

Forecasting: What do we learn?

"COVID-19 pandemic and how we deal with data"
Virtual BBS Seminar - 27 July 2021

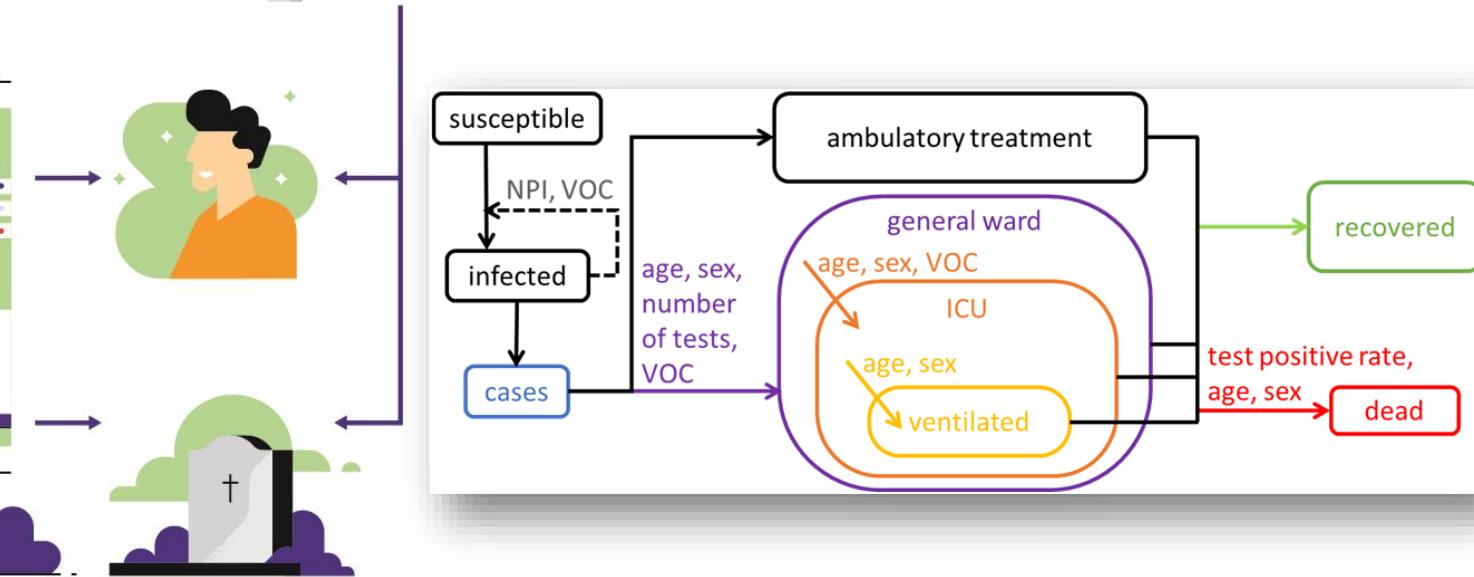
Thorsten Lehr, PhD
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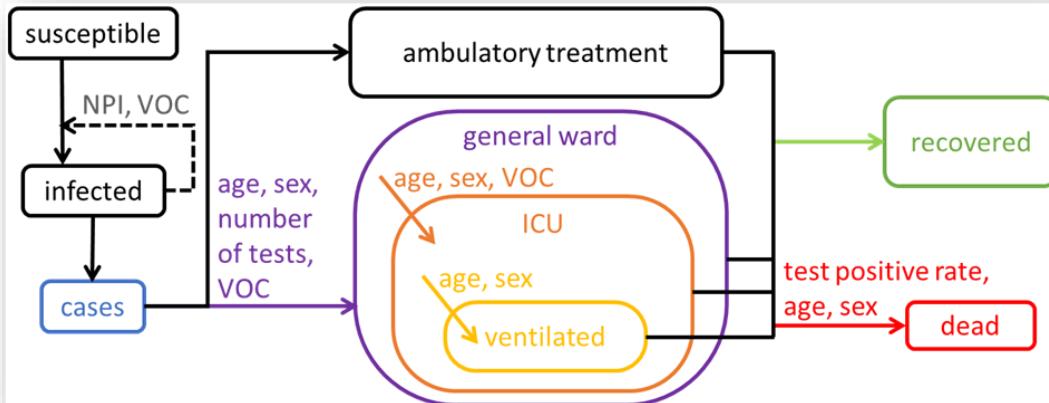
COVID-19



Age
Sex
VOC
Positive rate
Number tests
Lockdown
Saisongality
Vaccination
? ICU ?



COVID-19 Simulator



Data: RKI, Morgenpost, Intensivregister, Ministeries, Presse Releases, Metalt

```

dS/dt = -β * S(t)/N * E(t)
dE/dt = β * S(t) * N * E(t) - γ * E(t)
dA/dt = γ * E(t) - (1-Fh)*A(t) - Fh*t*A(t)
Fh = Hosp+(Fhosp-Hosp)*TIME**hill/(MTKH**hill+TIME**hill)
Fh(Age>80)=Fh*exp(-PR*PRhosp)
Fh(other ages)=Fh*age-specific factor
dT1hosp/dt = Fh*t*A(t) - t*T1hosp(t)
dT2hosp/dt = t*T1hosp(t) - t*T2hosp(t)
t = hosptrans + hosptrans2*T**hill/T**hill+MT_KH**hill)+PR*PRhosptrans
dQ/dt=(1-Fd)*(1-Fh)*t*A(t) - p*Q(t)
dQ2/dt = p*Q(t) - p*Q2(t)
dQD/dt=Fd*(1-Fh)*t*A(t) - δ*D(t)
dQD2/dt=δ*D(t) - δ*D2(t)
dHdeath/dt = FdH*t*FeH*T2hosp(t)-δh*Hdeath(t)
dH2death/dt=δh*Hdeath(t)-δh*H2death(t)
dICUdeath/dt = FdICU*t*(1-FeH)*(1-FeV)*T2hosp(t)-δICU*ICUdeath(t)
dICU2death/dt = δICU*ICUdeath(t)-δICU*ICU2death(t)
dVdeath/dt = FdV*t*(1-FeH)*FeV*T2hosp(t)-δV*Vdeath(t)
dV2death/dt = δV*Vdeath(t)-δV*V2death(t)
dHalive/dt = (1-FdH)*t*FeH*T2hosp(t)-ph.*Halive(t)
dH2alive/dt=ph.*Halive(t)-ph.*H2alive(t)
dICUalive/dt = (1-FdICU)*t*(1-FeH)*(1-FeV)*T2hosp(t)-pICU*ICUalive(t)
dICU2alive/dt = pICU*ICUalive(t)-pICU*ICU2alive(t)
dValive/dt = (1-FdV)*t*(1-FeH)*FeV*T2hosp(t)-pV*Valive(t)
dV2alive/dt = pV*Valive(t)-pV*V2alive(t)
FeV = ToBEAT1 + (ToBEAT2-ToBEAT1)*T**hill/(T**hill+MTicu **hill)
δh = δh(Age)*(0.5+(1-exp(-PR*PRhosp))
dRhospital/dt=ph.*H2alive(t)+pICU*ICU2alive(t)+pV*V2alive(t)-p*Rhospital(t)
dR/dt=p*Q2(t)+p*Rhospital(t)
dD/dt=δh*H2death(t)+δICU*ICU2death(t)+δV*V2alive(t)+δ*D2(t)
  
```

COVID-19 Simulator
Modellierung für die deutschen Bundesländer

Sicht Modell Berichte **Simulator**

Neuigkeiten:

Der Simulator ist online.
Datenteile aktualisiert.
Nächstes Update: 28.07.2021

Ziel des Projekts CoSim ist die Entwicklung eines mechanistischen mathematischen Modells zur **Beschreibung der COVID-19 Infektionen** inkl. Krankenhausbettenbelegung, Intensivmedizinische Behandlung (ICU), Beatmung und Todesraten in den einzelnen Bundesländern und der **Abschätzung von Nicht-Pharmazeutischen Interventionen** (NPI, z.B. Schulschließung) über die Zeit.

