

Session 4 (BIAS & EFFECT): Exercise sheet

Foundations of Clinical Research · Level 1 · Neudata · #ClearDataClearImpact · Week 4 · Saturday 21 November 2026 · online, 19:30–22:30

Name: _____

Department: _____

This sheet is sent by email before the session, as a Word file and as a PDF. Keep it open on your screen and type your answers into the Word file (or print the PDF). Have a pen, paper and a calculator (or your phone) ready. For the calculations, simple division is enough. The instructor checks every answer live with the 2x2 calculator ([Course/Resources/tools/2x2_calculator.xlsx](#)).

All in-session exercises are done by the **whole class together**: the instructor shows each item on the shared screen, you answer in the **poll** or the **chat**, and the instructor types the class answer on the shared screen. There are no groups. The proposal builder (Part F) is your **own** individual work.

Part	Activity	When	How
A	Spot the bias (4 scenarios)	End of section 4.1 (5 min)	Whole class: poll for each scenario, one fix in the chat
B	Confounding or effect modification? (3 scenarios)	Homework (optional)	On your own
C	Two 2x2 calculations	After the break (15 min)	Whole class: poll for each answer
D	PPV in two settings	Homework (optional)	On your own
E	Read a forest plot and choose the risk-of-bias tool	End of section 4.3 (8 min)	Whole class: polls and chat
F	Proposal builder 4: exposure, outcomes and biases	End of the session (38 min) and homework	Instructor models it live; then you draft your own

Our running question: in adults with septic shock, does a restrictive fluid strategy, compared with usual care, reduce 28-day mortality?

The two papers (course folder, [Course/Papers](#)): Paper 1, Boulet 2024 (a pilot randomised trial of restrictive fluids); Paper 2, Hyun 2023 (a registry cohort of fluid balance and death).

Key words of the day: bias · confounding · effect modification (interaction) · reverse causation · risk · risk ratio (RR) · risk difference (RD) · number needed to treat (NNT) · odds ratio (OR) · sensitivity · specificity · positive and negative predictive value (PPV, NPV) · ROC (receiver operating characteristic) curve · forest plot · I-squared (I^2 , heterogeneity) · risk-of-bias tool.

Other abbreviations on this sheet: ICU = intensive care unit; CI = confidence interval; RCT = randomised controlled trial.

Part A: Spot the bias

How it runs. The instructor shows each scenario and opens a poll: **selection bias**, **recall bias**, **observer bias** or **confounding**. After the result, type **one practical way** to reduce it in the chat.

#	Scenario	Main bias	One way to reduce it
1	In a case-control study, families of patients who died of sepsis remember the days before ICU admission in more detail than families of survivors.		
2	In an unblinded trial of restrictive fluids, the doctor who knows each patient's group decides when the patient is "ready for ICU discharge".		
3	A study of fluid balance and death includes only patients who stayed in the ICU for 3 days or more.		
4	In a registry, patients with a higher lactate received more fluid and also died more often. The authors conclude that fluid increases mortality.		

Part B: Confounding or effect modification? (homework, optional)

Instructions. Each study splits its result by a third factor. Compare the strata **with each other** and **with the overall (crude) result**. Decide: **confounding**, **effect modification (interaction)** or **neither**. Then say what the authors should report.

Rule of thumb: strata similar to each other but different from the crude result mean confounding.
Strata different from each other mean effect modification.

#	Study (hypothetical)	Overall RR	Stratum 1	Stratum 2	Your answer	What to report
1	Vasopressor X vs Y in septic shock and death by day 28. Clinicians chose X mainly for patients with a high lactate.	1.80	lactate below 4: RR 1.00	lactate 4 or more: RR 1.00		
2	Restrictive vs usual fluids and death by day 28	0.70	age below 65: RR 0.50	age 65 or over: RR 0.95		
3	A nurse-led charting protocol and incomplete fluid charts	0.80	day shift: RR 0.80	night shift: RR 0.79		

Part C: Two 2x2 calculations

How it runs. Draw each table on your paper first. The instructor then asks each answer as a poll, checks it live with the 2x2 calculator on the shared screen, and a volunteer says the result in one plain sentence.

