Advanced Novel Randomization Implementation in REDCap for Clinical Trials:

Overview of REDCap Randomization and Introduction of Covariate-Adaptive Randomization Techniques

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Disclaimer / Disclosures

The views presented today are my own. They do not represent those of my institution, my funders, nor my networks at large.

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Overview

- Basic randomization in REDCap (1.0)

- Why do we randomize, and why would we adapt?
  - Issues around chance imbalances
  - Types of randomization methods that we may consider
  - What are adaptive methods?

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Basic Randomization Features in REDCap (1.0)*

- *Institutions may vary*
- *Newest version of REDCap (2.0) has advanced features – will be discussed later*

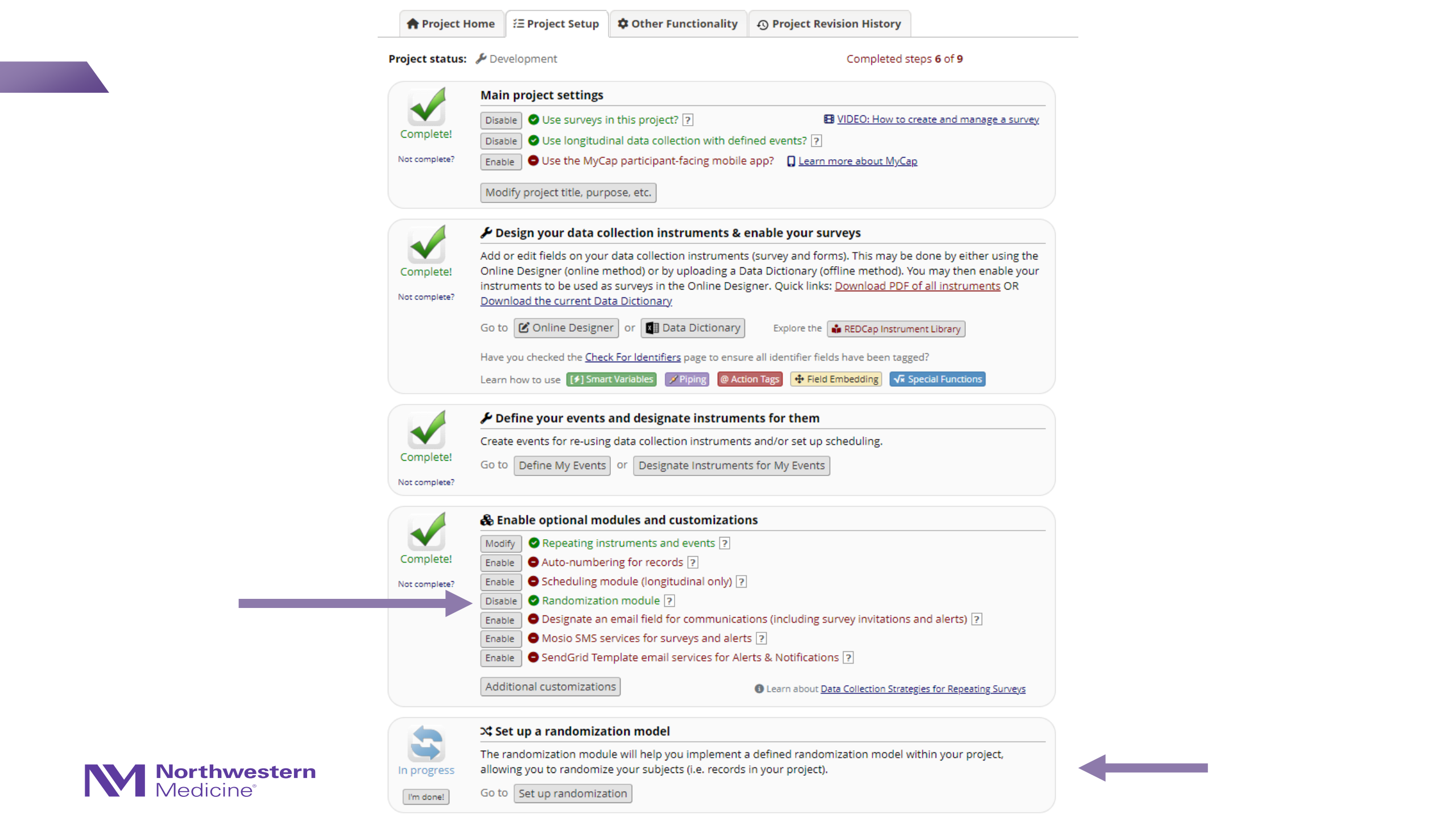
Randomization in REDCap

REDCap 1.0

- Allows for custom **pre-generated** (i.e., not adaptive) randomization list
- Must be tied to a single event in a single “Arm”

- Important to consider using differing user rights:
  - Setup (programmer/analyst/statistician)
  - Dashboard (unblinded personnel)
  - Randomize (unblinded personnel performing randomization)

- To set up: select appropriate option(s) on the Project Setup checklist tab…


Project Home
Project Setup
Other Functionality
Project Revision History
Project status: Development
Completed steps 6 of 9
Main project settings
Complete!
Not complete?
Disable
Use surveys in this project?
VIDEO: How to create and manage a survey
Disable
Use longitudinal data collection with defined events?
Enable
Use the MyCap participant-facing mobile app?
Learn more about MyCap
Modify project title, purpose, etc.
Design your data collection instruments & enable your surveys
Complete!
Not complete?
Add or edit fields on your data collection instruments (survey and forms). This may be done by either using the Online Designer (online method) or by uploading a Data Dictionary (offline method). You may then enable your instruments to be used as surveys in the Online Designer. Quick links: Download PDF of all instruments OR Download the current Data Dictionary
Go to Online Designer or Data Dictionary
Explore the REDCap Instrument Library
Have you checked the Check For Identifiers page to ensure all identifier fields have been tagged?
Learn how to use [ƒ] Smart Variables Piping @ Action Tags Field Embedding √x Special Functions
Define your events and designate instruments for them
Complete!
Not complete?
Create events for re-using data collection instruments and/or set up scheduling.
Go to Define My Events or Designate Instruments for My Events
Enable optional modules and customizations
Complete!
Not complete?
Modify
Repeating instruments and events
Enable
Auto-numbering for records
Enable
Scheduling module (longitudinal only)
Disable
Randomization module
Enable
Designate an email field for communications (including survey invitations and alerts)
Enable
Mosio SMS services for surveys and alerts
Enable
SendGrid Template email services for Alerts & Notifications
Additional customizations
Learn about Data Collection Strategies for Repeating Surveys
Set up a randomization model
In progress
I'm done!
The randomization module will help you implement a defined randomization model within your project, allowing you to randomize your subjects (i.e. records in your project).
Go to Set up randomization
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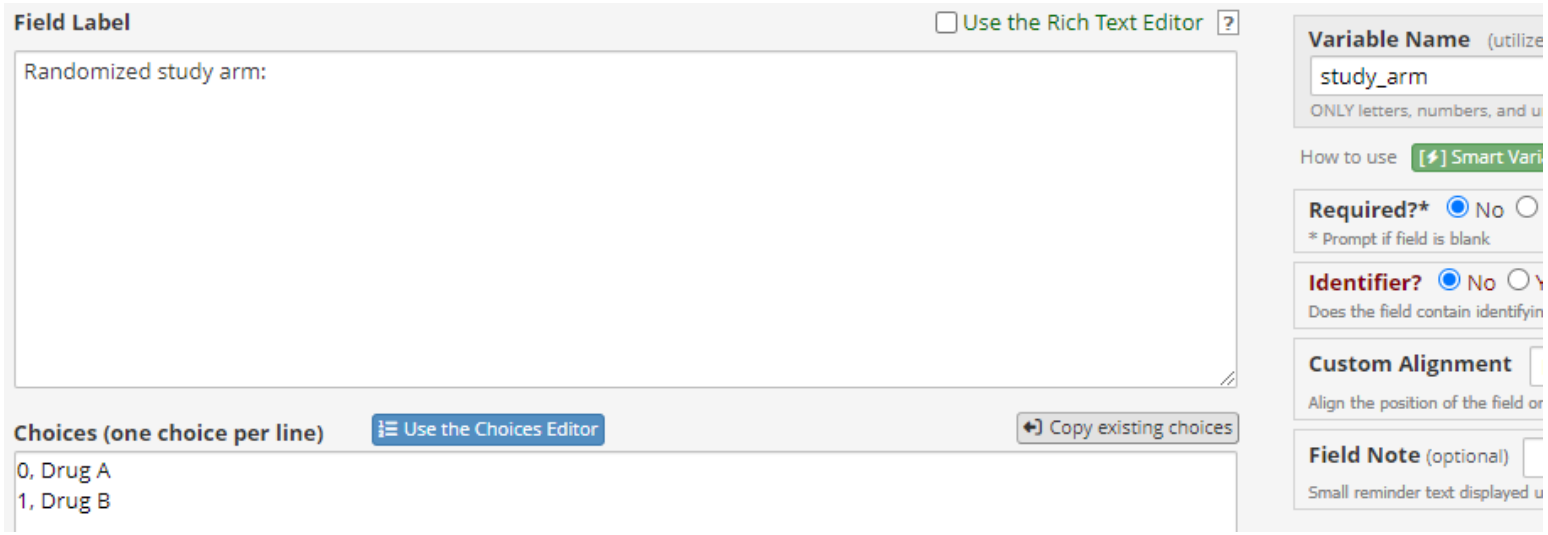
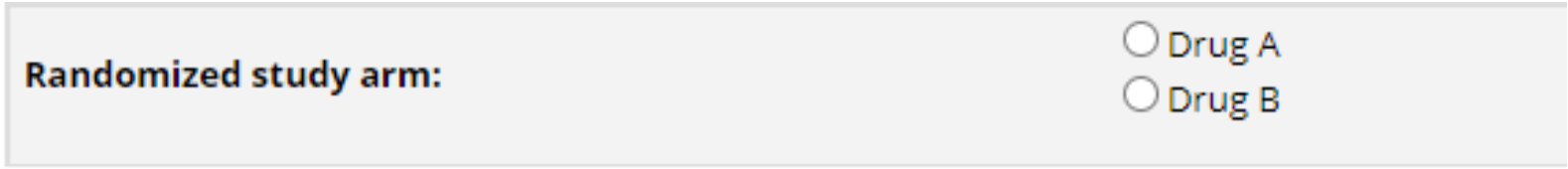
Example: Hypothetical Clinical Trial

Hypertension

Instrument name	Fields
Informed Consent	10
Eligibility	31
Demographics	20
Labs	29
Randomization	3
Participant Status	19
Global Health	10
Conmeds	12
Adverse Events	33
Protocol Violation	13

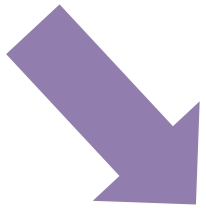


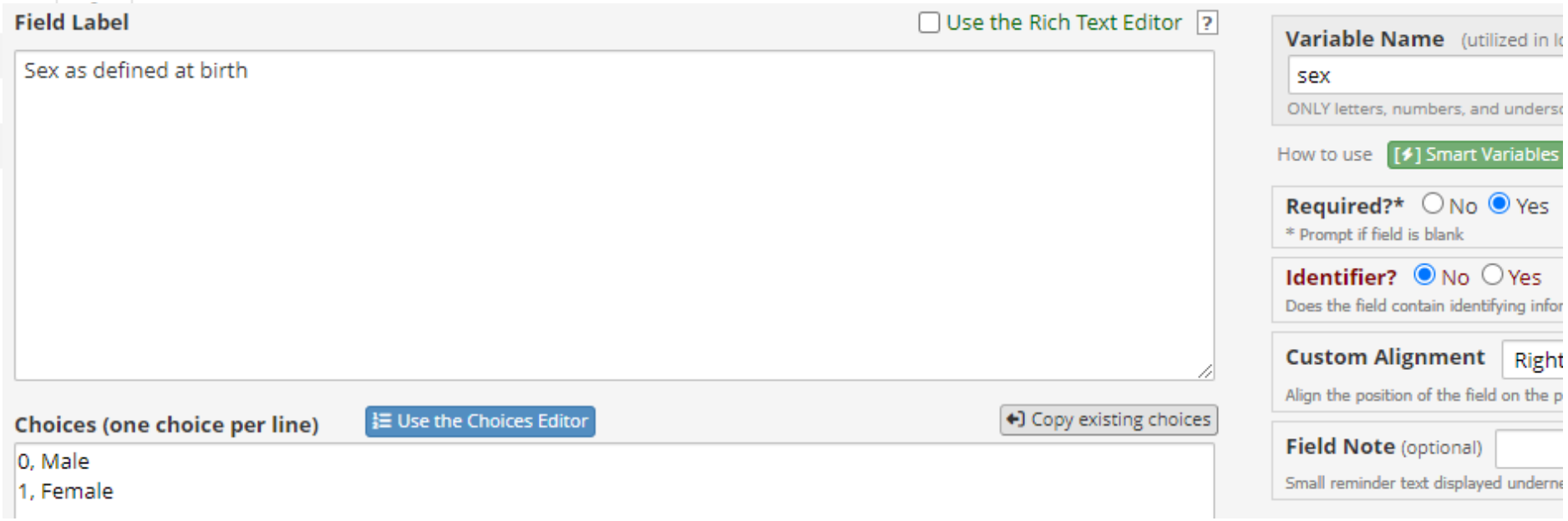


Example: Hypothetical Clinical Trial – stratified design

Stratify on Sex

Instrument name	Fields
Enrollment Checklist	14
Demographics	9
Medical History	5
Treatment Allocation	1
Vitals	4
Laboratory Assessment	4
IP Tracking	
Termination	
Departures	
Adverse Events	





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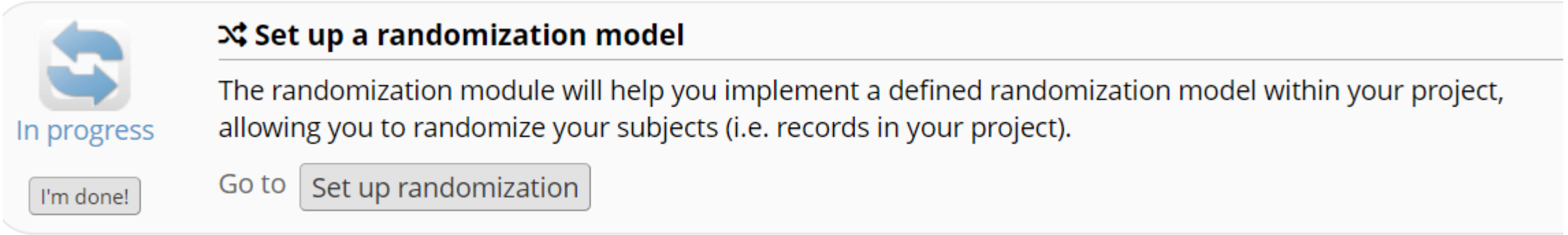
Once you have your relevant fields + event grid set up…



Setting up Randomization in REDCap

Stratified on sex →

"study_arm" is the randomization field →

STEP 1: Define your randomization model

This step will allow you to define the randomization model you will be implementing and all its parameters, which includes defining strata (if applicable) and optionally randomizing subjects per group/site (if a multi-site study).

A) Use stratified randomization? ☑

It is often necessary to ensure equal treatment among a number of factors. Stratified randomization is the solution to achieve balance within one or more subgroups, such as gender, race, diabetics/non-diabetics, etc. By choosing strata (multiple choice criteria fields), you may then be able to ensure balance within those subgroups. Tell me more

Choose strata (criteria fields used for stratification; may specify up to 14 multiple choice fields)

sex (Sex as defined at birth) for Baseline (Arm 1: Main Assess

Add another stratum

B) Randomize by group/site? ☐

If this is a multi-center/multi-site project (or something similar), you may want to stratify the randomization by each group/site. You can select an existing multiple choice field that represents the groups/sites, OR you can use Data Access Groups to stratify by group/site.

