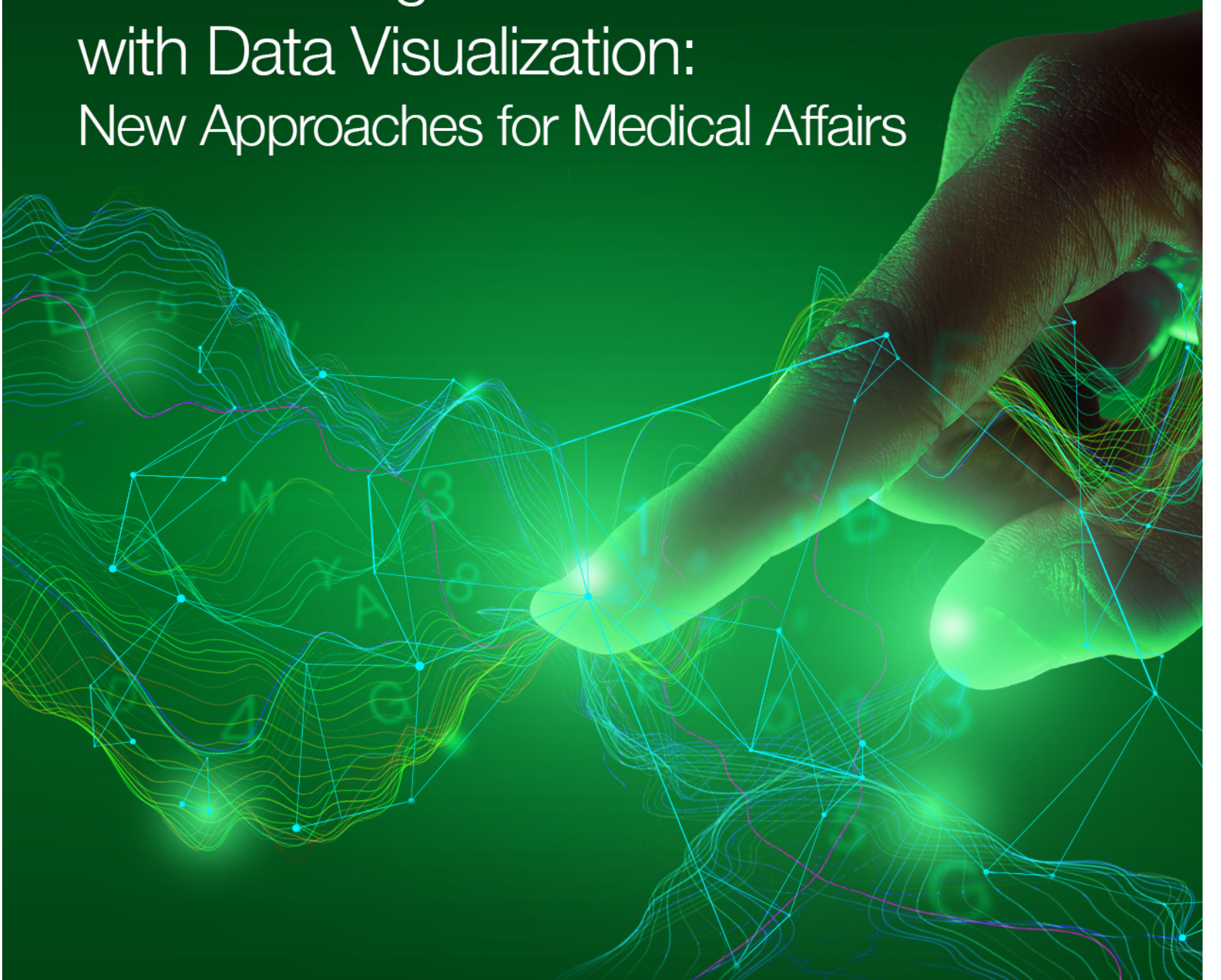
ELEVATE

Transforming Evidence Generation with Data Visualization:

New Approaches for Medical Affairs



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Introduction

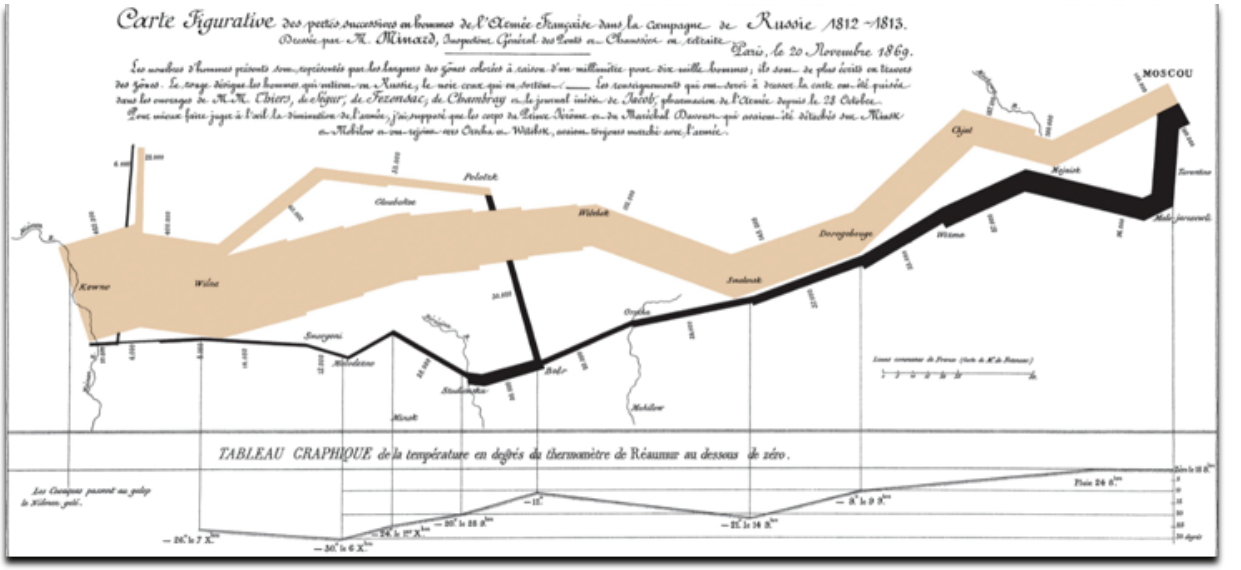
As evidence generation becomes more advanced and integrated into Medical Affairs strategic plans, there is a greater need to maximize the impact of this research through new possibilities in scientific communication. One element of successfully communicating complex clinical and nonclinical data is visualization, and especially data visualization using emerging digital technologies.[1] Data visualization draws on a variety of disciplines, combining elements of statistics, programming, computer science, operations research, graphic design, and data science – along with expertise in technology, data architecture, clinical acumen, medical governance and more. Data visualization is the representation of data through use of common graphics, such as charts, plots, infographics, and even animations. [2] The value of data visualization is that it allows complex relationships to be represented in a way that is easy to understand. This Elevate article will discuss the increasing demand for visual communication and offers a best practice format for data visualization in publications, medical information, and scientific communications, with examples of visually rich content that have driven success in communication, education, and knowledge management.

Approaching Data Generation and Scientific Communication in a Digital World

Meaningful evidence generation plans have become a core of strategy for Medical Affairs in demonstrating the value of approved pharmaceutical products and devices. Along with defining the aims of clinical and real-world studies needed to support strategic priorities, Medical Affairs teams must decide how the results of these studies will be communicated to their intended audiences. Increasingly, opportunity exists to expand scientific communication beyond traditional publication channels and formats. This new approach requires publication and scientific communications teams within Medical Affairs to step beyond their traditional processes and collaborate with digital strategy teams, embedding visualization initiatives in the evidence generation planning process. The need to plan for visual communication of complex data may be even more essential in light of Medical Affairs' developing role in patient communications. For example, demonstrating the power of visualizations in patient communications, a recent study found that visualizations used in patient communication led to a 94% increase in comprehension.[3] Today, the use of digital strategies for medical engagement and scientific exchange are expected to offer interactive, high-quality content that is tailored to stakeholder needs and preferences.[4, 5, 6] The faster Medical Affairs teams can develop and deliver the right information in the right format, to the right stakeholders to help individuals make better clinical decisions, the greater and more valuable the strategic role of Medical Affairs becomes to the entire organization.

