

EVC initiative team
Clinical Development & Analytics
Global Drug Development



Effective Visual Communication (EVC) for Quantitative Scientists

Marc Vandemeulebroecke, Baldur Magnusson, Mark Baillie & Alison Margolskee

ASCPT Pharmacometrics & Pharmacokinetics Webinar (part 1)

Friday, January 15, 2021

<https://graphicsprinciples.github.io/>

Welcome to the ASCPT Webinar!

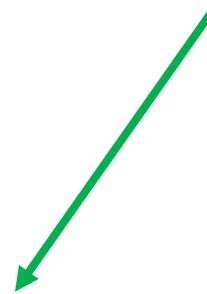
The presentation will start momentarily

Housekeeping Notes

- All attendees are auto-muted
- Please use the chat function to address ASCPT staff
- Please forward ideas for future webinar topics and/or questions on today's webinar to members@ASCPT.org
- We will be recording today's presentation. This presentation and all previously recorded webinars are available to members via the Online Learning page on ASCPT.org



Please direct your questions through the Q&A function at any time throughout the presentation; if viewing in full screen, you may need to hover over the bottom of your screen to see this option



Effective Visual Communication (EVC) for Quantitative Scientists



Global Group Head for
Biostatistics

Marc Vandemeulebroecke



Methodologist supporting
clinical development and
analytics

Mark Baillie



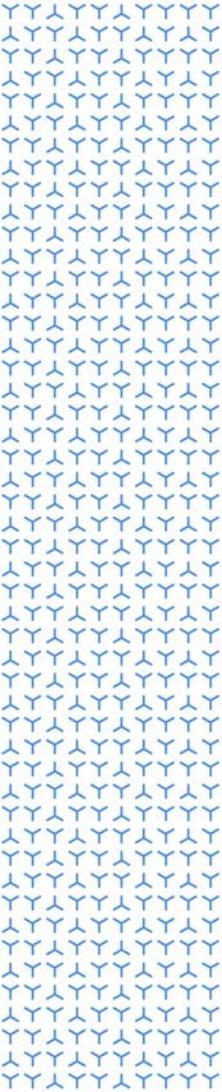
Global Group Head in Early
Development Analytics

Baldur Magnusson



Senior Principal
Pharmacometrician
supporting Cardiovascular
and Metabolism projects

Alison Margolskee



Introduction and Agenda

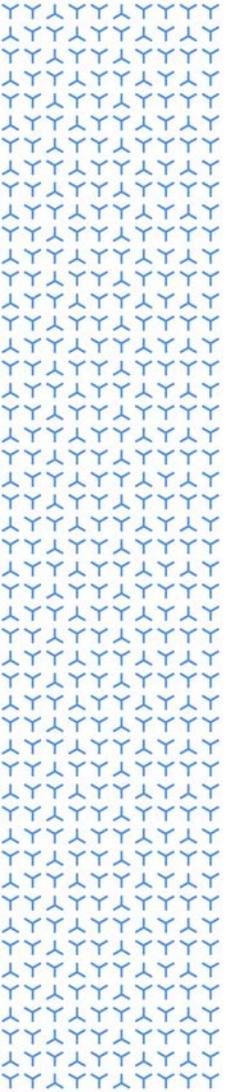
Marc Vandemeulebroecke

Agenda for Webinar: Part 1

Timing	Agenda Item	Presenter
3 min	Introduction and learning outcomes	Marc
15 min	Importance of EVC and overview of principles	Baldur
10 min	Structured approach to EVC	Mark
12 min	Your turn: homework assignment 1) Graph + purpose 2) Dataset + purpose 3) Bring your own example	Alison
3 min	Recap and resources	Marc
10 min	Q&A and close	Neeraj

Learning outcomes

- Appreciate why effective visual communication is a key competency for the quantitative scientist.
- Explain the three principles of EVC (purpose, clarity and message).
- Design a visualization based on a specific purpose.
- Redesign a visualization to show data clearly.
- Enhance the message of a visualization.
- Recognize where to apply the three principles of effective visual communication in your daily work.



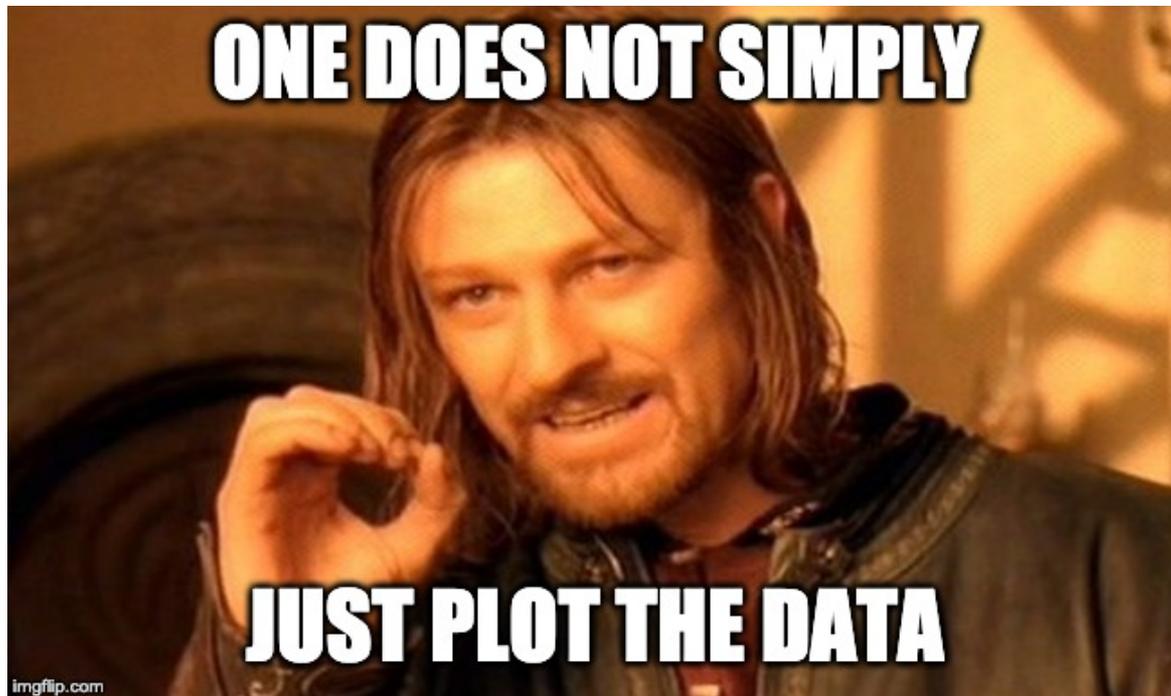
Motivation

Baldur Magnusson

Plotting data is fun, but...

- A bad plot can be worse than no plot
- Producing a lot of graphs \neq effective visual communication

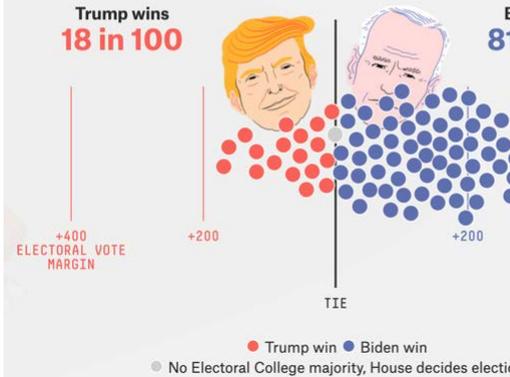
Great graphs are not trivial



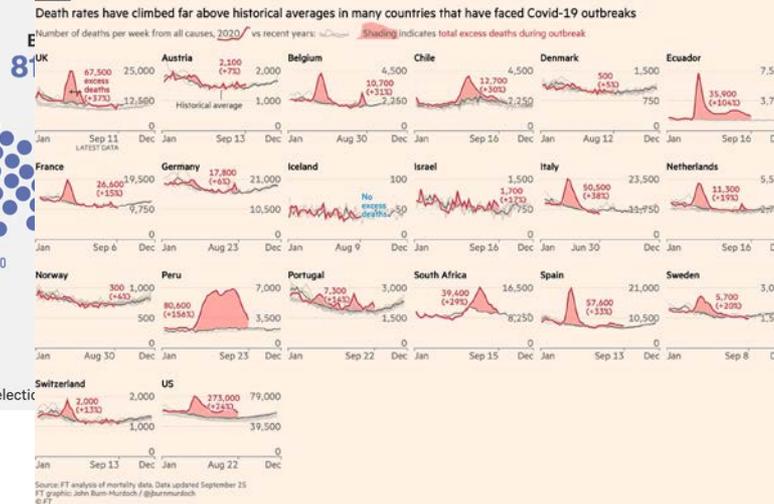
Effective visualizations are all around us

Biden is *favored* to win the election

We simulate the election 40,000 times to see who wins most often. The sample of 100 outcomes below gives you a good idea of the range of scenarios our model thinks is possible.



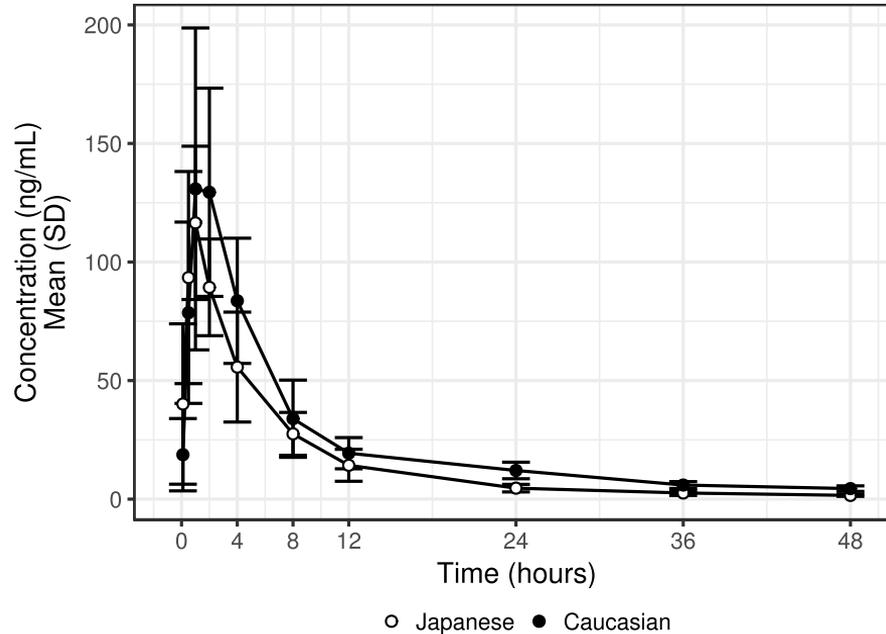
<http://www.fivethirtyeight.com>



<http://www.ft.com/coronavirusfree>

<http://vis-sig.github.io/blog>

Is exposure different? How?