C) Choose your randomization field

This is the field where the allocated randomization (treatment) group will be saved and stored, and is where the Randomize button will appear on your data collection form.

study_arm (Randomized study arm:) for Baseline (Arm 1: Main Assess

Save randomization model | Erase randomization model

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STEP 2: Download template allocation tables (as Excel/CSV files)

Below are some example files that you may download to get a general idea for how you may structure your own randomization table. You do not have to use any of these. In fact, **we recommend that you NOT use these exact templates** but instead recommend that you merely use them as an example or baseline to start from in order to create your own custom allocation file. After uploading your allocation table in Step 3 below, it will then be used as a lookup table to perform assignments when subjects are being randomized. **NOTE:** Record names (e.g., study ID) should NOT be included as a column in your allocation table, but only the fields listed in the example files below. More details

Example #1 (basic) | Example #2 (all possible combos) | Example #3 (5x all possible combos)

study_arm	sex
0	0
1	0
1	0
0	0
1	0
1	0
0	0
0	0
0	0
1	0
0	1
0	1
1	1
1	1
0	1

NOTES:

- Do NOT modify the first row, although you may modify, add, or delete any other row in this file.
- Remember that this file is ONLY a template and should NOT be used as-is as your allocation table.
- You do not have to delete this 'notes' column when uploading your allocation table (it will be ignored).
- Below is a list of all raw coded values and their corresponding option labels for each strata field and/or

Values/labels for "study_arm" (Randomized study arm:):

0	Drug A
1	Drug B

Values/la

0	Male
1	Female

STEP 3: Upload your allocation table (CSV file)

Once you have created your custom allocation table as a CSV file and made sure that you kept the format prescribed in the template files from Step 2 above, you may now upload the file below. It will be checked for any possible errors first before it is accepted and stored in REDCap. Please note that you will need to create two different allocation tables: one to be used for testing while your project is in development status and the other for use when in production status. Below are some important reminders before you begin uploading your allocation tables.

Reminders:

- Once your project is in production status, the allocation tables will become locked and unmodifiable.
- Be sure to include more assignments in your allocation table than you think you will need (to accommodate possible drop-out and drop-in of subjects).
- Record names (e.g., study ID) should NOT be included as a column in your allocation table, but only the fields listed in the example files from Step 2 above.

Not uploaded yet

Upload allocation table (CSV file) for use in DEVELOPMENT status

Choose File | No file chosen

Upload File

Not uploaded yet

Upload allocation table (CSV file) for use in PRODUCTION status

Choose File | No file chosen

Upload File

Randomization Notes

- Always add a “cushion”
- Always test thoroughly with study team involved
- Tables will be locked once in production
- **Development randomization table CANNOT be the same as the production table**
- Blinded studies are rather difficult to work out logistically (possible, but may need to be creative with this – restrict access and/or use code for randomization field)…

Randomization Logistics for Blinded Studies

Example Study: Maintaining the blind and ensuring drug kits correctly corresponded to the right arm required some additional thought

"Trick" - made our randomization field the "kitnumber" – no longer 0s and 1s…

[kitnumber]	Drug Kit Number	dropdown
		1492556 | 1492556
		1754916 | 1754916
		1663910 | 1663910
		1944231 | 1944231
		1525094 | 1525094
		1175102 | 1175102
		1842499 | 1842499
		1262338 | 1262338
		1378141 | 1378141

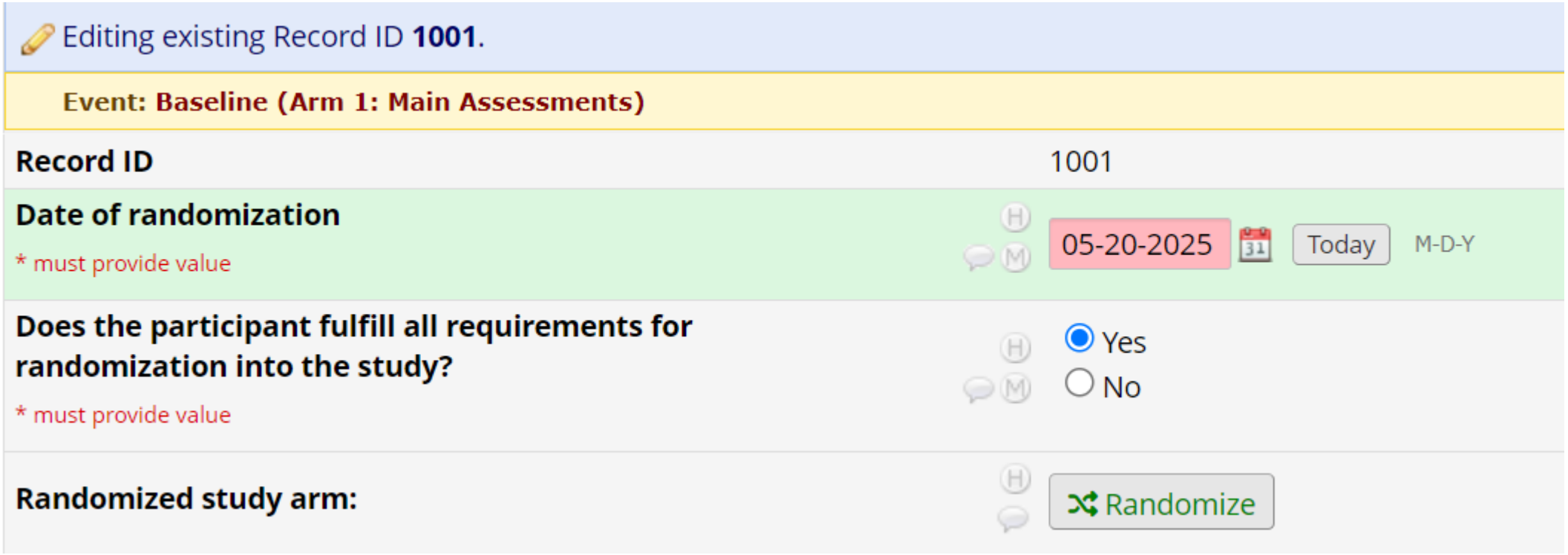
Randomization Logistics for Blinded Studies

Example – output .csv file from randomization script

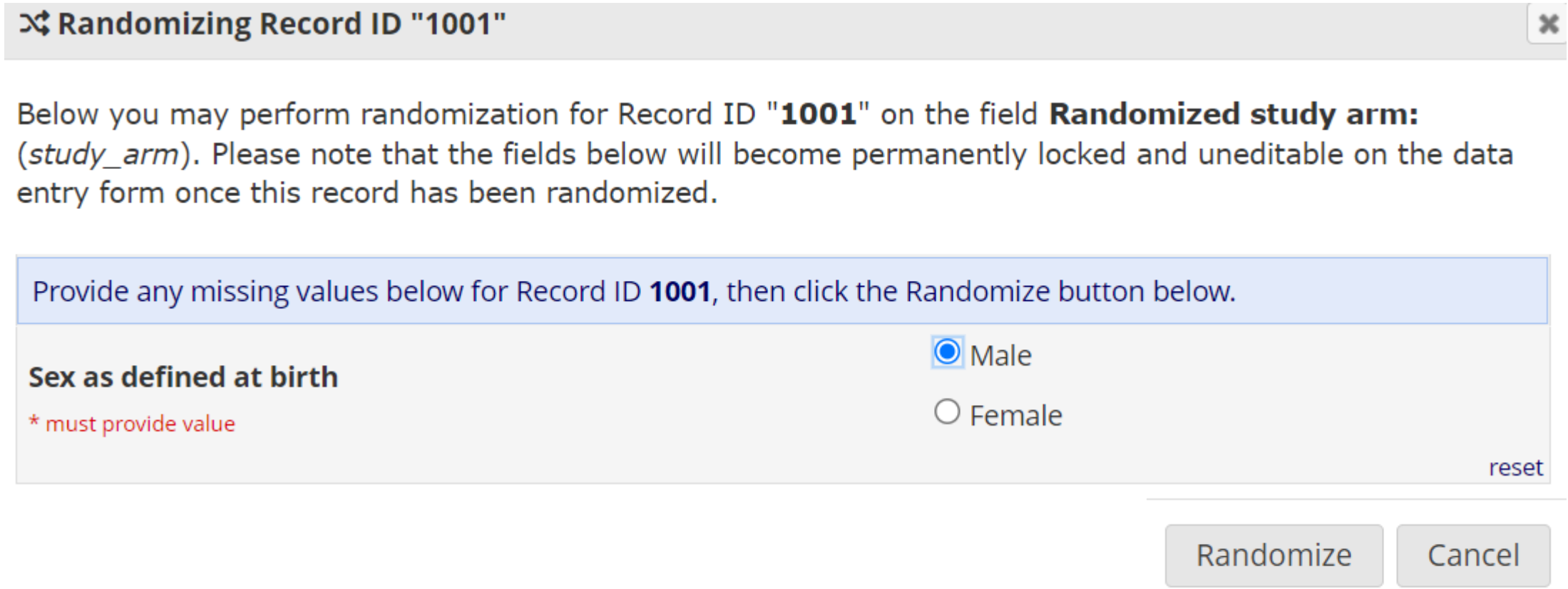
blockID	blockSize	rnum	kitnumber	trt	sequence
1	6	0.492557	1492556	Treatment codes here (0s and 1s)	1
1	6	0.754916	1754916		2
1	6	0.66391	1663910		3
1	6	0.944232	1944231		4
1	6	0.525095	1525094		5
1	6	0.175102	1175102		6

This is what was uploaded into REDCap

Note – Data Entry Interface



Note – Data Entry Interface



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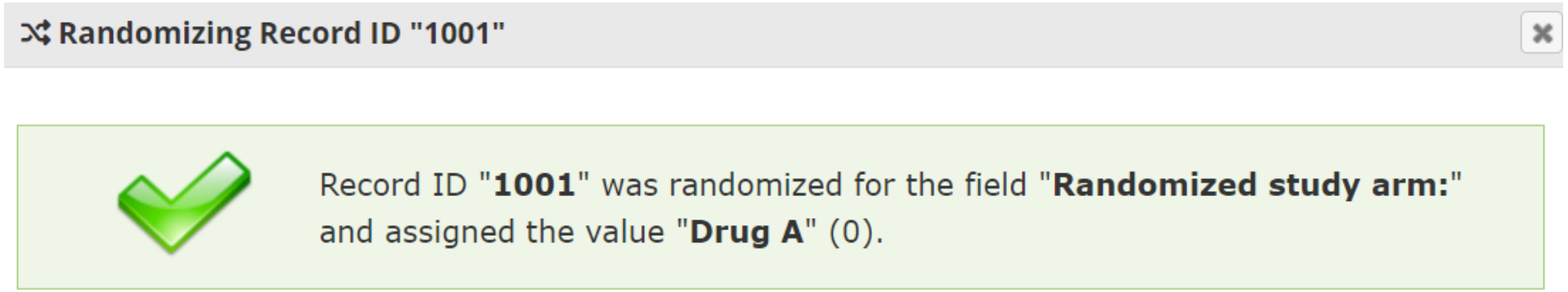
Note – Data Entry Interface



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Switching Gears:

Why do we randomize, and why would we adapt?

Why do we randomize?

- Randomness in treatment assignment also allows for valid statistical inferences in clinical trials (**independence** assumption)

- Primarily to **prevent bias**
  - **Selection bias**
  - **Accidental bias**

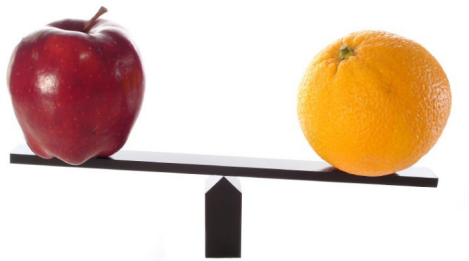
Why do we need to worry about (im)balance?

First, intuitively…we care about 'face validity'

- When we report on a trial using the typical 'Table 1', we hope to see comparable study arms with respect to key influential variables…

Characteristic	Study Arm 1 (N=114) N(%) or Mean(std)	Study Arm 2 (N=120) N(%) or Mean(std)	Overall (N=234) N(%) or Mean(std)
Age, years	56 (12)	54 (11)	55 (11)
Male sex (at birth)	63 (55)	54 (45)	117 (50)
…			
…			
History of Myocardial Infarction (MI)	80 (70)	20 (17)	100 (43)

- **Note** that random allocation ensures that baseline variables will be 'balanced', on **average**



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Why do we need to worry about (im)balance?

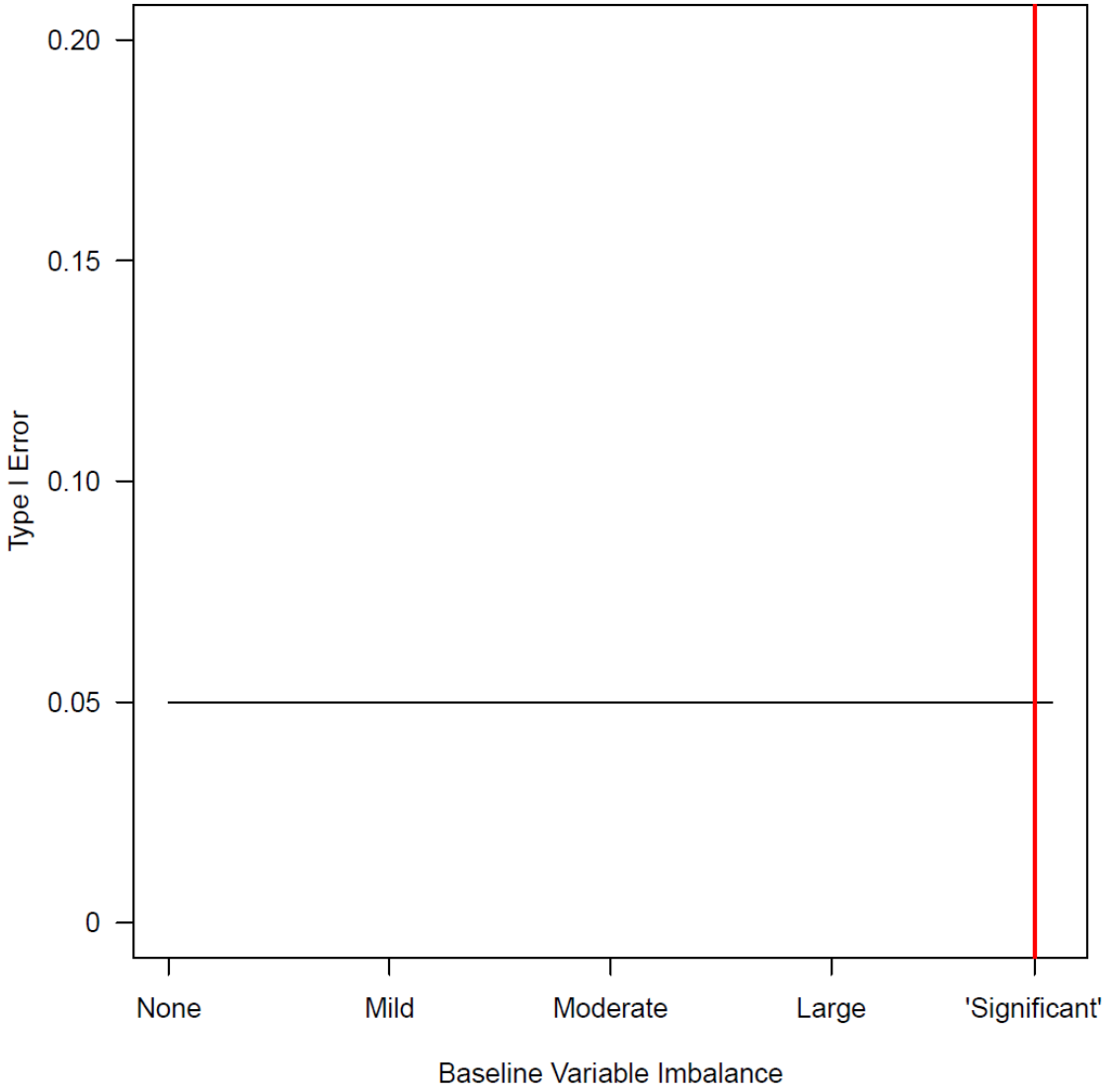
Second, statistically…there will be chance imbalances that may be nontrivial

- The **expected** level of baseline variable imbalance = 0
- BUT, a single clinical trial is just **1 realization** of **a random phenomenon**

- **Chance imbalances** are possible and **guaranteed** – every single randomized trial will exhibit some sort of imbalance across study arms
  - The (covariate) **distributions will not be identical**
  - We are not (and cannot be) matching participants across arms with respect to all variables

Consider the relationship between type I error and baseline variable imbalance…

- Assume randomized trial with 2 study arms and some continuous outcome
- X-axis: baseline variable imbalance
- Y-axis: type I error (unadjusted case)



