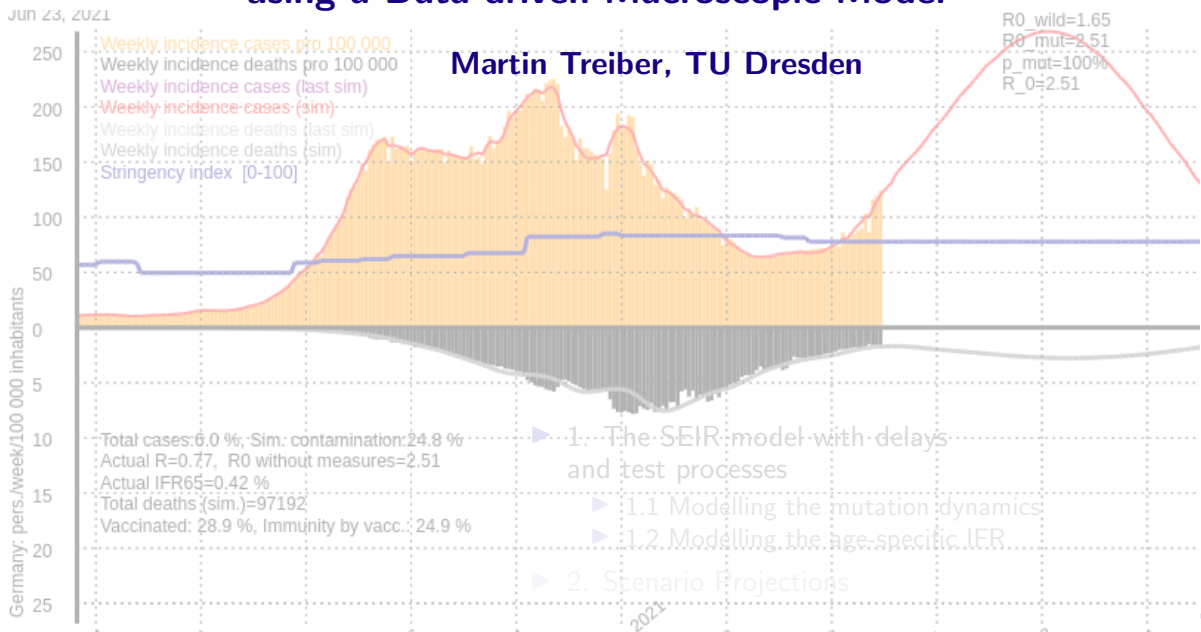


Scenario Projections of the Covid-19 Pandemic using a Data-driven Macroscopic Model

Martin Treiber, TU Dresden

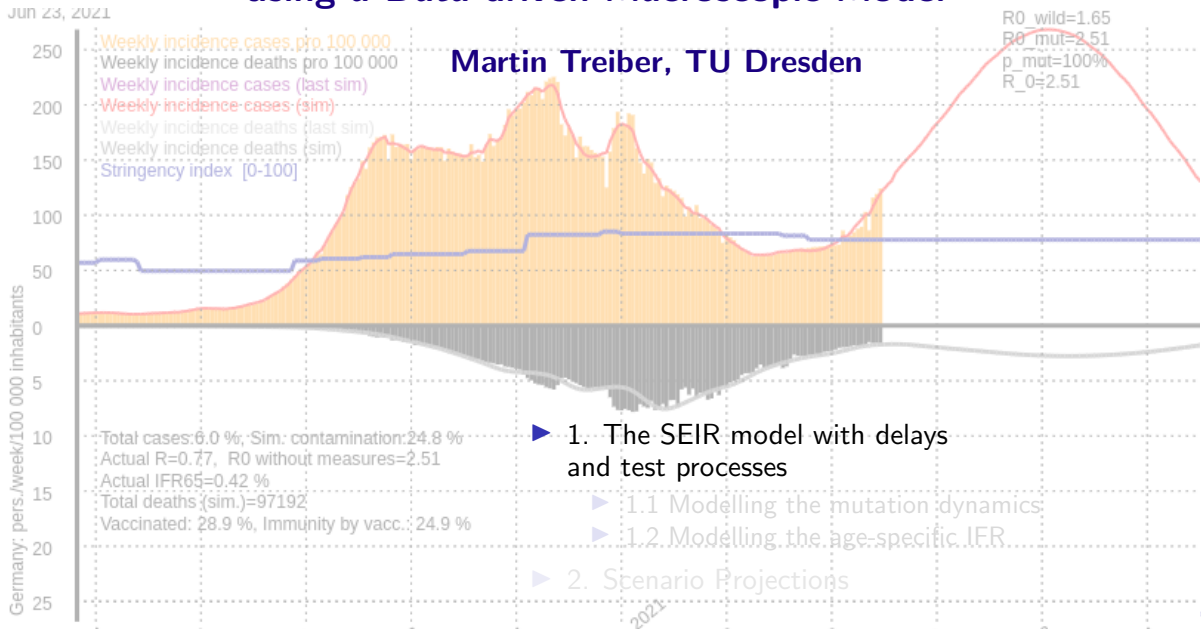
R_0 wild=1.65
 R_0 mut=2.51
 p_{mut} =100%
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► 1. The SEIR model with delays
and test processes

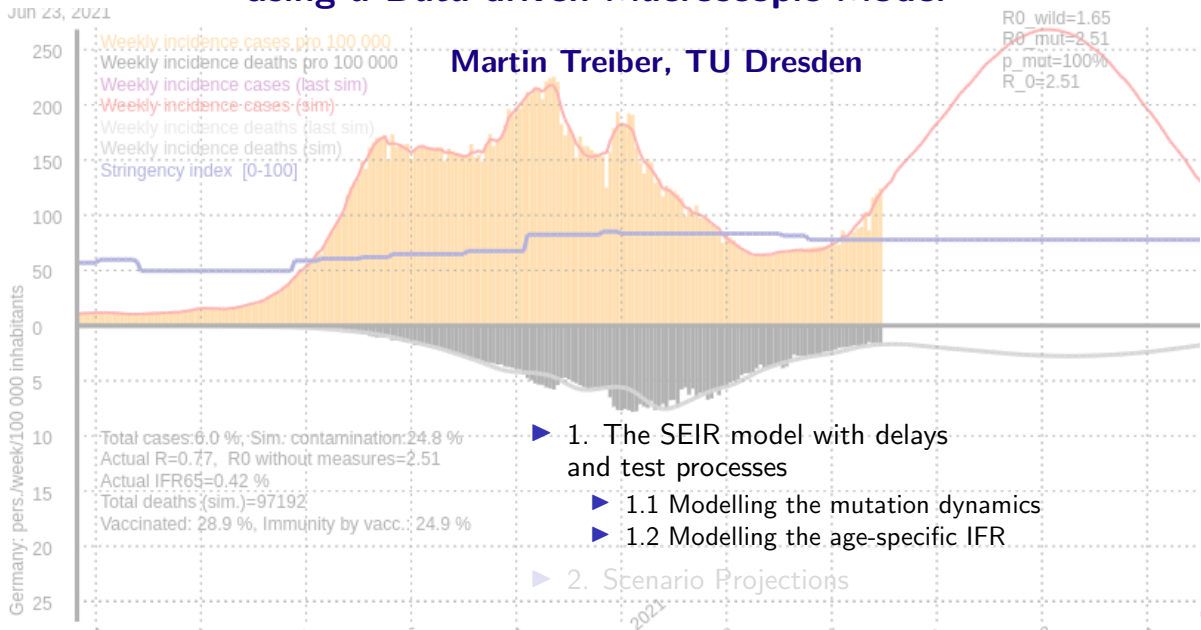
- 1.1 Modelling the mutation dynamics
- 1.2 Modelling the age-specific IFR

