Using REDCap and R to Rapidly Produce Biomedical Publications

01 - Introduction

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May 30, 2023

The Plan

- What is REDCap (and why bother)?
- How to build a basic case report form
- What is rational to do in REDCap
  - Multiple instruments
  - Longitudinal assessments
  - Repeated instruments
- Show the Miami needle exchange database (IDEA)
- Using `rUM` to make a publication ready paper
- The manual export (and why it is suboptimal)
- Importing all forms from a project into R with tidyREDCap
- Using tidyREDCap summary functions to add to the paper
- What `REDCapTidieR` does
- What `REDCapDM` does
- Getting data into REDCap with `REDCapR`

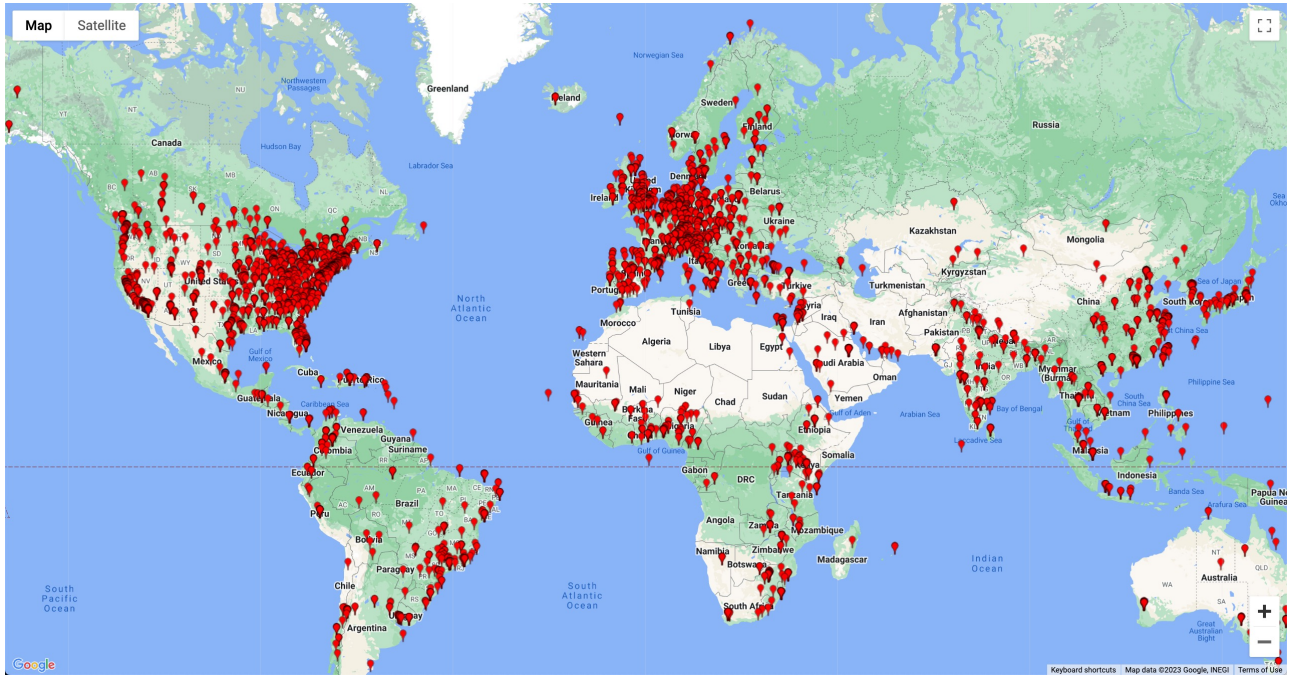
What is REDCap (and why bother)?

What's the big deal?

- Based at Vanderbilt University and supported by the National Institutes of Health
- Not open-source (the license specifies noncommercial research use only)
- Continuous development since 2004
- Supports researcher- and participant-facing data entry
- Supports online and offline data collection

By the Numbers

- Free to consortium members (slightly limited by international export controls)
- Wildly popular
  - 6,000+ institutions in more than 150 countries
  - Acknowledged in more than 23,000 articles



Technology and Legal

- Tech
  - Written in PHP
  - Database is MySQL or Maria DB
  - Authentication includes LDAP, Shibboleth, OpenID, Google OAuth2 and more
  - Solid API support
- Legal
  - REDCap is 21 CFR Part 11-ready
  - Built-in logging and audit trails
  - Designed to support *safe harbor* deidentification

How do I access it?

- Most academic medical centers have it.
- Check the partner list: https://projectredcap.org/partners/.
- We will use the demo instance at Vanderbilt: https://redcapdemo.vanderbilt.edu/.
  - Normally, you will use point-and-click tools.
  - Today, we will show you things and you will have read-only access to some data.

Workflows

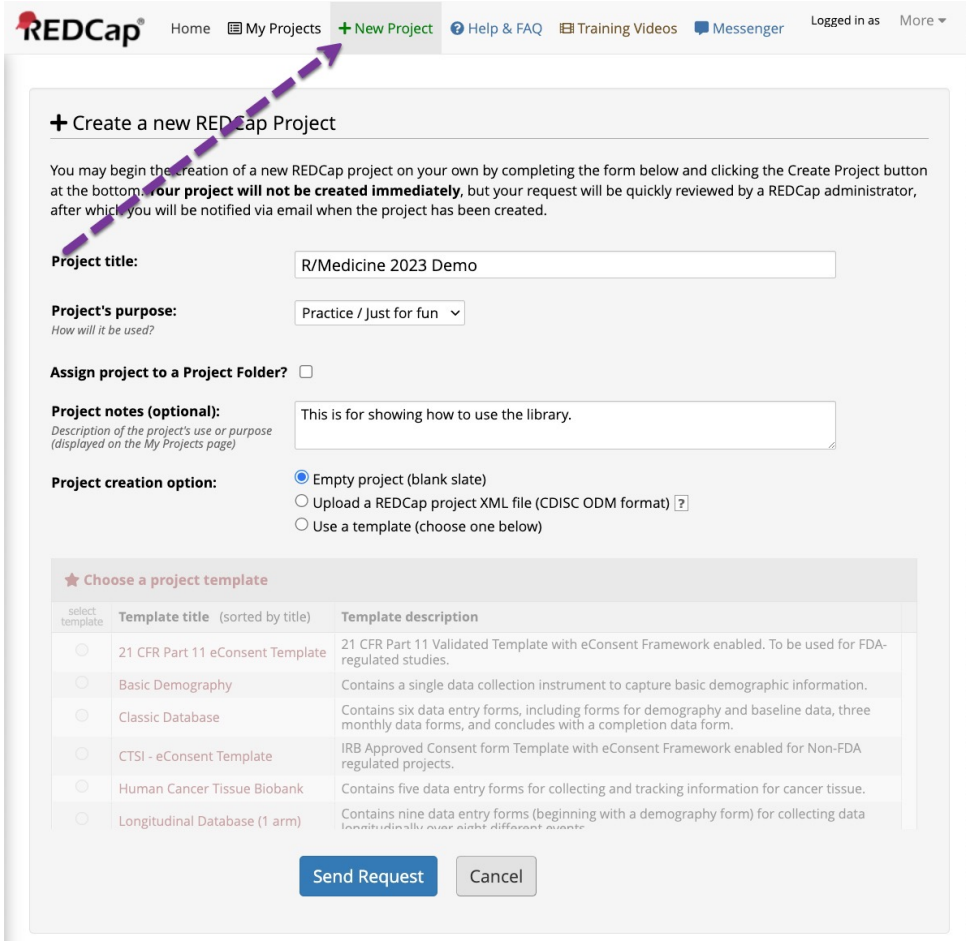
Steps

1. Create a project
2. Add/create a data entry form/instrument
3. Collect/enter data
4. View/summarize in REDCap
5. Export for additional magic

But wait... there's more!

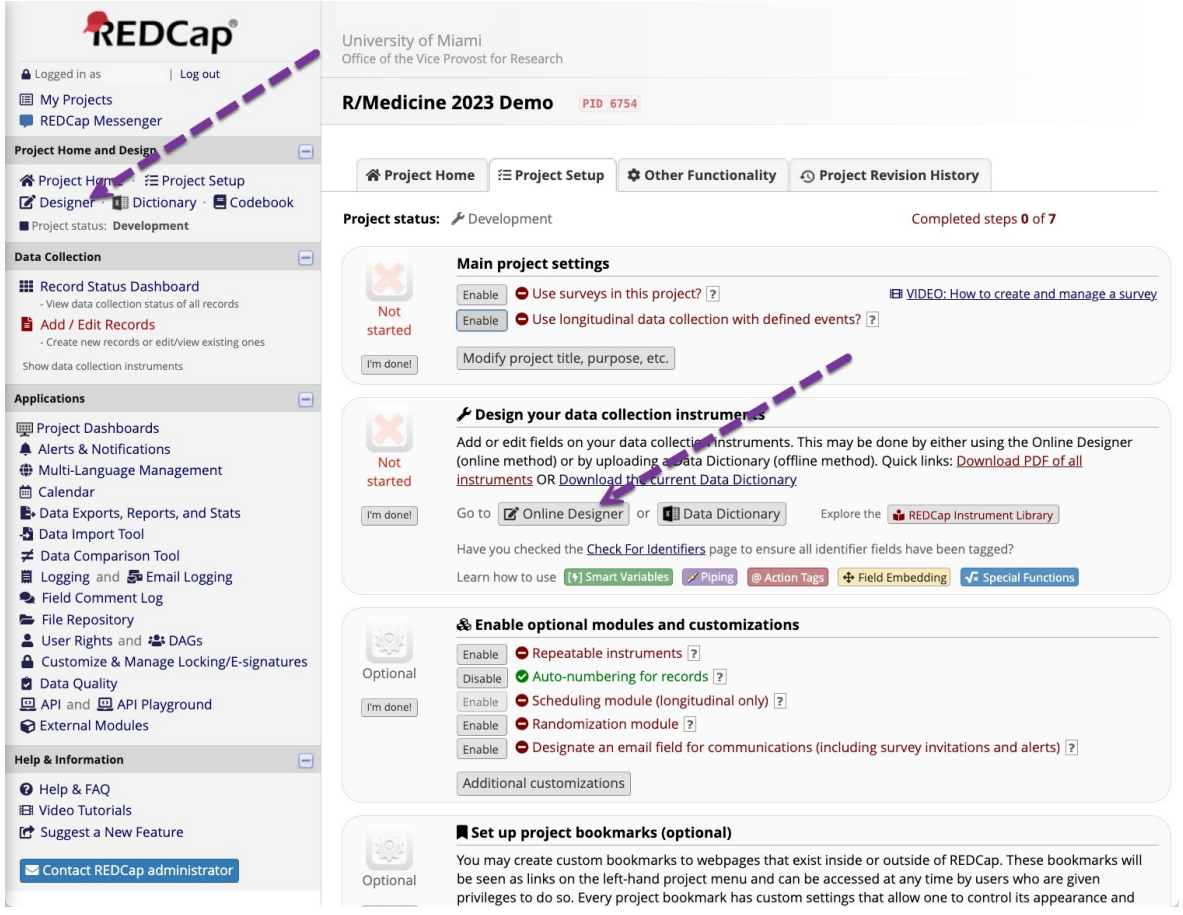
- Multi-site support with Data Access Groups
- Built-in, multi-language support
- Randomization
- Longitudinal projects with study calendars and scheduling
- Repeated instruments for assessing unplanned repeats
  - Describe each "stop by" clinic visit
  - Describe each adverse event
- Public or private dashboards
- Send emails/text
- Extensible via *External Modules*

Create A Project 1



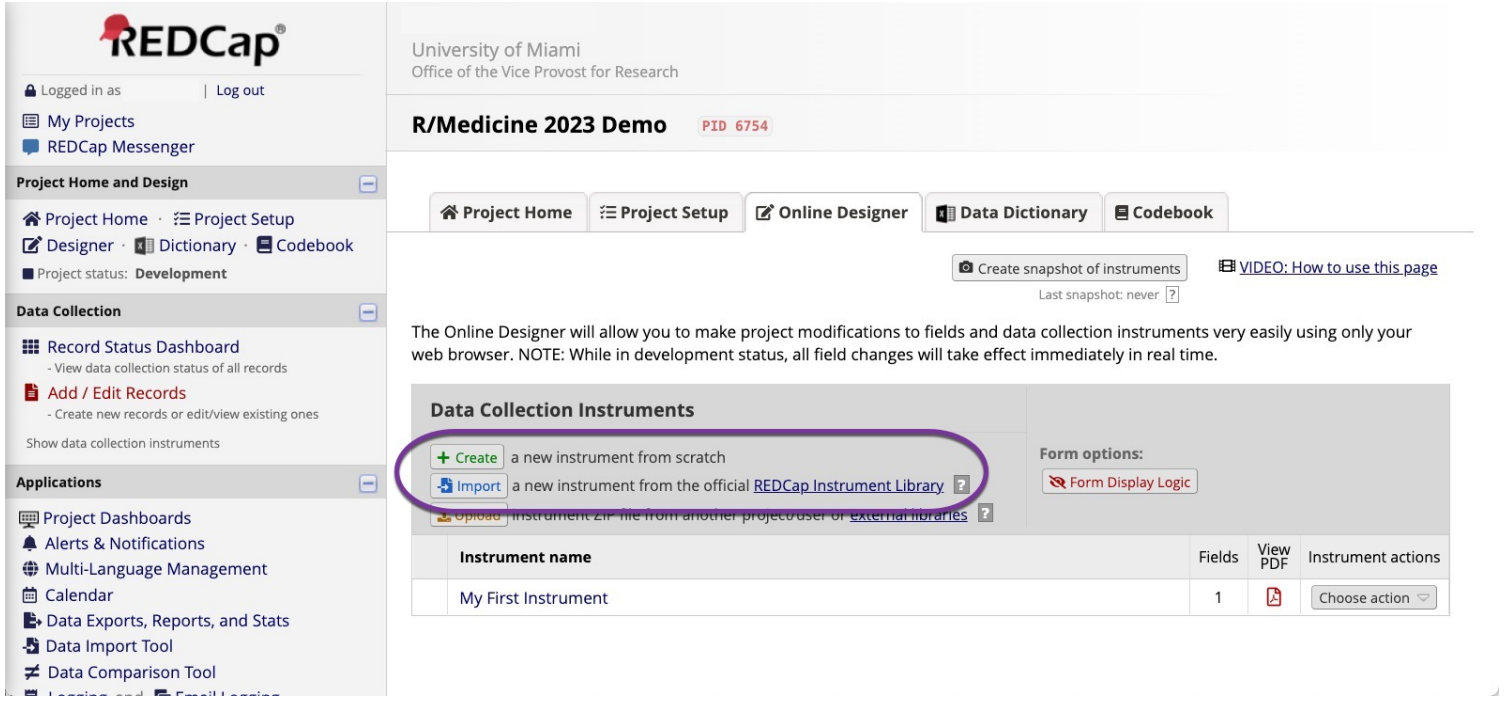
Create A Project 2

- Use the **Designer** to add your content.