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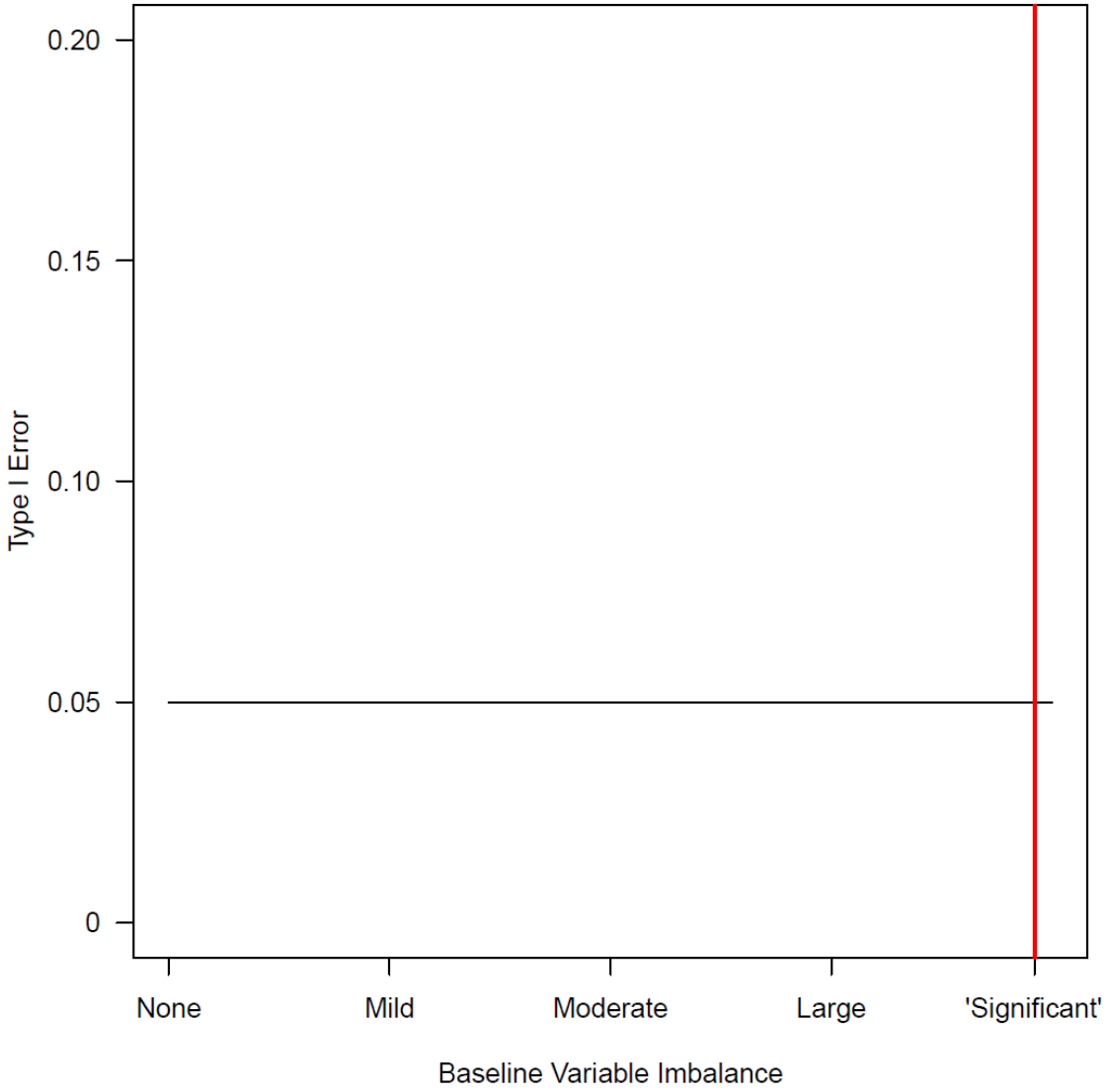
Consider the relationship between type I error and baseline variable imbalance…

- If we have **chance imbalance** for some variable that is **not important** in predicting outcome
- → type I error will not be affected by these chance imbalances in that non-influential variable



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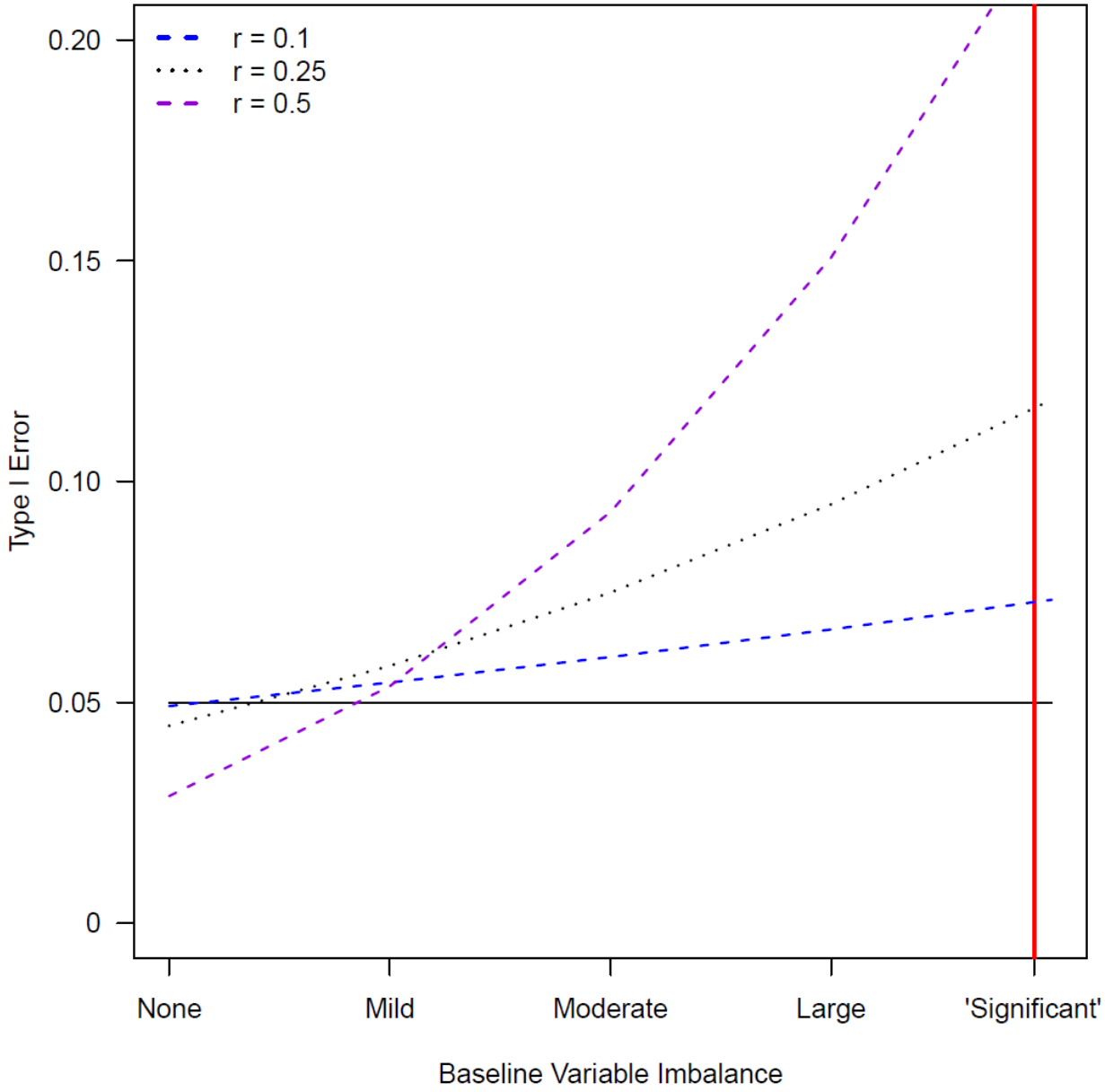
However, if we have a somewhat influential variable at baseline, any imbalance in that variable will begin to have an affect on analyses (if we do not account for them in some way)



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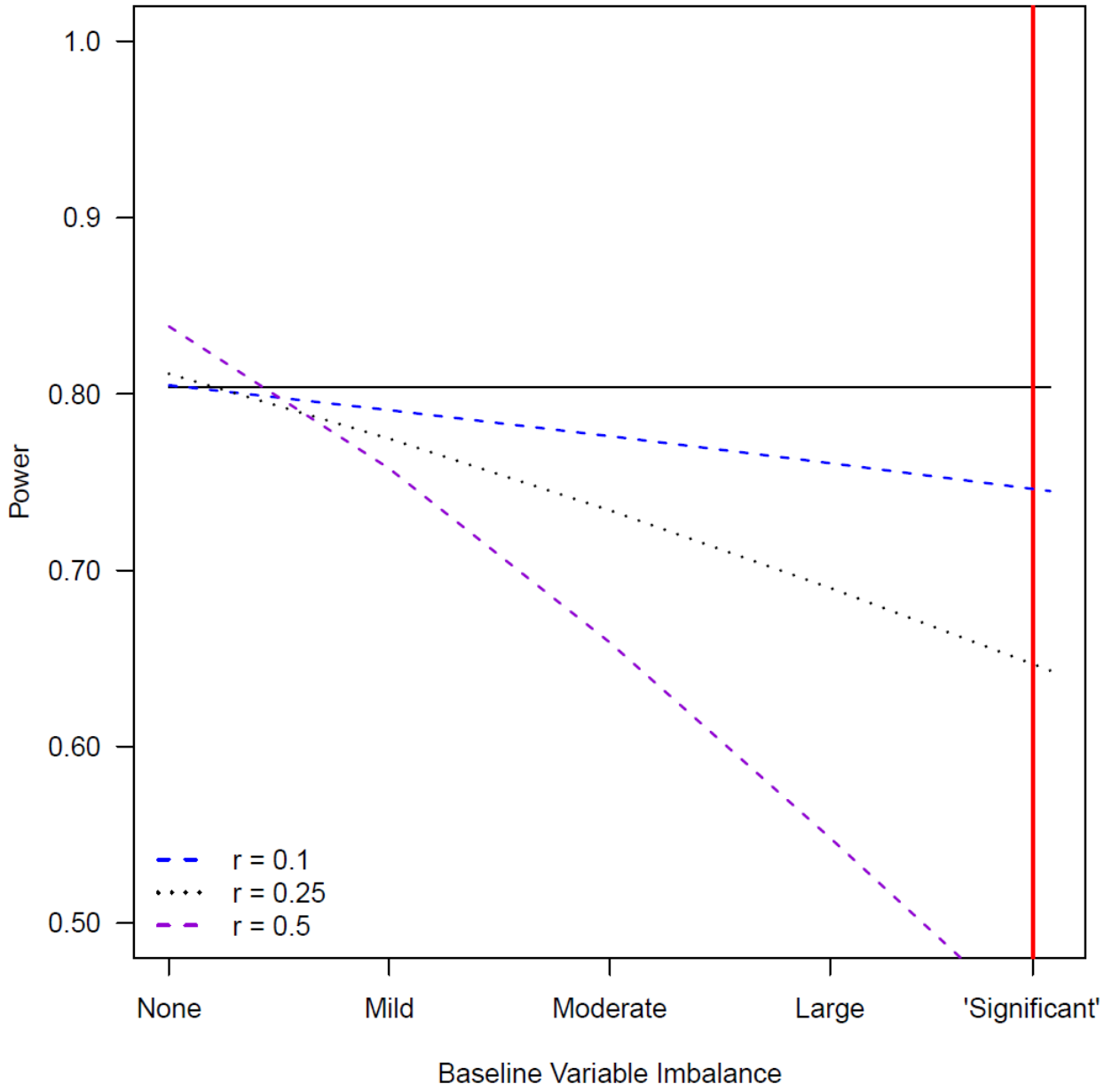
This visual illustrates the effect on power (y-axis) vs. baseline variable imbalance

Note: that these are examples of hypothetical scenarios and the effect depends on direction of imbalance (for instance, are we 'favoring' intervention arm or placebo arm?)



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What can we do about these issues with imbalance in randomized trials?

- → it seems a good idea to give the randomization a little help in '**controlling imbalance**' in key baseline variables

- There are several options for controlling imbalance (i.e., moving away from simple random allocation)

Adaptive Randomization Algorithms

What are they? How do they work? Why not just 'stratify'?

Types of Randomization Methods

- Fixed Allocation
  - Simple (Complete)
  - Block
  - Stratified

- **Adaptive Randomization**
  - **Baseline characteristics: covariate-adaptive**
  - Response: response-adaptive

Adaptive Randomization Algorithms

What are they? How do they work? Why not just 'stratify'?

Types of Randomization Methods

- Fixed Allocation
  - Simple (Complete)
  - Block
  - **Stratified – perhaps the most common/well known**
- **Adaptive Randomization**
  - **Baseline characteristics**
  - Response

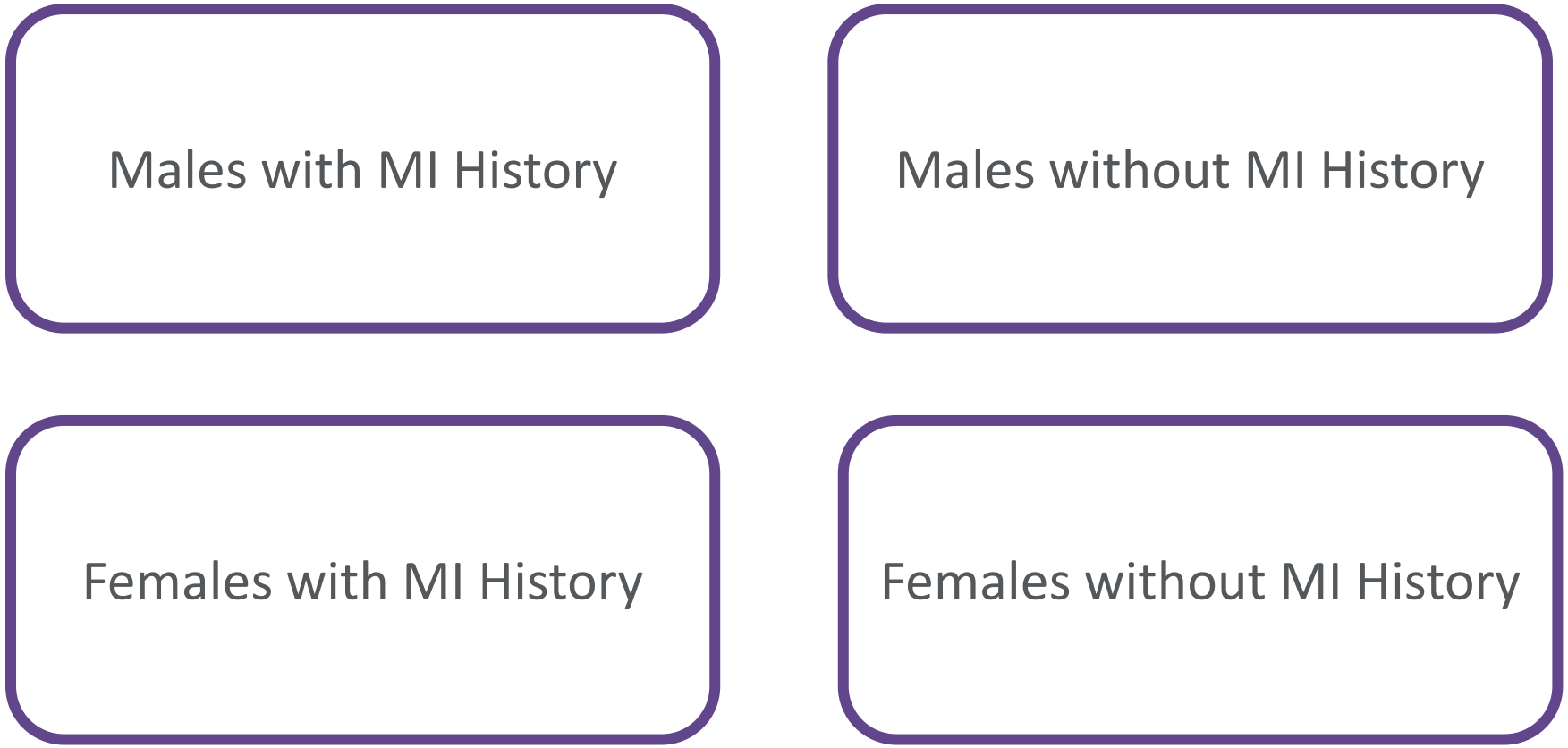
Digression on Stratification…

Idea: stratify (categorize important variables), then perform randomization scheme within those categories

