MONASH University

Epidemiology by Design: Building a Usable SIRS Pipeline

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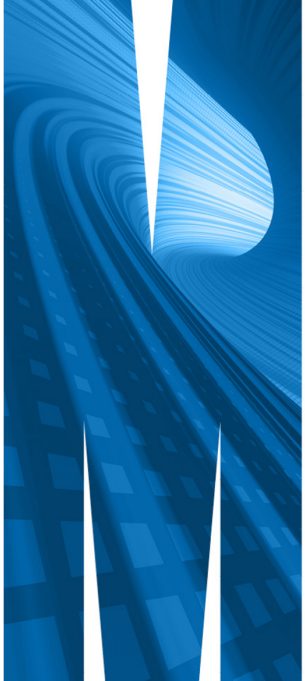

Project Snapshot

Package (working name)

- epi-simulation

Who's it for

- Epidemiology analysts
- Public-health planners
- Modelling/biostats teams

My role

- Design the workflow
- Build simulators & plots
- Package + docs
- Live demos & handover

Repo

- https://github.com/idem-lab/epi-simulation

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Why It Matters

- Fast, clear signals for seasonal illness planning
- Decision-ready visuals from modelling
- Repeatable outputs teams can share quickly
- Quick what-if comparisons to test options
- Consistent, standardized figures across projects/terms

Project Goal

Overall Aim:

- Standardised package
- Simple visuals
- Faster decisions

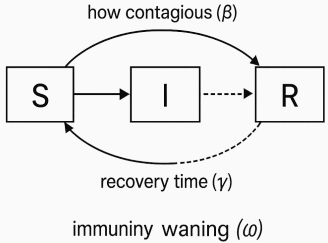
Core Outputs:

- Baseline
- Seasonality
- Risk band
- Multi-group

What Users Can Do Now:

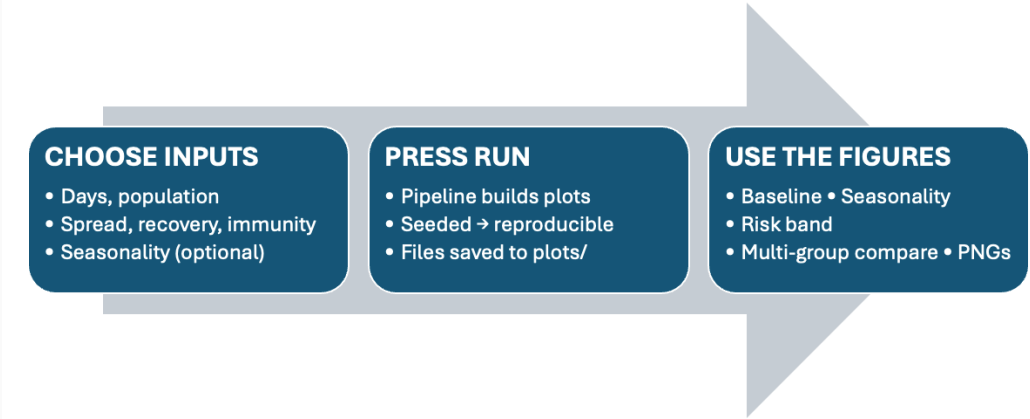
- Quick start
- What-if
- Compare groups
- Export PNGs

What is the SIR Model?



- **S** – Susceptible: can get it
- **I** – Infected: contagious now
- **R** – Recovered: temporarily immune
- **Flows**: S $\rightarrow$ I (spread), I $\rightarrow$ R (recovery), R $\rightarrow$ S (waning)
- **Model used**: SIRS (includes waning immunity)

How It Works (At a Glance)