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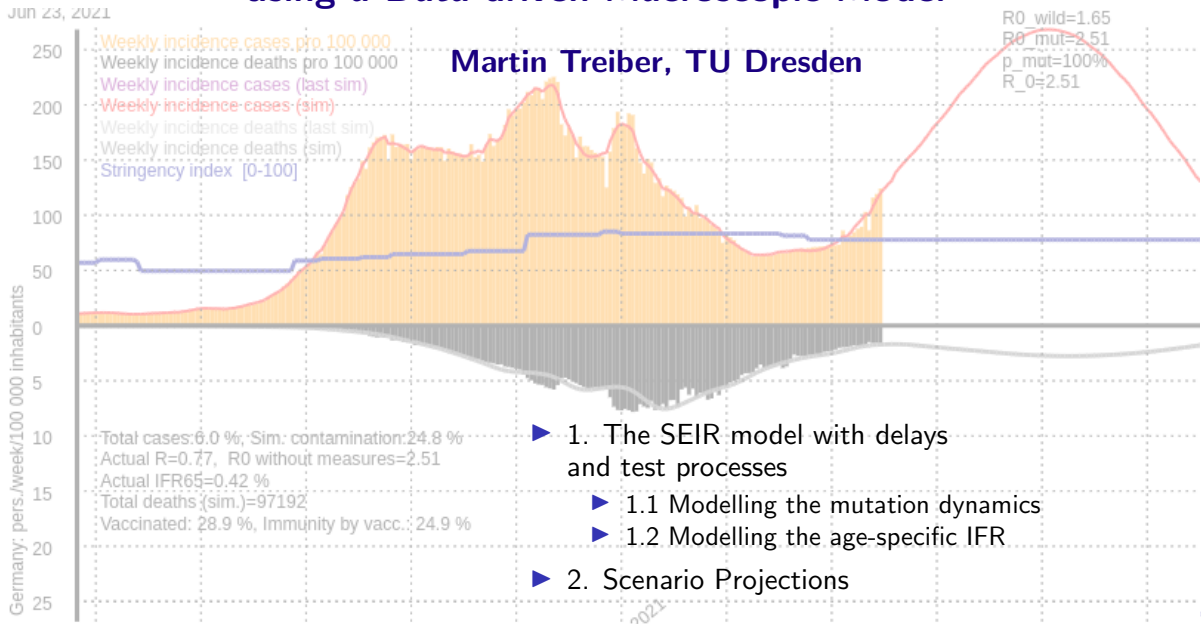


- ▶ 1. The SEIR model with delays and test processes
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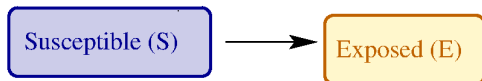
1. Macroscopic SEIR model with explicit delays and test dynamics

- ▶ Different infection *phases* (compartments) and their *transitions*
- ▶ Macroscopic dynamic variables: fractions of the population in the compartments

Susceptible (S)