Example

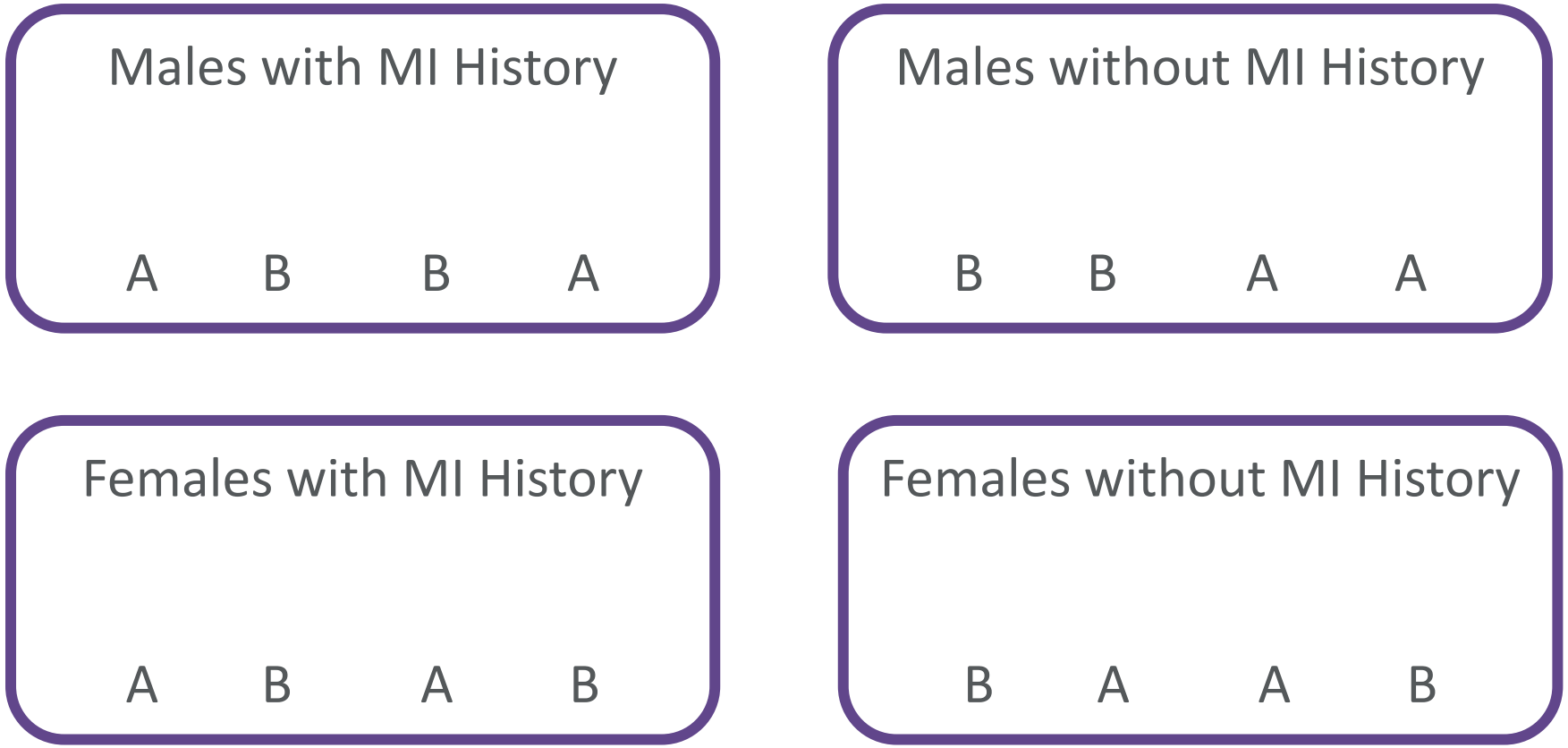
- Example: **Sex (M/F)** and **Myocardial Infarction (MI) History (yes/no)** group = important predictors
- We have **4 strata** (2 x 2)
- Within each stratum, apply the blocked design

Stratified Block Design



Slide credit: Lauren Balmert Bonner

Stratified Block Design



Slide credit: Lauren Balmert Bonner

Stratified Block Design

Male without MI

Males with MI History	Males without MI History
A B B A	B B A A
Females with MI History	**Females without MI History**
A B A B	B A A B

Slide credit: Lauren Balmert Bonner

Stratified Block Design

Males with MI History

A B B A

Males without MI History

B B A A

Females with MI History

A B A B

Females without MI History

B A A B

Slide credit: Lauren Balmert Bonner

Stratified Block Design

Female with MI

Males with MI History

A B B A

Males without MI History

B B A A

Females with MI History

A B A B

Females without MI History

B A A B

Slide credit: Lauren Balmert Bonner

Stratified Block Design

Males with MI History

A B B A

Males without MI History

B B A A

Females with MI History

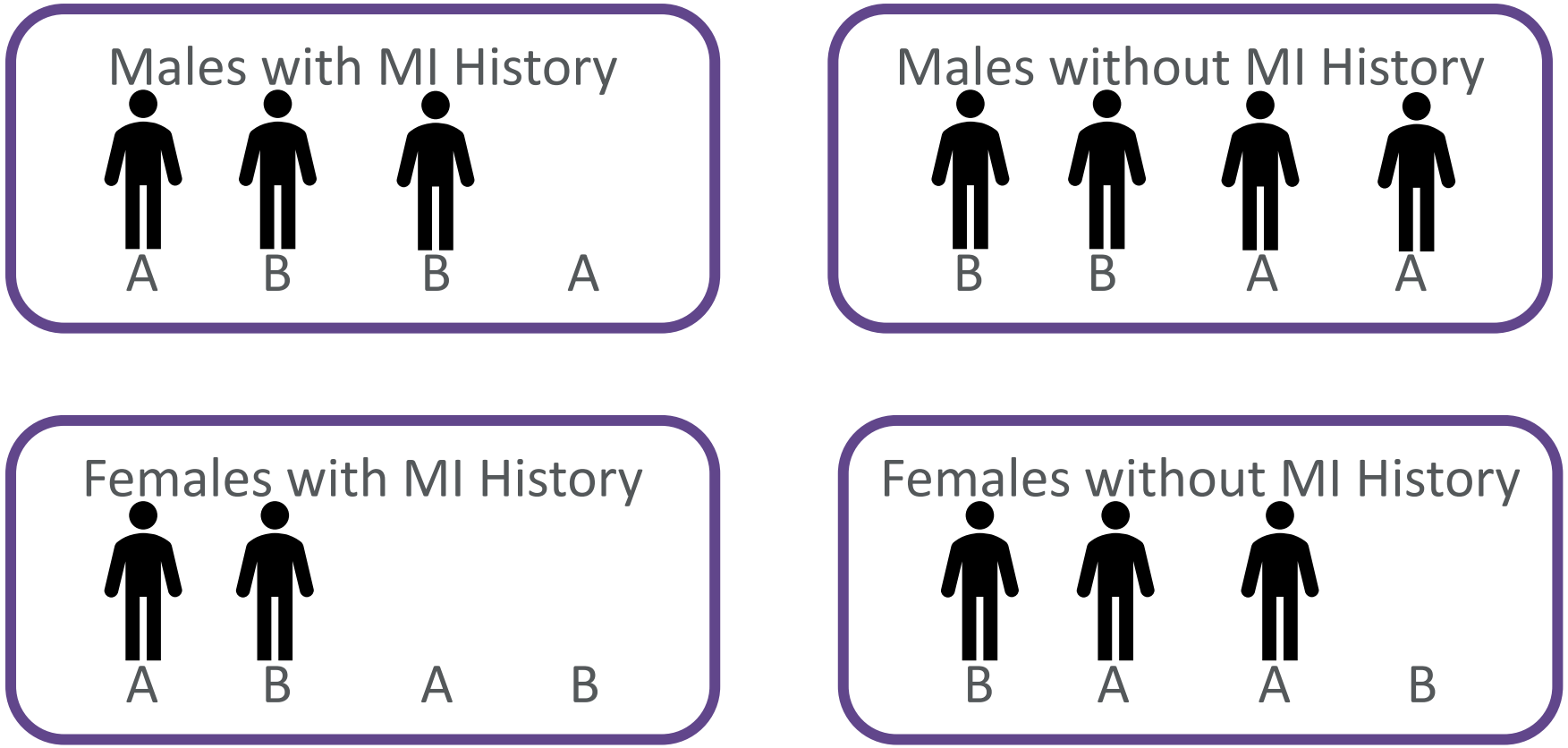
A B A B

Females without MI History

B A A B

Slide credit: Lauren Balmert Bonner

Stratified Block Design



Slide credit: Lauren Balmert Bonner

Issues with Stratified Block

- Unfilled blocks may present a problem with efficiency
- Must **categorize** continuous variables

- **As number of strata** increase, performance becomes similar to simple randomization
  - **Example:** Clinical center (assume 5), sex (2 categories), age (4 categories: 21-30,30-35,36-40,>40 years), baseline disease status (mild, moderate, severe)
    - Each center has 2 x 4 x 3 = 24 strata within which we need to apply a randomization scheme!
    - Thus, 5 x 24 = 120 strata total!

- Requires **pre-generated lists**: may be electronic, sealed envelopes, pharmacy list, etc. → opportunity for error
- There are also some statistical issues: efficiency and 'deterministic' assignments

Adaptive Randomization Algorithms

What are they? How do they work? Why not just 'stratify'?

Most methods fall under the heading of "Minimization"

- Proposed by Taves, Simon, Pocock (1970s)
- Assignment to treatment arm is determined by minimizing imbalance between study arms in terms of prognostic covariates
- Have the ability to incorporate many covariates
- **Marginally** control imbalances in key baseline variables (rather than within strata and all possible combinations of strata)

Examples of Covariate-Adaptive Methods

- Minimization (Taves, 1974; Pocock & Simon, 1975)
- Optimal Biased Coin Randomization (Atkinson, 1982)
- Optimal Biased Coin with Covariates Randomization (Atkinson, 1999)
- **Minimal Sufficient Balance (Zhao, Hill, & Palesch, 2015)**
- Common-Scale Minimal Sufficient Balance (Johns et al., 2022)

Adaptive Randomization Algorithms

What are they? How do they work? Why not just 'stratify'?

Idea…first determine how we measure "imbalance" for each variable (LOTS of options)

1. Choose imbalance function (*D*) to minimize for each variable (weight each variable, if desired)
2. Let overall imbalance, ***D*** = sum of imbalance for all variables
3. For **incoming participant**, calculate D under assignment to each possible treatment
   a. Take into account that participant's covariate information AND all previous allocations
   b. Look at what would happen to overall imbalance if we assign to one study arm over another
4. Assign participant to arm with smallest D with higher probability: (0.5,1]

(Covariate) Adaptive Randomization Algorithms - Benefits

- Can handle a **large number** of covariates (especially when compared to stratification)
- **May not need to categorize continuous variables**, depending on algorithm
- Can ensure imbalance control with very high probability (less likely to have large chance imbalances)
- Can be **expanded** to include additional covariates over the course of the study
- Can adapt to…
  - **Randomization errors**
  - **Withdrawals prior to intervention/data collection**
  - **Correct for erroneously entered data**

(Covariate) Adaptive Randomization Algorithms - Considerations

These methods are very powerful and efficient, but they do require work and planning

- Data collection platform and randomization interface between the platform
  - e.g., If using REDCap → algorithm needs to be run outside of REDCap, and then result patched back in
- Who will be running the algorithm, on what machine, and what sort of redundancy is required?
- Data collection **timing** in relation to timing of randomization
  - **How fast** does this need to occur?
  - How likely is it that an individual is assigned an intervention/study drug ID/kit number, but then dropout prior to receipt?
- How is the **blind** maintained (if relevant)?

(Covariate) Adaptive Randomization Algorithms - Considerations

These methods are very powerful and efficient, but they do require work and planning

- These algorithms are **complicated** – it is not something that you can often 'set and forget'
- Require **front-end** investment: **testing**, ***testing***, ***testing*** + troubleshooting
- **Care** should be taken in choosing the method of randomization/algorithm with respect to the covariates of interest, study infrastructure, and available personnel.
  - Will we have covariates collected in a timely manner?
  - Are there specific timeframes within which randomization must occur?
  - How will algorithms be run?
  - What if something breaks?

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End of 1st Segment – Thank you for your attention!

Minimal Sufficient Balance

Marilly Palettas
Center for Biostatistics

Disclosure

- No relevant disclosures

Overview

- Introduction of Minimal Sufficient Balance (MSB)
- Implementation in active clinical trial
- REDCap walk-through

Why Balanced Groups Matter

Avoiding Chance Imbalances

Even properly randomized trials can have groups differ in baseline covariates that are relevant prognostic factors

Impact on Outcomes

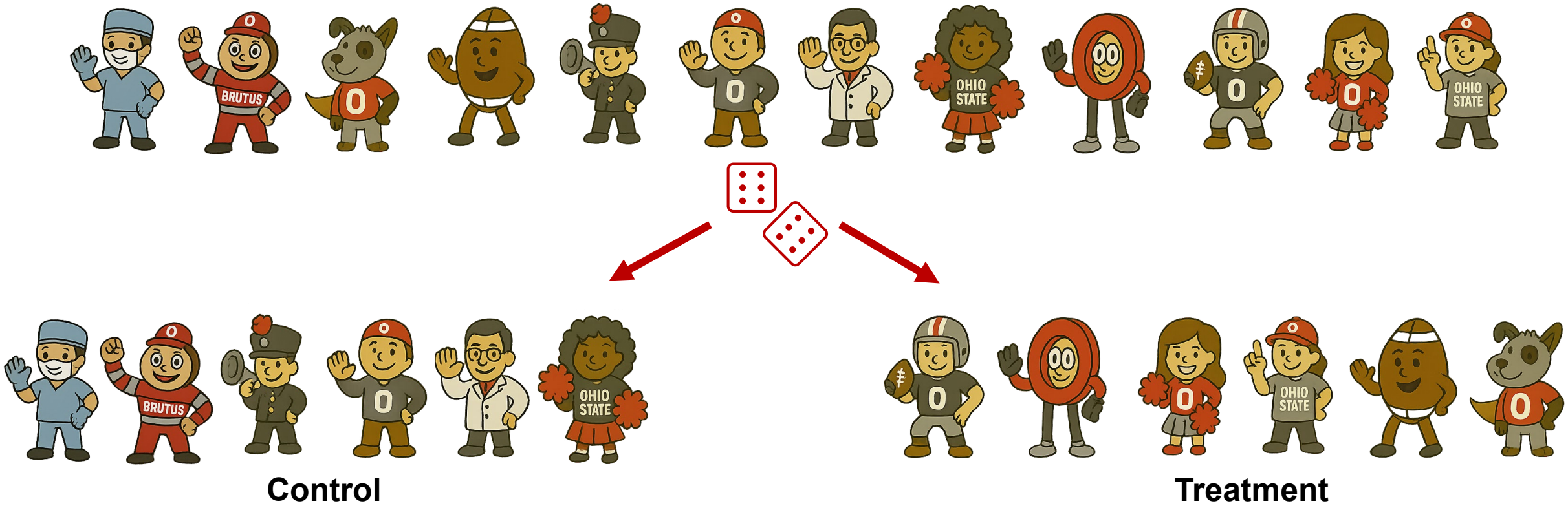
Imbalanced baseline covariates may skew treatment effect estimation

Loss of Power

Imbalance across important baseline prognostic factors during randomization may result in significant loss in statistical power to detect treatment differences, even if these factors are adjusted for in analysis

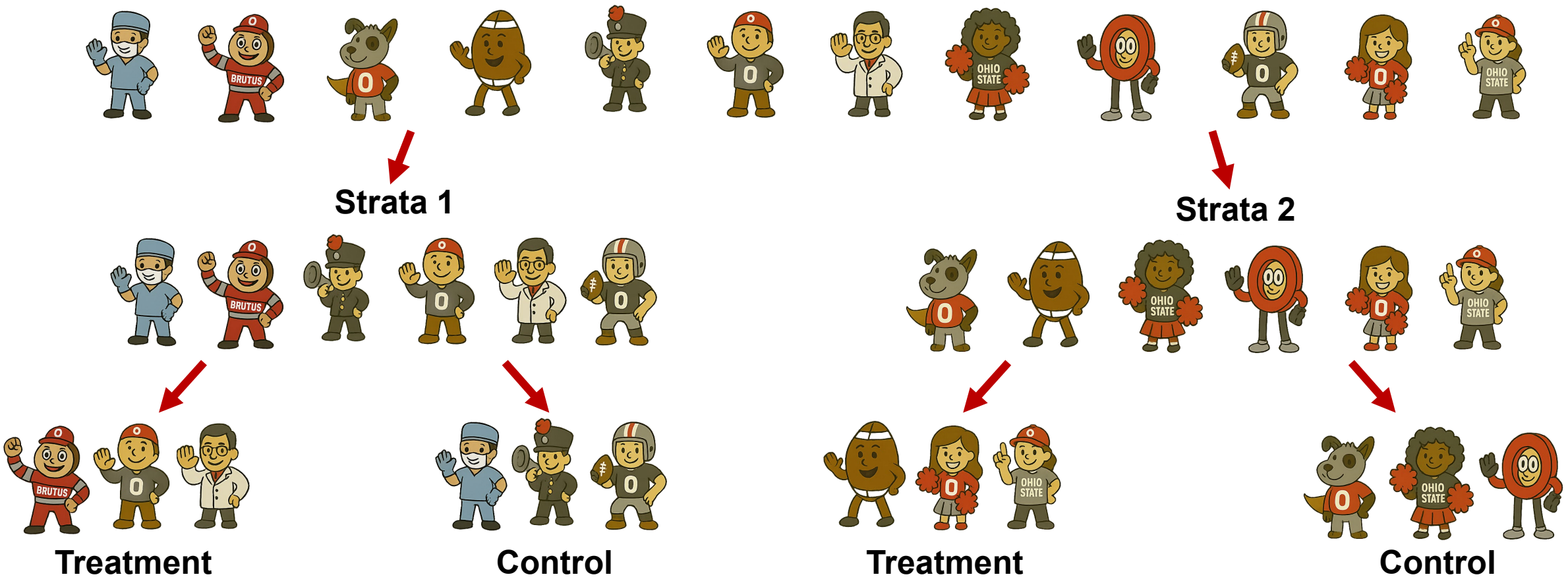
Limitations of Standard Methods (1 of 3)

Simple Randomization



Limitations of Standard Methods (2 of 3)

Stratified Randomization



Limitations of Standard Methods (3 of 3)

Minimization

Control

Treatment

Current Totals (after 11 allocations)

	Treatment	Control
Wearing Block O	4	2
Males	4	1

What is Minimal Sufficient Balance?

