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Improvement Cymru Academy Toolkit Guide

Data Visualisation

Introduction

Data visualisation is a powerful tool that transforms raw data into visual formats, making it easier to understand, interpret, and derive insights. In the healthcare sector, this capability is particularly crucial as healthcare professionals deal with vast amounts of data daily, from patient records and treatment outcomes to operational metrics and research findings. Effective data visualisation can help make sense of this data, leading to improved patient care, streamlined operations, and informed decision-making.

In the context of continuous improvement in healthcare, data visualisation supports various initiatives such as quality improvement projects, patient safety programs, and performance monitoring. By presenting data in a clear and accessible manner, you can quickly identify areas needing attention and communicate findings to stakeholders effectively. This not only enhances the efficiency and effectiveness of healthcare delivery but also fosters a culture of transparency and accountability.

Rationale

In healthcare, the rationale for using data visualisation is multifaceted, addressing the unique challenges and opportunities within the sector. Here are some key reasons why data visualisation is essential in healthcare:

1. **Enhancing Patient Care**
    - **Quick Insights**: Visualising patient data, such as vital signs, laboratory results, and treatment histories, allows healthcare providers to quickly grasp a patient's condition and make timely decisions.
    - **Pattern Analysis**: By visualising patterns in patient outcomes, you can identify effective treatments and areas needing improvement, leading to better patient care.

2. **Improving Operational Efficiency**
    - **Resource Management**: Visual tools can help track and manage resources such as staff, equipment, and beds, ensuring optimal utilisation and reducing waste.
    - **Process Optimisation**: Visualising workflow data can highlight bottlenecks, constraints and inefficiencies, guiding process improvements and enhancing overall operational efficiency.
    - **Supporting Quality Improvement**

Data visualisation enables continuous monitoring and analysis of key performance indicators (KPIs) such as readmission rates, infection rates, and patient satisfaction scores, facilitating ongoing quality assurance including quality improvement efforts.

Facilitating Communication

- **Stakeholder Engagement**: Clear and compelling visualisations can effectively communicate complex data to various stakeholders, including clinicians, administrators, and patients, fostering informed decision-making and collaboration. See our Involving Others Toolkit guide here for more information.
- **Patient Education**: The use of visual data can help you to explain medical conditions, treatment options, and health patterns to patients, enhancing their understanding and engagement in their own care.

3. **Driving Data-Driven Decision Making**
    - **Evidence-Based Practice**: Visualising clinical data supports evidence-based practice by making research findings and clinical guidelines more accessible and actionable.
    - **Predictive Analytics**: Advanced visualisation techniques can integrate predictive analytics, helping you to anticipate and mitigate potential issues before they arise.

4. **Enhancing Research and Innovation**
    - **Data Exploration**: Researchers can use visualisation tools to explore large datasets, uncovering new insights and driving innovation in medical research.
    - **Collaboration**: Data visualisation can facilitate collaboration among researchers by providing a clear and shared understanding of complex data.

The rationale behind data visualisation is to effectively communicate data in a visual format. Visual representations can highlight key information quickly, facilitating better decision-making and fostering a culture of data-driven improvement.

Background

Data visualisation in healthcare has a rich history and has evolved significantly over the years, driven by advancements in technology and the increasing complexity of healthcare data. One of the earliest and most notable uses of data visualisation in healthcare was by Florence Nightingale in the 1850s. She used polar area diagrams, also known as “coxcombs,” to illustrate the causes of mortality in the Crimean War, highlighting the impact of sanitary conditions on soldier deaths. This pioneering work demonstrated the power of visual data to drive public health reforms.

Throughout the 20th century, the development of statistical graphics and charts, such as bar charts, line graphs, and pie charts, provided healthcare professionals with tools to better understand and communicate data. These visualisations were used in epidemiology, public health, and clinical research to track disease outbreaks, monitor patterns, and evaluate treatment outcomes.

The advent of computers in the latter half of the 20th century revolutionised data visualisation. With the ability to process large datasets quickly, healthcare organisations began using software to create more complex and detailed visualisations. This period saw the rise of electronic health records (EHRs) and the integration of data visualisation tools within these systems.

In recent decades, advanced data visualisation tools such as Tableau, Power BI, and various Python libraries (e.g., Matplotlib, Seaborn) have become integral to

healthcare analytics. These tools allow for the creation of interactive and dynamic visualisations, enabling users to explore data in real-time and gain deeper insights.

Today, interactive dashboards are widely used in healthcare to monitor key performance indicators, track patient outcomes, and manage resources. These dashboards provide real-time updates and allow users to drill down into specific data points for more detailed analysis.

