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/

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Welcome to the ASCPT Webinar!

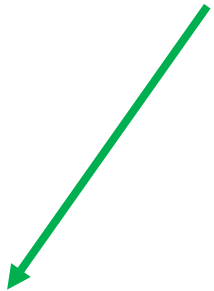
The presentation will start momentarily

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

ASCPT American Society for Clinical Pharmacology & Therapeutics

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



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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

ASCPT American Society for Clinical Pharmacology & Therapeutics

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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

https://github.com/GraphicsPrinciples/webinar

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.

https://github.com/GraphicsPrinciples/webinar

Motivation

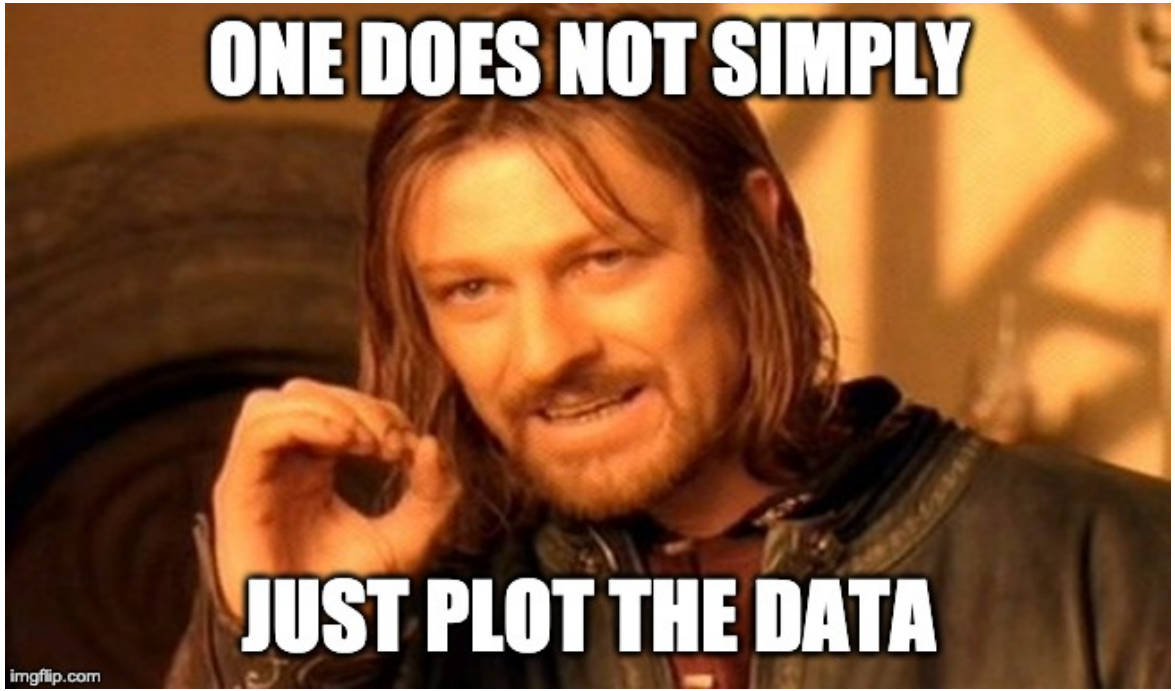
Baldur Magnusson

Plotting data is fun, but...

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

https://github.com/GraphicsPrinciples/webinar

Great graphs are not trivial



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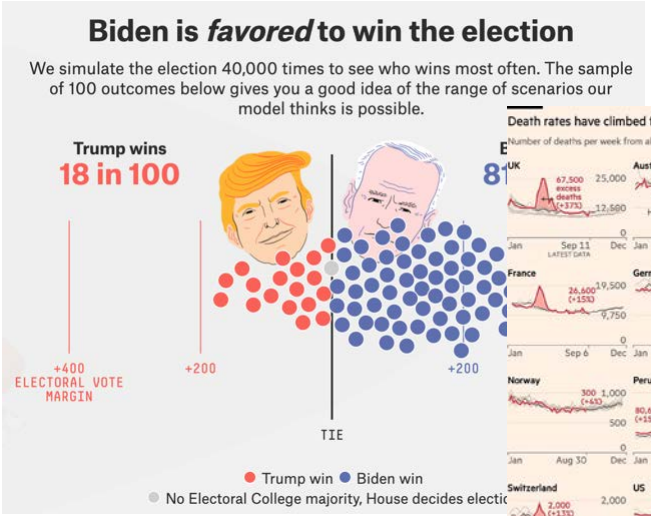
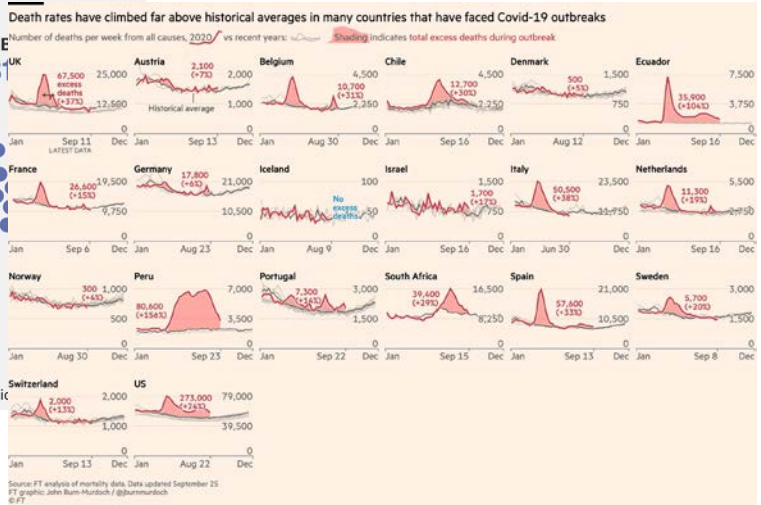
Effective visualizations are all around us