Covariate-Adaptive Design

MSB dynamically uses baseline information to decide how to allocate the next participant with minimal but sufficient constraint

Inclusive of Key Covariates

Include all important baseline factors – even continuous ones – without categorizing them

Monitoring Imbalance

Continuously monitors balance using statistical tests as a real-time measure of covariate distribution

"Minimal" Intervention

Intervenes only if imbalance exceeds a preset tolerance, using a biased coin method rather than forced assignment

Benefits of using MSB

Balanced Baseline	Effectively balances treatment groups across multiple covariates, including continuous ones
Better Interim Decisions	Ensures interim data aren't distorted by uneven baseline risk factors
Preservation of Randomness	Maintains allocation unpredictability and guards against selection bias
Reduced Bias	Prevents serious imbalances, reducing potential for baseline-driven bias in outcomes
Improved Statistical Power	Trials can more sensitively detect true treatment effects with balanced groups

How MSB Decides the Next Assignment

"Voting" by Covariates

Each covariate "votes" on where the next patient should go based on current imbalance

Counting the Votes

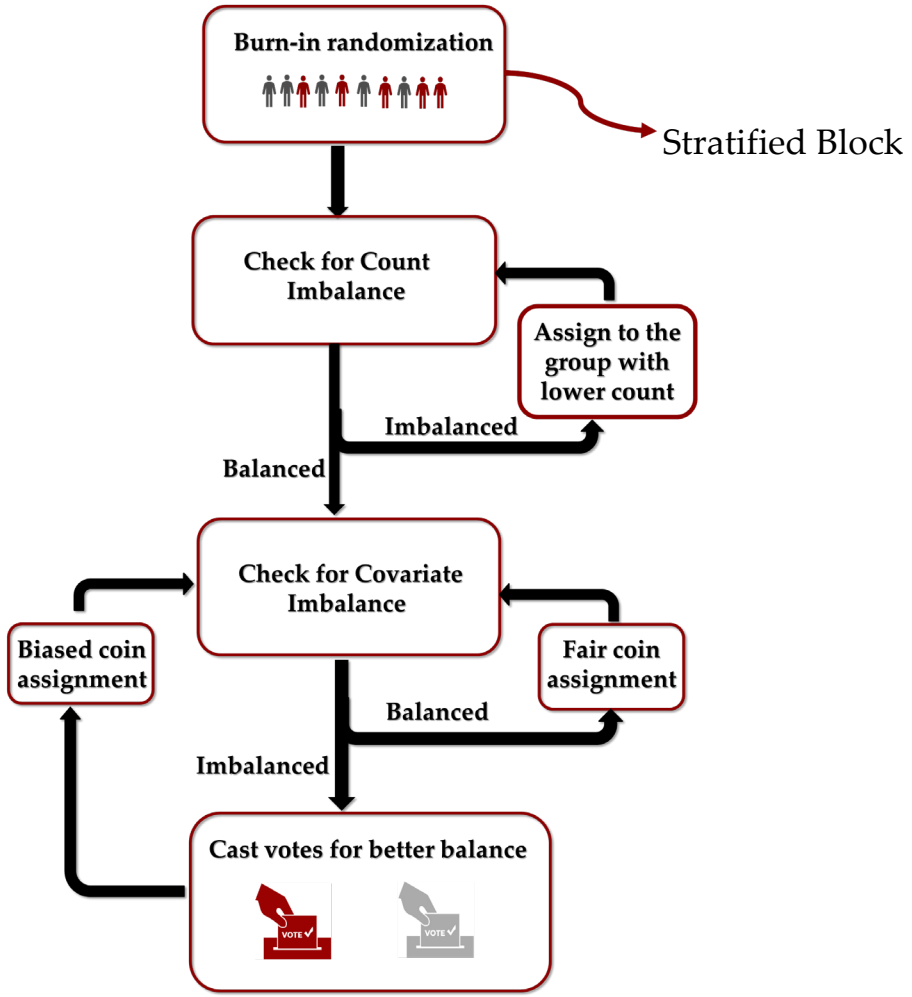
The algorithm tallies these covariate votes to determine preference

Clear Preference

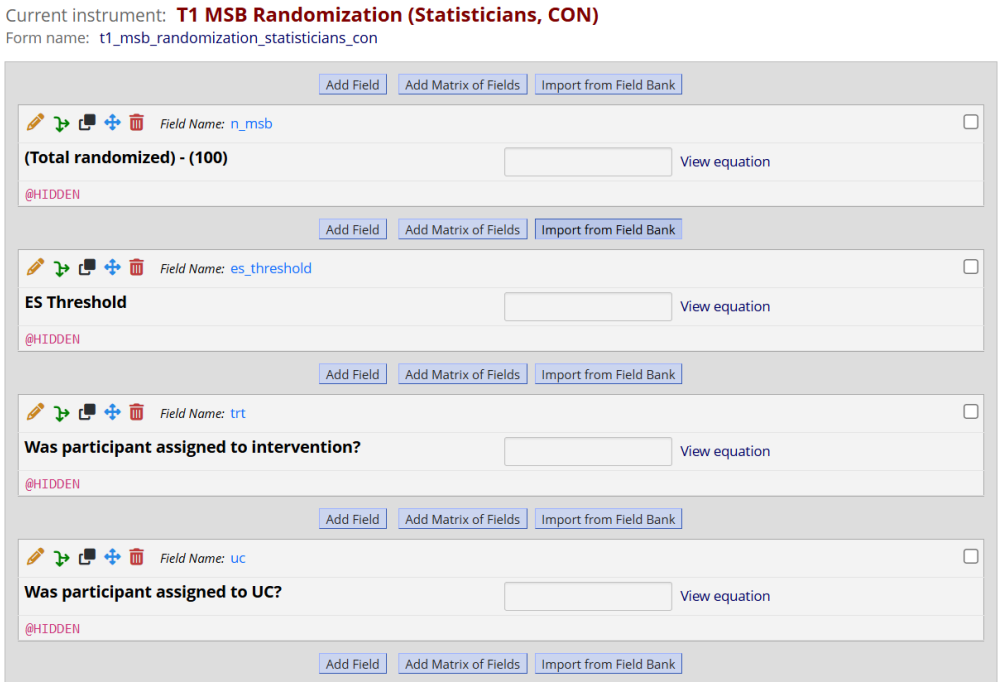
If one arm gets a clear majority, MSB uses a biased coin randomization (e.g., 65/35) favoring that arm

No Strong Preference

If votes are tied or neutral, MSB uses standard 50/50 probability



From Proprietary Software to REDCap



Original Implementations

MSB required custom programming or specialized randomization systems when first introduced

Limited Availability

Many trialists stuck with simpler methods due to lack of user-friendly tools for MSB

REDCap's Role

REDCap is widely used for managing clinical trial data but doesn't natively support MSB

Adapting MSB to REDCap

Through REDCap's extensibility, we can integrate MSB into the workflow

Implementing MSB in REDCap – Step by Step

Define Covariates

Decide which baseline covariates to balance and collect before randomization

Indicate Readiness

Set up a field to mark when a participant is ready for randomization

Run MSB Calculations

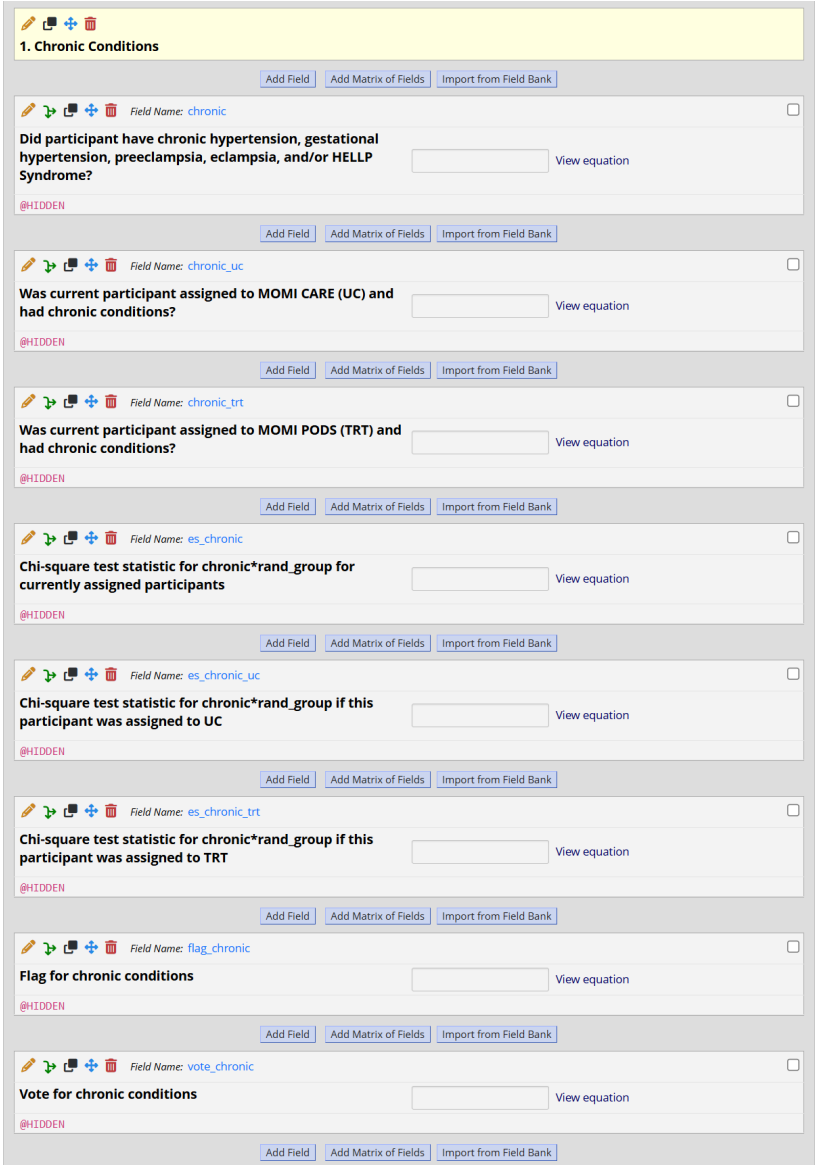
Hard code effect size calculations for each baseline covariate of interest

Sum Up Votes

Formulas tally votes for all covariates to calculate imbalance and determines allocation using biased coin logic

Return Allocation

REDCap randomization allocation table determines treatment group assignment.

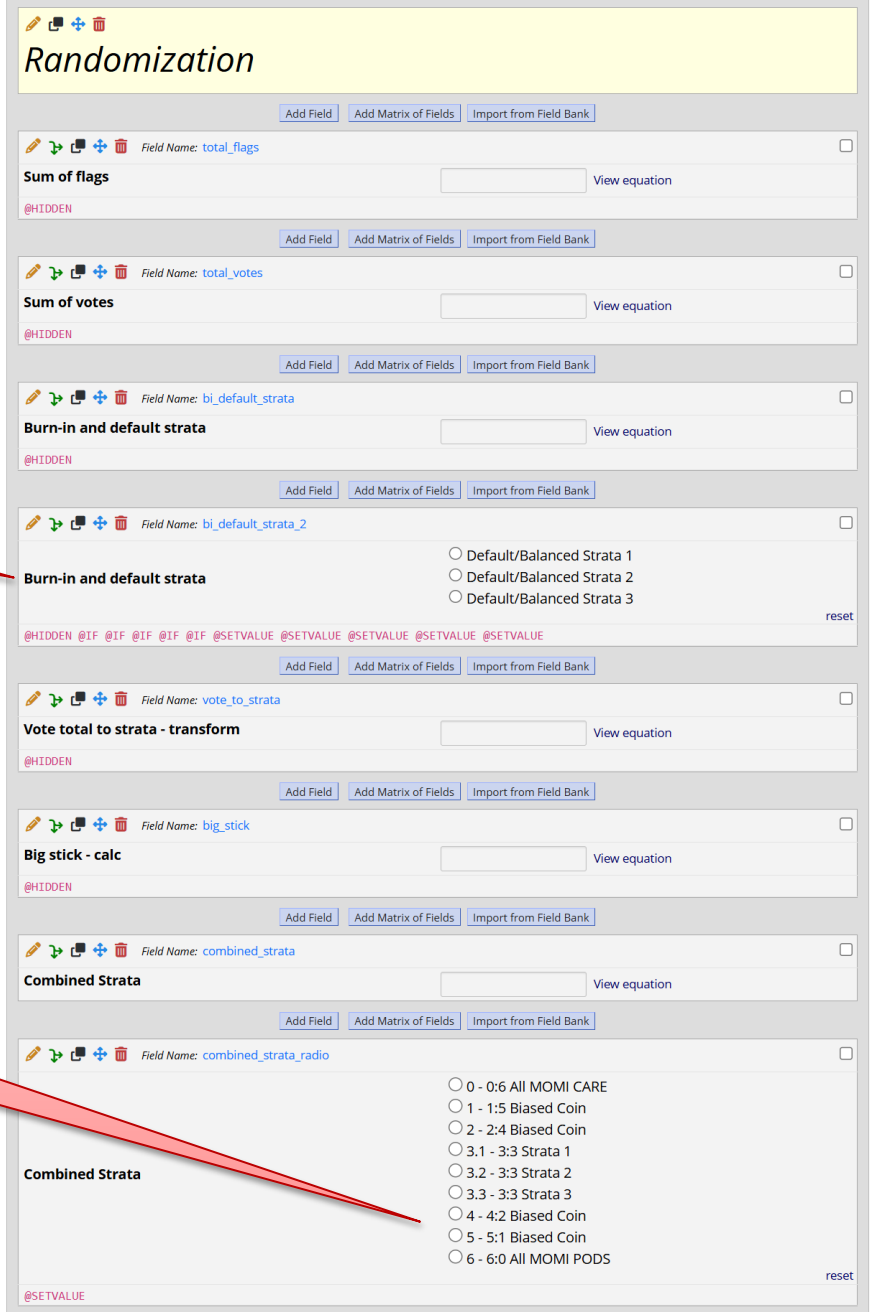


MOMI PODS Trial

Burn-in randomization period (first 100 patients randomized) using standard stratified block randomization

Post burn-in randomization period
Study arm allocation imbalance assessed
If the difference in study arm allocation was 4 or more, either *bc0* or *bc6* was utilized, with a deterministic assignment to the arm with fewer patients

(Im)Balance assessed:
If imbalanced, tally votes and utilize the appropriate table. If not imbalanced, default randomization tables were utilized



Key Takeaways

1. **Enhanced Trial Integrity**
   - MSB provides robust covariate balance with randomization integrity
2. **Balances on Key Covariates Without Over Stratification**
   - Enables for balance on both categorical and continuous baseline covariates, without requiring full stratification, avoiding issues with sparse strata and enabling flexible enrollment
3. **Practical Implementation**
   - Suitable for dynamic trial settings and can be implemented within platforms like REDCap, supporting real-time, site-level allocation decisions

Acknowledgments

- Madison Hyer
- Lai Wei
- Valerie Durkalski-Mauldin
- Melica Nikahd
- Shivam Joshi

RESPONSE ADAPTIVE RANDOMIZATION IN REDCAP

JOHN VANBUREN

UNIVERSITY OF UTAH DATA COORDINATING CENTER

HEALTH
UNIVERSITY OF UTAH

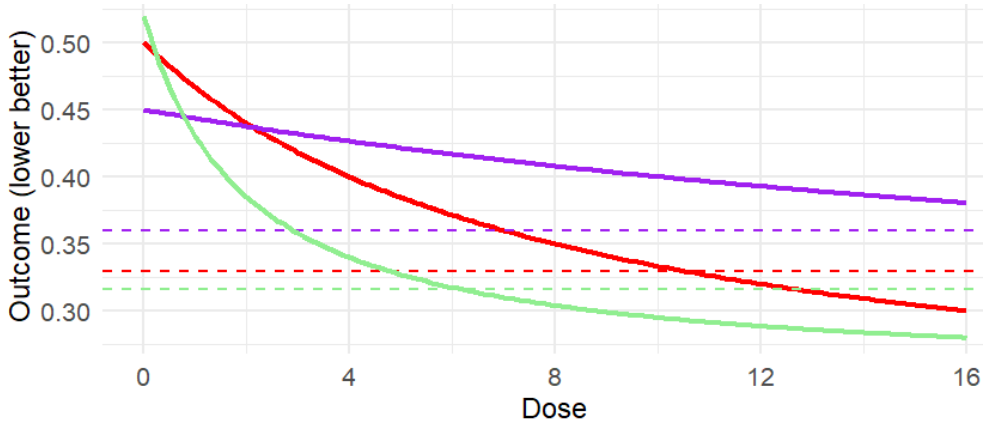
UTAH DCC
DATA COORDINATING CENTER

OUTLINE

- Overview of response-adaptive-randomization (RAR)
- Case example study
- Implementation in REDCap

RESPONSE ADAPTIVE RANDOMIZATION

- Goal: update the randomization allocation across arms based on observed outcome data to favor arms performing better



J Clin Oncol. 2012 Sep 10;30(26):3258-63. doi: 10.1200/JCO.2011.39.8420. Epub 2012 May 29.

