

# Scenario modeling

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## Model scenarios and simulation

### Simulation framework

- All staff assigned a work schedule that determines time frames when they are working.  $\mathbf{I}(w_{it})$  is an indicator function for whether staff member  $i$  is working at the facility at time  $t$ . Work schedules can be simulated or drawn directly from CDCR data.
- Testing frequency can be assigned on an individual or staff-wide basis. Again, can be simulated or drawn directly from CDCR data.
- New infections among staff can come from the community or from the facility either from other staff or from residents.
- All staff are subject to force of infection,  $\Lambda$ , that is partitioned between the community and the workplace by parameter  $\alpha$ , such that  $\lambda_w = \Lambda\alpha$  and  $\lambda_c = \Lambda(1 - \alpha)$ .  $\Lambda$  is further modified according to the staff location such that they are only subject to  $\lambda_w$  while working, thus:  $\Lambda_{it} = \lambda_w \mathbf{I}(w_{it}) + \lambda_c(1 - \mathbf{I}(w_{it}))$
- New cases among staff at each time step are then generated by subjecting all susceptible staff to a Bernoulli trial where  $p = \Lambda_{it}$
- Whenever new staff infection generated, draw from distributions to determine:
  - asymptomatic or symptomatic case
  - latent period  $t_{latent}$
  - incubation period ( $t_{incubation}$ )
  - total infectious period ( $t_{infectious}$ )  
to generate an infectiousness profile ( $\beta_{it}$ ). Assuming constant  $\mathcal{R}$  across all individuals,  $r_{it} = \mathcal{R}\beta_{it}$
- Testing schedule determines when staff is tested
- For now assume that isolation only occurs after testing. Future sims can incorporate asymptomatic rates and probability of self-isolating given symptom onset/duration of symptoms
- Main outcome is expected number of cases transmitted by staff over the simulation timeframe:  $\mathbf{E}[cases] = \sum_{t=1}^{t_{sim}} \sum_{i=1}^n \mathbf{I}(w_{it})r_{it}$

### Scenarios

- “Observation” scenario with observed community prevalence, number of staff at each facility, observed staff testing frequency and characteristics (PCR/TAT, antigen). Could see how well matches observed

resident importations and staff cases detected as model validation, but I wouldn't expect a real close match

- Simulations across community prevalence and testing frequency (continuous scales, could have heat map of expected resident cases)
- More discrete scenarios with e.g. high, medium, low community prevalence and high, medium, low testing frequency
- Would like to make space for an adaptive scenario of some sort in which staff testing frequency is a function of community prevalence (i.e. more tests when community transmission is high, fewer when community transmission is low)