

MODULE

2

Attrition

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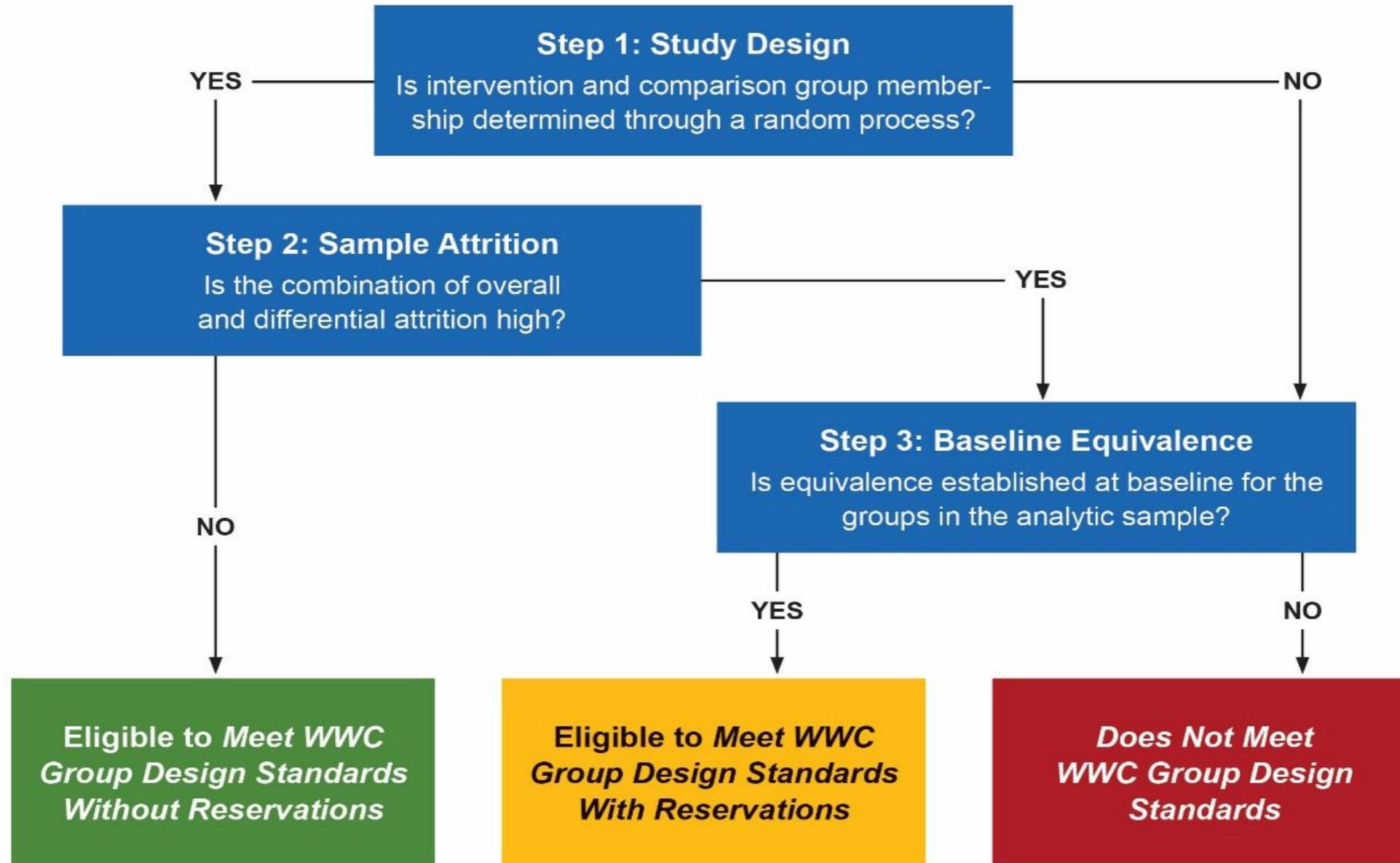
MODULE

2 Attrition

After completing this module, you will be able to:

- ❖ Define **attrition** and explain why it is important
- ❖ Calculate attrition rates and apply WWC standards for **randomized controlled trials (RCTs)**
- ❖ Identify what the WWC does and does not consider attrition

Group Design Standards Framework

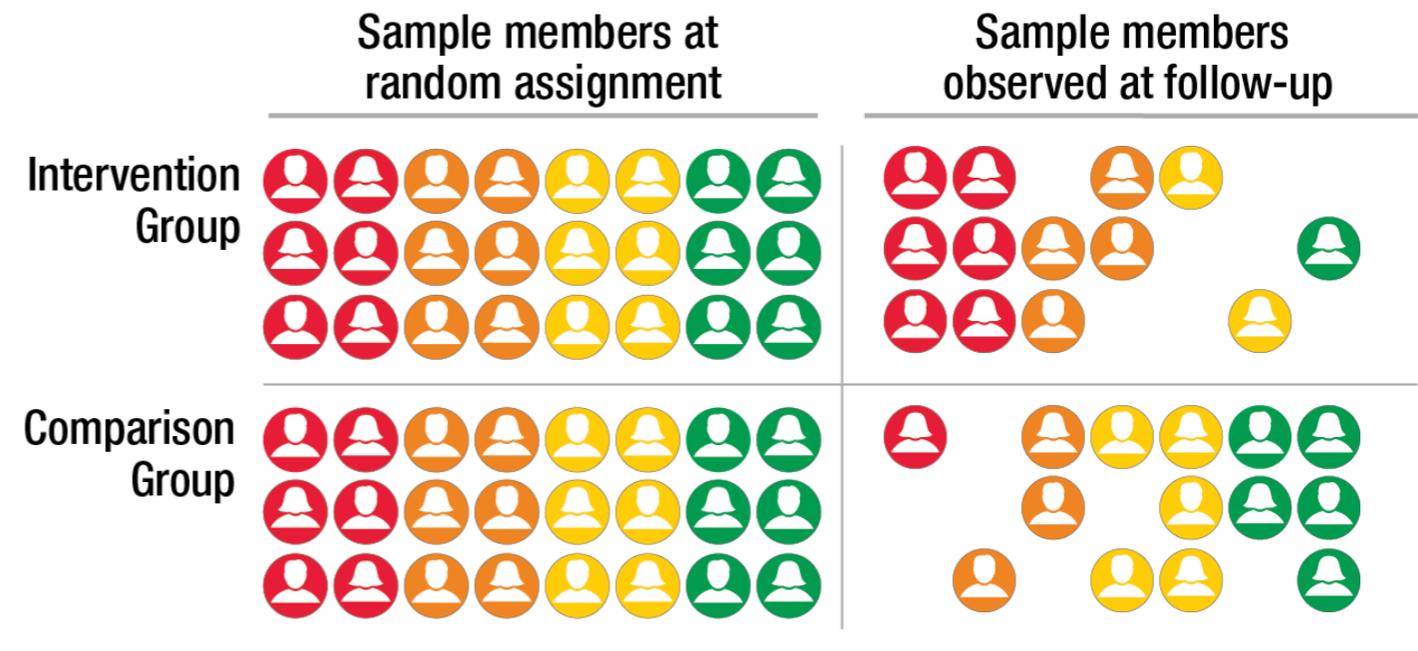


What is Attrition?