Bayesian adaptive randomized trial design for patients with recurrent glioblastoma

Lorenzo Trippa [1], Eudocia Q Lee, Patrick Y Wen, Tracy T Batchelor, Timothy Cloughesy, Giovanni Parmigiani, Brian M Alexander

Affiliations + expand

PMID: 22649140 PMCID: PMC3434985 DOI: 10.1200/JCO.2011.39.8420

Case example

- Posterior probability that the E_{max} curve is decreasing
- Allocate to Pr(ED85)

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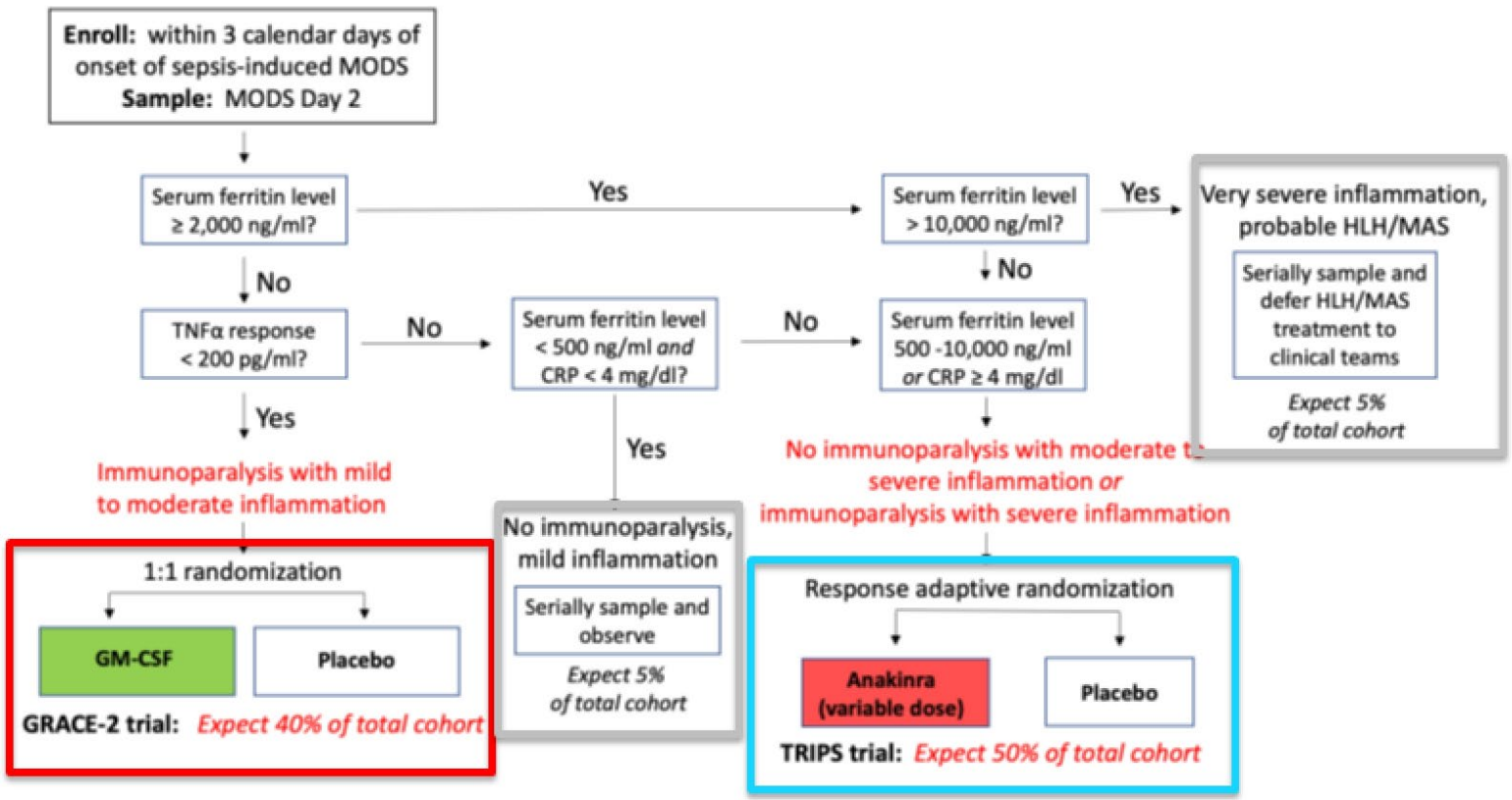
PRECISE

PeRsonalizEd immunomodulation in pediatriC sepsIS-inducEd MODS

Critically ill children with MODS will be immunophenotyped into one of four groups:

1. Immunoparalysis with mild to moderate inflammation;
2. No immunoparalysis with mild inflammation;
3. No immunoparalysis with moderate to severe inflammation, OR immunoparalysis with severe inflammation;
4. Very severe inflammation, probably macrophage activation syndrome (MAS) or hemophagocytic lymphohistiocytosis (HLH).



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PRECISE

- REDCap Cloud database
- 1095 total participants
  - 400 GRACE-2
  - 500 TRIPS
- REDCap randomization module

REDCap Cloud Database

Blood Results	
Date and time results received from Nationwide:*	[redacted]
TNFα (pg/mL):*	332.5
Ferritin (ng/mL):*	235
CRP (mg/dL):*	20.7

Study Cohort Assignment and Immunophenotype
Study Cohort Assignment:
TRIPS

PRECISE

TRIPS

- Target 400 subjects
- 4 doses anakinra vs placebo
- Frequent stopping boundaries
- Placebo fixed at 50% and anakinra updated based on outcomes
- Primary outcome at 28 days

Interim	Sample Size (Enrolled)	$Pr(E_{max} < 0)$	
		Efficacy Boundary	Futility Boundary
1	180	—	—
2	210	—	—
3	240	>0.998	<0.010
4	270	>0.997	<0.025
5	300	>0.996	<0.050
6	330	>0.995	<0.075
7	360	>0.994	<0.100
8	390	>0.993	<0.125
9	420	>0.992	<0.150
10	450	>0.991	<0.175
11	480	>0.990	<0.200
12	500 (max)	>0.978	—

REDCap Cloud Database

Were the immunophenotype results reported from Nationwide?*	Yes

Blood Results

Date and time results received from Nationwide:*	[redacted]
TNFα (pg/mL):*	332.5
Ferritin (ng/mL):*	235
CRP (mg/dL):*	20.7

Study Cohort Assignment and Immunophenotype

Study Cohort Assignment:

TRIPS

Immunophenotype

No immunoparalysis with moderate to severe inflammation

TRIPS Randomization Website

REDCap Cloud Database

https://redcap.utahdcc.org/redcap/redcap_v14.5.14/DataEntry/record_status_dashboard.php?pid=418

Website REDCap unique to this round of randomization

REDCap Randomization Database

TRIPS Randomization

Data Access Group: **CHOP**

Editing existing Randomization Record ID **1553-5**.

Randomization Record ID	1553-5
Please complete the following questions to confirm subject eligibility in TRIPS	
REDCap Cloud Subject ID: * must provide value	[redacted]1072 0 characters remaining Assigned in the main database
TNFα (pg/mL): * must provide value	322.5
Ferritin (ng/mL): * must provide value	235
CRP (mg/dL): * must provide value	20.7
Are you ready to randomize this subject to the TRIPS study? * must provide value	(•) Yes ( ) No
Randomization code:	Already randomized T-2386
Form Status	
Complete?	Complete
	-- Cancel --

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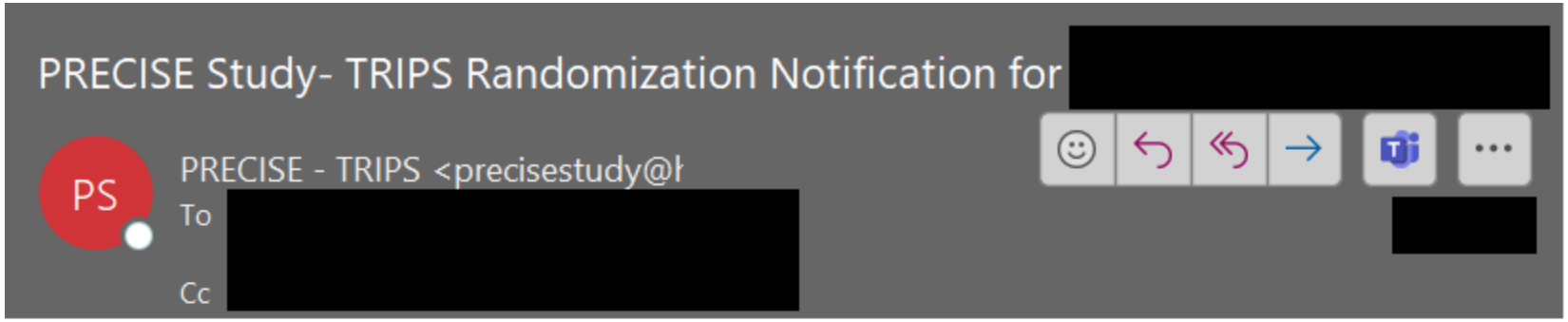
REDCap Randomization Email



Hello,

REDCap Randomization Record ID 1553-5 has been randomized in the PRECISE - TRIPS randomization database.

RedCap Cloud Subject ID: [redacted]-1072

Patient has been assigned randomization code: T-2386

Site Pharmacists: please proceed to enter the randomization code in the PRECISE randomization excel table for dosing calculations once study drug has been ordered and confirmed. Please remember this is a double-blind study and no information should be shared with the treating physician or the study team.

REDCap Cloud Database

TRIPS Randomization Website

https://redcap.utahdcc.org/redcap/redcap_v14.5.14/DataEntry/record_status_dashboard.php?pid=418

TRIPS Randomization Data

Date and Time of TRIPS randomization in REDCap:*	[redacted]	
REDCap Randomization Record ID:*	1553-5	
REDCap Randomization Code:*	T-2386	

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TRIPS Randomization Website REDCap Cloud Database

https://redcap.utahdcc.org/redcap/redcap_v14.5.14/DataEntry/record_status_dashboard.php?pid=418

- Switch websites in REDCap Cloud to new TRIPS Randomization sequence
- De-activate and remove access to current TRIPS randomization REDCap
- Activate and give access to new TRIPS randomization REDCap

3 Different REDCap Randomization Projects

PRECISE- GRACE2 Randomization

PRECISE- TRIPS Randomization

Future TRIPS Randomization

SUMMARY

- Two embedded RCTs within a project
- Linked clinical database to external REDCaps to allow for multiple randomizations
- After an interim is completed, main clinical database updated with new REDCap randomization link

REDCap Randomisation 2.0

Matt Shotwell
Vanderbilt University Medical Center
2025-05-21

Material adapted from talks by:

- Luke Stephens - Murdoch Children's Research Institute
- Jon Casey - Vanderbilt University Medical Center

REDCap Randomisation 2.0

This is the story of **Randomisation 2.0**

Record ID	11
Randomization stratum * must provide value	
Randomization group	Randomize

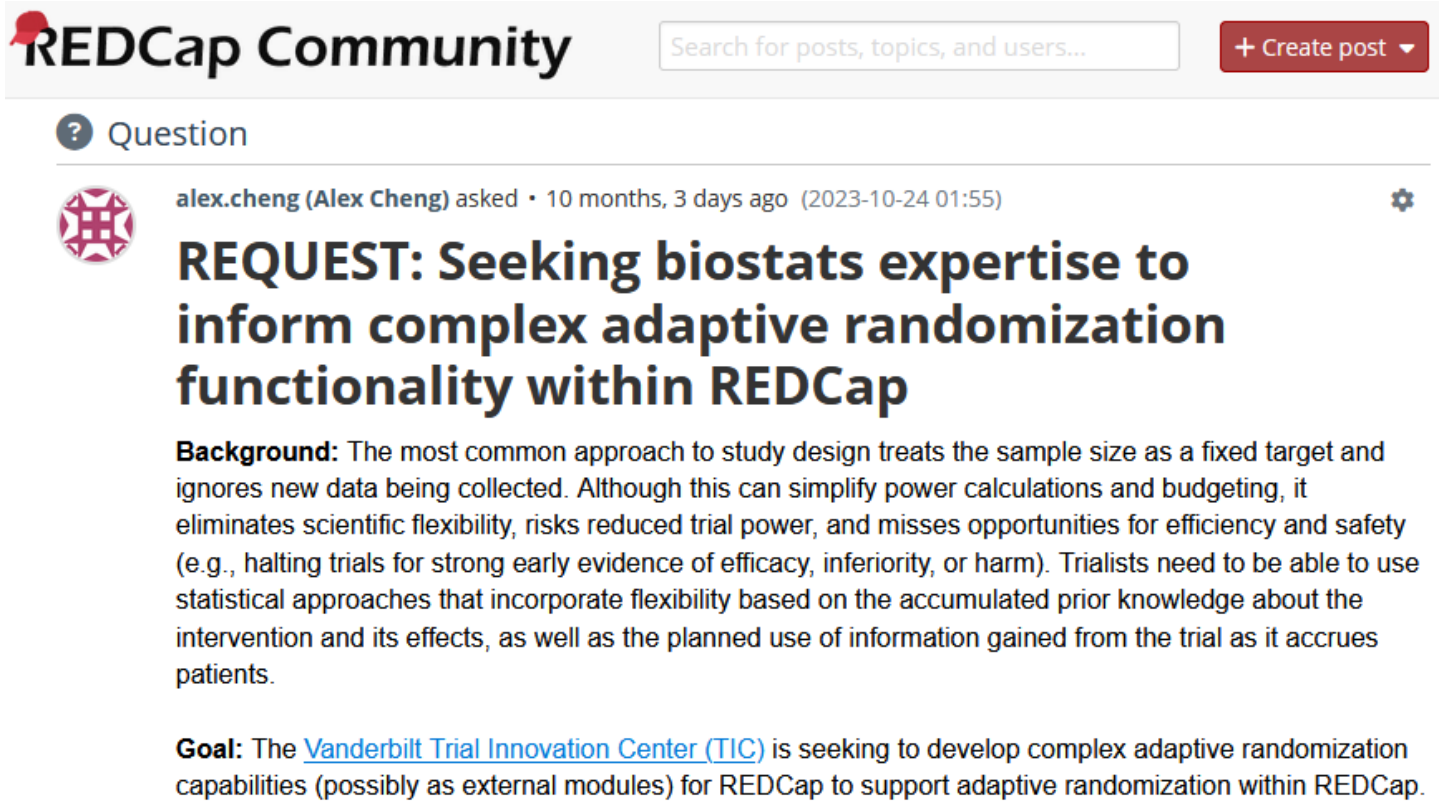
	A	B
1	randalloc	stratum
2	1	1
3	2	1
4	1	1
5	2	1
6	2	1
7	1	1
8	1	1
9	2	1
10	1	1

Version 4.11.0 (released on 2012-04-27)

- NEW FEATURES & IMPROVEMENTS:
  - New Randomization module
  - The randomization module in REDCap will help your users implement a defined randomization model within their project, allowing them to randomize their subjects (i.e. records in their project). In this module, they will first define the randomization model with various parameters. Based on the defined parameters, the module creates a template allocation table, which they can use to structure the randomization table that they will import. The module also monitors the overall allocation progress and assignment of randomized subjects.

Available in latest Version 15.4.0 (2025-02)

REDCap Randomisation 2.0



REDCap Randomisation 2.0

Starting November 2023…

Consultation and discussions with a range of stakeholders from VUMC / VICTR and other clinical trials centres:

- Various meetings
- Demonstrations
- Design Studio

Agreed list of enhancements for development

1. Multiple randomisations in a project
2. Improve concealed allocation support
3. Smart variables e.g. for time / number
4. Real-time trigger logic
5. Administrator tools for editing
6. API method
7. Hook function

8. **Alternative allocation algorithms**
9. **Medication pack management**

REDCap Randomisation 2.0

Intuitive, familiar interface

Summary | Setup 1 | Dashboard 1

STEP 1: Define your randomization model

This step will allow you to define the randomization model you will be implementing and all its parameters, which includes defining strata (if applicable) and optionally randomizing subjects per group/site (if a multi-site study).

