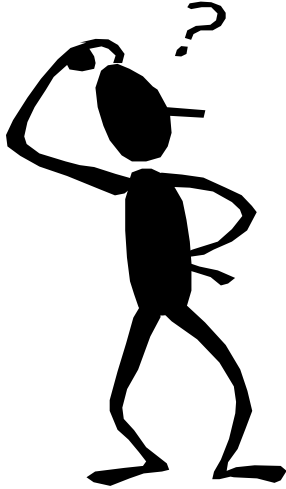


Which Design Is Best?

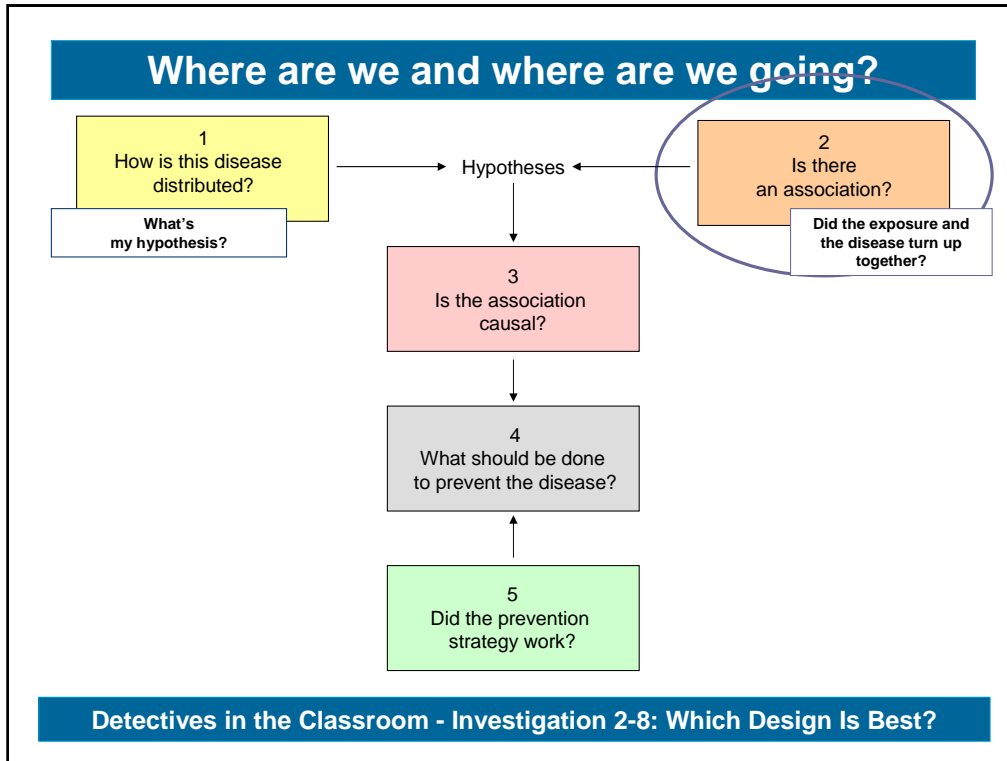


Which Design Is Best?

Detectives in the Classroom - Investigation 2-8: Which Design Is Best?

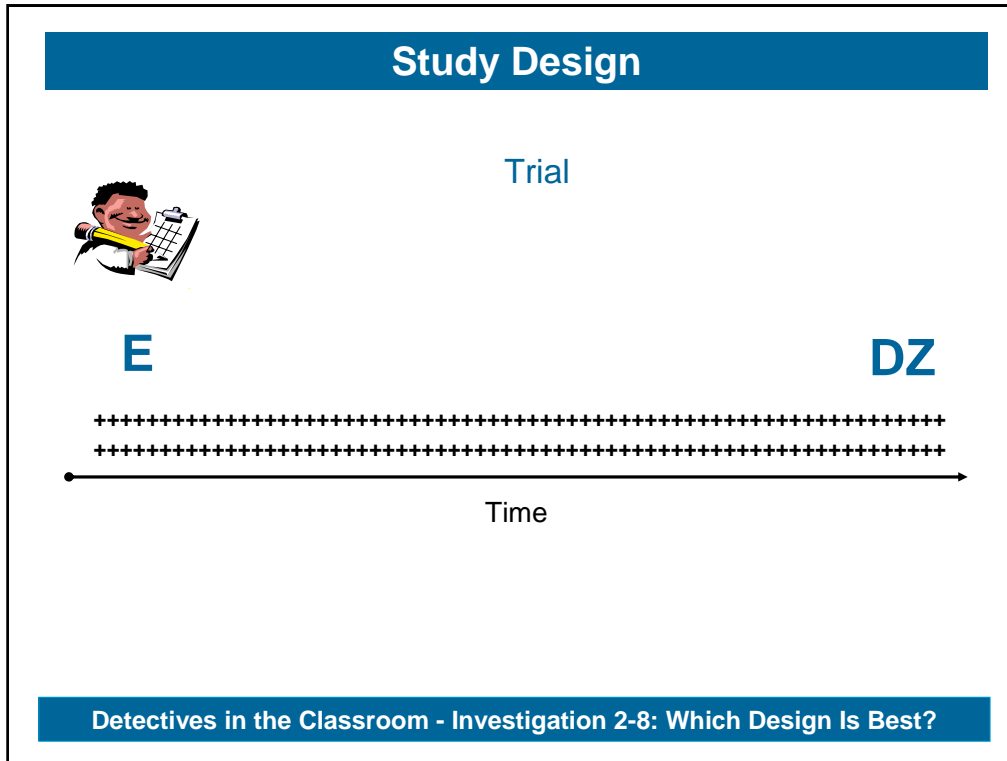
In **Investigation 2-8: Which Design Is Best?** students will become more familiar with the four basic epidemiologic study designs, learn to identify several strengths and weaknesses of each, and realize the circumstances under which each design is “best.”