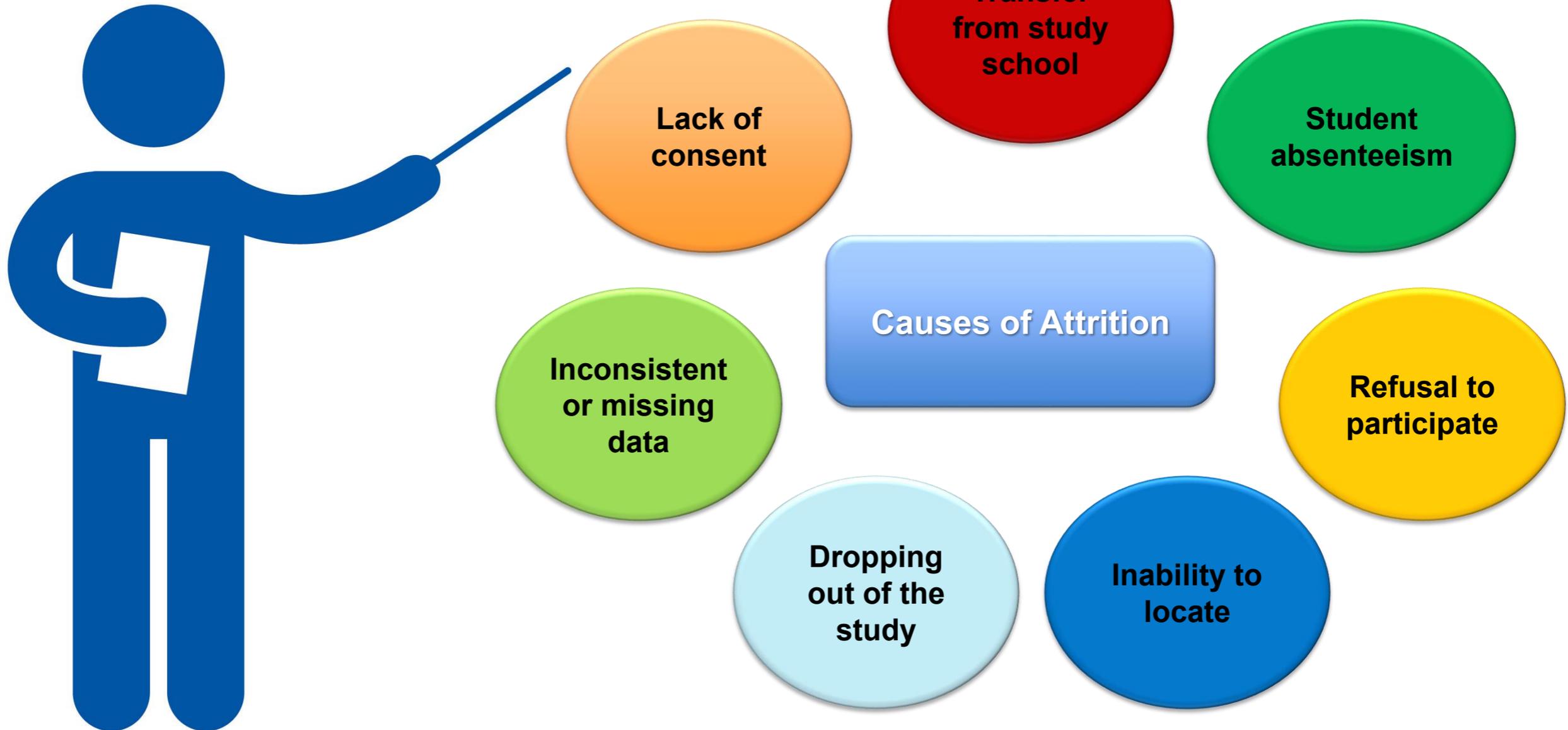
Attrition is the loss of study units from a sample.

It occurs when an analysis does not include a sample member who was randomly assigned.

Within a study, attrition rates may vary across time periods, data sources, and **outcomes**.



What Causes Attrition?

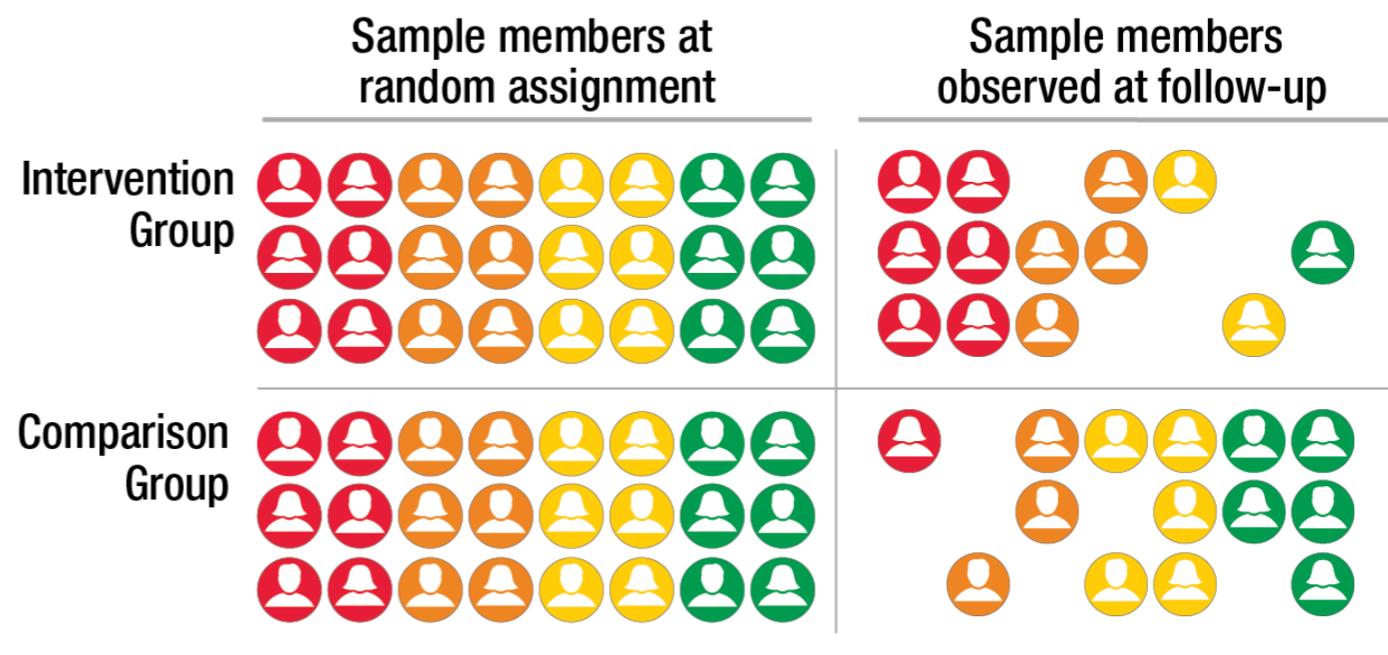


Why Does the WWC Care About Attrition?

Using random assignment, the intervention and comparison groups should be similar.

When attrition occurs, the groups can become dissimilar.

This can lead to bias in the estimated effect of the intervention.



If red individuals always score higher, the estimated impact could be too large.

Attrition and the WWC

Overall Attrition

The percentage of randomly assigned units for which the authors do not observe outcome data.

Level of attrition for the whole sample.

Differential Attrition

The absolute value of the percentage point difference between attrition rates for the intervention group and the comparison group.

