Quick Guide: Data Visualization for Nurse Practitioner (NP) Research and Quality Improvement (QI)

American Association of NURSE PRACTITIONERS®

Data visualization is the graphical representation of data to illustrate patterns, trends and relationships. Data displays such as charts, graphs and maps help to simplify complex data, making it easier to understand and use. Constructing data displays is an essential skill for NPs and NP students involved in research, quality improvement, evidence-based practice and policy advocacy.

Effective data visualization helps NPs and students to:

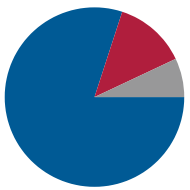
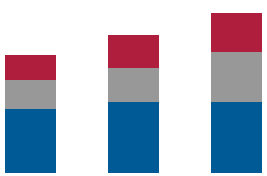
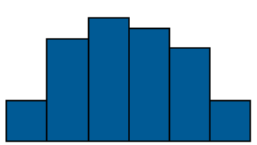
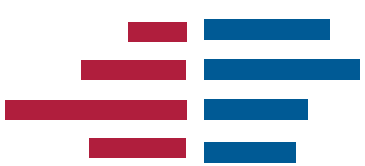
- Guide decision-making and intervention design by highlighting trends and patterns in health care data.
- Enhance data interpretation by revealing meaningful relationships, outliers and emerging trends.
- Strengthen communication with patients and non-clinical decision-makers by presenting complex research and QI findings in a clear and accessible way.

Research and QI have distinct aims, and QI uses specialized data displays. Research projects aim to discover and expand knowledge by finding patterns, relationships or trends. QI projects focus on improving outcomes for patients and health care systems by standardizing processes to achieve consistent, predictable results aligned with established goals.

Although many types of data visualizations are relevant to both research and QI **(Table1)**, QI projects also use specialized processes and visualizations, such as run and control charts **(Table2)**.

Table 1. Ten common data visualizations for research

Note: Selecting the best type of visualization should align with the nature of the data, research goals, audience and dissemination format.

Type	Description	Best for	Limitations
Pie chart 	A circular chart showing proportions or percentages of categories or values that add up to 100.	Showing proportions or percentages of a whole.	Difficult to compare many small categories; can take up significant visual space.
Bar graph 	A graph using either horizontal or vertical bars to illustrate comparisons across categories or groups.	Comparing groups and identifying patterns, including over time.	Scale choices can exaggerate or minimize differences.
Stacked bar graph 	A type of bar graph that segments each bar to distinguish component parts.	Comparing subcategories within a larger category.	Can become difficult to interpret when there are many segmented parts.
Histogram 	A graph showing the distribution of data across a range of values.	Identifying patterns, clusters, gaps and outliers.	Combining multiple variables on the same histogram can be difficult and cluttered.
Population pyramid 	A horizontal bar chart that displays the distribution of populations by demographic characteristics.	Comparing population structures.	Difficult to interpret when comparing multiple population groups.