1. **Draw the 2x2 table first.** Exposure (or treatment) in **rows**, with the exposed or treated group on top. Outcome in **columns**, with "outcome yes" on the left.
2. Round to two decimals.
3. Say the result in **one sentence** a colleague without research training would understand.

Reminder

Measure	Formula (from the table a, b, c, d)
Risk in exposed or treated	$a / (a + b)$
Risk in unexposed or control	$c / (c + d)$
Risk ratio (RR)	risk exposed ÷ risk control
Risk difference (RD)	risk exposed minus risk control
Number needed to treat (NNT)	$1 \div RD $ (RD written as a proportion, e.g. 0.05)
Odds ratio (OR)	$(a \times d) \div (b \times c)$

Calculation 1: a fluid trial

A hypothetical trial randomised 400 adults with septic shock to a restrictive fluid strategy (200 patients) or usual care (200 patients). By day 28, **20** patients had died in the restrictive group and **30** in the usual-care group.

	Died by day 28: YES	Died by day 28: NO	Total
Restrictive	a =	b =	
Usual care	c =	d =	

1. Risk with restrictive fluids = _____ Risk with usual care = _____
2. RR = _____ 3. RD = _____ 4. NNT = _____ 5. OR = _____
6. The worked example in the slides had the same RR (20/100 vs 30/100). Why is the NNT different here? _____
7. One sentence for a colleague: _____

Calculation 2: a fluid case-control study

Investigators selected **40** ICU patients with sepsis who needed new dialysis (cases) and **80** ICU patients with sepsis from the same units who did not (controls). They looked back at each patient's fluid balance on day 3. Among the cases, **24** had a positive balance and 16 had not. Among the controls, **16** had a positive balance and 64 had not.

	Cases (new dialysis)	Controls (no dialysis)
Positive fluid balance on day 3	a =	b =
Zero or negative balance	c =	d =

- OR = _____
- Why can you **not** calculate the risk of dialysis, the RR or the NNT from this study?

- Could the arrow run the other way here (reverse causation)? Why?

- One sentence for a colleague: _____

Note: in a case-control study the columns are the case and control groups. The OR formula $(a \times d) \div (b \times c)$ stays the same.

Extra practice (self-study): another topic

A trial randomised 400 adults on a medical ward to a new pressure-relieving mattress (200 patients) or a standard mattress (200 patients). A new pressure injury developed in **10** patients on the new mattress and in **20** on the standard mattress. Draw the table and calculate the two risks, RR, RD, NNT and OR. Is the OR close to the RR here? Why?

Part D: PPV in two settings (homework, optional)

Instructions. The same test has **sensitivity 90%** and **specificity 80%**. Complete each table for 500 people, then calculate PPV and NPV.

Disease present = prevalence $\times$ 500. True positives (TP) = sensitivity $\times$ disease present. True negatives (TN) = specificity $\times$ disease absent. FP = false positives; FN = false negatives.

Setting 1: ICU, prevalence 20%

	Disease present	Disease absent	Total
Test positive	TP =	FP =	
Test negative	FN =	TN =	
Total			500

PPV = $TP / (TP + FP)$ = _____ NPV = $TN / (TN + FN)$ = _____

Setting 2: screening, prevalence 2%

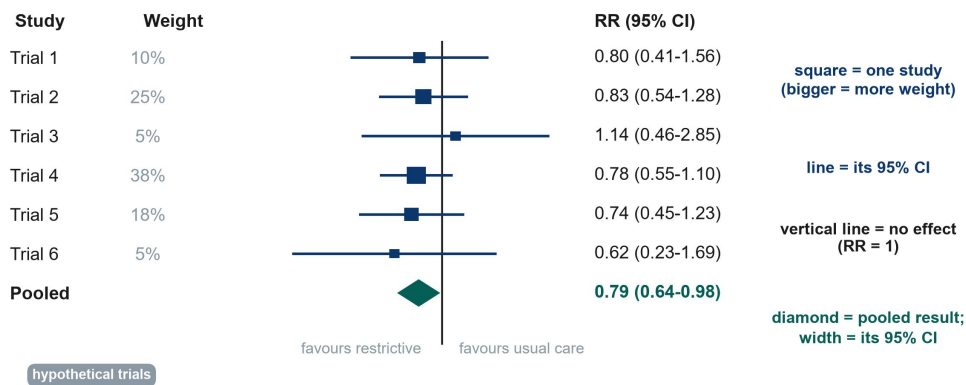
	Disease present	Disease absent	Total
Test positive	TP =	FP =	
Test negative	FN =	TN =	
Total			500

PPV = _____ NPV = _____

1. Why is the PPV so different when the test is the same? _____
2. Calculate the positive likelihood ratio, $LR+ = \text{sensitivity} / (1 - \text{specificity}) =$ _____. Does it change between the settings? _____
3. Optional: repeat for a prevalence of 50%.

