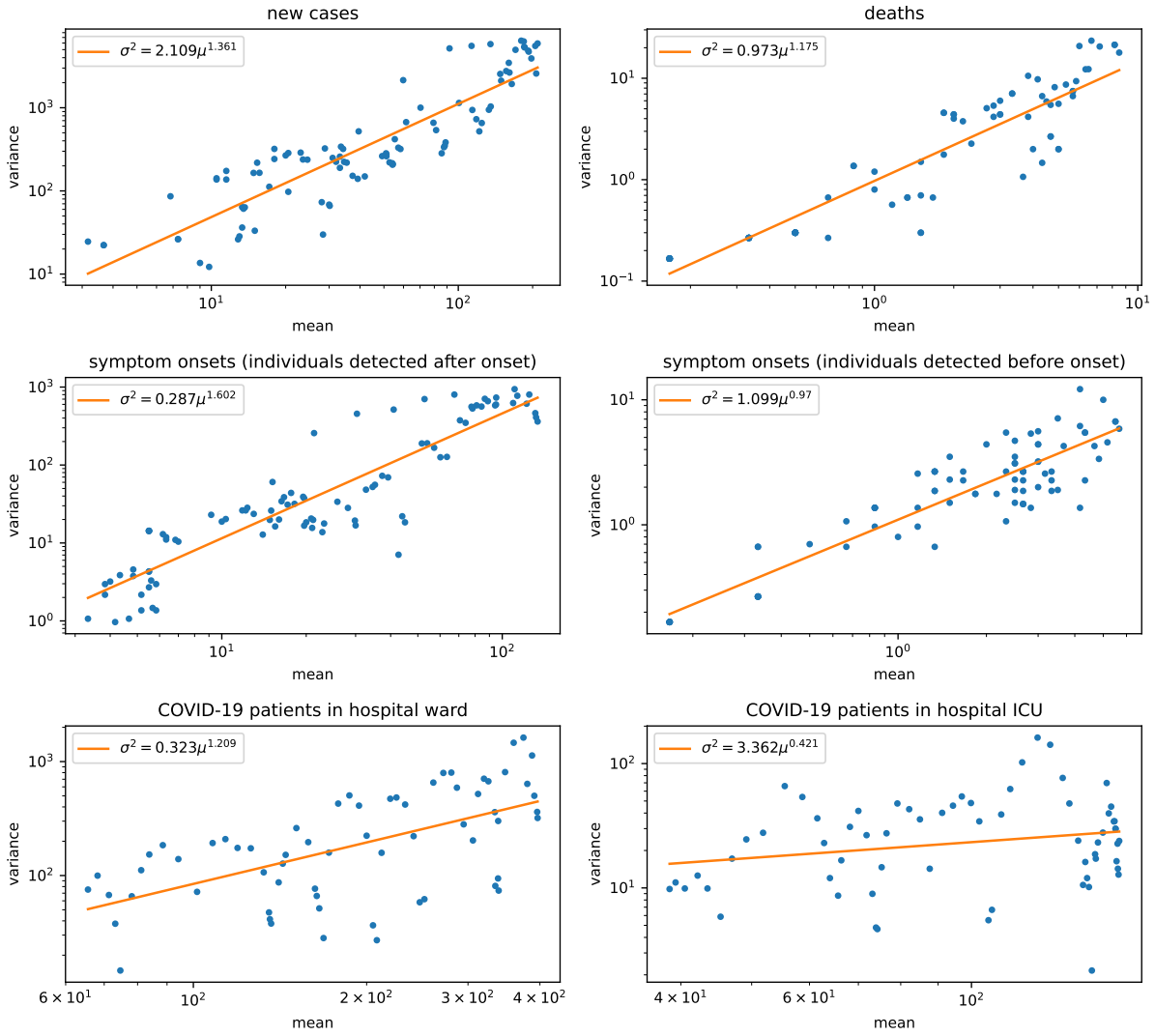
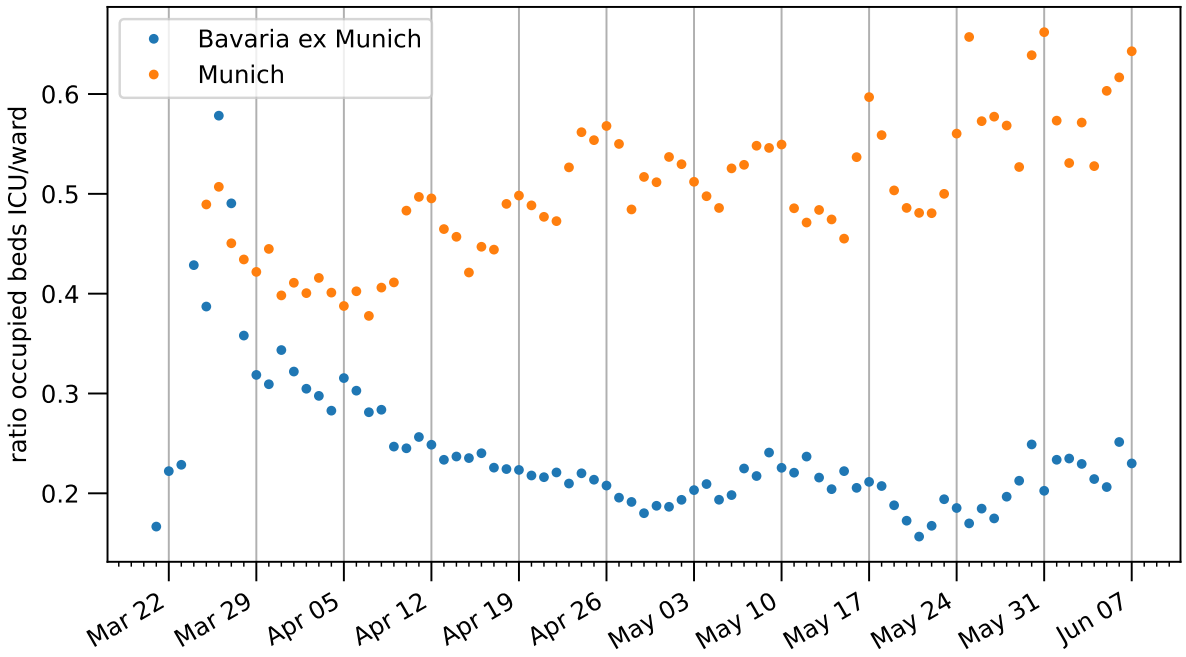
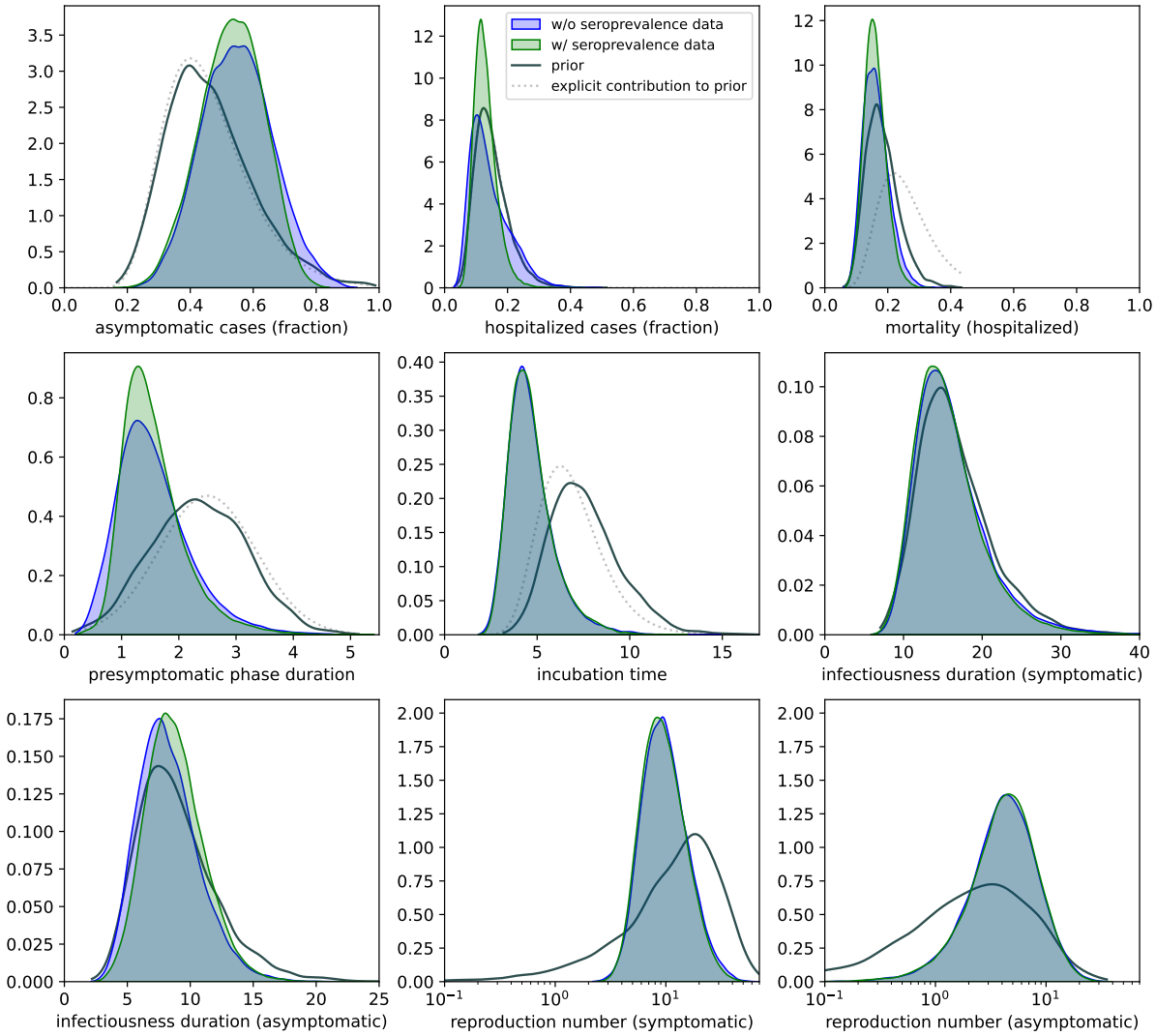
Supplementary figures and tables for "Integrative modelling of reported case numbers and seroprevalence reveals time-dependent test efficiency and infectious contacts"



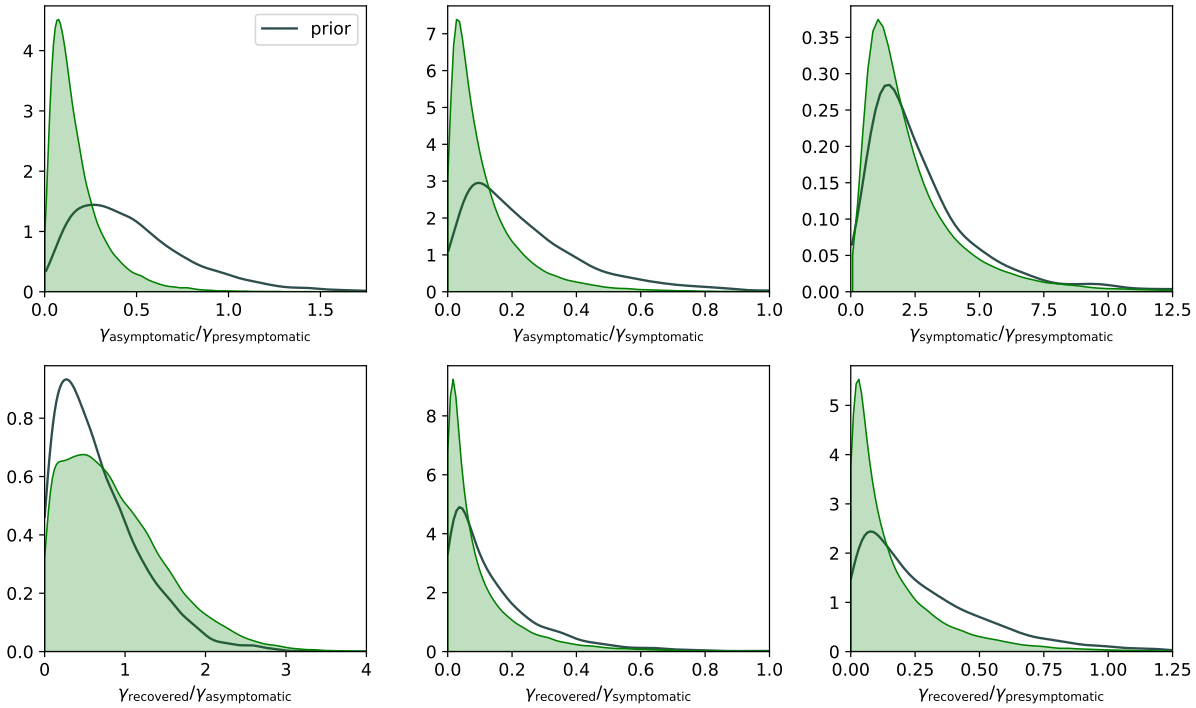
Supplementary Figure 1: Relation between mean and variance in case count data. Means and variances are computed from the timeseries over windows 5 days long.