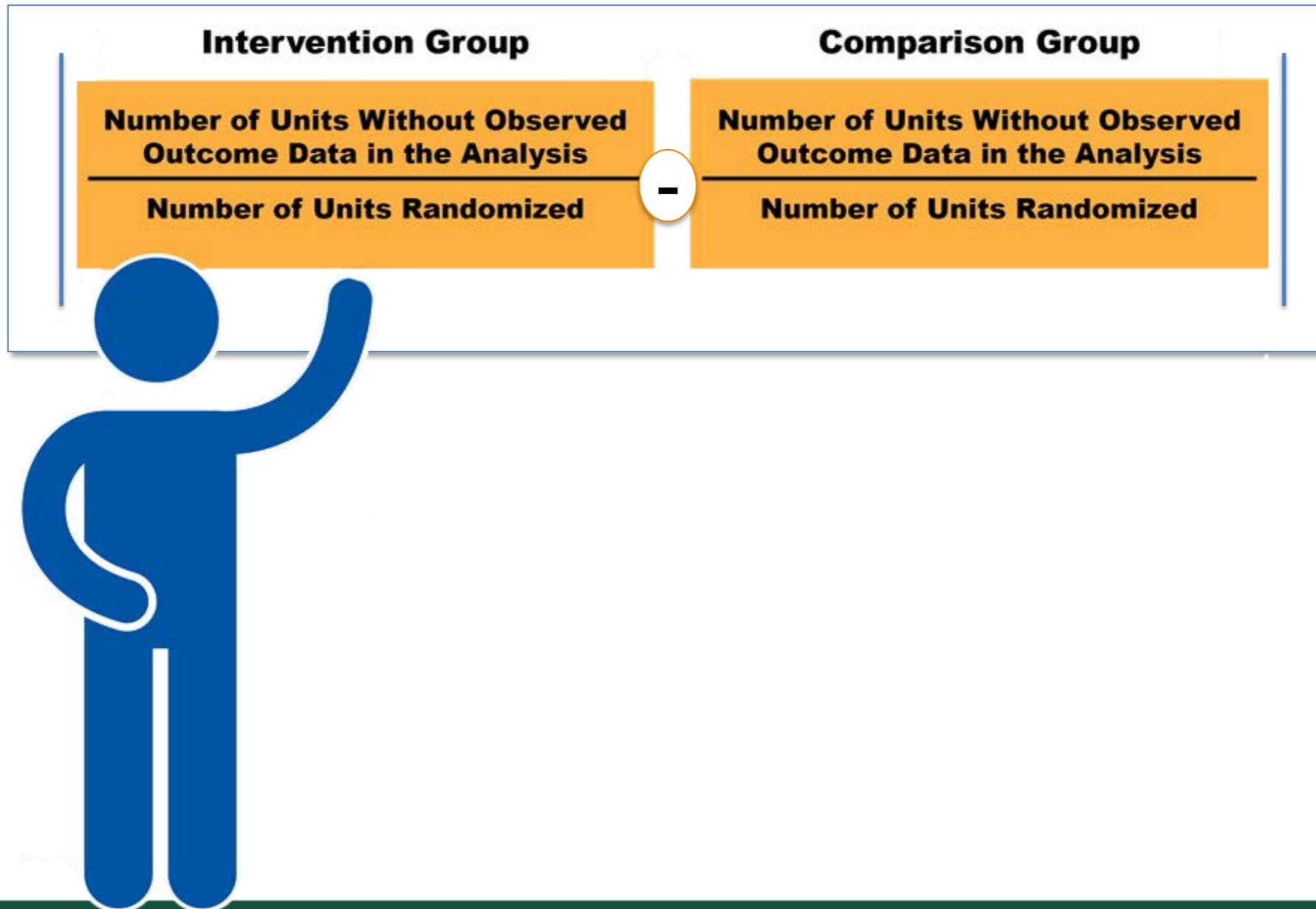
Level of attrition for the intervention group minus the level of attrition for the comparison group.

How Does the WWC Calculate Overall Attrition?

$$\text{Overall Attrition Rate} = \frac{\text{Number of Units Without Observed Outcome Data in Analysis}}{\text{Number of Units Randomized}}$$



How Does the WWC Calculate Differential Attrition?



Example: Calculating Attrition, Part 1

A research team randomly assigns 1,000 students to the intervention group and 1,100 to the comparison group. The team collects posttest data from 900 intervention students and 927 comparison students.

- ❖ What is the overall attrition?
- ❖ What is attrition for the intervention group?
- ❖ What is attrition for the comparison group?
- ❖ What is the differential attrition?

Example: Picturing Attrition

Sample groups	Number of students assigned	Number of students who contribute posttest data
Intervention group	1,000	900
Comparison group	1,100	927
Total	2,100	1,827

Example: What Is the Overall Attrition?

To calculate overall attrition, you need two quantities:

1

Total sample size

- There were 1,000 intervention group students and 1,100 comparison group students.
- The total sample is 2,100.

2

Total number of sample members with observed data

- There were 900 intervention group students and 927 comparison group students with observed outcome data.
- The total is 1,827.

To calculate overall attrition: $(2,100 - 1,827)/2,100 = 273/2,100 = 13\%$

Example: What Is the Differential Attrition?

To calculate differential attrition, you need two quantities:

1

Attrition for the intervention group

- Total sample size: 1,000
- Number of students without observed data: $1,000 - 900 = 100$
- Attrition for the intervention group = $100/1,000 = 10\%$

2

Attrition for the comparison group

- Total sample size: 1,100
- Number of students without observed data: $1,100 - 927 = 173$
- Attrition for the comparison group = $173/1,100 = 15.7\%$

To calculate differential attrition = $| 10 - 15.7 | = 5.7$ percentage points

The WWC Attrition Standard

- ❖ The attrition standard limits the amount of bias that could result from attrition in an RCT that receives the highest rating.
- ❖ Based on a model that identifies the amount of bias for each combination of overall and differential attrition.
- ❖ Defines high attrition as bias ≥ 0.05 standard deviations.
- ❖ Defines low attrition as bias < 0.05 standard deviations.

Matching Game: Attrition and the WWC Standard

Match a phrase in the **left column** with a phrase in the **right column**.

1. Attrition

A. The percentage of randomly assigned individuals who do not have outcome data

2. Overall attrition

B. Systematic error in an estimate due to loss of sample

3. Attrition bias

C. When an analysis does not include an outcome from an individual randomly assigned in the study

4. Differential attrition

D. Effect size (ES) of $|0.05|$ (0.05 standard deviations)

5. Tolerable level of bias

E. The difference between intervention and comparison group attrition

Knowledge Check 1

Which is not a cause of attrition?

- A. Researchers collected parent permission forms after random assignment. Some parents did not want their child to participate in the study.
- B. Thomas had permission from his parents to participate in the study, but he refused to complete the assessment.
- C. Anne took the pretest, participated in the intervention, then dropped out of the study.
- D. Juanita did not consent to the study before random assignment, so the authors did not collect outcome data from her.

Answer to Knowledge Check 1

- A is an incorrect answer.** Nonconsent following random assignment is a cause of attrition.
- B is an incorrect answer.** Refusal to participate is a cause of attrition.
- C is an incorrect answer.** An individual dropping out of the study after randomization is a cause of attrition.
- D is the correct answer.** Nonconsent before randomization is not a cause of attrition.

Knowledge Check 2

Which is not a cause of attrition?

- A. Ricky, Elena, and Sam were absent on the day of outcome data collection.
- B. Martin was not listed on the class roster that was used to randomly assign students, so he was not randomized to a condition. Because of this, the researchers did not collect outcome data from Martin.
- C. Researchers could not locate Jim, Juan, and Samina because they did not attempt to track and collect data from students who moved or dropped out of school.
- D. Researchers used school records to construct study outcomes, and the records were incomplete.

Answer to Knowledge Check 2

- ❑ **A is an incorrect answer.** Participants' being unavailable or absent on the day(s) of data collection is a cause of attrition.
- ❑ **B is the correct answer.** A participant must be randomly assigned to be counted as attrition.
- ❑ **C is an incorrect answer.** The research team's inability to locate participants who were randomized is a cause of attrition.
- ❑ **D is an incorrect answer.** Inconsistent or incomplete administrative records leading to missing data are a cause of attrition.