Next Slide



Remind students again that in the Module 2 investigations, they are learning how to answer the second Essential Question: “Is there an association between the hypothesized cause and the disease?”

Next Slide



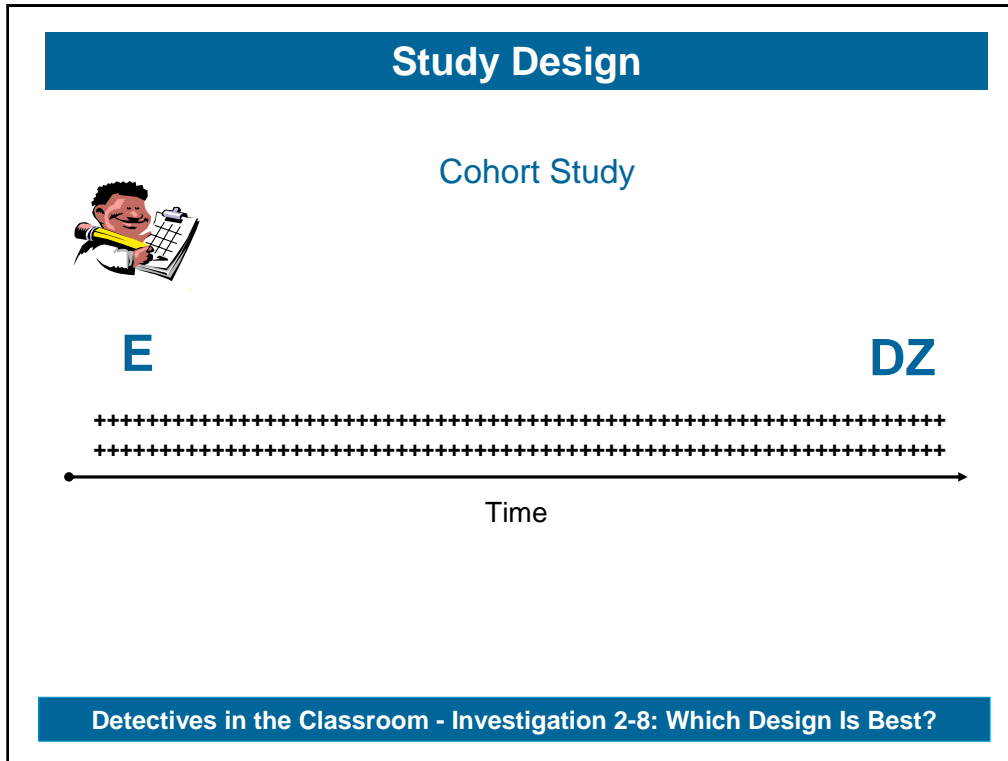
Review the four basic epidemiologic study designs.

Choose a student to tell the class what he or she understands about the study design depicted on the slide.

Trial:

1. Define the treatment and control groups.
2. Administer exposure to the treatment group, but not the control group.
3. Follow through time and compare the risk of disease in the treatment group with that in the control group.
4. The epidemiologist is involved during the entire time between exposure and disease.

Next Slide



Choose a student to tell the class what he or she understands about the study design depicted on the slide.


Cohort Study:

1. Select a healthy study sample.
2. Observe who is exposed and who is not exposed.
3. Follow through time and compare the risk of disease in the exposed group with that in the unexposed group.
4. The epidemiologist is involved during the entire time between exposure and disease.

Next Slide

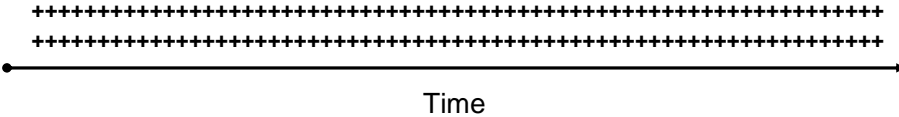
Study Design

Case-Control Study



DZ

E



Time

Detectives in the Classroom - Investigation 2-8: Which Design Is Best?