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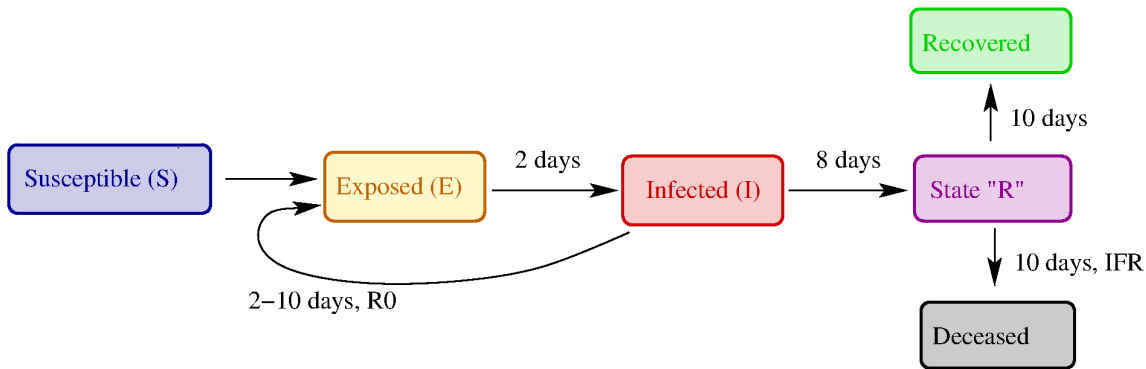
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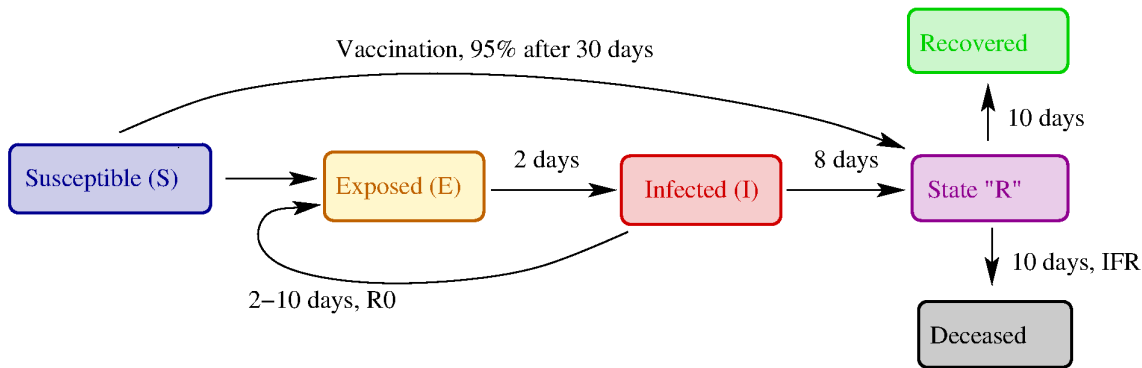
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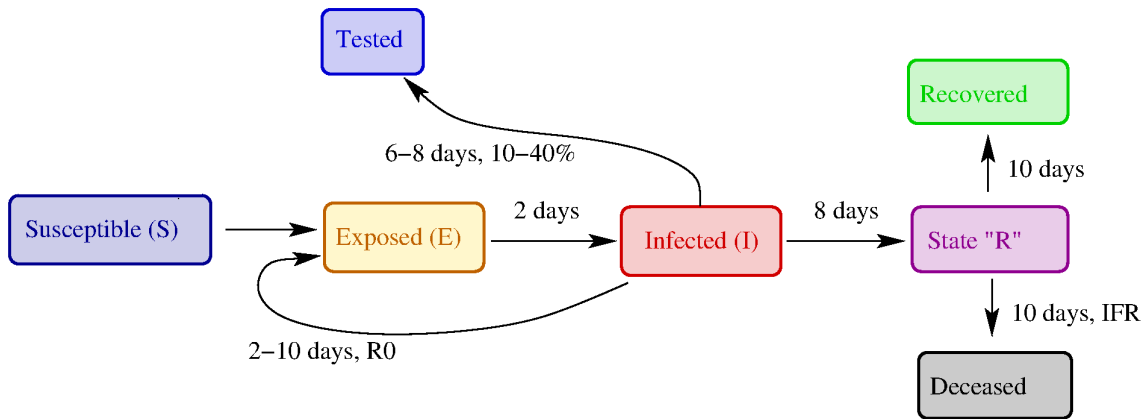
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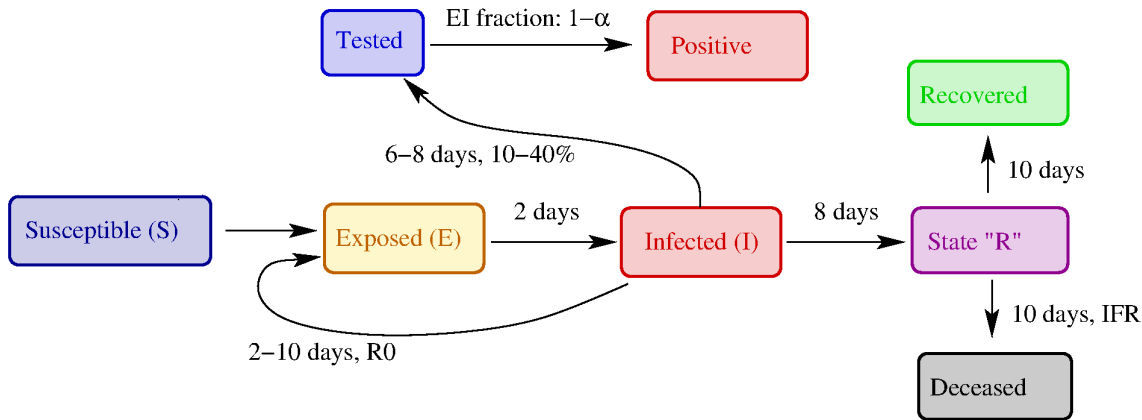
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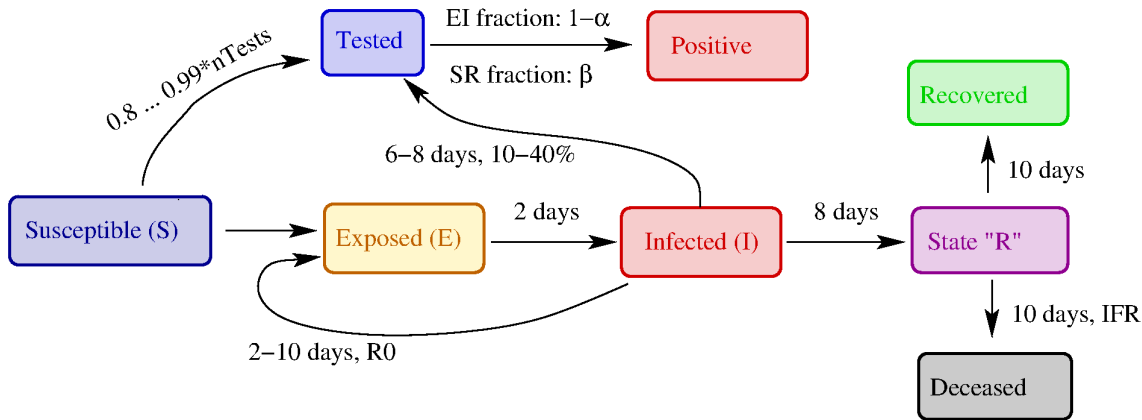
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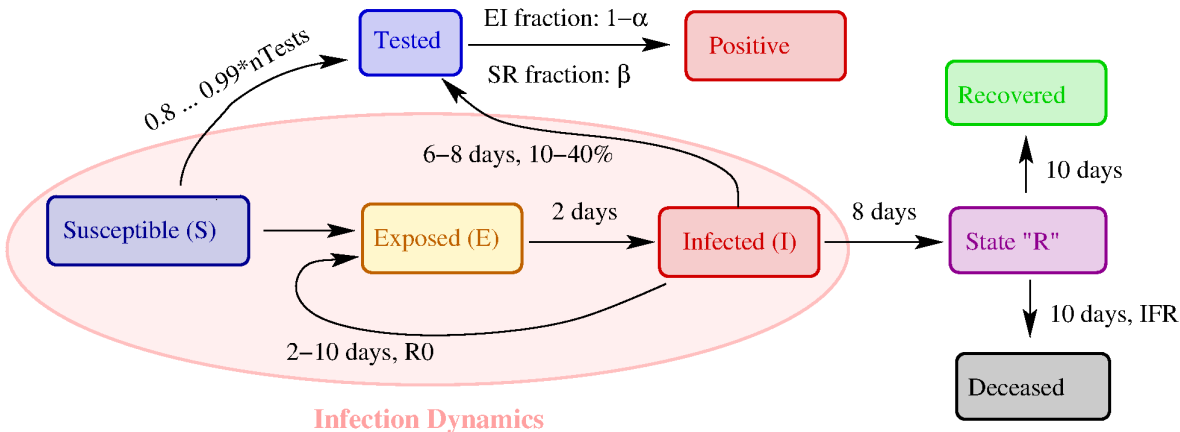
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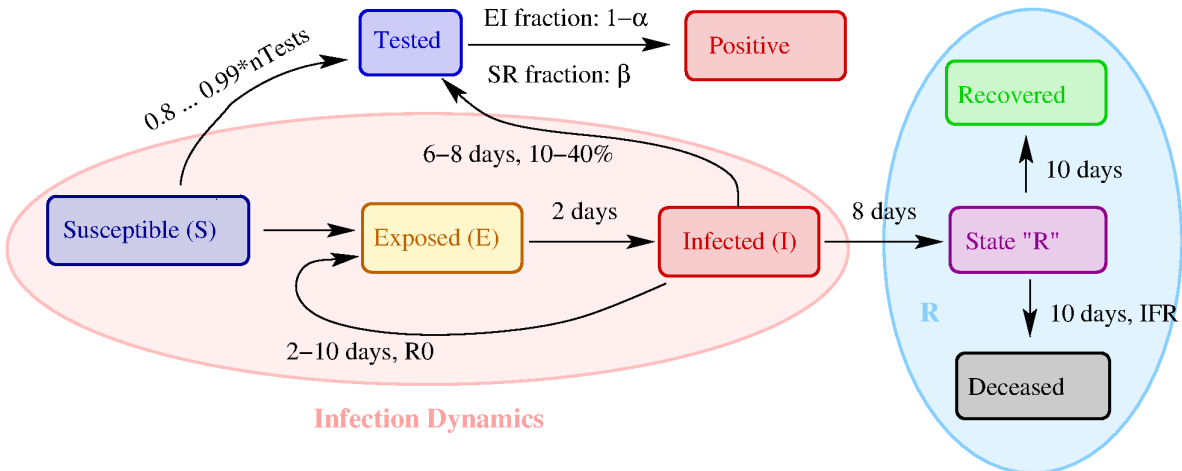
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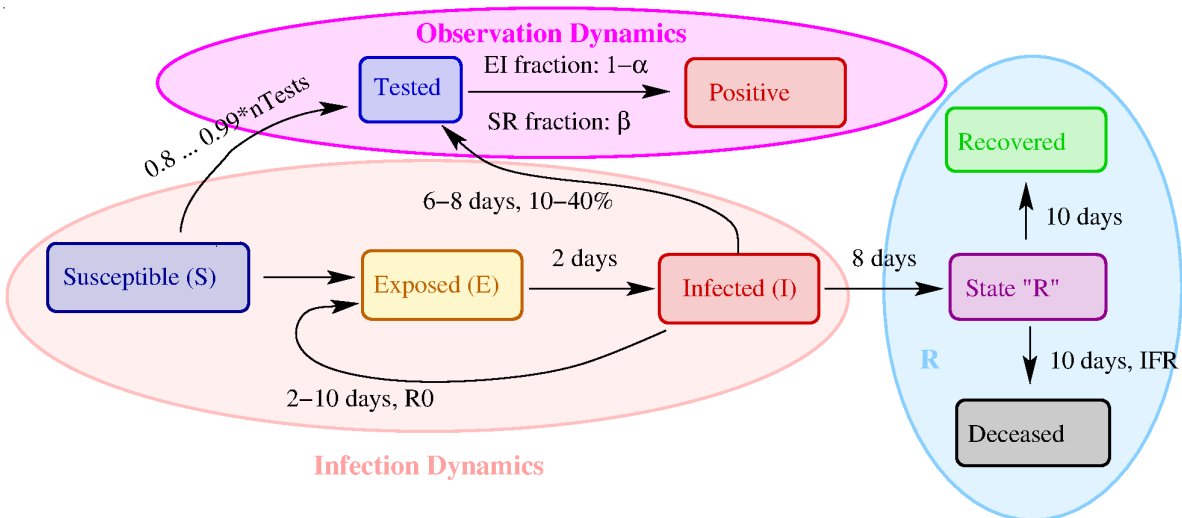
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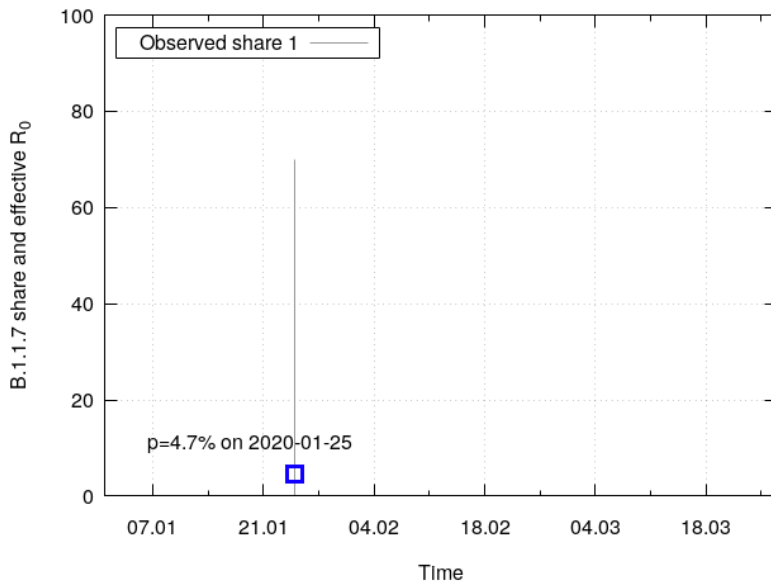