Das Modell soll den weiteren Verlauf der Infektionen (inkl. Krankenhausbelegung, ICU, Beatmung, Todesraten) und **verschiedene mögliche Szenarien** (z.B. Aufhebung Kontaktverbote) simulieren.

Das Modell wird wieder neue Szenarien generieren.

Diese Online-Plattform ermöglicht die Anwendung eines Simulators.

Mathematische Modellierung des Verlaufs der SARS-CoV-2-Pandemie in den deutschen Bundesländern und Stadt- und Landkreisen

Christian Dörr*, Katharina Görl*, Katharina Gohl*, Anna Blasius*, Olaf Quante*, Michael Körber*, Jérôme Hövel, Christian Schimpf, Loren Pöhl, Daniel Tietz*, Beatrix Böhm*, Prof. Dr. Ingrid Smidt*, Prof. Dr. Thomas Wink*, Prof. Dr. Stephan Körber*, Prof. Dr. Michael Kretschmer*, Prof. Dr. Thomas Löffelholz*

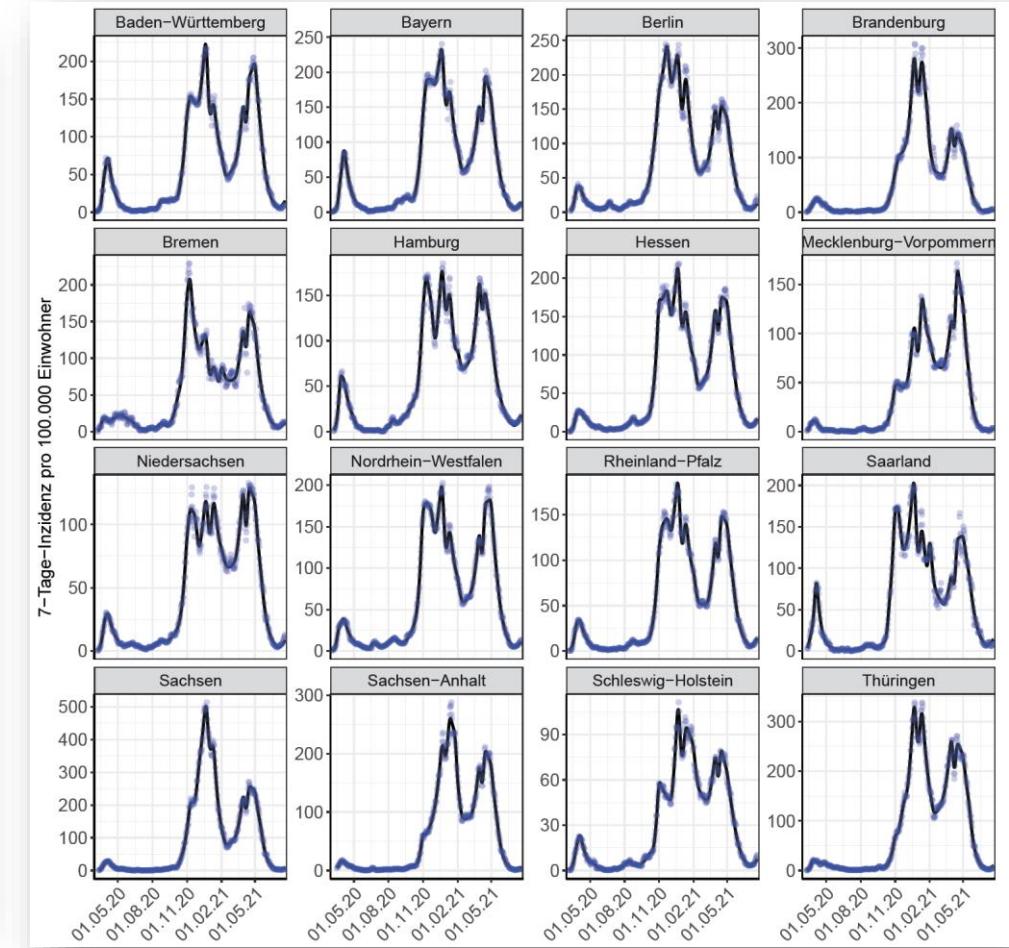
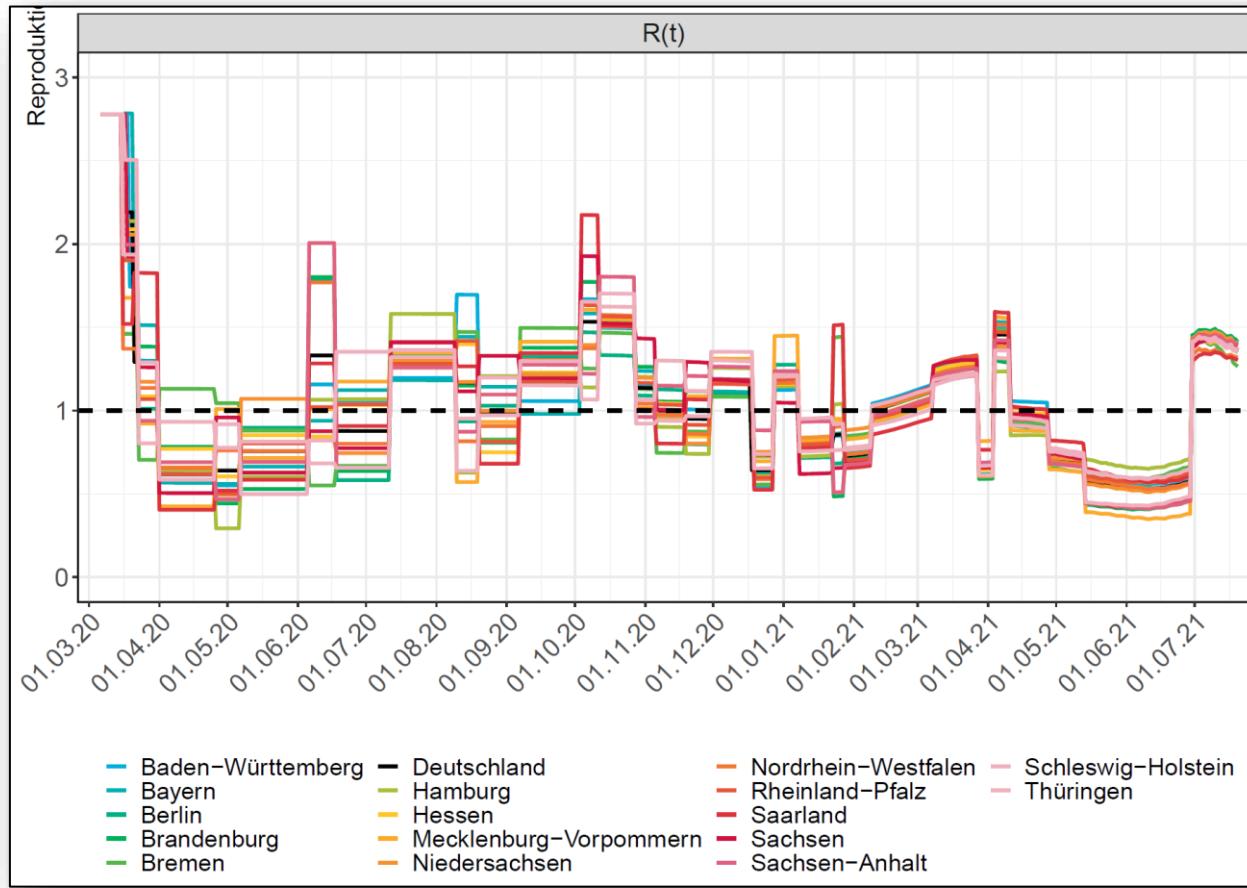
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‡Klinik für Anästhesiologie, Intensivmedizin und Schmerztherapie, Universitätsklinikum des Saarlandes