Data visualisation continues to evolve, driven by technological advancements and the growing need for data-driven decision-making in healthcare. As the field progresses, it will play an increasingly vital role in improving patient outcomes, enhancing operational efficiency, and advancing medical research.

When to use it?

Data visualisation is a critical component of continuous improvement initiatives in healthcare. It helps to identify areas for enhancement, track progress, and communicate results effectively. Here are some specific scenarios where visualisation can drive improvement efforts:

By incorporating data visualisation into your improvement initiatives, enables you to make data-driven decisions that enhance patient care, operational efficiency, and overall quality.

How to use…

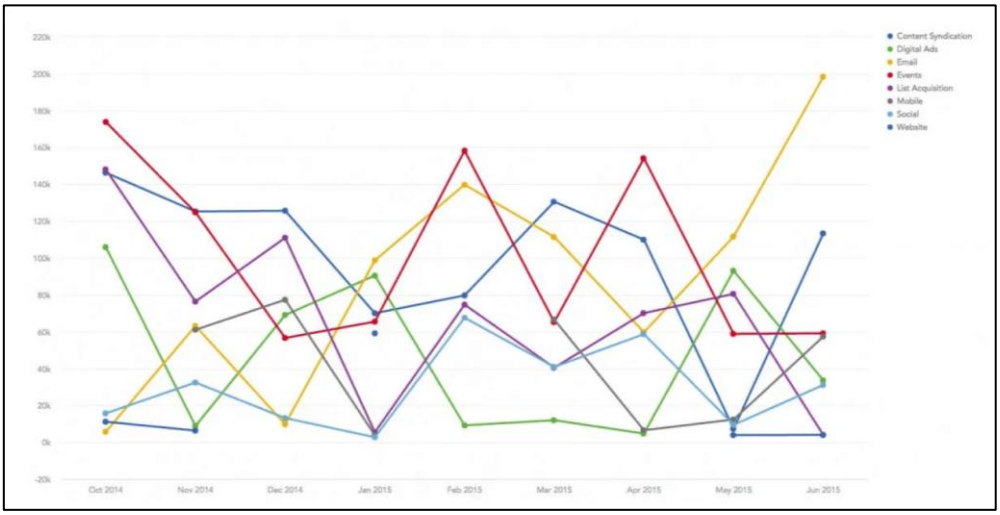
There are many types of data visualisation, but the most used charts include bar charts, pie charts, time series charts and scatter plots. In general:

- Bar charts are for showing the relationship between 1 categorical variable (e.g. health condition) against 1 numerical variable (e.g. age, height).
- Pie charts are for the same thing but are best used for data that contains 2-3 categories.
- Scatterplots are for finding correlations between 2 numerical variables.
- Time series are for showing changes over time (time vs. numerical variable).

You need to consider the most appropriate format for the data that you wish to display. Here are some examples of poor data visualisation.

Example 1

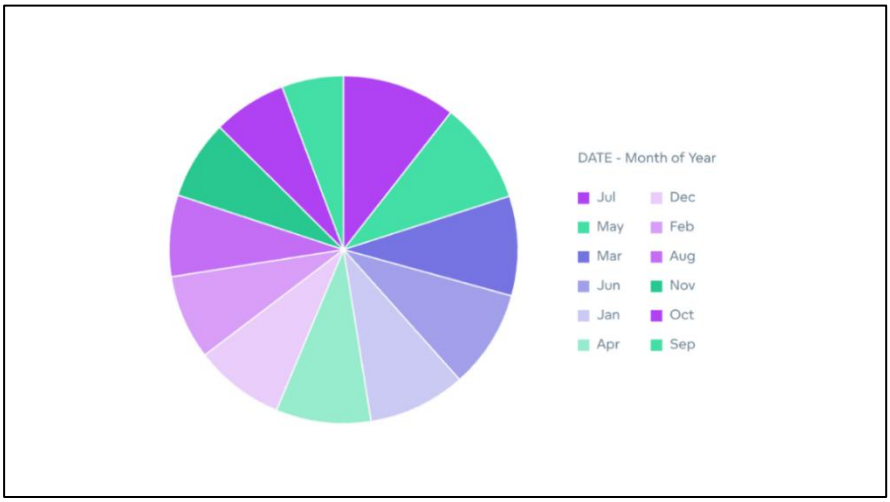
In this example of a line chart, the numerous intersecting lines make it difficult to discern any clear patterns in the data.