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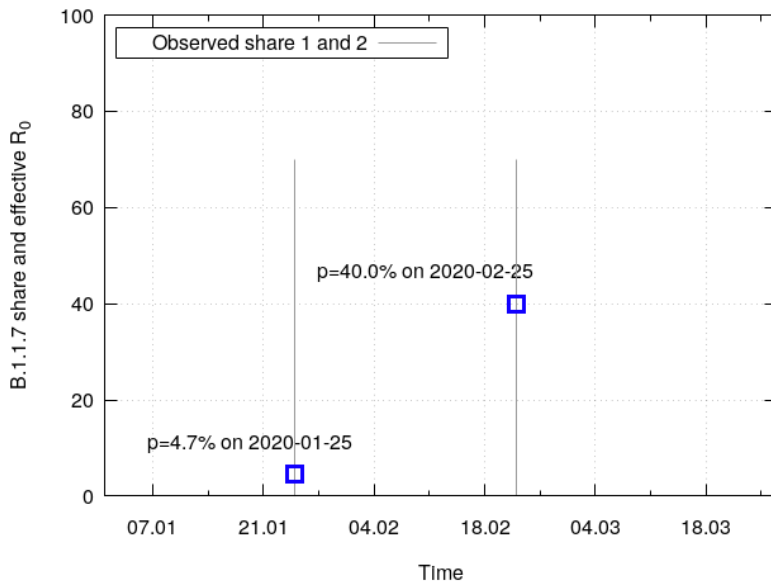
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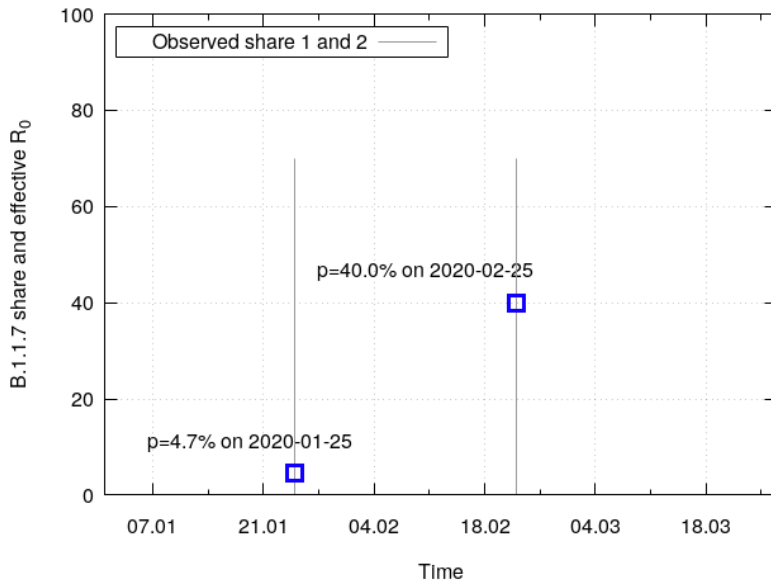
1.1 Modelling the mutation dynamics



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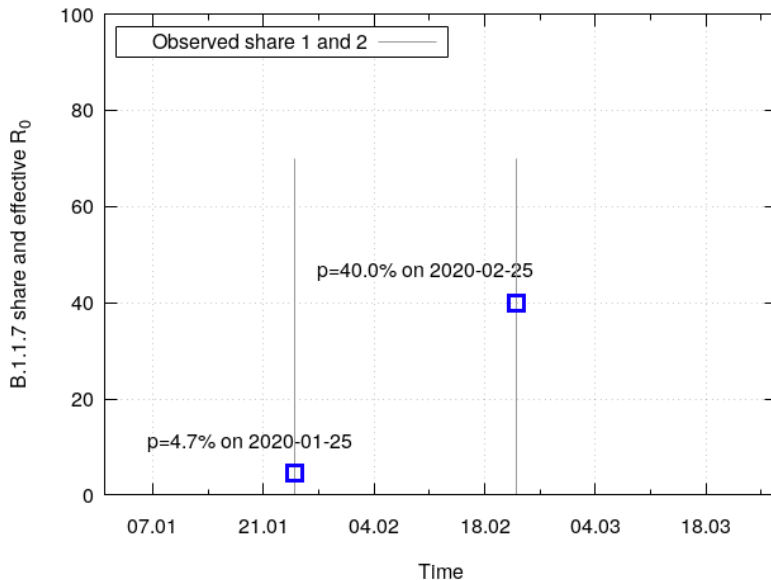
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Odds ratio

$$y = \frac{p}{1 - p}$$

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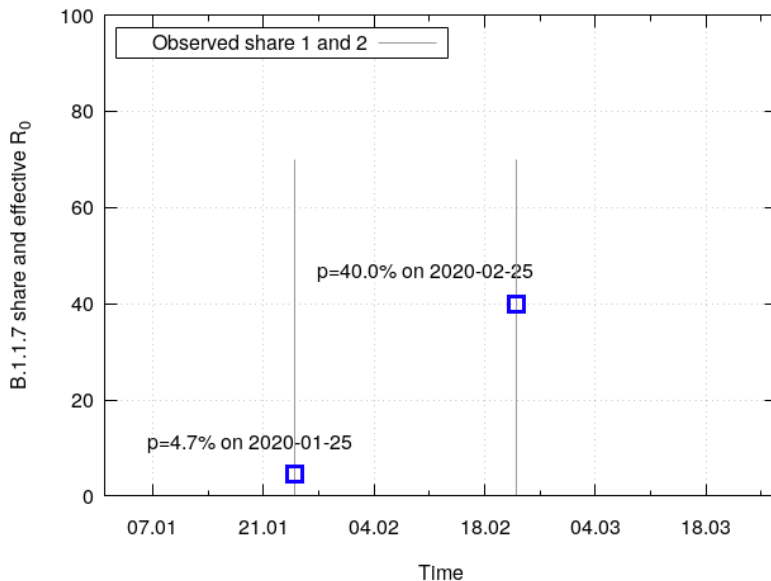


Odds ratio

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$$y = y_0 e^{r_y t}$$

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Odds ratio

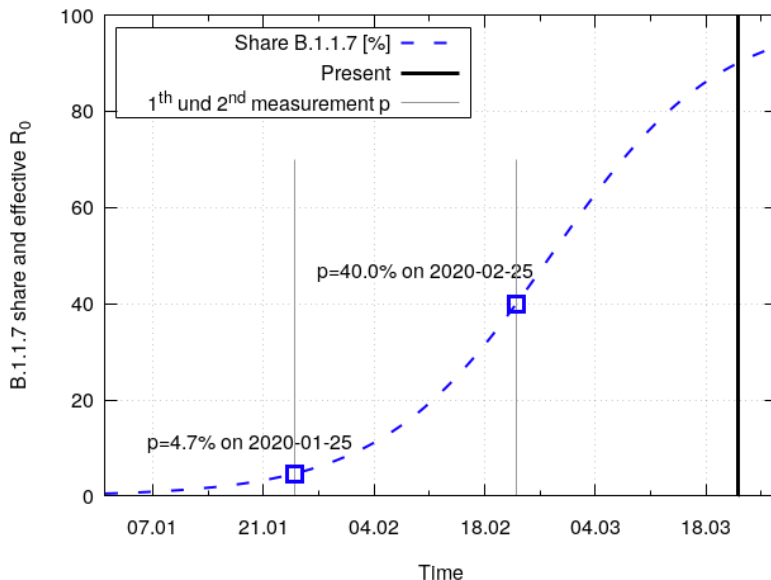
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Estimation growth rate