Report vom 21. Juli 2021
Modellstand vom 21. Juli 2021
Datenstand vom 21. Juli 2021

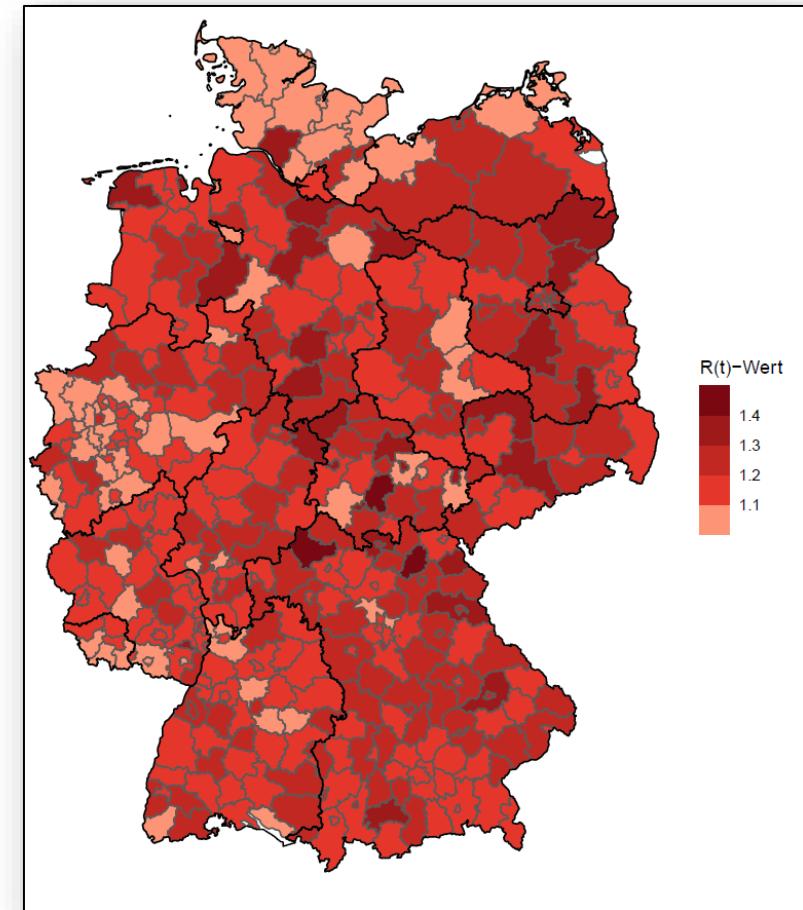
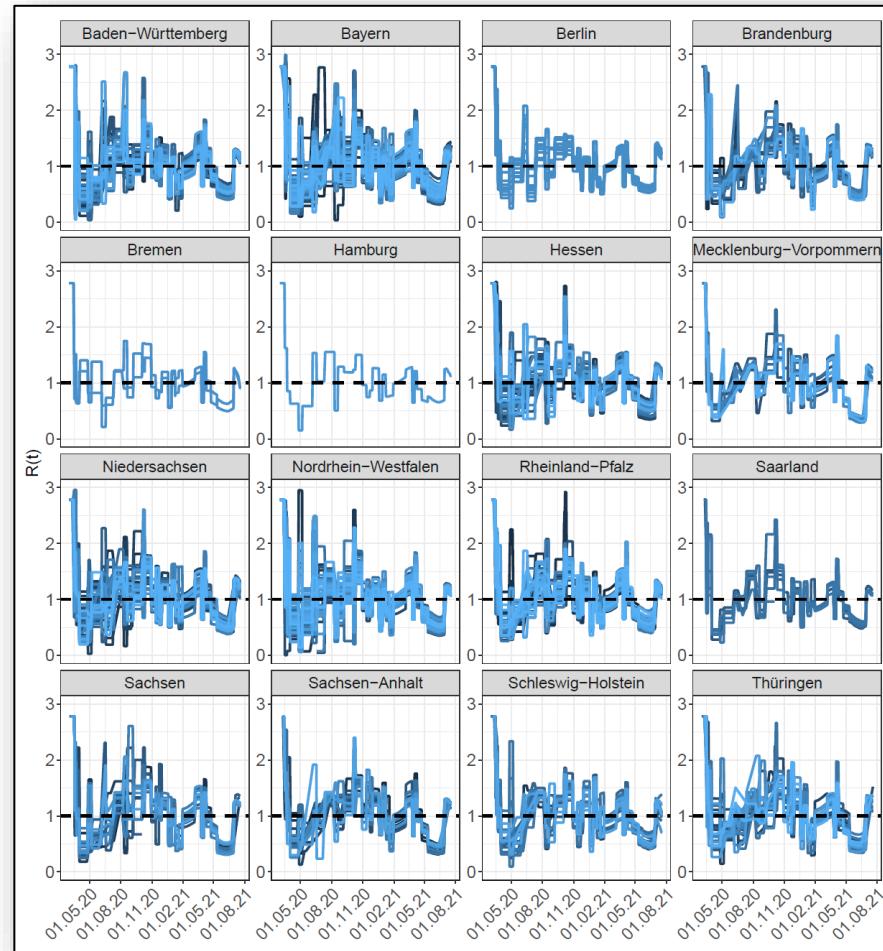
<https://covid-simulator.com/>