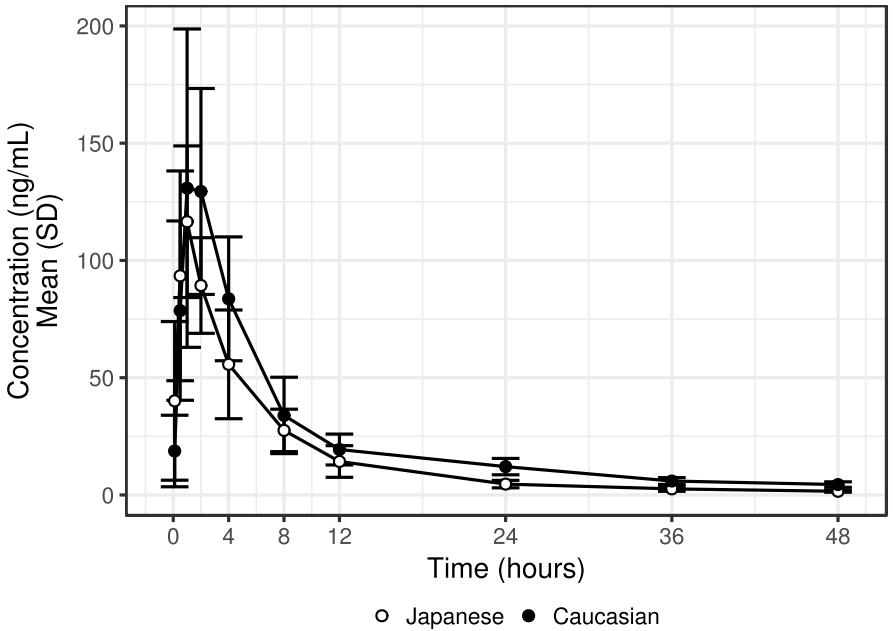
http://www.fivethirtyeight.com



http://www.ft.com/coronavirusfree

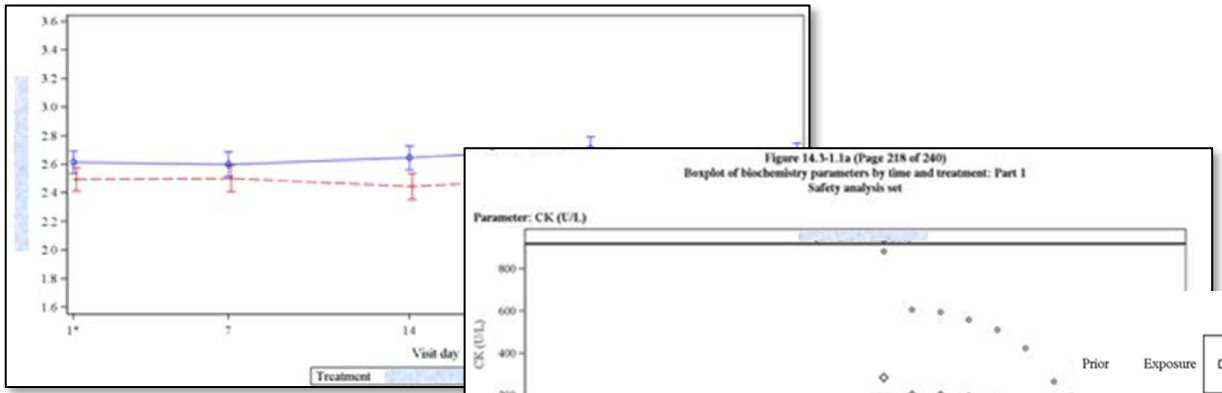
http://vis-sig.github.io/blog

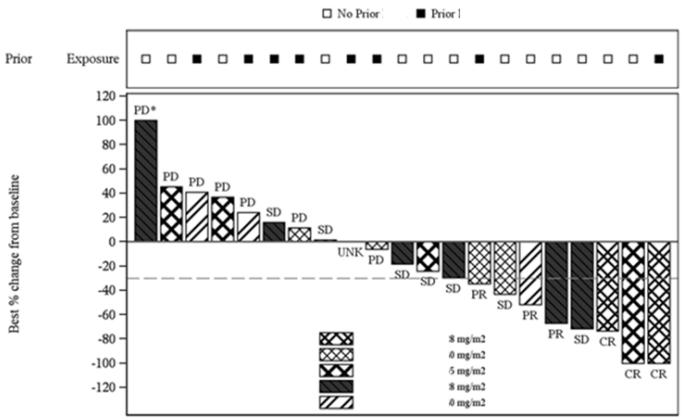
Is exposure different? How?



What are we supposed to conclude?

It is not hard to find more examples of ineffective visualizations





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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

