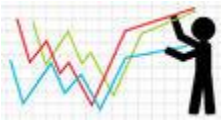
Public Health Foundation

Quality Improvement (QI) Graphic Tools To Help Us Understand Data

John W. Moran, Amanda McCarty, Robert Hines, and Annie Vosel[1]
Updated July, 2024

"*There is magic in graphs. The profile of a curve reveals in a flash a whole situation – the life history of an epidemic, a panic, or an era of prosperity. The curve informs the mind, awakens the imagination, convinces*." – Henry D. Hubbard[2]

Why should we use QI graphic tools to help us understand data?



"*Data represents raw elements or unprocessed facts, including numbers and symbols to text and images. When collected and observed without interpretation, these elements remain just data—simple and unorganized. When these pieces are analyzed and contextualized, they transform into something more meaningful*."[3] For data to provide information to a decision maker it must be analyzed, organized, and interpreted. Having a data strategy is necessary to transform collected data into useful knowledge, which can be used to make decisions. Data is just a collection of raw quantitative or qualitative facts observed and recorded. QI tools help organize the raw data, which can then be analyzed and turned into useful information.

The definition of QI in public health states: *"Quality improvement in public health is the use of a deliberate and defined improvement process, such as Plan-Do-Check-Act, which is focused on activities that are responsive to community needs and improving population health. It refers to a continuous and ongoing effort to achieve measurable improvements in the efficiency, effectiveness, performance, accountability, outcomes, and other indicators of quality in services or processes which achieve equity and improve the health of the community."*[4]

To achieve measurable improvements, we must have a systematic and continuous process of measuring and assessing the performance and outcomes of our products and services. To make improvements, it is essential for a health department to have a robust Performance

[1] Authors profiles are at the end of this article.
[2] https://www.maartenlambrechts.com/2017/01/25/an-ode-to-charts-from-1939.html/ accessed July 6, 2024.
[3] https://bloomfire.com/blog/data-vs-information/ accessed July 6, 2024.
[4] *Defining Quality Improvement in Public Health*; Journal of Public Health Management & Practice: January/February 2010 - Volume 16 - Issue 1 - p 5–7, Riley, William J. PhD; Moran, John W. PhD, MBA, CQIA, CQM, CMC; Corso, Liza C. MPA; Beitsch, Leslie M. MD, JD; Bialek, Ronald MPP; Cofsky, Abbey -.

Management System (PMS) that collects progress and performance data and presents it as information. This PMS is essential for identifying gaps, monitoring progress, and evaluating the impact of Quality Improvement (QI) interventions. However, choosing the right tools and methods for QI data collection and analysis can be challenging, as there are many factors to consider, such as the purpose, availability, timeliness, validity, reliability, and usability of the data. In this article, we will discuss some of the most effective tools and methods for gathering baseline data to obtain information related to QI efforts.

There are many ways to obtain accurate and reliable data. A few of the most common approaches to collecting quantitative and qualitative data are listed below:

- Surveys
- Questionnaires
- Interviews
- Focus groups
- Observation
- Expert opinion
- Brainstorming
- Sampling – Random and Non-random

To have useful data from any of the above approaches, it is important to:

- Define the purpose of collecting the data
- Determine who the customer audience is for the data
- Think ahead on how the data will be summarized and presented and ensure the data collection process allows that to happen easily and consistently
- Define what type of data (quantitative or qualitative) is to be collected
- Establish the collection rules – sampling, frequency, etc.
- Determine where the data will be collected
- Define who will collect the data
- Determine when they will collect the data
- Determine where and how long the data will be saved
- Determine the best way to visualize the data
- Make the data collection simple by using check sheets and checklists
- Develop questionnaires that have clear, concise, and relevant questions
- Develop appropriate and consistent scales and response options
- Pilot test the data collection process before launching it
- Not have an *"other"* category to record data - have clear discrete defined categories to record the data.