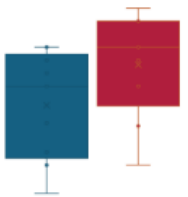
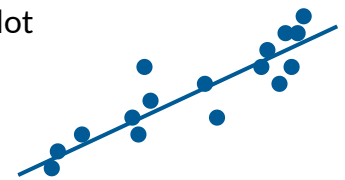
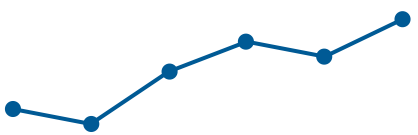
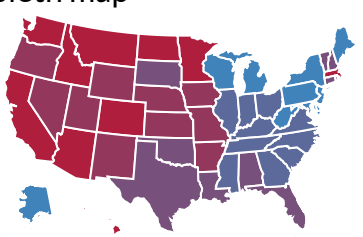
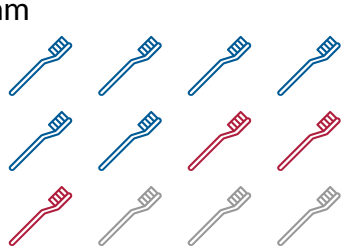
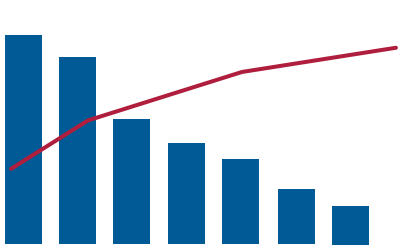
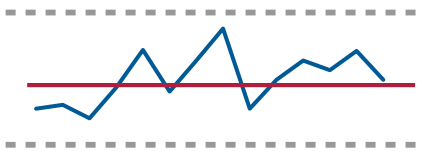
Type	Description	Best for	Limitations
Box and whisker 	A plot that shows how data are distributed by displaying the median, the range of typical values and any unusually high or low values (outliers).	Comparing the center, spread and outliers of one or more datasets.	May hide important details about the distribution because it does not show clusters, gaps or multiple peaks.
Scatter plot 	A graph illustrating all values for two variables, one on each axis. Scatter plots sometimes have a line showing correlation.	Identifying correlations and trends.	Correlation may imply a cause-and-effect relationship between two variables when none exists.
Line graph 	A graph displaying numerical values over time or along a continuous scale (e.g., a patient's temperature over hours or a tumor's size over months). An area chart is a type of line graph in which the area below the line is filled with color.	Depicting trends over time.	May create the impression of continuous change between observations, even when no data is available between those points.
Choropleth map 	A representation of geographic areas or regions that are colored, shaded or patterned in relation to a variable (e.g., patient population density or per-capita income).	Visualizing variation across a geographic area or the level of variability within a region.	Color choices can exaggerate or minimize the effect in certain regions or areas and may be hard to distinguish for people with visual impairment.
Pictogram 	A representation of quantities or categories using icons where each icon represents one or more units out of a total (e.g., 10% or 10 clinicians). Icons can be any shape or image.	Demonstrating proportions or percentages.	Not practical for large or detailed datasets.

Table 2. Three common data visualizations for QI projects

Note: Specialized tools are usually required to develop data visualizations for QI projects. Pareto charts can be developed in Excel using the QI Macros add-on feature, while run charts can be created in Tableau.

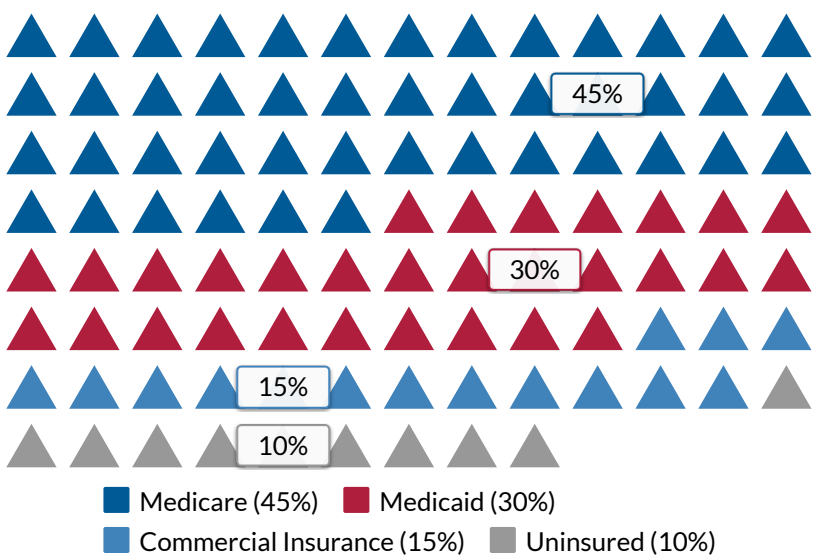
Type	Description	Best for	Limitations
Pareto chart 	A chart that represents individual drivers of an observed quality problem in descending order by bars, and the cumulative total responsibility these drivers have for the outcome using a line. The cumulative total line helps to focus on the "vital few" issues to solve for the biggest impact on quality.	Identifying the most significant causes of a clinical problem for resource allocation and prioritization.	Poorly defined or overlapping categories can produce misleading results.
Run chart 	A type of line graph that plots clinical data points over time and includes a median line representing the middle value of the data points.	Showing performance across a QI project.	Only provides basic information about data variation.
Control chart 	An expanded version of a run chart that represents process or outcome data over time, using calculated upper and lower control limits and a mean line.	Assessing the success of a QI project after sufficient data are available.	Can only track one variable on a chart.

Helpful tips!