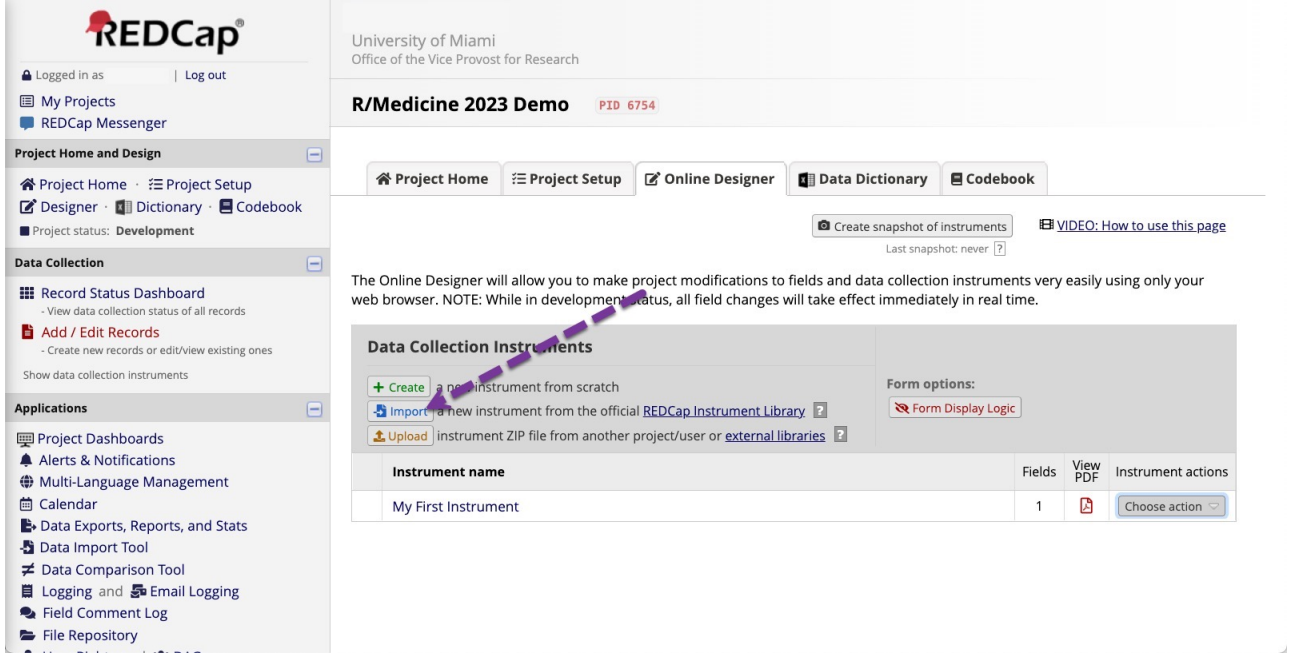
Add/create a data entry instrument/form.

- Add an instrument from the REDCap Shared Instrument library (at Vanderbilt).
- Make your own data entry form.
- Do both.

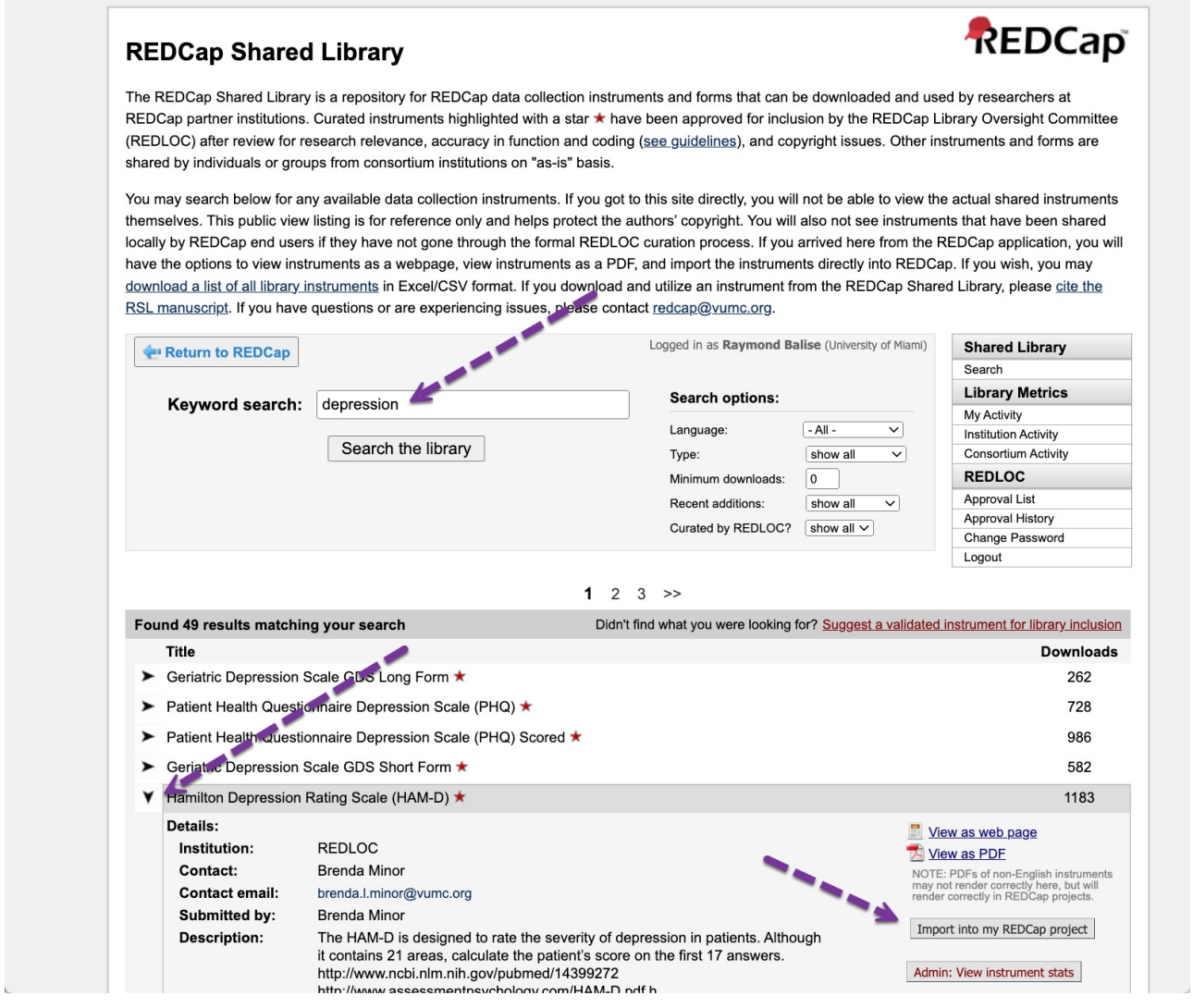


REDCap Shared Instrument Library 1

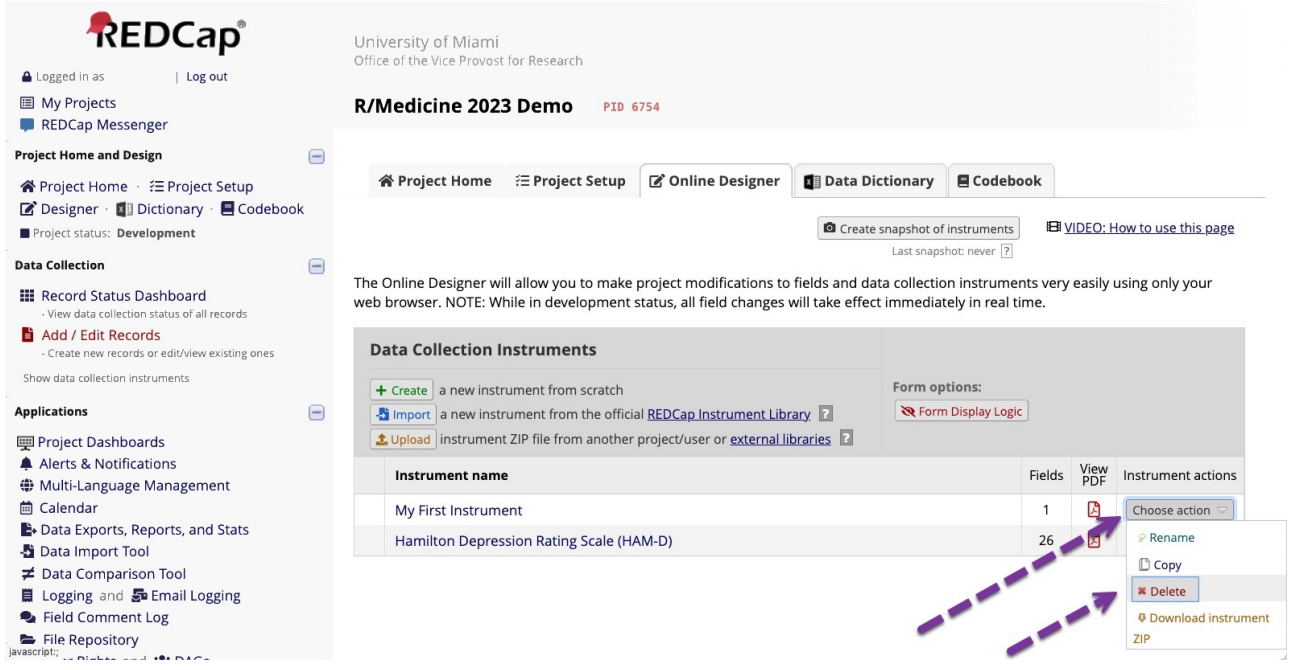
- You can point and click to add one of the thousands of instruments in the REDCap library.