What are we supposed to conclude?

What if we could do better?

Producing visualizations that...

-  Are crafted for a specific purpose
-  Adhere to good graphical principles
-  Are designed for a particular audience
-  Answer the question clearly

Could lead to...

-  More impactful communication
-  Elevated influence
-  Informed decision-making

3 principles for improving visual communications

- **1st principle: Have a clear purpose**

- Understand the question you are trying to answer
- Identify the quantitative evidence to answer that question
- Know your audience and focus the design to support their needs



- **2nd principle: Show the data clearly**

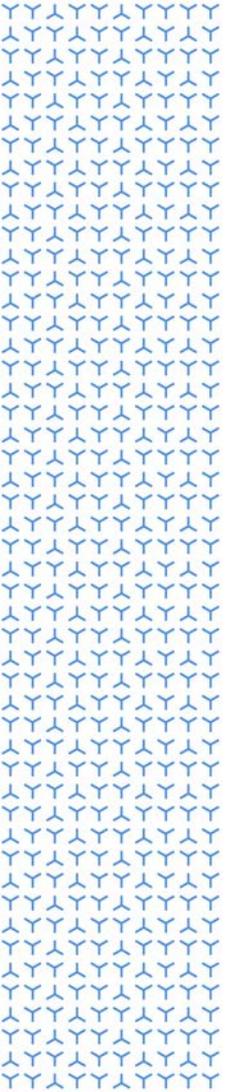
- Choose the appropriate graph type to display your data
- Avoid misrepresentation (use appropriate scales)
- Maximize data to ink ratio (reduce distraction, less is more)



- **3rd principle: Make the message obvious**

- Minimize mental arithmetic (e.g. plot the difference)
- Use proximity and alignment to aid in comparisons
- Use colors and annotations to highlight important details





Principles with examples

Principles for EVC

Graphics Principles Cheat Sheet v1.1

Communication

Effective visualizations communicate complex statistical and quantitative information facilitating insight, understanding, and decision making.

But what is an effective graph?

This cheat sheet provides general guidance and points to consider.

Planning

Clearly identify the purpose of the graph, e.g. to deliver a message or for exploration?

Identify the quantitative evidence to support the purpose

Identify the intended audience (specialists, non-specialists, both) and focus the design to support their needs

Adopt the design to space or formatting constraints (e.g. clinical report, slide deck or publication)

Who

What

Why

Where

Principles of Effective Graphic Design

Proximity – group related elements together
Alignment – elements on the same vertical or horizontal plane are perceived as having similar properties
Simplicity – cut anything superfluous, only include elements that add value, limit to 2-3 colors or fonts

White space (empty space) – use white space to minimize distraction & provide clarity

Legibility – sans serif fonts are easier to read, use color for emphasis instead of a new typeface

Color – select colors that present enough contrast to make the graph legible. Choose monochromatic color schemes to prevent clashing. Use dark colors and accent colors to emphasize important information

Visual Hierarchy – use color, font, image size, typeface, alignment & placement to create a viewing order

Focal Points – primary area of interest that immediately attracts the eye; emphasize the most important content and make it your focal point. Use contrasting colors to draw attention

Repetition – repeating elements can be visually appealing, repeated shapes, labels, colors

Familiarity – using familiar styles, icons, navigation structure makes viewers feel confident

Consistency – be consistent with heading sizes, font choices, color schemes, and spacing. Use images with similar styles

Effectiveness Ranking

A graph is a representation of data that visually encodes numerical values into attributes such as lines, symbols and colors. The Cleveland-McGill scale can be used to select the most effective attributes for your purpose.

Volume	Color hue	Depth, 3d position	Color intensity	Area	Slope or Angle	Length	Position on unaligned scale	Position on common scale

Least accurate	Most accurate
<ul style="list-style-type: none"> volume charts poorly designed heat maps multivariate density plots heat maps bubble charts, mosaic charts line graphs, pie charts stacked bar charts, waterfall chart small multiple plots dot plots, bar charts, parallel coordinate plots 	<ul style="list-style-type: none"> Use reference lines and other visual anchors.

Selecting the right base graph

Consider if a standard graph can be used by identifying suitable designs based on the (i) purpose (i.e. message to be conveyed or question to answer) and (ii) data (i.e. variables to display).

Example plots categorized by purpose

Deviation	Correlation	Ranking	Distribution	Evolution	Part-to-whole	Magnitude
<ul style="list-style-type: none"> Chg. from baseline Waterfall 	<ul style="list-style-type: none"> Scatter plot Heat map 	<ul style="list-style-type: none"> Horizontal bar chart Dotplot 	<ul style="list-style-type: none"> Boxplot Histogram 	<ul style="list-style-type: none"> Kaplan Meier Line plot 	<ul style="list-style-type: none"> Stacked bar chart Tree map 	<ul style="list-style-type: none"> Vertical bar chart Forest plot

Facilitating Comparisons

Proximity improves association
 Place labels next to data instead of using legends

Group together elements to be compared directly

Ease visual inspection
 Order values to help compare across many categories

Reduce mental arithmetic
 Plot the final comparison e.g. mean difference not two means

Emphasize the data by minimizing unnecessary ink, e.g. by using gridlines with a light color

Utilize existing resources for selection of appropriate palettes such as Color Brewer or Numex

Color for emphasis or distinction

Restrained use of color is highly effective in organizing a narrative and calling attention to certain elements.

Think carefully before introducing additional color. Do you really need it?

Do not use color to differentiate categories of the same variable

Use colors or shades to represent meaningful differences such as positive/negative values, treatments or doses

Be consistent, use the same color to mean the same thing in a series of graphs (e.g. treatment, dose)

Use a bold, saturated or contrasting color to emphasize important details

Implementation Considerations

Plot cause on the x-axis and effect on the y-axis. Use this standard convention in order to avoid misinterpretation.

Aspect ratio can influence interpretation. Aim for a 4:5 degree angle of change to avoid over-interpretation of slope.

Use position for comparisons rather than length (i.e. dots instead of bars), especially for non-linear scales (e.g. log scale, ratio, AUC, CL)

Do not plot log-normally distributed variables on a linear scale (e.g. hazard ratio, AUC, CL)

When displaying data measured on the same scale, also plot them on the same scale for easy comparison.

Connected data imply continuity. Do not connect data across a disconnected or uneven time scale.

Visit together close together are perceived to be closer in time. Space the visits proportionally to the time between each in order to avoid confusion.

Plot data and inferences to support stories about modes.

Keep the font style simple – sans serif is easier to read.

Display text with enough contrast to be visible. Favor the use of dark on light instead of light on dark whenever possible.

Bold or italics should only be used for layering or emphasis. Emphasizing everything means nothing gets emphasized.

Try not to text at an angle, as this decreases readability. Think of alternative solutions such as transposing the graph.

Putting it all together – Remove the clutter & emphasize the message

Creating a graph is an iterative process: produce, review and refine.

Colors, backgrounds, and borders can be removed and gridlines reduced.

It is easier to see differences in position over a difference in length, i.e. a dot over a bar.

Using too many colors can be distracting. Use white background and try using other methods to distinguish different curves.

One solution could be repeating the data in different panels, highlighting individual curves in a darker color.

Legibility and Clarity

Effective graphs stand alone. They use titles, annotations, labels, shapes, colors, and textures to deliver important information.

Label axes with clear measurement units and provide annotations that support the message.

Use font size to create hierarchy (e.g. set titles 20% larger than all other labels to make them more prominent).

Do not type too small or too condensed. Break long titles into two lines. Shift or adjust size of labels that overlap.

Keep the font style simple – sans serif is easier to read.

Display text with enough contrast to be visible. Favor the use of dark on light instead of light on dark whenever possible.

Bold or italics should only be used for layering or emphasis. Emphasizing everything means nothing gets emphasized.

Try not to text at an angle, as this decreases readability. Think of alternative solutions such as transposing the graph.

Good graph checklist

Clear Communication

Is the message of the graph as clear as possible?

Is it easy for someone unfamiliar with the data to interpret the graph?

Are the patterns/relationships easily identified?

Is the graph tailored to its primary purpose and audience?

Is the correct graph type used?

Facilitating Comparisons

Are elements to be compared grouped together?

Are labels placed next to data instead of in legends?

Have categories been ordered for easy comparison?

Can the plot be read without doing mental calculations?

Are the estimates of interest plotted (e.g. mean differences with confidence intervals)?

Color for emphasis or distinction

Are graphical elements displayed in a dark color on a light background?

Are grid lines drawn with a thin line and a light color such as grey?

Are colors used sparingly (e.g. max 3)?

Do all elements in the graph have a purpose (e.g. colors, textures, grid lines)?

Are the same colors used to mean the same thing in a series of graphs?

Implementation Considerations

Are multiple panels plotted on the same scale?

Are log-normally distributed variables plotted on a log scale?

Are common baselines used wherever possible?

Does the orientation of the axes aid interpretation?

Does the aspect ratio allow the reader to see variations in the data?

Are data across a disconnected time scale kept disconnected?

Are data spaced proportionally to the actual time interval (instead of according to visit number)?

Are data and inferences plotted to support stories about modes?

Are a number of patients by group reported if this adds context?

Legibility and Clarity

Can all graphical elements be seen?

Does the graph have a clear title, axis labels, annotations and data units?

Can the font be read without eye strain or effort?

Are sans-serif fonts used?

Do text sizes have correct hierarchy (big to small, main text to subtext)?

Are the elements of the graph clearly labeled (e.g. points, error bars, lines, shaded regions)?

Are labels oriented horizontally where possible?

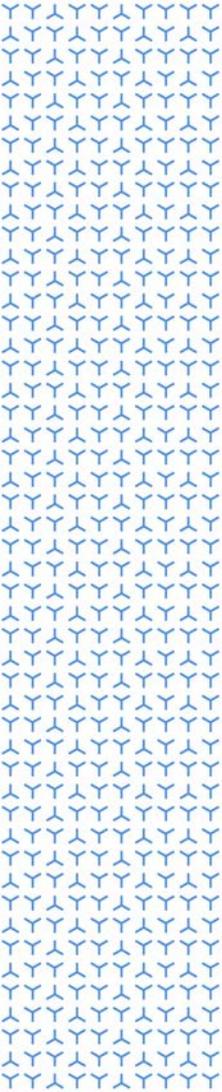
Resources

Books:
 E. R. Tufte. The visual display of quantitative information. Connecticut, Graphics Press, 2001.
 Cleveland, W.S. and McGill, Robert. Graphical presentation theory, experimentation and application to the development of graphics methods. JASA, vol. 79, No. 387, pp. 531 – 554, 1984.
 S. Few. Show Me The Numbers: Designing Tables and Graphs to Engage Your Audience. Berkeley, CA, Analytics Press, 2012.
 D. I. Willing. The Wall Street Journal Guide to Information Graphics: The Dots and Dots of Presenting Data, Facts, and Figures. December 16, 2013.
 J. Duromet, T. Hays, and J. Freeman. Effective communication for rational minds. PRINCIPAL, N. B. Rotz, Creating More Effective Graphs, Chart House.