1. Choose the right graph for your message

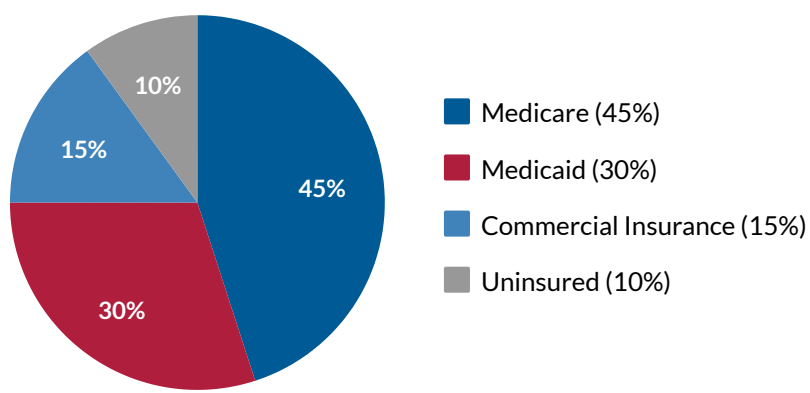
Select the chart type that best communicates your key message. Different types of visualization emphasize different relationships, trends, distributions or comparisons, so choose the one that makes the message easiest to understand. For example, **Graph A** makes the key data distribution by insurance type difficult to see, whereas **Graph B** clearly highlights that most patients are insured by Medicare, followed by Medicaid and commercial insurance.

Graph A



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Graph B



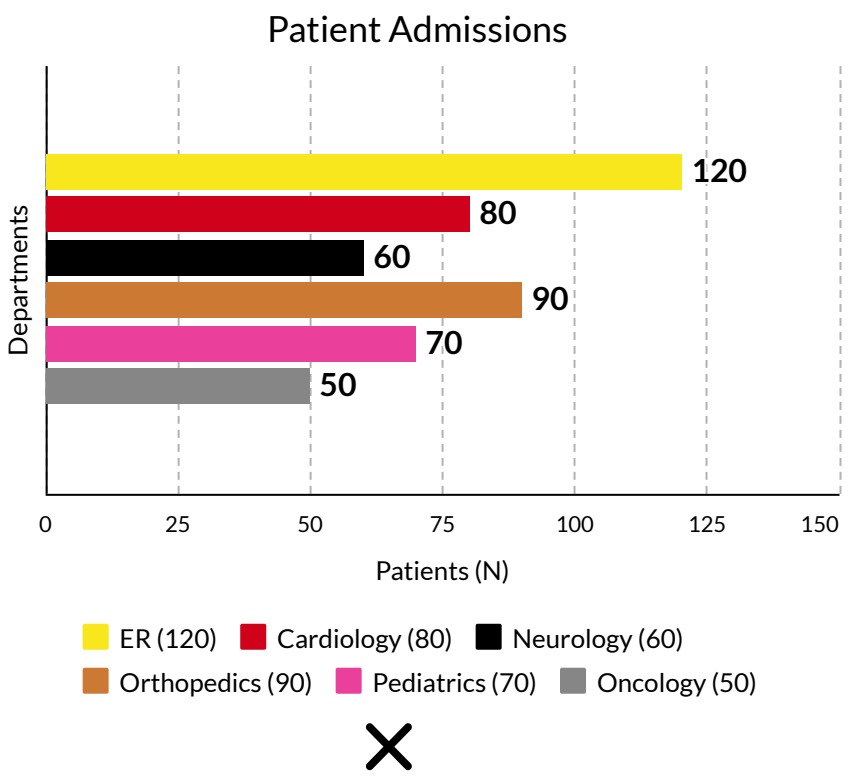
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Helpful tips!