GitHub

R(t) Values



Reproduktionszahl – R(t) Wert



Hospital admission

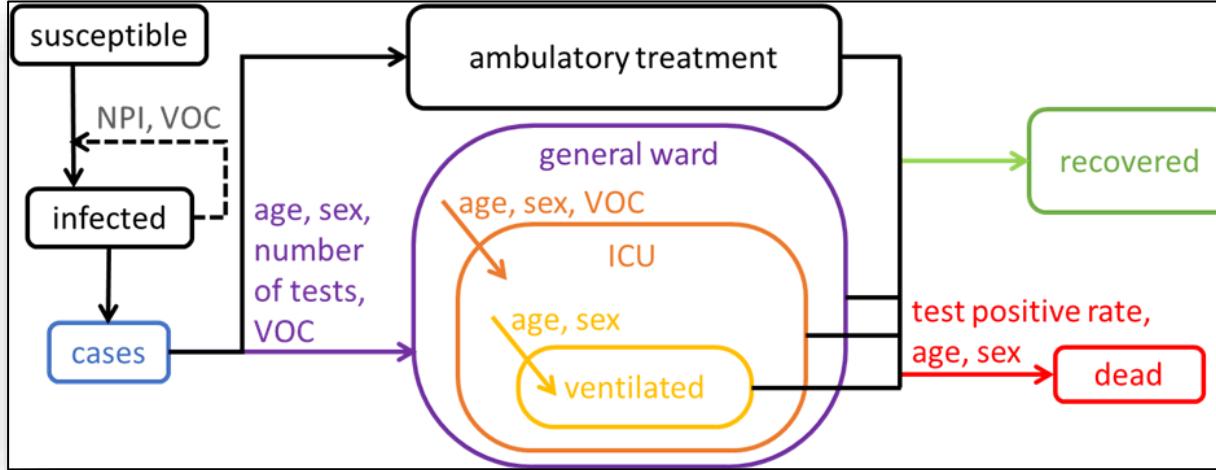
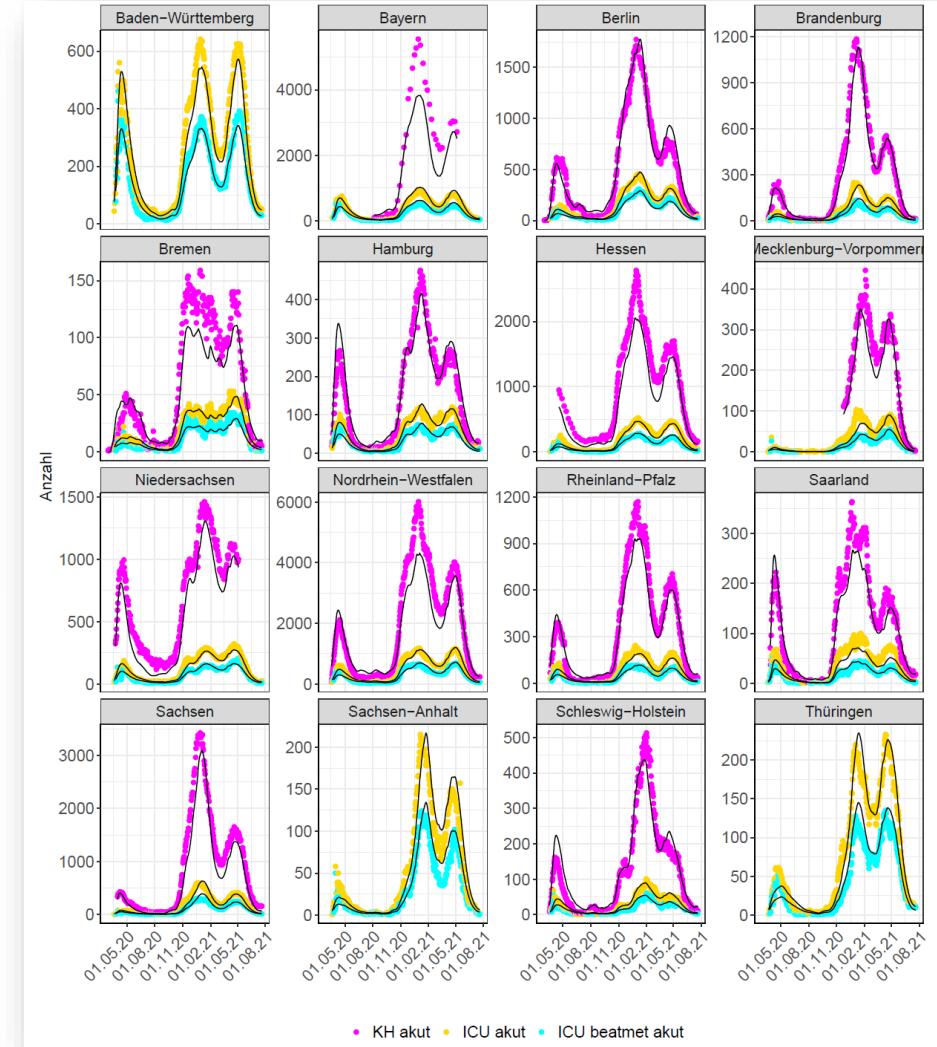
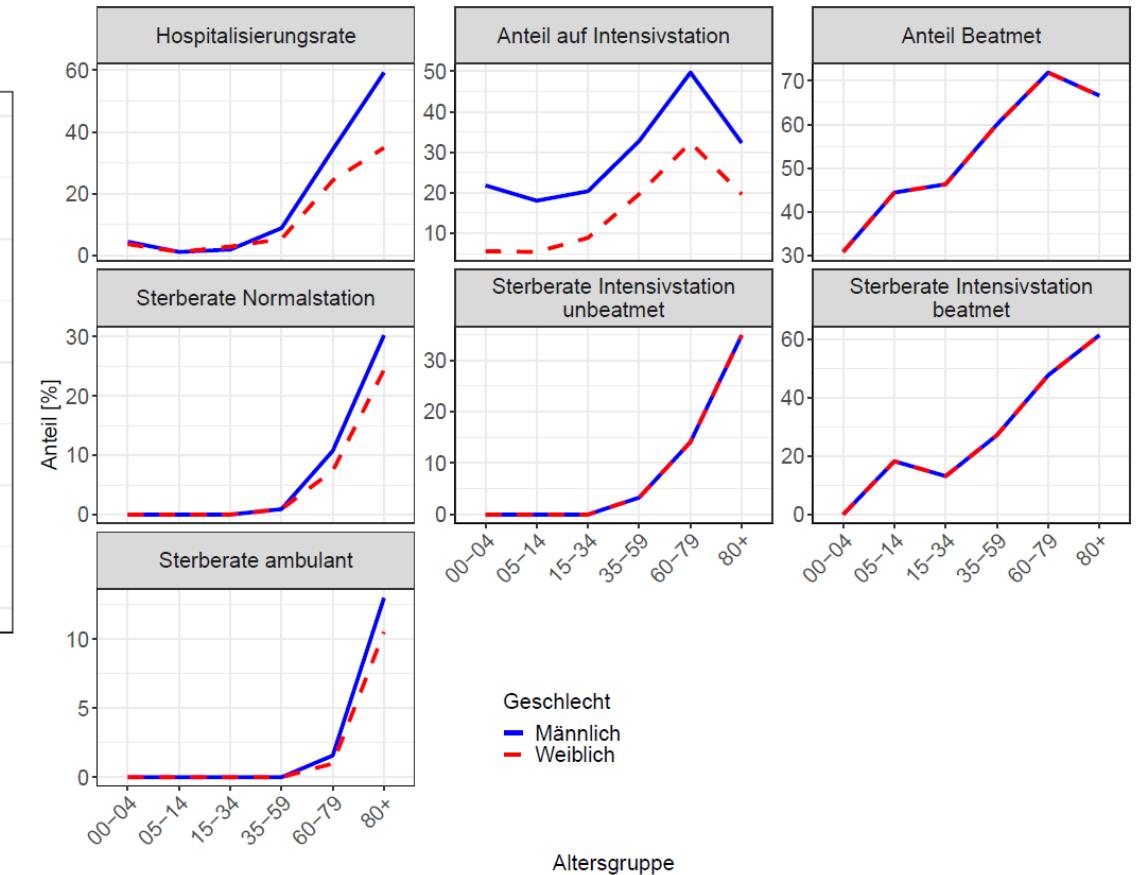
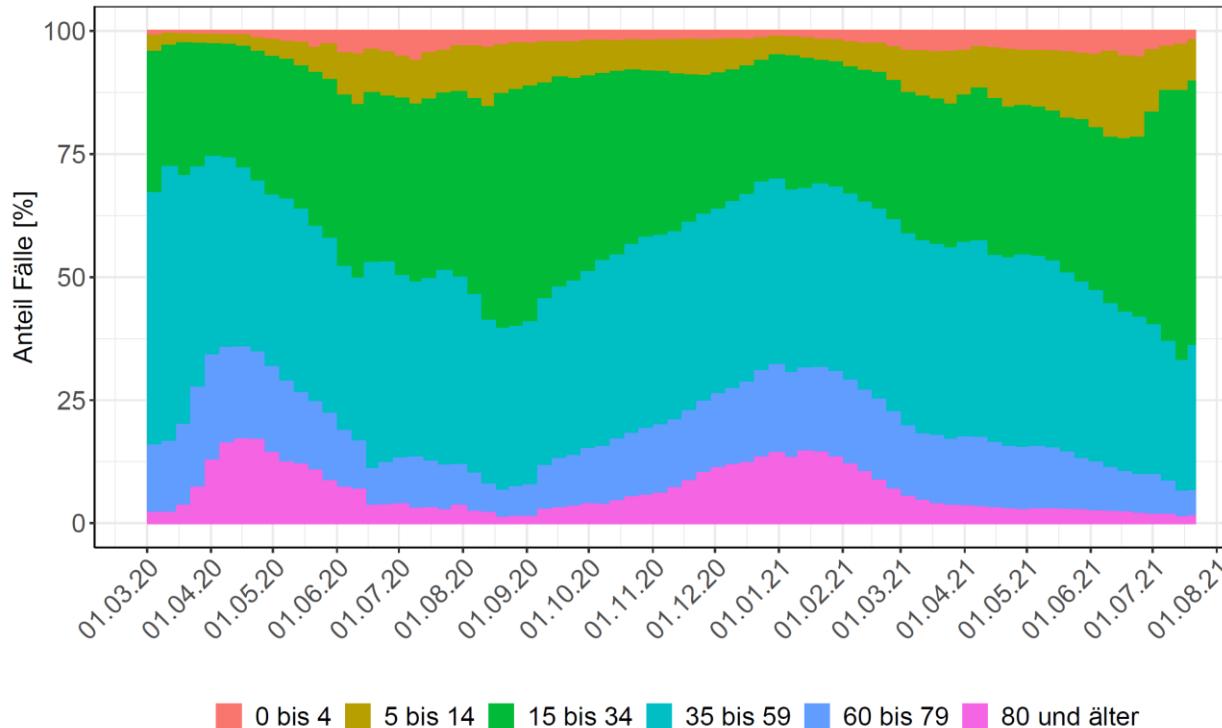