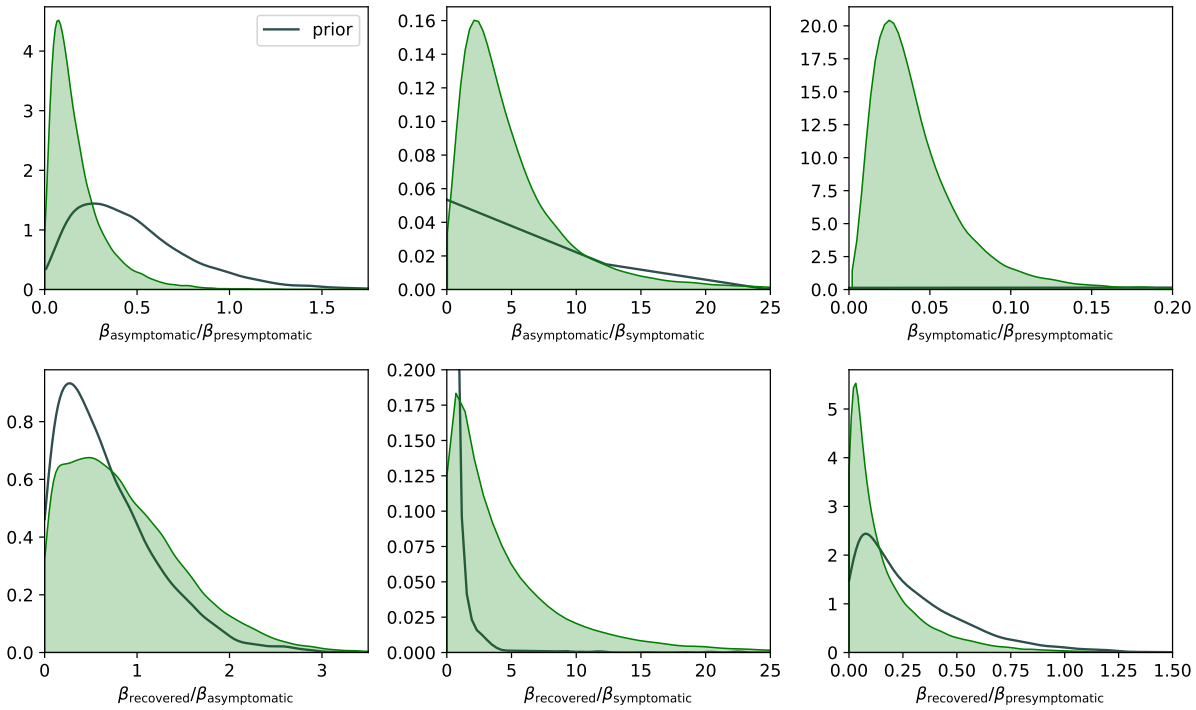
Supplementary Figure 2: Ratio between beds occupied by COVID-19 patients in ICU and ward, respectively for the city of Munich and the rest of Bavaria.