NOTE: This section is currently locked and uneditable because the randomization setup process has already been completed. Because this project is in Production status, the randomization setup values below CANNOT be modified.

A) Use stratified randomization?

It is often necessary to ensure equal treatment among a number of factors. Stratified randomization is the solution to achieve balance within one or more subgroups, such as sex, race, diabetics/non-diabetics, etc. By choosing strata (multiple choice criteria fields), you may then be able to ensure balance within those subgroups. Tell me more

B) Randomize by group/site?

If this is a multi-center/multi-site project (or something similar), you may want to stratify the randomization by each group/site. You can select an existing multiple choice field that represents the groups/sites, OR you can use Data Access Groups to stratify by group/site.

C) Choose your randomization field

This is the field where the "Randomize" button will appear on your data collection form. The type of field you choose (text field vs. single-select multiple choice field) dictates the Allocation Type for this randomization model.

For open randomization:

- Select a single-select (dropdown or radio) field. The randomized **group allocation** will be saved to this field.

For concealed (blinded) randomization:

- Select a text field that does not have field validation. The assigned **randomization number** will be saved to this field.

Note that the randomization number is available through the smart variable `[rand-number]`.

randomization (Randomization)

Allocation will be **concealed (blinded)** with **randomization number** assigned to this **text** field.

Save randomization model | Erase randomization model

Summary

Show 10 entries | Search:

#	Target	Allocation Type	Stratification	Total Allocations (Production)	Setup	Dashboard	Randomization ID
1	randomization		×	3			2815
2	randomization_2		×	3			2816

Showing 1 to 2 of 2 entries | Previous 1 Next

+ Add new randomization model

STEP 2: Download template allocation tables (as Excel/CSV files)

Below are some example files that you may download to get a general idea for how you may structure your own randomization table. You do not have to use any of these. In fact, **we recommend that you NOT use these exact templates** but instead recommend that you merely use them as an example or baseline to start from in order to create your own custom allocation file. After uploading your allocation table in Step 3 below, it will then be used as a lookup table to perform assignments when subjects are being randomized. **NOTE:** Record names (e.g., study ID) should NOT be included as a column in your allocation table, but only the fields listed in the example files below. More details

Example #1 (basic) | Example #2 (all possible combos) | Example #3 (5x all possible combos)

STEP 3: Upload your allocation table (CSV file)

Once you have created your custom allocation table as a CSV file and made sure that you kept the format prescribed in the template files from Step 2 above, you may now upload the file below. It will be checked for any possible errors first before it is accepted and stored in REDCap. Please note that you will need to create two different allocation tables: one to be used for testing while your project is in development status and the other for use when in production status. Below are some important reminders before you begin uploading your allocation tables.

Reminders:

- Once your project is in production status, the allocation tables will become locked and unmodifiable.
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Already uploaded

Upload allocation table (CSV file) for use in DEVELOPMENT status

Download table

REDCap Randomisation 2.0

Intuitive, familiar interface

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Showing 1 to 2 of 2 entries | Previous 1 Next

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Already uploaded

Upload allocation table (CSV file) for use in DEVELOPMENT status

Download table

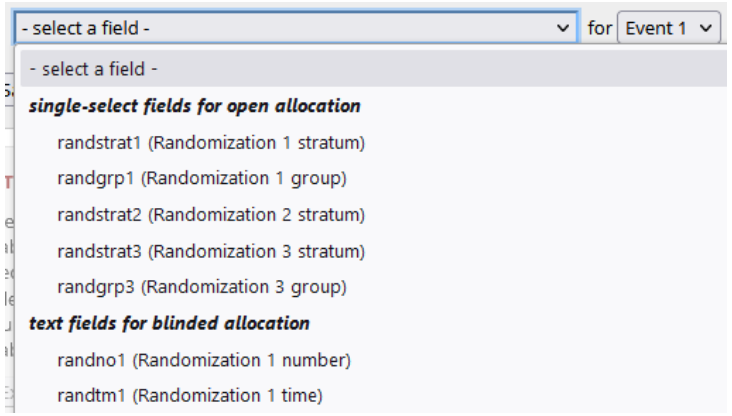
REDCap Randomisation 2.0

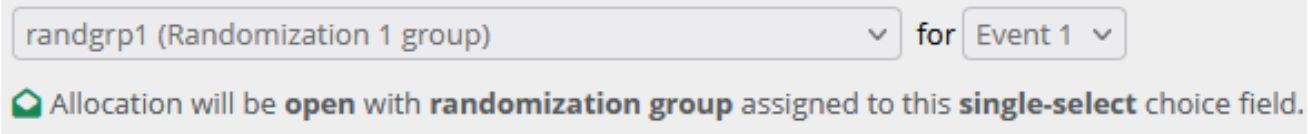
2. Improved support for concealed allocation

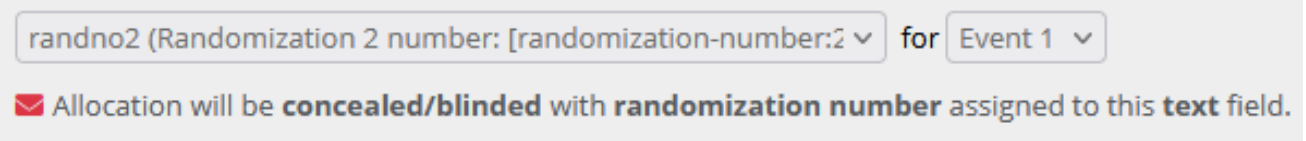
Randomising user sees only an allocation id – randomisation number

Separate list of number to group mapping:

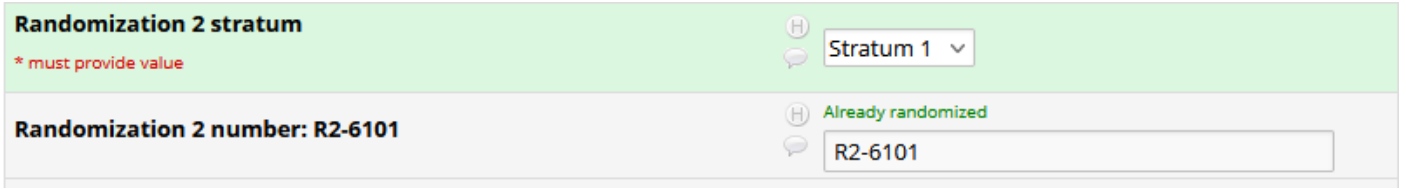
- In Pharmacy, for medication pack dispensing
- In separate project for code break







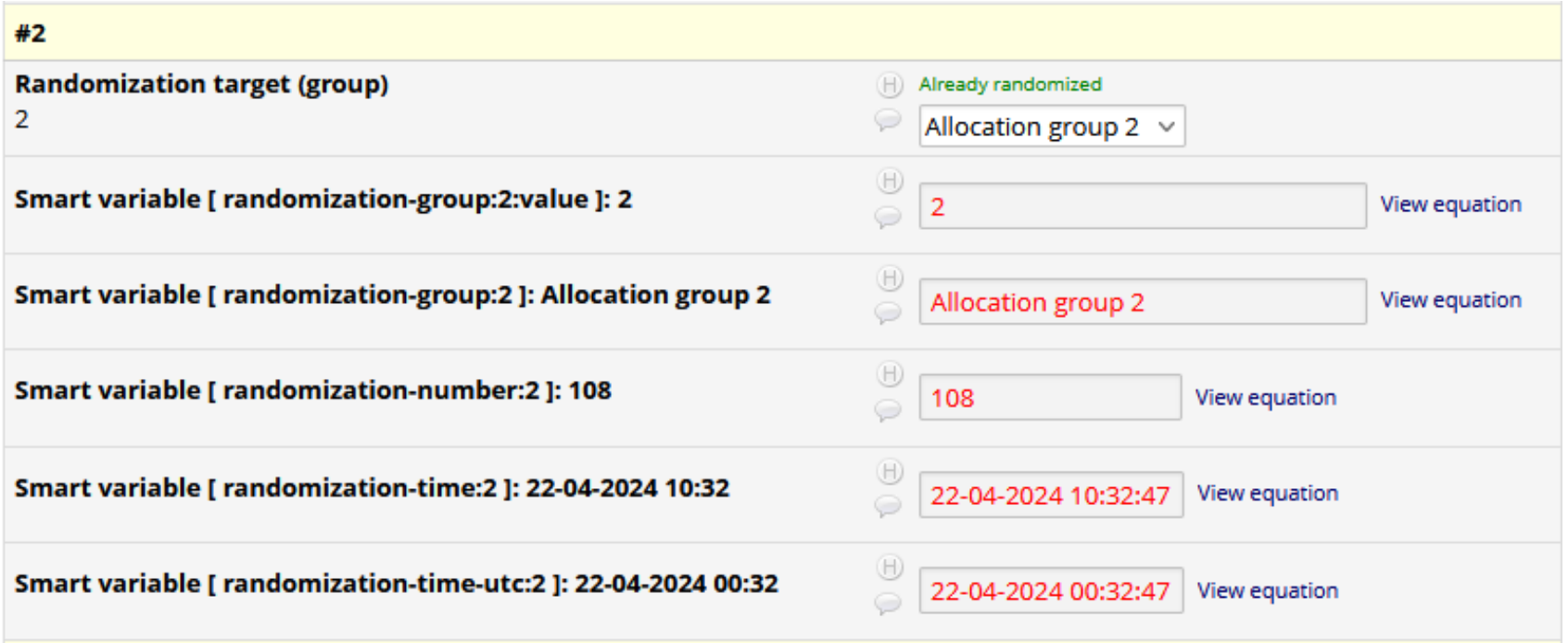
	A	B	C	D
1	redcap_randomization_number	redcap_randomization_group	randstrat2	redcap_data_access_group
2	R2-6101	Blinded Group 1	1	6
3	R2-6102	Blinded Group 2	1	6
4	R2-6103	Blinded Group 1	1	6
5	R2-6104	Blinded Group 2	1	6
6	R2-6105	Blinded Group 1	1	6



REDCap Randomisation 2.0

3. Smart variables

- `[rand-number]`
- `[rand-time]`
- `[rand-time-utc]`
- ~~`[rand-group]`~~



Specify which when have multiple

- `[rand-number:2]`

REDCap Randomisation 2.0

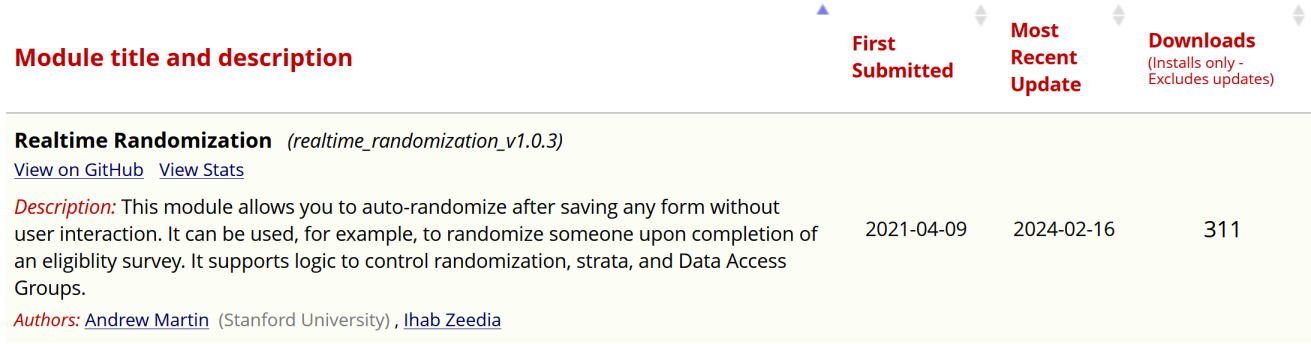
4. Real-time trigger logic

Automatically perform a randomisation on form save when logic condition is true

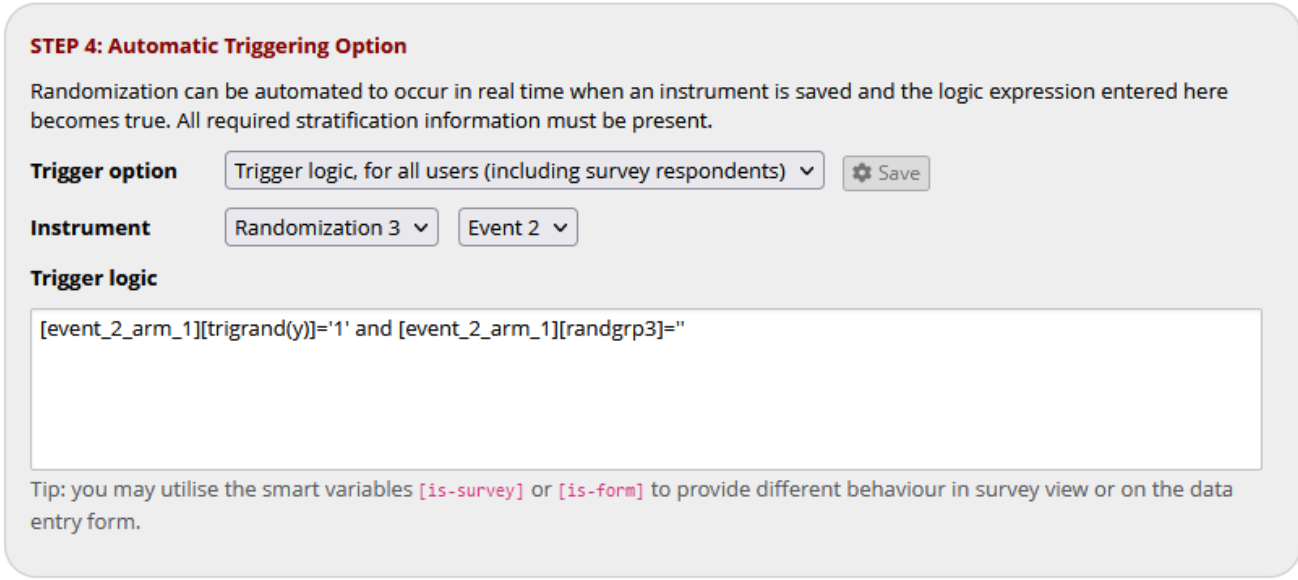
Inspired by Andy Martin's "**Realtime Randomization**" external module

Options:

- Off: click "Randomize" button to randomise
- Trigger for users with "Randomize" permission only
- Trigger for all users – including survey



Module title and description	First Submitted	Most Recent Update	Downloads (Installs only - Excludes updates)
Realtime Randomization *(realtime_randomization_v1.0.3)* View on GitHub View Stats *Description:* This module allows you to auto-randomize after saving any form without user interaction. It can be used, for example, to randomize someone upon completion of an eligiblity survey. It supports logic to control randomization, strata, and Data Access Groups. *Authors:* Andrew Martin (Stanford University) , Ihab Zeedia	2021-04-09	2024-02-16	311



