Data dashboards for clinical and research practice

Using REDCap and R

Clinical Brown Bag Talk Series
Department of Psychology, Vanderbilt University

Francisco Meyer, April 19 2022

Logistics

- Sample code + slides shared on talk GitHub repository
  - https://github.com/fcmeyer/vu-brownbag2022-shinyredcap
- Will email link after talk
- Feel free to ask questions :)

Learning objectives

By the end of this talk, you should…

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1. Learn what a data dashboard is
2. Understand scenarios where a data dashboard can be useful to clinical/research practice
3. Learn about three different sets of tools you can use to build a data dashboard from REDCap data
4. Understand how to move forward in your learning / go forth and build dashboards

What is a data dashboard?

Examples

Looks cool, but hard.

Good news everyone!

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- There's mature and well-supported **free, open source tools** to make your own dashboards
- Bonus: I'll give you some materials to get started :)

How do I make a dashboard?

Four steps to success

1. Is a data dashboard appropriate to address my needs?
2. Do I use a pre-built solution or build my own?
3. Write necessary code (and test)
4. Enjoy!

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4. **How many times** do I expect to need to generate a report on these key metrics?
5. Does it make sense to invest in building a data dashboard? Or can I get what I need **faster** with another solution?

Ideal use cases

- Monitoring data collection progress
- Review data quality during ongoing collection
- Tracking patient progress
- Data exploration (e.g., prior to data cleaning)

Overkill use cases

(It always depends but…)

- A straightforward plot / test you only need to do once or twice
  (just do it the easy way…)
- Confirmatory analysis
  (use Rmarkdown report instead)

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Work smart, not hard

Leverage pre-built or simpler solutions whenever you can!

Project Dashboards

Pre-built Dashboards	`datadigest`
	`radiant`
	`ExPanD`

REDCap Project Dashboards

REDCap Project Dashboards

Features

- Built into REDCap!
- No need for additional software or programming experience
- Easily share with other researchers who have access to your REDCap project
- Probably easiest and most straightforward approach for simplest use cases

REDCap Project Dashboards

When would I use them?

*As time goes on, this might change! I am very excited for the future of this exciting feature :)

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- Data exploration (e.g., subsetting)
- More complex metrics of interest that are derived from “raw” data
- Data not hosted/collected on REDCap

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Pre-built dashboards in R

But first, we need to get the REDCap data into R.

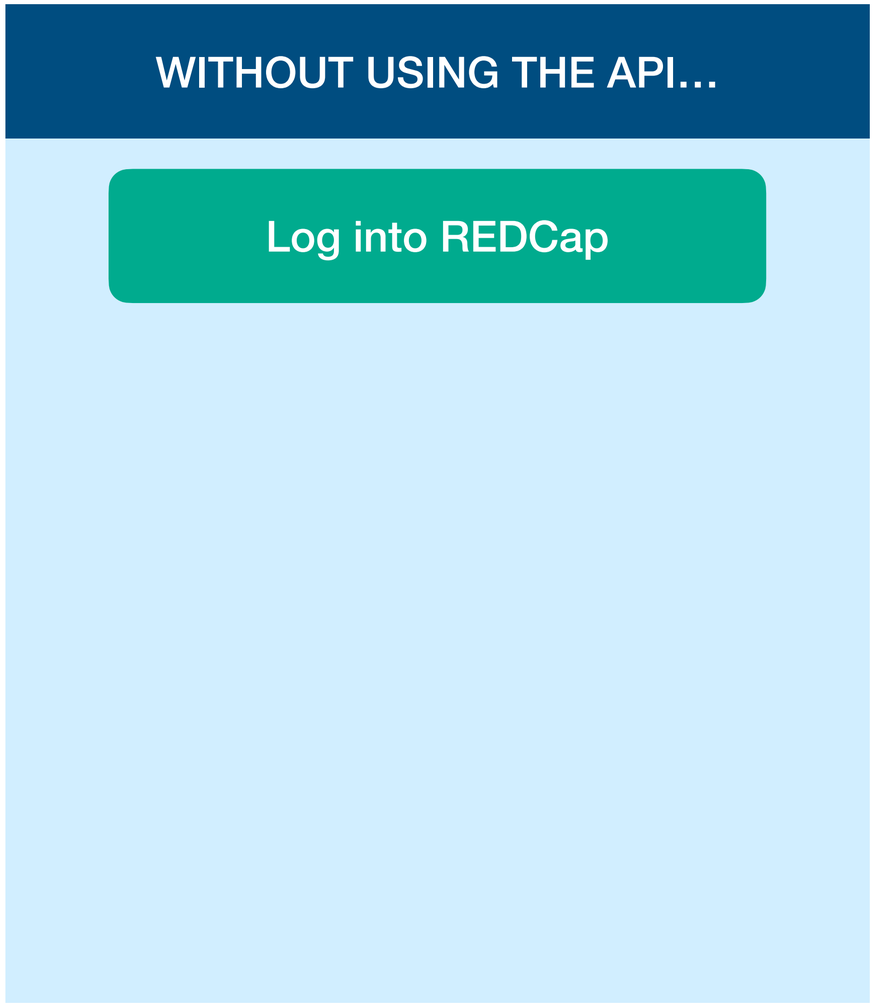
Pre-requisite: getting REDCap data into R

Why use the REDCap API?

WITHOUT USING THE API…

Pre-requisite: getting REDCap data into R

Why use the REDCap API?



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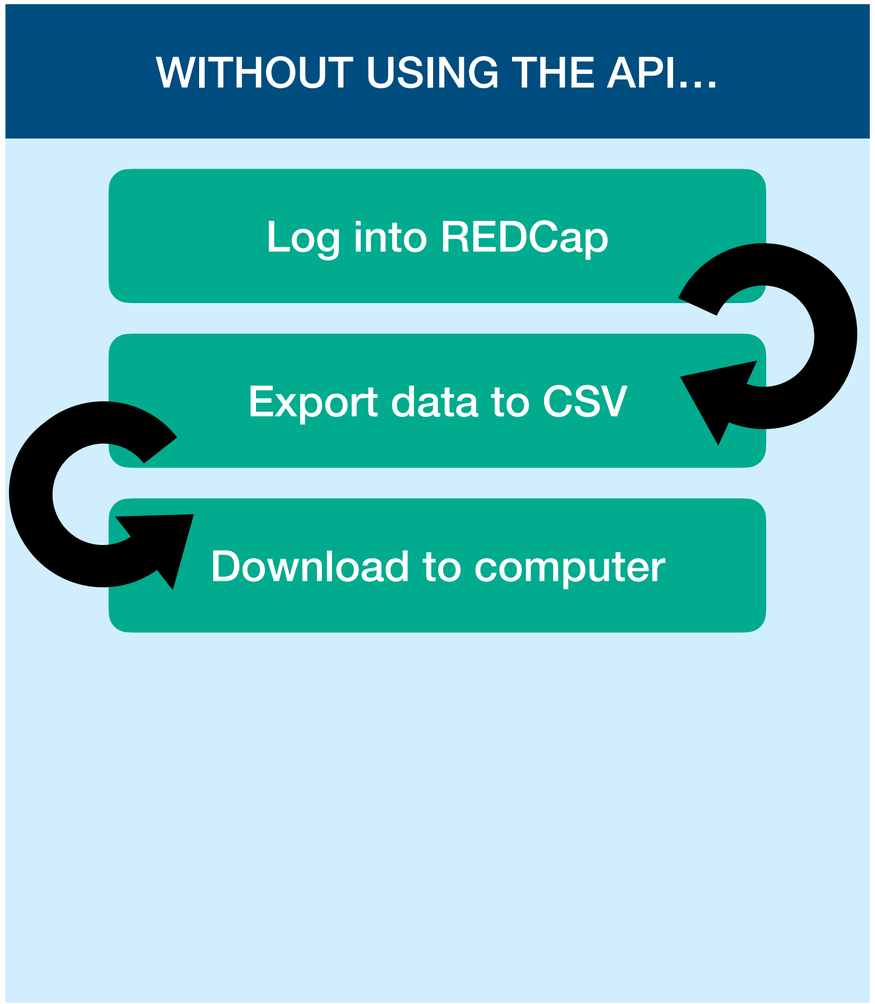