Napoleon's Retreat from Moscow – A Case Example for Medical Affairs

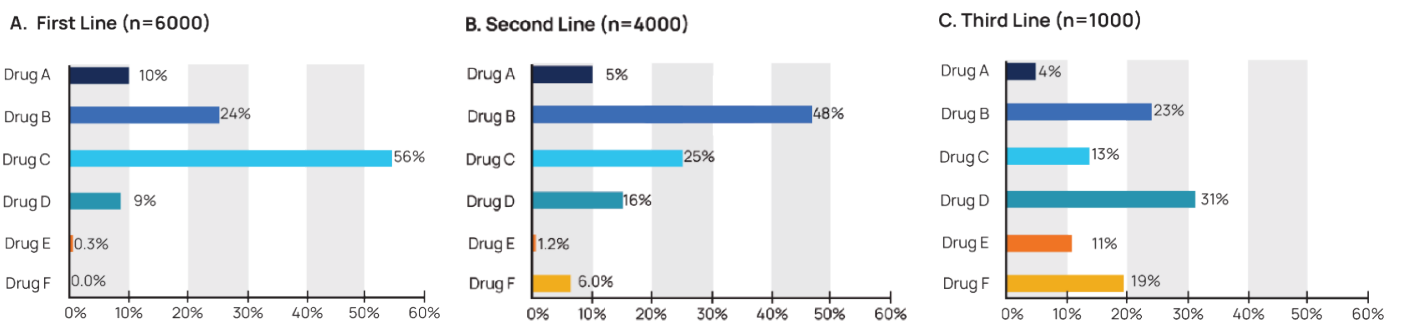
Students of French history may recall Charles Minard's illustration of Napoleon's disastrous military campaign into Russia [1812-1813] (below).[7] The graphic depicts the terrain, route, and size of Napoleon's military force as it marched across Europe into Moscow. The gold-colored path depicts the beginning of the French Army's campaign into Russia (estimated to be 422,000 men at the outset), while the black-colored path shows the unit's retreat from Moscow, with the narrowing width representing the dwindling number of surviving soldiers. Minard's simple depiction of the military operation's failure is considered a classic in data visualization, creatively demonstrating how visualization of data can quickly communicate a strong narrative of an outcome – here, not only Napoleon's retreat from Moscow, but also the fatal impact of extreme winter temperatures on soldiers who had survived battle and attempted to return home. It is a genius display of the ability to convey multivariate information transparently and simply through visual representation. For Medical Affairs teams, the journey of our patients through disease can be equally complex, requiring equally ingenious visual representations. The remainder of this article will walk through typical steps for visualizing information to create understanding.



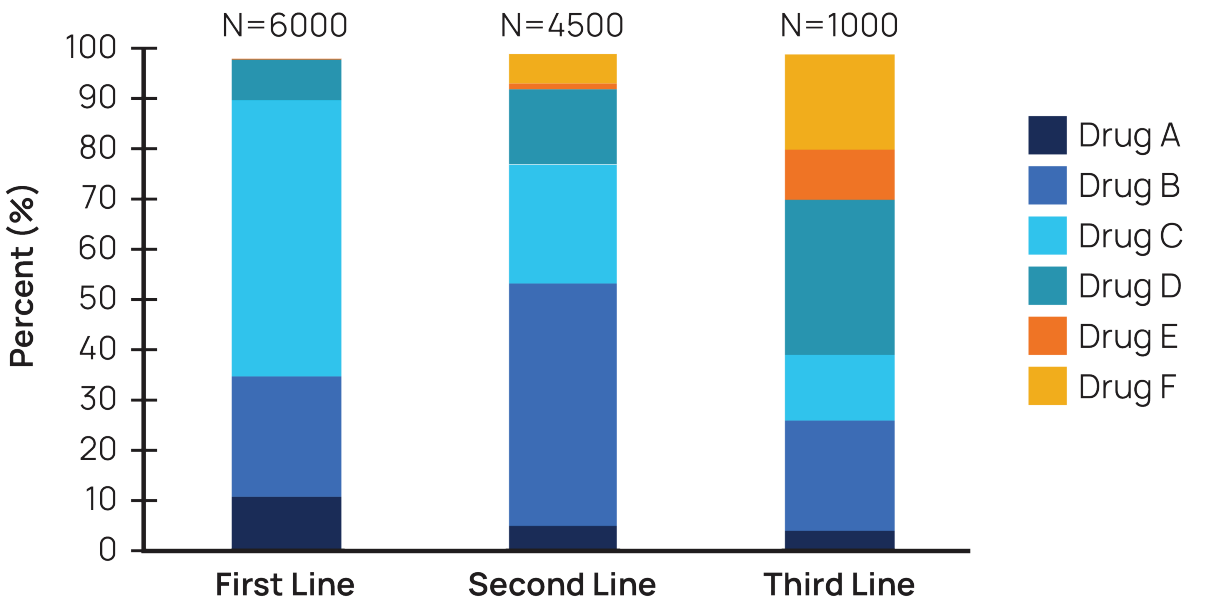
Charles Minard's illustration of Napoleon's disastrous military campaign into Russia [1812-1813]