Choose a student to tell the class what he or she understands about the study design depicted on the slide.

Case-Control Study:

1. Select a group of people with the disease (cases) and a similar group without the disease (controls).
2. Ask both groups about their exposures in the past.
3. Compare the proportion of exposure in the diseased group (cases) with that in the non-diseased group (controls).
4. The epidemiologist is involved after the disease has occurred and relies on people's memories to gather information about exposure.

Next Slide

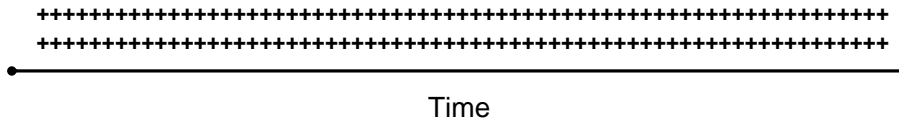
Study Design

Cross-Sectional Study



E

DZ



Detectives in the Classroom - Investigation 2-8: Which Design Is Best?

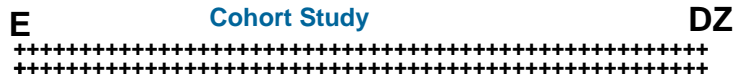
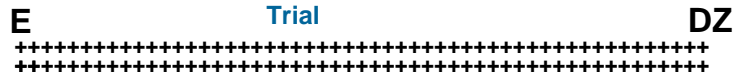
Choose a student to tell the class what he or she understands about the study design depicted on the slide.

Cross-Sectional Study:

1. Select a study sample.
2. Ask each person about both exposure and disease at that point in time (a “snapshot”).
3. Compare the disease risk in the exposed group with that in the unexposed group.
4. The epidemiologist gathers data only at that one point in time.

Next Slide

4 Study Designs



E
DZ



E
DZ

Detectives in the Classroom - Investigation 2-8: Which Design Is Best?

Show students all four basic epidemiologic study designs at the same time. Emphasize that when they are able to explain these four diagrams showing how to study the journey between exposure and disease, they will have gained a basic understanding of the different ways in which epidemiologists test hypotheses.

Next Slide

Which Design Is Best?



4 Study Designs

Case-Control Study

Cohort Study

Cross-Sectional Study

Trial


Detectives in the Classroom - Investigation 2-8: Which Design Is Best?

Now students will look further at the four epidemiologic study designs. The designs are shown in alphabetical order: the case-control study, the cohort study, the cross-sectional study, and the trial.

Because of the different times during the journey at which the epidemiologist starts to investigate and the different times at which the exposure and disease are measured, *each study design has both advantages and disadvantages*. This will be explored next.

Next Slide

Which Design Is Best?

 4 Study Designs

1st
2nd
3rd
4th

Weaker


Stronger

Detectives in the Classroom - Investigation 2-8: Which Design Is Best?

Students will be asked to rank the four study designs in order according to particular characteristics.

Next Slide

Which Design Is Best?



4 Study Designs

↓	1 st	Cross-Sectional Study	↑
↓	2 nd	Case-Control Study	↑
↓	3 rd	Cohort Study	↑
↓	3 rd	Trial	↑

Longest
Time

↓

Shortest
Time

↑

Detectives in the Classroom - Investigation 2-8: Which Design Is Best?

Have students rank the designs according to *the length of time it takes to complete the study*.

They should give first rank to the study design that can identify an association in the least amount of time.

Choose a student to explain his or her ranking.

Help students understand that the “snapshot” design, a *cross-sectional study*, will take the least amount of time.

A *case-control study* will take at least some additional time because the epidemiologist must select cases and controls and then meet with each study participant to ask questions about past exposures. Even if the questions are asked in a mailed questionnaire, it will take time to gather in all the replies.


A *cohort study* will take even longer because the epidemiologist has to wait several months or years for disease to develop or not develop.

The *trial* can also take a long time.

⚙ Teacher Alert: There is no rule about the relative time it takes to do a trial versus a cohort study. It depends on the disease being studied and the time between exposure and disease.

Next Slide

Which Design Is Best?



4 Study Designs

1 st	Cross-Sectional Study
2 nd	Case-Control Study
3 rd	Cohort Study
4 th	Trial

Most Expensive

↓

Least Expensive

↑

Detectives in the Classroom - Investigation 2-8: Which Design Is Best?

Have students rank the designs according to *expense*.

They should give first rank to the study design that can identify an association that is the least expensive.

Choose a student to explain his or her ranking.

Help students understand why the *cross-sectional study* would be the least expensive. Study expense is closely related to the degree of the epidemiologist's involvement and the length of the study. The cross-sectional study is the quickest and "dirtiest" design. Relative to the other designs, the epidemiologist does not spend as much time with study subjects or as much time and effort measuring exposure and disease.