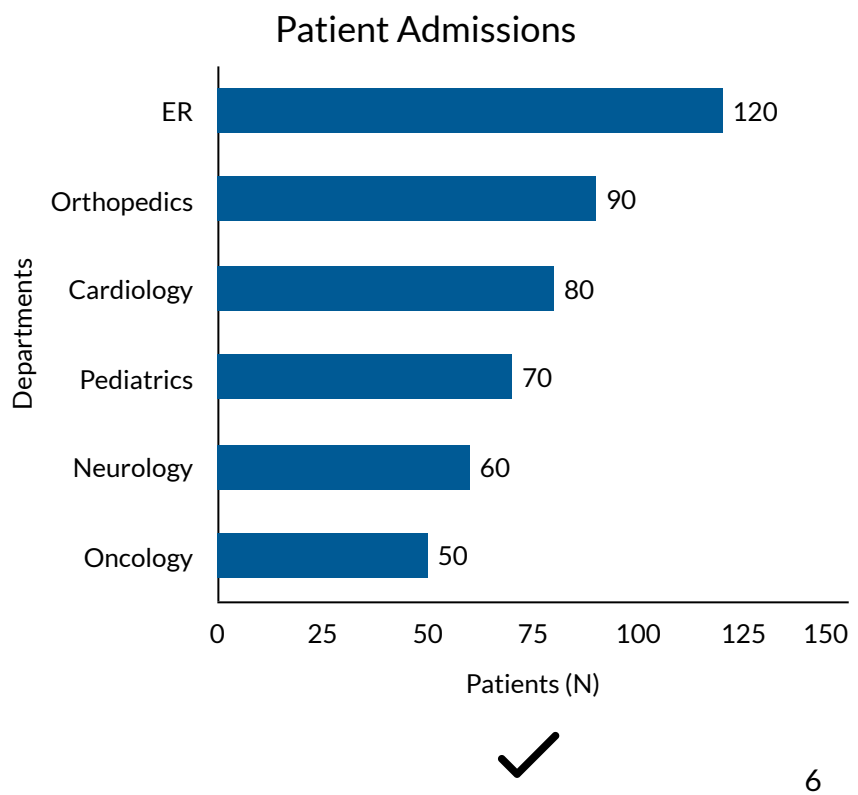
2. Keep it simple and only keep necessary information.

Reduce clutter by removing unnecessary gridlines, legends and redundant information. A clean, simple design highlights key messages and improves credibility by reducing distractions. For example, **Graph C** is crowded with gridlines, unnecessary colors and redundant variable counts, while offsetting category labels in a legend. In contrast, **Graph D** removes non-essential elements and redundant information, making the data easier to read and interpret.

Graph C



Graph D

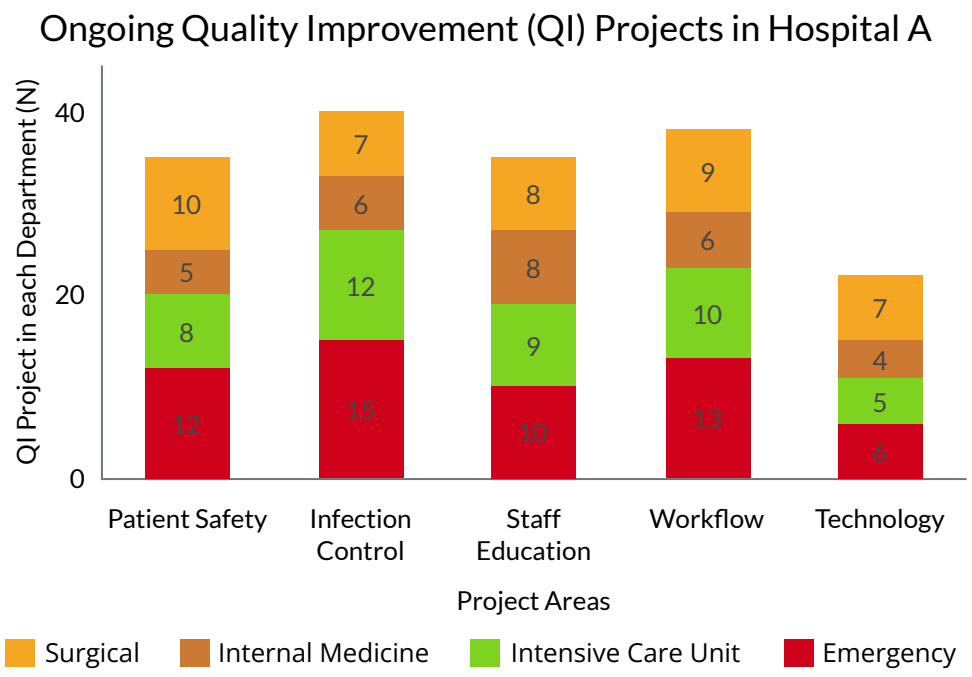


Helpful tips!