Visualization of the Patient Journey

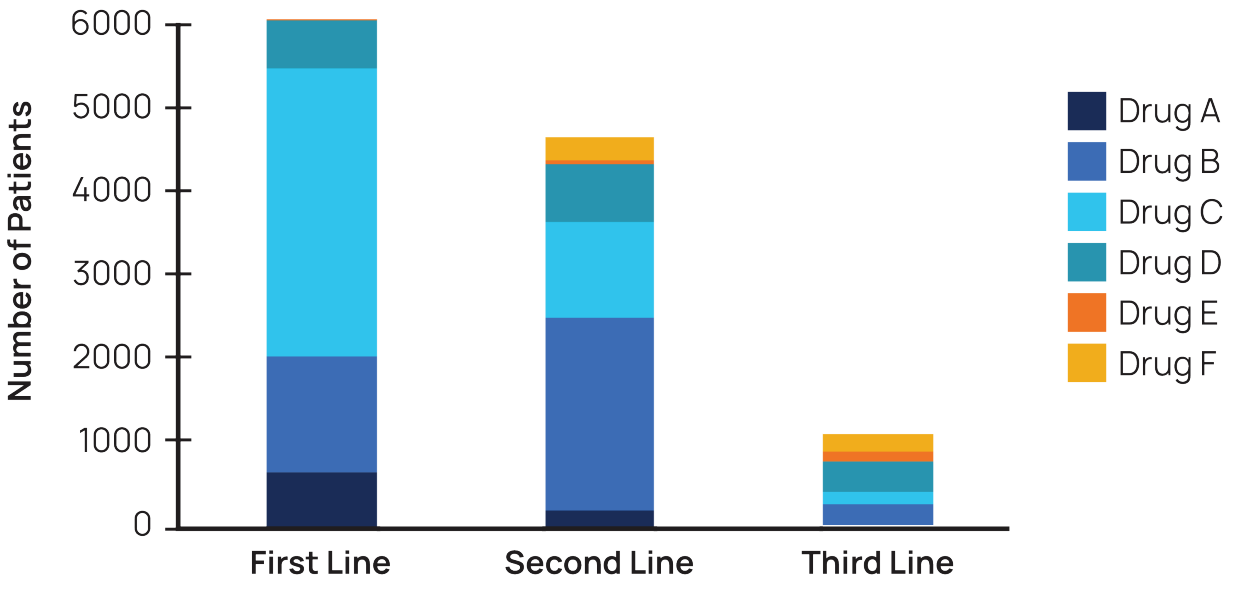
Oncology provides a rich data source to explore visualizations of the patient journey. Not only do multiple treatment options exist for many cancers, but patients often require and receive multiple lines of therapy, switching treatments to maximize efficacy and minimize toxicity. One common question from oncologists and other healthcare cancer providers is, "How often and in what sequence are treatments prescribed in each setting?" One way we might provide a visual answer to this question is shown below (using fictional Drugs A, B, C, D, E, and F). Here, the descriptive data on a large sample of treated cancer patients is being presented in a series of simple horizontal bar charts. The frequency charts show that "Drug C" is the most often used drug for 1st line treatment (56%), followed by "Drug B" (24%). In the next bar chart, a smaller total sample of patients is being treated, and "Drug B" is being used most frequently as the 2nd line therapy (48%). In the third bar chart, we see that "Drug D" is the most used treatment option for 31% patients that have survived or have chosen to receive a 3rd line of therapy. Importantly, these bar charts provide a visual answer to original question, namely how often each drug is used in 1st, 2nd and 3rd line settings.