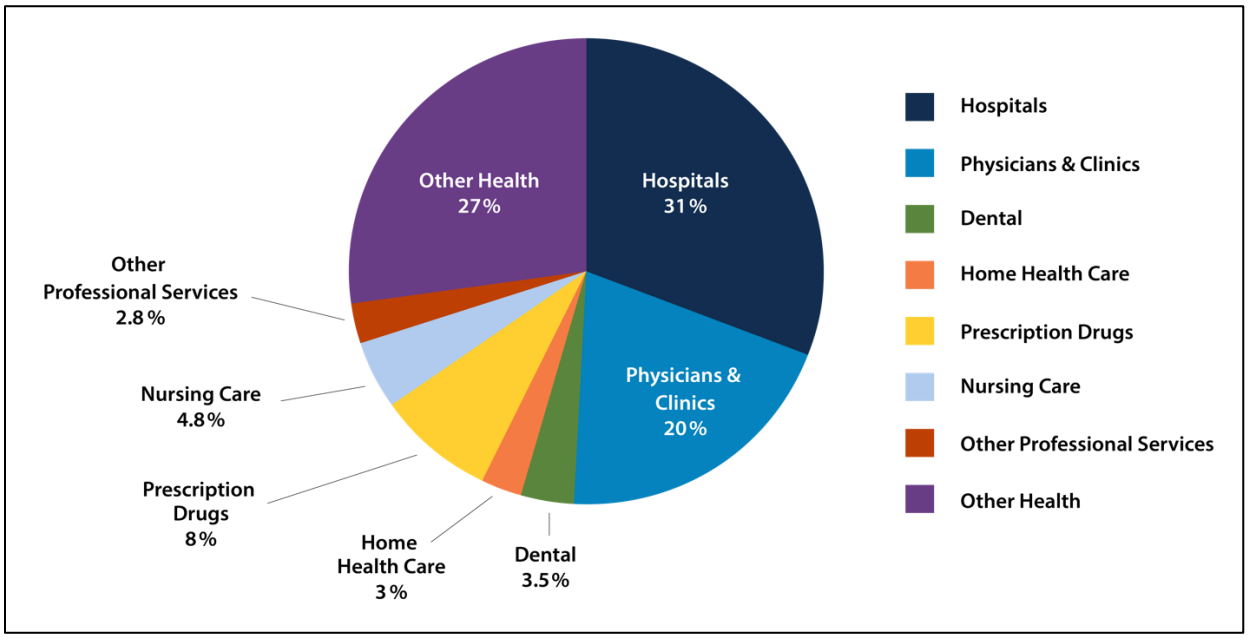
Before starting any process improvement activity, we must have baseline data to understand the starting point before proceeding with improvement activities. From this point of reference, improvements made can be measured and observed.

Most common types of QI graphic tools to help us understand data: *(A more detailed description of the following types of graphic QI tools can be found in the Public Health Quality Improvement Encyclopedia[5]).*

When using any of these tools, avoid oversharing of information. It is important to use the right tool(s) to bring attention to meaningful data. A bad design of presenting the data can distract the intended audience. Simplicity beats complexity.

"Numbers have an important story to tell. They rely on you to give them a clear and convincing voice." Stephen Few[6]

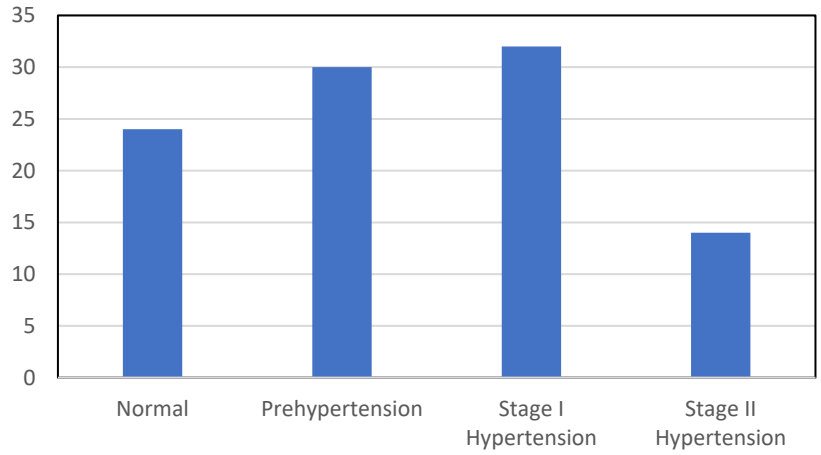
Pie Chart: A Pie Chart is a type of graph that displays data in a circular graph. The pieces of the graph are proportional to the fraction of the whole in each category. In other words, **each slice of the pie is relative to the size of that category** in the group as a whole. The entire "pie" represents 100 percent of a whole, while the pie "slices" represent portions of the whole.