The *case-control study* spends more time and/or money on defining cases and controls and in obtaining a detailed history of past exposures.

The *cohort study* involves larger numbers of study subjects and often repeated measures of exposures and disease over a long study period. At the end, it also takes more time and/or money to trace everyone's disease status.

A *trial* involves the additional steps of randomization, giving a treatment to the experimental group over time, and periodically determining disease status.

Next Slide

Which Design Is Best?



4 Study Designs

↓	1 st	Trial	↑
↓	2 nd	Cohort Study	↑
↓	3 rd	Case-Control Study	↑
↓	4 th	Cross-Sectional Study	↑

Least Accurate (pointing down) **Most Accurate** (pointing up)

Detectives in the Classroom - Investigation 2-8: Which Design Is Best?

Have students rank the designs according to *accuracy of exposure measurement*.

They should give first rank to the study design that is most accurate.

Choose a student to explain his or her ranking.

Help students understand how the *trial* definitely measures exposure most accurately, since it is the only design that actually *gives measured exposures* to study subjects.


After the trial, the next most accurate measurement of exposure would generally be provided by the *cohort study* because exposure is being measured at the time of the study.

In a *case-control study*, the subjects are asked to remember and report *past* exposures. This information may not be accurate because people may forget their exposures. Even worse, people who have the disease (cases) may recall their exposures more completely or in an exaggerated way, compared with people who do not have the disease (controls).

The *cross-sectional study* is generally last in terms of accuracy because it is simply a measure of exposure at one point in time, which does not provide enough detail to be very helpful in figuring out relationships between exposures over time and disease.

Next Slide

Which Design Is Best?



4 Study Designs

<div style="text-align: center;">↓</div> <p style="color: red; font-weight: bold; transform: rotate(-45deg);">Least Similar</p>	<p style="color: red; font-weight: bold;">1st</p> <p style="color: blue; font-weight: bold;">Trial</p> <p style="color: red; font-weight: bold;">2nd</p> <p style="color: blue; font-weight: bold;">Cohort Study</p> <p style="color: red; font-weight: bold;">2nd</p> <p style="color: blue; font-weight: bold;">Case-Control Study</p> <p style="color: red; font-weight: bold;">2nd</p> <p style="color: blue; font-weight: bold;">Cross-Sectional Study</p>	<div style="text-align: center;">↑</div> <p style="color: red; font-weight: bold; transform: rotate(45deg);">Most Similar</p>
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Detectives in the Classroom - Investigation 2-8: Which Design Is Best?

Have students rank the designs according to the *likelihood that the study groups will be similar*. They should give first rank to the study design in which the study groups will be most similar. Choose a student to explain his or her ranking.

Help students understand that in the *trial* the study groups are definitely the most similar. Randomization, if done correctly and successfully, virtually guarantees that the two groups will be very similar with regard to personal characteristics (e.g., sex, age, race) and other factors. This is good because then it is most like a laboratory experiment, in which all the animals have the same environment except for the exposure being studied. It is a *controlled experiment*. A trial is the closest an epidemiologist can get to a controlled experiment involving humans.

All the other study designs are observational rather than experimental, so it is more difficult to be sure that study groups are similar.

After all, in observational studies, people are making their own decisions about many things they are exposed to—the exposed/not exposed groups are not randomly selected (as in a trial). Thus, none of the observational designs can guarantee that the study groups are similar.


Case-control studies pose a particular challenge in trying to find a comparison group of people (controls) who are similar to the group with the disease (cases) but who do not have the disease. This is a particular vulnerability of the case-control design.

In all observational studies, it is sometimes possible to use statistical analyses to help control for differences in study groups.

✧ **Teacher Alert:** This concept may be difficult for students to grasp at this time. Emphasize that in observational studies we want the study groups to be as similar as possible with respect to characteristics such as age, gender, and socioeconomic status, so that differences or similarities between the disease risks in the exposed and unexposed groups can be attributed to that exposure and not to other differences between the groups.

Next Slide

Which Design Is Best?



4 Study Designs

↓	1 st Trial	↑
↓	2 nd Cohort Study	↑
↓	3 rd Case-Control Study	↑
↓	4 th Cross-Sectional Study	↑

Least
Sound

↓

Most
Sound

↑

Detectives in the Classroom - Investigation 2-8: Which Design Is Best?

Have students rank the designs according to *scientific soundness*.

They should give first rank to the study design that has the greatest scientific soundness.

Choose a student to explain his or her ranking.

Help students understand why the *trial* is the most scientifically sound. The trial is the gold standard because it studies two similar groups and because exposures are determined by randomization and administered in a measured way. This situation is similar to a laboratory experiment and is more accurate than studying free-living people as they go about their lives.

The *cohort study* is the next best because it follows people over the course of the journey from exposure to disease and measures exposures along the way.

The *case-control study* is weaker because the epidemiologist is there only at the end of the journey and has to rely on people's memories of past exposures.