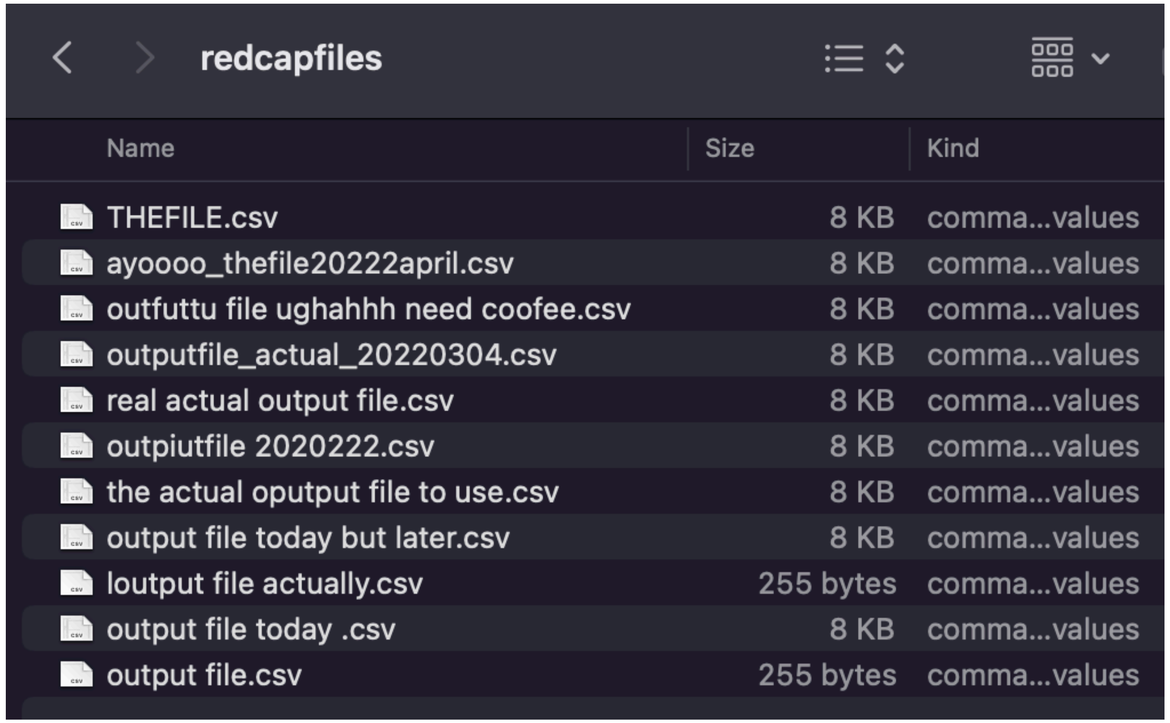

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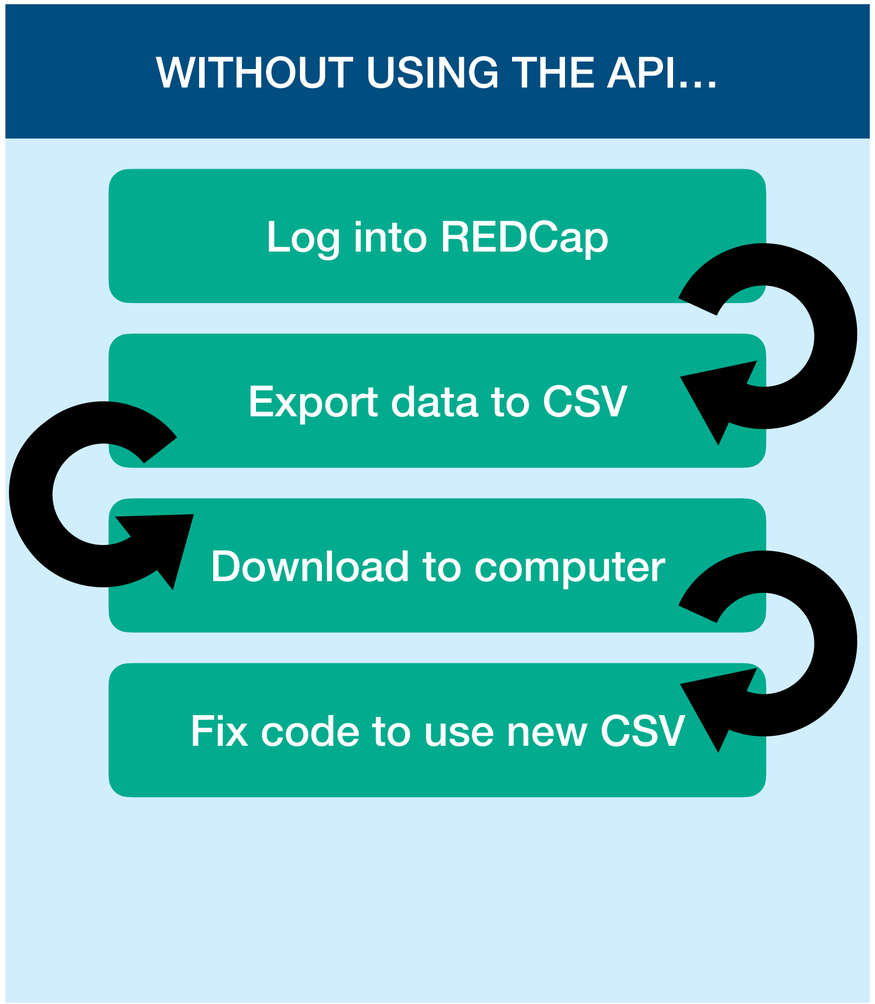

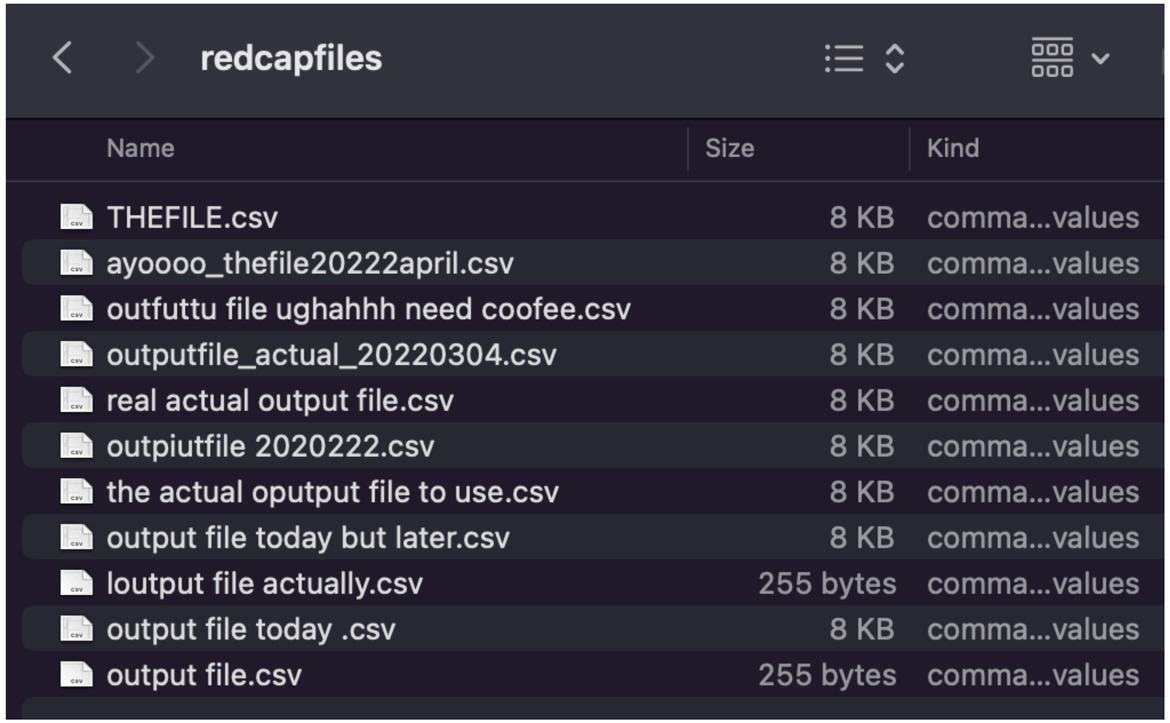


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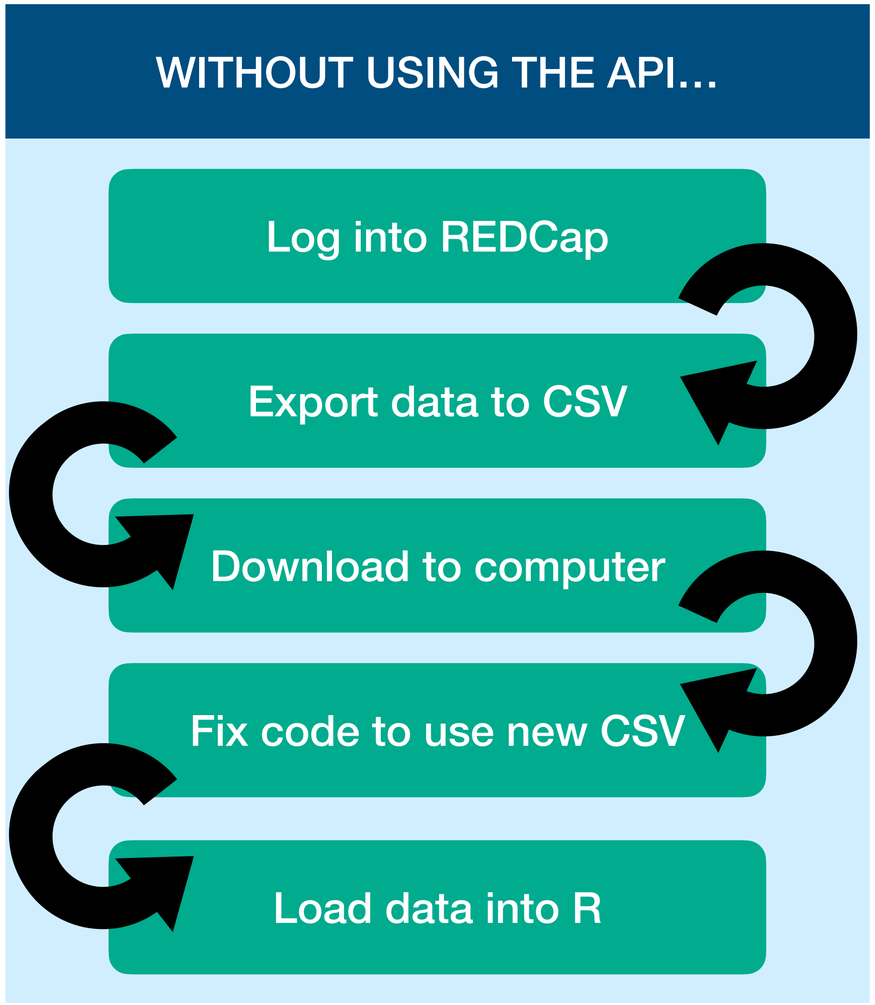