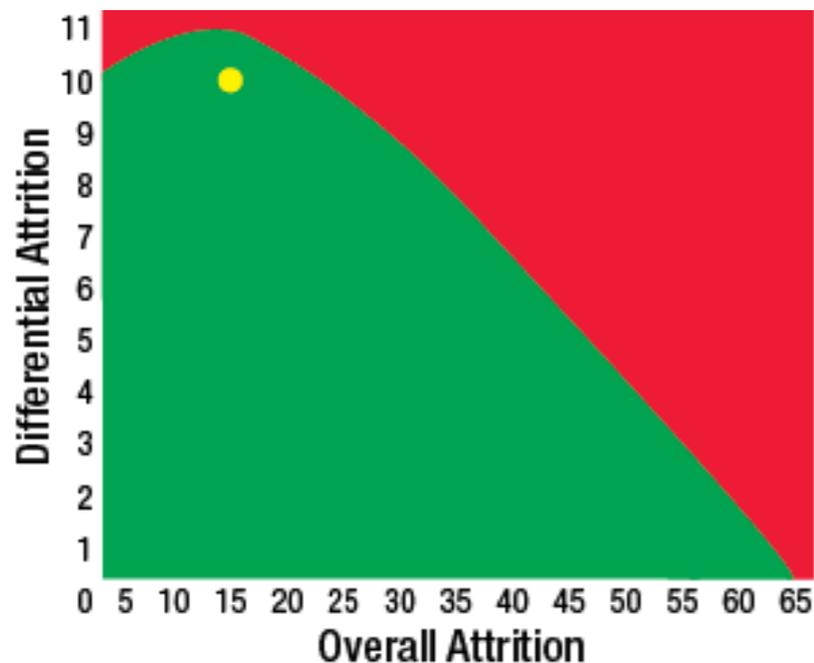
Attrition Thresholds

- ❖ Based on the attrition model, the WWC has defined two thresholds for attrition.
- ❖ The thresholds separate high and low attrition.
 - ❖ Low attrition can *Meet WWC Group Design Standards Without Reservations*.
 - ❖ High attrition can *Meet WWC Group Design Standards With Reservations* if the study demonstrates equivalence.
- ❖ The **optimistic threshold** assigns less attrition bias to each combination of overall and differential attrition.
- ❖ The **cautious threshold** assigns more attrition bias to each combination.

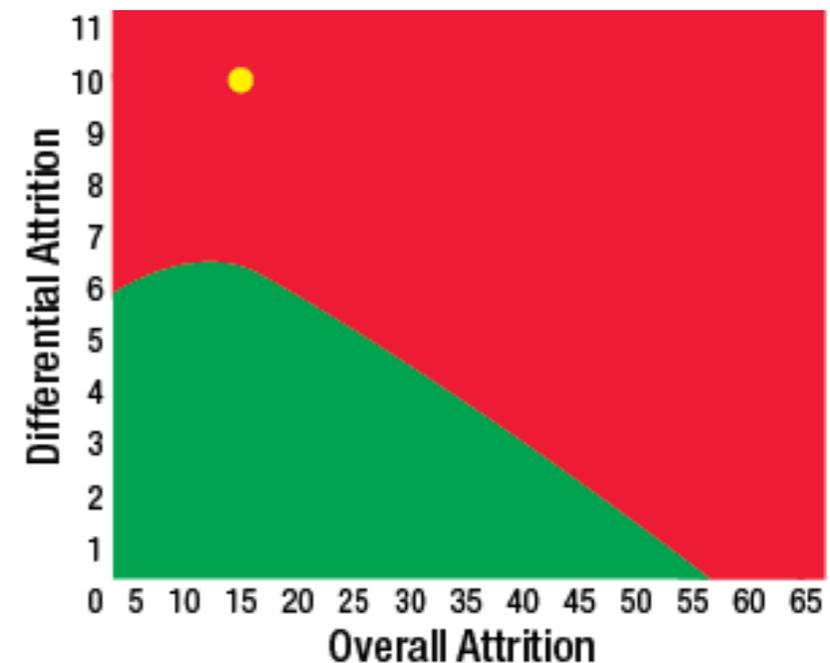
Selecting an Attrition Threshold

- ❖ The review protocol specifies an attrition threshold.
- ❖ The yellow dot is a study with low attrition under the optimistic attrition threshold and high attrition under the cautious threshold.

Optimistic Attrition Threshold



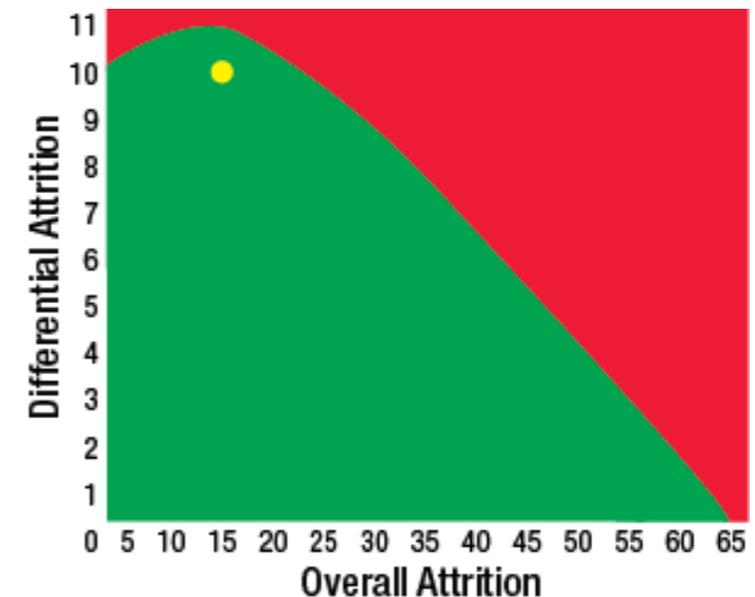
Cautious Attrition Threshold



Selecting the Optimistic Attrition Threshold

- ❖ The WWC uses the optimistic threshold when the intervention is unlikely to affect attrition.
- ❖ Expected bias due to attrition is lower, so more attrition is acceptable.