Part E: Read a forest plot and choose the risk-of-bias tool

How it runs. The instructor shows the plot on the shared screen and asks each question as a poll or in the chat. The plot is the one shown in section 4.3 (six hypothetical trials of restrictive vs usual fluids; outcome death; fixed-effect pooling).



Trial	Restrictive: died / total	Usual care: died / total
Trial 1	12 / 60	15 / 60
Trial 2	30 / 150	36 / 150
Trial 3	8 / 40	7 / 40
Trial 4	45 / 250	58 / 250
Trial 5	20 / 100	27 / 100
Trial 6	5 / 30	8 / 30

Reading the plot

1. (Poll) Which trial carries the most weight? Why? _____
2. (Poll) Does any single trial show a clear effect (a 95% CI that does not cross 1)?

3. (Chat) Does the pooled diamond cross $RR = 1$? Write the pooled result in one plain sentence.

4. (Self-study) Trial 3 points the other way ($RR\ 1.14$). Should it worry you? Why or why not?

Choosing the tool (poll). For each study, choose: **RoB 2** (Cochrane risk-of-bias tool for randomised trials), **ROBINS-I** (non-randomised studies of interventions), **Newcastle-Ottawa Scale (or ROBINS-E)** (cohort or case-control studies of exposures), **QUADAS-2** (diagnostic accuracy studies) or **AMSTAR 2** (systematic reviews). A one-page chooser is in [Course/Resources/Risk_of_Bias_Tool_Chooser.pdf](#).

#	Study	Tool
a	Paper 1, Boulet 2024: randomised trial of restrictive vs usual fluids	
b	Paper 2, Hyun 2023: registry cohort, positive vs negative fluid balance	
c	Systematic review and meta-analysis of fluid-restriction trials	
d	(Self-study) Before-after study of a fluid protocol on one unit	
e	(Self-study) Point-of-care lactate compared with the laboratory reference test	
f	(Self-study) Cluster-randomised trial of a fluid-charting protocol (12 ICUs)	

Part F: Proposal builder 4 (exposure, outcomes and biases)

This is your own work. Every participant writes their own research proposal on a question from their own department (see [Course/Assignment/proposal_brief.md](#)).

How it runs (38 minutes).

1. **Watch (15 min).** The instructor fills in rows 4-6 below for the running example on the shared screen, thinking aloud.
2. **Draft (16 min).** You fill in the same rows for your own question, quietly (cameras optional). Ask questions in the chat.
3. **Feedback (7 min).** Three volunteers paste one bias and its fix in the chat; the instructor comments.

Then finish as homework and copy your answers into the proposal template ([Course/Templates/Research_Proposal_Template.docx](#), Part 2). Rows 1-3 (design, setting, population) were drafted after Session 3. For every outcome write **what**, **how** and **when**.

My research question: _____

#	Section	What to write	My answer
4	Exposure or intervention and comparator	What exactly is the exposure or intervention, and how is it defined or measured? Who is the comparison group?	
5	Outcomes	ONE primary outcome: what it is, how and when it is measured. 2-3 secondary outcomes.	
6	Main biases and how I reduce them	Name at least two threats (selection, information, confounding) and the step in your design that reduces each.	

My claim at the end will be: ☐ "caused" (randomised design) ☐ "associated with" (observational design), because _____

Self-check before you finish

- ☐ There is a comparison group, or I explain why my study is descriptive.
- ☐ There is only ONE primary outcome, with a method and a time point.
- ☐ If my design is observational, I have named the main confounders (think: confounding by indication).
- ☐ Each bias has a concrete mitigation step ("we will be careful" is not a mitigation).
- ☐ Part 2 is complete: design, setting, population (Session 3) + exposure, comparator, outcomes, biases (today).