Finally, the *cross-sectional design* is the weakest because it measures exposure and disease at only one point in time and does not provide information about the time order of the exposure and the disease.

Next Slide

Epi Team Challenge



Detectives in the Classroom - Investigation 2-8: Which Design Is Best?

Divide the class into Epi Teams of four or five students per team.

Next Slide

Epi Team Challenge

<u>Study Designs</u>	<u>Main Strengths</u>	<u>Main Weaknesses</u>
Trial	1	5
Cohort Study	2	6
Case-Control Study	3	7
Cross-Sectional Study	4	8

Detectives in the Classroom - Investigation 2-8: Which Design Is Best?

Tell students they are about to have an Epi Team Challenge to see how well they can identify the strengths and weaknesses of the four study designs.

Give each student an **Investigation 2-8: Epi Log Worksheet**.

⚙ Teacher Alert: As a variation, challenge cards can be laminated for repeated use or can be printed on poster board.

Next Slide

Epi Team Challenge

<u>Study Designs</u>	<u>Main Strengths</u>	<u>Main Weaknesses</u>	
Cross- Sectional	Cohort	Case- Control	Controlled Trial
Cross-Sectional Study	4	8	

Detectives in the Classroom - Investigation 2-8: Which Design Is Best?

Give each Epi Team a set of **Study Design Cards**.

The Challenge will proceed as follows:

1. A question about a study design will appear on the screen.
 2. Epi Teams will have 30 seconds to identify the study design or designs that answer the question.
 3. You will ask for “Answers,” and a member of each Epi Team will hold up the **Study Design Card** or **Cards** with the Team’s answer(s).
 4. You will ask selected Epi Teams to explain their answer(s).
 - ⚙ Teacher Alert: Call on Epi Teams with the correct answers at the beginning.
 5. You will address misconceptions.
 6. You will identify the correct answer(s).
 7. Each Epi Team will earn 10 points for every correct answer and lose 10 points for every incorrect answer. No points will be lost if an Epi Team does not answer.
 8. As the teacher writes scores on the board, students will insert the correct answer(s) in their **Investigation 2-8: Epi Log Worksheet**.
- Repeat the above steps for each question.

Next Slide

Epi Team Challenge

<u>Study Designs</u>	<u>Main Strengths</u>	<u>Main Weaknesses</u>
Trial	1	5
Cohort Study	2	6
Case-Control Study	3	7
Cross-Sectional Study	Fastest 4	8

Which study design is the **fastest**?

Detectives in the Classroom - Investigation 2-8: Which Design Is Best?

Question: Which study design is the fastest?

Address misconceptions.

The cross-sectional study is fast because there is no waiting for disease or other outcome to develop (as in a trial or cohort study). Rather, it is a snapshot of the exposures and diseases of a group of people at one point in time. It is faster than a case-control study because it is not necessary for the epidemiologist to take time to gather cases and select controls.

Next Slide

Epi Team Challenge

<u>Study Designs</u>	<u>Main Strengths</u>	<u>Main Weaknesses</u>
Trial	1	Time Consuming 5
Cohort Study	2	Time Consuming 6
Case-Control Study	3	7
Cross-Sectional Study	Fastest 4	8

Which study designs are the **most time consuming**?

Detectives in the Classroom - Investigation 2-8: Which Design Is Best?

Question: Which study designs are the most time consuming?

Address misconceptions.

Be sure students understand why the trial and cohort study designs take more time. The major reason is that the epidemiologist actually observes the entire journey between exposure and disease. The case-control and cross-sectional designs just use information already at hand.

Next Slide

Epi Team Challenge

<u>Study Designs</u>	<u>Main Strengths</u>	<u>Main Weaknesses</u>
Trial	Most Scientifically Sound 1	Time Consuming 5
Cohort Study	2	Time Consuming 6
Case-Control Study	3	7
Cross-Sectional Study	Fastest 4	8

Which study design is the **most scientifically sound**?

Detectives in the Classroom - Investigation 2-8: Which Design Is Best?

Question: Which study design is the most scientifically sound?

Address misconceptions.

Scientific soundness has to do with the rigor of the design and our certainty that the results are correct. The one design that is actually experimental (rather than observational) is the controlled trial and is therefore the most sound.

Students should recall that in the trial, study groups are as similar as possible because the participants are randomly assigned to exposed and unexposed groups; further, the trial has the tightest control over administration and measurement of exposure. The observational studies do not have these advantages.

Next Slide

Epi Team Challenge

Study Designs	Main Strengths	Main Weaknesses
Trial	Most Scientifically Sound 1	Time Consuming 5
Cohort Study	2	Time Consuming 6
Case-Control Study	Can Study Rare Diseases 3	7
Cross-Sectional Study	Fastest 4	8

Which study design is **best for studying rare diseases?**

Detectives in the Classroom - Investigation 2-8: Which Design Is Best?