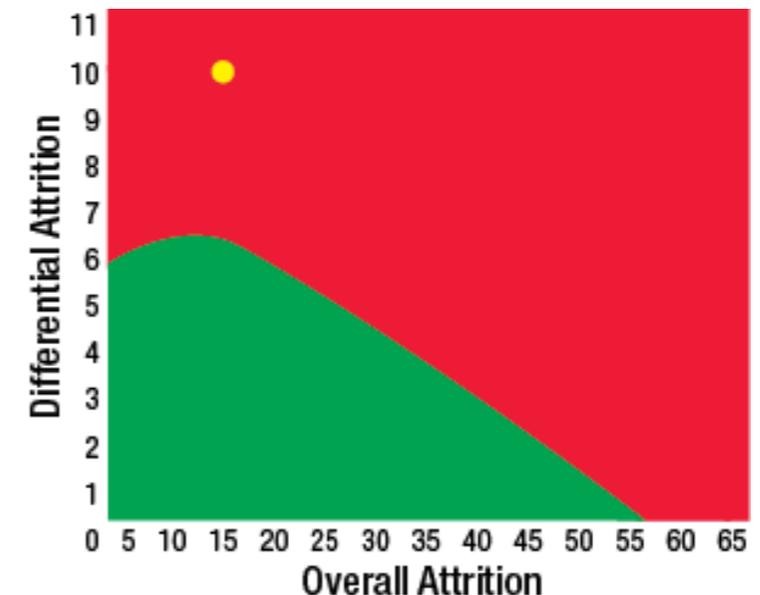
Optimistic Attrition Threshold



Selecting the Cautious Attrition Threshold

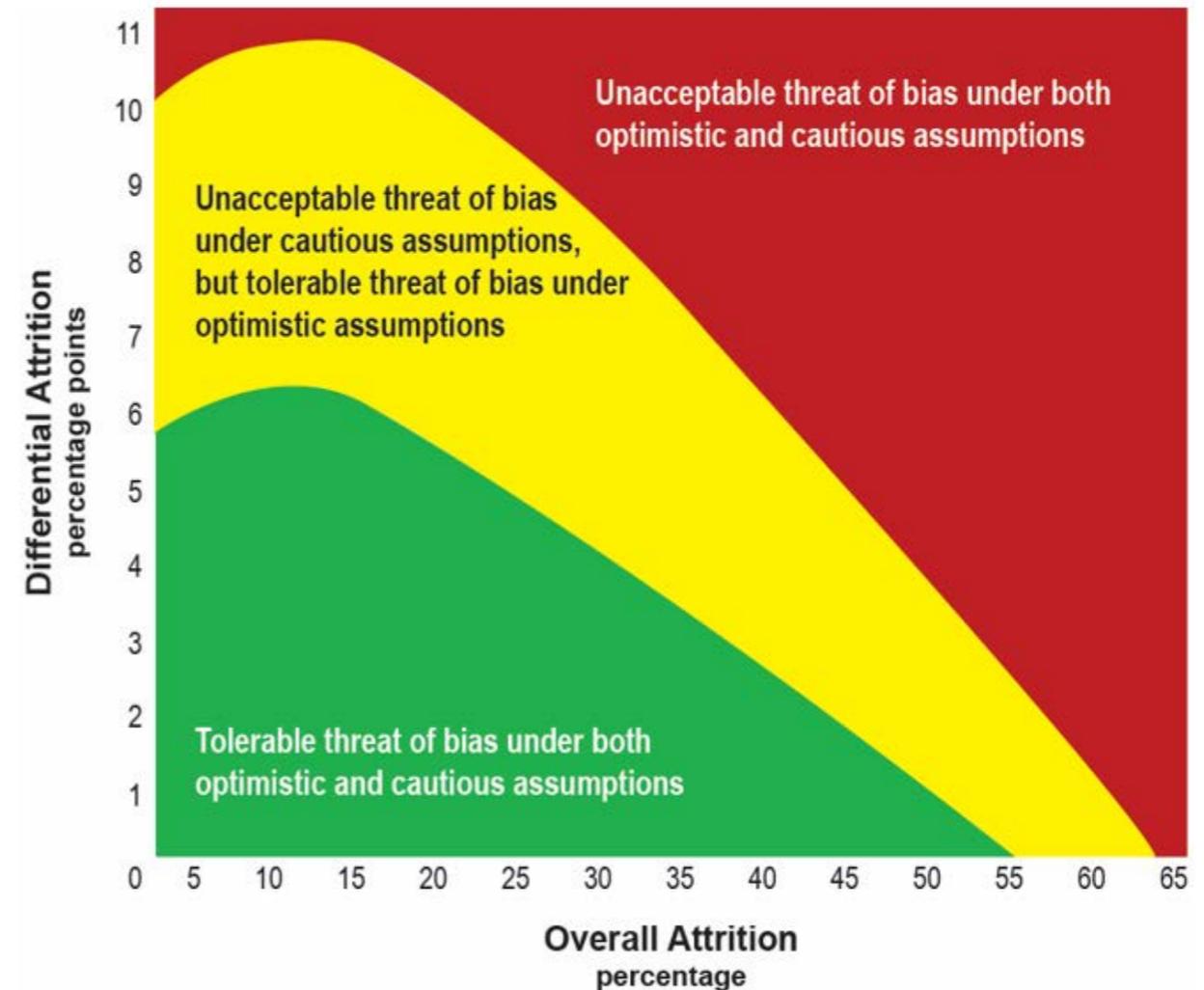
- ❖ The WWC uses the cautious threshold when the intervention is more likely to affect attrition.
- ❖ Expected bias due to attrition is higher, so less attrition is acceptable.

Cautious Attrition Threshold



Summarizing the Two Attrition Thresholds

- ❖ For the optimistic threshold, the WWC considers attrition that falls within the green and yellow areas acceptable.
- ❖ For the cautious threshold, the WWC considers only attrition that falls within the green area acceptable.



Using the Attrition Thresholds

- ❖ The *WWC Standards Brief on attrition* summarizes basic information.
- ❖ The *WWC Standards Handbook* includes a table with maximum allowable differential attrition for each level of overall attrition under each threshold.
- ❖ The **Study Review Guide** calculates attrition and applies thresholds.
- ❖ Review the WWC white paper about “Assessing Attrition Bias,” available on the WWC website, for more about the WWC attrition model and thresholds.

Example: Calculating Attrition, Part 2

A research team randomly assigns 1,000 students to the intervention group and 1,100 to the comparison group. The team collects posttest data from 900 intervention students and 927 comparison students.

Remember, we calculated overall attrition for this example earlier and it was 13 percent. Differential attrition was 5.7 percentage points.

- Does this example have low attrition under the cautious threshold?
- Does this example have low attrition under the optimistic threshold?

Example: Applying the Attrition Threshold

- ❖ Find the row for 13 percent overall attrition in the table, found in the *WWC Standards Handbook*.
- ❖ Under the cautious threshold, the maximum allowable differential attrition is 6.1 percentage points. Therefore, this is low attrition.
- ❖ Under the optimistic threshold, the maximum allowable differential attrition is 10.8 percentage points. Therefore, this is low attrition.

Highest Differential Attrition for a Sample to Maintain Low Attrition, by Overall Attrition, Under Optimistic and Cautious Assumptions

Overall Attrition	Differential Attrition		Overall Attrition	Differential Attrition		Overall Attrition	Differential Attrition	
	Cautious Boundary	Optimistic Boundary		Cautious Boundary	Optimistic Boundary		Cautious Boundary	Optimistic Boundary
0	5.7	10.0	22	5.2	9.7	44	2.0	5.1
1	5.8	10.1	23	5.1	9.5	45	1.8	4.9
2	5.9	10.2	24	4.9	9.4	46	1.6	4.6
3	5.9	10.3	25	4.8	9.2	47	1.5	4.4
4	6.0	10.4	26	4.7	9.0	48	1.3	4.2
5	6.1	10.5	27	4.5	8.8	49	1.2	3.9
6	6.2	10.7	28	4.4	8.6	50	1.0	3.7
7	6.3	10.8	29	4.3	8.4	51	0.9	3.5
8	6.3	10.9	30	4.1	8.2	52	0.7	3.2
9	6.3	10.9	31	4.0	8.0	53	0.6	3.0
10	6.3	10.9	32	3.8	7.8	54	0.4	2.8
11	6.2	10.9	33	3.6	7.6	55	0.3	2.6
12	6.2	10.9	34	3.5	7.4	56	0.2	2.3
13	6.1	10.8	35	3.3	7.2	57	0.0	2.1
14	6.0	10.8	36	3.2	7.0	58	-	1.9
15	5.9	10.7	37	3.1	6.7	59	-	1.6
16	5.9	10.6	38	2.9	6.5	60	-	1.4
17	5.8	10.5	39	2.8	6.3	61	-	1.1
18	5.7	10.3	40	2.6	6.0	62	-	0.9
19	5.5	10.2	41	2.5	5.8	63	-	0.7
20	5.4	10.0	42	2.3	5.6	64	-	0.5
21	5.3	9.9	43	2.1	5.3	65	-	0.3

Knowledge Check 3

A study randomly assigned 5,000 students to an intervention condition (2,500 students) or a comparison condition (2,500 students). The study team collected outcome data from 2,000 intervention group students and 2,400 comparison group students. Using the optimistic threshold, which level of attrition does this study have?