https://github.com/GraphicsPrinciples/webinar

https://youtu.be/pfxulpF9XOw

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

https://graphicsprinciples.github.io/cheatsheet.html

Principles for EVC

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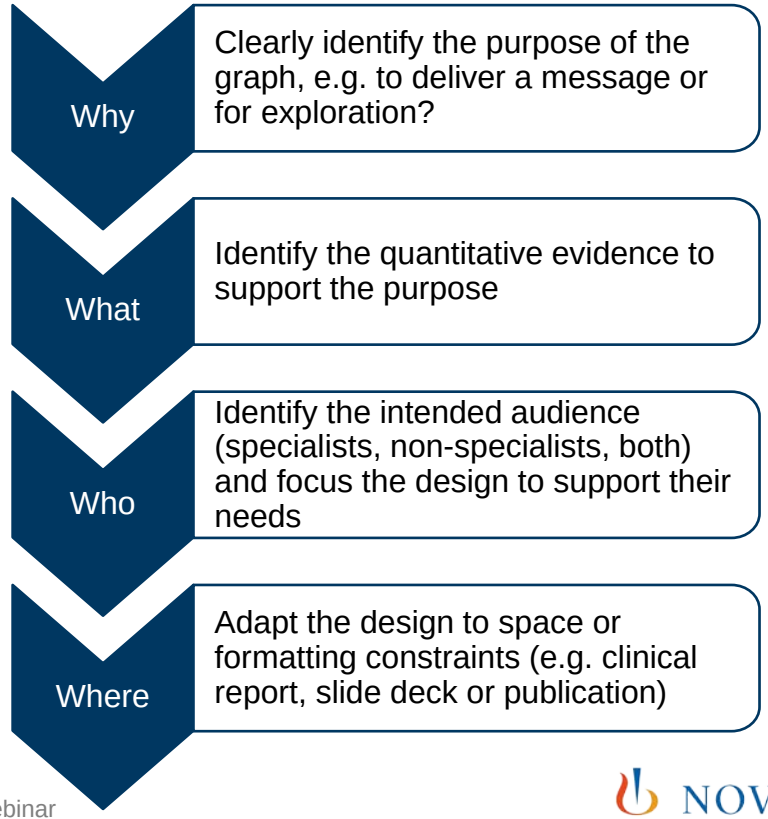
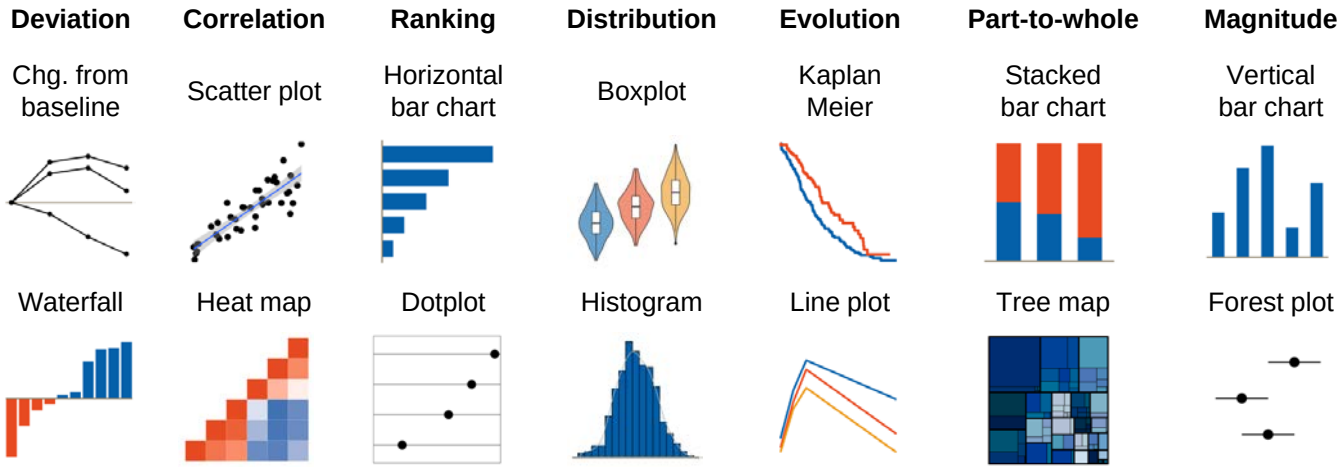
Law 1
Have a clear purpose

Have a clear purpose



Law 2
Show the data clearly

Choosing the correct graph type aids interpretation



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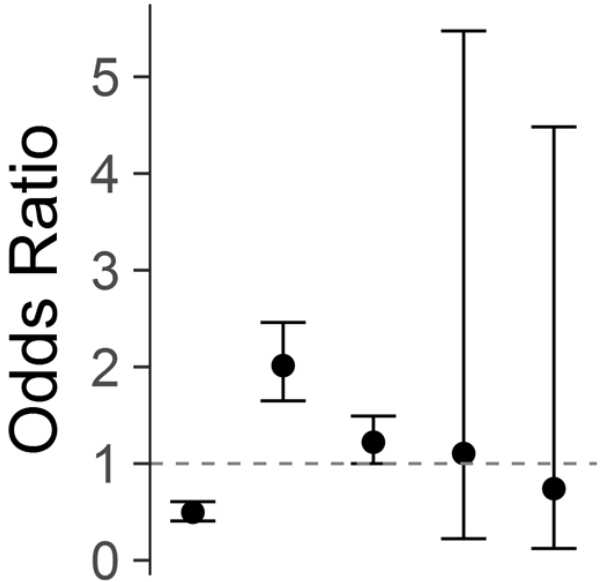
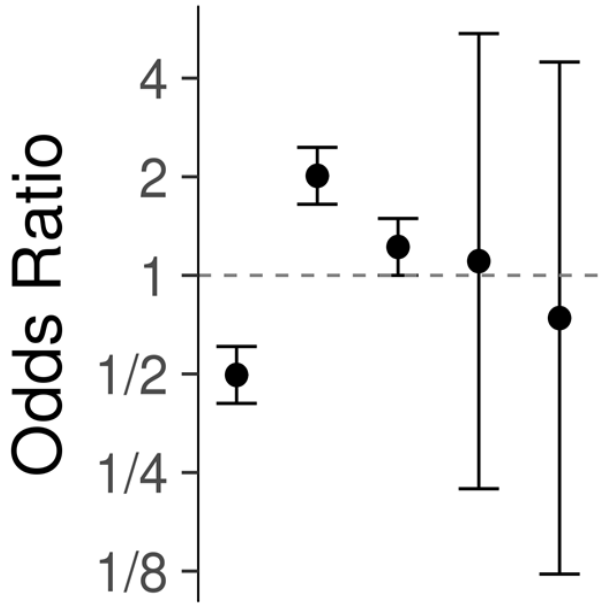
Choose the right scale for your data

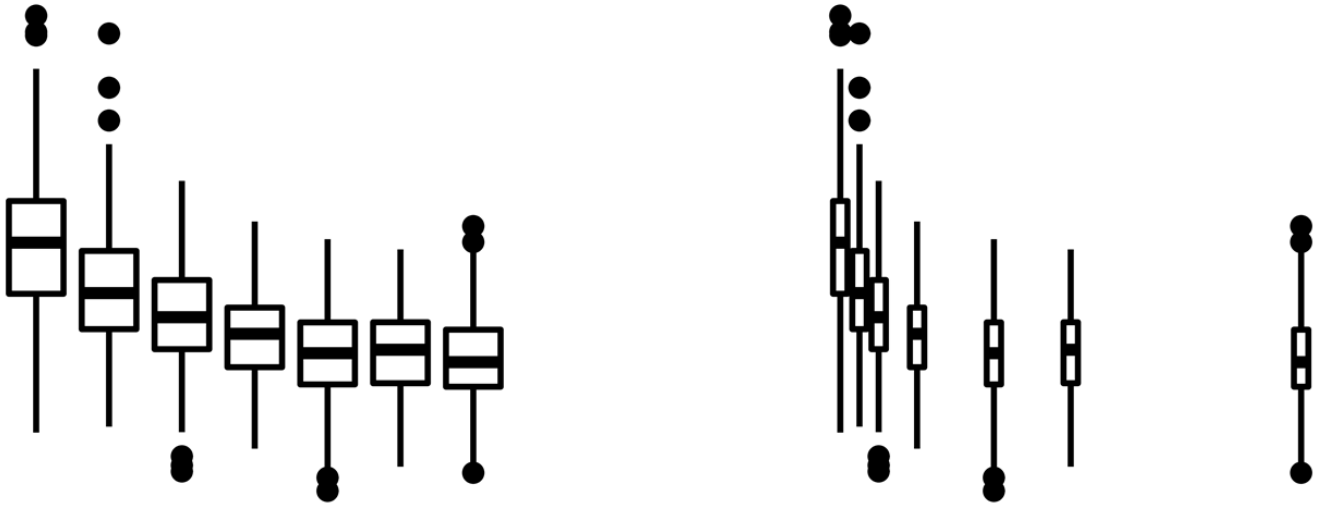
Avoid plotting log-normally distributed variables on a linear scale (e.g. hazard ratio, AUC, CL)