$$r_y \approx \frac{\ln y(t_2) - \ln y(t_1)}{t_2 - t_1}$$

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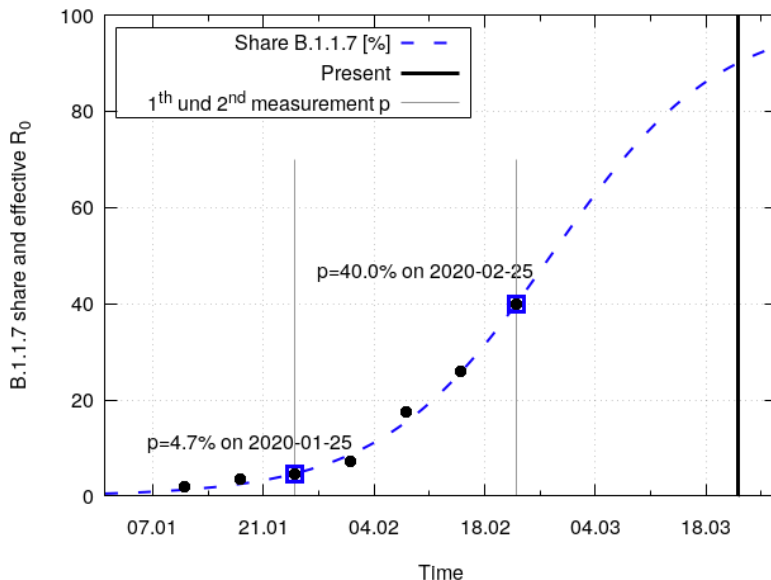
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Estimation B.1.1.7 share

$$p = \frac{y}{1 + y}$$

$$= \frac{p_0 e^{r_y t}}{1 + p_0 (e^{r_y t} - 1)}$$

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Odds ratio

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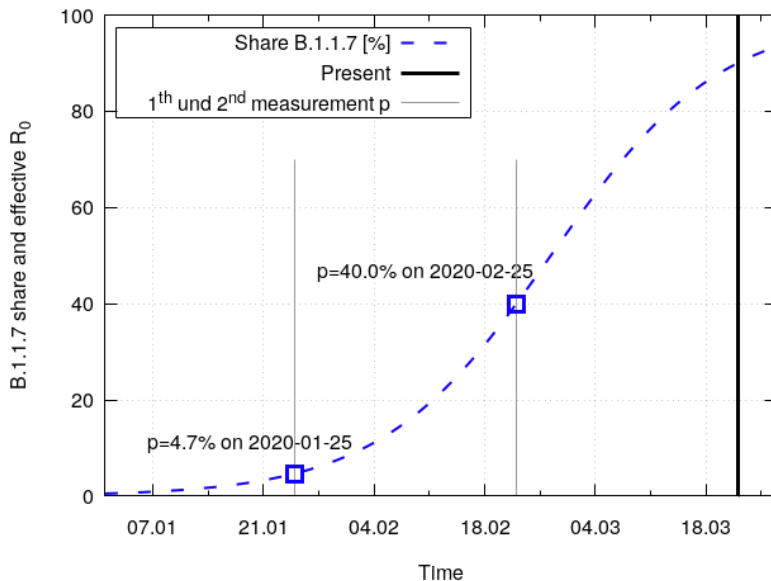
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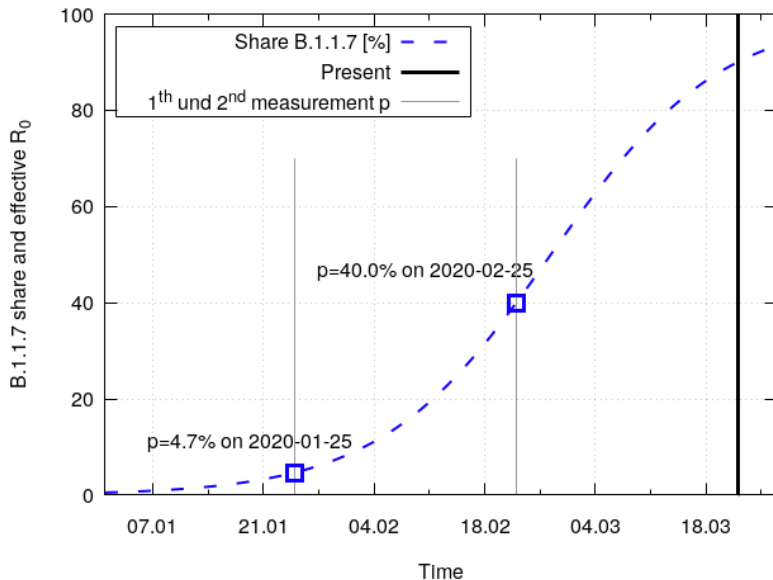
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τ : generation time

$$R_0^{\text{mut}} / R_0^{\text{wild}} = \tau r_y + 1$$

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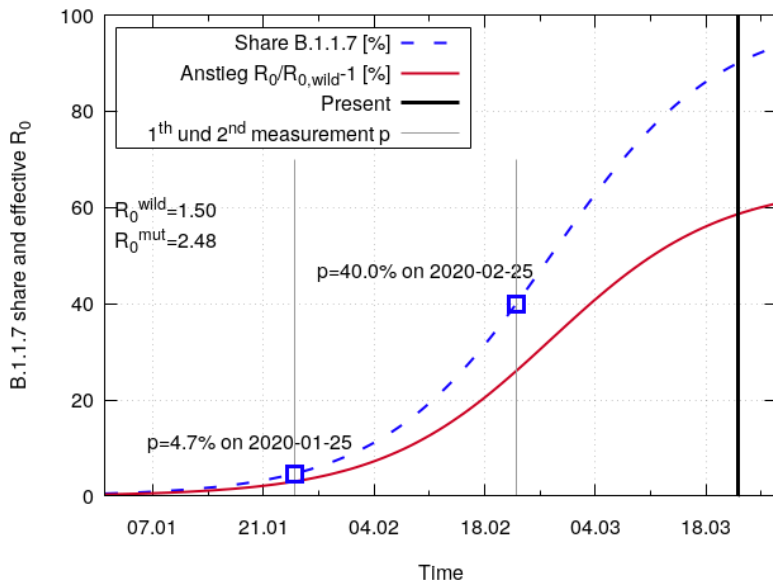
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Effective R_0 :

$$R_0 = (1 - p)R_0^{\text{wild}} + pR_0^{\text{mut}}$$

1.1 Modelling the mutation dynamics



τ : generation time

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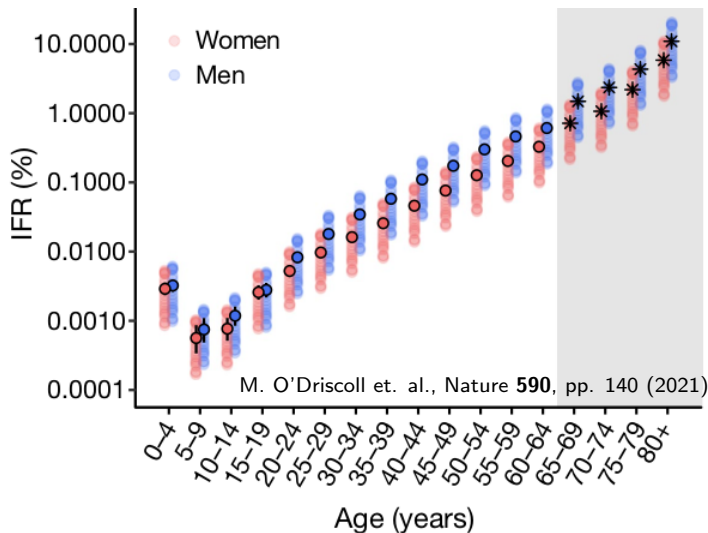
Effective R_0 :