- A. High attrition.**
- B. Low attrition.**

Answer to Knowledge Check 3

The correct answer is **A**, this study has high attrition.

Overall attrition

- Total sample size: $2,500 + 2,500 = 5,000$
- Students with observed data: $2,000 + 2,400 = 4,400$
- Overall attrition: $(5,000 - 4,400)/5,000 = 600/5,000 = 12\%$

Differential Attrition

Intervention Group

$$(2,500 - 2,000)/2,500 = 20\%$$

Comparison Group

$$(2,500 - 2,400)/2,500 = 4\%$$

To calculate differential attrition: $|20 - 4| = 16$ percentage points

The maximum differential attrition is 10.9 percentage points under the optimistic threshold when overall attrition is 12 percent, which is less than the 16 percentage point difference. Therefore, the study has high attrition.

Issue: Missing Data, Imputation, and Attrition

Studies sometimes impute missing outcome data.

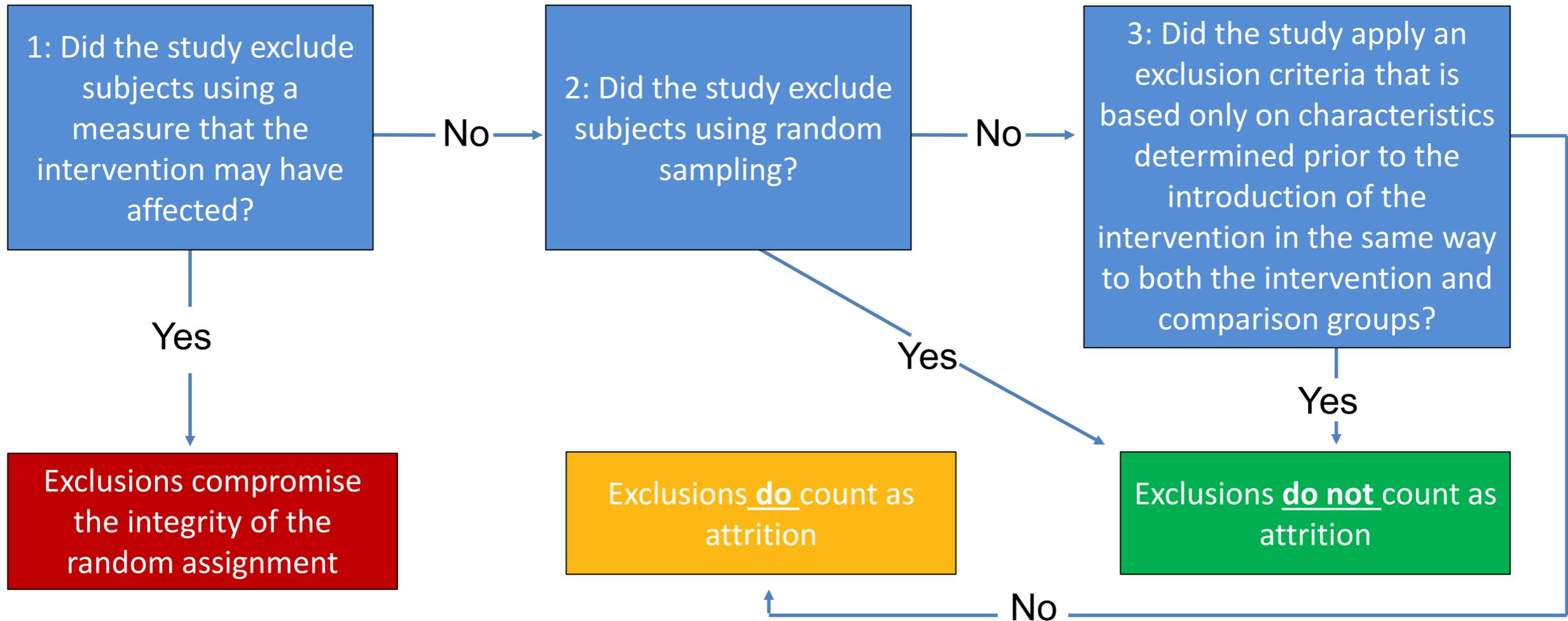
Imputation is replacing unobserved data in some way.

Research indicates that, like attrition, imputation may introduce bias into study findings.

- ❖ If an RCT reports on analyses based on imputed outcome data, the WWC considers the **imputed** data to be attrition.
- ❖ The WWC Standards Handbook describes standards for reviewing group design studies with imputed data

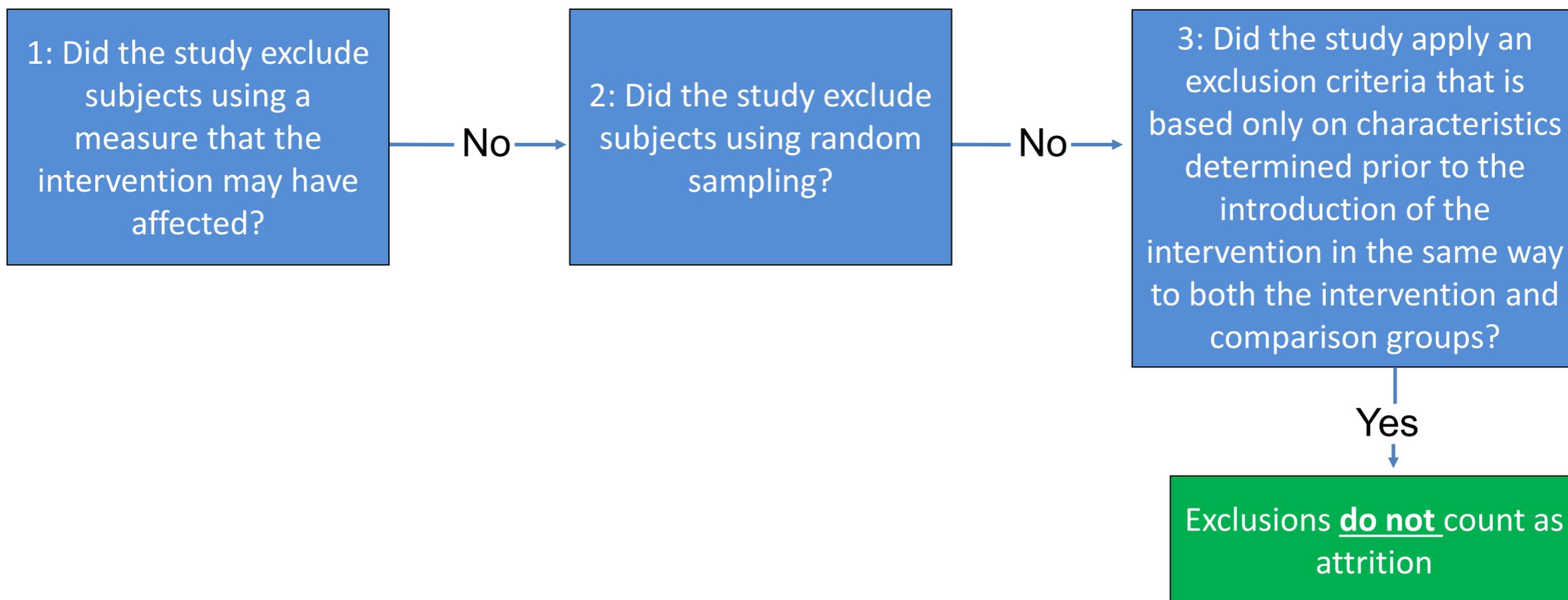
Issue: Exclusion of Sample Members

The WWC treats exclusions in one of three ways, depending on the answers to three questions:



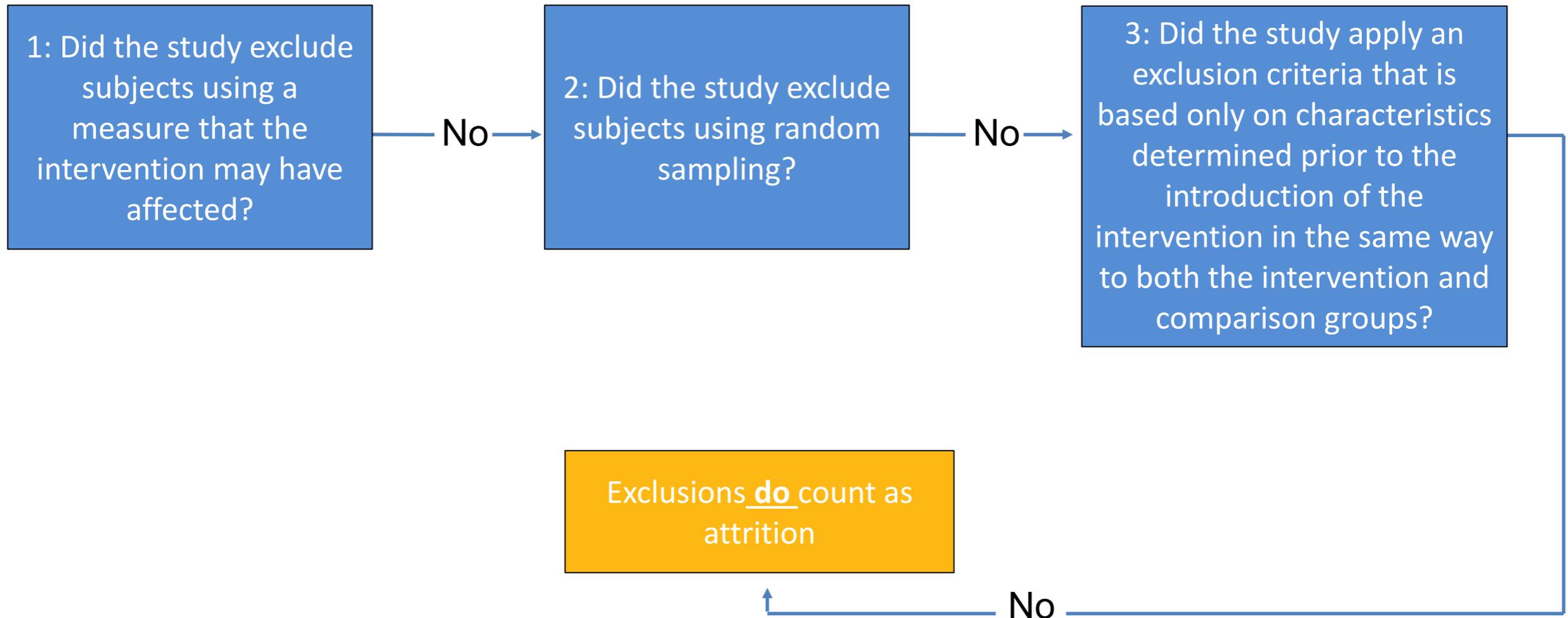
Issue: Exclusion of Sample Members

Example 1: A study is testing the effect of a math intervention on 4th-grade students. It mistakenly included some 3rd- and 5th-grade students during random assignment. The researchers exclude those students from the analysis.



Issue: Exclusion of Sample Members

Example 2: A study excluded younger students from the intervention group, but not from the comparison group.



Issue: Exclusion of Sample Members

Example 3: A study excluded students who didn't attend all intervention sessions.

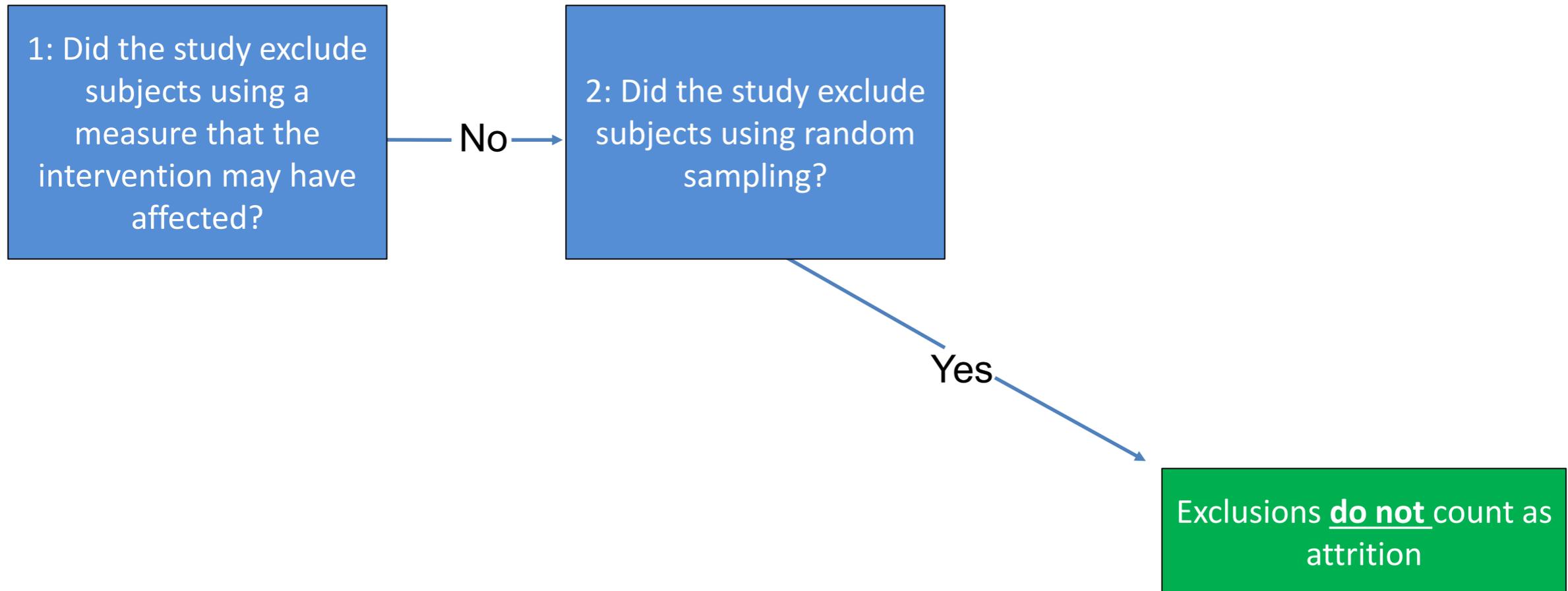
1: Did the study exclude subjects using a measure that the intervention may have affected?