Space measurements proportional to the time between each

Measurements displayed close together are perceived to be closer in time



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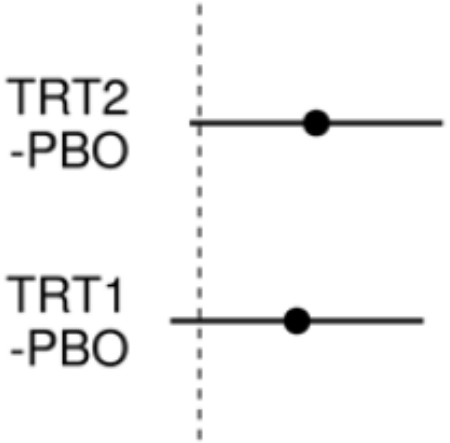
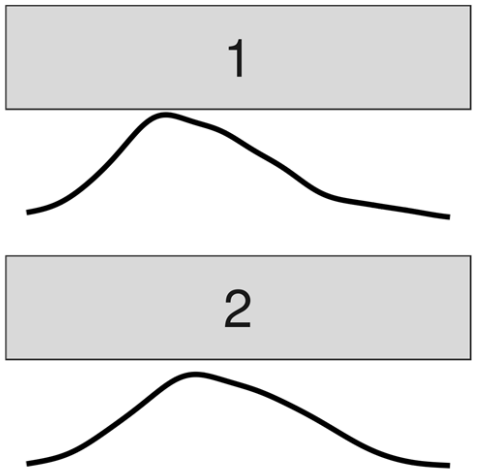
Law 3
Make the message obvious

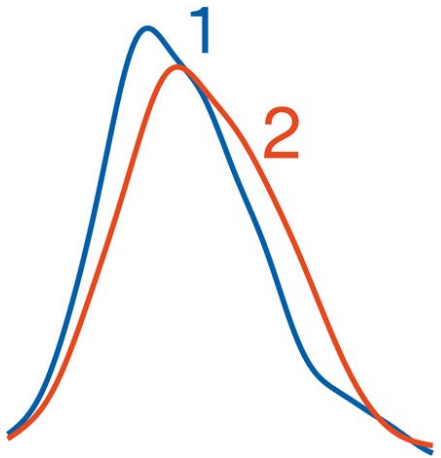
Show the answer!

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

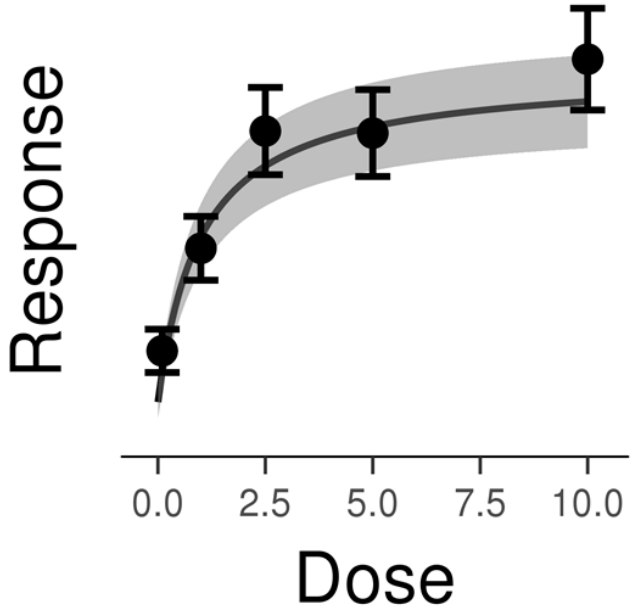


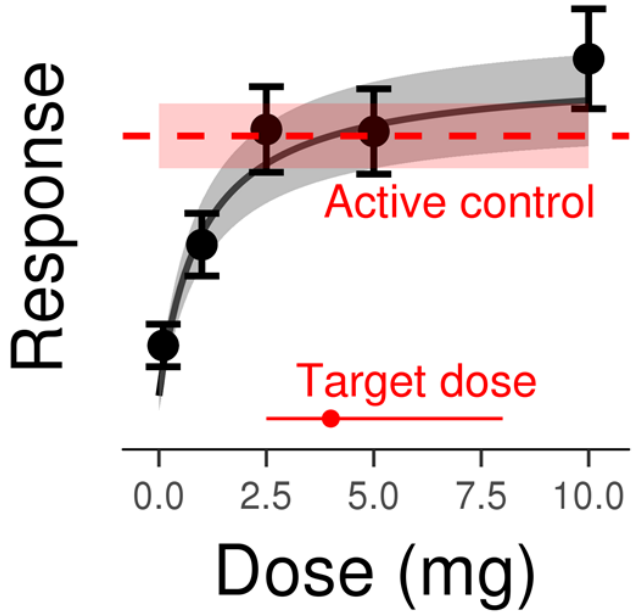
Group elements to aid direct comparison





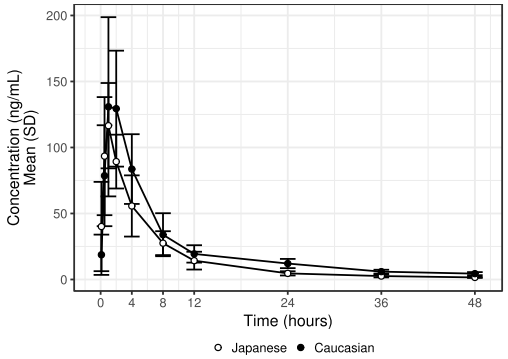
Use informative labels and annotations to support the message