National Library of Medicine. Finding and Using Health Statistics. Kurani, Nisha, et al. "How Has U.S. Spending on Healthcare Changed over Time?" Peterson-KFF Health System Tracker, 25 Feb. 2022.

[5] *Public Health Quality Improvement Encyclopedia*, J. Moran et al, Public Health Foundation, ©2012.
[6] https://www.domo.com/blog/data-storytelling-data-scientist-skills/ accessed July 6, 2024.

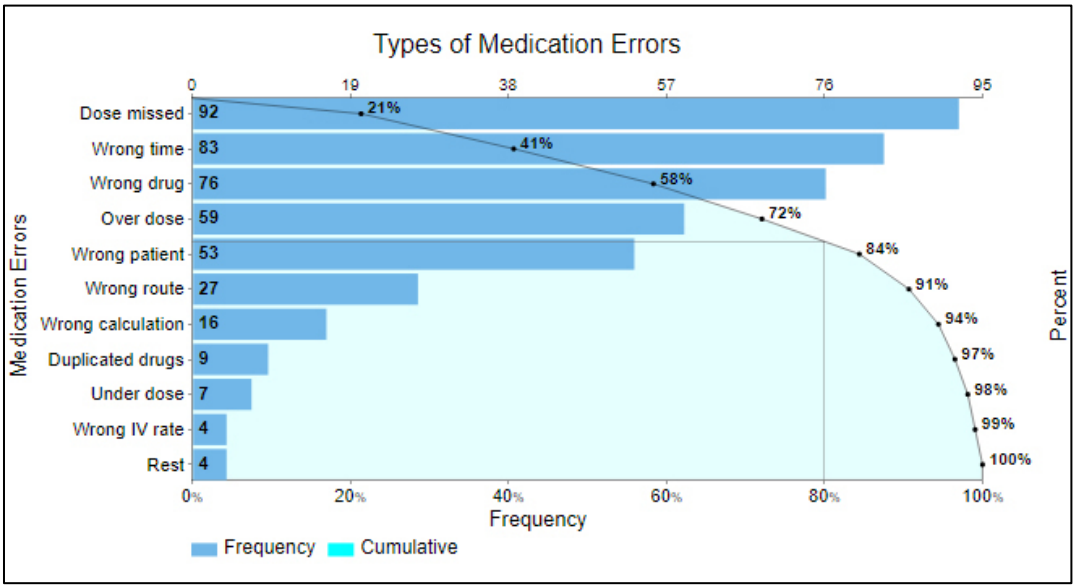
Bar Chart: A tool used to provide a visual presentation of categorical data. Categorical data is a grouping of data into discrete groups, such as months of the year, age group, shoe sizes, or animals. These categories are usually qualitative. In a column (vertical) bar chart, categories appear along the horizontal axis, and the height of the bar corresponds to the value of each category. A vertical bar chart is sometimes called a column chart.



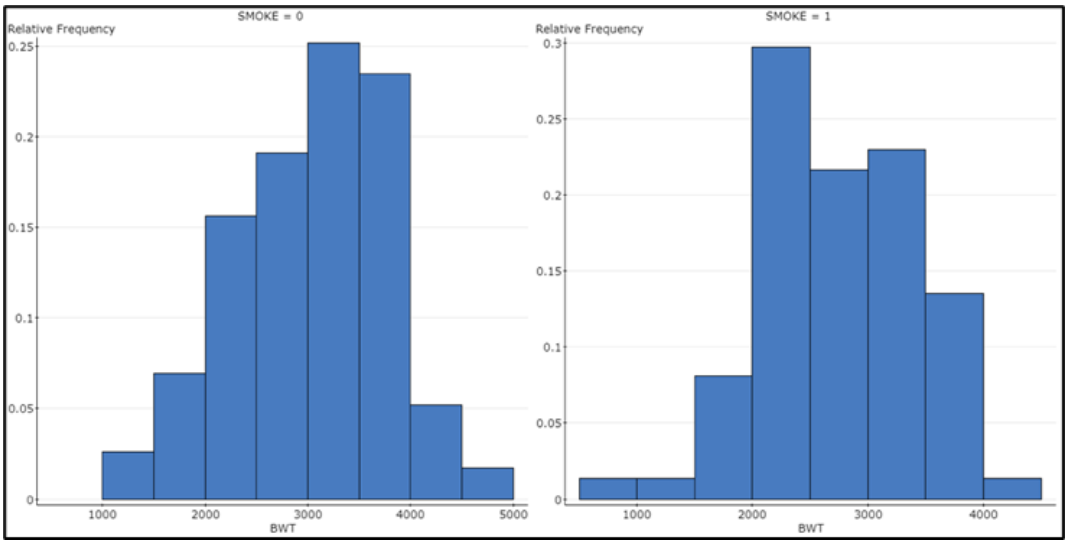
The bar chart shows a summary of information that can be used to determine the next steps. Compared to the original format of the data collected, meaningful discussions and determinations can be made using the bar chart. An excerpt from the original information collected is represented in the table below.

