

Data visualization and visual encodings:

Data visualizations are powerful mechanisms that translate numerical and categorical information into visual encodings, allowing viewers to easily comprehend and understand the data.

Examples of Data Properties and Best Uses of Visual Encodings

Example	Encoding	Useful values	Scales
	position, placement	infinite	ordered, quantitative, ordinal, categorical, relational
A, B, C; 1, 2, 3	text labels	infinite	alphanumerically ordered, quantitative, ordinal, categorical, relational
	length	many	ordered, quantitative, ordinal
	size, area	many	ordered, quantitative, ordinal
	saturation, brightness	few	ordered, ordinal
	colour (hue)	few (< 20)	unordered, categorical
	shape	few	unordered, categorical

Figure 1. A table of data properties and their best uses of visual encodings. The visual encoding used can be affected by the number of data values, as well as the data type and scale. Table adapted from [1].

Static data visualizations:

However, traditional data visualizations often come in a static form, that prohibit data transformation actions such as sorting, filtering, and drill-down. An example of a static data visualization is the Screening Activity Report [2] (SAR) from Cancer Care Ontario (CCO).

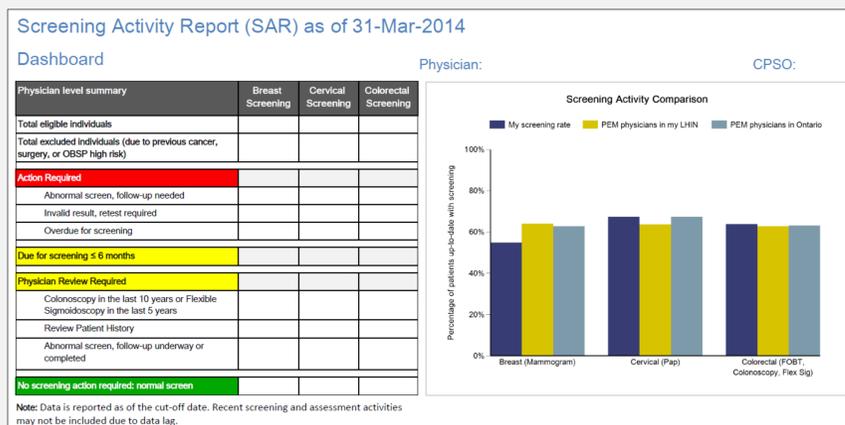


Figure 2. A Screening Activity Report from Cancer Care Ontario - an example of a static data visualization. Users are unable to interact with and manipulate the data table or bar chart.

Interactive data visualizations:

A study [3] on implementing interactive data visualizations in organizations found that:

- 70% of interactive visualization adopters improved collaboration and knowledge sharing
- 64% of adopters improved speed of decision making
- 64% of adopters improved trust in the underlying data

Literature [4] shows three main benefits of interactive and visual data analysis methods:

1. A visual approach to conduct independent data exploration is less dependent on external querying tools
2. They provide clarity, efficiency and precision when communicating complex ideas
3. They can be integrated with systems to display large volumes of filtered data in near real-time

User Interactions:

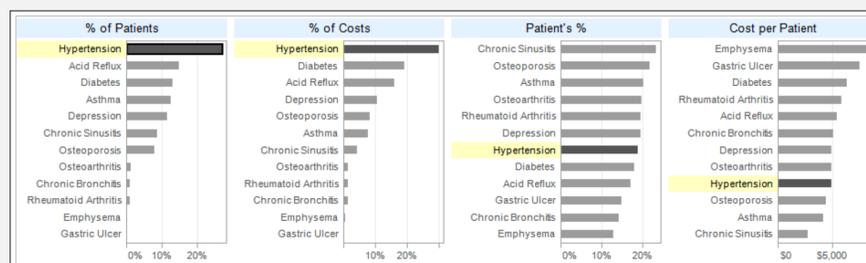


Figure 3. An example of a linked visualization to show how all data bars related to hypertension are highlighted on user mouse over. [5]

Linked visualizations allow the same data in multiple charts to display the same interactions, such as highlighting or hovering over a data object with the mouse.

Brushing allows data to be filtered on specific dimensions, selecting values that lie between a minimum and maximum.

User interactions facilitate analytical reasoning, data exploration and decision making.

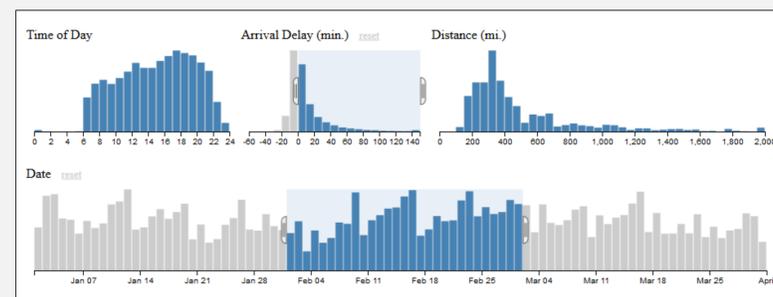


Figure 4. An example of brushing in an interactive visualization of flight data. The entire month of February is selected in the bottom histogram, while data entries with a positive arrival delay are selected in the top middle histogram. [6]