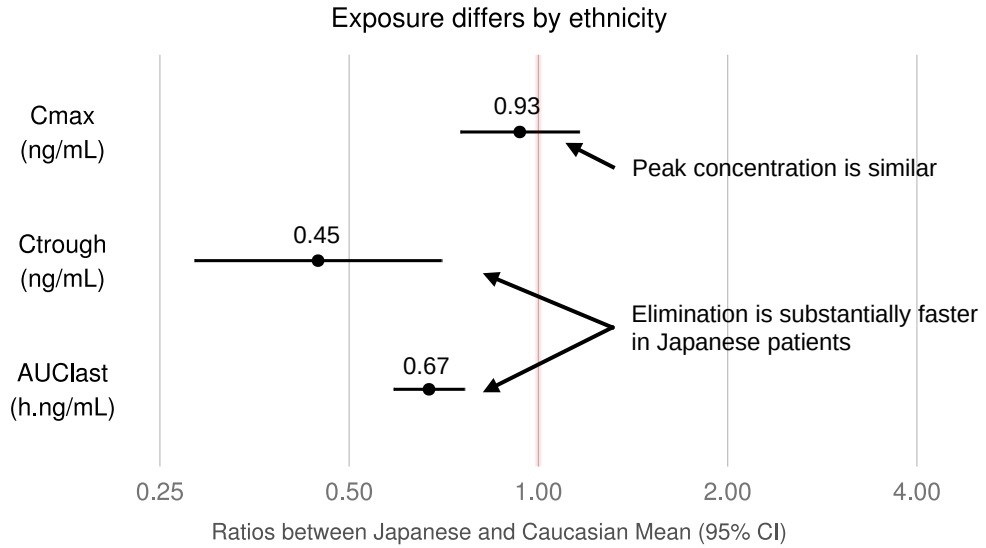




 https://github.com/GraphicsPrinciples/webinar

Putting it all together – is exposure different?





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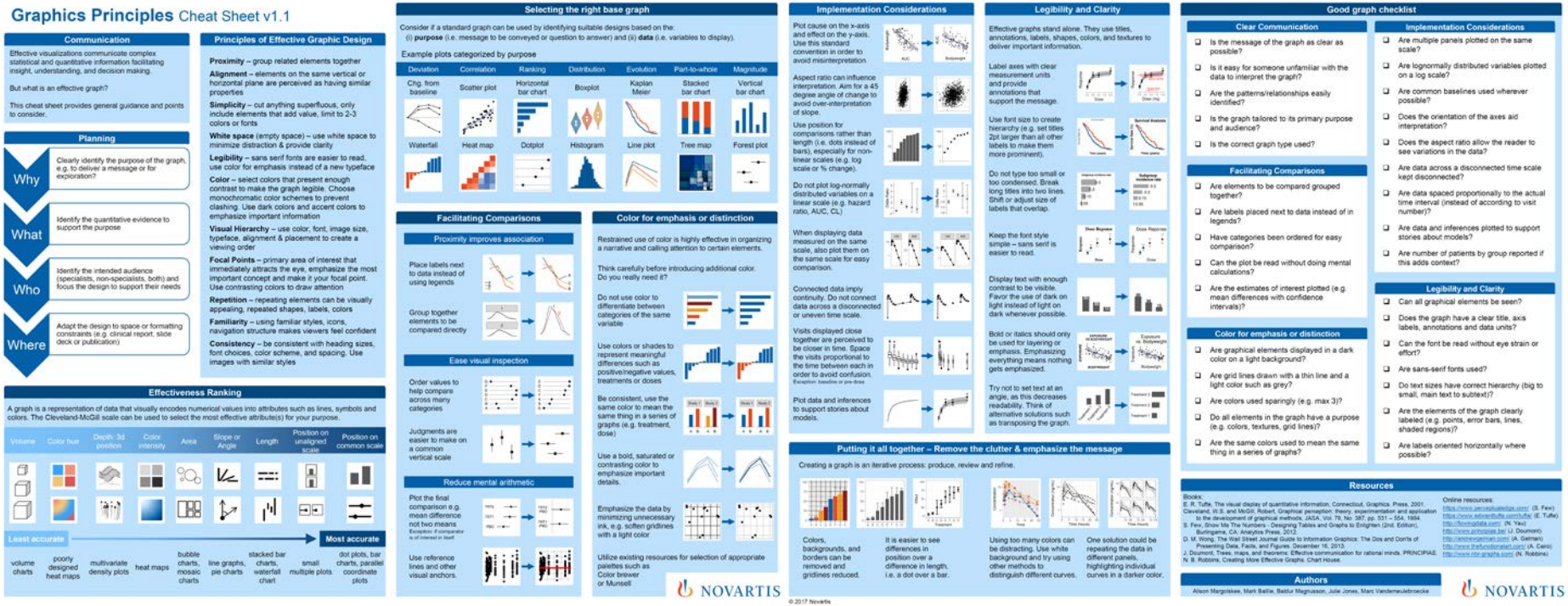
https://graphicsprinciples.github.io/cheatsheet.html

Principles for EVC



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Structured EVC approach

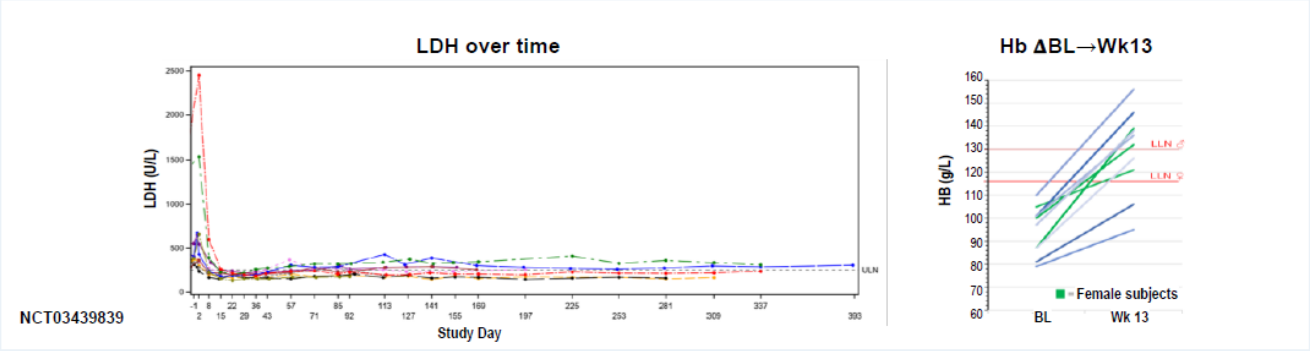
Mark Baillie

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↓)



 https://github.com/GraphicsPrinciples/webinar

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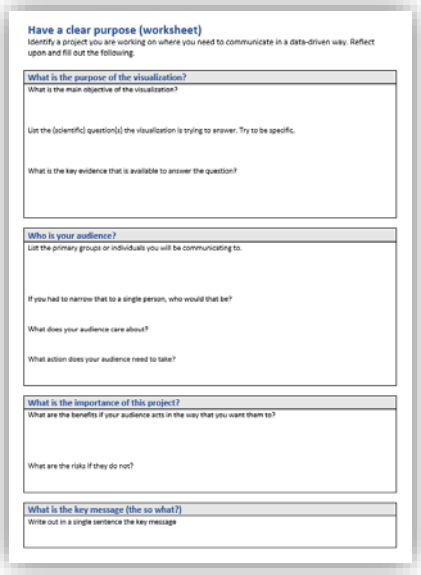
1st principle
Have a clear purpose