Tabelle 1: Durchschnittliche Liegedauern auf den verschiedenen Stationen

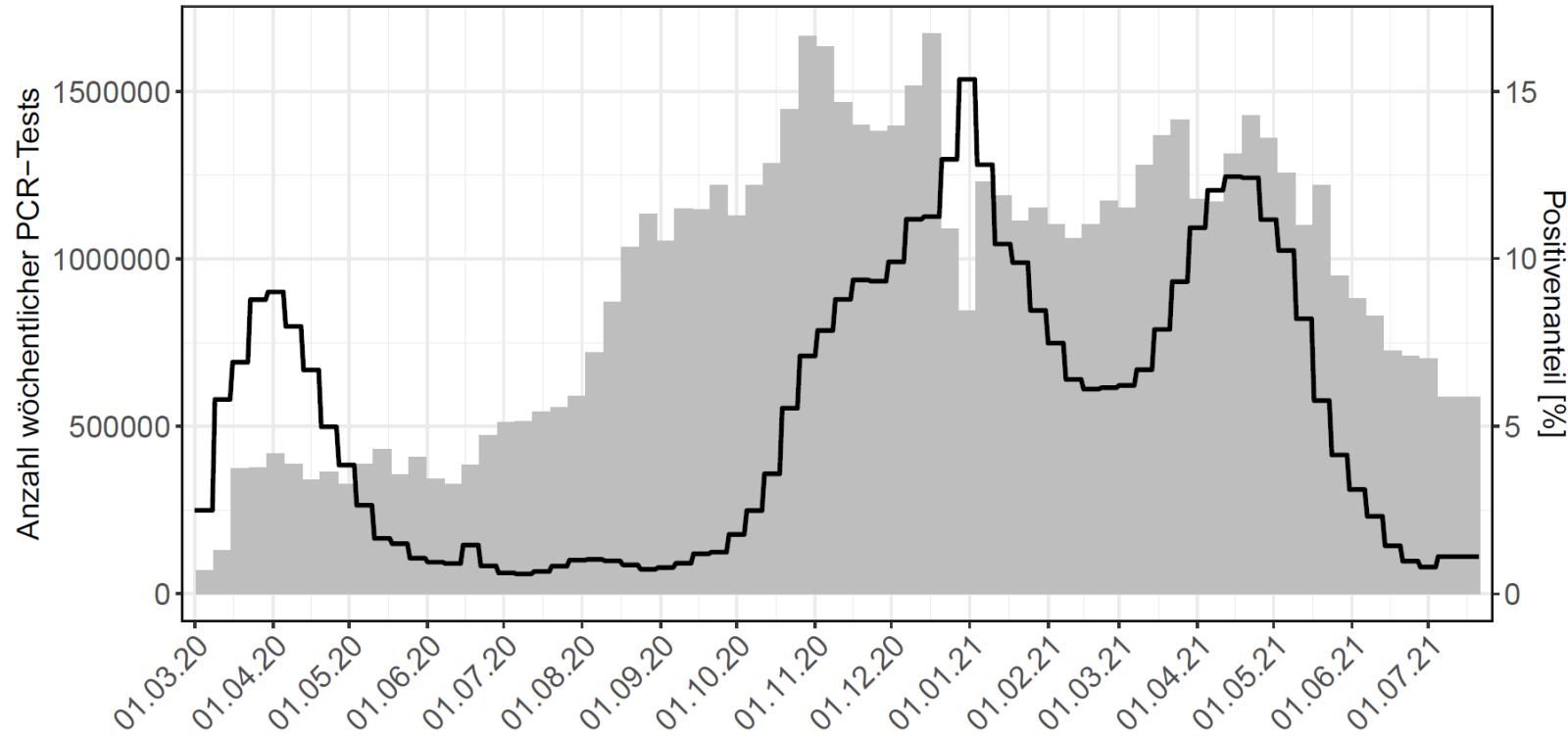
		Liededauer [Tage]	ICU [% Aufenthalt]	Beatmung [% Aufenthalt]
Normalstation	Entlassen	11.5	-	-
	Verstorben	10.6	-	-
ICU	Entlassen	20.4	29	-
	Verstorben	20.0	44	-
unbeatmet	Entlassen	28.6	43	28
	Verstorben	15.5	68	63