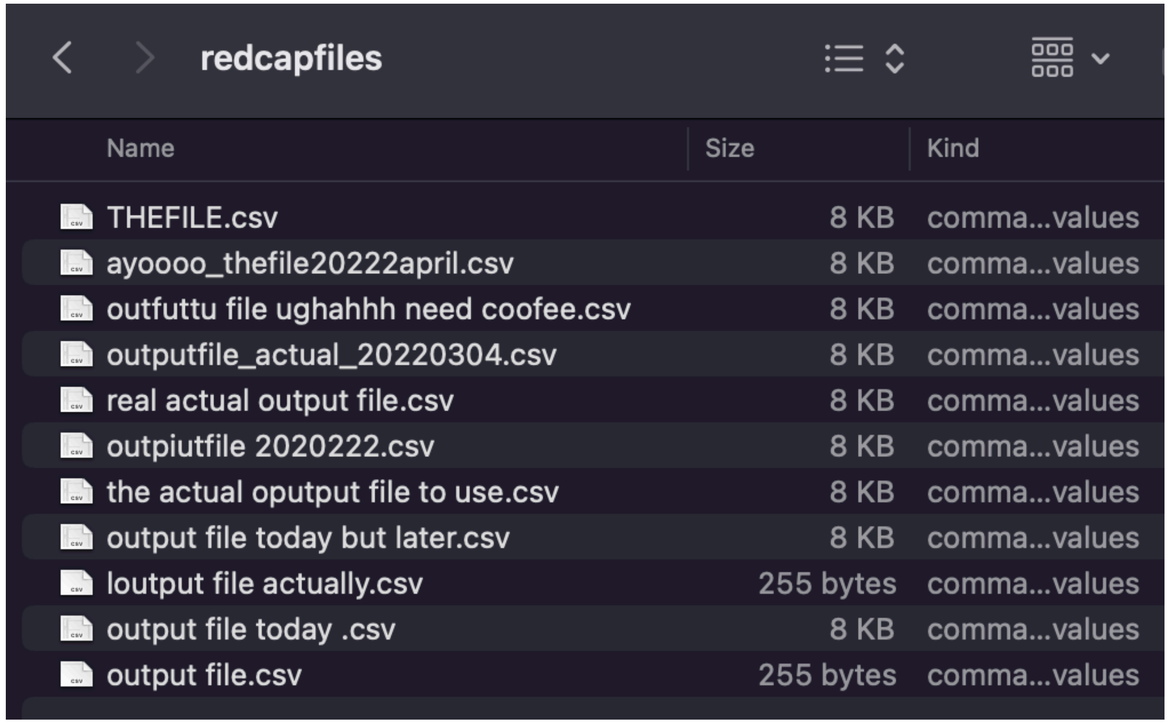


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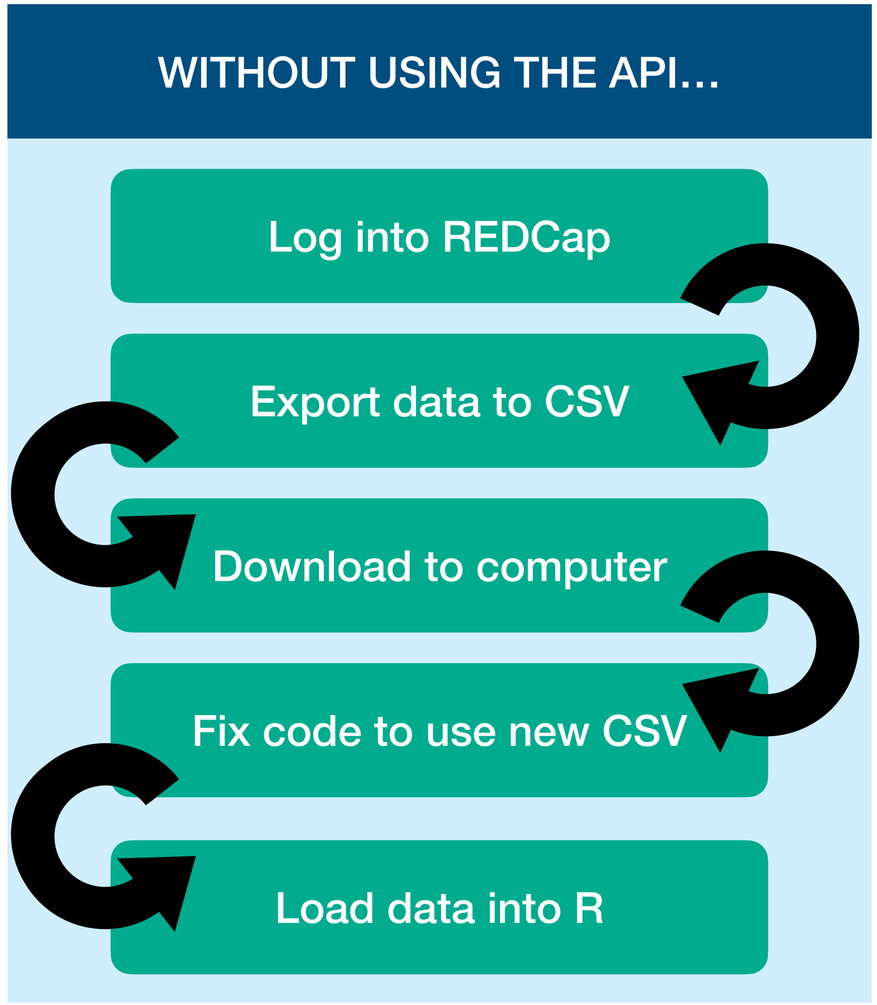


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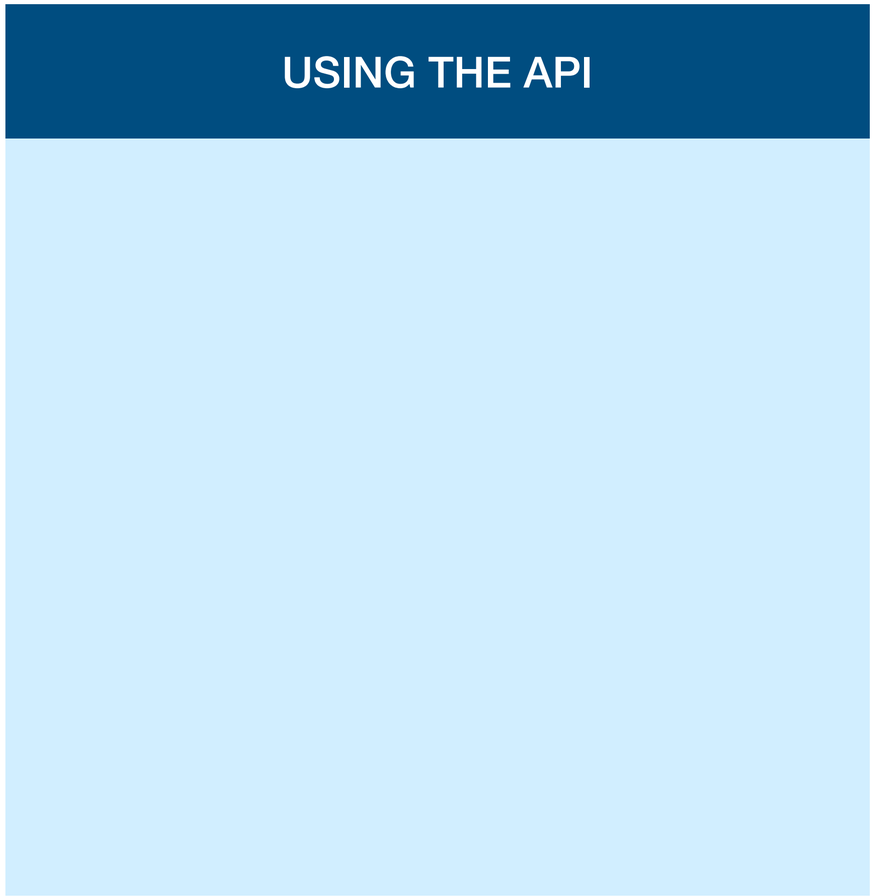

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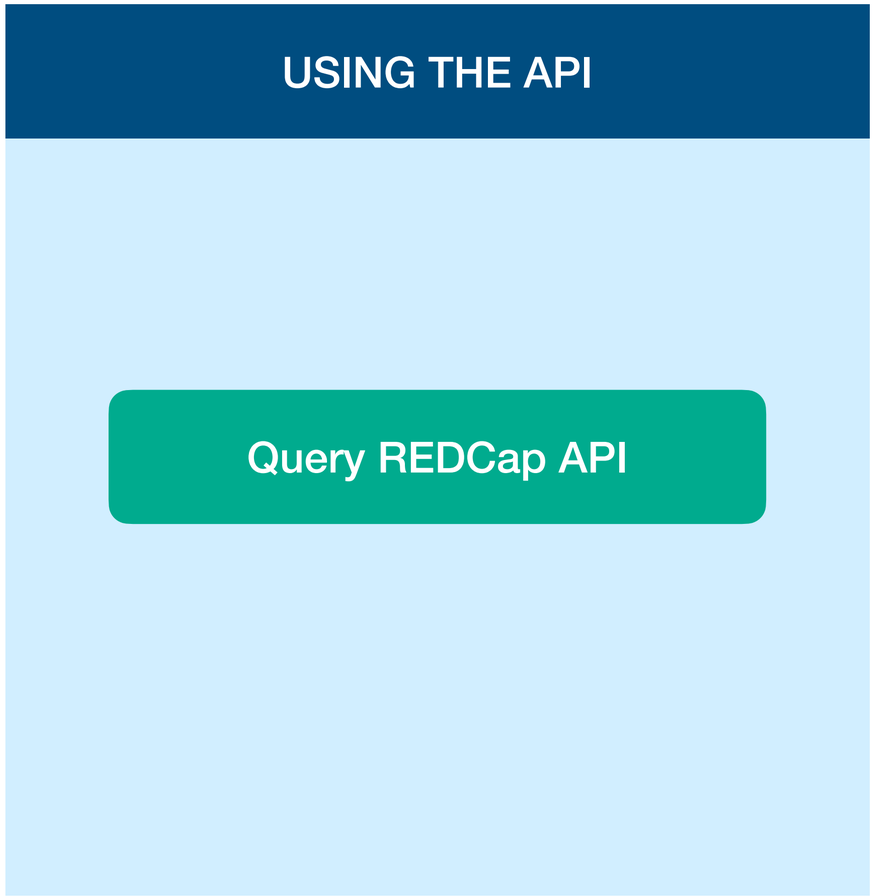


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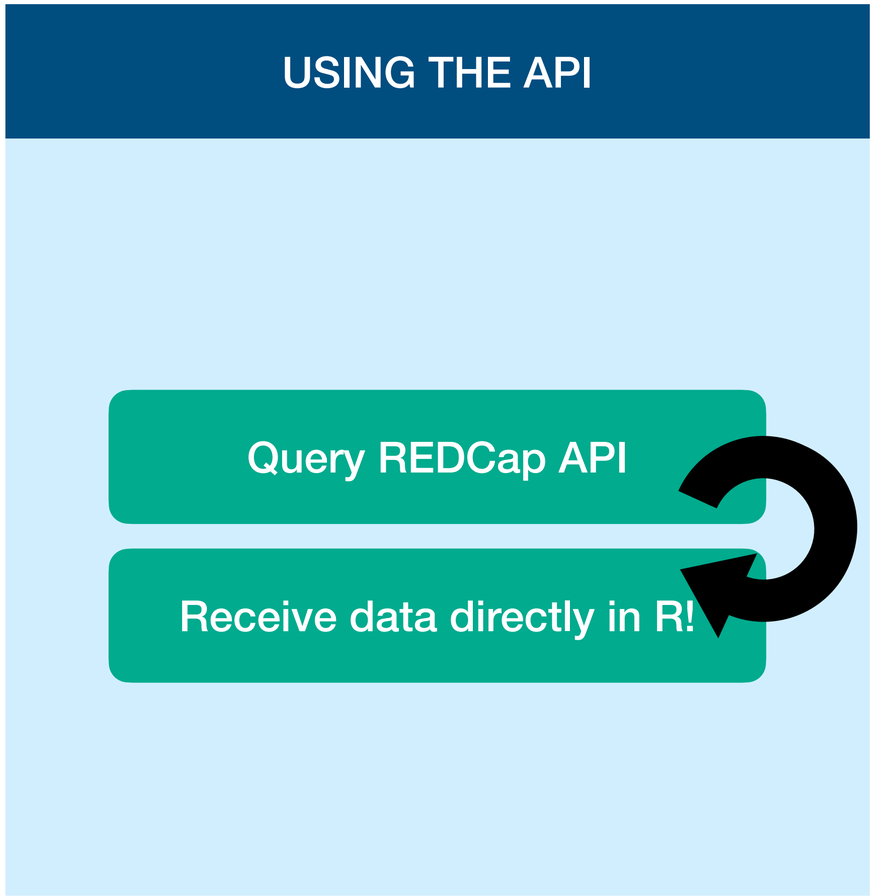


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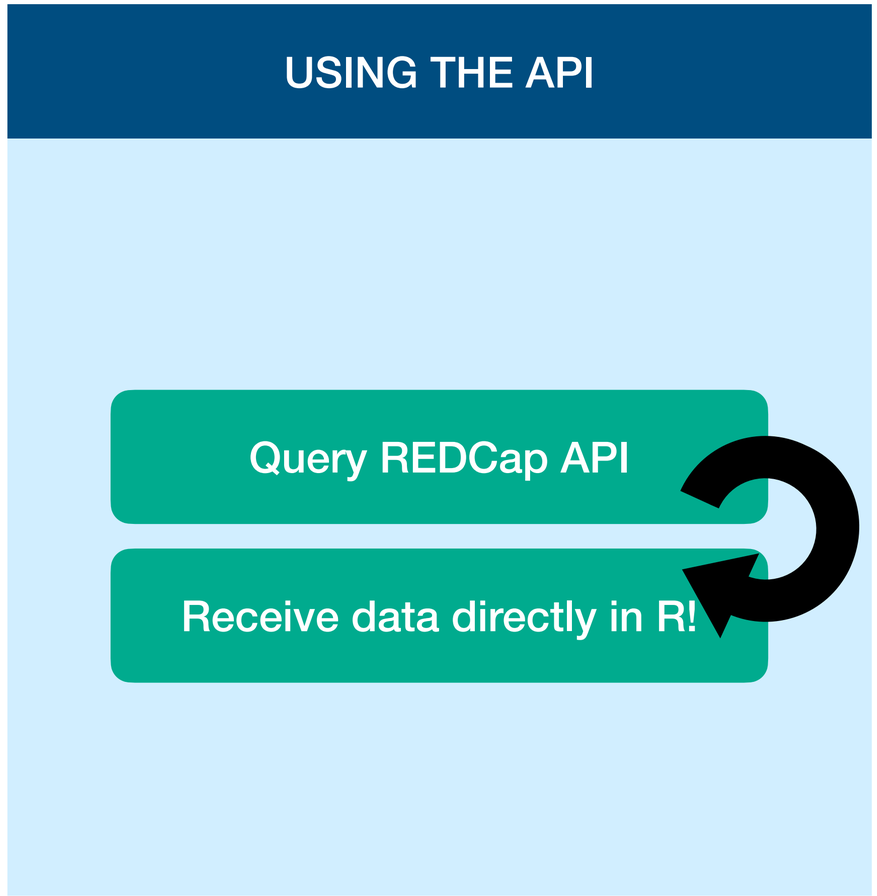