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?

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- 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?)

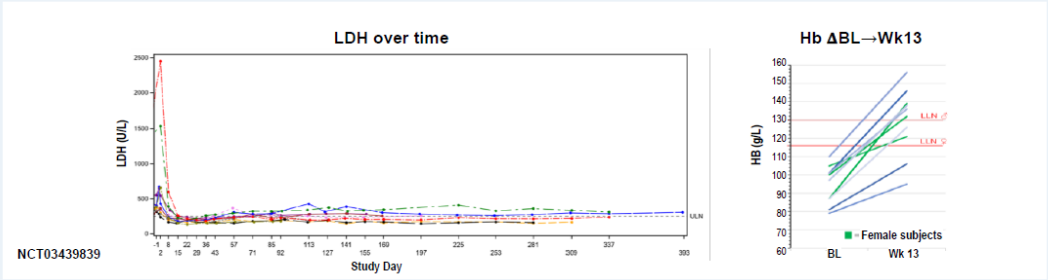
- Write out in a single sentence the key message

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-naive 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

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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 *LNP023 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

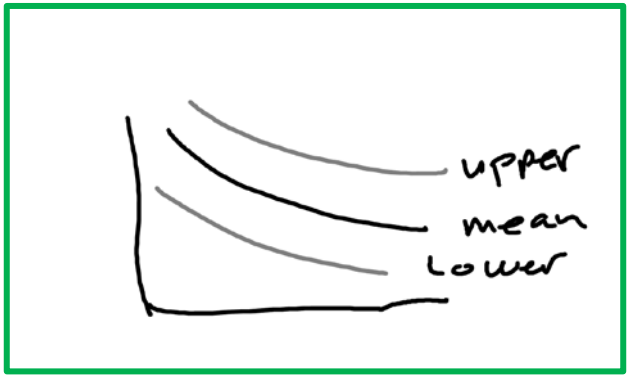
- The “purpose” worksheet is a guide to stay in line with the key evidence that supports your key message
- Try to display the same sets of data in different ways and select the one you consider the more adapted (often being the simplest)
- It is then time to iterate and eliminate clutter
  - Add what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

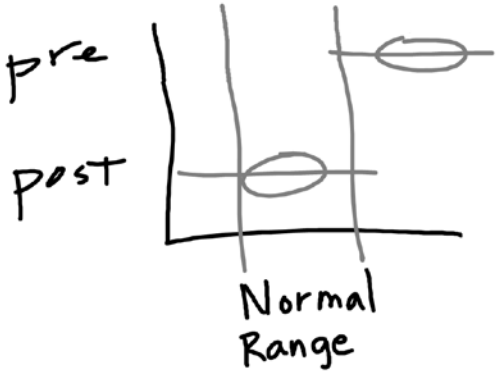
2nd principle - select the appropriate graph

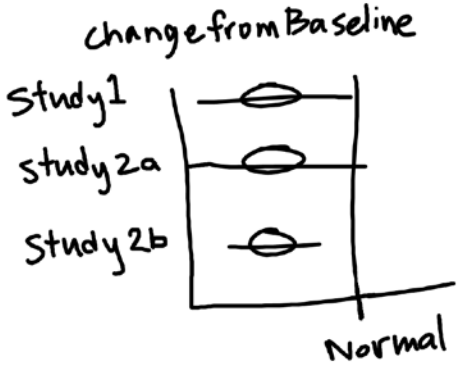
- Brainstorm different ways to display the data
- The more ideas the better!
- Select the display that supports the key message

Continuing with LNP example

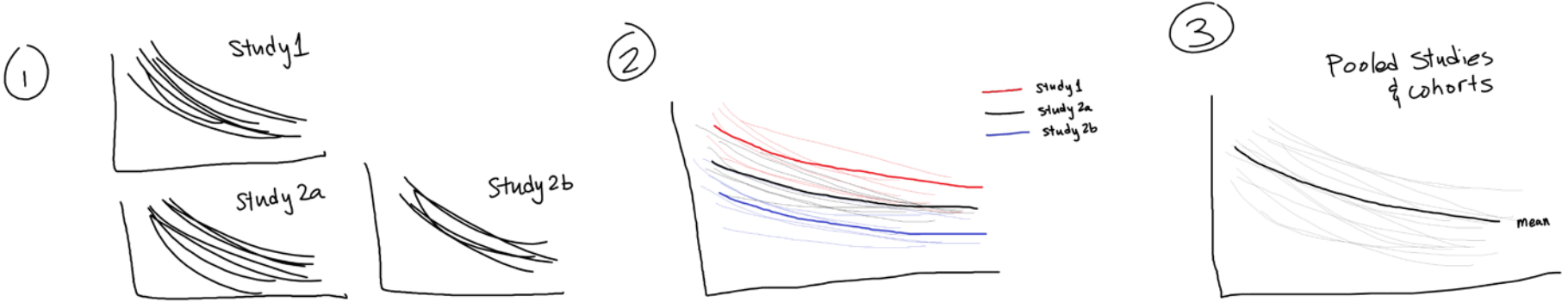
- What is the key message:
  - LNP023 reduces LDH levels to normal
- The key evidence to support this:
  - Two studies with different dose cohorts
  - LDH as a surrogate for efficacy