Question: Which study design is best for studying rare diseases?

Address misconceptions.

This is the first time students are hearing about this situation, but they should be able to reason that the case-control design allows study of rare diseases because the first step is to identify cases. In contrast is the cohort design, which starts out with a group of healthy people, some of whom *have*, and *do not have*, the exposure of study interest. Imagine that it would take many thousands of people and possibly years of follow-up to produce a few cases of a rare disease.

⚙ **Teacher Alert:** Remind students of the train analogy. In the case-control study, the investigator can be at the train station and meet trains that have completed the journey. Considering that there are many trains, he or she can find a few cases of the rare disease on each train. On the other hand, in the cohort design, the only way to find a lot of cases of a very rare disease would be to have a huge train with thousands of people on it and/or to be on the train for a very long time so enough cases would develop. As the investigator rides on this huge train for a long time, he or she might find enough cases of the rare disease. But this is not ideal—it is very time consuming and expensive to ride on this huge train for a long time. Thus, the case-control design is more efficient for studying rare diseases.

Next Slide

Epi Team Challenge

<u>Study Designs</u>	<u>Main Strengths</u>	<u>Main Weaknesses</u>
Trial	Most Scientifically Sound 1	Time Consuming 5
Cohort Study	2	Time Consuming 6
Case-Control Study	Can Study Rare Diseases 3	Possible Time-Order Confusion 7
Cross-Sectional Study	Fastest 4	Possible Time-Order Confusion 8

Which study designs **do not identify**
the time order of exposure and disease?

Detectives in the Classroom - Investigation 2-8: Which Design Is Best?

Question: Which study designs do not identify the time order of exposure and disease?

Address misconceptions.

This will be another challenging question for students. Help them uncover the fact that in the case-control and cross-sectional designs, the investigator does not start out with a group of healthy people, measure exposure, and *then* measure disease. Therefore, the time order of the exposure and disease cannot be identified with certainty.

⚙ **Teacher Alert:** Make sure students understand that if you see people for the first time only after they already have the disease, it is not possible to know which came first, the exposure or the disease. The only sure way is to first see people when they are healthy and observe that they have the exposure and not the disease. Then, if you follow them through time and observe that they get the disease, you will be more certain that the exposure came first. This is not possible in the case-control and cross-sectional designs.

Next Slide

Epi Team Challenge

<u>Study Designs</u>	<u>Main Strengths</u>	<u>Main Weaknesses</u>
Trial	Most Scientifically Sound 1	Time Consuming 5
Cohort Study	2	Time Consuming 6
Case-Control Study	Can Study Rare Diseases 3	Possible Time-Order Confusion 7
Cross-Sectional Study	Fastest 4	Possible Time-Order Confusion Least Confidence in Findings 8

Which study design **gives the least confidence in findings?**

Detectives in the Classroom - Investigation 2-8: Which Design Is Best?

Question: Which study design gives the least confidence in findings?

Address misconceptions.

The cross-sectional study is the least rigorous design because it is a snapshot at one point in time and does not even try to assess what the exposures were during the whole journey between exposure and disease.

Next Slide

Epi Team Challenge

<u>Study Designs</u>	<u>Main Strengths</u>	<u>Main Weaknesses</u>
Trial	Most Scientifically Sound Best Measure of Exposure 1	Time Consuming 5
Cohort Study	2	Time Consuming 6
Case-Control Study	Can Study Rare Diseases 3	Possible Time-Order Confusion 7
Cross-Sectional Study	Fastest 4	Possible Time-Order Confusion Least Confidence in Findings 8

Which study design **provides the best measure of exposure?**

Detectives in the Classroom - Investigation 2-8: Which Design Is Best?

Question: Which study design provides the best measure of exposure?

Address misconceptions.

Students should reason that the trial has the best measure of exposure because it is the only design in which the investigator actually administers a measured exposure to the exposed group.

Next Slide

Epi Team Challenge

<u>Study Designs</u>	<u>Main Strengths</u>	<u>Main Weaknesses</u>
Trial	Most Scientifically Sound Best Measure of Exposure 1	Time Consuming 5
Cohort Study	Most Accurate Observational Study 2	Time Consuming 6
Case-Control Study	Can Study Rare Diseases 3	Possible Time-Order Confusion 7
Cross-Sectional Study	Fastest 4	Possible Time-Order Confusion Least Confidence in Findings 8

Which study design is the **most accurate observational study**?

Detectives in the Classroom - Investigation 2-8: Which Design Is Best?

Question: Which study design is the most accurate observational study?

Address misconceptions.

The cohort design is more accurate, and we have the most confidence in its findings compared with the other observational studies. A main reason is that the cohort design follows study subjects more closely during the journey between exposure and disease. For example, it allows for measurement of exposures *as they are occurring during the journey*. The case-control study waits until the end of the journey and then asks people to recall past exposures, and the cross-sectional study measures exposure only at one point in time. Another reason the cohort study design is more accurate is that since it starts out with healthy people (unlike the case-control or cross-sectional study), it is possible to establish that exposure occurred first, then disease.