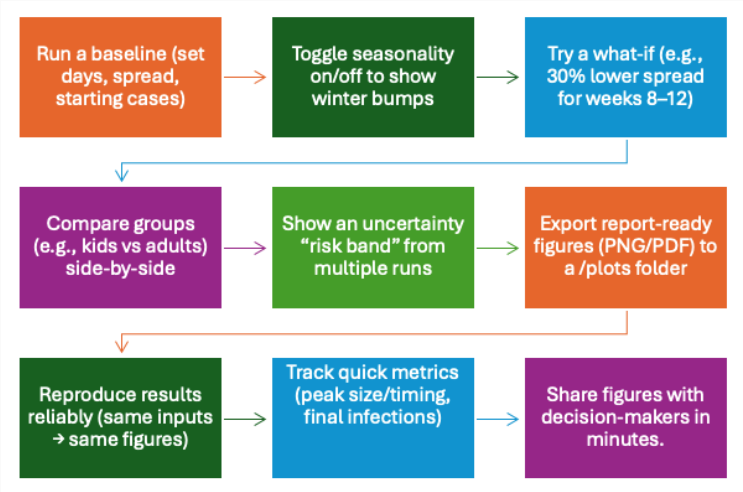
Quick Demo (What I'll change)

- **Days (`n_times`)** — length of the run
- **Population (`pop`)** — number of people
- **Seed cases (`I_init`)** — starting infections
- **Contagiousness (`beta`)** — how easily it spreads
- **Recovery time (`gamma`)** — how fast people recover
- **Immunity waning (`omega`)** — how fast immunity fades
- **Sims (`n_sims`)** — width of the risk band
- **Seed (`seed`)** — makes the run repeatable

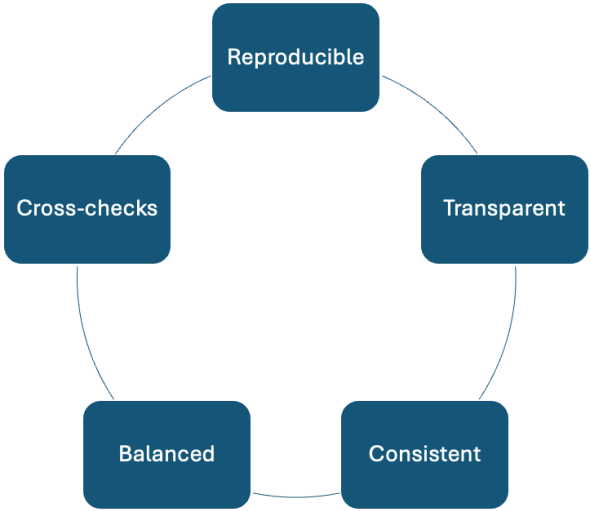
Quick Demo (Code I'll run)

```
# Load helpers + simulators
R.utils::sourceDirectory("R/", modifiedOnly = FALSE)
source("R/simulate_sirs_det.R")
source("R/simulate_sirs_stoch.R")
source("R/plot_det_vs_stoch.R")

# Inputs to tweak
n_times <- 365; pop <- 100000; I_init <- 10
beta <- 0.18; gamma <- 1/7; omega <- 1/30

# Run baseline + ribbons
det <- simulate_sirs_det(n_times, pop, I_init, beta, gamma, omega)
st  <- simulate_sirs(n_times, pop, I_init, beta, gamma, omega,
                     epsilon = 0, alpha = NULL, n_sims = 200,
                     stochastic = TRUE, seed = 42)

plot_det_vs_stoch(det, st, state = "incidence", probs = c(0.1, 0.9))
```

What People Can Do Now



Trust & Quality



Challenges & Limitations

Challenges we faced:

- Clarity vs speed
- Naming & standards
- Uncertainty handling
- Environment quirks
- Multi-group setup

Current limitations:

- No real-data calibration yet
- Simple dynamics (SIRS only)
- Performance at high sims/P
- Packaging & docs in progress
- Reliant on user inputs

What's Next?

- **Calibrate to real data** — fit parameters to recent term data for local realism.
- **Add simple age/school groups** — kids vs adults (or year bands) with split outputs.
- **One-click weekly report** — auto-export PNG/PDF bundle for briefings.
- **Preset scenarios** — baseline, winter bump, holiday closure, quick what-ifs.
- **Package + quick-start docs** — install, run, and reproduce in minutes.
- **Pin versions & basic tests** — lock deps; add unit checks for core functions.