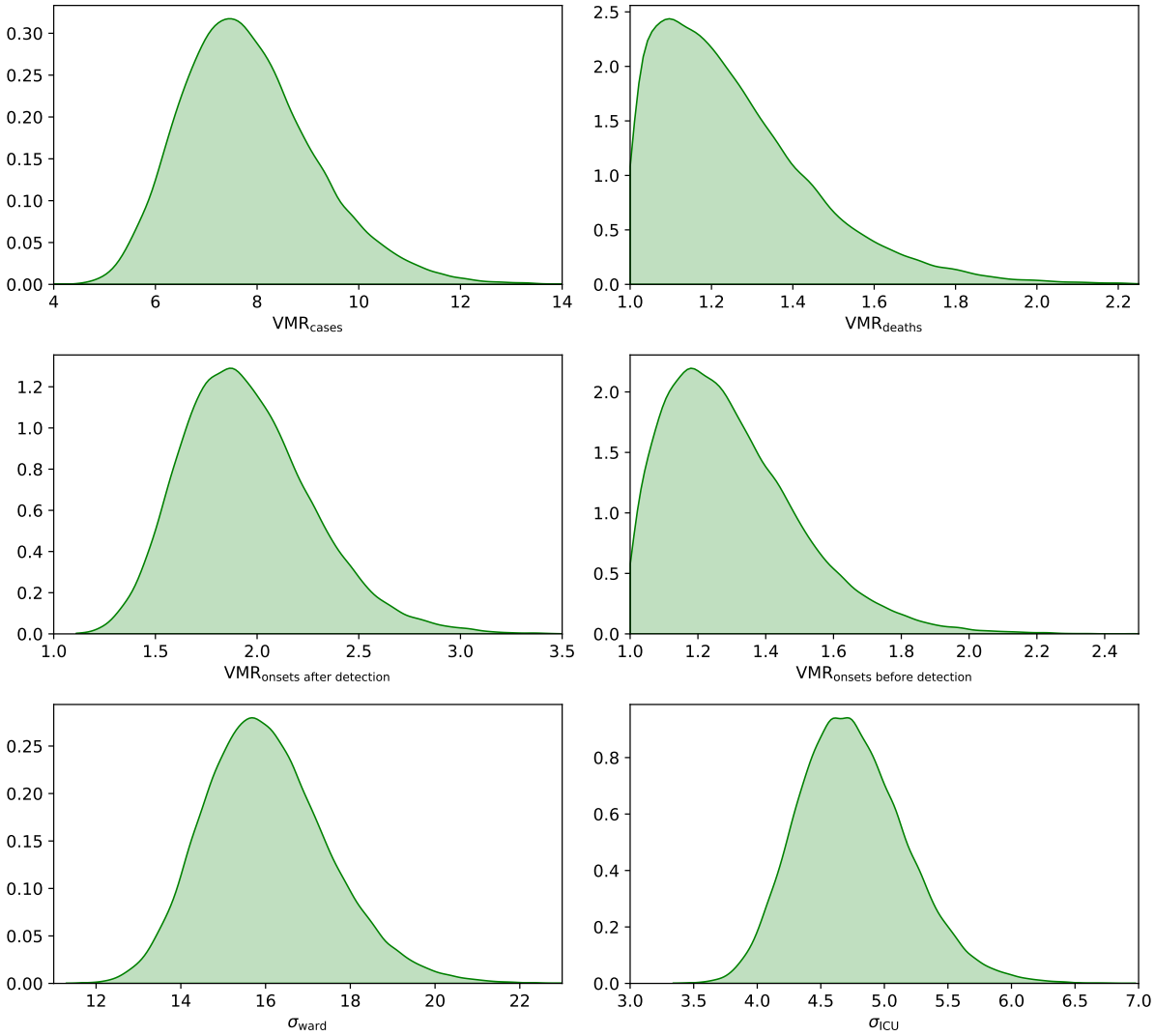
Supplementary Figure 3: Posterior distributions for a small subset of significant model parameters. We have plotted the KDEs obtained for both the case in which seroprevalance data is used for fitting and the one in which it is not. Prior distributions are also plotted: the solid lines are the KDEs obtained from MCMC sampling of the prior, while the dotted lines (where present) are the contributions to the prior density due to the quantity under consideration.