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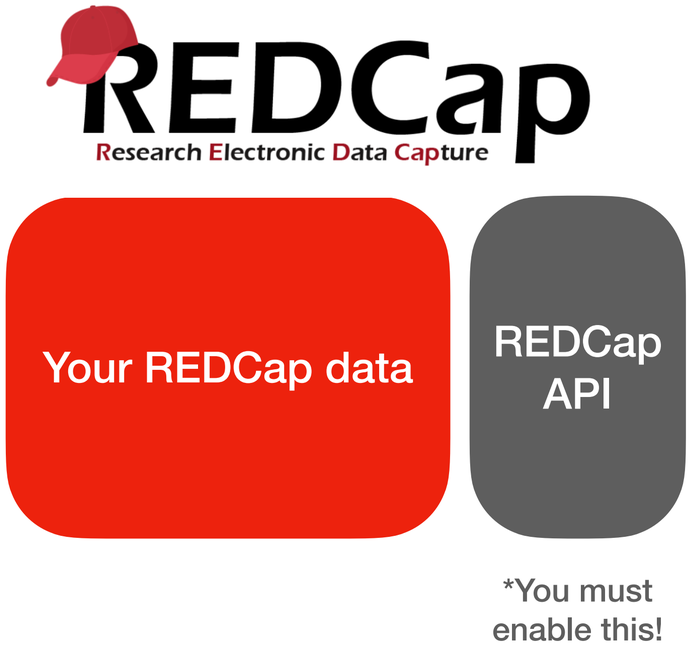

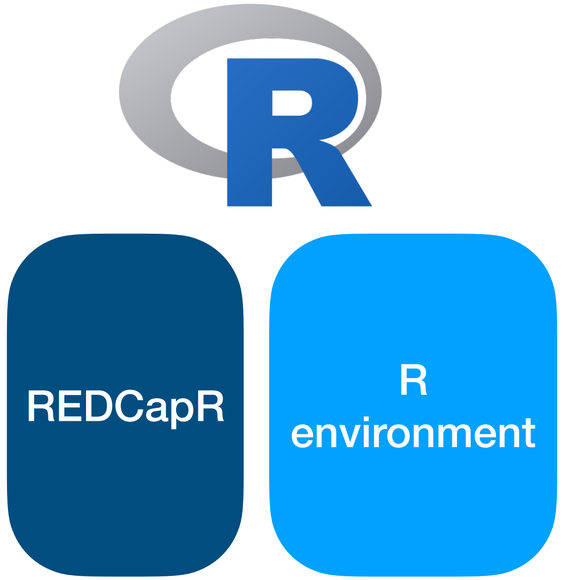

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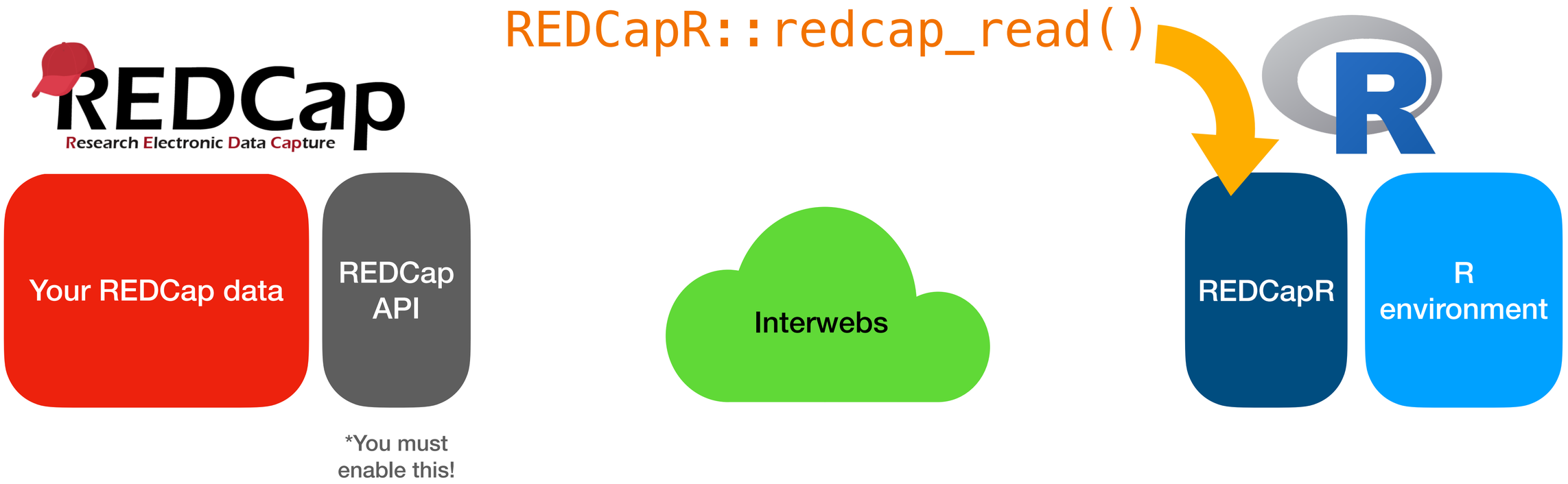

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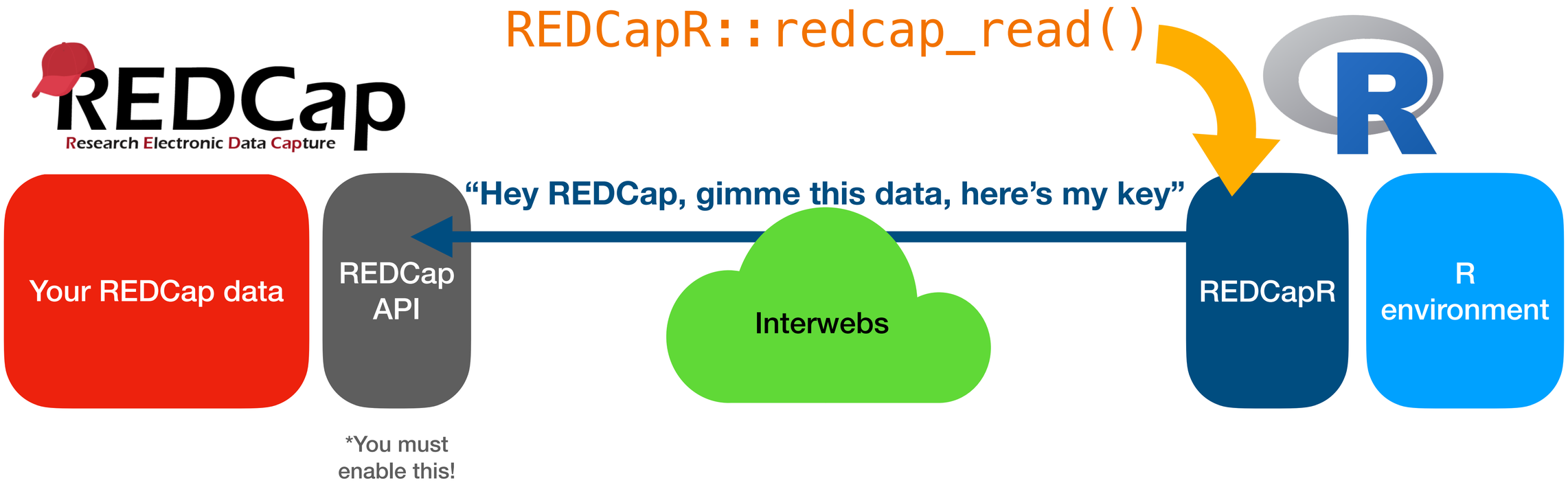

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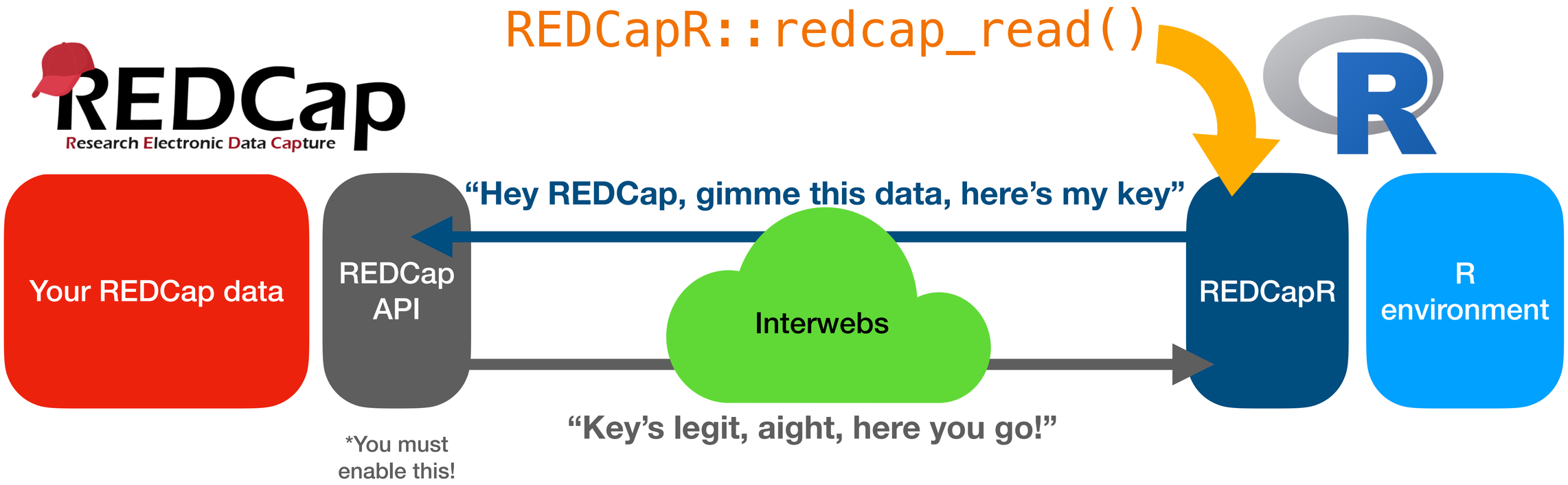