Next Slide

Epi Team Challenge

<u>Study Designs</u>	<u>Main Strengths</u>	<u>Main Weaknesses</u>
Trial	Most Scientifically Sound Best Measure of Exposure 1	Time Consuming 5
Cohort Study	Most Accurate Observational Study 2	Time Consuming 6
Case-Control Study	Can Study Rare Diseases 3	Possible Time-Order Confusion 7
Cross-Sectional Study	Fastest Least Expensive 4	Possible Time-Order Confusion Least Confidence in Findings 8

Which study design is the **least expensive**?

Detectives in the Classroom - Investigation 2-8: Which Design Is Best?

Question: Which study design is the least expensive?

Address misconceptions.

The cross-sectional study is the least expensive because it takes the briefest look, a snapshot, at exposure and disease at just one point in time. The epidemiologist does not spend as much time with study subjects and does not collect as many data as in the other designs.

Next Slide

Epi Team Challenge

Study Designs	Main Strengths	Main Weaknesses
Trial	Most Scientifically Sound Best Measure of Exposure 1	Time Consuming Unethical for Harmful Exposures 5
Cohort Study	Most Accurate Observational Study 2	Time Consuming 6
Case-Control Study	Can Study Rare Diseases 3	Possible Time-Order Confusion 7
Cross-Sectional Study	Fastest Least Expensive 4	Possible Time-Order Confusion Least Confidence in Findings 8

Which study design
would be unethical for harmful exposures?

Detectives in the Classroom - Investigation 2-8: Which Design Is Best?

Question: Which study design would be unethical for harmful exposures?

Address misconceptions.

The trial is the only design in which study subjects are intentionally given the exposure. If the exposure is hypothesized to be harmful, it would not be ethical to intentionally expose people to something believed to be harmful. In observational studies, harmful exposures can be studied because the investigator just observes what people are exposed to in their daily lives.

Next Slide

Epi Team Challenge

<u>Study Designs</u>	<u>Main Strengths</u>	<u>Main Weaknesses</u>
Trial	Most Scientifically Sound Best Measure of Exposure 1	Time Consuming Unethical for Harmful exposures 5
Cohort Study	Most Accurate Observational Study Good Measure of Exposure 2	Time Consuming 6
Case-Control Study	Can Study Rare Diseases 3	Possible Time-Order Confusion 7
Cross-Sectional Study	Fastest Least Expensive 4	Possible Time-Order Confusion Least Confidence in Findings 8

Which study design
provides a good measure of exposure?

Detectives in the Classroom - Investigation 2-8: Which Design Is Best?

Question: Which study design provides a good measure of exposure?

Address misconceptions.

The next best thing to the *excellent* exposure measurement in a trial is the *good* exposure measurement in a cohort study. In this design, it may be possible for investigators to carefully measure exposures throughout the journey between exposure and disease. This is not as possible in the case-control and cross-sectional designs.

Next Slide

Epi Team Challenge

<u>Study Designs</u>	<u>Main Strengths</u>	<u>Main Weaknesses</u>
Trial	Most Scientifically Sound Best Measure of Exposure 1	Time Consuming Unethical for Harmful exposures Most Expensive 5
Cohort Study	Most Accurate Observational Study Good Measure of Exposure 2	Time Consuming Most Expensive 6
Case-Control Study	Can Study Rare Diseases 3	Possible Time-Order Confusion 7
Cross-Sectional Study	Fastest Least Expensive 4	Possible Time-Order Confusion Least Confidence in Findings 8

Which study designs are **the most expensive?**

Detectives in the Classroom - Investigation 2-8: Which Design Is Best?

Question: Which study designs are the most expensive?

Address misconceptions.

Both the trial and the cohort study are among the most expensive, because of the longer course of the study and the attention paid to obtaining accurate and complete information on exposure and outcome.

Next Slide

Epi Team Challenge

Study Designs	Main Strengths	Main Weaknesses
Trial	Most Scientifically Sound Best Measure of Exposure 1	Time Consuming Unethical for Harmful exposures Most Expensive 5
Cohort Study	Most Accurate Observational Study Good Measure of Exposure 2	Time Consuming Most Expensive 6
Case-Control Study	Can Study Rare Diseases Relatively Less Expensive and Relatively Fast 3	Possible Time-Order Confusion 7
Cross-Sectional Study	Fastest Least Expensive 4	Possible Time-Order Confusion Least Confidence in Findings 8

Which study design is
relatively less expensive and relatively fast?

Detectives in the Classroom - Investigation 2-8: Which Design Is Best?

Question: Which study design is relatively less expensive and relatively fast?

Address misconceptions.