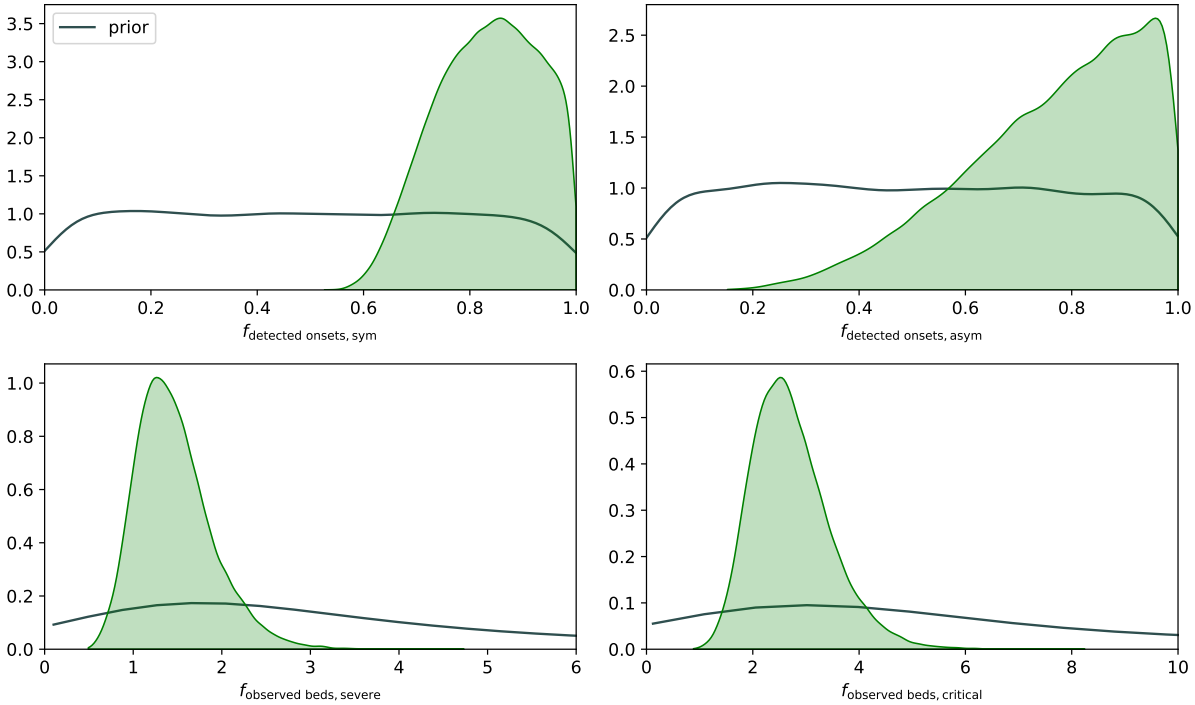
Supplementary Figure 4: Posterior distributions for the infectiousness level γ. Only the prior and the results obtained using seroprevalence data have been plotted.



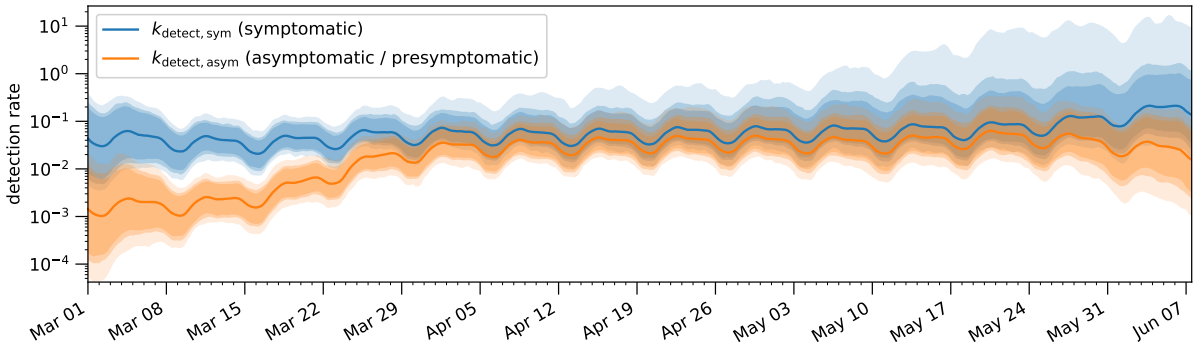
Supplementary Figure 5: Posterior distributions for the average number β of secondary infections per day. Only the prior and the results obtained using seroprevalence data have been plotted.