Online resources:
<https://www.chartwell.com/> (S. Few)
<https://www.d3.js.org/> (M. Tufte)
<https://www.gyrf.com/> (M. Tufte)
<https://www.infocart.com/> (A. Gemeny)
<https://www.infocart.com/> (A. Gemeny)
<https://www.infocart.com/> (N. Rotz)

Authors
 Alison Margolis, Mark Sella, Balraj Mageshram, Julie Jones, Marc Vandermeulen



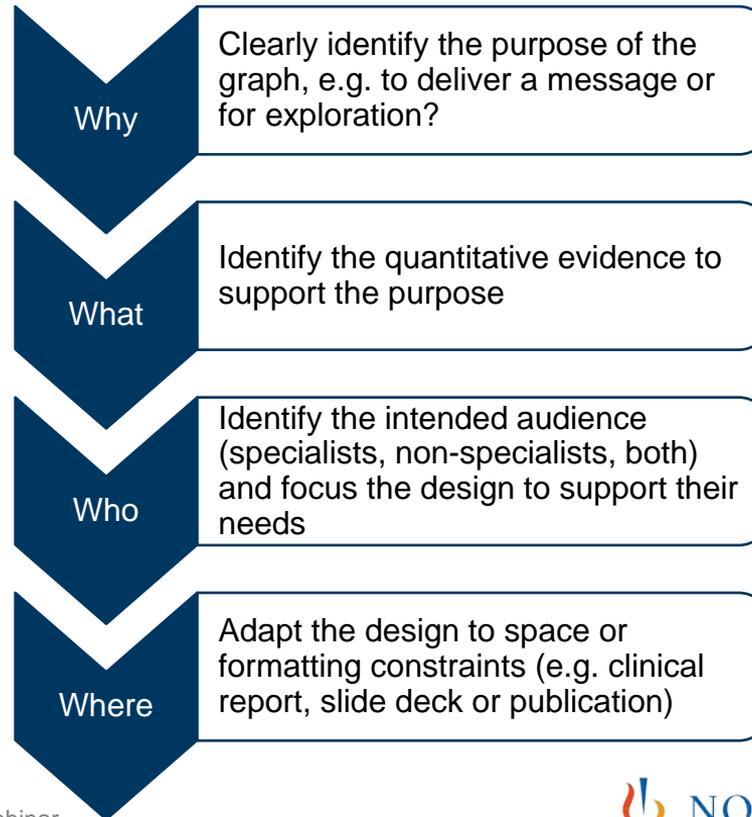


Forget about the graph, think about the purpose.



Law 1 Have a clear purpose

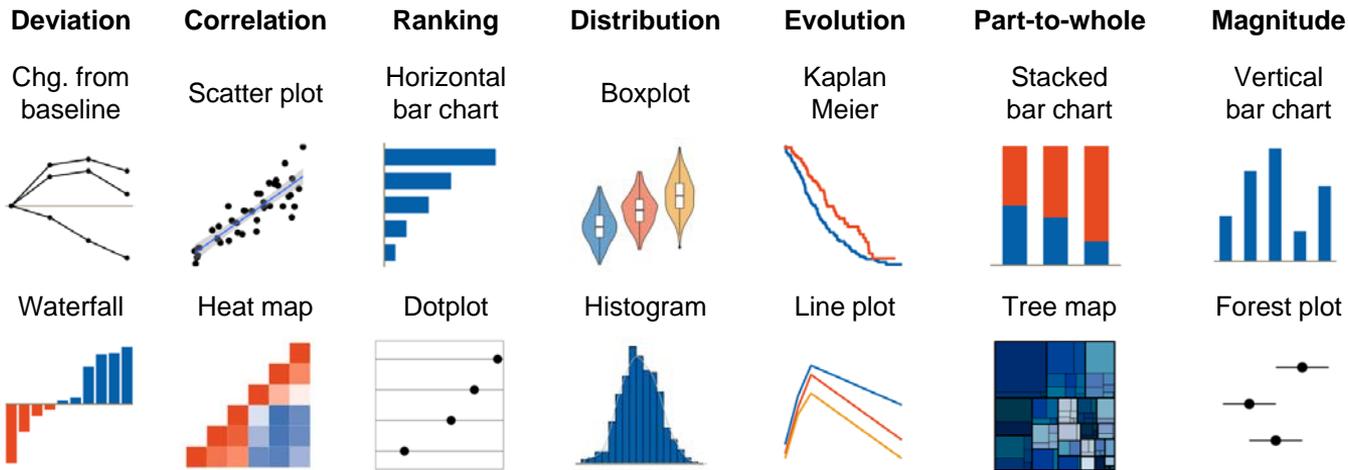
Have a clear purpose



Law 2
Show the data **clearly**

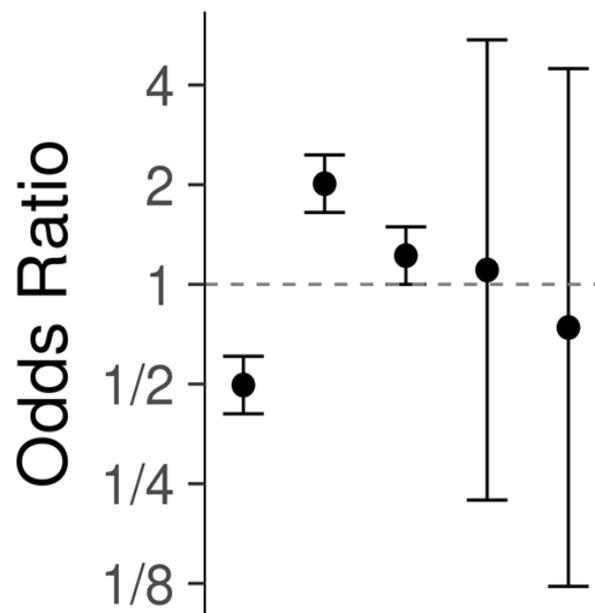
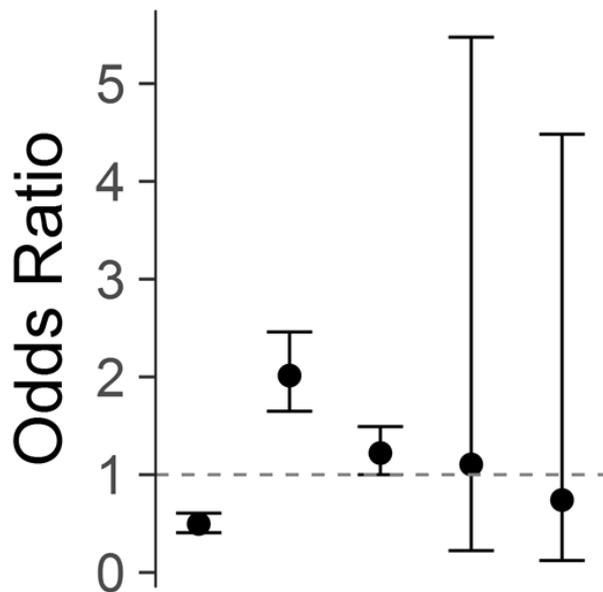


Choosing the correct graph type aids interpretation



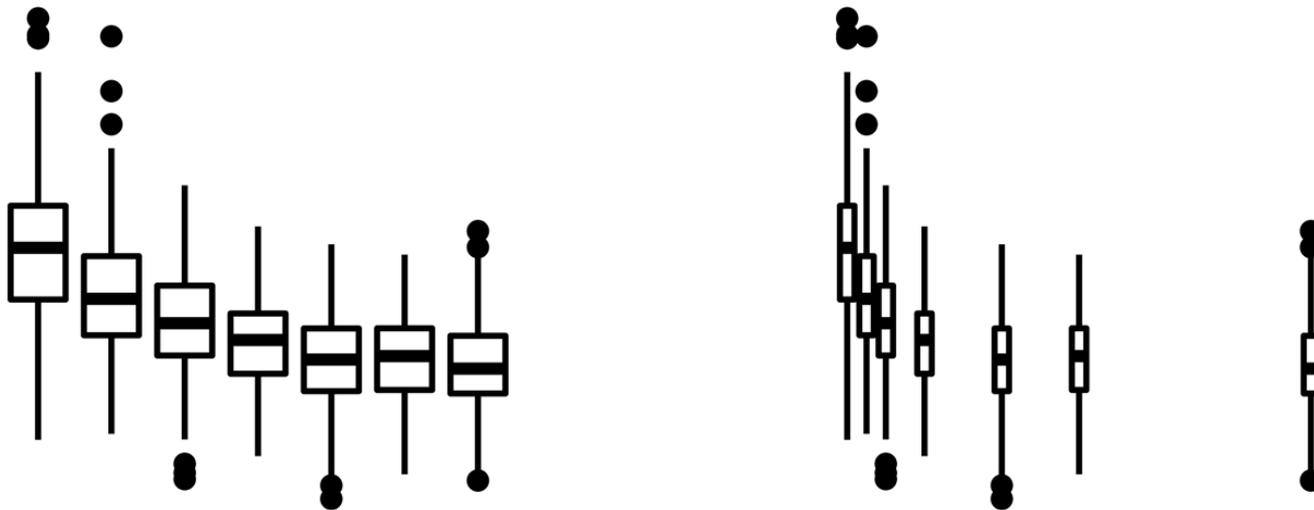
Choose the right scale for your data

Avoid plotting log-normally distributed variables on a linear scale
(e.g. hazard ratio, AUC, CL)