The case-control study is in the middle. It is not as expensive or time-consuming as a trial or cohort study, and not as inexpensive or fast as a cross-sectional study.

Next Slide

Epi Team Challenge

<u>Study Designs</u>	<u>Main Strengths</u>	<u>Main Weaknesses</u>
Trial	Most Scientifically Sound Best Measure of Exposure 1	Time Consuming Unethical for Harmful exposures Most Expensive 5
Cohort Study	Most Accurate Observational Study Good Measure of Exposure 2	Time Consuming Most Expensive 6
Case-Control Study	Can Study Rare Diseases Relatively Less Expensive and Relatively Fast 3	Possible Time-Order Confusion Possible Error in Recalling Past Exposures 7
Cross-Sectional Study	Fastest Least Expensive 4	Possible Time-Order Confusion Least Confidence in Findings 8

Which study design creates the possibility of error in recalling past exposures?

Detectives in the Classroom - Investigation 2-8: Which Design Is Best?

Question: Which study design creates the possibility of error in recalling past exposures?

Address misconceptions.

The case-control study is vulnerable to serious error in recalling past exposures. Not only is it difficult for people to remember exposures many years in the past, but cases (people with the disease), compared with controls, might recall their past exposures more accurately because they are searching for explanations for their illness. This can seriously bias the results of a study.

Next Slide

Which Design Is Best?

Study Designs	Main Strengths	Main Weaknesses
Trial	Most Scientifically Sound Best Measure of Exposure 1	Time Consuming Unethical for Harmful exposures Most Expensive 5
Cohort Study	Most Accurate Observational Study Good Measure of Disease 2	Time Consuming Most Expensive 6
Case-Control Study	Relatively Less Expensive and Relatively Fast 3	Possible Time-Order Confusion Possible Error in Recalling Exposures 7
Cross-Sectional Study	Fastest Least Expensive 4	Possible Time-Order Confusion Least Confidence in Findings 8

It depends

Which Design Is Best?

Detectives in the Classroom - Investigation 2-8: Which Design Is Best?

In summary, ask students to reconsider the original question, “Which design is best?” Try to make them realize that the answer is “It depends”

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It depends on

- Regulations
- Time urgency
- How much is known about the association
- Money
- Whether the exposure is believed to be beneficial

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It depends on the following questions:

- Is there a regulation that requires a particular research design to be used? (The Food and Drug Administration requires that new medications be tested in trials. It would be cheaper for the pharmaceutical industry to sell medications and perform the less scientifically sound observational studies to determine how well the medications work.)
- How quickly is an answer needed? (Sometimes the case-control and cross-sectional designs are preferable, even though we are less confident of their findings. Rather, the speed with which they can provide some evidence for or against the hypothesis can be valuable. Said another way, although the cohort study is the most accurate observational study, it may not be the design of choice when decisions need to be made quickly.)
- How much is already known about the association? [Traditionally, a hypothesis that is new or has little supporting evidence will be tested with a quicker study. Only after there seems to be a strong basis for the hypothesis will interest and support be sufficient for the more advanced study design approaches. Cohort studies are used as more advanced tests of a hypothesis supported by case-control studies. Sometimes a trial will be conducted to finalize the evidence for a hypothesis already supported by cohort studies as long as the exposure of interest is beneficial (see the fifth question, below).]
- How much money do you have to test the hypothesis? (In the real world, money is always a consideration. As above, only after a hypothesis has a lot of support will there be financial support for major cohort studies or trials.)
- Is the exposure hypothesized to be harmful or beneficial? (If the exposure is hypothesized to be harmful, it is unethical to test the hypothesis in a trial.)

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An Example

Which Design Is Best?



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Present the following scenario:

Seven children from the same high school were diagnosed with leukemia within the past 2 years. At a recent PTA meeting, parents demanded that something be done to find out why. One parent suggested it is the school's drinking water. Another believed it to be the toxic dump site in the neighborhood of the school. Still another said it is the food in the cafeteria.

Given these circumstances, ask students:

- Which study design do you think would be best? (Parents want and need some information quickly so they can make a decision regarding what is best for their children. Despite the fact that we are less confident of the findings of case-control and cross-sectional studies, the speed with which they can provide some evidence for or against these hypotheses can be valuable.)

Then ask:

- Why not a cohort design? (Parents do not want to wait years for the results of a cohort study while their children are part of a "natural experiment" and the investigator counts leukemia cases.)
- Why not a trial? (Given that it is hypothesized that these exposures cause a disease, it would not be ethical to intentionally expose children to something believed to be harmful.)

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Which Design Is Best?

What is your
personal
favorite?



Why?

4 Study Designs

Case-Control Study

Cohort Study

Cross-Sectional Study

Trial

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In summary, ask students:

- Taking into consideration everything you have learned, what is your favorite study design? Explain your choice.

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Which Design Is Best?



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This concludes **Investigation 2-8: Which Design Is Best?** and students can now put away their **Epi Logs**.