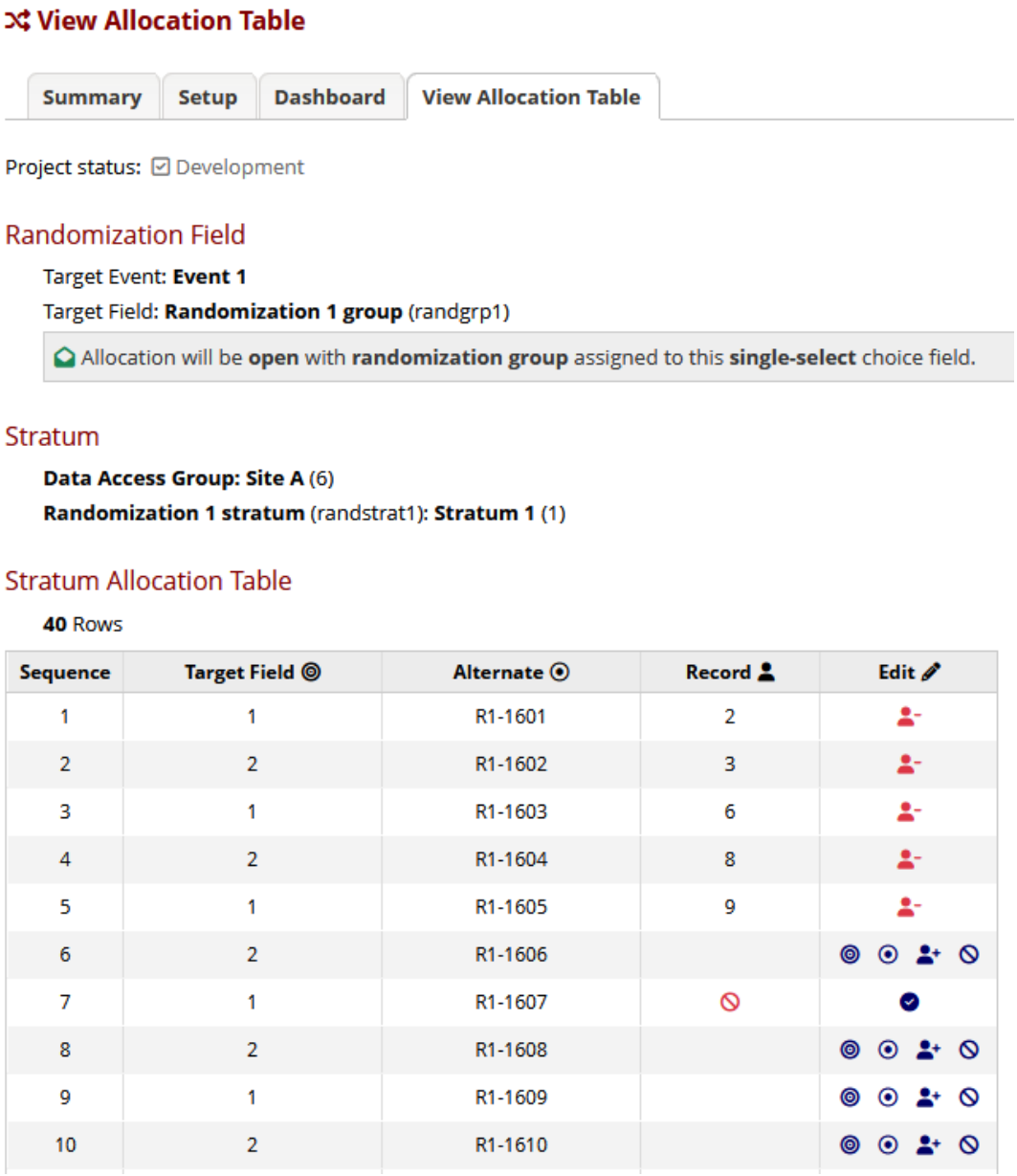
REDCap Randomisation 2.0

5. Administrator Editing Tools

Administrator access from Dashboard

(Rare!) Actions:

- Manual randomisation
- Remove a randomisation
- Make list entry unavailable
- Make list entry available
- Edit target field
- Edit alternate field



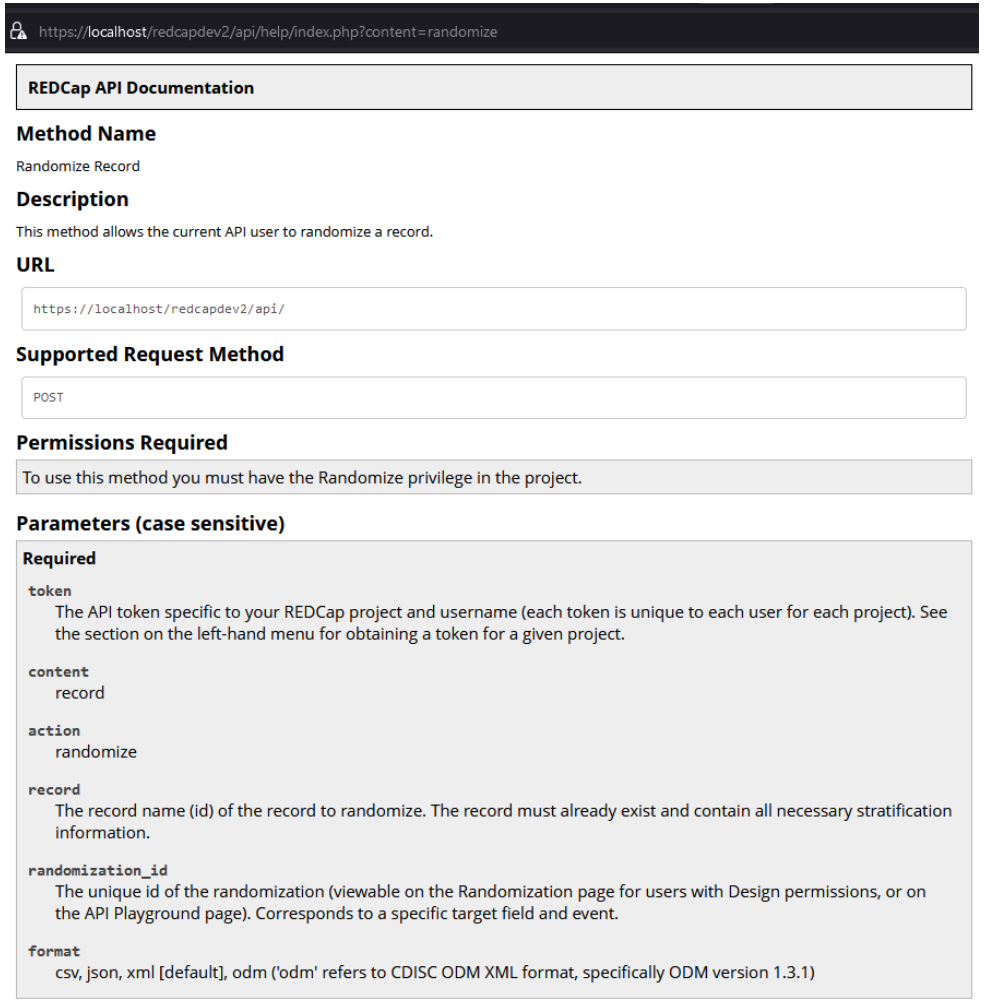
REDCap Randomisation 2.0

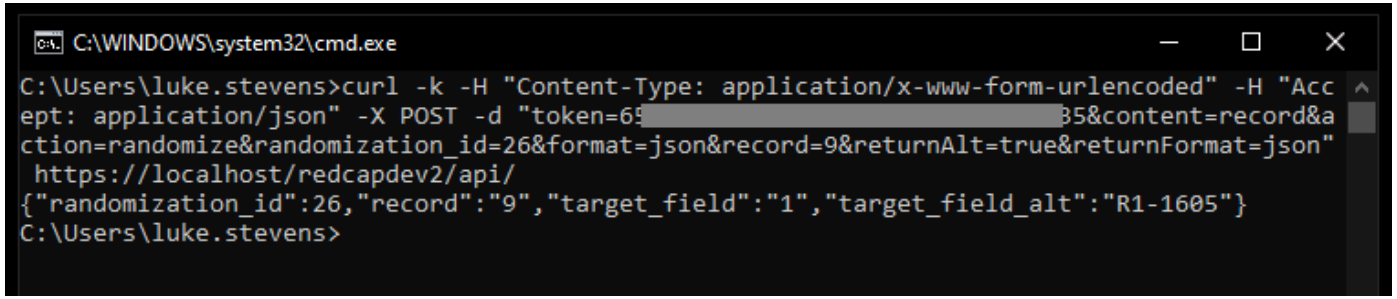
6. API Method

Randomise a record using an API call from outside REDCap

Facilitate integration of randomisation functionality into other systems and processes

Does not replicate data import method: record must exist and have stratification data





REDCap Randomisation 2.0

7. Hook Function

Called at the point where REDCap selects the next allocation

Methods for querying the allocation table:

- Read next allocation for stratum
- Update table data

Facilitates development of alternative allocation algorithms e.g. dynamic:

- Update allocation group for record dynamically based on previous allocations

redcap_randomize_record

(REDCap >= 17.?.?)

`redcap_randomize_record` — Allows custom actions to be performed prior to the randomization of a record e.g. to override the default randomization allocation.

Description

```
void redcap_randomize_record ( int $project_id, int $randomization_id, string $record, array $field_values, int $group_id )
```

It is expected that only one external module implementing this hook will be enabled in a single project. A warning will be generated if multiple external modules return results from this hook.

Location of Execution

The function is executed immediately prior to lookup and assignment of the next available entry in the randomization allocation table. This lookup and allocation is skipped if all redcap_randomize_record hooks return false.

README GPL-3.0 license

REDCap External Module: Extended Randomisation

Luke Stevens, Murdoch Children's Research Institute https://www.mcri.edu.au/

https://github.com/lsgs/redcap-extended-randomisation2

Summary

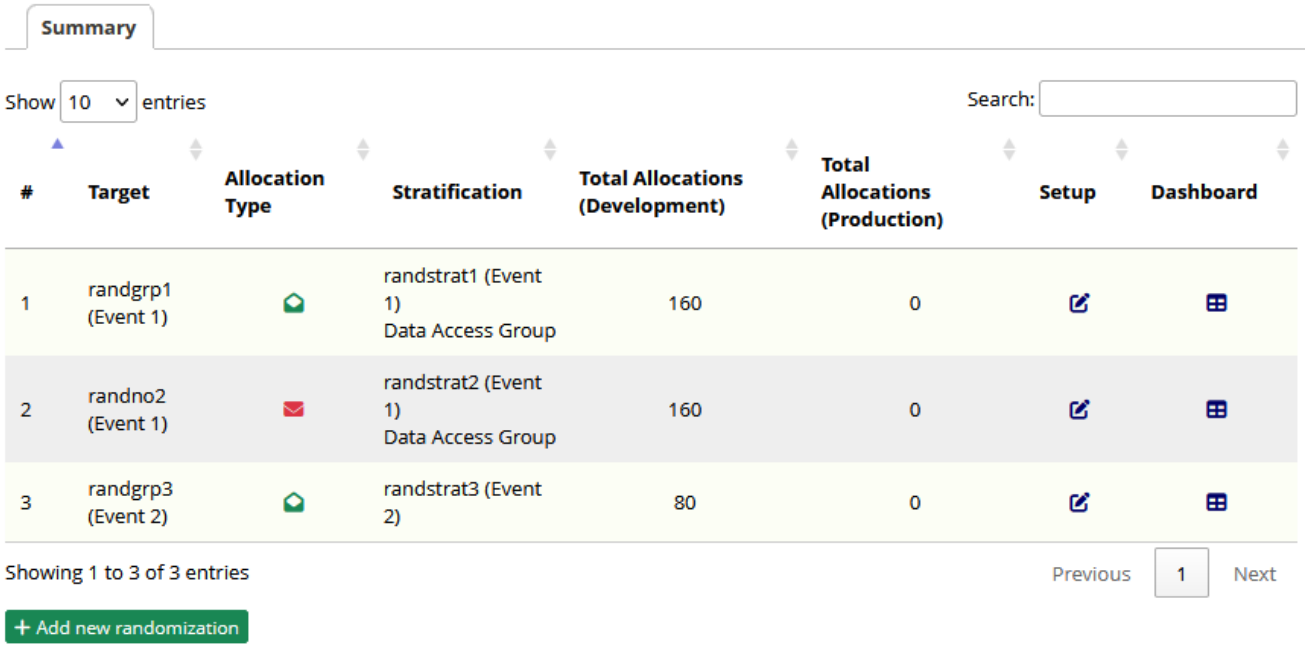
REDCap external module for dynamic randomisation (biased coin minimisation) utilising the new `redcap_randomize_record()` hook.

REDCap Randomisation 2.0

1. Multiple randomisations in a project

Trials are increasing in diversity and complexity*:

- Adaptive trials – randomisation configuration alterations at defined points in trial
- Platform trials – multiple interventions, parallel or sequential

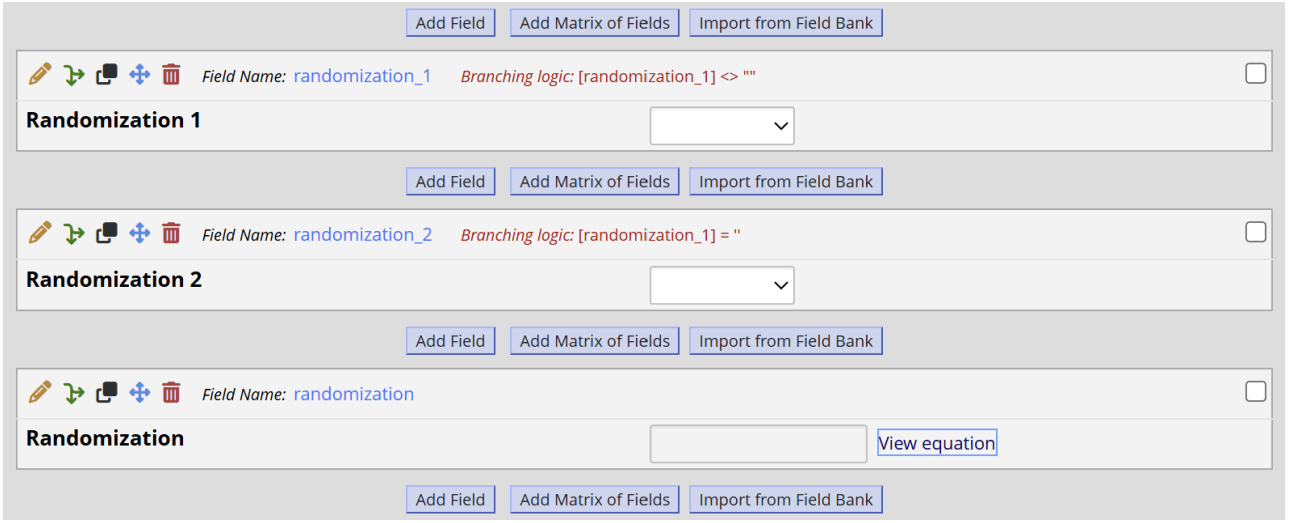


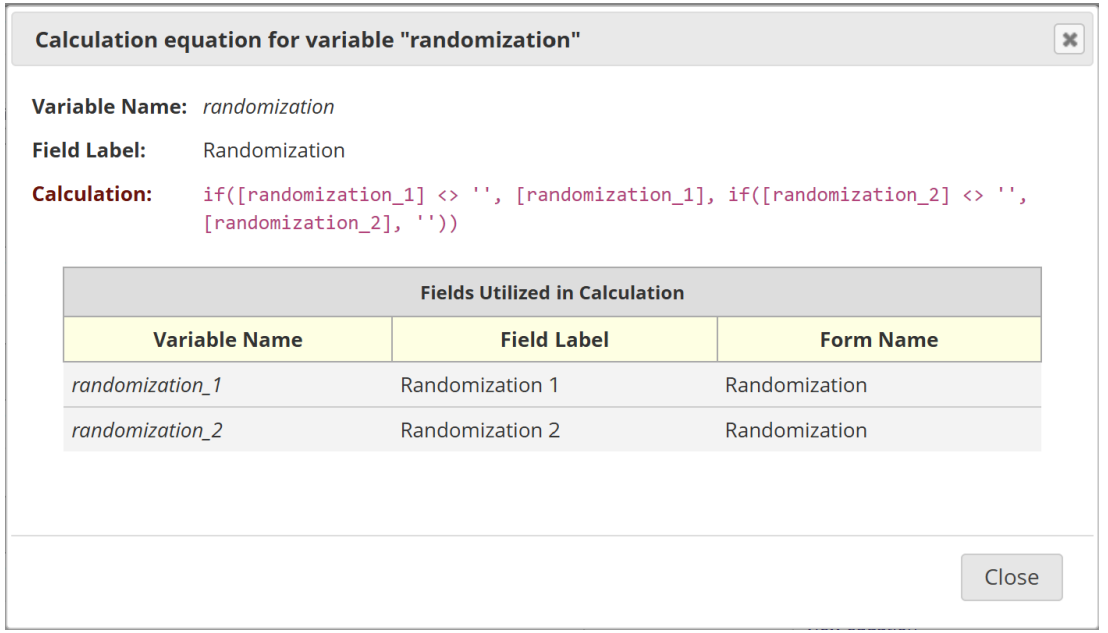
* Zabor, E. C., Kaizer, A. M., & Hobbs, B. P. (2020). Randomized Controlled Trials. *Chest*, *158*(1S), S79-S87. https://doi.org/10.1016/j.chest.2020.03.013

REDCap Randomisation 2.0

Use case: (intermittent) adaptive randomization

- The PRECISE trial (VanBuren) was response adaptive
- Allocation ratios across 4 dose levels updated at each of 12 interims
- May be accomplished by adding new randomizations at each interim
- Use branching logic to hide old randomizations
- Combine randomizations using calculated field





REDCap Randomisation 2.0

Use case: (continuous) adaptive randomization

- Adaptation that occurs prior to each randomization still extra work
- MSB (Palettas) could be implemented using hook function (external module)

redcap_randomize_record

(REDCap >= 17.?.?)

`redcap_randomize_record` — Allows custom actions to be performed prior to the randomization of a record e.g. to override the default randomization allocation.

Description

```
void redcap_randomize_record ( int $project_id, int $randomization_id, string $record, array $field_values, int $group_id )
```

It is expected that only one external module implementing this hook will be enabled in a single project. A warning will be generated if multiple external modules return results from this hook.

Location of Execution

The function is executed immediately prior to lookup and assignment of the next available entry in the randomization allocation table. This lookup and allocation is skipped if all redcap_randomize_record hooks return false.

REDCap Randomisation 2.0

"And remember — with great randomization flexibility comes great responsibility.“

Questions?