Good Data, 2024

Example 2

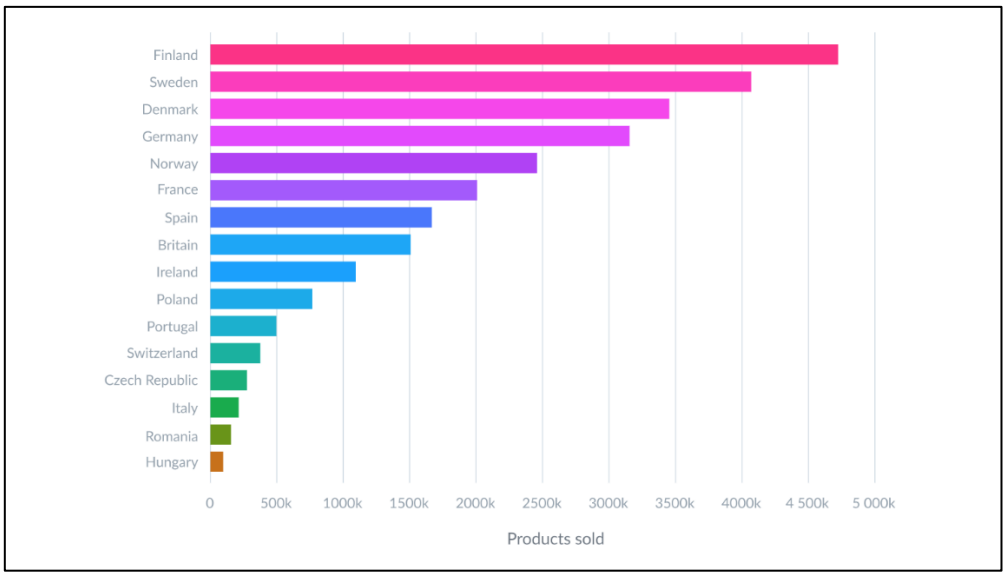
This example has more segments than the recommended for a pie chart. When there are too many slices, the chart becomes cluttered, making it difficult to distinguish between the differences in segments. This overwhelms the viewer and reduces the chart's ability to convey meaningful insights.



Good Data, 2024

Example 3

The colours have been randomly assigned to represent different countries. While they may make the chart visually appealing, they don't enhance understanding of the data. In fact, rather than providing clarity, the colours add visual noise that distracts from the message the data is meant to convey.



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Here is a summary to help you to use data visualisation in your improvement work:

1. **Define your aim**: Clearly understand what you want to achieve with your visualisation.
2. **Choose the right type of chart**: Select the appropriate visualisation type (e.g., bar chart, line graph, scatter plot) based on your data, audience and aim.
3. **Use tools**: Utilise data visualisation tools like Excel, Tableau, or Power BI to create your visuals according to your level of competence using these tools.
4. **Cleanse your data**: Ensure your data is accurate and cleansed before visualising. The goal is to improve data quality by handling issues like missing values, duplicates, inconsistencies, and outliers identified as human error during the data capture.

5. **Design for clarity**: Focus on simplicity and clarity. Avoid clutter and use colours and labels effectively. Remove distractions such as grid lines where they do not add value to your chart.
6. **Iterate and Improve**: Continuously refine your visualisations based on feedback and new data.

Helpful Tips

Here are some tips to help you use data visualisation:

- Whilst the afore mentioned charts are valid - in improvement we rely upon **time series data** - i.e. data visualised over time
- **Know your audience:** Tailor your visualisations to the knowledge level and interests of your audience.
- **Tell a story:** Use your visuals to tell a compelling story that guides the viewer through the data.
- **Keep it simple:** Avoid overcomplicating your visuals. Simplicity enhances understanding.
- **Use colour wisely:** Use colours to highlight key data points but avoid using too many colours, which can be distracting.
- **Test and validate:** Always test your visualisations to ensure they accurately represent the data and are easy to understand.

Additional resources

If you would like to learn more about making improvement to your workplace take a look at our website for what we offer you Improvement Cymru Academy - Public Health Wales (nhs.wales) or email us improvementcymruacademy@wales.nhs.uk to find about the improvement courses we can offer.

Further reading

Good data (2024). *9 Bad Data Visualisation Examples That You Can Learn From.* [Online] Available at: 9 Bad Data Visualization Examples That You Can Learn From | GoodData [Accessed 18 Dec 2024].

Lloyd, R. (2017). *Quality health care. A guide to developing and using indicators*. Burlington, Massachusetts, United States. Jones and Bartlett Publishers, Inc.; 2nd Revised edition.

Provost.L. & Murray.S. (2011). *The Health Care Data Guide: Learning from Data for Improvement*. USA. John Wiley & Sons.

What is data visualisation? What Is Data Visualization? | IBM (Accessed 18 Dec 2024)