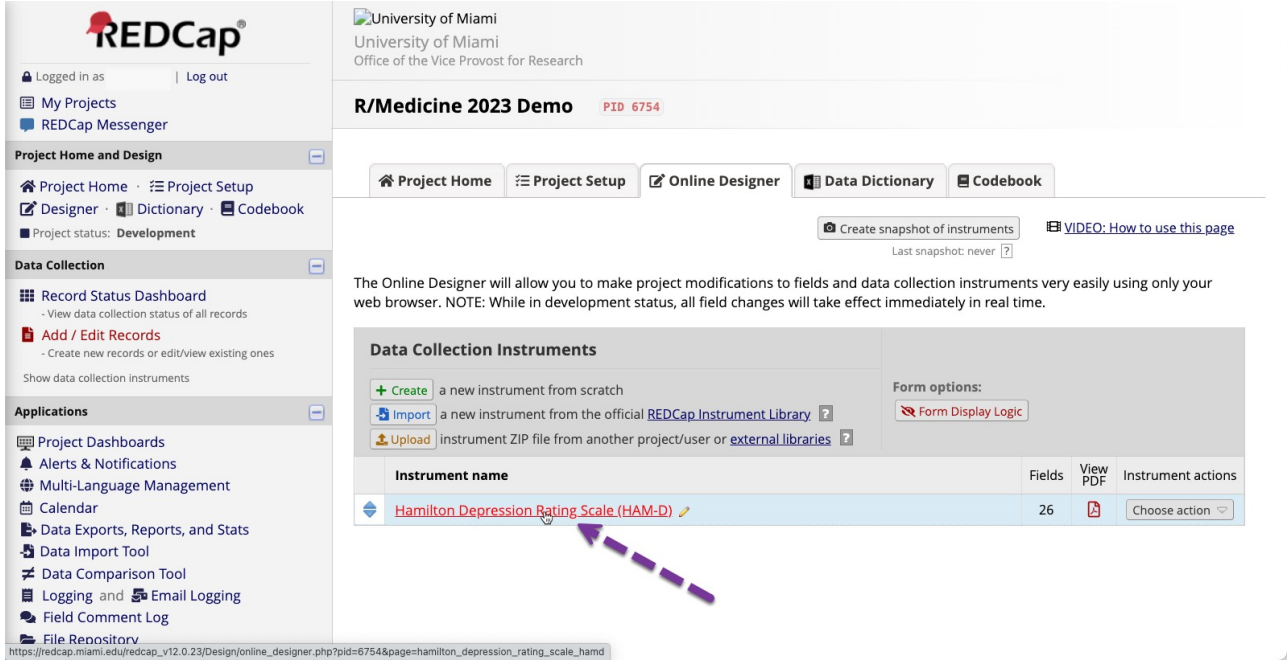
REDCap Shared Instrument Library 2



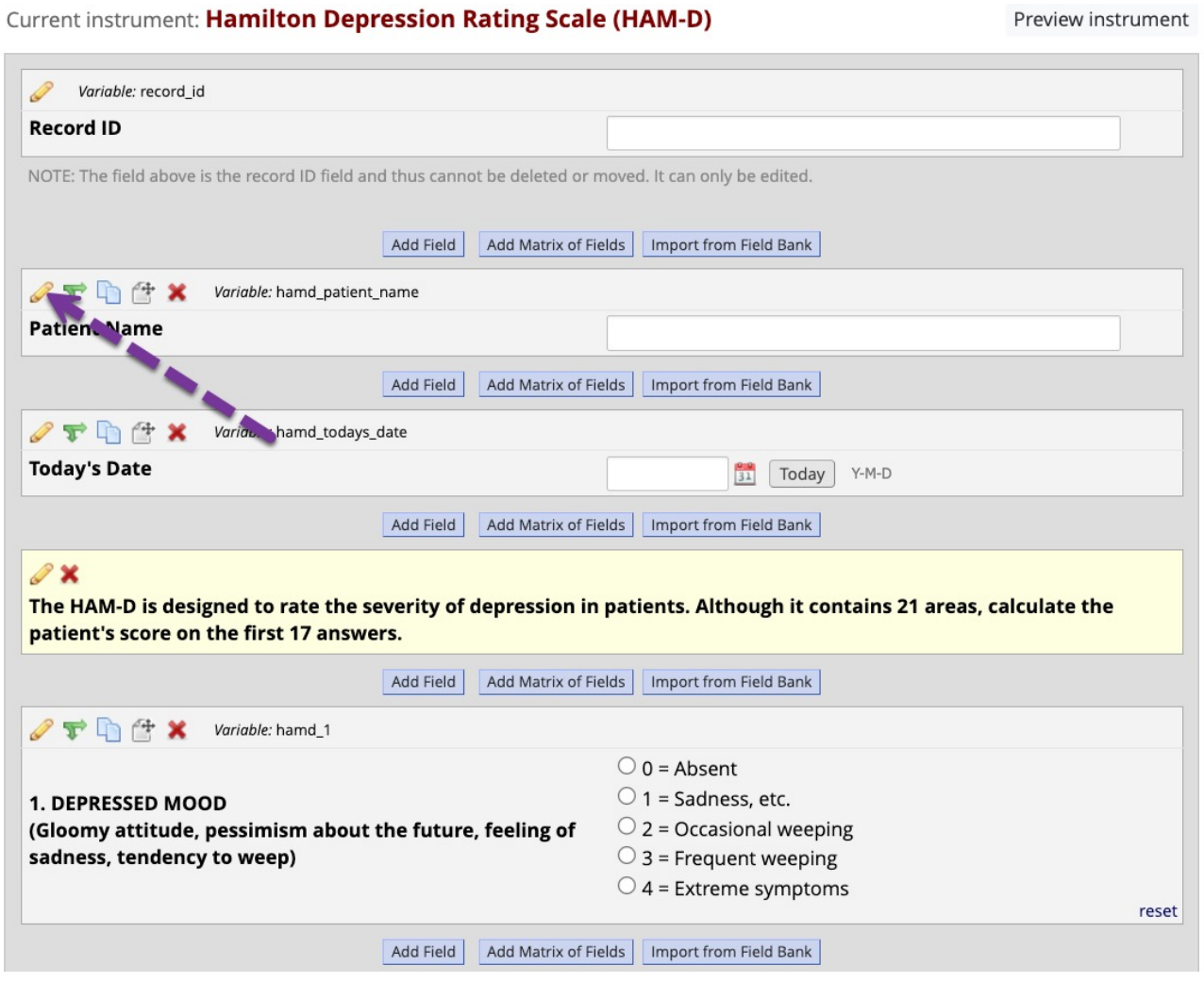
REDCap Shared Instrument Library 3



REDCap Shared Instrument Library 4

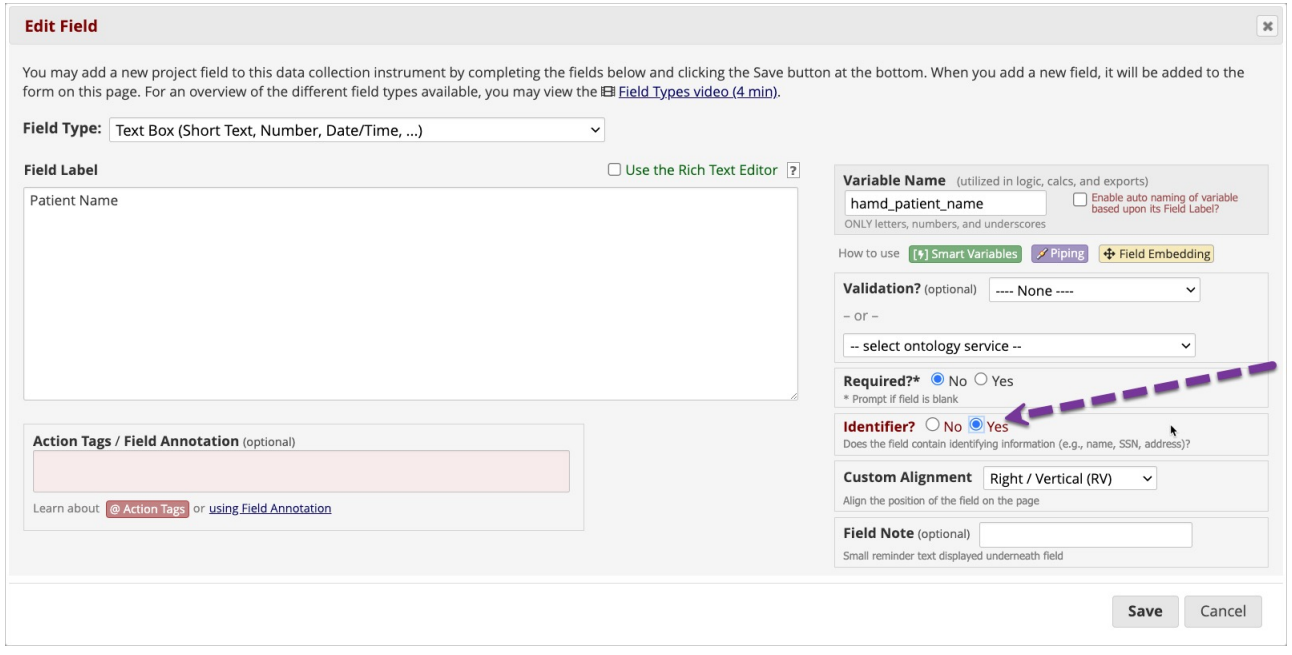


REDCap Shared Instrument Library 5

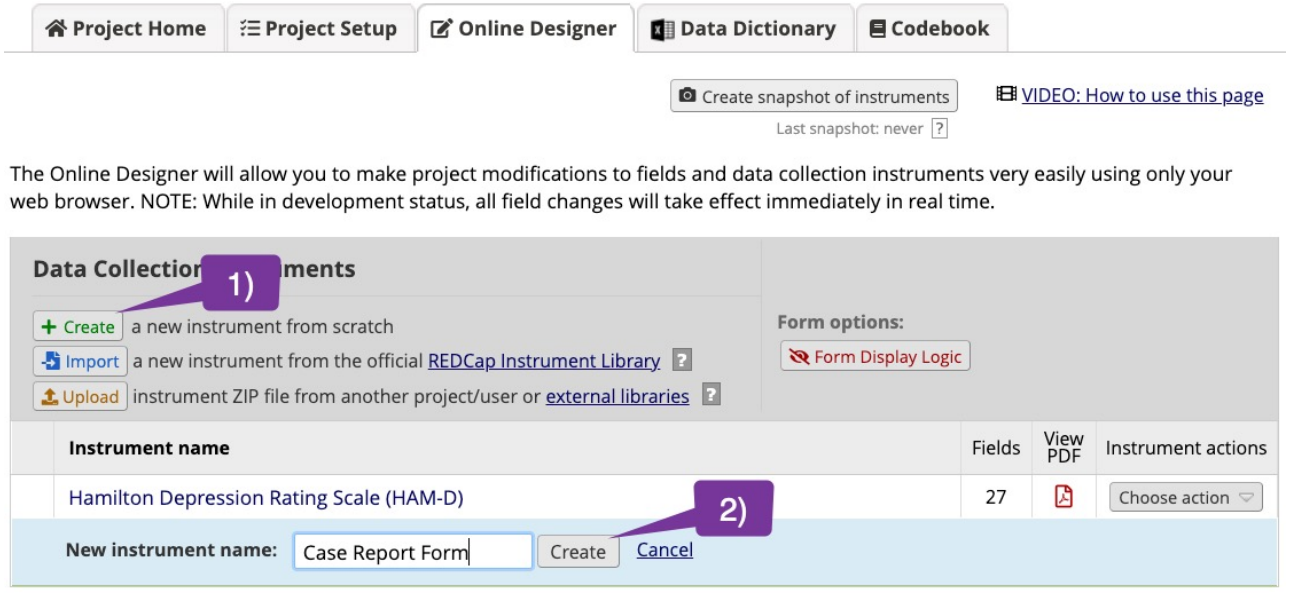


REDCap Shared Instrument Library 6

The license for the instruments bans meaningful changes but you can change the appearance and set details:

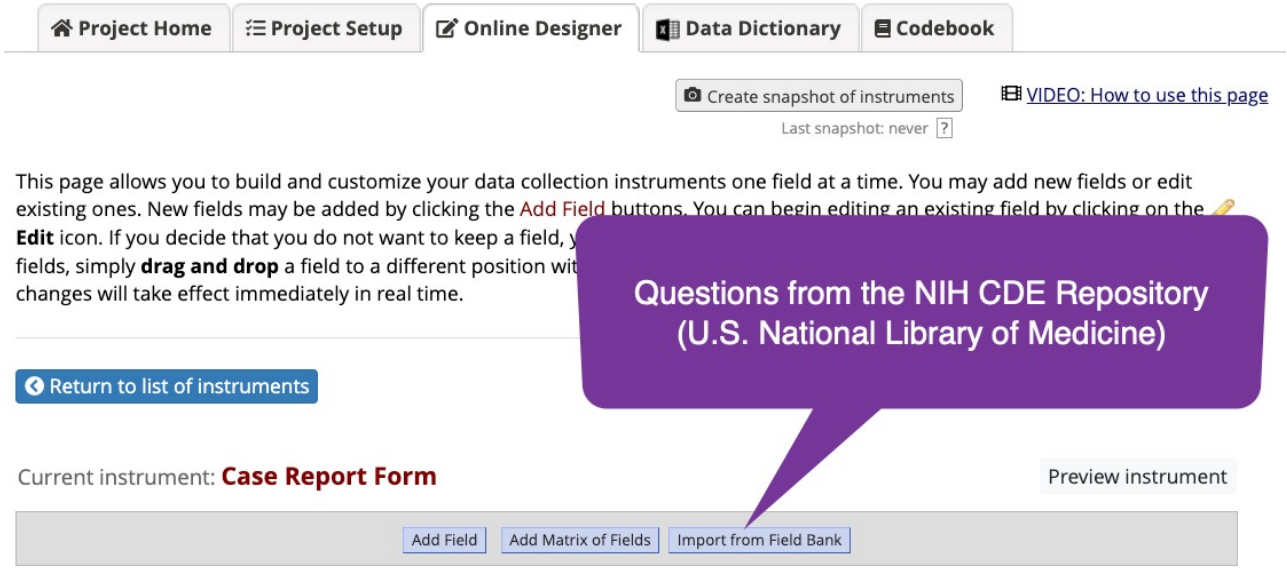


Create a Form - Question/Field Bank 1



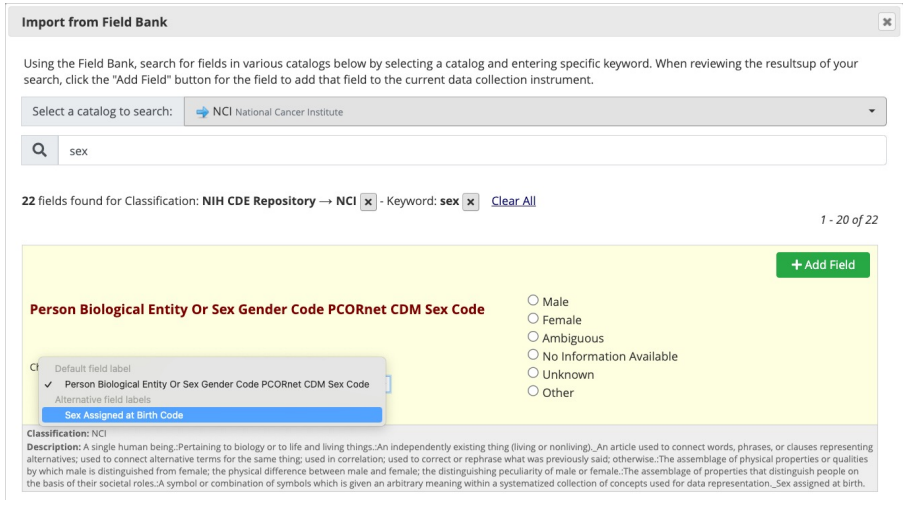
Create a Form - Question/Field Bank 2

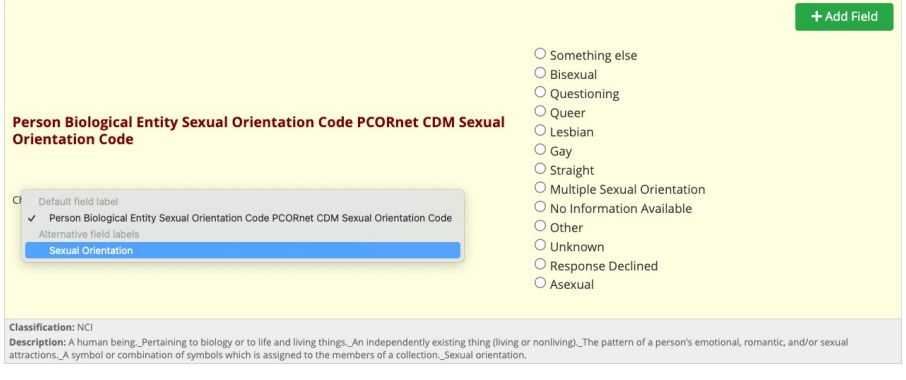
- The NIH Common Data Element Repository allows you to code questions consistently.