3. Use color strategically and design for accessibility

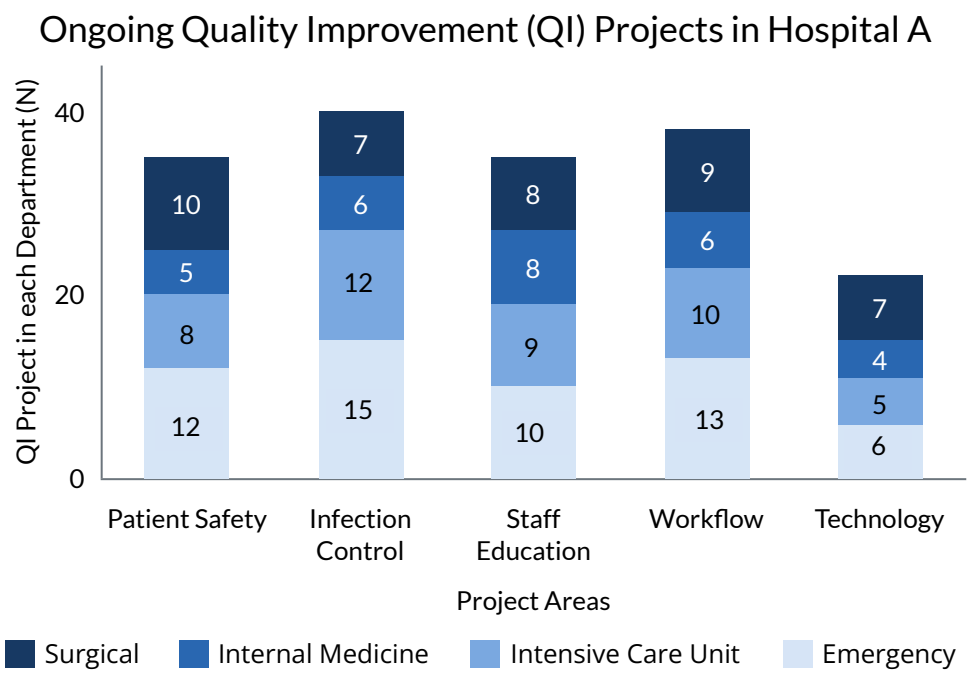
Use sufficient color contrast, clear data labels, readable fonts and alt text to ensure visualizations are accessible for all users and devices. Leverage built-in accessibility features in various visualization tools such as Microsoft Office, Adobe, Canva, Power BI and Tableau. Different visualization tools can check color contrast and enable alt text (i.e., written text embedded in an image that allows people using screen readers to hear a description of the image). For example, **Graph E** uses colors that may be difficult to distinguish for people with limited vision and low-contrast data labels while **Graph F** does a better job of using color and label contrast.

Graph E



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Graph F

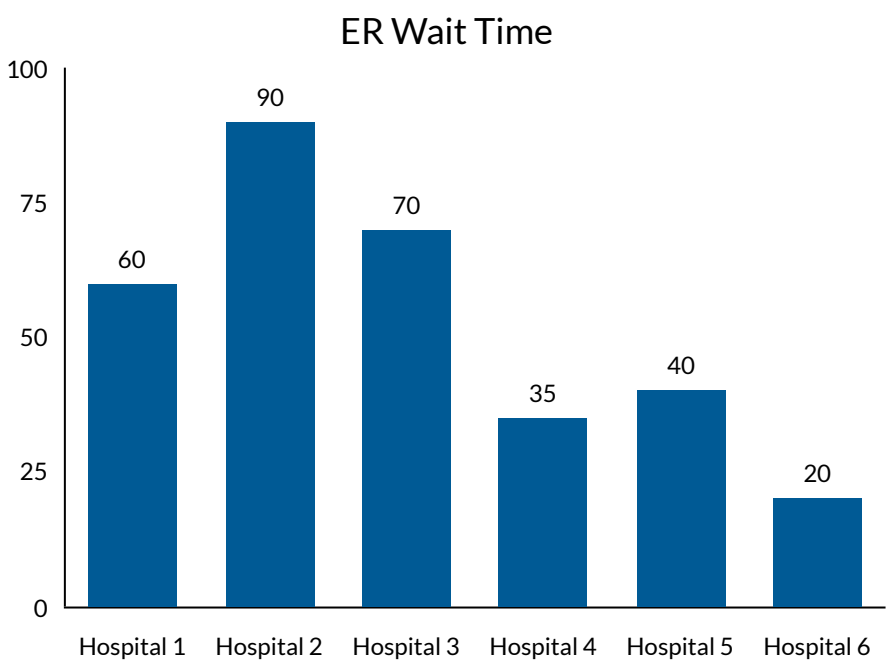


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4. Provide context for interpretation