Yes

Exclusions compromise the integrity of the random assignment

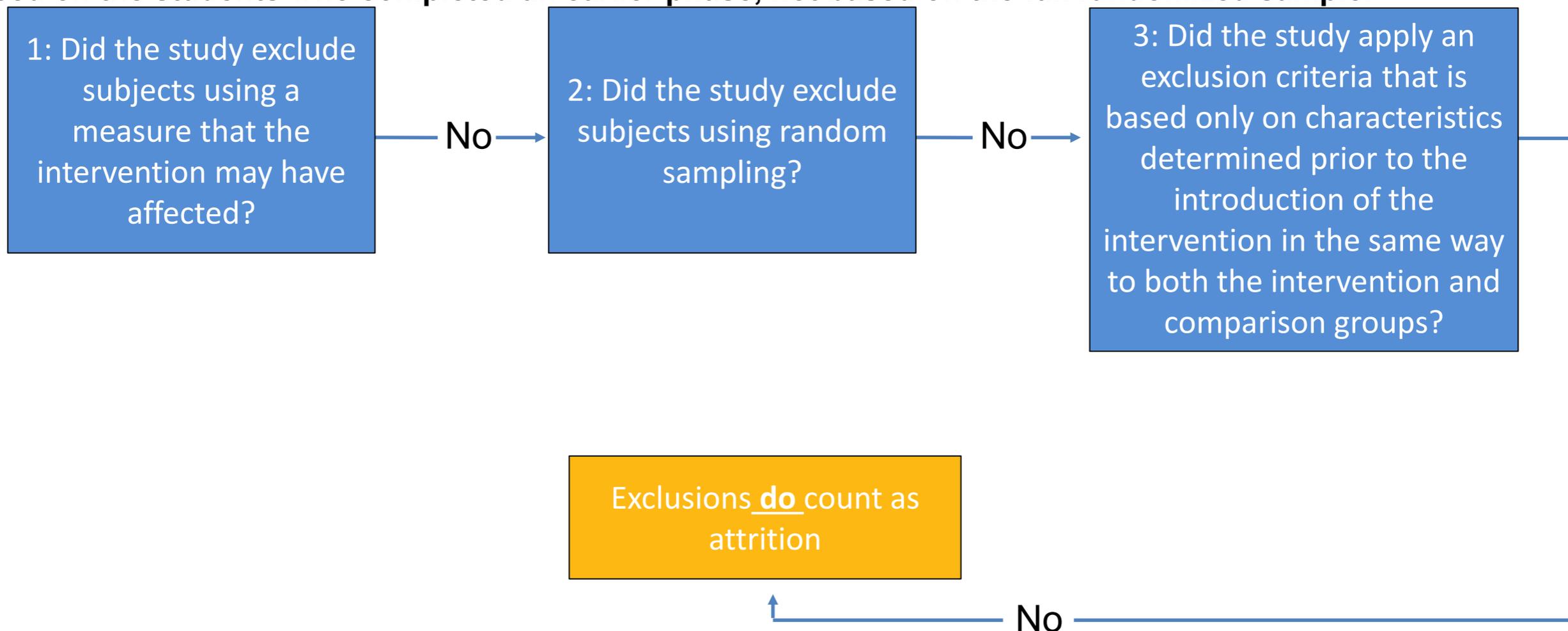
Issue: Exclusion of Sample Members

Example 4: In a study, researchers collect outcome data from a random subsample of the originally randomly assigned sample.



Issue: Exclusion of Sample Members

Example 5: In a study, researchers will conduct follow-up surveys in two waves. They randomly selected students who completed wave 1 to participate in the follow-up survey for wave 2. The researchers subsampled based on the students who completed an earlier phase, not based on the full randomized sample.



Issue: Nonparticipation

An individual assigned to the intervention may not participate.

Individuals assigned to the intervention who don't participate may decrease the chances of finding impacts.

They do not introduce bias, provided they contribute outcome data and the study analyzes them according to their assigned condition.

- ❖ According to the WWC, nonparticipation is attrition if the study did not collect outcomes from nonparticipants.
- ❖ According to the WWC, nonparticipation is not attrition if the study:
 - ❖ Collected outcome data from nonparticipants, and
 - ❖ Analyzed nonparticipants according to their assigned condition.
- ❖ If researchers change the condition of nonparticipants for analysis, then the WWC considers the study a compromised RCT.

Issue: Incomplete Information

Sometimes studies do not report all sample sizes needed to calculate attrition rates.

Example: A study reports the number of students who left the study, but not how many were in each condition. Therefore, it is possible to calculate overall attrition, but not differential attrition.

- ❖ The WWC asks authors to supply any missing information.
- ❖ If only some information is available, the reviewer can assume the worst case.
- ❖ In the example, the reviewer should assume all students left from one condition. The reviewer should do this for each condition, and use the highest differential attrition result.

Knowledge Check 4

True or False. If some randomly assigned youth lack parental consent to participate in a study, it is not necessary to factor them into attrition calculations.

- True
- False

Answer to Knowledge Check 4

This statement is false. According to the WWC, any sample loss after random assignment is attrition; the overall and differential attrition calculations should include this attrition.

Knowledge Check 5

In a randomized controlled trial, researchers assigned 250 students to the intervention group and 210 students to the comparison group. Twenty-one students withdrew from the study after random assignment.

Using the optimistic threshold, does the study have high or low attrition?

- A. High attrition.
- B. Low attrition.
- C. Unclear; not enough information provided.

Answer to Knowledge Check 5

The correct answer is B, this study has low attrition.

- ❖ It is unclear how the 21 students who withdrew from the study were distributed to the intervention and comparison groups.
- ❖ However, as a worst-case scenario, all students could be from one group.
- ❖ Overall attrition is 4.6%.
- ❖ The differential attrition rate is either 8.4 or 10.0 percentage points under the worst-case scenarios. This attrition combination is below the acceptable threshold of 10.5 percentage points for the optimistic threshold.
- ❖ So, the worst-case scenario is 4.6% overall attrition and 10.0 percentage-point differential attrition.

Extreme scenario: Intervention group			
	Students at assignment	Students with observed outcome data	Attrition calculation
Intervention group	250	229	4.6% overall, 8.4 percentage point differential
Comparison group	210	210	

Extreme scenario: Comparison group			
	Students at assignment	Students with observed outcome data	Attrition calculation
Intervention group	250	250	4.6% overall, 10.0 percentage point differential
Comparison group	210	189	

Knowledge Check 6

A study enrolls 20,000 youth and randomly assigns 15,000 of them to the intervention condition. The researchers collect immediate posttest data on 18,000 youth (14,000 intervention and 4,000 comparison). They collect six-month follow-up data on 17,000 youth (13,500 intervention and 3,500 comparison). For the two-year follow-up, the researchers can afford to collect data from only 10,000 youth.

Which option for subsampling would not count as attrition?

- A.** For the two-year follow-up data collection, the researchers propose to randomly select 7,500 of the 15,000 intervention group youth and 2,500 of the 5,000 comparison group youth.
- B.** For the two-year follow-up data collection, the researchers propose to randomly select 7,500 intervention group youth and 2,500 comparison group youth who participated in the six-month follow-up data collection.

Answer to Knowledge Check 6

- **A is the correct answer.** The WWC would not count the subsampling as attrition. The researchers proposed to select a subsample from the initial sample to follow up. The WWC would assess attrition at the two-year follow-up time point relative to the 10,000 youth selected in the random subsample.
- **B is an incorrect answer.** The WWC would count the subsampling as attrition. The researchers proposed to select from among the youth who responded to the six-month follow-up. Because this is not a subsample from the original sample, the researchers are not applying the exclusion criteria in the same way to both the intervention and comparison groups. The WWC would assess attrition at the two-year follow-up time point relative to the 20,000 youth who originally went through random assignment.

MODULE

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Conclusion

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- ❖ You can access all the resources mentioned in this module through the WWC website, **whatworks.ed.gov**.
- ❖ The full slide deck for this module, including detailed responses to the knowledge check questions, is available on the WWC website.
- ❖ To receive a certificate of completion for viewing these training modules, you must view the videos on the WWC website.

Thank you!