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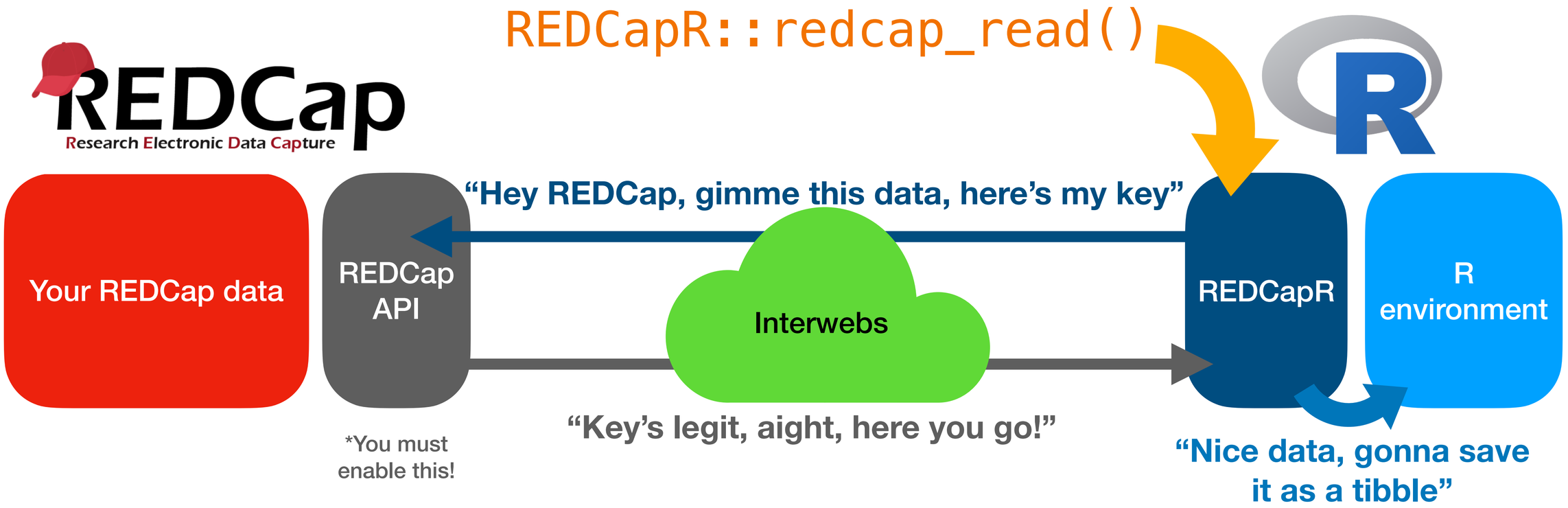

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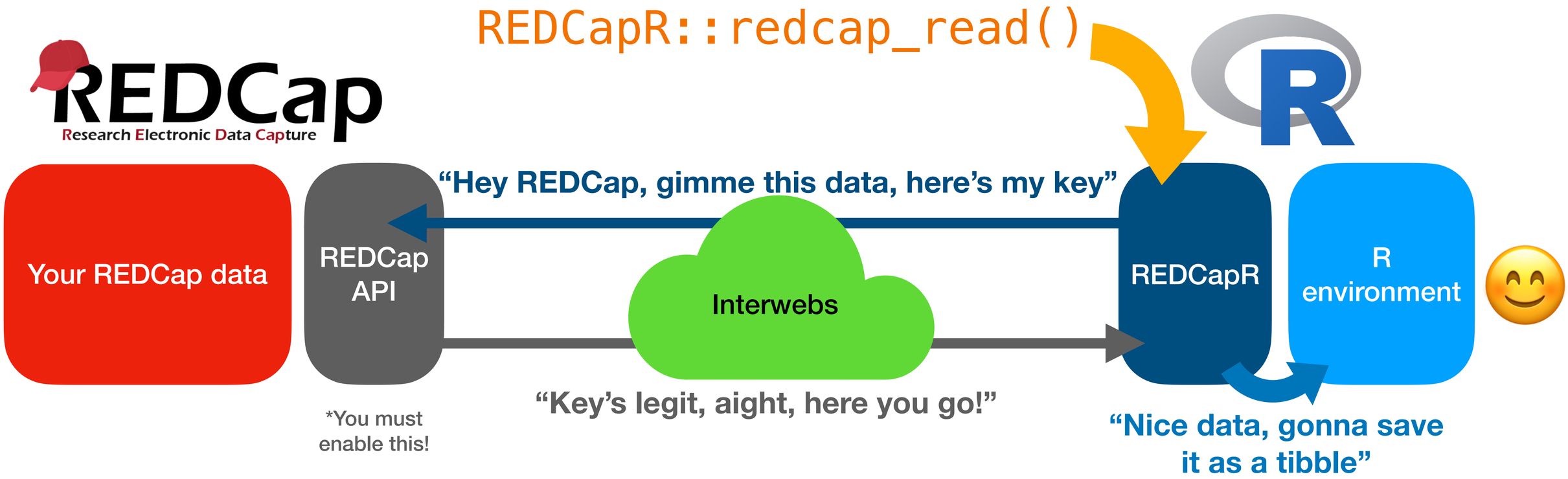

How do I learn more about using REDCapR?

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- I shared some **examples** of this on the **talk GitHub repository**! Check out:
  - `notebooks/redcap_01_setting_up_keys.Rmd`
  - `notebooks/redcap_002_api_read_redcapr.Rmd`

How do I learn more about using REDCapR?

- Make sure to check out REDCapR's **awesome documentation**:
  - https://ouhscbbmc.github.io/REDCapR/index.html
  - **Especially recommend** top two entries in "Articles" section!
- **Alternatives** to REDCapR you may want to consider:
  - `redcapAPI`, another great R package with similar functionalities
  - `PyCap`, if you are a Python user

Ok, so we know how to get our data in.

Now let’s get back to pre-built dashboards in R!

Pre-built dashboards in R

Powerful plug-and-play solutions with minimal effort!

Pre-built Dashboards	
	`datadigest`
	`radiant`
	`ExPanD`

- `datadigest`
  - https://github.com/RhoInc/datadigest
- `radiant`
  - https://radiant-rstats.github.io/docs/data/view.html
- `ExPanDaR`
  - https://joachim-gassen.github.io/ExPanDaR/

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Needs unlikely to be met:

- subject-specific plots (e.g., for clinic), uploads to REDCap, data validation, niche data plots (e.g., Manhattan, ggseg), etc.

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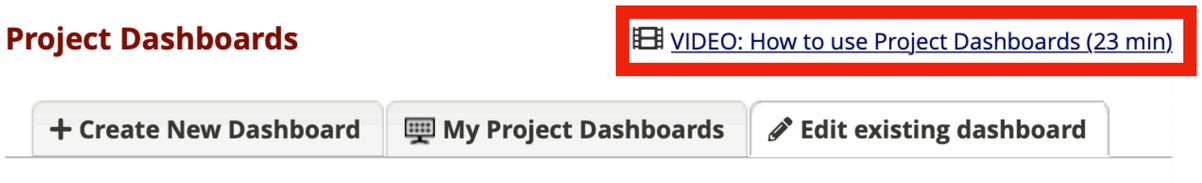

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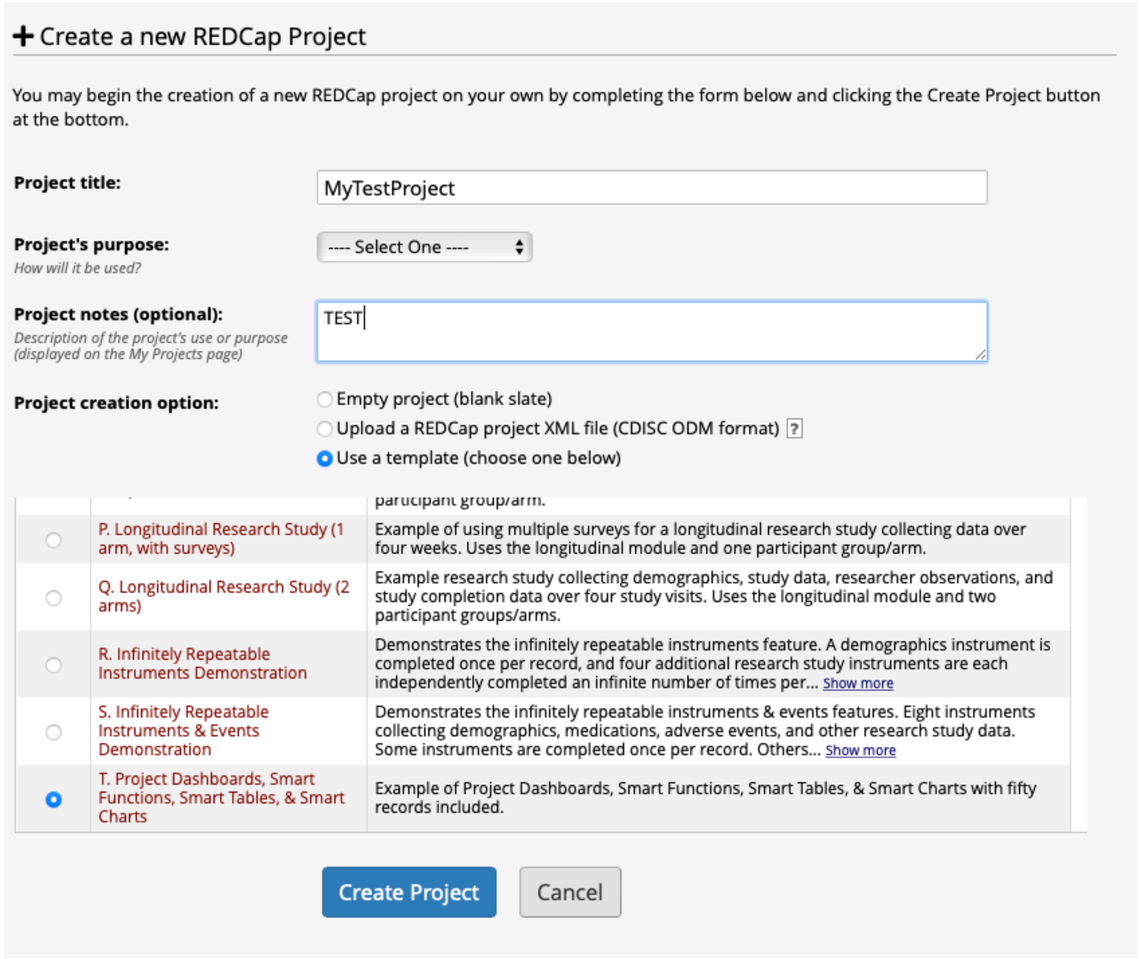