Space measurements proportional to the time between each

Measurements displayed close together are perceived to be closer in time

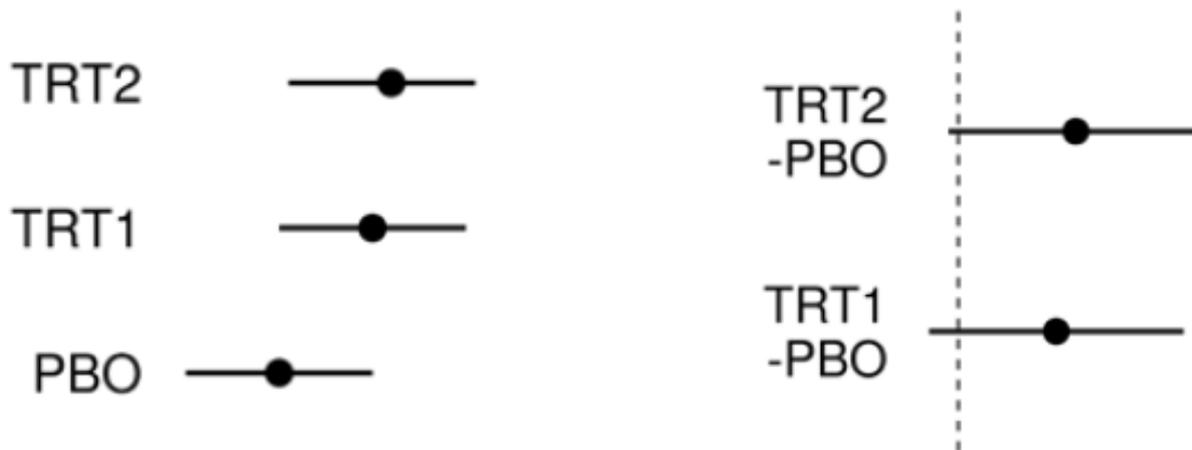


Law 3
Make the **message** obvious

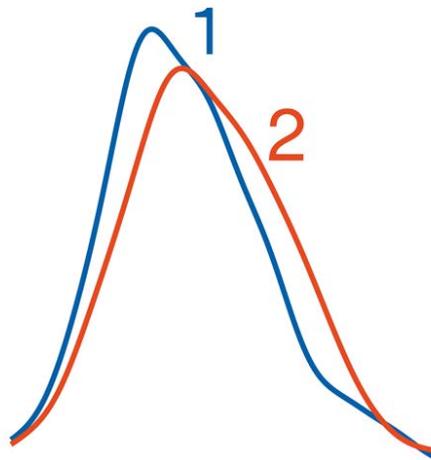
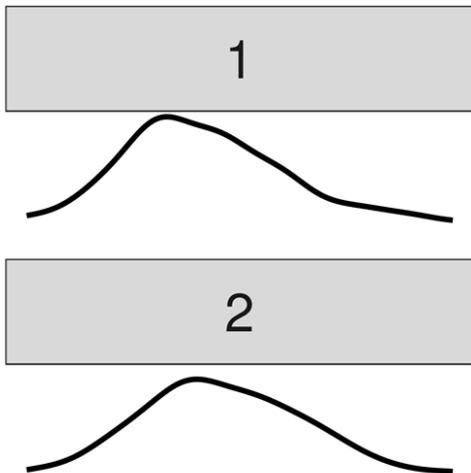


Show the answer!

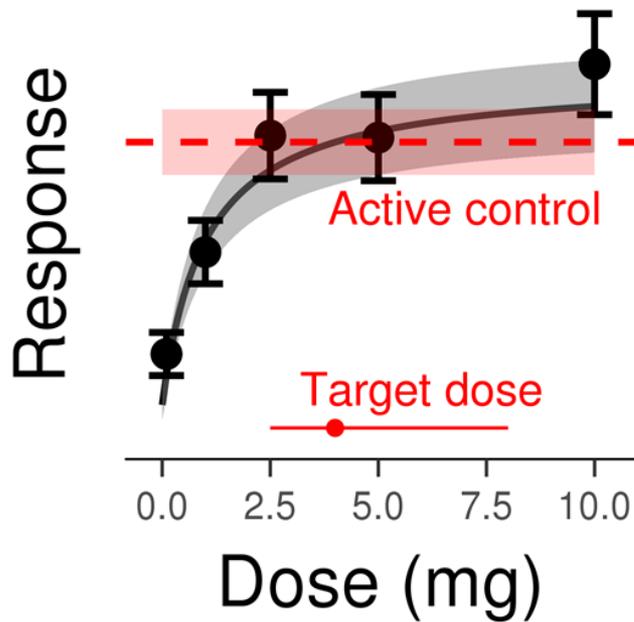
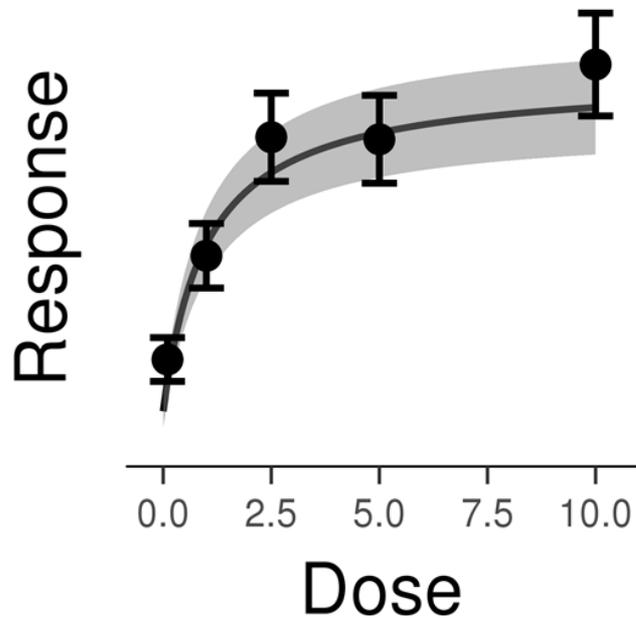
If the question is about a treatment effect, plot that directly



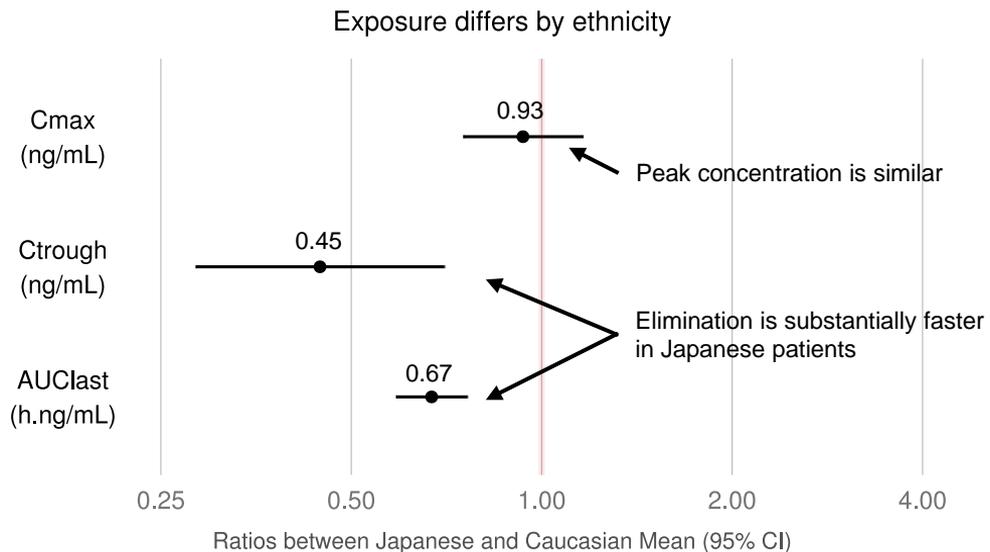
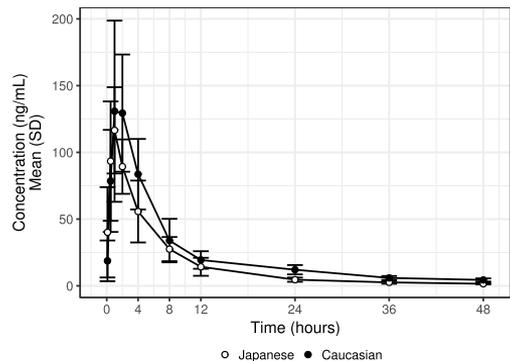
Group elements to aid direct comparison



Use informative labels and annotations to support the message



Putting it all together – is exposure different?



Principles for EVC

Graphics Principles Cheat Sheet v1.1

Communication

Effective visualizations communicate complex statistical and quantitative information facilitating insight, understanding, and decision making. But what is an effective graph?

This cheat sheet provides general guidance and points to consider.

Planning

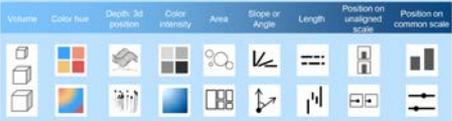
- Why** - Clearly identify the purpose of the graph, e.g. to deliver a message or for exploration?
- What** - Identify the quantitative evidence to support the purpose
- Who** - Identify the intended audience (specialists, non-specialists, both) and focus the design to support their needs
- Where** - Adapt the design to space or formatting constraints (e.g. clinical report, slide deck or publication)

Principles of Effective Graphic Design

Proximity – group related elements together
Alignment – elements on the same vertical or horizontal plane are perceived as having similar properties
Simplicity – cut anything superfluous, only include elements that add value, limit to 2-3 colors or fonts
White space (empty space) – use white space to minimize distraction & provide clarity
Legibility – sans serif fonts are easier to read, use color for emphasis instead of a new typeface
Color – select colors that present enough contrast to make the graph legible. Choose monochromatic color schemes to prevent clashing. Use dark colors and accent colors to emphasize important information
Visual Hierarchy – use color, font, image size, typeface, alignment & placement to create a viewing order
Focal Point – primary area of interest that immediately attracts the eye; emphasize the most important content and make it your focal point. Use contrasting colors to draw attention
Repetition – repeating elements can be visually appealing, repeated shapes, labels, colors
Familiarity – using familiar styles, icons, navigation structure makes viewers feel confident
Consistency – be consistent with heading sizes, font choices, color schemes, and spacing. Use images with similar styles

Effectiveness Ranking

A graph is a representation of data that visually encodes numerical values into attributes such as lines, symbols and colors. The Cleveland-McGill scale can be used to select the most effective attributes for your purpose.



- Least accurate: volume charts, poorly designed heat maps, multivariate density plots, heat maps, bubble charts, mosaic charts
- Most accurate: line graphs, pie charts, stacked bar charts, bar charts, waterfall chart, small multiple plots, dot plots, bar charts, parallel coordinate plots

Selecting the right base graph

Consider if a standard graph can be used by identifying suitable designs based on the (i) purpose (i.e. message to be conveyed or question to answer) and (ii) data (i.e. variables to display).