1	96/60	Normal
2	162/100	Stage II
3	144/90	Stage I
4	124/84	Prehypertension
5	140/96	Stage I
6	132/88	Prehypertension
7	142/96	Stage I

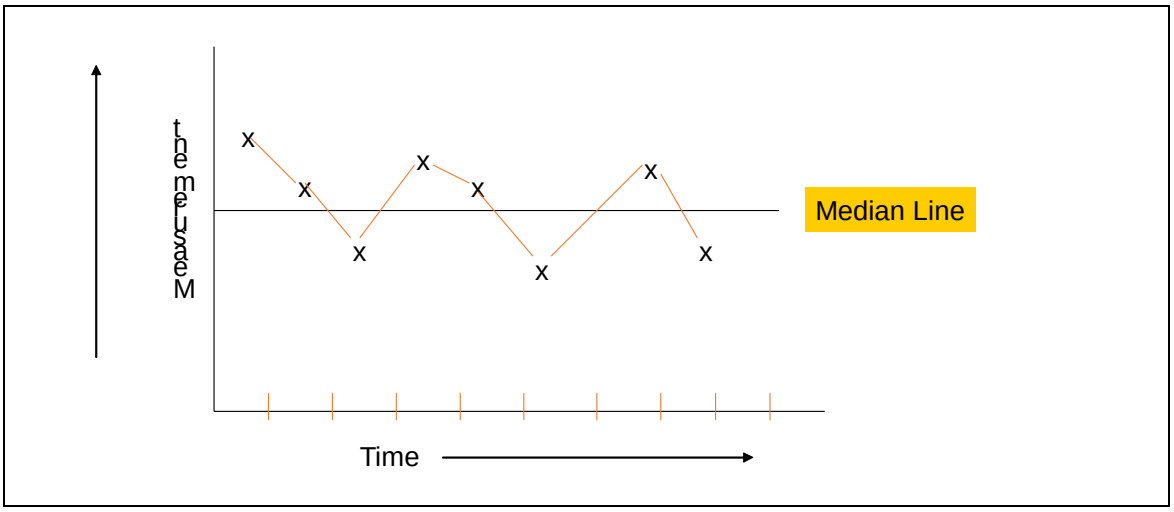
Pareto Charts: These are specialized Bar Charts. The bars are arranged in order of size, starting with the largest bar on the top left. The chart immediately identifies the most important items to be analyzed, based on size. In a Pareto Chart, all responses add up to 100 percent. In the example below, priority improvement efforts should focus on dose missed, wrong time, and wrong drug.