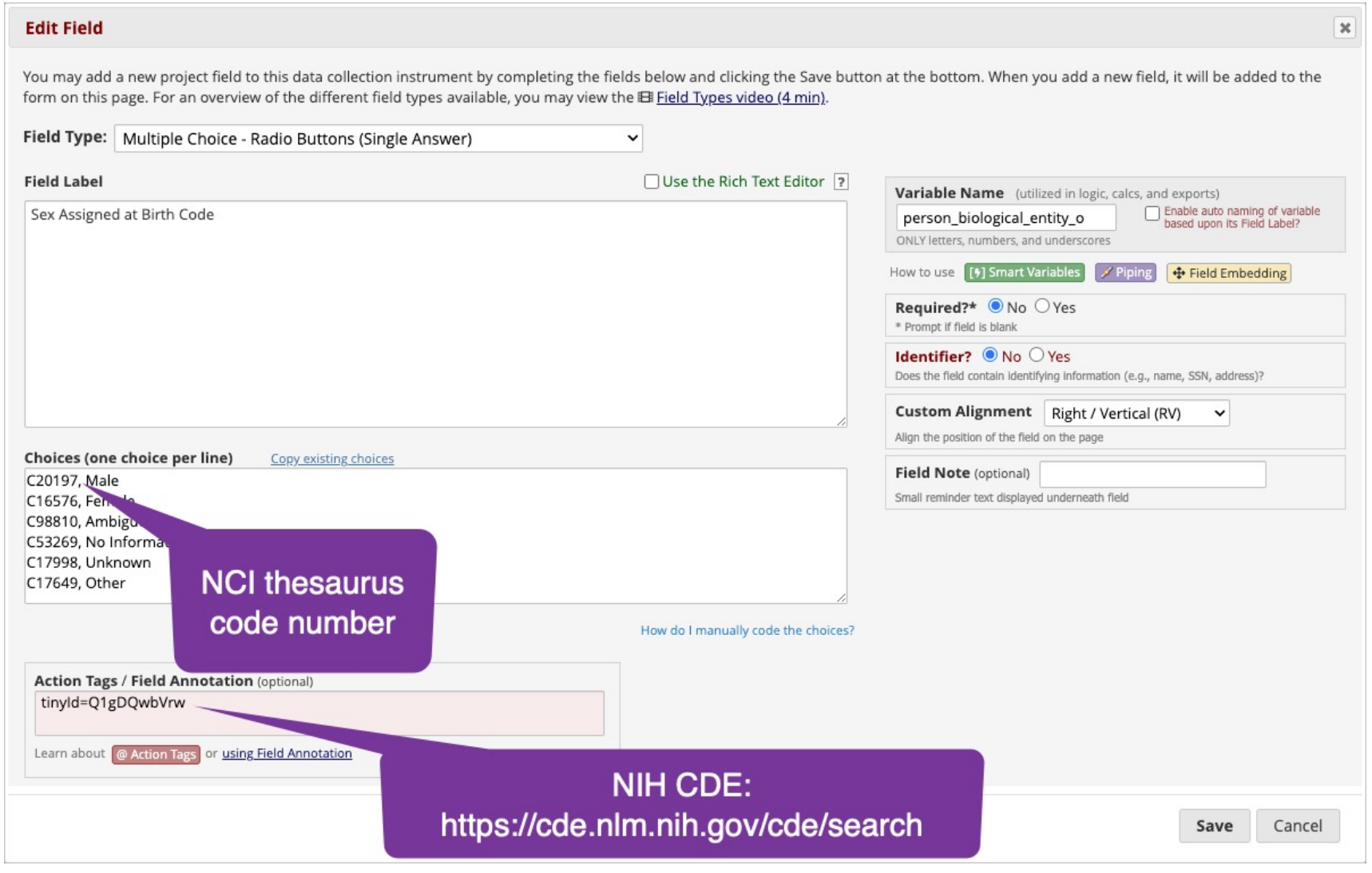
Create a Form - Question/Field Bank 3

Inside the NIH CDE Repository, the NCI variables are rich:

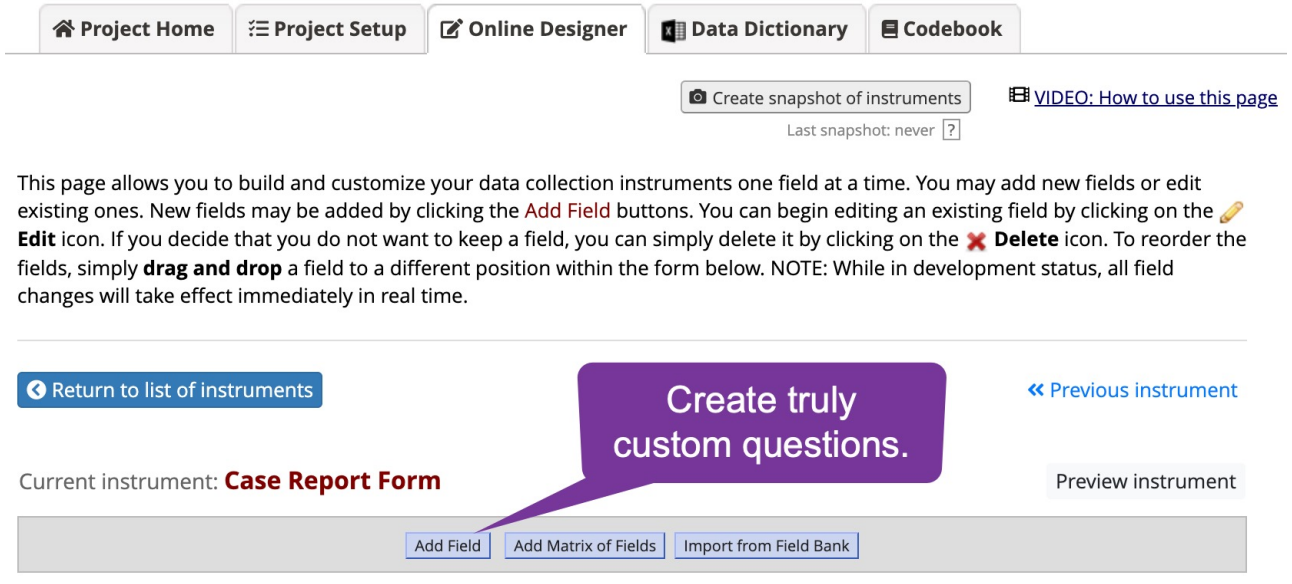




Create a Form - Question/Field Bank 4

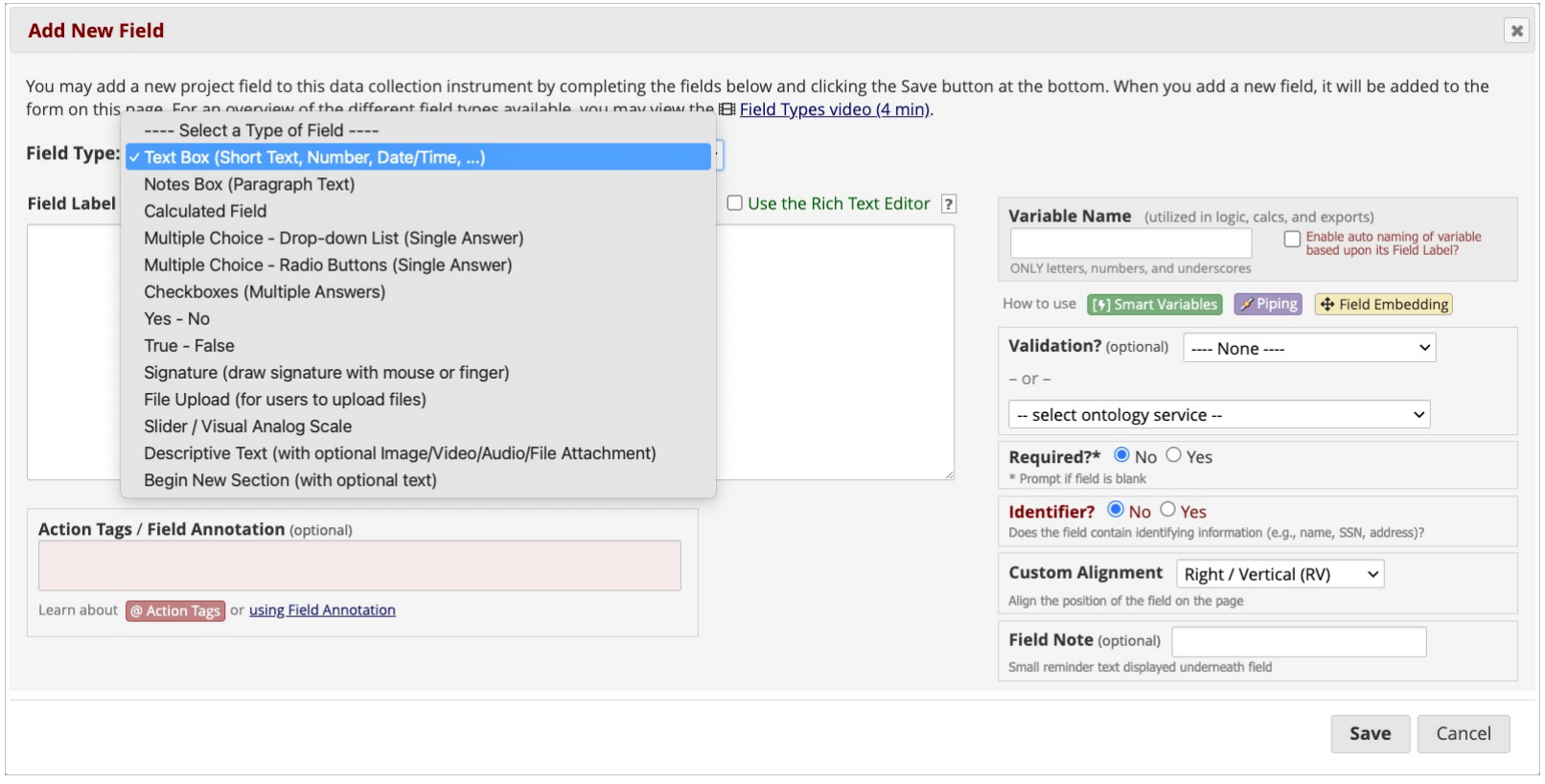


Create a Form - Custom Questions 1



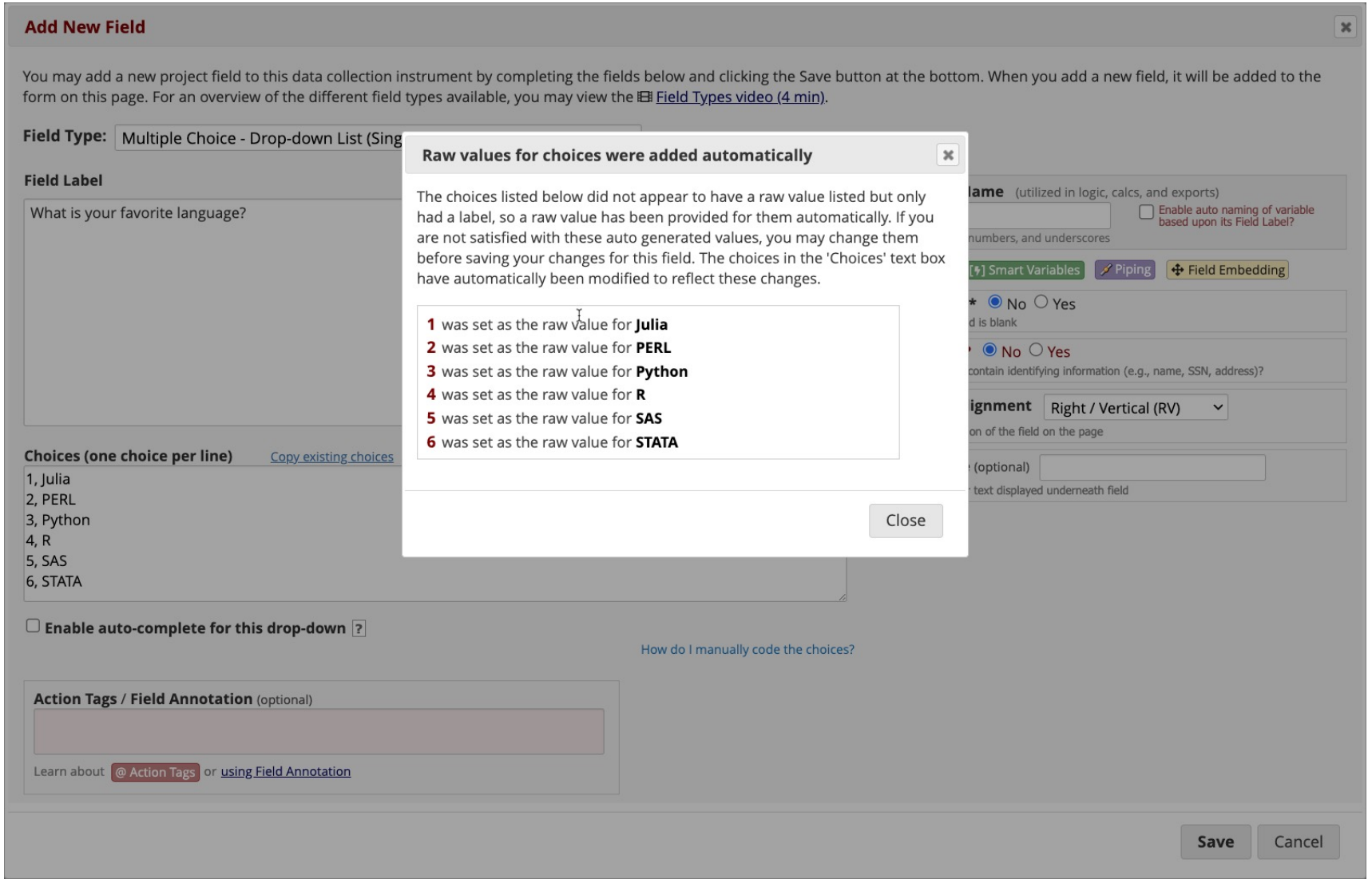
Create a Form - Custom Questions 2

You can make truly custom forms by adding your own field:

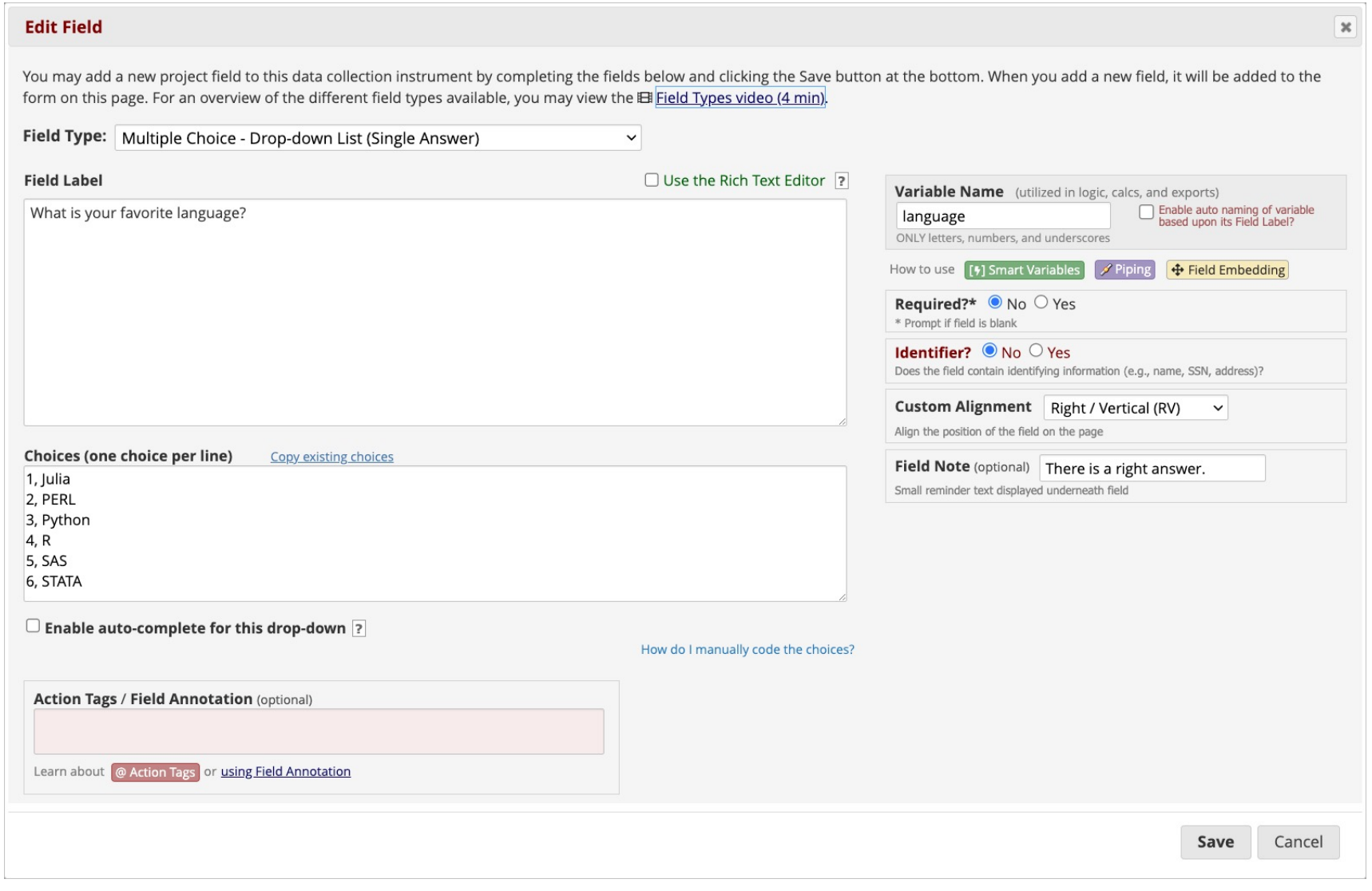


NOTICE: Text can/should have validation.

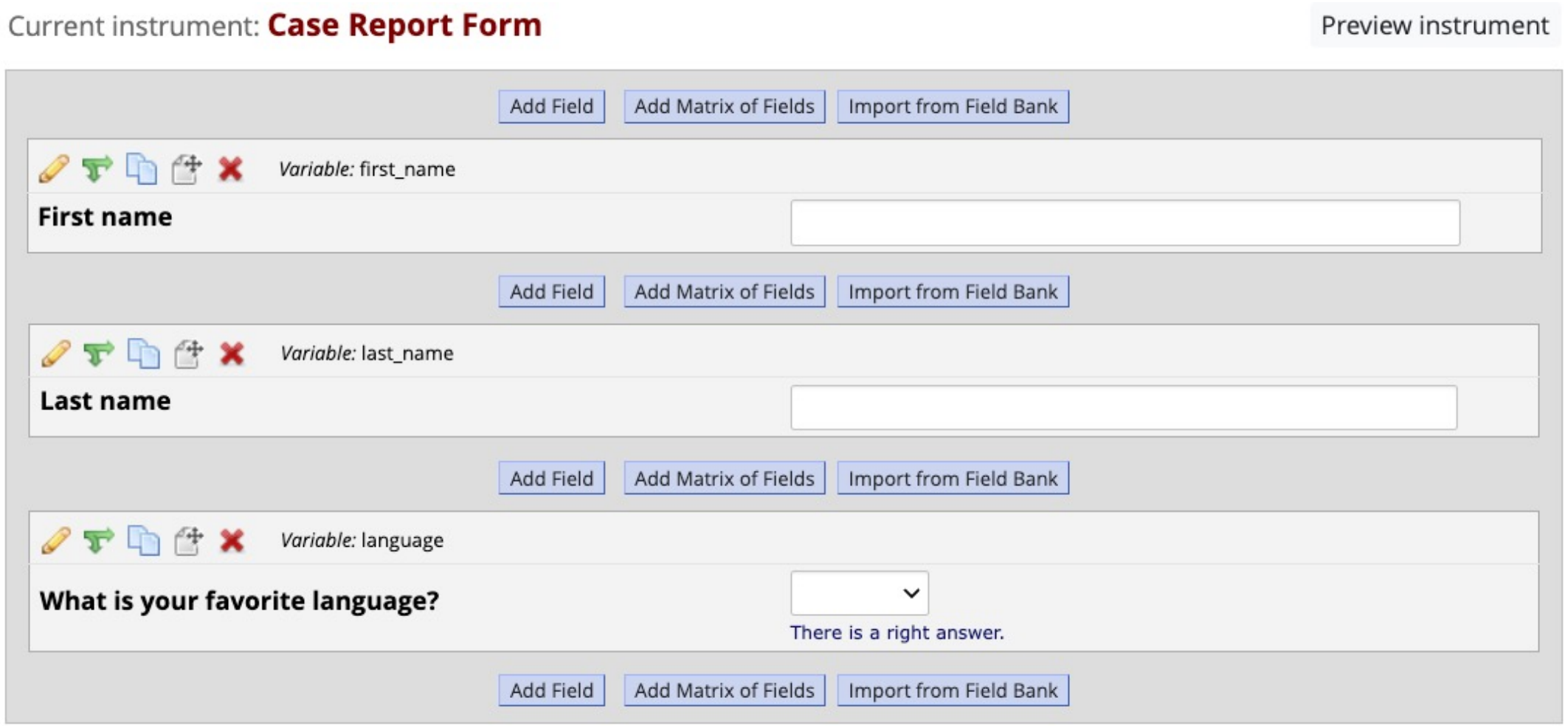
Create a Form - Custom Questions 3



Create a Form - Custom Questions 4

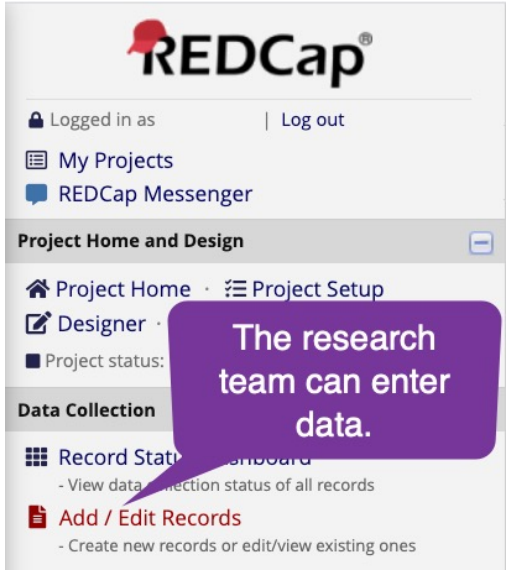


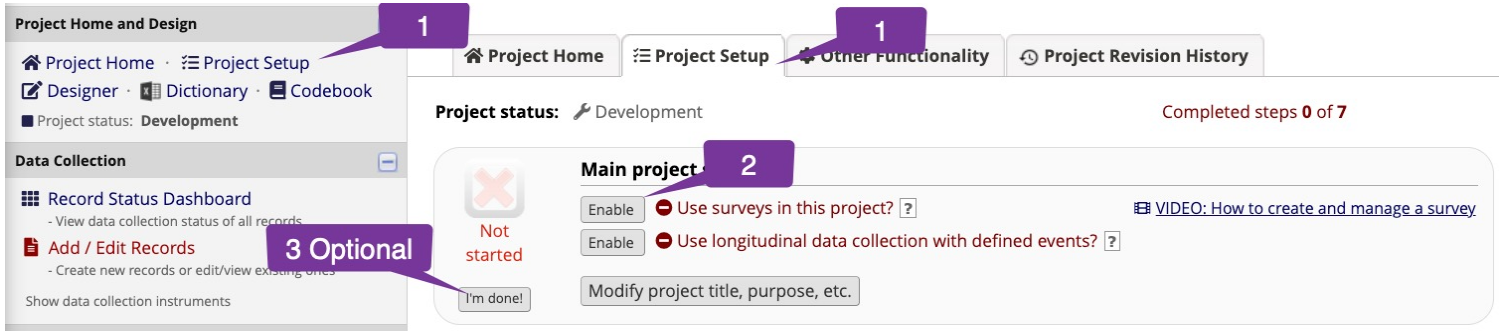
Create a Form - Custom Questions 5



Collect/Enter Data 1

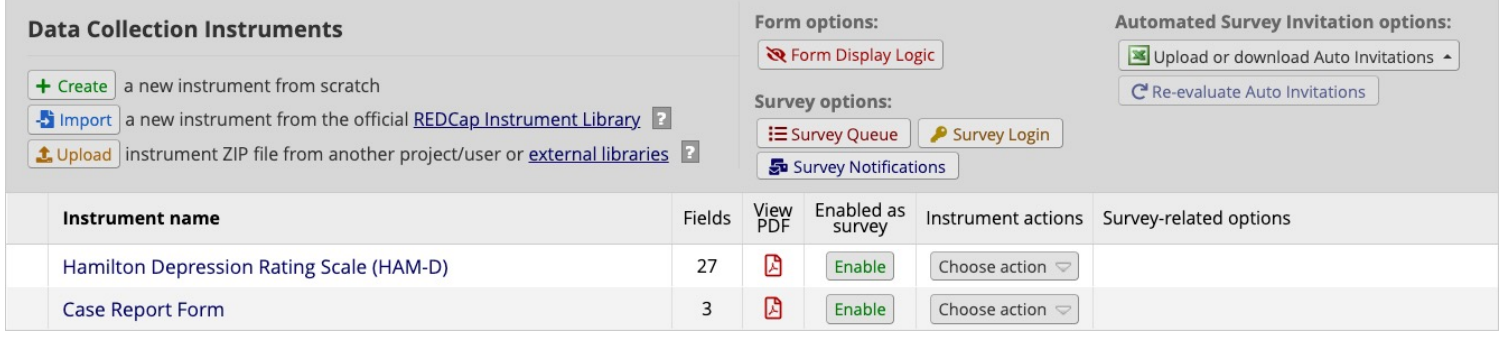
- After you have created your forms, the research team can enter data or you can turn the form into a survey.
- To use surveys, you need to enable them for a project, then tag an individual form as a survey.