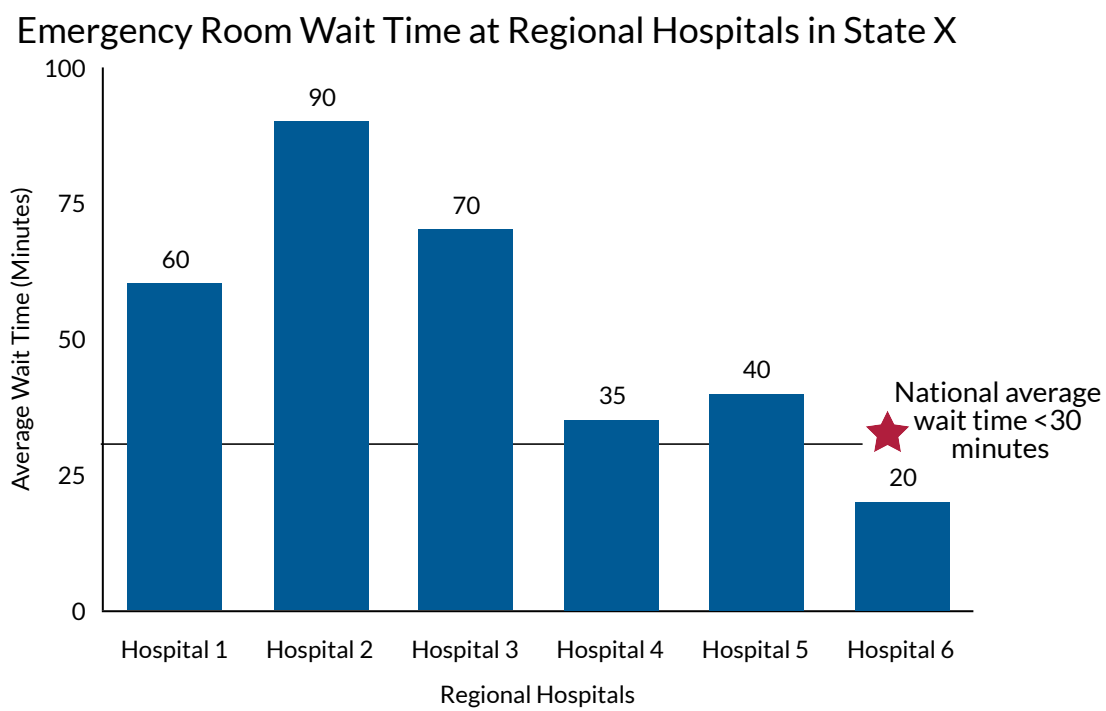
Help readers understand the data by including meaningful titles, labels, annotations, units, benchmarks or comparisons where needed. Context transforms numbers into meaningful insights. For example, **Graph G** is difficult to interpret at a glance due to insufficient labeling. In contrast, **Graph H** provides a detailed title, axis labels, units for time and additional context using the national average wait time, making the data easy to understand at a glance and more useful for the hospitals represented in the graph.