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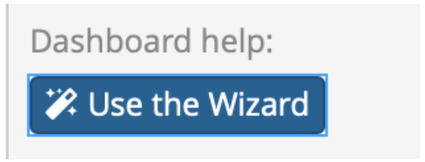
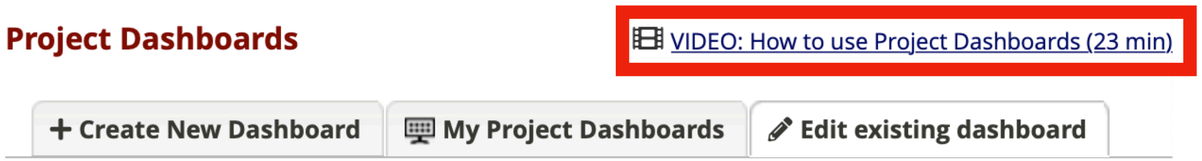
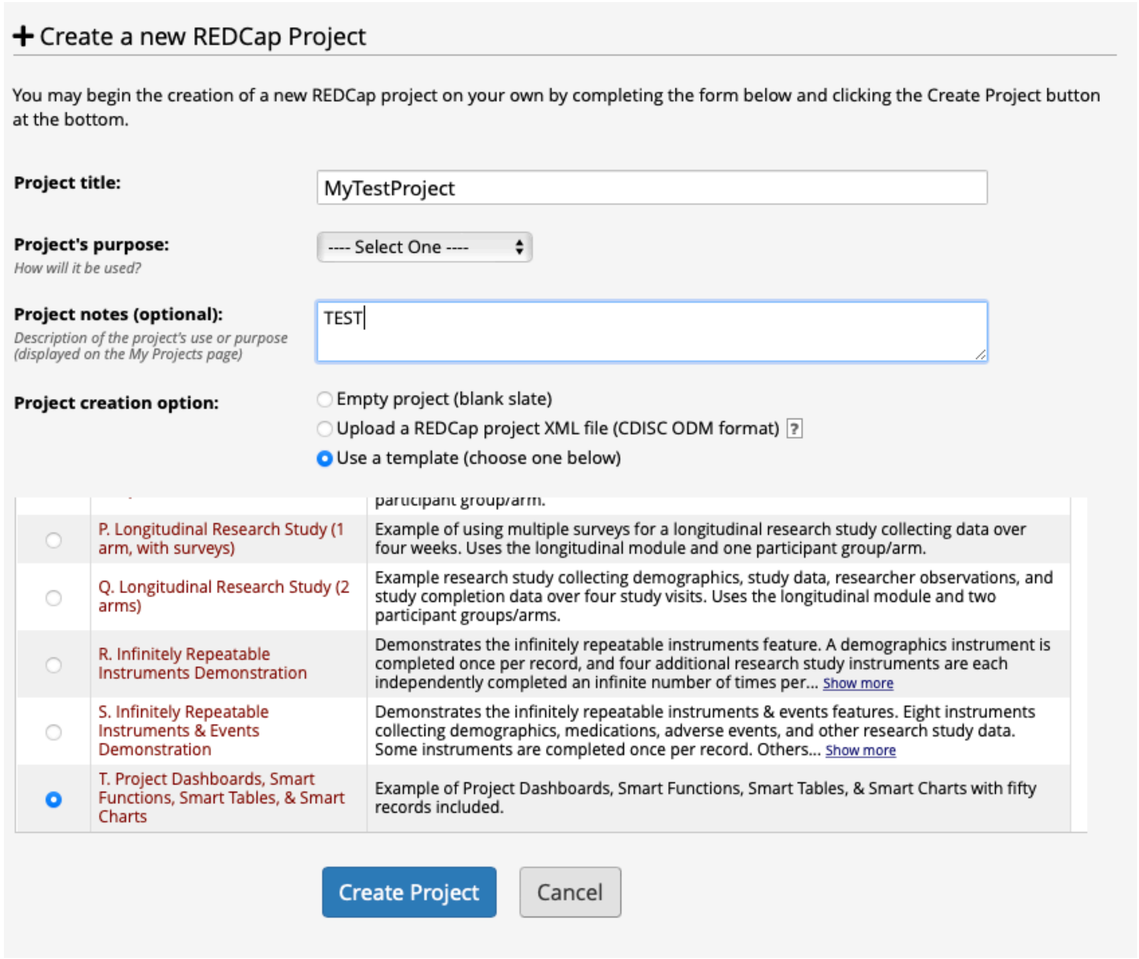
- Use the very helpful **wizard tool**







Code to use a pre-built R dashboard with REDCap data

A simple template

All you need is a script that does the following:

1. **Downloads your data** directly to R from REDCap using the REDCap API
2. **Launches** the pre-built dashboard of your choice

See the example in the GitHub repository: `notebooks/prebuilt_dashboards.R`

NOTE: you can also use these dashboards with non-REDCap data 😇

Great, but how do I write code for my own dashboard?

Three (sub-steps) to success

1. Is a data dashboard appropriate to address my needs?
2. Do I use a pre-built solution or build my own?
3. Write necessary code (and test)
    1. Determine platform/libraries to use + learn necessary skills
    2. Build a base
    3. Expand the base
4. Enjoy!

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Building REDCap dashboards: tools you could use

(A non-exhaustive list)

		
Dashboard back-end		
REDCap interface	`REDCapR` `redcap_api`	`PyCap`
Data wrangling	`tidyverse` `datatable`	`pandas`
Plotting	`ggplot2` `plotly`	`matplotlib` `plotly`

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- Prefer libraries with **good documentation and examples**
- Consider **idiosyncrasies** of your **expected use case**
  - e.g., if working with massive datasets, `collapse` might be faster

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- Leverage **cheatsheets, vignettes and tutorials**

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- **Start small** and expand
- Leverage **cheatsheets, vignettes and tutorials**
- It’s **normal to backtrack**

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My suggested approach

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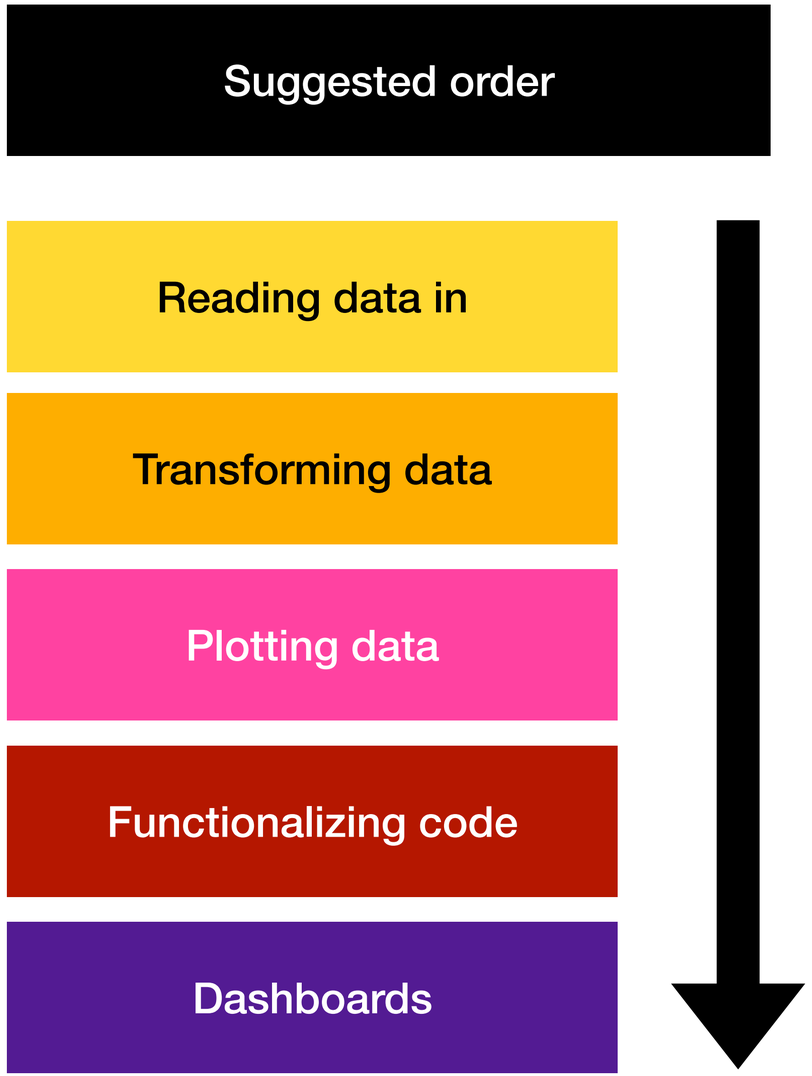
- **Start small** and expand
- Leverage **cheatsheets, vignettes and tutorials**
- It's **normal to backtrack**



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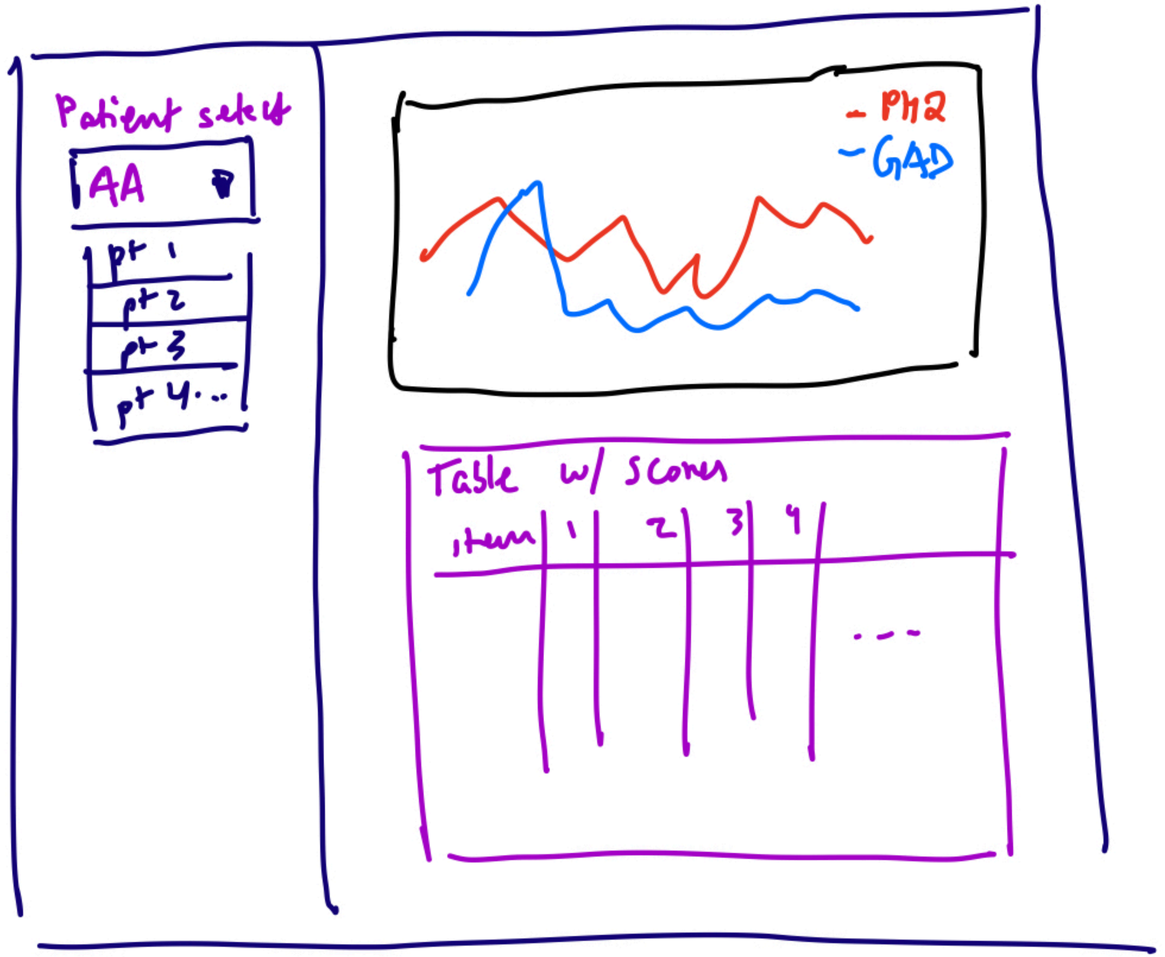
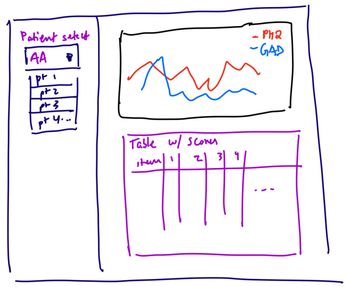
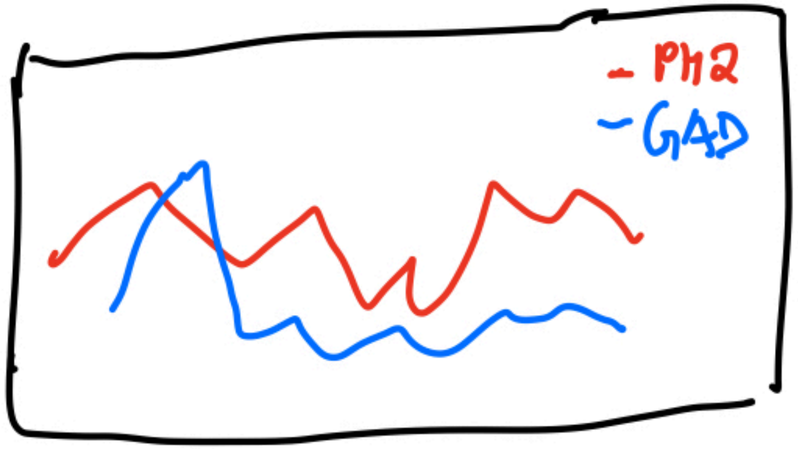
- Again - **backtracking is a normal part** of the process