2nd principle – Iterate and eliminate clutter



 https://github.com/GraphicsPrinciples/webinar

3rd principle
Make the message obvious

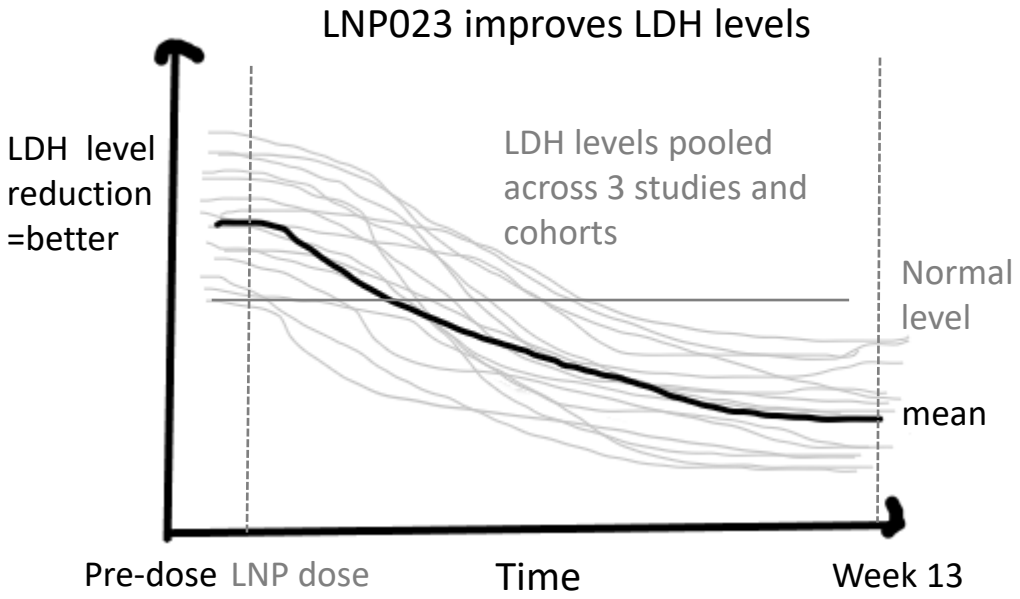
Make your message obvious

- 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

 https://github.com/GraphicsPrinciples/webinar

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



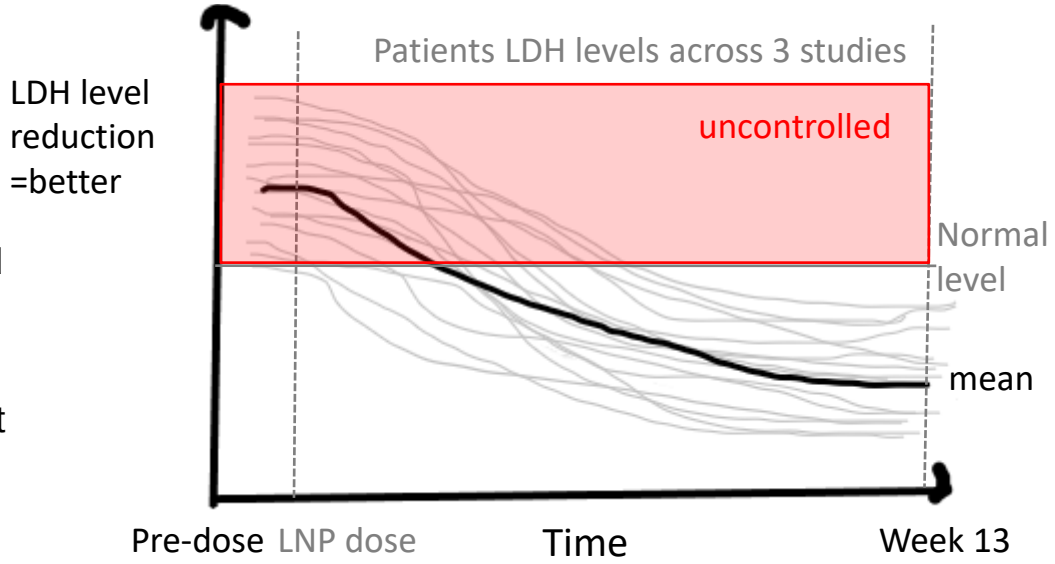
3rd principle – tell a story

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

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Your turn! (Homework for Part 2)

Alison Margolskee

Your turn! (Homework for Part 2)

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

- 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 >= 35% in previously treated patients (with 95% CI > 25%) and >= 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

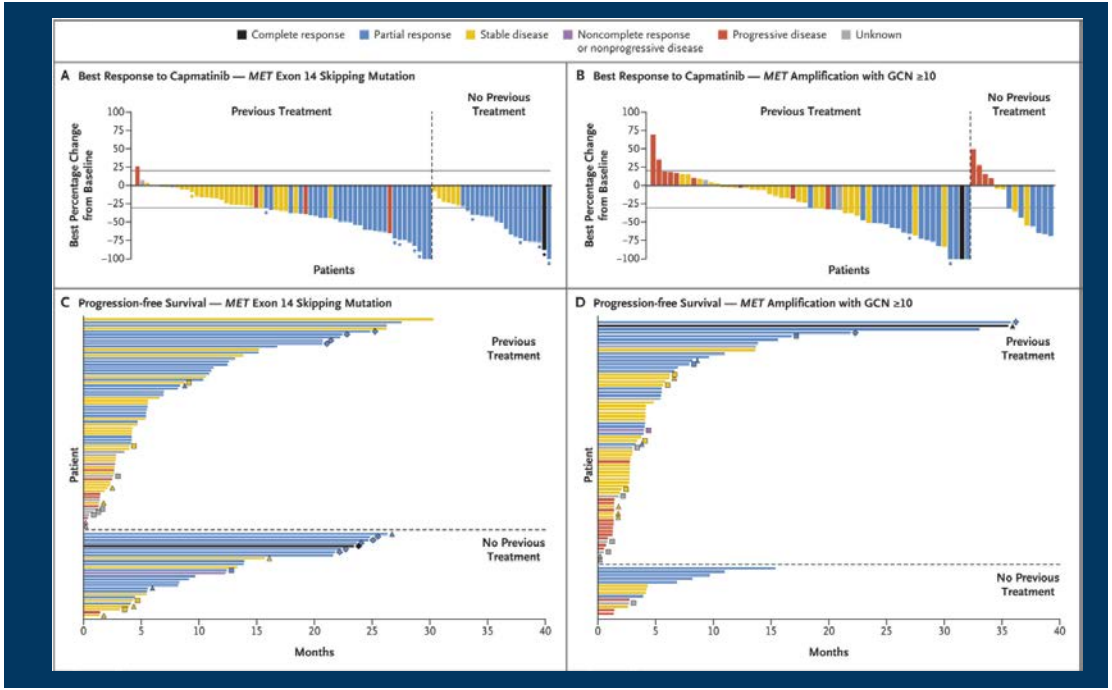
If you had to narrow that to a single person, who would that be?
Oncology development head

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

- 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?