Quality improvement in primary care:

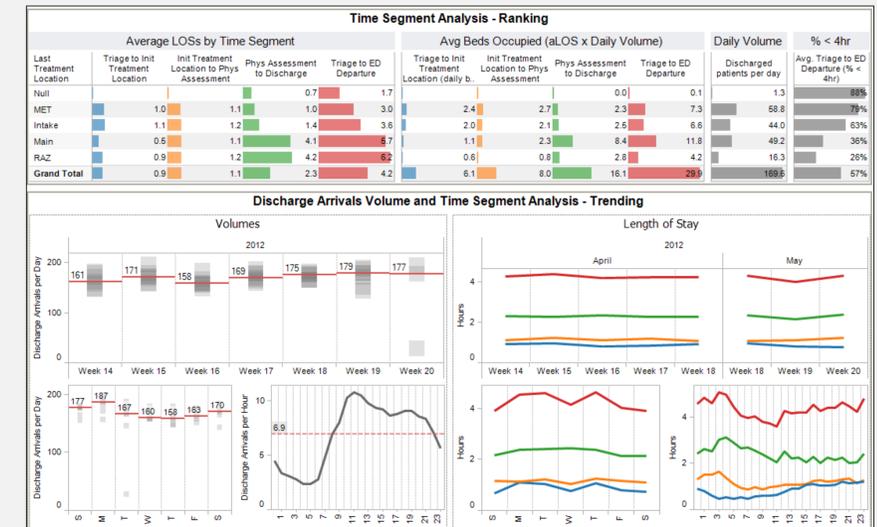


Figure 5. Volume and length of stay dashboard from Alberta Health Services [7].

Interactive visualizations such as dashboards can be used to display aggregated data of Quality Improvement Plan indicators. Patterns and trends in population health can be identified by visualizing patient health data from the EMR.

Data sources, reports and visualization techniques for QIP Indicators

Quality Improvement Plan Indicator	Data sources, reports needed and visualization techniques
Access	
% of patients able to see a provider on the same day or next day when needed	EMR, standardized appointment types, appointments export, dashboards, run charts
% of patients who visited ED for conditions best managed elsewhere	Hospital discharge reports, data mapping, dashboards, run charts
Integrated	
% of patients who saw their primary care provider 7 days post hospital discharge for selected conditions	Hospital discharge reports, data mapping, EMR, standardized appointment types, appointments export, dashboards, run charts
Patient-Centeredness	
% of patients who stated someone in the office always gave them an opportunity to ask questions	Standardized patient satisfaction surveys, dashboards, run charts
Population Health	
% of patient population over age 65 that received influenza immunizations	EMR, ad-hoc reports, flu clinic data set [8], geomaps, linked visualizations, brushing, calendar heatmaps
% of eligible patients up-to-date for colorectal cancer screening	EMR, ad-hoc reports, SAR, flow diagrams / Sankey diagrams, linked visualizations, calendar heatmaps

Figure 6. A summary table outlining several quality indicators found in the Quality Improvement Plan, with the references, resources and visualization techniques that can best be used to visualize the data.

References:

1. Illinsky N. Properties and Best Uses of Visual Encodings [Internet]. Complex Diagrams. [updated 2013 Sep 25, cited 2014 Sep 30]. Available from: <http://complexdiagrams.com/properties>
2. Cancer Care Ontario. Screening Activity Report - CCO [Internet]. Cancer Care Ontario. [updated 2014 Aug 21, cited 2014 Sep 30]. Available from: https://www.cancercare.on.ca/pcs/primcare/sar/?WT.mc_id=sar
3. Krensky, P. Interactive Data Visualization: The Age of "Look but Don't Touch" is Over [Internet]. Aberdeen Group. [2014 May, cited 2014 Sep 30]. Available from: <http://bit.ly/7YkxMP>
4. Simpaio, AE, Ahumada, LM, Galvez, JA, Rehman, MA. A Review of Analytics and Clinical Informatics in Health Care. J Med Syst. 2014 Apr 3 [cited 2014 Sep 30];38:45.
5. Few, S. Coordinated Highlighting in Context - Bringing Multidimensional Connections to Light [Internet]. Perceptual Edge. Visual Business Intelligence Newsletter. [2010 Jul, Aug, Sep, cited 2014 Sep 30]. Available from: <http://bit.ly/LovCGnK>
6. Square, Inc. Crossfilter [Internet]. Github [2012, cited 2014 Sep 30]. Available from: <http://square.github.io/crossfilter/>
7. Alberta Health Services. Volume & LOSs Dashboard. DIMR Strategic Analytics Unit. [2012 May 15, cited 2014 Sep 30].
8. Ontario.ca. Flu Shot Clinics | Ontario.ca [Internet]. Queens Printer for Ontario. [updated 2014 Aug 1, cited 2014 Sep 30]. Available from: <https://www.ontario.ca/health-and-wellness/flu-shot-clinics>