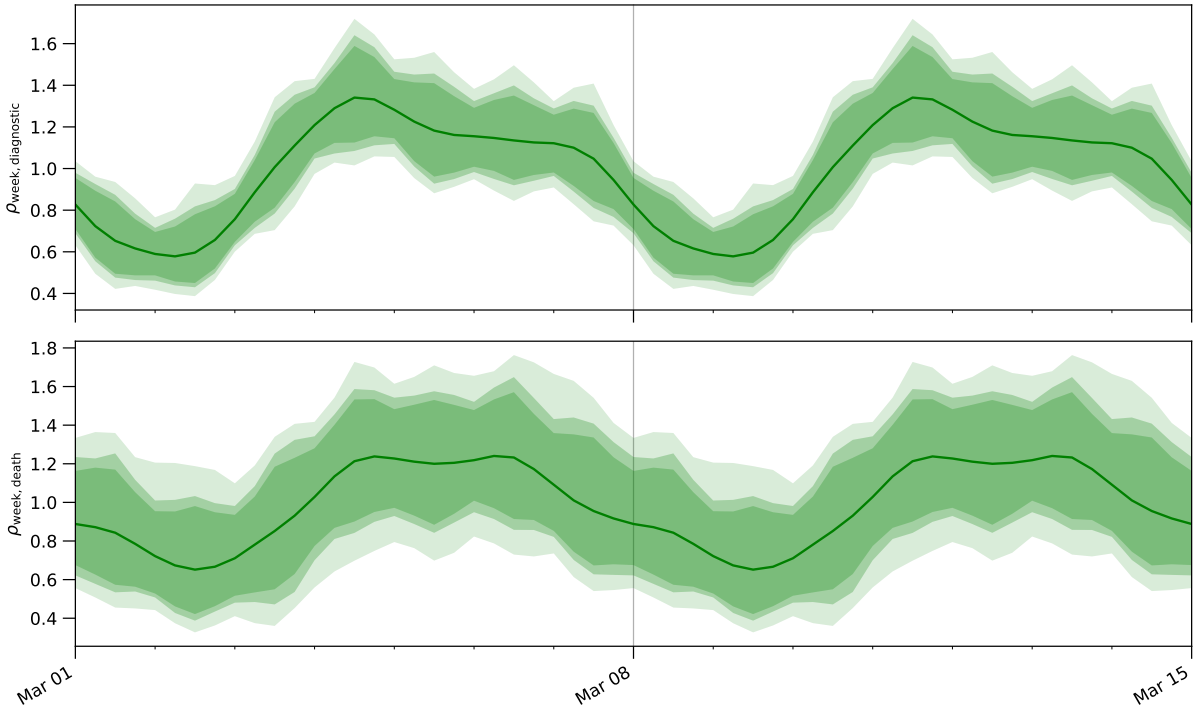
Supplementary Figure 6: Posterior distributions for the noise levels of the observables. For negative binomial distributions the variance-to-mean ratio (VMR) is used, while standard deviations σ are given for normal distributions. Only the results obtained using seroprevalence data have been plotted.



Supplementary Figure 7: Posterior distributions for the scaling factors of the observables. The first row shows the scaling factors controlling the probability of a symptom onset date being reported, while the second row shows the scaling factors estimating the under-/over- representation of the observed hospital bed counts due to either data incompleteness or influx of patients from surrounding areas. Only the prior and the results obtained using seroprevalence data have been plotted.



Supplementary Figure 8: Temporal evolution of the detection rates. The bands correspond to 85%/90%/95% posterior credible intervals, while the solid line denotes the median value.



Supplementary Figure 9: Posterior distributions of the weekly variability in the detection rate and in the death reporting delay. The bands correspond to 85%/90%/95% posterior credible intervals, while the solid line denotes the median value.