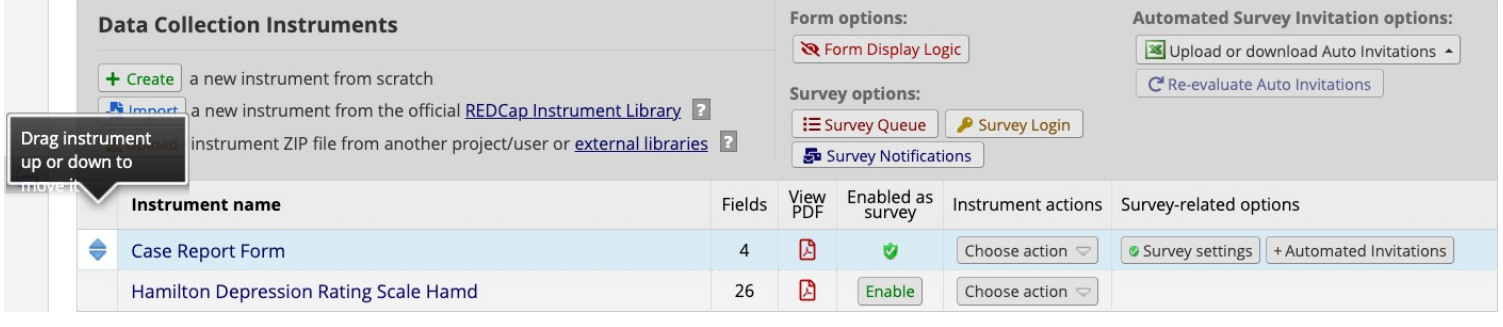




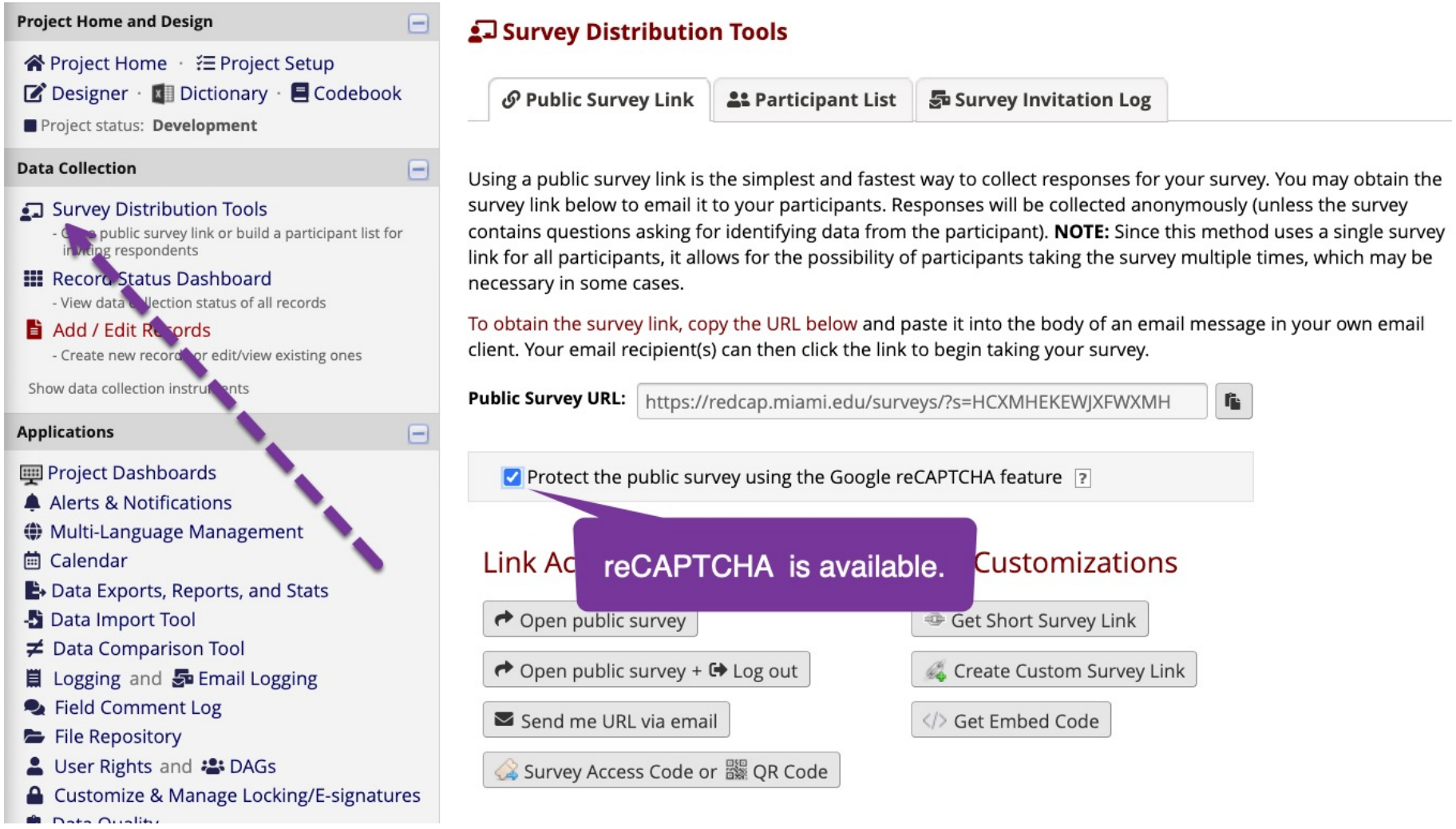
Collect/Enter Data 2

- The survey needs to be the first questionnaire/instrument.





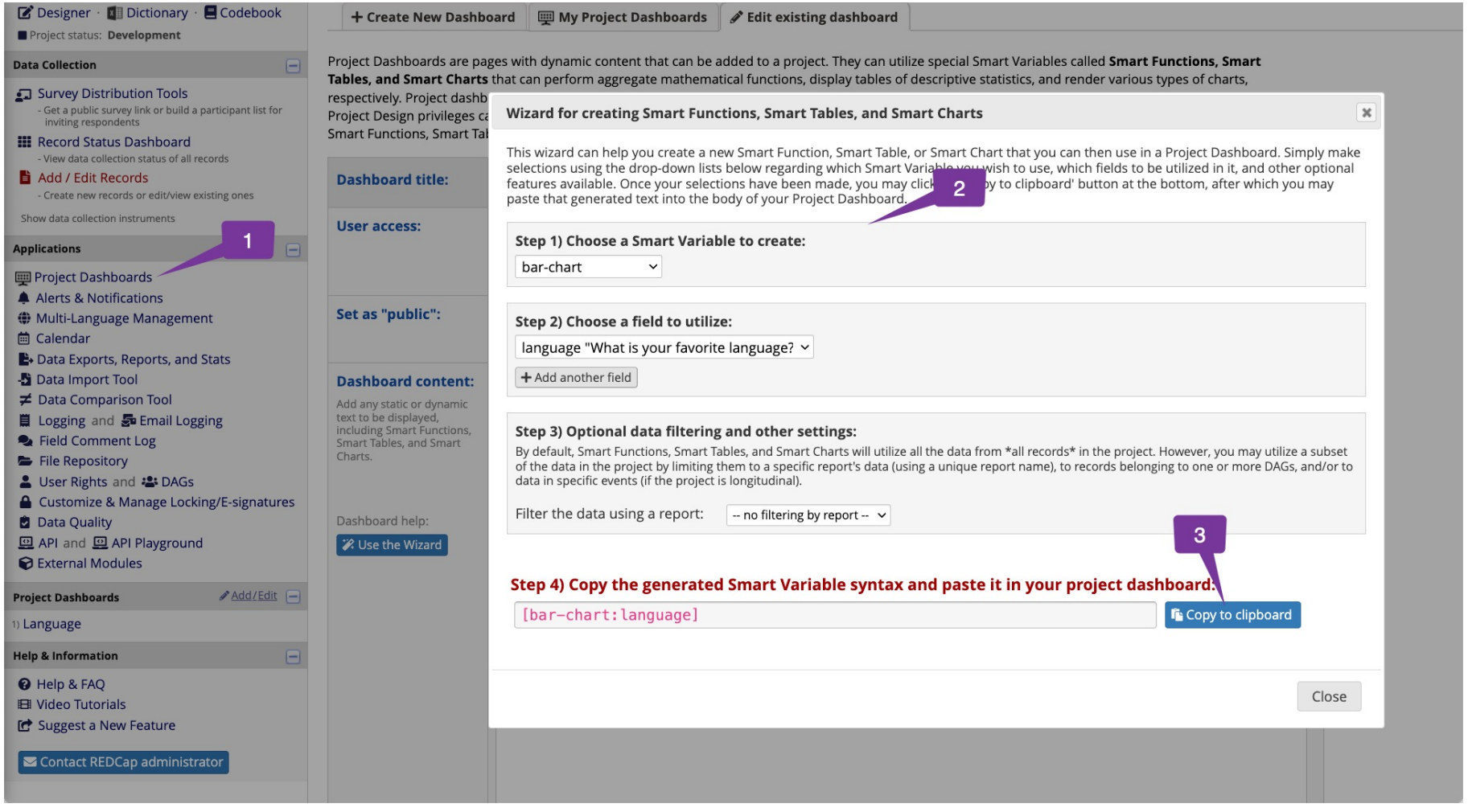
Collect/Enter Data 3



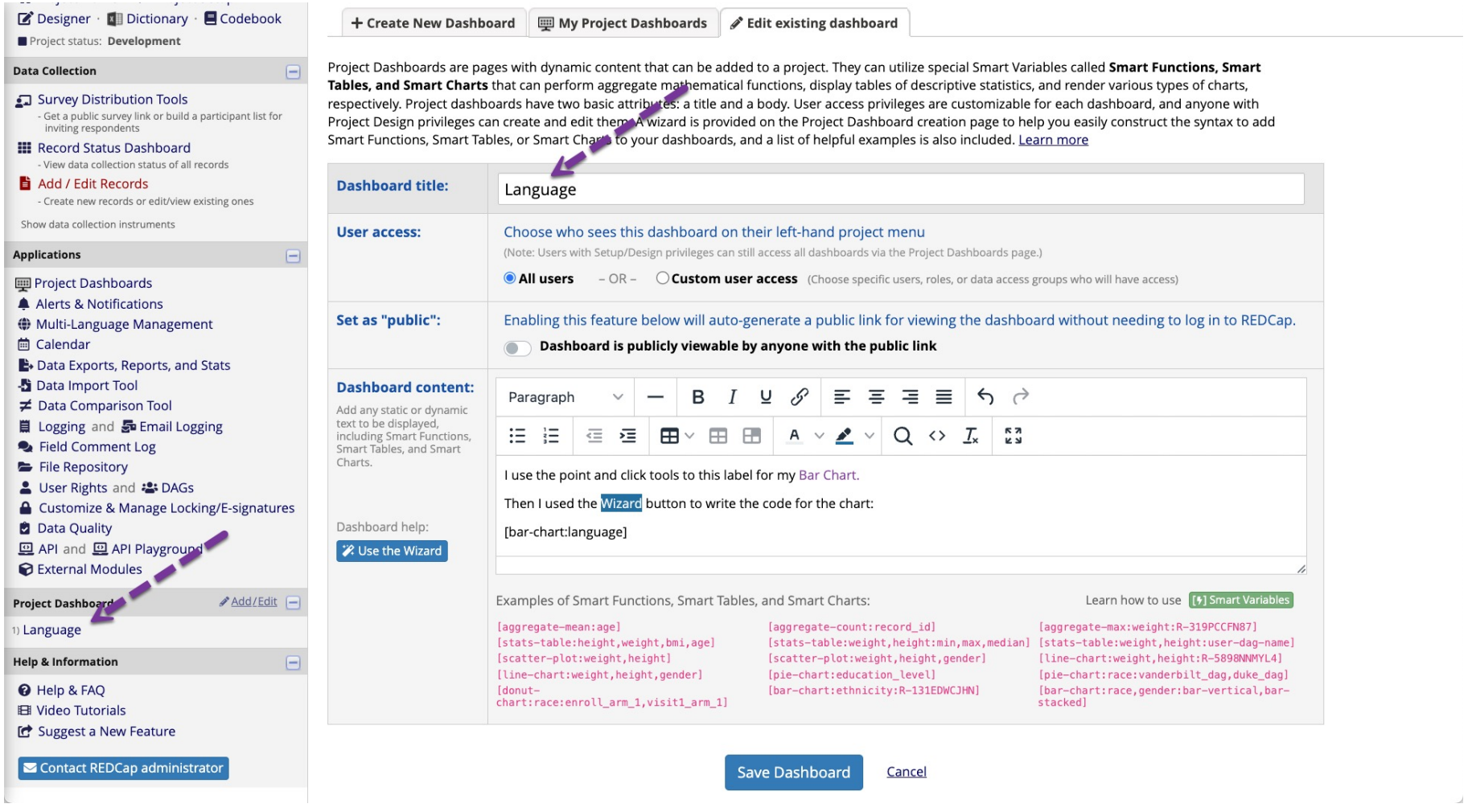
View/Summarize in REDCap

- You can easily make public/private:
  - dashboards with summary statistics and basic graphics
  - quick **Stats & Charts** reports
  - tabular reports