Example plots categorized by purpose

Deviation	Correlation	Ranking	Distribution	Evolution	Point-to-point	Magnitude
Cup from baseline 	Scatter plot 	Horizontal bar chart 	Boxplot 	Kaplan Meier 	Stacked bar chart 	Vertical bar chart
Waterfall 	Heat map 	Dotplot 	Histogram 	Line plot 	Tree map 	Forest plot

Facilitating Comparisons

- Proximity improves association** - Place labels next to data instead of using legends
- Group together elements to be compared directly** - Group together elements to be compared directly
- Ease visual inspection** - Order values to help compare across many categories. Judgments are easier to make on a common vertical scale.
- Reduce mental arithmetic** - Plot the final comparison e.g. mean difference not two means. Use reference lines and other visual anchors.

Color for emphasis or distinction

- Restraint use of color is highly effective in organizing a narrative and calling attention to certain elements.
- Think carefully before introducing additional color. Do you really need it?
- Do not use color to differentiate categories of the same variable.
- Use colors or shades to represent meaningful differences such as positive/negative values, treatments or doses.
- Be consistent, use the same color to mean the same thing in a series of graphs (e.g. treatment, dose).
- Use a bold, saturated or contrasting color to emphasize important details.
- Emphasize the data by minimizing unnecessary ink, e.g. soften gridlines with a light color.
- Utilize existing resources for selection of appropriate palettes such as Color Brewer or NumScale.

Implementation Considerations

- Plot cause on the x-axis and effect on the y-axis. Use this standard convention in order to avoid misinterpretation.
- Aspect ratio can influence interpretation. Aim for a 4:5 degree angle of change to avoid over-interpretation of slope.
- Use position for comparisons rather than length (i.e. dots instead of bars), especially for non-linear scales (e.g. log scale, or % change).
- Do not plot log-normally distributed variables on a linear scale (e.g. hazard ratio, AUC, CL).
- When displaying data measured on the same scale, also plot them on the same scale for easy comparison.
- Connected data imply continuity. Do not connect data across a disconnected or uneven time scale.
- Visuals get close together are perceived to be closer in time. Space the visuals proportional to the time between each in order to avoid confusion. Plot dates instead of year-dose.
- Evolution data and inferences to support stories about modes.

Putting it all together – Remove the clutter & emphasize the message

- Creating a graph is an iterative process: produce, review and refine.
- Colors, backgrounds, and borders can be removed and gridlines reduced.
- It is easier to see differences in position over a difference in length, i.e. a dot over a bar.
- Using too many colors can be distracting. Use white background and try using other methods to distinguish different curves.
- One solution could be repeating the data in different panels, highlighting individual curves in a darker color.

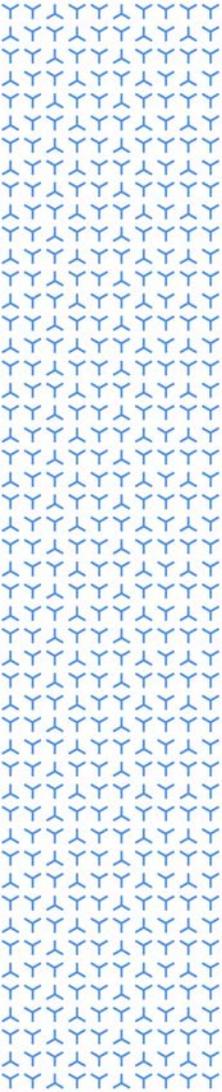
Good graph checklist

- Clear Communication**
 - Is the message of the graph as clear as possible?
 - Is it easy for someone unfamiliar with the data to interpret the graph?
 - Are the patterns/relationships easily identified?
 - Is the graph tailored to its primary purpose and audience?
 - Is the correct graph type used?
- Facilitating Comparisons**
 - Are elements to be compared grouped together?
 - Are labels placed next to data instead of in legends?
 - Have categories been ordered for easy comparison?
 - Can the plot be read without doing mental calculations?
 - Are the estimates of interest plotted (e.g. mean differences with confidence intervals)?
- Color for emphasis or distinction**
 - Are graphical elements displayed in a dark color on a light background?
 - Are grid lines drawn with a thin line and a light color such as grey?
 - Are colors used sparingly (e.g. max 3)?
 - Do all elements in the graph have a purpose (e.g. colors, textures, grid lines)?
 - Are the same colors used to mean the same thing in a series of graphs?
- Implementation Considerations**
 - Are multiple panels plotted on the same scale?
 - Are log-normally distributed variables plotted on a log scale?
 - Are common baselines used wherever possible?
 - Does the orientation of the axes aid interpretation?
 - Does the aspect ratio allow the reader to see variations in the data?
 - Are data across a disconnected time scale kept disconnected?
 - Are data spaced proportionally to the actual time interval (instead of according to visual number)?
 - Are data and inferences plotted to support stories about modes?
 - Are number of patients by group reported if this adds context?
- Legibility and Clarity**
 - Can all graphical elements be seen?
 - Does the graph have a clear title, axis labels, annotations and data units?
 - Can the font be read without eye strain or effort?
 - Are sans-serif fonts used?
 - Do text sizes have correct hierarchy (big to small, main text to subtext)?
 - Are the elements of the graph clearly labeled (e.g. points, error bars, lines, shaded regions)?
 - Are labels oriented horizontally where possible?

Resources

- Books:**
 - E. R. Tufte. The visual display of quantitative information. Connecticut, Graphics Press, 2001.
 - Cleveland, W.S. and McGill, Robert. Graphical presentation theory, experimentation and application to the development of graphics methods. JASA, vol. 79, No. 387, pp. 531 – 554, 1984.
 - S. Few. Show Me The Numbers: Designing Tables and Graphs to Engage Your Audience. Berkeley, CA, Analytics Press, 2012.
 - D. H. Wang. The Wall Street Journal Guide to Information Graphics: The Dots and Dots of Presenting Data, Facts, and Figures. December 16, 2013.
 - J. Duromet, T. Hess, and J. Freeman. Effective communication for rational minds. PRINCIPAL, N. B. Rotz, Creating More Effective Graphs, Chart House.
- Online resources:**
 - <https://www.chartwell.com/> (S. Few)
 - <https://www.visualizingdata.com/> (R. Tufte)
 - <https://www.d3js.org/> (M. Bostock)
 - <https://www.chartjs.org/> (J. Duromet)
 - <https://www.infocision.com/> (A. Casati)
 - <https://www.glyphicons.com/> (D. Atkinson)

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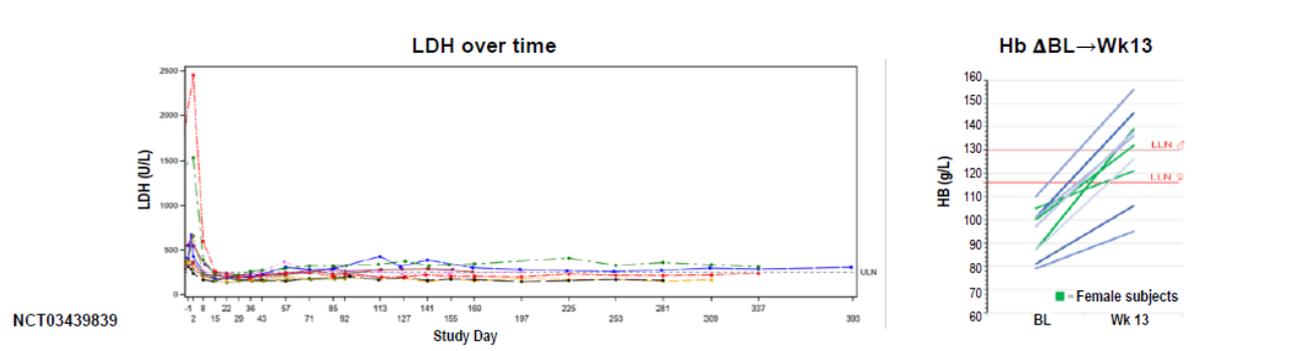
Structured EVC approach

Mark Baillie

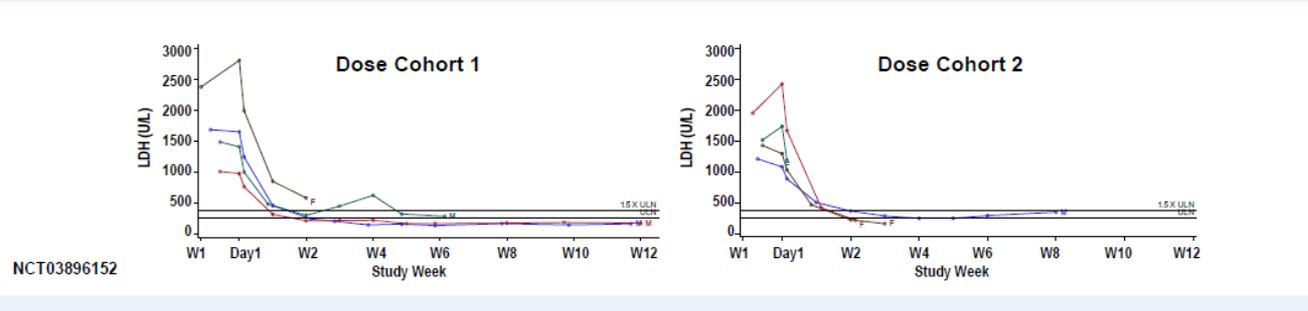
Early Phase 2 data support advancing LNP023 as a front-line treatment for PNH

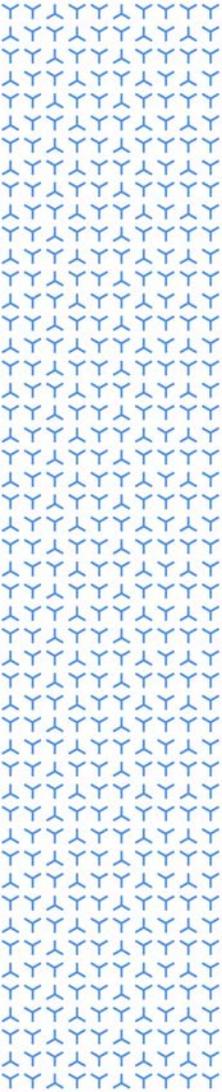
<https://www.novartis.com/sites/www.novartis.com/files/2019-12-05-novartis-r-d-day-investor-presentation.pdf>

In a Phase 2 PNH trial, LNP023 add-on to eculizumab in patients with hemolysis delivered consistent LDH normalization and transfusion-free hemoglobin increase in all patients



The ongoing LNP023 monotherapy trial in eculizumab-naive PNH patients shows early efficacy (LDH↓)





Forget about the graph, think about the purpose.



1st principle
Have a clear purpose

Have a Clear Purpose Worksheet

- Having a clear purpose for a visualization encompasses having clarity around 4 areas:
 - What is the **purpose**?
 - Who is your **audience**?
 - What is the **importance** of this visualization?
 - What is the key **message** of this visualization?
- A worksheet was created to be used as a guide to help defining the clear purpose a graph is supposed to achieve

Have a clear purpose (worksheet)
Identify a project you are working on where you need to communicate in a data-driven way. Reflect upon and fill out the following:

What is the purpose of the visualization?
What is the main objective of the visualization?