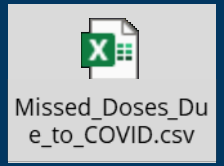
Decide whether to continue or stop the trial, or make serious effort / do nothing to increase compliance

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

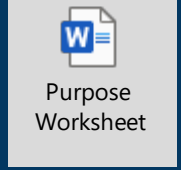
- id = unique subject identifier
- TRT = treatment group ("Continuous Treatment", "1 missing dose", "2 missing doses", "3 missing doses", "Placebo")
- time = time of event (years)
- status = event identifier (1 = right censored / lost to follow up, 2 = event of interest)
- label = description of event
- 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

Your example here!

Purpose worksheet, empty



Recap and resources

Marc Vandemeulebroecke

https://youtu.be/pfxulpF9XOw

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

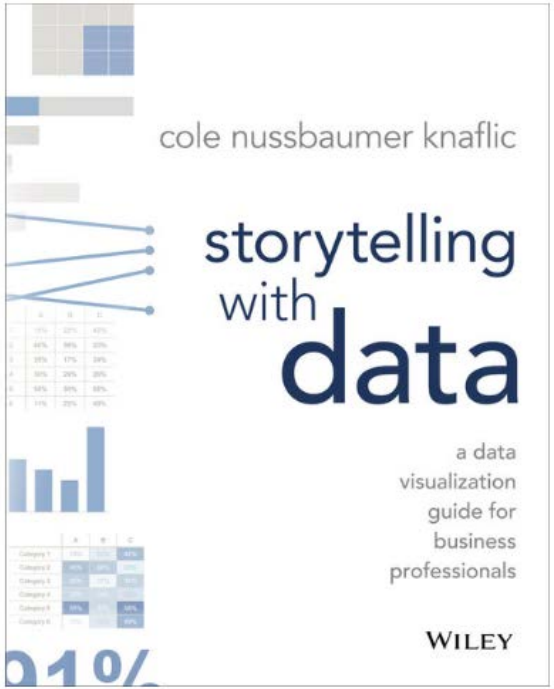
- 2nd principle: Show the data clearly
  - Choose the appropriate graph type to display your data
  - Avoid misrepresentation (use appropriate scales)
  - Maximize data to ink ratio (reduce distraction, less is more)

- 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.

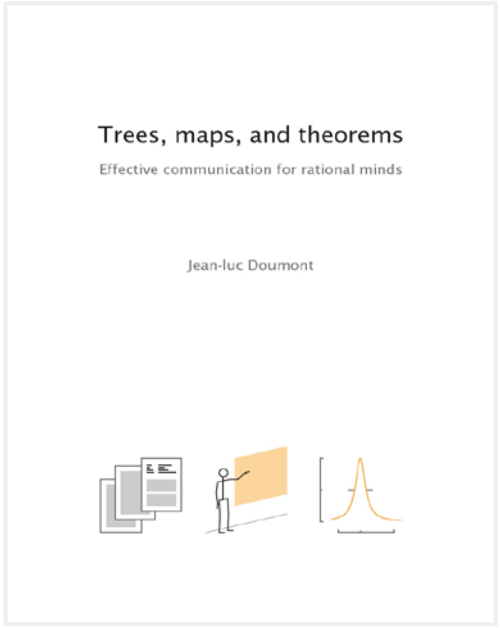
Resources, where to find out more?



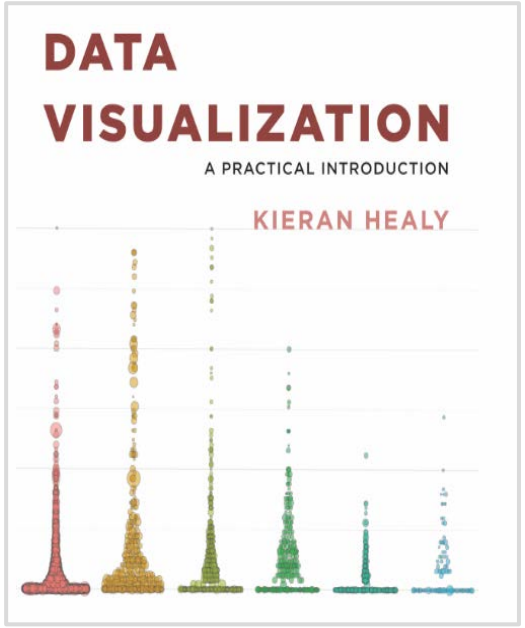
http://www.storytellingwithdata.com/books

- 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

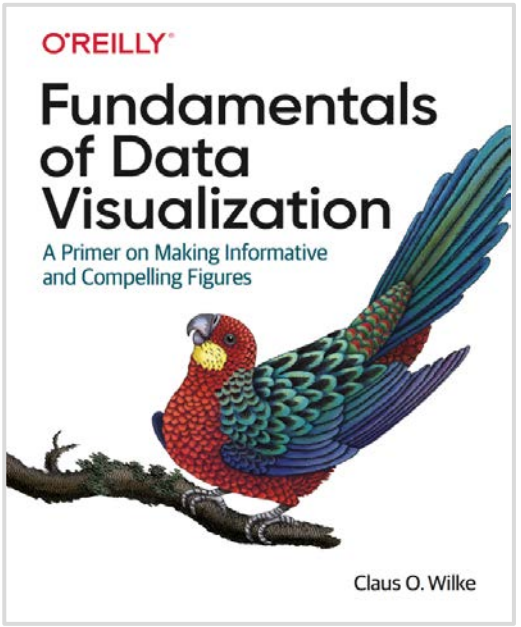
Even more resources?



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



https://socviz.co/



https://serialmentor.com/dataviz/

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- Ivo Vranesic
- Meredith Godat
- Sam Maitra
- David Carr

And many more…

https://github.com/GraphicsPrinciples/webinar

ASCPT American Society for Clinical Pharmacology & Therapeutics

NOVARTIS | Reimagining Medicine