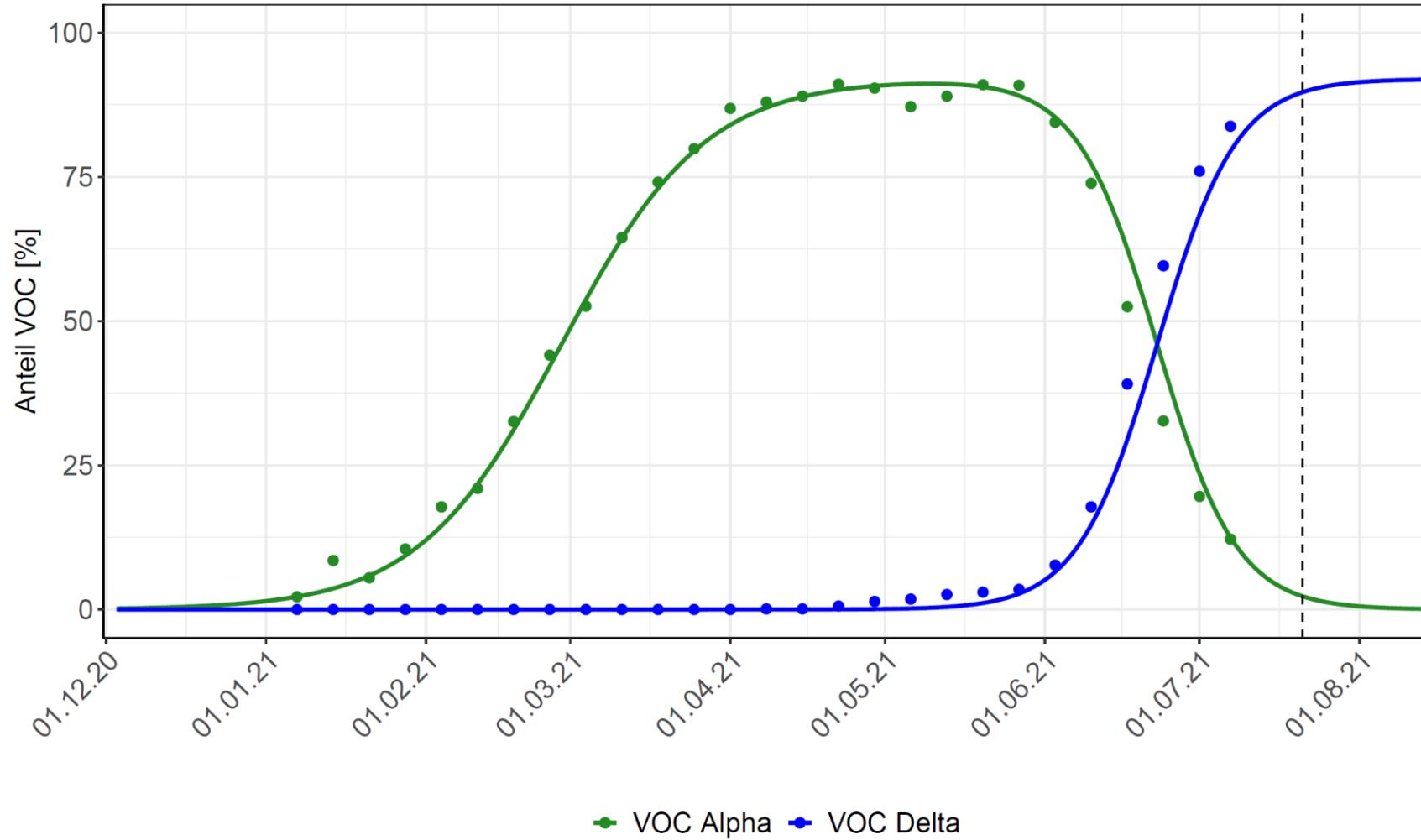
Age, Sex and Hospital Admission



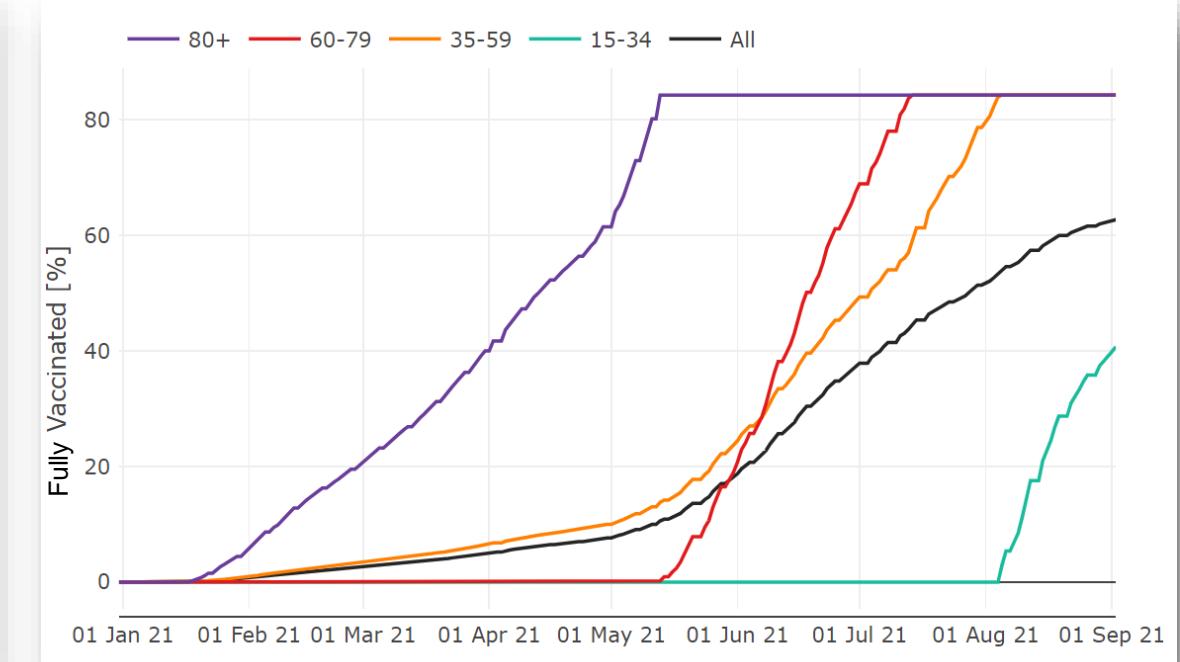
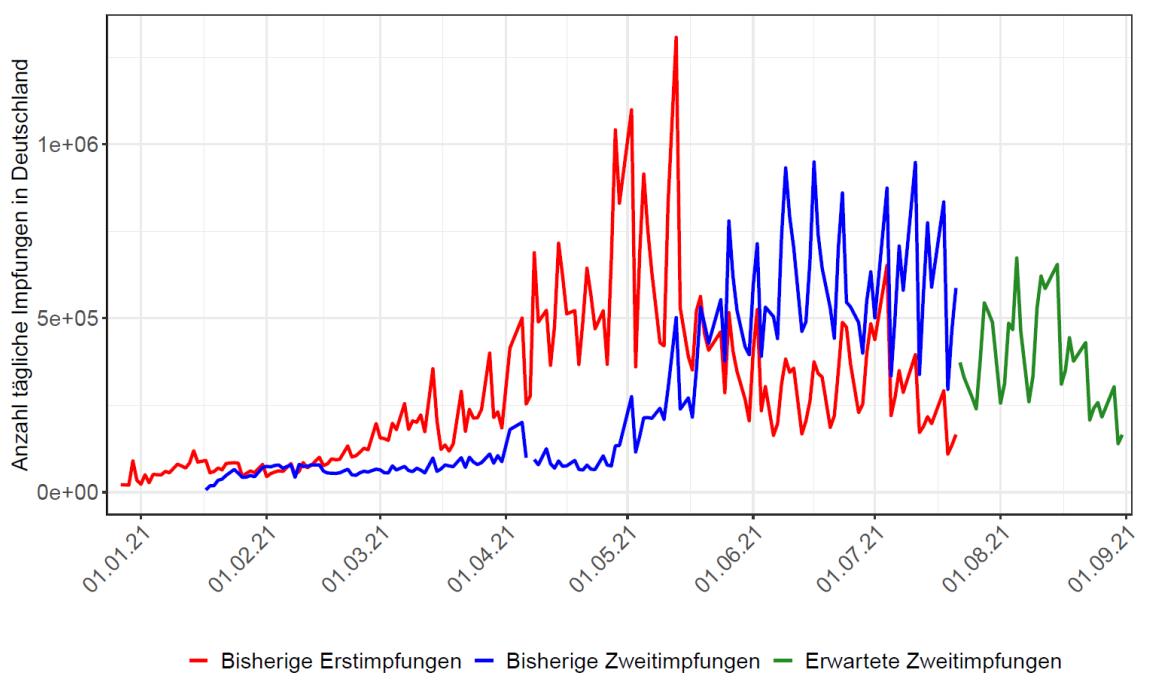
Test positive rate and number of tests