Graph G



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Graph H



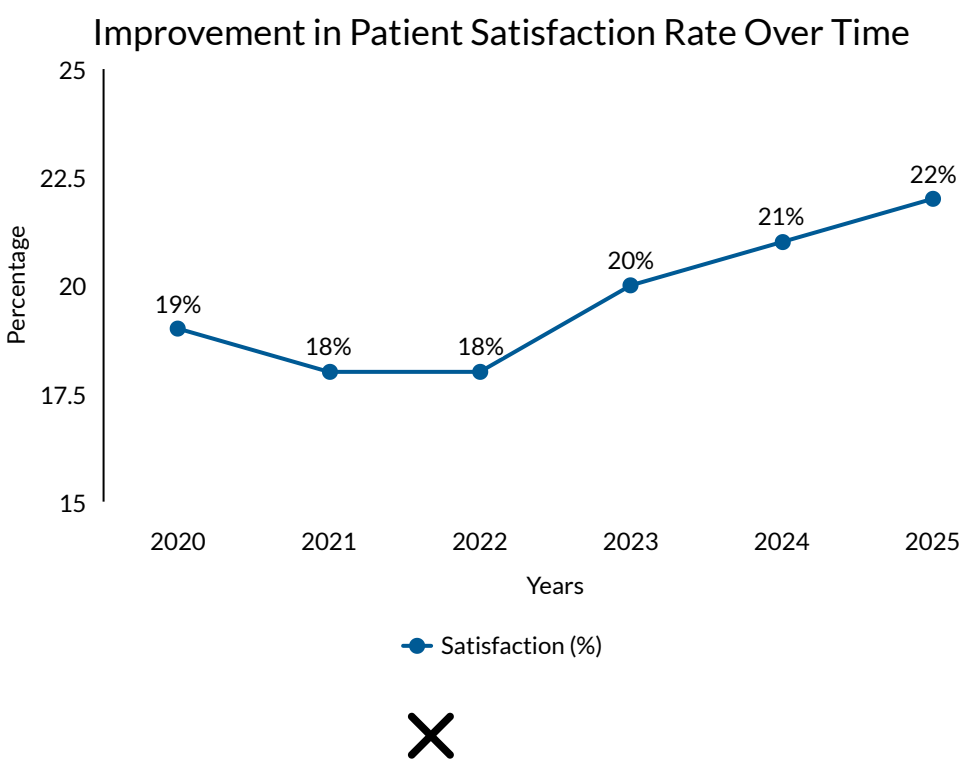
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Helpful tips!

5. Develop graphs that avoid distorting the data

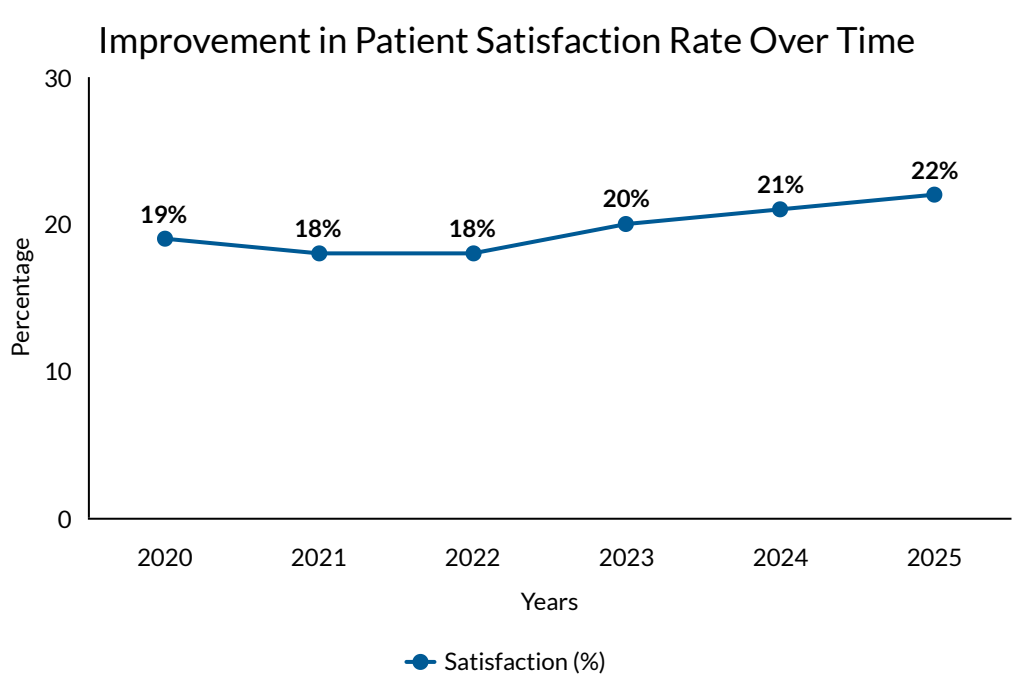
Design graphs that help readers draw accurate and appropriate conclusions by avoiding distorted scales, inconsistent axes and other visual exaggeration that can overstate or understate differences in the data. For example, the truncated axis of **Graph I** makes patient satisfaction appear to have greatly improved over 5 years, whereas **Graph J** uses a scale that allows fair comparison overtime.

Graph I



✗

Graph J



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Additional resources

- Midway, S. R. (2020). Principles of effective data visualization. *Patterns*,*1*(9), 100141. https://doi.org/10.1016/j.patter.2020.100141
- *Data visualizations*. (n.d.). Agency for Healthcare Research and Quality. https://www.ahrq.gov/data/data-visualization/index.html?page=1
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