$$R_0 = (1 - p)R_0^{wild} + pR_0^{mut}$$

$$\Rightarrow R_0^{wild}, R_0^{mut} \text{ known}$$

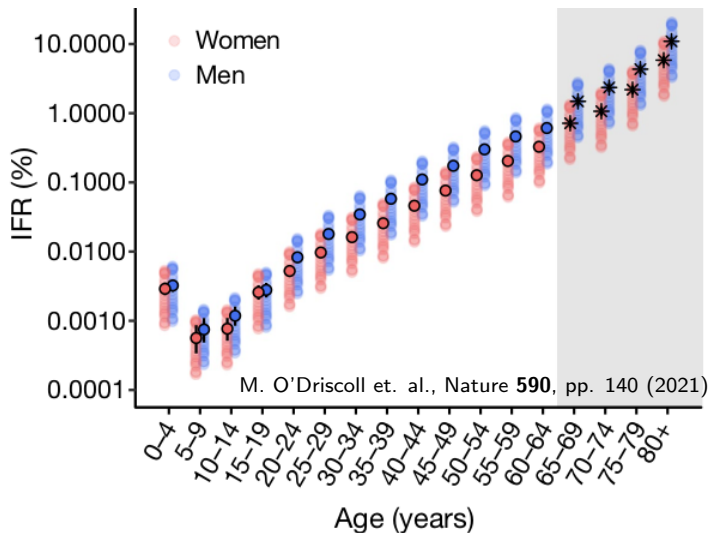
$$\Rightarrow \text{forecast } R_0(t)$$

1.2 Modelling the age-specific infection fatality rate (IFR)



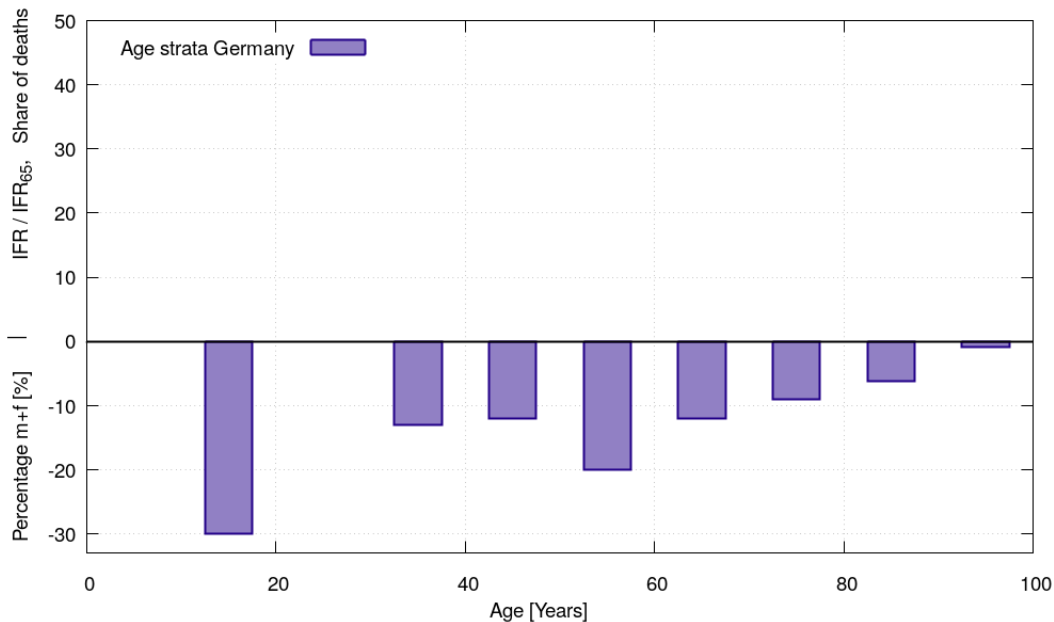
- ▶ The IFR exhibits a nearly exponential growth with the age
- ▶ The same is true for the case fatality rate (CFR) and for the total one-year fatality
- ▶ The gender difference is weak (corresponds to ≈ 5 years)
- ▶ The infection probability exhibits a much weaker age dependency
- ▶ \Rightarrow leave infection spread model unchanged (enables interactive just-in-time calibration) and calculate the IFR in age strata afterwards

1.2 Modelling the age-specific infection fatality rate (IFR)

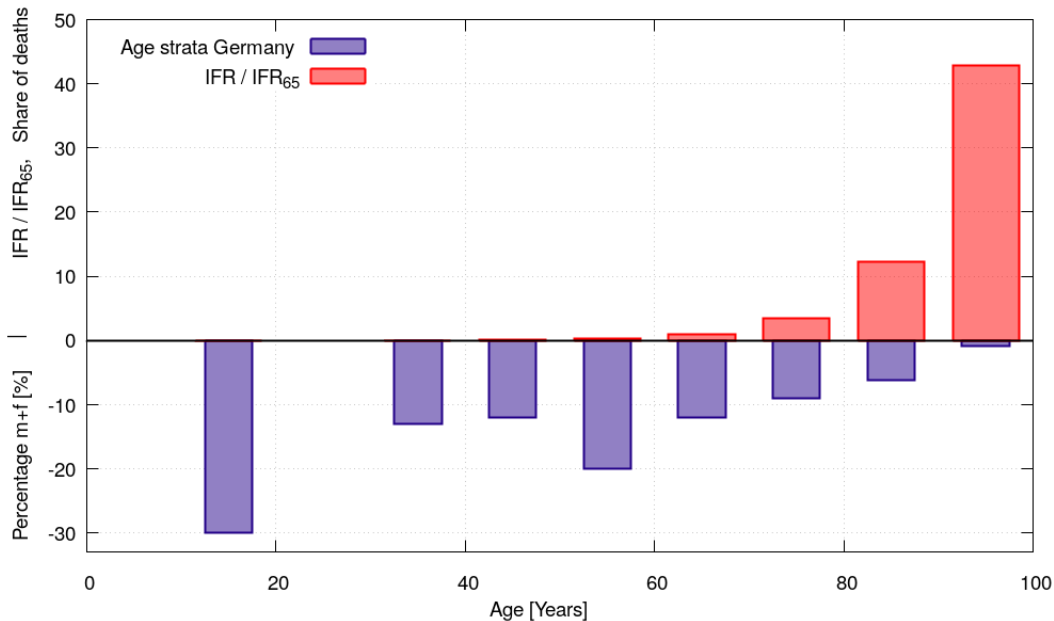


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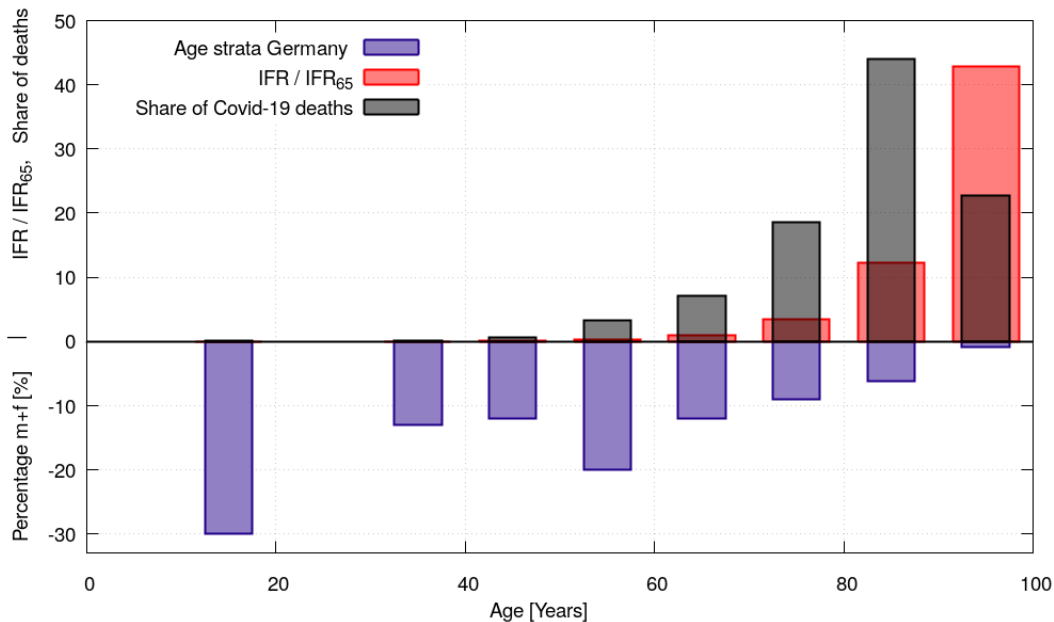
Calculating the global IFR as multiple of IFR_{65}