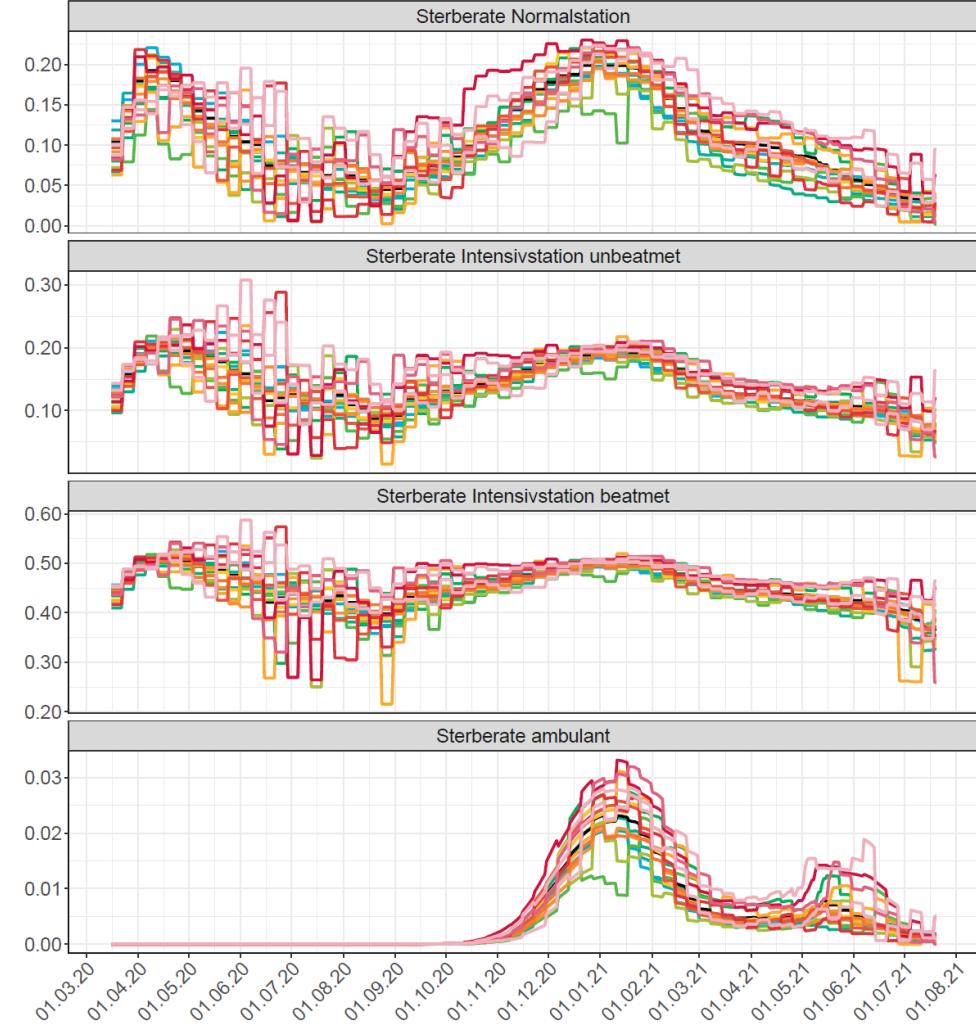
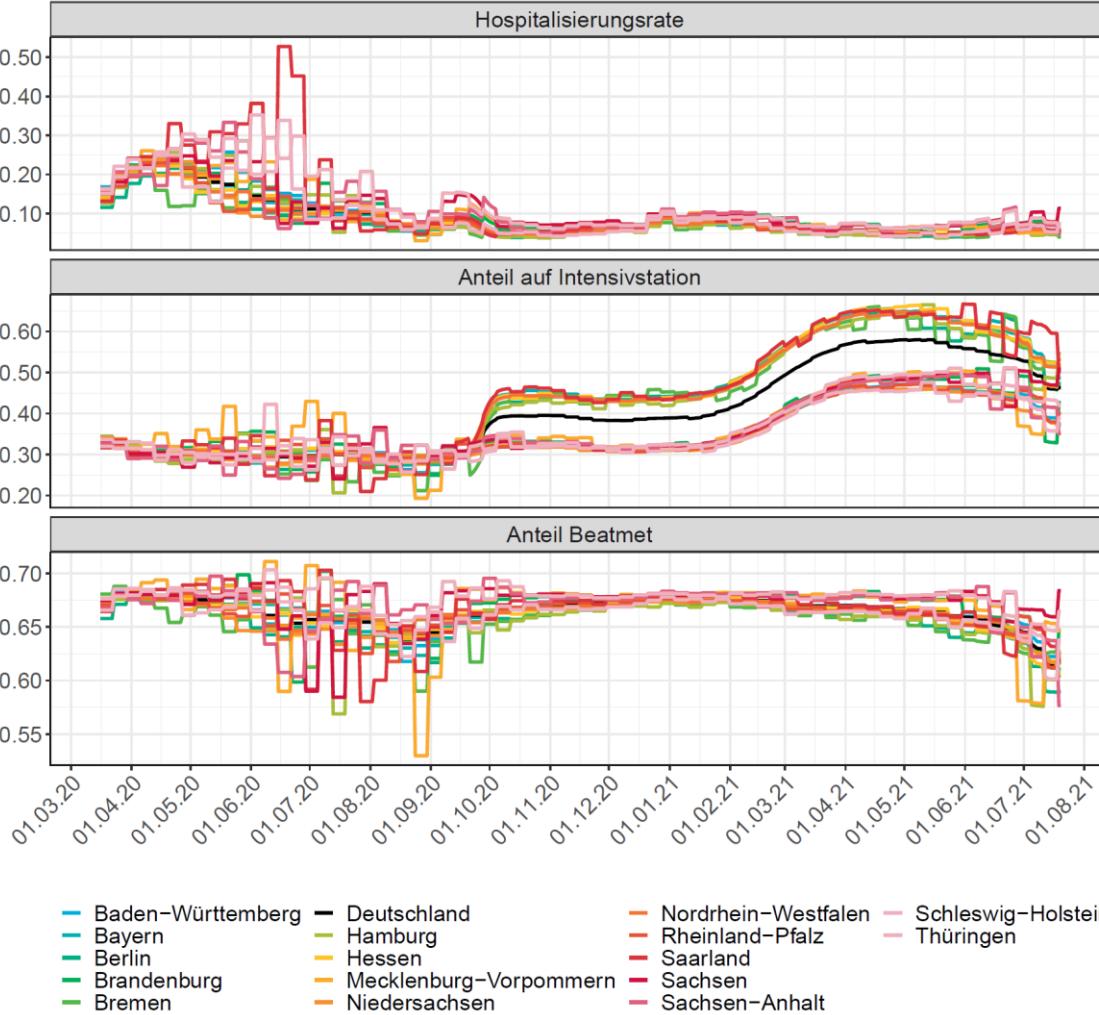
Variants of Concern (VOC)