Transition time (days)	Empirical distribution	Notes	Source	Prior on mean value
Incubation	$\text{Log}\mathcal{N}(\mu = 1.63, \sigma = 0.5)$ mean 5.6, 95% CI 5.0–6.3 Erlang($k = 6, \lambda = 0.88$)	meta-analysis	McAloon et al. (2020) Linton et al. (2020) Lauer et al. (2020)	$\text{Log}\mathcal{N}(\mu = 1.9, \sigma = 0.25)$
Presymptomatic	mean 2.3, 95% CI 0.8–3.0 median 2.5, IQR 2–3		He et al. (2020) Wei et al. (2020)	$\mathcal{N}(\mu = 2.5, \sigma = 0.85)$
Post-symptomatic infectiousness	mean 13.4	meta-analysis; hospitalized patients only; detectable virus does not imply infectious	Byrne et al. (2020)	$\text{Log}\mathcal{N}(\mu = 2.56, \sigma = 0.35)$
Asymptomatic infectiousness	Gamma(3) with mean 6 median 9, IQR 6–11, range 3–21		Byrne et al. (2020) Sakurai et al. (2020)	$\text{Log}\mathcal{N}(\mu = 2.2, \sigma = 0.35)$
Symptoms	median 7, IQR 3–10	German study; hospitalized individuals only	Dreher et al. (2020)	$\mathcal{N}(\mu = 7, \sigma = 2.8)$
Symptom onset to hospitalization	mean 7.8, SD 6.2, median 4, IQR 7 median 4, IQR 1–8	international study German study	ISARIC (2020) Dreher et al. (2020)	$\mathcal{N}(\mu = 7.5, \sigma = 2.1)$
Symptom onset to hospitalization (no ICU needed)	median 3, IQR 1–7	German study; non-ARDS patients (less likely to need ICU)	Dreher et al. (2020)	$\text{Log}\mathcal{N}(\mu = 1.57, \sigma = 0.425)$
Symptom onset to hospitalization (ICU needed)	median 7, IQR 2–10	German study; ARDS patients (more likely to need ICU)	Dreher et al. (2020)	$\mathcal{N}(\mu = 7.5, \sigma = 2.0)$
Symptom onset to ICU	median 9, IQR 4–12	German study	Dreher et al. (2020)	$\text{Log}\mathcal{N}(\mu = 2.14, \sigma = 0.35)$
Hospitalization to ICU	mean 2.9, SD 6.8, median 1, IQR 3	international study	ISARIC (2020)	$\mathcal{N}(\mu = 2, \sigma = 1.25)$
Hospitalization	mean 12.6, SD 13, median 9, IQR 12 median 8, IQR 5–1 median 10, IQR 5–19	international study German study German study; ARDS patients (possible over-estimation)	ISARIC (2020) Dreher et al. (2020) Tolksdorf et al. (2020)	$\text{Log}\mathcal{N}(\mu = 2.27, \sigma = 0.265)$
Hospitalization (no ICU needed)	median 7, IQR 5–13	German study; ARDS patients (possible over-estimation)	Tolksdorf et al. (2020)	$\mathcal{N}(\mu = 7.5, \sigma = 1.575)$
Hospitalization (ICU needed)	median 16, IQR 8–27	German study; ARDS patients (possible over-estimation)	Tolksdorf et al. (2020)	$\mathcal{N}(\mu = 15.25, \sigma = 4.25)$
Hospitalization (deceased only)	median 10, IQR 4–16	German study; ARDS patients (more likely to die)	Tolksdorf et al. (2020)	$\mathcal{N}(\mu = 11, \sigma = 4.3)$
ICU stay	mean 13.2, median 8.5, IQR 14.5 median 4, IQR 2–10 median 5, IQR 2–15	international study German study German study; ARDS patients (possible over-estimation)	ISARIC (2020) Dreher et al. (2020) Tolksdorf et al. (2020)	$\text{Log}\mathcal{N}(\mu = 2.07, \sigma = 0.35)$

Supplementary Table 1: Prior information on the epidemiological process (transition times).

Fraction	Empirical estimate	Notes	Source	Prior
Mortality (hospitalized individuals)	22%	large-scale German study	Karagiannidis et al. (2020)	$\text{Log}\mathcal{N}(\mu = -1.4, \sigma = 0.333)$
	21%	German study; ARDS patients (more likely to die)	Tolksdorf et al. (2020)	
Hospitalization	10%	German study	Schilling et al. (2020)	$\text{Log}\mathcal{N}(\mu = -1.96, \sigma = 0.35)$
	15%		Robert Koch Institute (2020)	
ICU (hospitalized individuals)	17%	international study	ISARIC (2020)	$\text{Log}\mathcal{N}(\mu = -2, \sigma = 0.45)$
	8%	German study	Schilling et al. (2020)	
	17.23%	large-scale German study; non-invasive ventilation	Karagiannidis et al. (2020)	
	13.15%	large-scale German study; invasive ventilation	Karagiannidis et al. (2020)	
	37%	German study; ARDS patients (more likely to need ICU care)	Tolksdorf et al. (2020)	

Supplementary Table 2: Prior information on the epidemiological process (fractions).

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