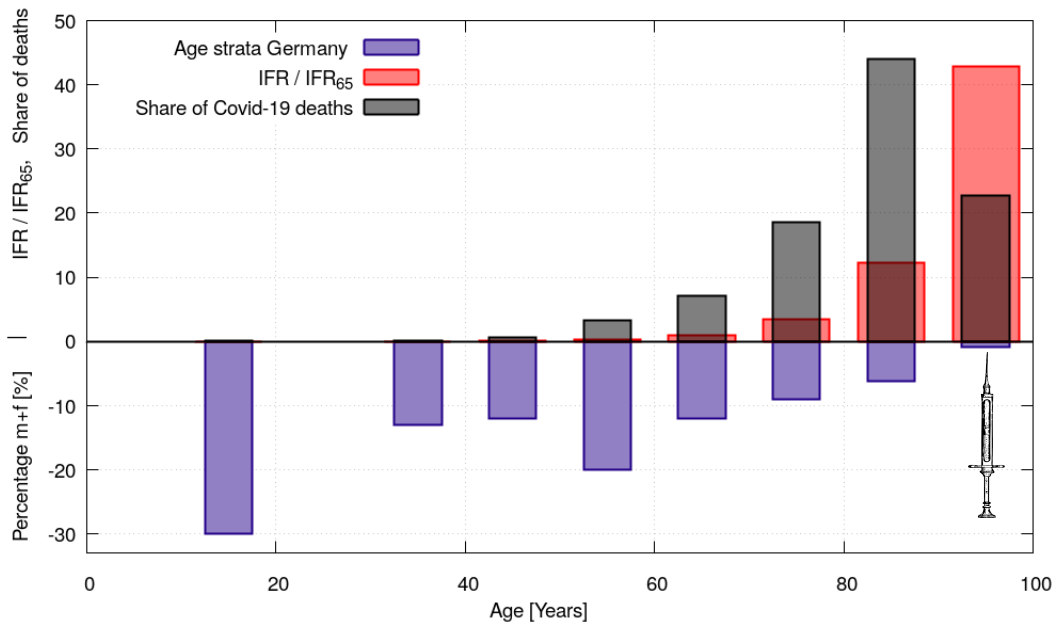
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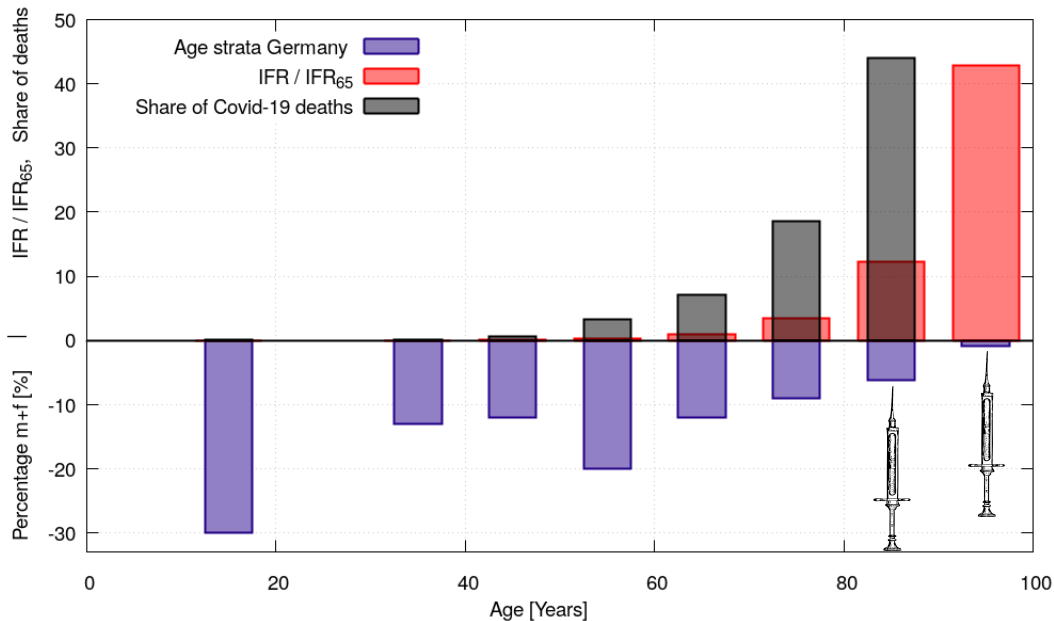
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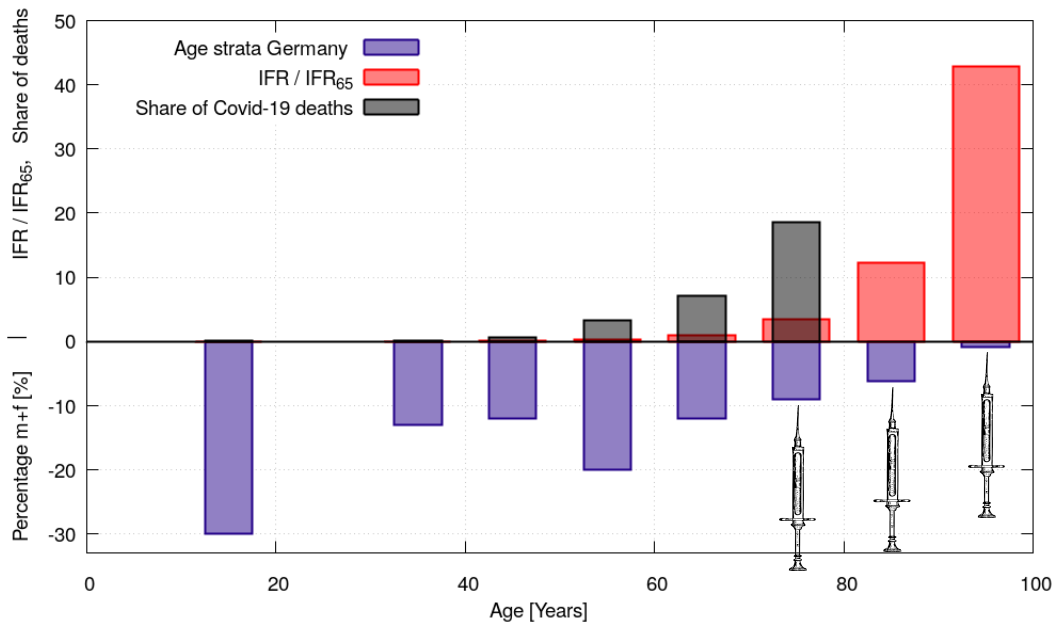
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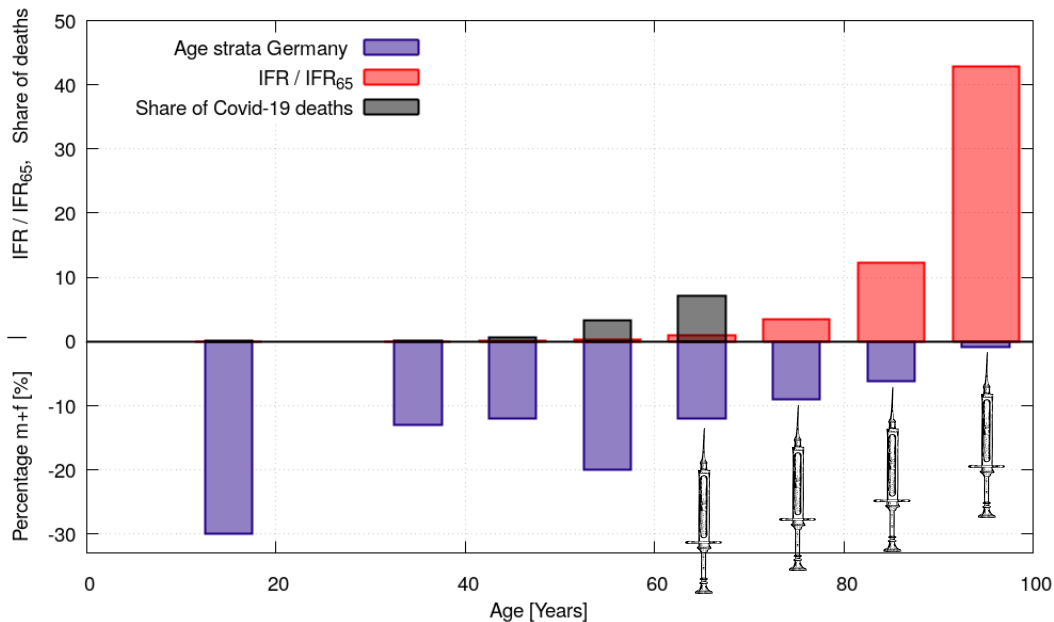
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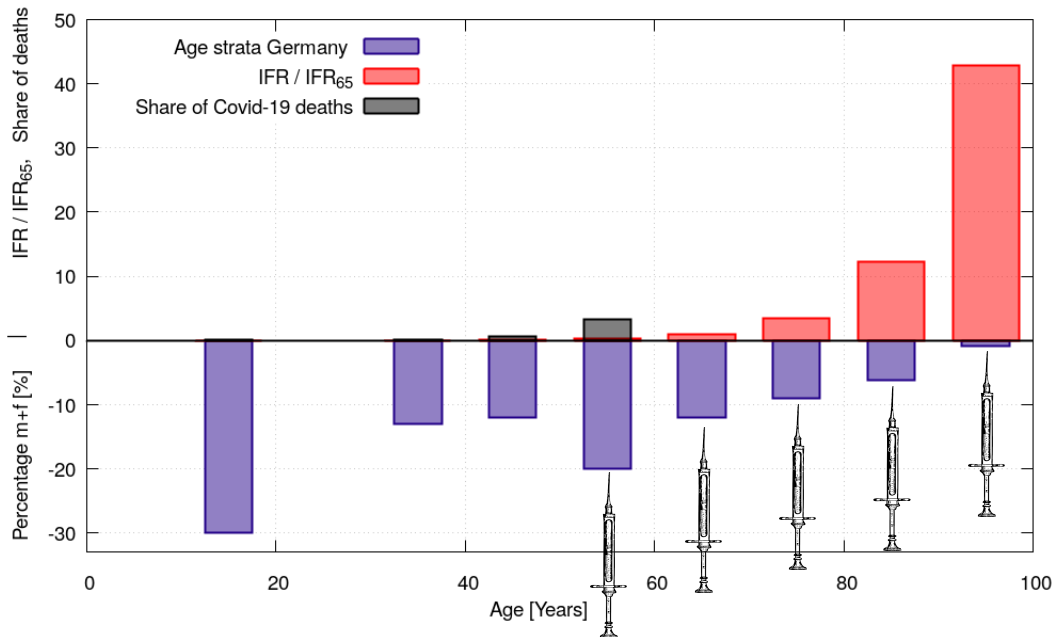