If, instead, the question of interest was not how often each of these drugs is used in each setting, but how often any single drug is used, it might make more sense to present each bar chart stacked as follows. From this visualization, a healthcare provider could see, for example, that "Drug F" is much more commonly used as a third-line treatment than as a first-line treatment. Or a provider could see that "Drug B" is the overwhelming choice for second-line therapy. Again, these related but different visualizations serve the important purpose of answering the identified stakeholders' specific informational needs.

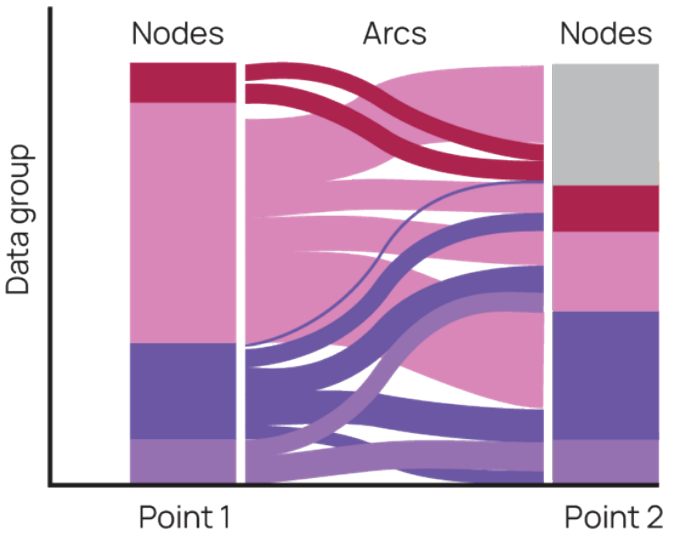


Continuing the evolution of these figures, if the primary question were refocused from wanting to know the percentage of patients receiving each drug in each setting, to wanting to know the number of patients receiving each drug, we could replot the stacked bars, as follows:



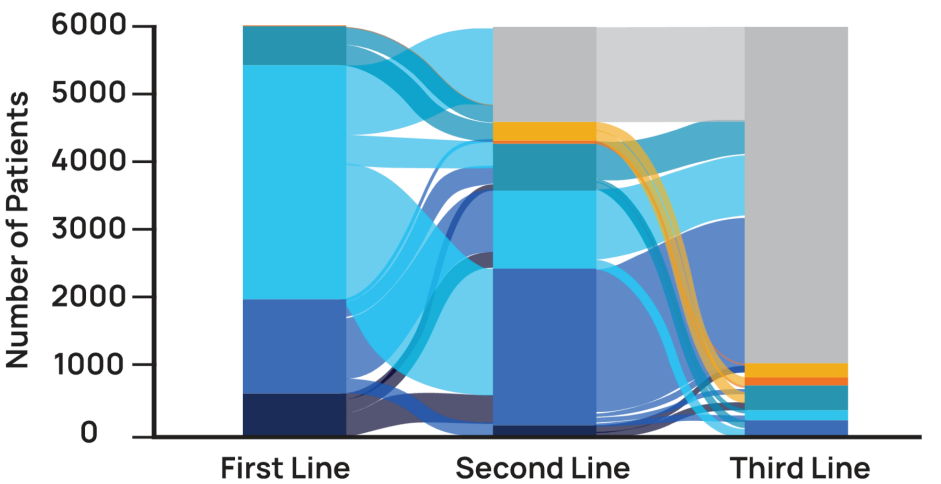
The Sankey Diagram

In this setting, it is also important to know the common sequences of therapies; for example, do patients who start with "Drug C" then commonly follow with "Drug B" or "Drug A"? If the data allows a longitudinal follow-up of patients from first line to third line, a more powerful way to show the flow of patients from each therapy is to use a Sankey diagram. A Sankey diagram includes nodes and arcs as shown below. As transitions occur, each arc flows from its source node to a target node.