Example: clinical dashboard



Example


Patient select
AA
pt 1
pt 2
pt 3
pt 4...
- PH2
- GAD
Table w/ scores
item
1
2
3
4
...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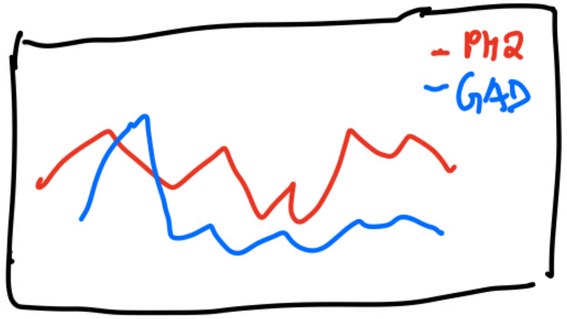

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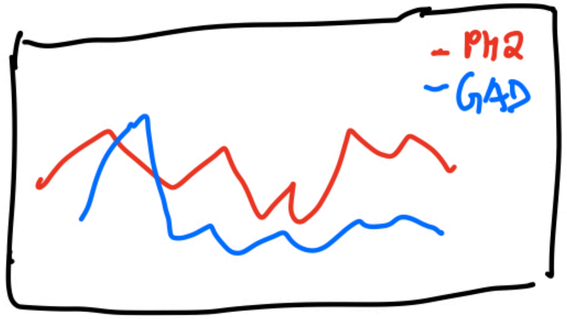

`shiny`

Embed plot in dashboard, adjust subject based on selection

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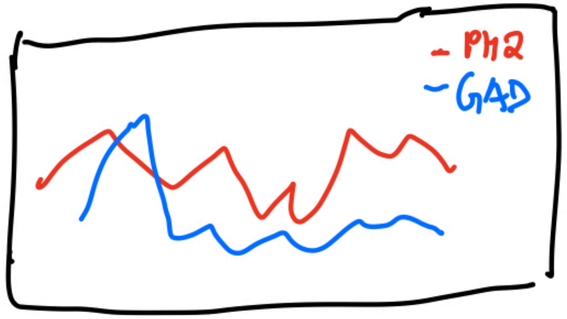

ggplot2

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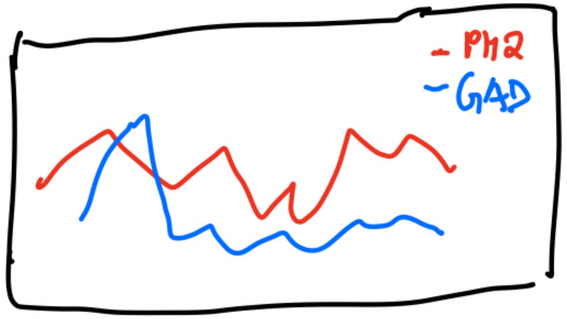

tidyverse

Wrangle & fitler data into long-format table for plotting

Cols:
datetime, PHQ-9. GAD-7 total

Filtered by:
subject == FCM

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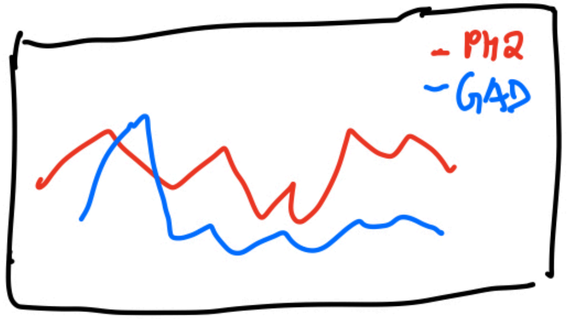

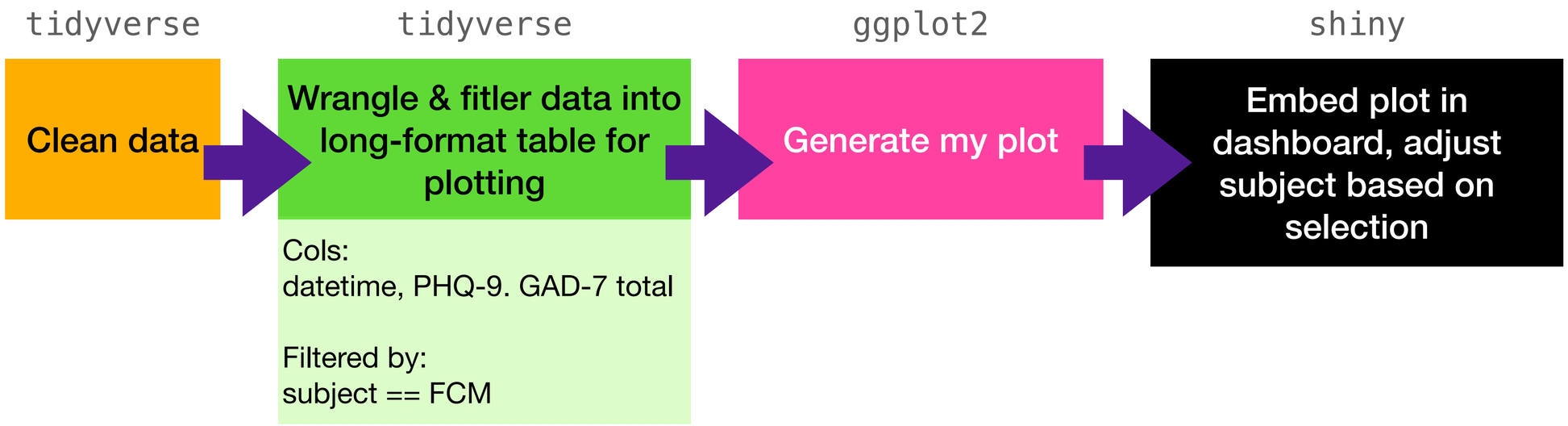

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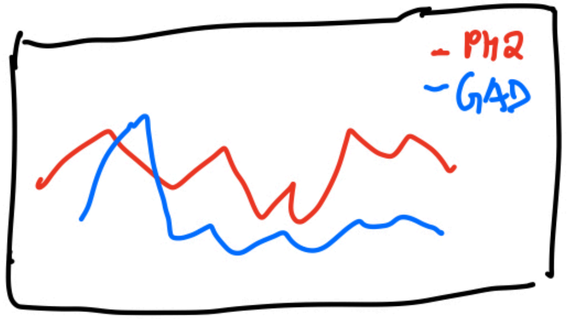

REDCap
Research Electronic Data Capture

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Example: clinical dashboard

REDCap
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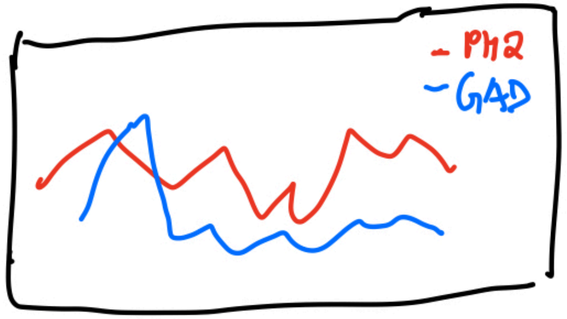
Check out on GitHub repo:
`notebooks/simple_to_complex_example.Rmd`
for an example of how this would look like in code!



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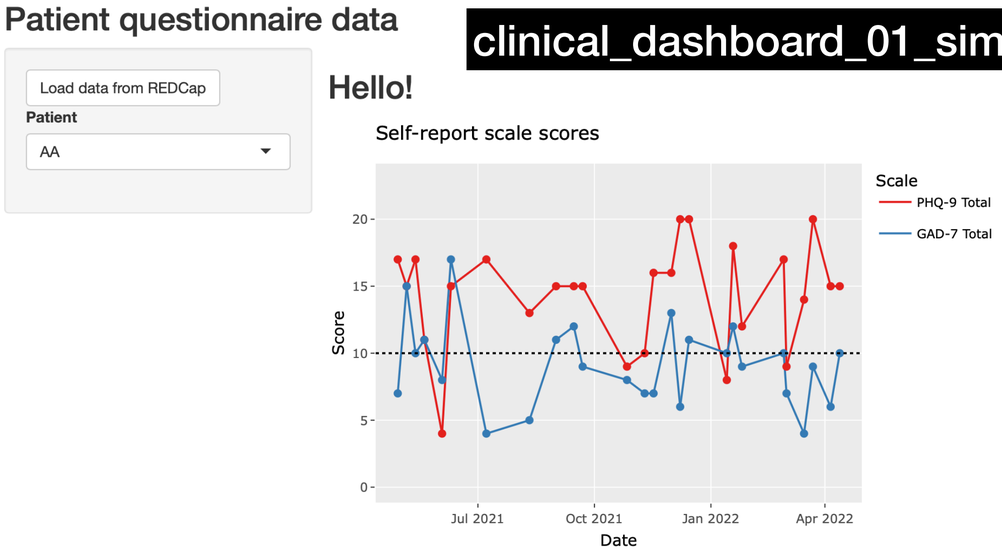

