readily compare the height of the bars to see the differences between categories.

Comparing the size of different “pieces” is more difficult than comparing the size of rectangles that are part of histograms or bar charts. In data analysis and analytics, pie charts are a controversial topic, and you'll find that some experts highly discourage their use.

### Slide 10 Scatter Plots

Scatter Plots require that you have two continuous variables. When you plot each “pair” of data on the x (horizontal) and y (vertical) axes, the graph displays the relationship between these data points. The example here shows the relationship between patient-reported wait times and the number of MDs and NPs working at the facility on various days during the measurement period.

On a scatter plot, you plot the exact data based on where it should appear based on the scale of your X and Y axes. The concentration and frequency of the data will lead to insights and conclusions from this type of diagram. In general, scatterplots will tell you about the association between two variables and, under certain circumstances, may give you insight into a possible causal relationship. However, scatterplots cannot prove cause and effect. You may identify a correlation (meaning consistency between the two variables...when one goes up, the other follows in the same direction or vice versa) .... but this does not necessarily prove causation between the two.

Scatterplots are useful when:

- Testing for possible cause and effect
- Verifying whether a relationship exists and investigating that relationship to better understand the process or outcome we intend to improve. A cause-and-effect relationship will be verified only after the improvement is tested and results are studied.

Scatterplots are not as useful when:

- You have a very large dataset.
- Your data on one or more axes is not continuous or has substantial gaps.
- You want to definitively prove cause and effect.
- You have a flat trendline, meaning the results are inconclusive.

### **Slide 11 Quality Data Dashboard**

Data Dashboards are an essential form of data visualization in quality improvement that compiles different display methods in one place to interpret and monitor interactions within the data. They give us insight into progress towards goals and can help predict future trends.

Dashboards are useful When:

1. You want to present high-level summaries of data in a snapshot
2. You want to tell a big-picture story to various partners
3. You want to monitor and/or analyze large amounts of data quickly
4. You want to engage partners into interacting with and impacting your data goals

### **Slide 12 In Summary**

- Data visualization is an important tool that aids in telling the story of your data through a graphical representation of information and data.
- Tables are a simple way to share data, but without an accompanying graph or chart, they can overwhelm and distract your audience.
- Different graphs are useful for different purposes. Determine if you want to compare, trend, or demonstrate relationships or distributions. This will help you identify the appropriate graph type for sharing your data.
- Finally, remember to use an appropriate amount of data needed to tell your story as you consider who your audience will be and how you want to tell your story with data. Keep your story simple and impactful, as using an overabundance of data and charts can easily distract or lose your audience entirely.