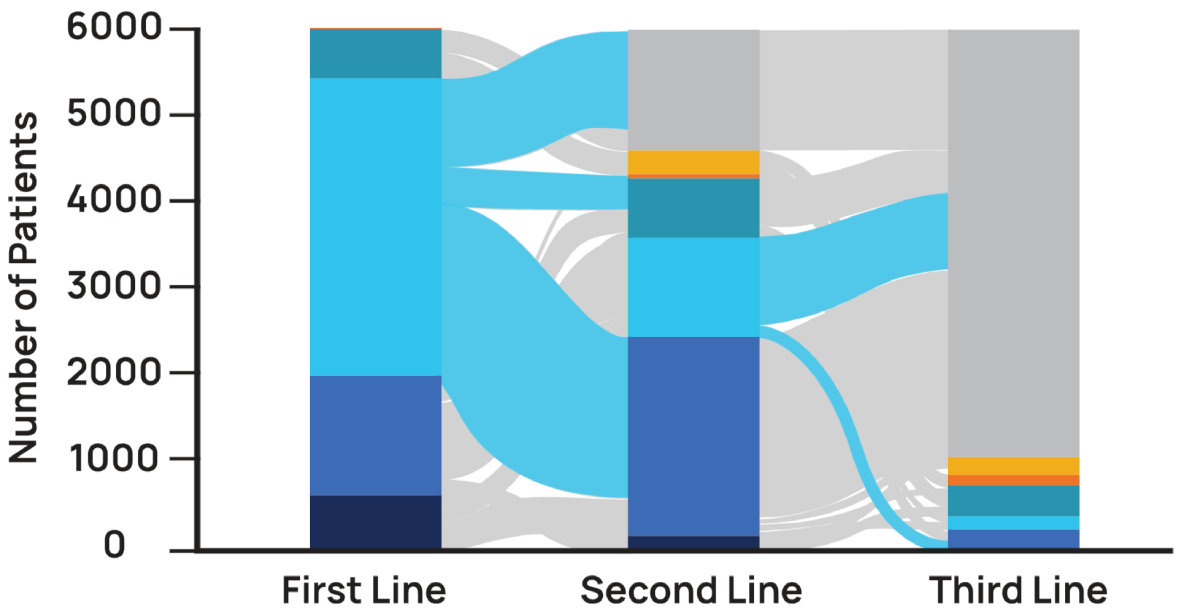
The Sankey Diagram

The different widths of each arc visualize the flow of data, movement, or change from point 1 to point 2.
The Sankey diagram is named after Captain Matthew Sankey who first used the data visualization approach in 1898 in an article explaining the energy efficiency of a steam engine.[8] Applying a Sankey diagram to our fictional example of oncology treatment switching data, the points along the X axis can be each line of treatment; the nodes are each drug; and the arc widths represent the flow of the number of patients from one treatment to another.



With this visualization, the audience can not only compare the number of patients at each line of treatment for each drug, but they can also see the number of patients that switch from one drug to another. Key advantages of the Sankey are visualization of the evolution of a population's status over milestones and the fact that multiple variables can be viewed with one graph. One downside of the Sankey diagram is its complexity. While this visualization does reveal a lot of information, it can be overwhelming to review – a lot is being shown all at once and it is difficult to prioritize what to look at, and why.

In Medical Affairs, often our goal is to highlight the use of a single drug, which could be done by highlighting a drug's path through a Sankey Diagram, as follows:

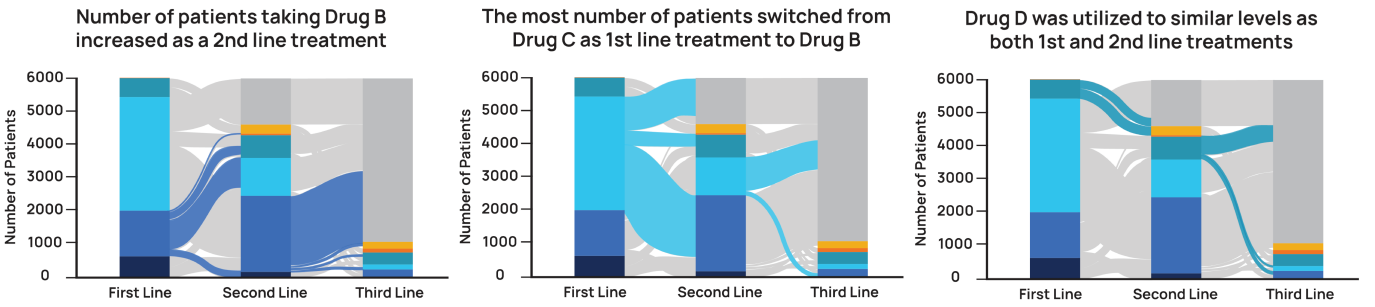


By highlighting paths of only "Drug C" (and desaturating the other bands for the other drugs), your eye will only have to follow the patient's journey of that drug. (There are several tools available online to create Sankey Diagrams including SankeyMatic, Flourish, and Visual Paradigm.)