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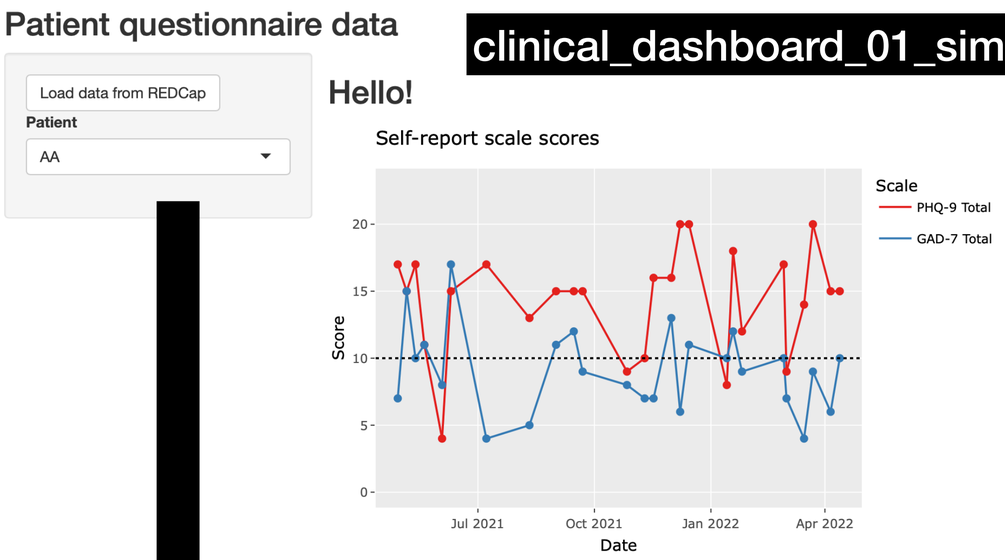
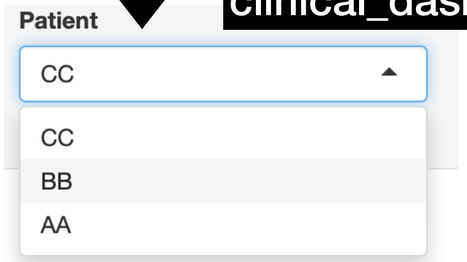


clinical_dashboard_01_simple

clinical_dashboard_02_dyninput



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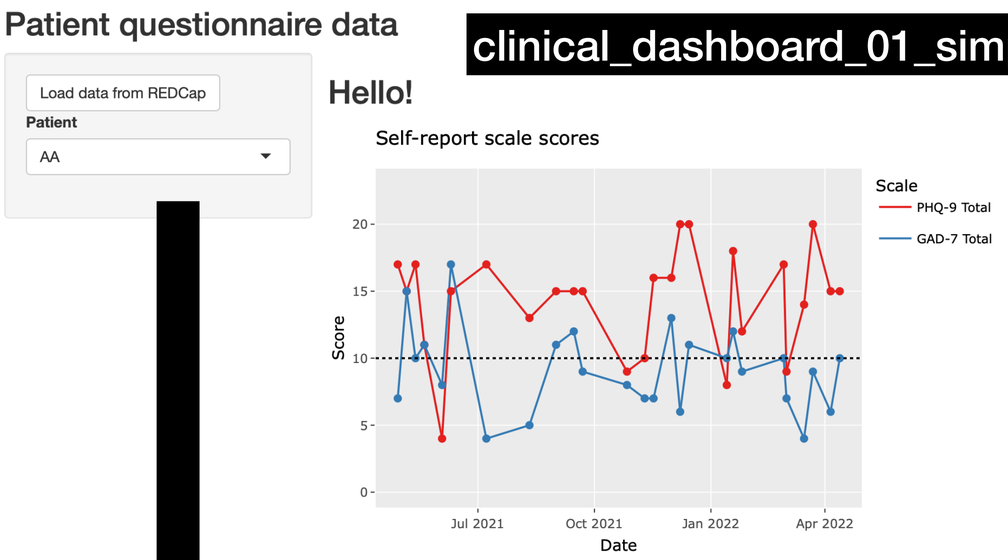
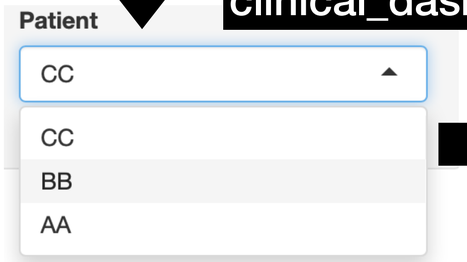
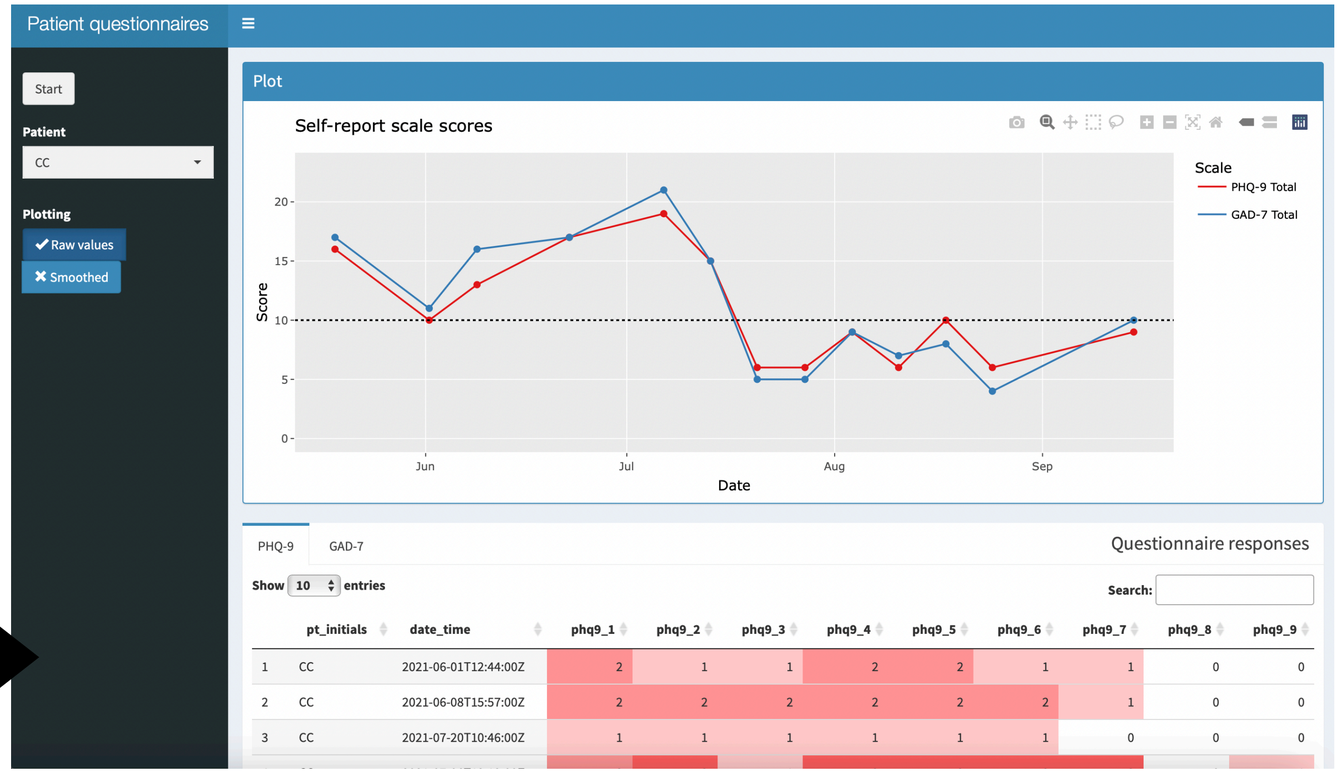


clinical_dashboard_02_dyninput



clinical_dashboard_03_fancy



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- **DO NOT SHARE YOUR REDCAP API KEYS** WITH OTHERS. DO NOT POST THEM ON GITHUB. BE CAREFUL!!!!!!!

Specific shiny + REDCap considerations

For advanced use cases and teams

- Deploying a shiny app for a team can be tricky.
  - I would advise **NOT** to host a shiny app that has an API key capable of accessing non-public data, especially PHI, on shinyapps.io.
  - Solution we've used with VUMC folks: Ubuntu VM hosted by VUIIS + Auth0 authentication + shinyauthr authentication.
  - Frankly, having each person run app locally with their own API keys might be most amenable in terms of security.

Specific shiny + REDCap considerations

For advanced use cases and teams

- If you have a very large dataset with lots of variables, downloading all the data upfront could make your app unfriendly or untenable. It may be advisable to program the app to run more **smaller queries** to speed up the process
    - E.g., download only list of subjects + timepoints; once subject is selected, download data ONLY FOR that subject

Summary & takeaways

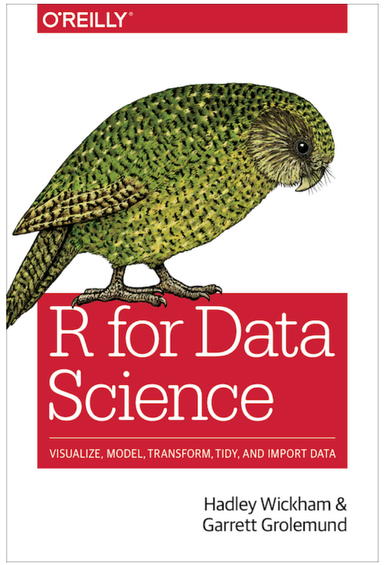
- Data dashboards can be useful for clinical and research practice, for cases where you need to monitor an ongoing process or data exploration
- REDCap Project Dashboards are a great option for monitoring research study progress and recruitment
- REDCap API interfaces in Rcan make it easy to leverage R-based pre-built dashboards
- You can build a dashboard using R shiny by expanding upon existing code and REDCap projects

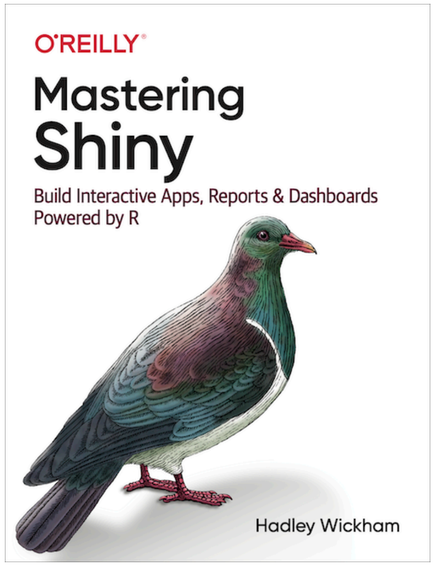
Reminder

- Github repository has tons of code for you to explore!!
  - https://github.com/fcmeyer/vu-brownbag2022-shinyredcap
  - See README file for instructions on how to set up a REDCap project with the sample clinical project + data

Additional resources

- RStudio Cheatsheets: https://www.rstudio.com/resources/cheatsheets/
- R Shiny Tutorials: https://shiny.rstudio.com/tutorial/
- RLadies (esp. for URM): https://rladies.org
- shinyWidgets
- shinydashboard





Questions? Thank you! :)