List the (scientific) question(s) the visualization is trying to answer. Try to be specific.

What is the key evidence that is available to answer the question?

Who is your audience?
List the primary groups or individuals you will be communicating to.

If you had to narrow that to a single person, who would that be?

What does your audience care about?

What action does your audience need to take?

What is the importance of this project?
What are the benefits if your audience acts in the way that you want them to?

What are the risks if they do not?

What is the key message (the so what?)
Write out in a single sentence the key message

The purpose worksheet is inspired by the big idea worksheet from the excellent book: Knaflic, Cole. *Storytelling With Data: Let's Practice!* Wiley, © 2019.

The 4 areas for a clear purpose

What is the purpose of the visualization?

- What is the main objective of the visualization?
- List the (scientific) question(s) the visualization is trying to answer. Try to be specific.
- What is the key evidence that is available to answer the question?

Who is your audience?

- List the primary groups or individuals you will be communicating to.
- If you had to narrow that to a single person, who would that be?
- What does your audience care about?
- What action does your audience need to take?

What is the importance of this project?

- What are the benefits if your audience acts in the way that you want them to?
- What are the risks if they do not?

What is the key message (the so what?)

- Write out in a single sentence the key message



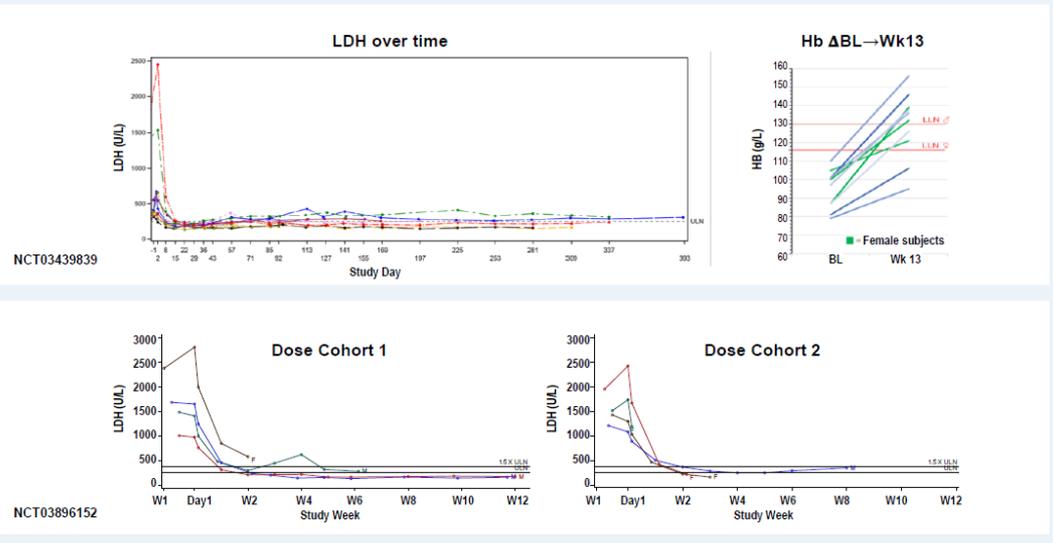
1st principle – have a clear purpose



Early Phase 2 data support advancing LNP023 as a front-line treatment for PNH

In a Phase 2 PNH trial, LNP023 add-on to eculizumab in patients with hemolysis delivered consistent LDH normalization and transfusion-free hemoglobin increase in all patients

The ongoing LNP023 monotherapy trial in eculizumab-naïve PNH patients shows early efficacy (LDH↓)



LNP023 included from the public 2019 R&D day deck
<https://www.novartis.com/sites/www.novartis.com/files/2019-12-05-novartis-r-d-day-investor-presentation.pdf>

Purpose



What is the purpose of the visualization?

What is the main objective of the visualization?

The visualization is to display supporting evidence that LNP023 has demonstrated proof of concept and is a good candidate to take into phase 3 development.

List the (scientific) question(s) the visualization is trying to answer. Try to be specific.

- *Is there a decrease in LDH to “normal levels” post LNP023 dose as a mono and combo therapy?*
- *Does LNP023 increase hemoglobin levels?*

What is the key evidence that is available to answer the question?

Two studies.

Two different dose cohorts in one study. Mono and combo.

LDH is a surrogate measure of efficacy for PNH.

Consistency across gender for Hemoglobin improvement.

Audience



Who is your audience?

List the primary groups or individuals you will be communicating to.

NVS senior management

Investors

Scientific community

If you had to narrow that to a single person, who would that be?

Development Unit Head.

What does your audience care about?

Clear demonstrable evidence that LNP023 has activity on markers related to PNH.

What action does your audience need to take?

A decision on whether to provide resources to take LNP023 to late stage development.

Importance and message



What is the importance of this project?

What are the benefits if your audience acts in the way that you want them to? |

This could improve lives of patients with an unmet need.

This could lead to a new scientific breakthrough and understanding of the disease.

This could be an asset to the company.

What are the risks if they do not?

Cancellation of an important compound.

Patients untreated.

What is the key message (the so what?)

Write out in a single sentence the key message

LNPO23 reduces LDH levels to normal; strong evidence the compound may improve the lives of patients with PNH.

2nd principle
Show the data clearly



Show the data clearly, an iterative process

- The “purpose” worksheet is a guide to stay in line with the key evidence that supports your key message
- Try to display the same sets of data in different ways and select the one you consider the more adapted (often being the simplest)
- It is then time to iterate and eliminate clutter
 - Add what is missing to show your data clearly
 - Remove what is just adding noise

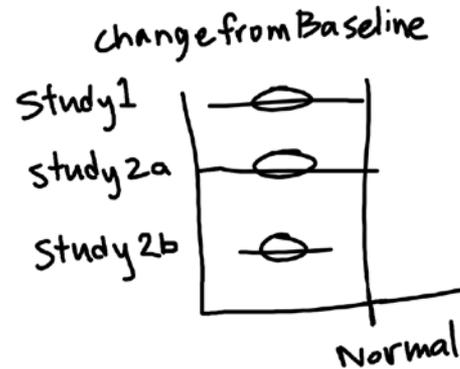
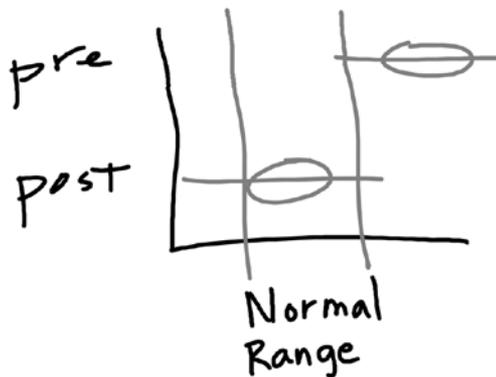
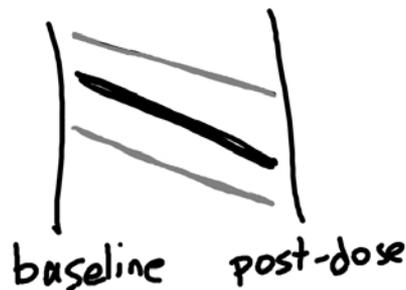
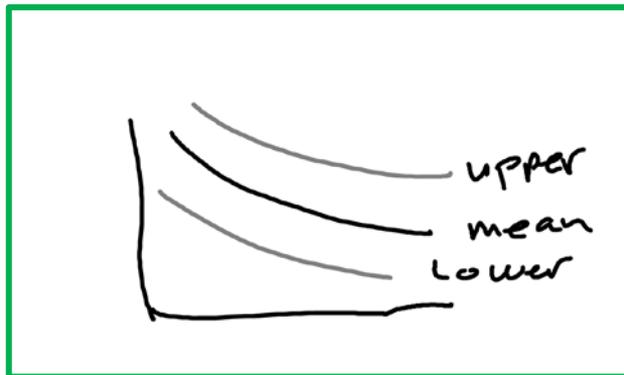


2nd principle - select the appropriate graph

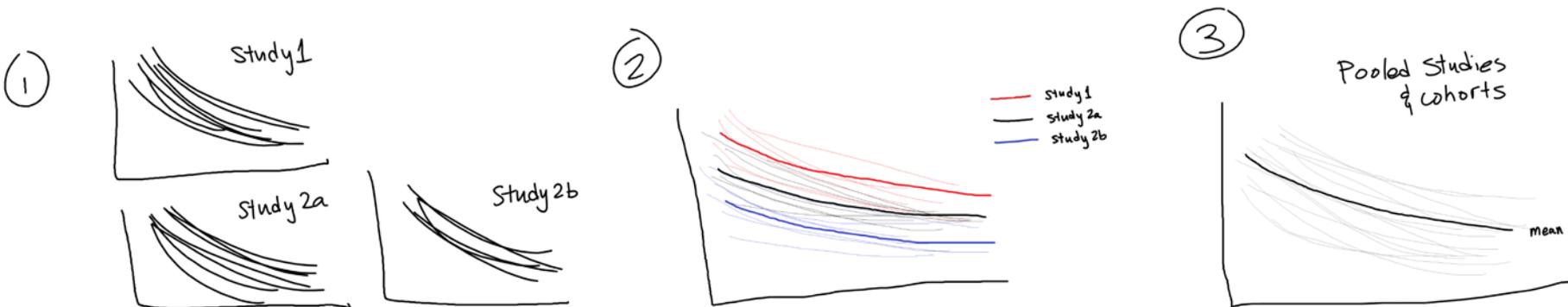
- Brainstorm different ways to display the data
- The more ideas the better!
- Select the display that supports the key message

Continuing with LNP example

- What is the key message:
 - LNP023 reduces LDH levels to normal
- The key evidence to support this:
 - Two studies with different dose cohorts
 - LDH as a surrogate for efficacy