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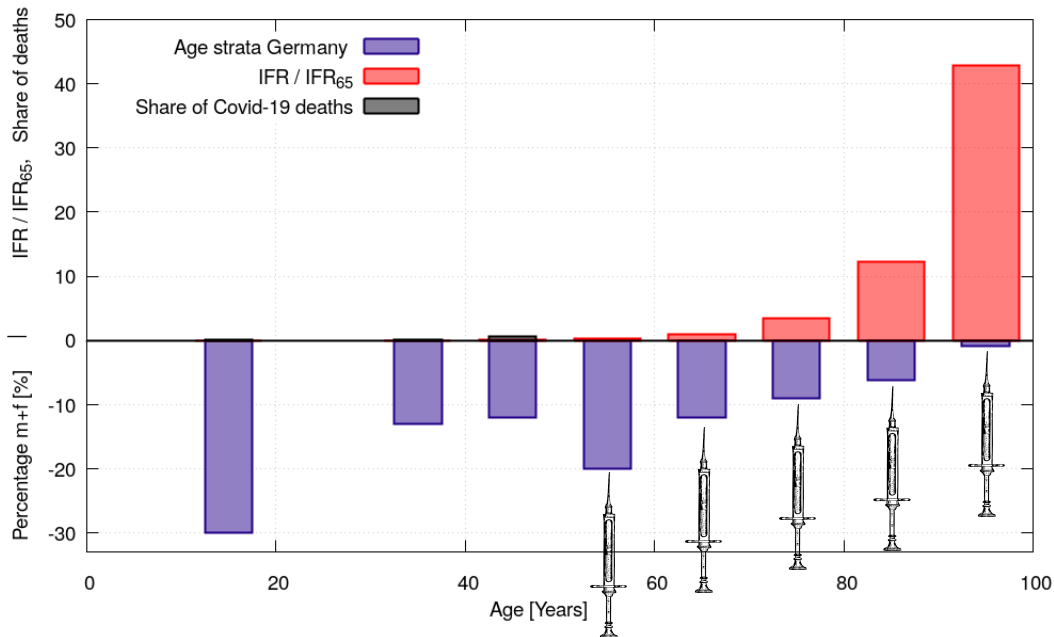
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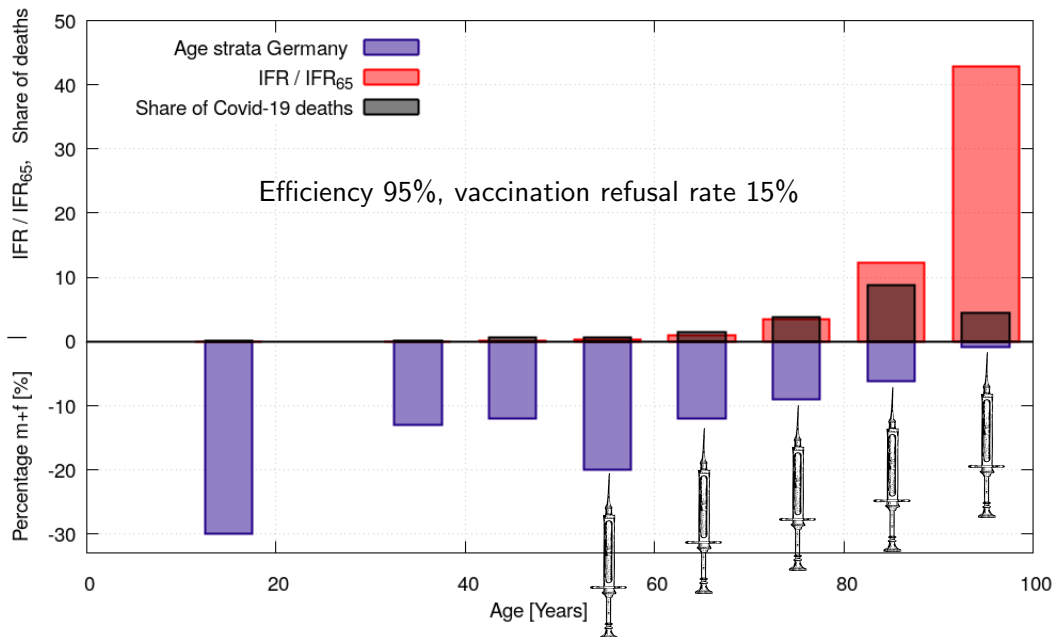
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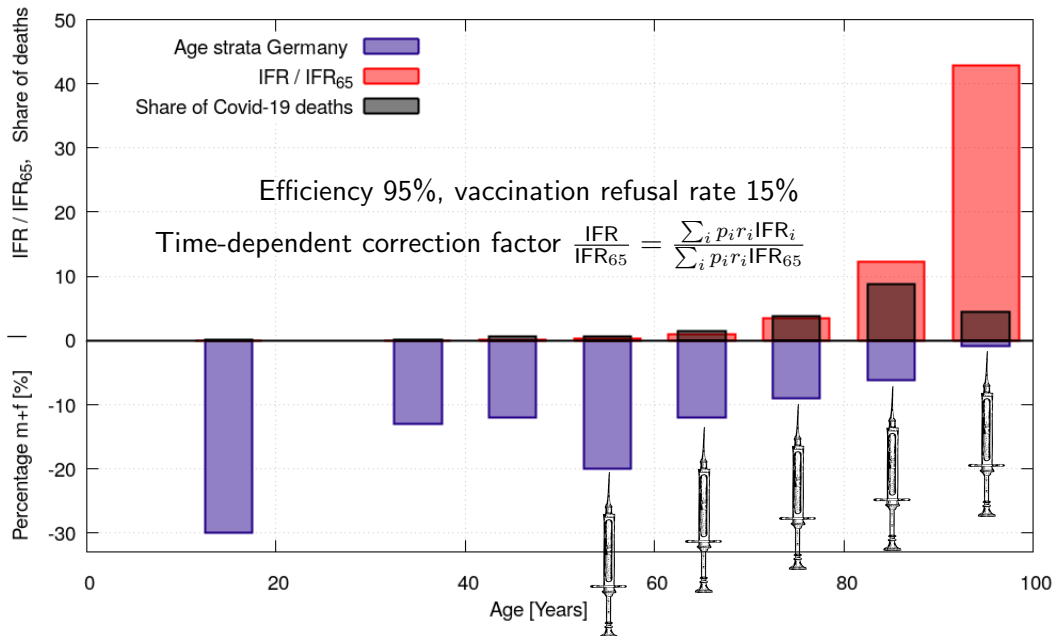
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Calculating the global IFR as multiple of IFR_{65}



Calculating the global IFR as multiple of IFR₆₅



Interactive simulations

Jun 23, 2021