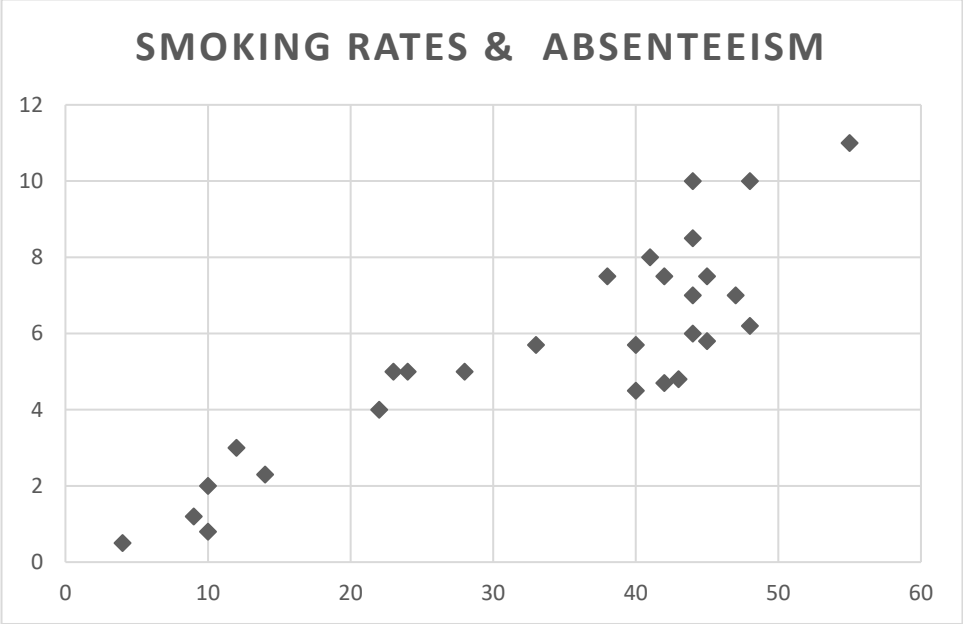
Histogram: This tool is used to clearly summarize, display, analyze, and interpret data. A histogram is a plot that shows the underlying frequency distribution (shape) of a set of continuous data. Histograms represent the frequency at which an event or set of events is observed using rectangles. The height of a rectangle (the vertical axis) represents the distribution frequency of a variable (the amount or how often that variable appears). It is similar to a Bar Chart, but a histogram groups numbers into ranges. Be careful to use histograms only for the frequency distribution they provide. The example below shows the birth weight of babies born to mothers who smoke versus those who do not smoke. It does not offer additional information related to health risks, if babies were carried to full term, etc.

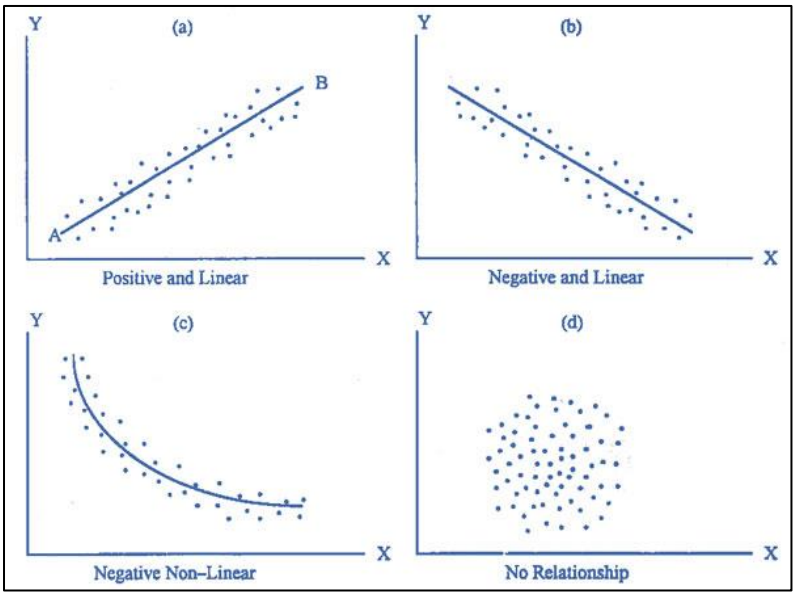


Run Chart: A line graph of data points plotted in chronological order with a median line dividing the data in half and used to understand how a process is performing over time. Run charts can be used to determine process stability and variation. For example, if the run chart below is a representation of clinic wait times throughout the day, the average wait time may be 15 minutes (represented by the median line). It is evident from this chart that the wait time is higher at the beginning of the day and becomes more consistent as the day continues. If the clinic wanted to improve this process, they would focus on the initial wait time in the morning. Reducing the clinic wait time in the morning will also reduce the overall average (median).