The Importance of Message Headings and Use of Small Multiples

The previous section is not meant to imply that Sankey diagrams with or without specific paths highlighted are the correct visualization for all research data or even all patient journeys. Instead, the section was meant to highlight the need to create visualizations from the perspective of the desired informational impact. Who are the relevant stakeholders? What are their informational needs? How does a visualization speak to these needs? Another way to highlight a visualization's informational purpose is with the use of message headings.

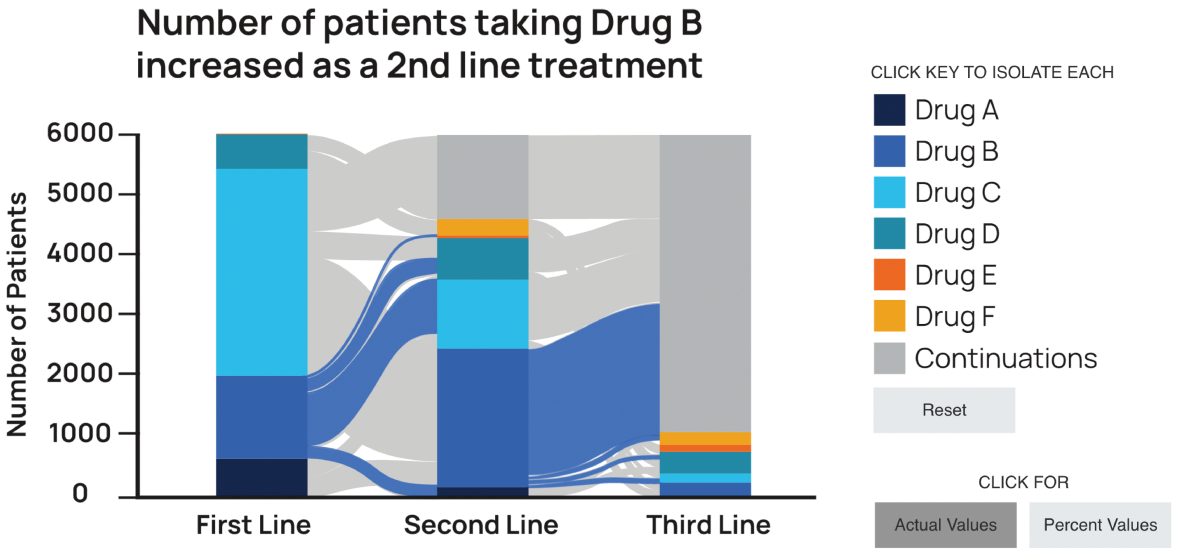
A graphic title tells the audience exactly what the visual represents. In your own scientific communications, we recommend using "message headings". More specifically, a message is the one main point you want a stakeholder to take away from each image. Clear and succinct message titles have been shown to be more effective than passive phrase titles in conveying technical information[9] and aiding retention[10] in various audiences. By using message headings together with a series of "small multiples" that each highlight a specific drug, you can make the information easier for the reader to review.



Beyond Publications – And the Use of Interactive Dashboards

In the series of steps above, we presented a series of visualizations that answered hypothetical healthcare provider questions; each visualization was optimized to provide the desired information. Dashboards or other interactive data visualization libraries allow users to interrogate the information specific to their needs, entering parameters to generating unique visuals to answer their own questions of relevance. A simple example can be found via this link: http://sankey.infograph-edtest.com/ (snapshot shown below)

Visualizing the Patient Journey Through a Treatment Switching Dashboard



Conclusion

As Medical Affairs leaders continue to advance their organization's data generation capabilities and evolve the application of digital scientific communications, such as omnichannel, the importance of creating and using effective visual communications will be critically important to the overall educational value and use by their stakeholders. The use of both static and interactive data visualization techniques from evidence generation and advanced analytic outputs has the potential to transform future Medical Affairs interaction models. Evidence Generation leaders, in collaboration with their partners in Scientific Communication and Digital Strategy should begin to consider how to visually communicate their data by using and combining universal icons, expert use of data visualizations, custom illustration, message titles, and other interactive sensory tools to make this data and information easier to comprehend.

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