2nd principle – Iterate and eliminate clutter



3rd principle
Make the **message** obvious



Make your message obvious

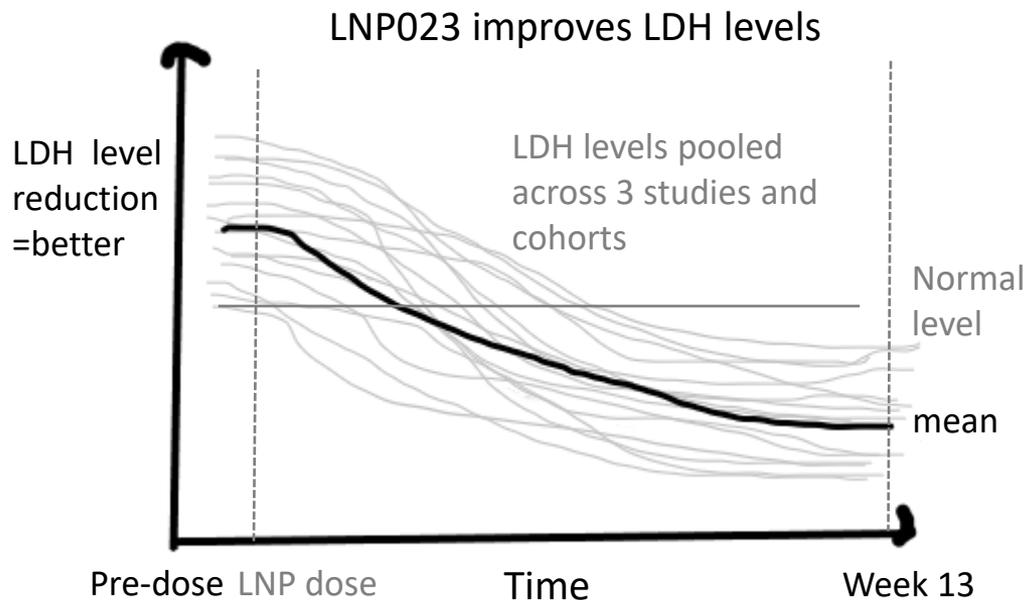
- This 3rd principle applies particularly when communicating to others
- Draw the audience attention to the critical element(s)
- Each element of the slide fits in the story it is aiming to tell



3rd principle – draw attention



- Draw the viewer's attention to points of interest
- Use arrows, labels, reference lines to drive home the message
- Make sure to have clear axis labels and informative titles



3rd principle – tell a story

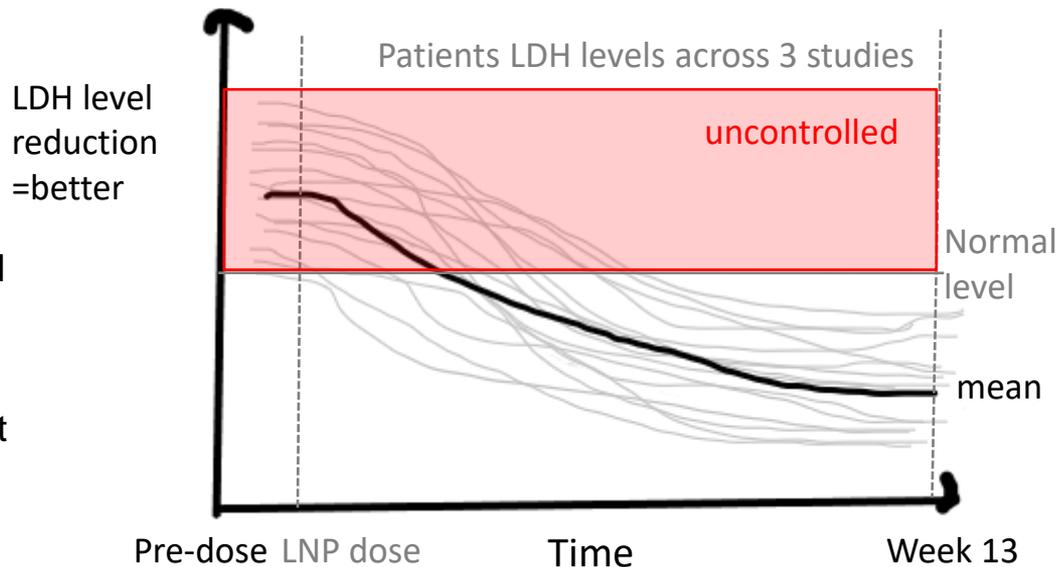


LNP023 reduces LDH to normal levels

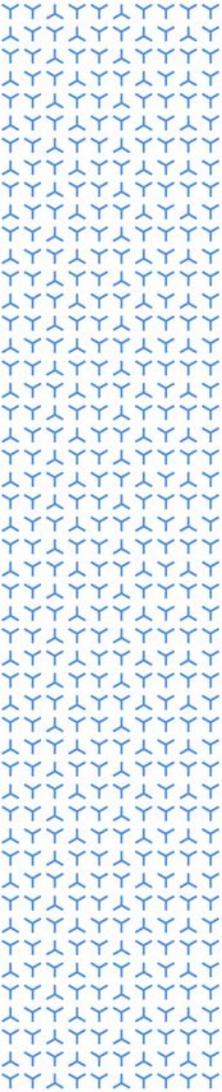
Practice telling the story of your graph, and make sure your graph captures the key points

Example story:

- LDH is a biomarker of hemolysis, released during destruction of RBC
- LNP023 reduces LDH to normal levels in PNH patients, indicating protection against hemolysis
- Recommend advancement of LNP023 to Phase 3



- Normal LDH levels indicate protection against hemolysis
- Recommend advancement of LNP to Phase 3



[https://github.com/
GraphicsPrinciples/
webinar](https://github.com/GraphicsPrinciples/webinar)

Your turn! (Homework for Part 2)

Alison Margolskee

Your turn! (Homework for Part 2)



[https://github.com/
GraphicsPrinciples
/webinar](https://github.com/GraphicsPrinciples/webinar)

- Apply the 3 principles of Effective Visualization to an example on your own
- 3 options to choose from (more details on next slides)
 1. Graph + purpose – rework the graph to show the data & message more clearly
 2. Dataset + purpose – create a graph from the dataset
 3. Bring your own example
- Assignment:
 1. Complete the Purpose Worksheet for the example you choose
 2. Select what data to display, and how to display it, iterate through a few alternatives in quick sketches
 3. Choose a graph or two from the previous step, and refine to make the message obvious
 4. Submit your examples by **Wednesday** via [webform](#) or [email](#) for Part 2 discussion/feedback

Note: For steps 2 and 3, you may choose to use pen and paper, or a drawing, graphing, or coding software. It's up to you!

Option 1) Efficacy of Capmatinib in NSCLC with MET mutations



[https://github.com/
GraphicsPrinciples
/webinar](https://github.com/GraphicsPrinciples/webinar)

- Background:
 - Phase 2 study of Capmatinib (MET receptor inhibitor) in NSCLC patients with various MET mutations
 - Primary endpoint: overall response (complete or partial response)
 - Secondary endpoint: duration of response
- Key question:
 - Does Capmatinib show meaningful response in patients with various types of MET mutation?

See reference for additional background, purpose and key messages:

Wolf et al. NEJM 2020; 383:944-957

<https://www.nejm.org/doi/full/10.1056/NEJMoa2002787>

Option 1) Efficacy of Capmatinib

Purpose
worksheet,
partially
completed



Purpose
Worksheet

See reference for additional background, purpose and key messages:

Wolf et al. NEJM 2020; 383:944-957
<https://www.nejm.org/doi/full/10.1056/NEJMoa2002787>

What is the purpose of the visualization?

What is the main objective of the visualization?

Summarize the efficacy results of the Capmatinib Phase 2 study in NSCLC patients with MET mutations

List the (scientific) question(s) the visualization is trying to answer. Try to be specific.

- Are the response rates clinically meaningful for patients with various types of MET mutation (exon 14 skipping, various degrees of amplification)?

What is the key evidence that is available to answer the question?

*- Individual RECIST data, individual duration of response, overall response rates by cohort
- cohorts defined as MET exon 14 skipping mutation (with and without prior treatment), and MET amplification with various levels of gene copy number (GCN) (with and without prior treatment)
- clinically relevant response defined as $\geq 35\%$ in previously treated patients (with 95% CI $> 25\%$) and $\geq 55\%$ in patients not previously treated (with 95% CI $> 35\%$)*

Who is your audience?

List the primary groups or individuals you will be communicating to.

- Capmatinib project team, NSCLC investigators, scientific community, head of oncology

If you had to narrow that to a single person, who would that be?

Oncology development head

What does your audience care about?

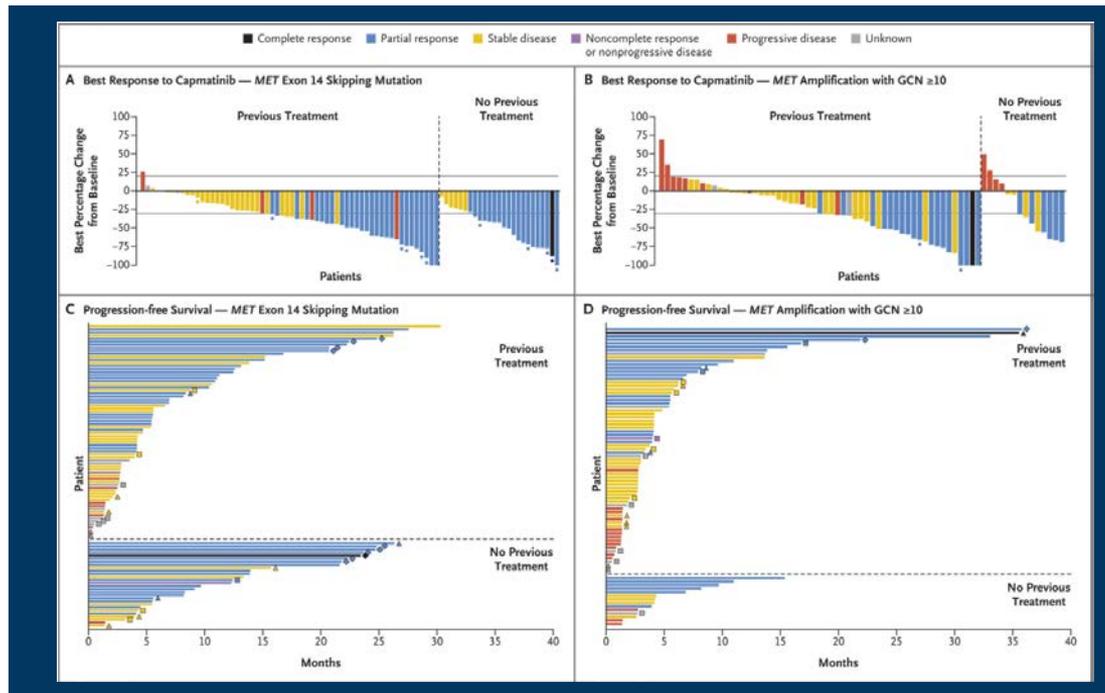
- Whether Capmatinib appears to work in any of the cohorts

What action does your audience need to take?