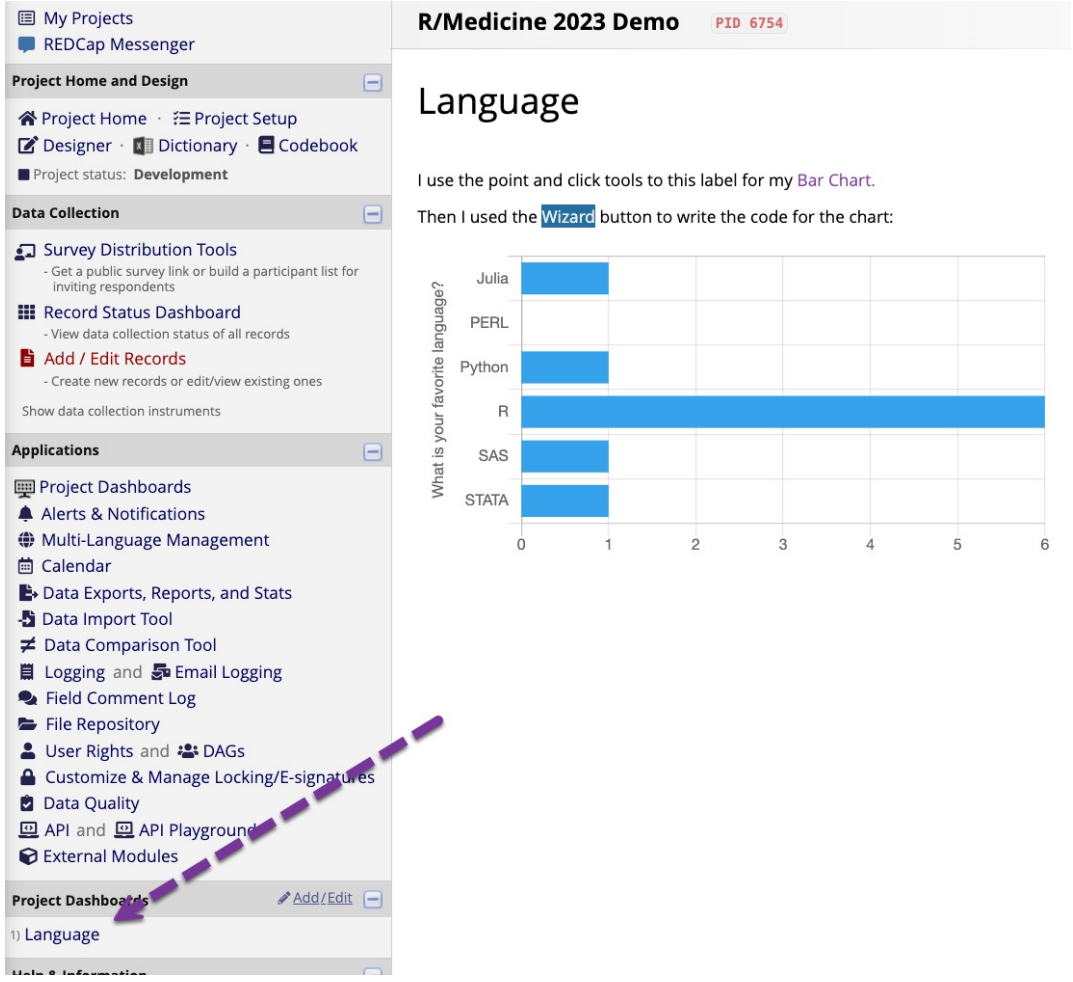
Dashboards 1



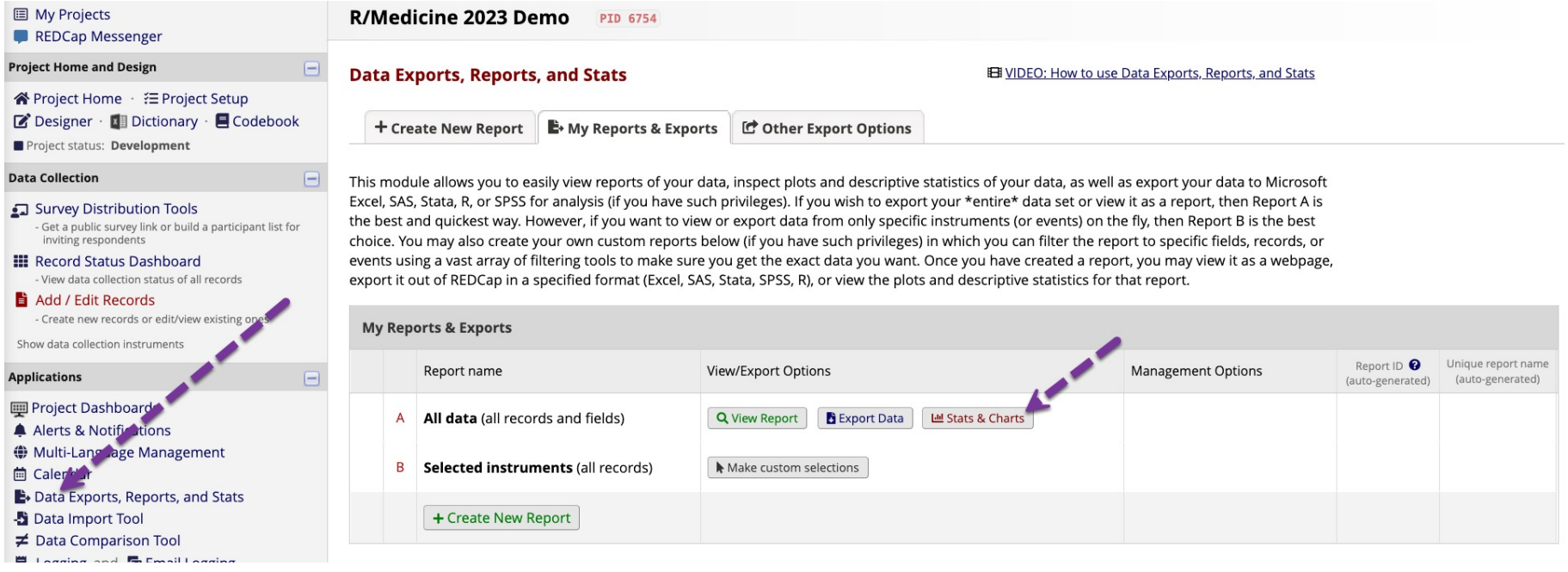
Dashboards 2



Dashboards 3



Stats & Charts 1



All data (all records and fields)

DISPLAY OPTIONS	
Select a data collection instrument to view	Case Report Form
Optional: Select a record to overlay onto the plots below	-- select record --
Viewing options:	Show plots & stats | Show plots only | Show stats only

First name *(first_name)*

Total Count (N)	Missing*
10	0 (0.0%)

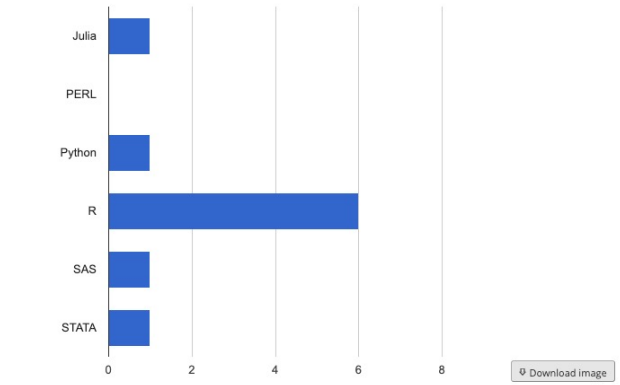
Last name *(last_name)*

Total Count (N)	Missing*
9	1 (10.0%)

What is your favorite language? *(language)* Refresh Plot | View as Bar Chart

Total Count (N)	Missing*	Unique
10	0 (0.0%)	5

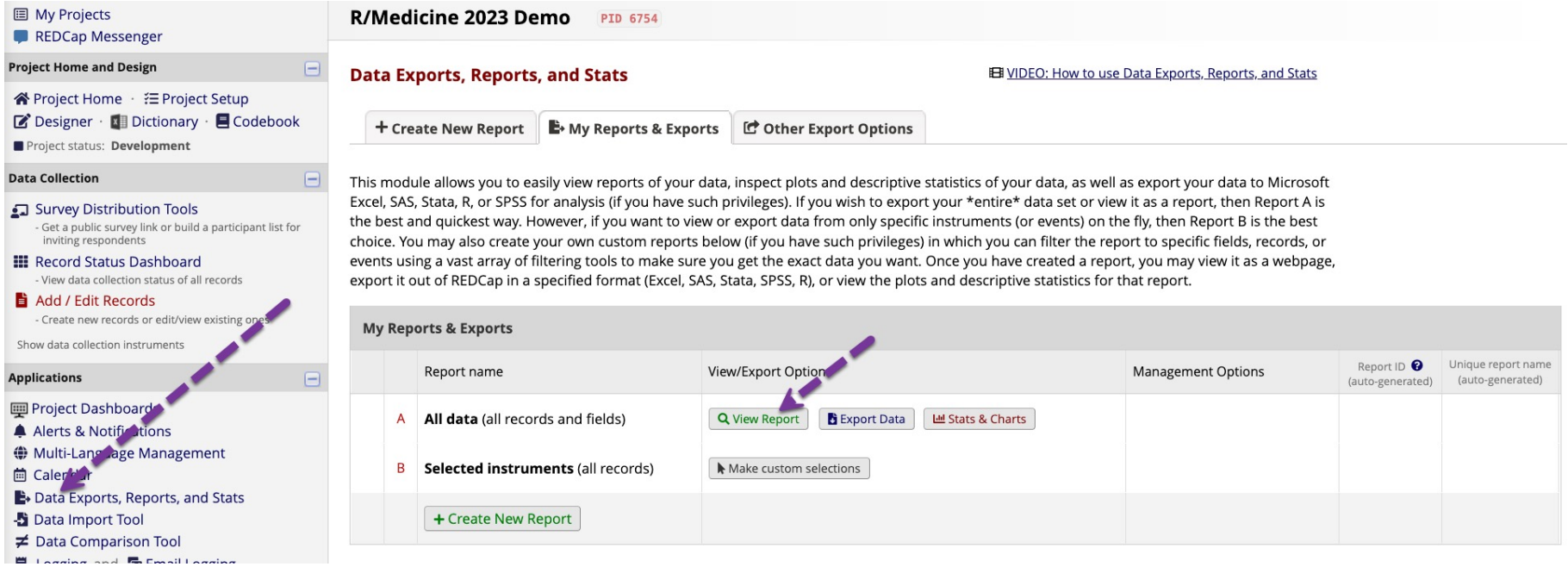
Counts/frequency: Julia (1, 10.0%), PERL (0, 0.0%), Python (1, 10.0%), R (6, 60.0%), SAS (1, 10.0%), STATA (1, 10.0%)



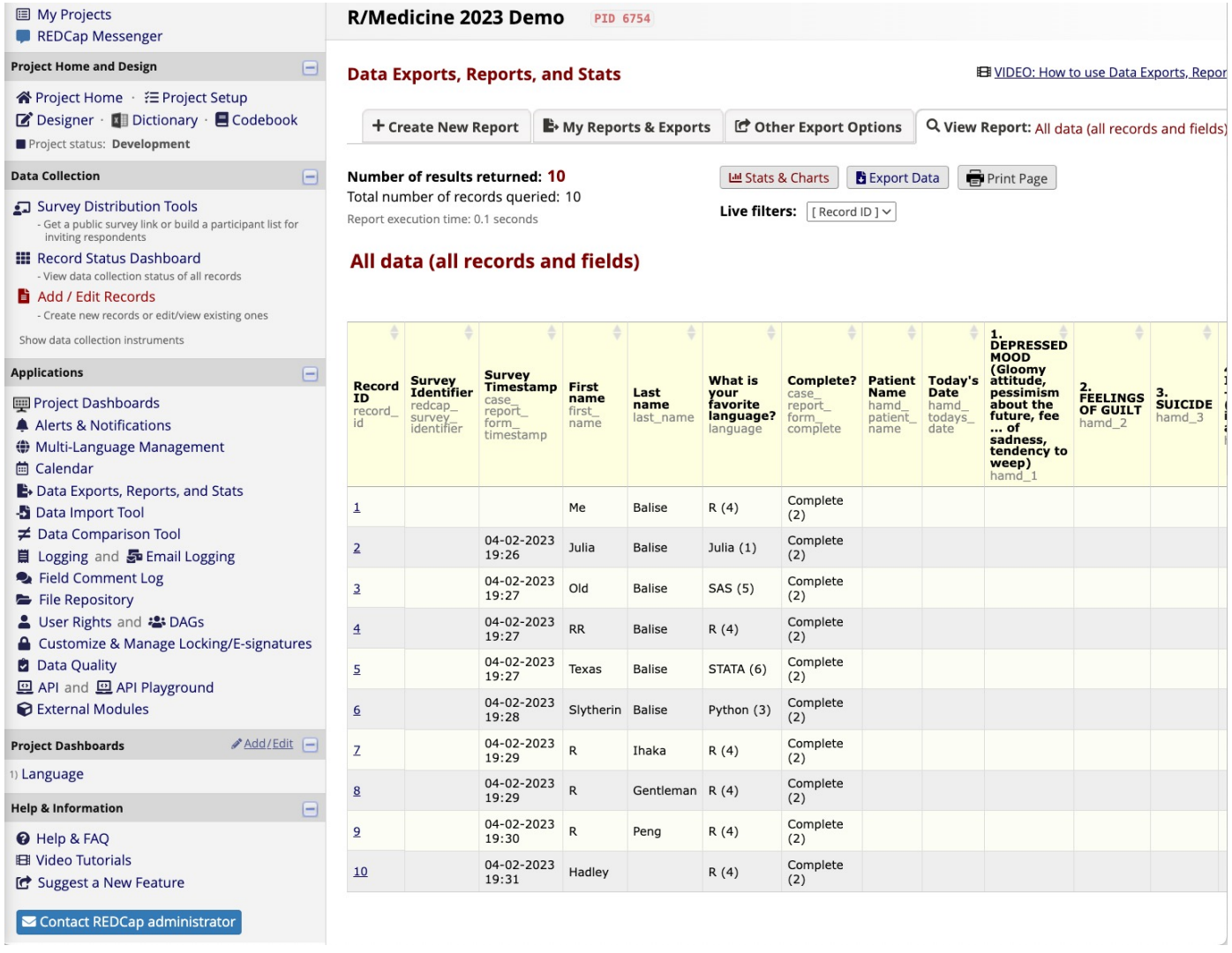
Complete? *(case_report_form_complete)* Refresh Plot | View as Bar Chart