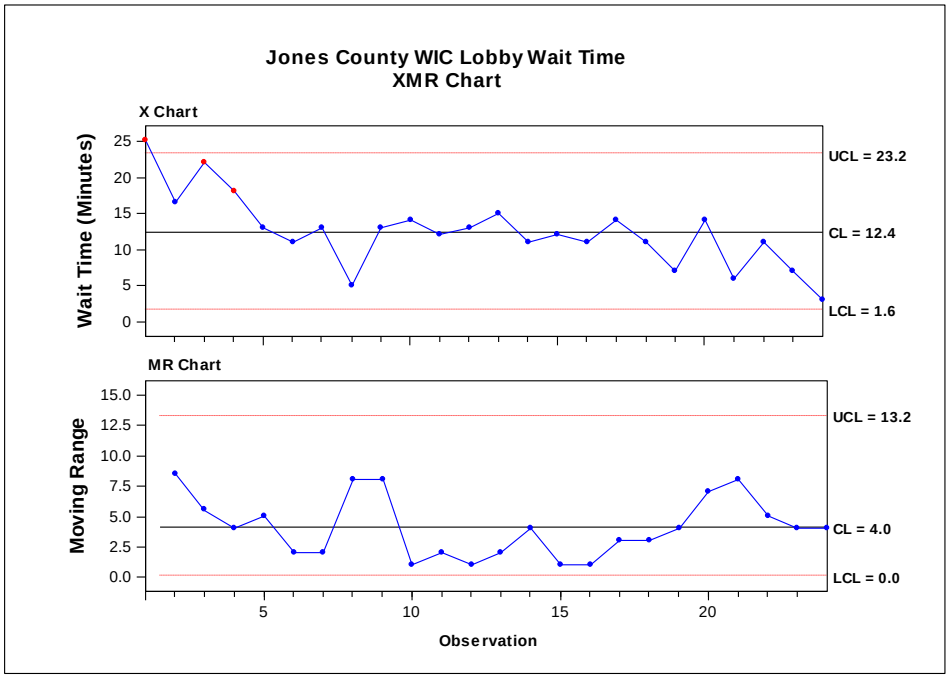


Scatter Diagram: An analytical method to determine if a relationship exists between two variables in pairs of observations. The purpose is to show if a change in one variable predicts a corresponding change in the second variable. Positive correlation indicates that the variables increase together, while negative correlation suggests that they decrease together. Scatter plots can help identify cause-and-effect relationships for further investigation. Based on the example below, we can see that there is a positive correlation in smoking rates and absenteeism. As smoking rate increases, absenteeism rates also increase.