- Decide whether to keep developing Capmatinib for NSCLC with MET mutations, and for which MET mutations specifically

Option 1) Efficacy of Capmatinib in NSCLC with MET mutations

- Right: Primary visualization of Phase 2 study results from Wolf et al. NEJM 2020
- Can you improve this graph, or create your own to display the key message(s)?



Wolf et al. NEJM 2020; 383:944-957

<https://www.nejm.org/doi/full/10.1056/NEJMoa2002787>

Option 2) Predicting Effect of Missed Doses due to COVID-19 on Efficacy



[https://github.com/
GraphicsPrinciples
/webinar](https://github.com/GraphicsPrinciples/webinar)

- Situation:
 - A Phase 3 time to event trial is being conducted for Drug A
 - Drug A is administered in the clinic by a healthcare provider
- Complication:
 - Due to COVID pandemic, patients' access to clinic has been greatly impacted
- Question:
 - What effect would 1, 2, or 3 missed doses have on the efficacy of the current trial?
 - Should the trial be stopped, or should the trial management team make significant efforts to increase compliance, or is the predicted impact negligible?

Option 2) Missed Doses due to COVID-19

Purpose worksheet, partially completed



Purpose Worksheet

What is the purpose of the visualization?

What is the main objective of the visualization?

Determine the effect of missed doses due to COVID pandemic on the efficacy of the drug

List the (scientific) question(s) the visualization is trying to answer. Try to be specific.

- Would efficacy (event-free survival, hazard ratio, decrease in PD marker) be greatly affected by 1, 2, or 3 missed doses due to COVID?

- What is the relationship between missed doses and predicted efficacy?

What is the key evidence that is available to answer the question?

Individual data for: Average drug exposure up to event of interest, treatment subgroup (# of missed doses), average decrease in PD marker up to event of interest, time to event of interest, model predicted relative change in hazard

Who is your audience?

List the primary groups or individuals you will be communicating to.

Project team / clinical trial team members

If you had to narrow that to a single person, who would that be?

Global project head

What does your audience care about?

The impact of missed doses on the hazard ratio

What action does your audience need to take?

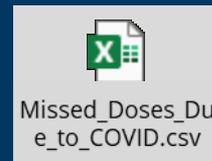
Decide whether to continue or stop the trial, or make serious effort / do nothing to increase compliance

Option 2) Predicting Effect of Missed Doses due to COVID-19 on Efficacy

Header of dataset

id	TRT	time	status	label	avgAUC	avgAUEC	HRR
1	Placebo	1.60	1	censored	0	-0.0526862995	-0.0263431498
2	Placebo	0.70	2	event	0	-0.2601473290	-0.1300736645
3	Placebo	2.90	1	censored	0	0.4552197065	0.2276098533
4	Placebo	1.95	2	event	0	0.3814016001	0.1907008000
5	Placebo	1.95	1	censored	0	0.2787141185	0.1393570592

Download dataset



Variable definitions

- id = unique subject identifier
- TRT = treatment group ("Continuous Treatment", "1 missing dose", "2 missing doses", "3 missing doses", "Placebo")
- time = time of event (years)
- status = event identifier (1 = right censored / lost to follow up, 2 = event of interest)
- label = description of event
- avgAUC = average drug exposure up to time of event (ng/mL)
- avgAUEC = average change from baseline in PD marker (mmol/L)
- HRR = model predicted relative change in hazard based on avgAUEC (relative to avgAUEC of 0)

Option 3) Bring your own example



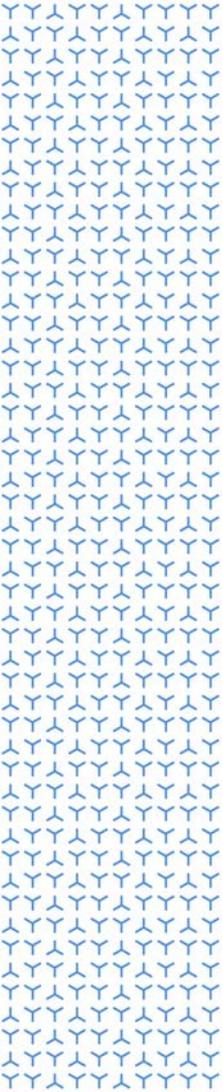
[https://github.com/
GraphicsPrinciples
/webinar](https://github.com/GraphicsPrinciples/webinar)

Your example here!

Purpose
worksheet,
empty



Purpose
Worksheet



Recap and resources

Marc Vandemeulebroecke

3 principles for improving visual communications

- **1st principle: Have a clear purpose**

- Understand the question you are trying to answer
- Identify the quantitative evidence to answer that question
- Know your audience and focus the design to support their needs



- **2nd principle: Show the data clearly**

- Choose the appropriate graph type to display your data
- Avoid misrepresentation (use appropriate scales)
- Maximize data to ink ratio (reduce distraction, less is more)



- **3rd principle: Make the message obvious**

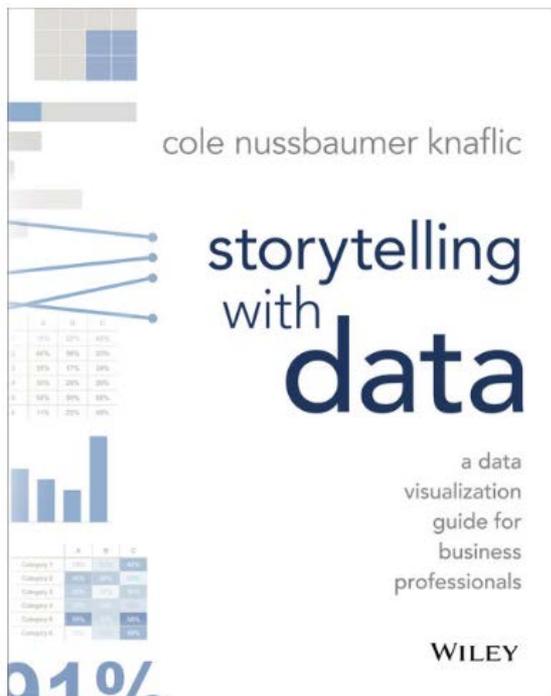
- Minimize mental arithmetic (e.g. plot the difference)
- Use proximity and alignment to aid in comparisons
- Use colors and annotations to highlight important details



Learning outcomes

- Appreciate why effective visual communication is a key competency for the quantitative scientist.
- Explain the three principles of EVC (purpose, clarity and message).
- Design a visualization based on a specific purpose.
- Redesign a visualization to show data clearly.
- Enhance the message of a visualization.
- Recognize where to apply the three principles of effective visual communication in your daily work.

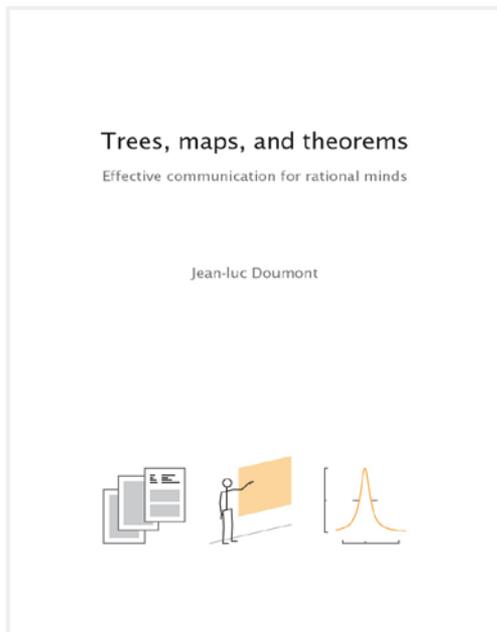
Resources, where to find out more?



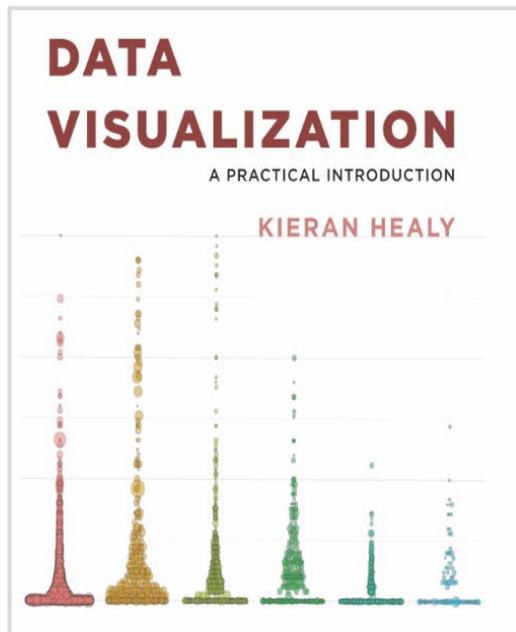
<http://www.storytellingwithdata.com/books>

- [Effective Visual Communication Website](https://graphicsprinciples.github.io/)
- [PKPD Exploratory graphics \(xGx\)](https://opensource.nibr.com/xgx)
- [Tutorial on effective visual communication](https://ascpt.onlinelibrary.wiley.com/doi/full/10.1002/psp4.12455)
- [Video on the three principles](https://youtu.be/pfxulpF9XOw)
- [Presentation checklist](https://opensource.nibr.com/xgx/Resources/Presentation_Checklist_v2_03.pdf)
- [Wonderful Wednesdays](https://www.psiweb.org/sigs-special-interest-groups/visualisation/welcome-to-wonderful-wednesdays)

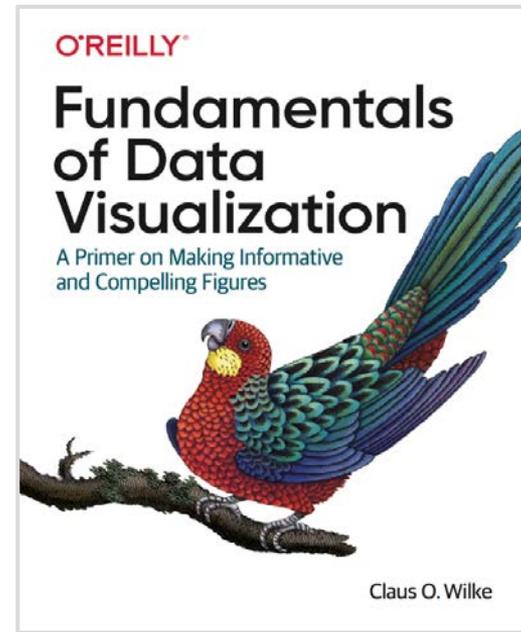
Even more resources?



<https://www.principiae.be/book/>



<https://socviz.co/>



<https://serialmentor.com/dataviz/>

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- Julie Jones
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- Sam Maitra
- David Carr

And many more...



<https://github.com/GraphicsPrinciples/webinar>