Total Count (N)	Missing*	Unique

Tabular Reports 1



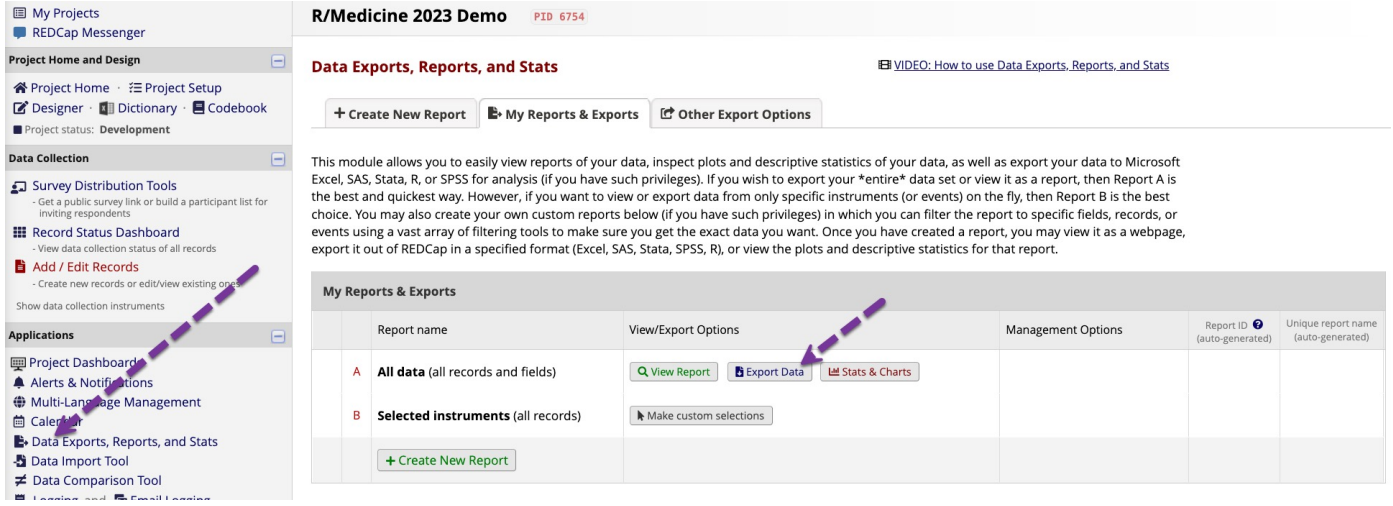
Tabular Reports 2



Record ID record_id	Survey Identifier redcap_survey_identifier	Survey Timestamp case_report_form_timestamp	First name first_name	Last name last_name	What is your favorite language? language	Complete? case_report_form_complete	Patient Name hamd_patient_name	Today's Date hamd_todays_date	1. DEPRESSED MOOD (Gloomy attitude, pessimism about the future, fee ... of sadness, tendency to weep) hamd_1	2. FEELINGS OF GUILT hamd_2	3. SUICIDE hamd_3
1			Me	Balise	R (4)	Complete (2)					
2		04-02-2023 19:26	Julia	Balise	Julia (1)	Complete (2)					
3		04-02-2023 19:27	Old	Balise	SAS (5)	Complete (2)					
4		04-02-2023 19:27	RR	Balise	R (4)	Complete (2)					
5		04-02-2023 19:27	Texas	Balise	STATA (6)	Complete (2)					
6		04-02-2023 19:28	Slytherin	Balise	Python (3)	Complete (2)					
7		04-02-2023 19:29	R	Ihaka	R (4)	Complete (2)					
8		04-02-2023 19:29	R	Gentleman	R (4)	Complete (2)					
9		04-02-2023 19:30	R	Peng	R (4)	Complete (2)					
10		04-02-2023 19:31	Hadley		R (4)	Complete (2)					

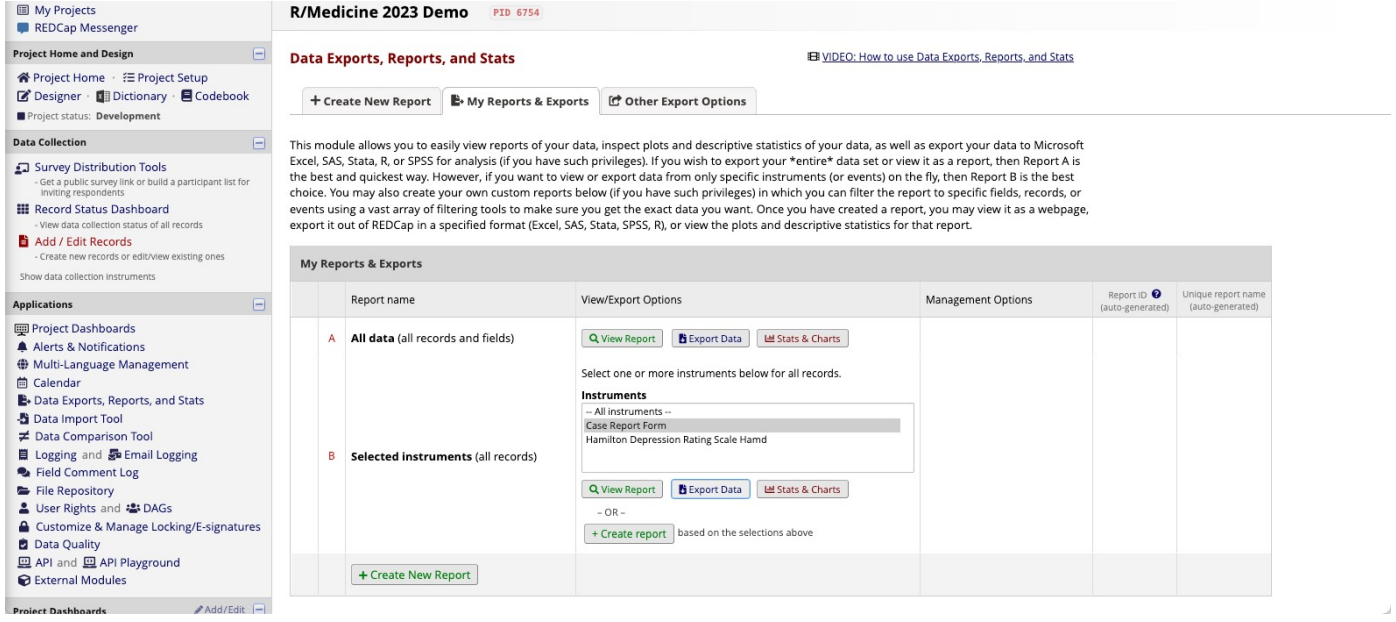
Export for Additional Magic 1

- You can manually export any tabular report.

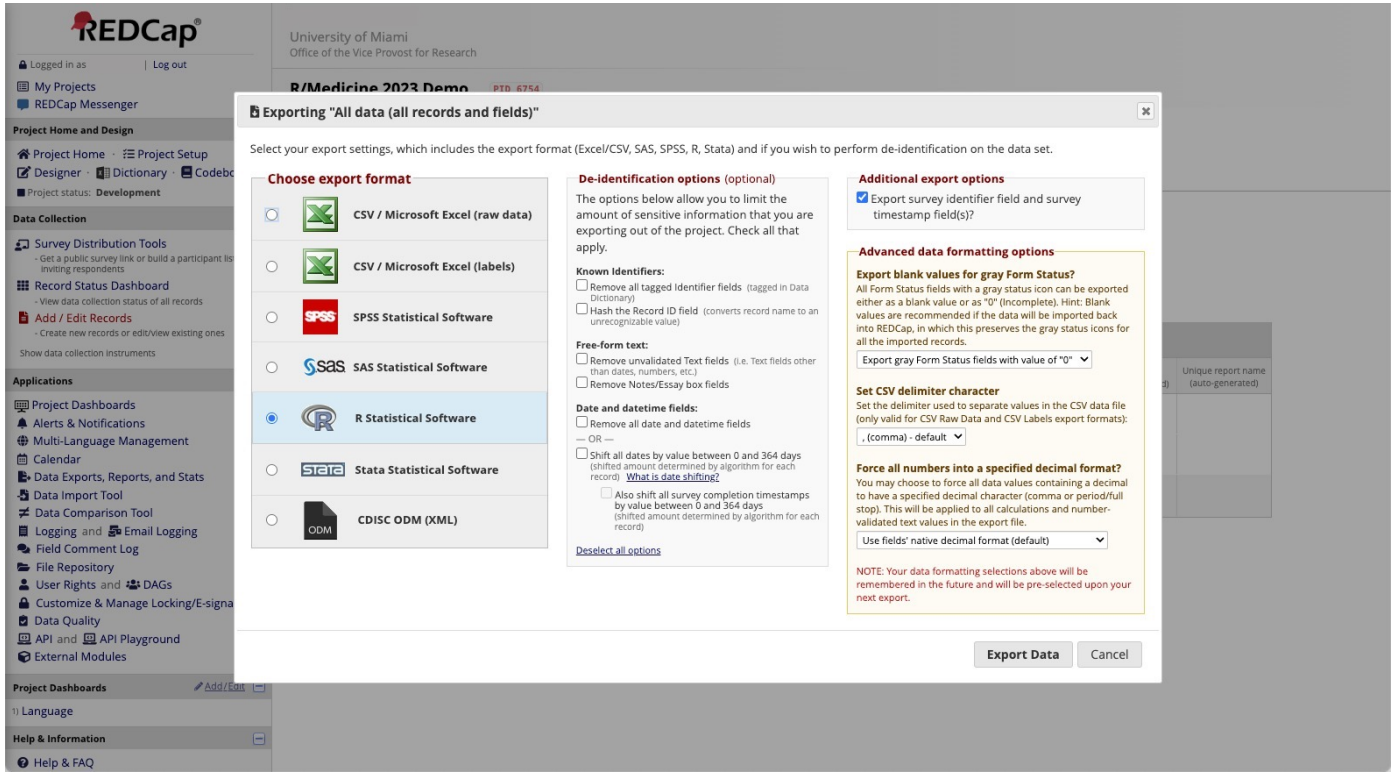


Export for Additional Magic 2

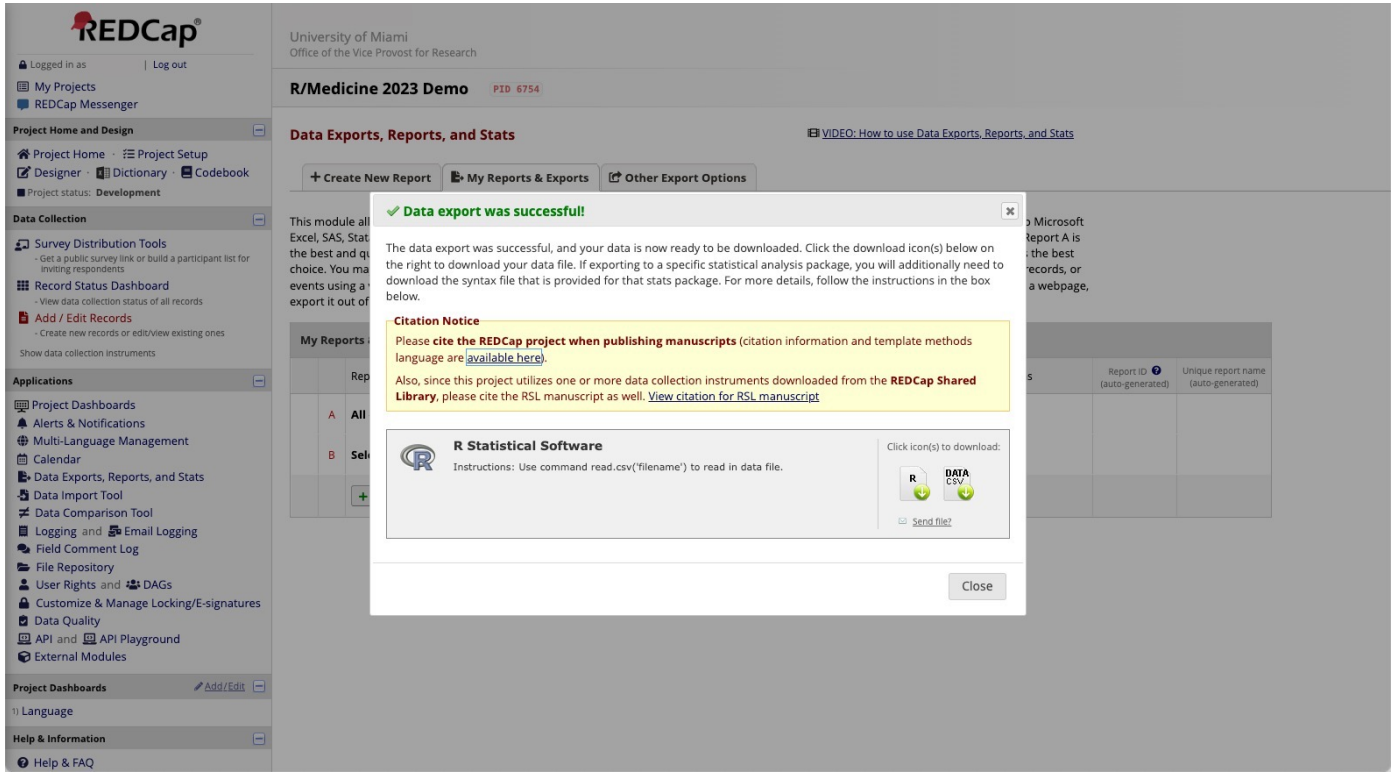
- Export a single form.



Export for Additional Magic 3



Export for Additional Magic 4



Export for Additional Magic 5

RMedicine2023Demo_R_2023-04-...

Source on Save | Run | Source

```r
#Clear existing data and graphics
rm(list=ls())
graphics.off()
#Load Hmisc library
library(Hmisc)
#Read Data
data=read.csv('RMedicine2023Demo_DATA_2023-04-03_0745.csv')
#Setting Labels

label(data$record_id)="Record ID"
label(data$redcap_survey_identifier)="Survey Identifier"
label(data$case_report_form_timestamp)="Survey Timestamp"
label(data$first_name)="First name"
label(data$last_name)="Last name"
label(data$language)="What is your favorite language?"
label(data$case_report_form_complete)="Complete?"
#Setting Units


#Setting Factors(will create new variable for factors)
data$language.factor = factor(data$language,levels=c("1","2","3","4","5","6"))
data$case_report_form_complete.factor = factor(data$case_report_form_complete,levels=c("0","1","2"))

levels(data$language.factor)=c("Julia","PERL","Python","R","SAS","STATA")
levels(data$case_report_form_complete.factor)=c("Incomplete","Unverified","Complete")

```

1:1 (Top Level) R Script

RMedicine2023Demo_DATA_2023...

Show whitespace

```
record_id,redcap_survey_identifier
,case_report_form_timestamp,first_name,last_name
,language,case_report_form_complete
1,,,Me,Balise,4,2
2,,"2023-04-02 19:26:54",Julia,Balise,1,2
3,,"2023-04-02 19:27:08",Old,Balise,5,2
4,,"2023-04-02 19:27:25",RR,Balise,4,2
5,,"2023-04-02 19:27:40",Texas,Balise,6,2
6,,"2023-04-02 19:28:19",Slytherin,Balise,3,2
7,,"2023-04-02 19:29:29",R,Ihaka,4,2
8,,"2023-04-02 19:29:58",R,Gentleman,4,2
9,,"2023-04-02 19:30:22",R,Peng,4,2
10,,"2023-04-02 19:31:04",Hadley,,4,2
12
```

1:1 Text file

API Export for Better Magic 1