

Course 3 · Week 4 — Evidence synthesis, ID, pre-registration

Cheatsheet — biostats_courses

R. Heller

Systematic review workflow

1. PICO: Population, Intervention, Comparator, Outcome.
2. Register protocol on PROSPERO.
3. Build search across ≥ 2 databases; peer-review with a librarian.
4. Two-screener title/abstract and full-text.
5. Extract, appraise (RoB 2 / ROBINS-I), synthesise.
6. Report with the PRISMA 2020 checklist and flow diagram.

Meta-analysis

```
library(metafor)
dat <- escalc(measure = "RR",
             ai = tpos, bi = tneg, ci = cpos, di = cneg,
             data = studies)
fit <- rma(yi, vi, data = dat, method = "REML")
fit
forest(fit, header = TRUE)
funnel(fit); retest(fit)
```

Statistic	Meaning
τ^2	between-study variance
I^2	% of total variance due to heterogeneity
Egger's test	funnel-plot asymmetry (small-study effects)

Fixed-effect only when heterogeneity is effectively zero. Default to random effects.

Network meta-analysis

```
library(netmeta)
net <- netmeta(TE, seTE, treat1, treat2, studlab,
              data = dat, sm = "MD", random = TRUE)
netgraph(net)
netrank(net, small.values = "good") # SUCRA ranking
decomp.design(net) # inconsistency
```

Transitivity + consistency are the core assumptions.

Infectious disease — SIR / SEIR

```
library(deSolve)
sir <- function(t, y, p) with(as.list(c(y, p)), {
  N <- S + I + R
  list(c(-beta * S * I / N,
        beta * S * I / N - gamma * I,
        gamma * I))
})
```

```
out <- ode(c(S = 999, I = 1, R = 0),
          times = 0:120,
          func = sir,
          parms = c(beta = 0.3, gamma = 0.1))
```

$R_0 = \beta/\gamma$. Herd-immunity threshold $\approx 1 - 1/R_0$.

Pre-registration and SAP

A pre-registration specifies, before data analysis:

- Primary outcome + exact estimand.
- Analysis model (fixed terms, adjustments, interactions).
- Handling of missing data.
- Multiplicity control.
- Sample-size justification.

OSF and ClinicalTrials.gov are the two common registries.

Decision rule for Week 4

- More than a handful of studies on a question → plan a systematic review.
- Multiple comparators of interest → network meta-analysis.
- Outbreak modelling → start with SIR, extend only as data justify.
- Confirmatory analysis → pre-registered; exploratory analyses are labelled as such in the manuscript.

Common pitfalls

- Declaring a review “systematic” without a pre-registered protocol.
- Pooling studies with fundamentally different populations / outcomes.
- Interpreting SUCRA rankings as if they were certain.
- Calling a compartmental model a “forecast” without uncertainty.

Further reading

- Higgins et al., *Cochrane Handbook for Systematic Reviews*.
- Keeling & Rohani, *Modeling Infectious Diseases in Humans and Animals*.
- Nosek et al. (2018), *The preregistration revolution*.