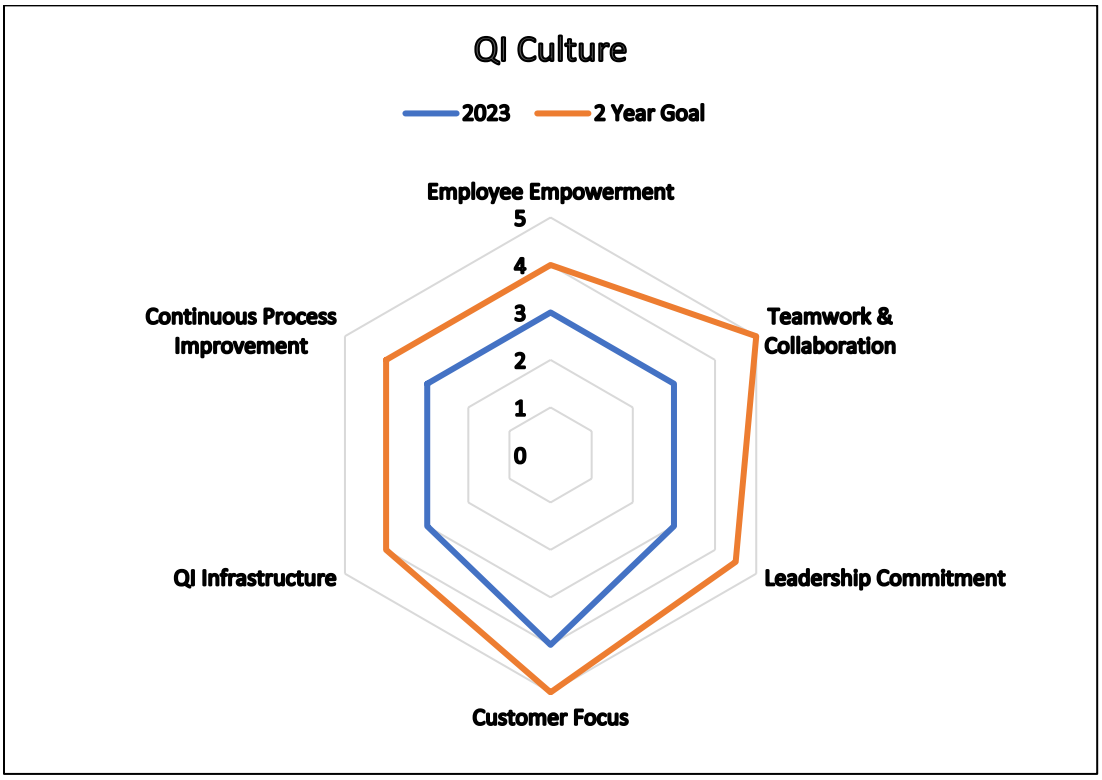




Control Chart: A statistical tool used to monitor a process over time and identify special causes of variation. There are many types of control charts depending on the type of data you are collecting. Variable data can be used in a moving range chart, Xbar – R chart or S chart. Similar to the run chart example, this shows the median of all data points on the chart but a specific upper control limit (UCL) and lower control limit (LCL) has been defined. If the data points fall outside of the UCL or LCL, this calls attention to variation occurring in the process. If outside of the UCL or LCL, the variation is beyond what is considered an efficient process.



Radar Chart: This chart is used to compare two or more items or groups on various features or characteristics. A radar chart, also known as a spider chart or star chart, is a type of data visualization used to display two or more dimensions of multivariate data. The radar chart is a great tool for displaying baseline levels in an assessment or collection process and establishing goals. In this example, a health department has completed a QI Cultural Assessment based on the six foundational elements of a QI culture. They determined their current level (2023) in each of the six areas and established a two-year goal. Their QI Council then developed an action plan to work toward achieving the two-year goals in each focus area.

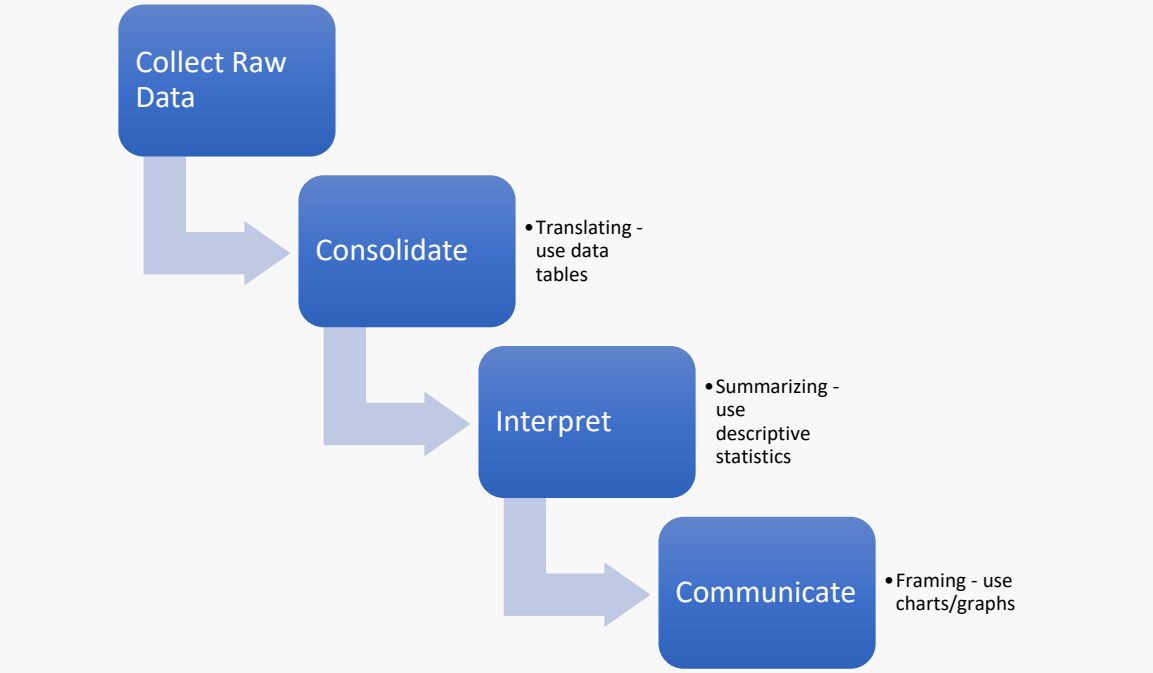


Summary:

"*The greatest value of a picture is when it forces us to notice what we never expected to see*." - John Tukey[7]

The purpose of using QI graphic tools is to help those reviewing the data to easily determine if their processes are delivering high quality products or services to their customers. These QI graphic tools help the organization to determine when to launch improvement activities or make a quick intervention to right a process.

Organizations need to have an ongoing, simple, and consistent Data Management Strategy[7] as shown below. This will help everyone in the organization to understand why we need reliable data, how to process the data, and then how to display the data so informed decisions can be made.



Authors

John W. Moran, PhD, is Senior Quality Advisor to the Public Health Foundation (PHF) and an Adjunct Professor in the Arizona State University College of Health Solutions' School for the Science of Health Care Delivery. He brings to PHF more than 30 years of quality improvement expertise in developing quality improvement tools and training programs, implementing, and evaluating quality improvement programs, and writing books and articles on quality

[7] https://www.tableau.com/learn/whitepapers/5-most-influential-data-visualizations-all-time/ accessed July 6, 2024.

improvement methods. Jack is a retired Senior Vice-President of Information Systems, Administrative and Diagnostic Services at New England Baptist Hospital. He was previously Chief Operating Officer of Changing Healthcare, Inc, specializing in management consulting and educational support to Health Care Organizations. For 21 years, Jack was employed at Polaroid Corporation where he worked in various senior management capacities in Manufacturing, Engineering, and Quality. His last position was as the Director of Worldwide Quality and Systems.

His past appointments include Senior Fellow at the University of Minnesota, School of Public Health in the Division of Health Policy and Management 2010–2015; President of the Advisory Board of Choose To Be Healthy Coalition of the Healthy Maine Partnership for York County, Maine, 2011–2016; faculty member of the CDC/IHI Antibiotic Stewardship project 2011-2012; PHAB's Evaluation and Quality Improvement Committee, 2013–2016; and more than 20 years as an Adjunct Professor in the Graduate and Undergraduate School of Engineering at the University of Lowell.

Amanda McCarty MS, MBA, MHA, is the Vice Chancellor of Health Sciences at the West Virginia Higher Education Policy Commission. She is also an Adjunct Professor in Health Care Administration at West Virginia University Institute of Technology.

From 2012-2016, she served as the Director of Performance Management & Systems Development at the West Virginia's Bureau for Public Health. At the Bureau, Amanda was a member of the health department's leadership team and was responsible for accreditation, performance management, strategic planning, workforce development and quality improvement efforts. Prior to joining the Bureau, Amanda worked for Mountain State Blue Cross Blue Shield/Highmark, Inc. in health promotion and disease prevention.

As a consultant for PHF, Amanda has provided training and technical assistance for state and local health departments in the areas of performance management systems development, workforce development, quality improvement, and the development of evaluation plans and logic models since 2013.

Robert Hines, MSPH, is a seasoned facilitator, quality improvement specialist, and public health professional with over 15 years of experience in various aspects of governmental public health. He has volunteered as a PHAB Site Visitor since 2014 and was a founding member of PHAB's Evaluation and Quality Improvement Committee. Robert currently serves as the Deputy Director for Planning and Performance at the Louisiana Department of Health, where his work is focused on process improvement, accreditation, and strategic and community health improvement planning through the lens of health equity.

Annie Vosel BSN, RN, serves as a consultant for PHF. She has over 30 years of experience working as a nurse, primarily in maternal and child health programs.

Annie worked for the Alabama Department of Public Health, where she was the Director of the Division of Women's and Children's Health as well as the Director for Alabama's Title X Family Planning Program. During this time, she developed a statewide clinical efficiency initiative for

the Family Planning program and participated in Alabama's National Public Health Improvement Initiative.

Annie earned her Bachelor of Science in Nursing from Auburn University.