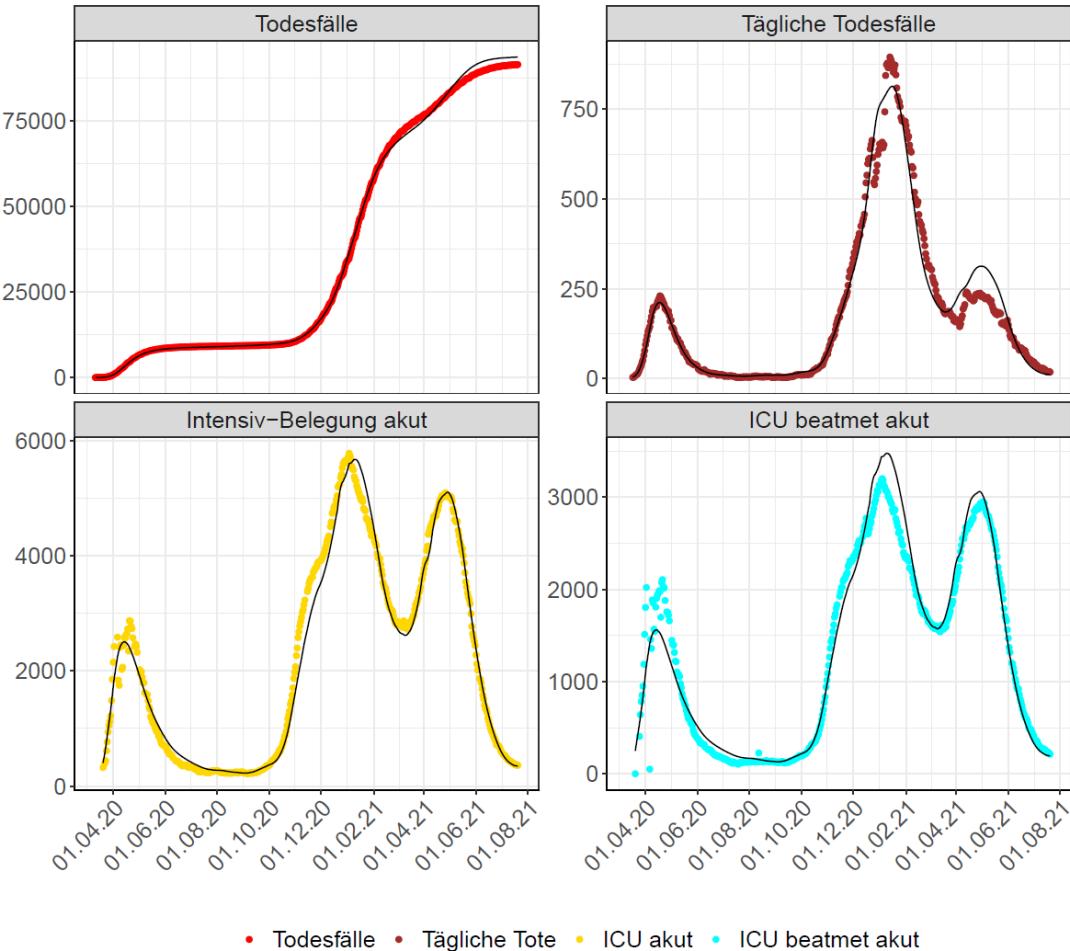
Vaccination



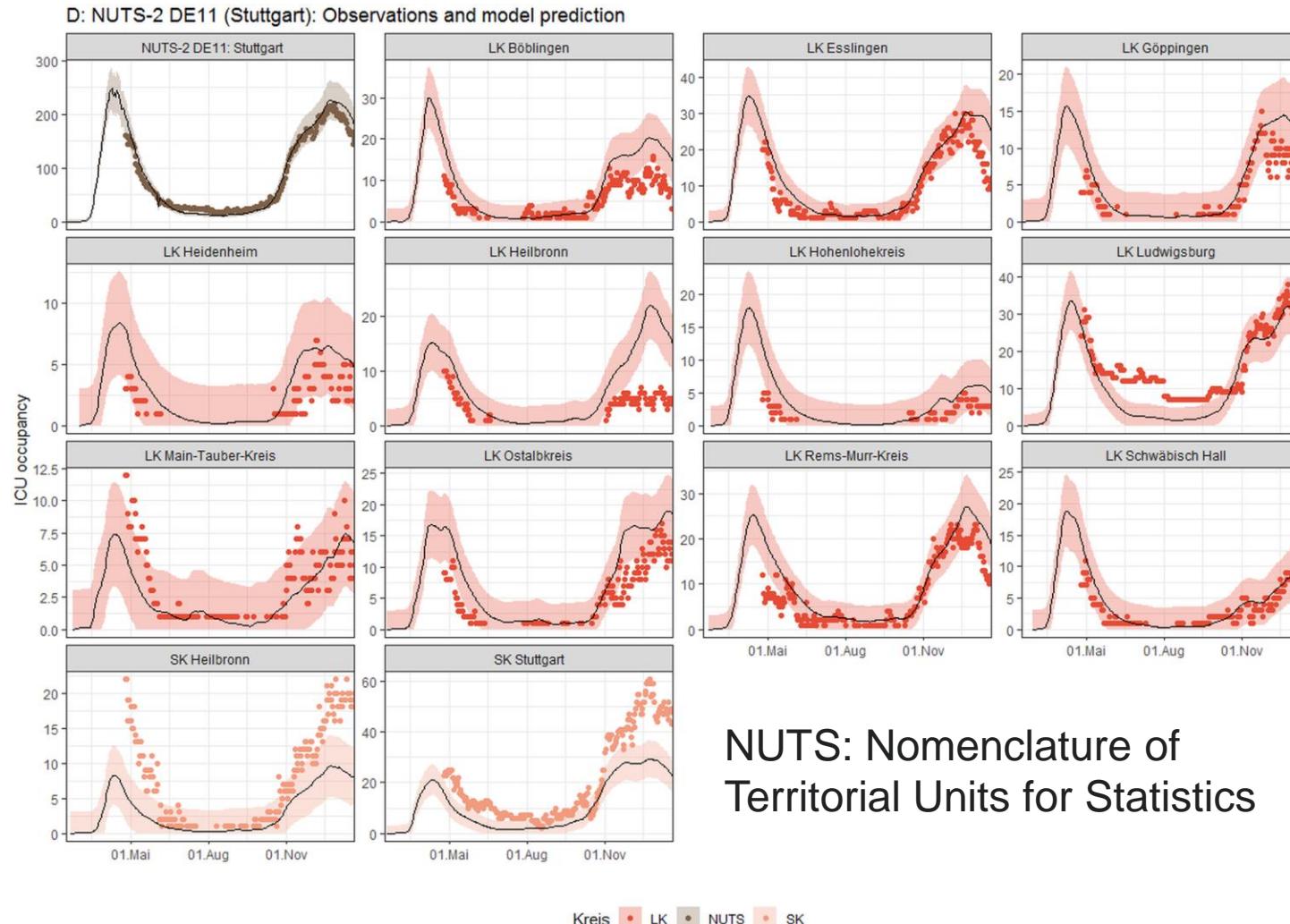
Hospitalization and Death Rates



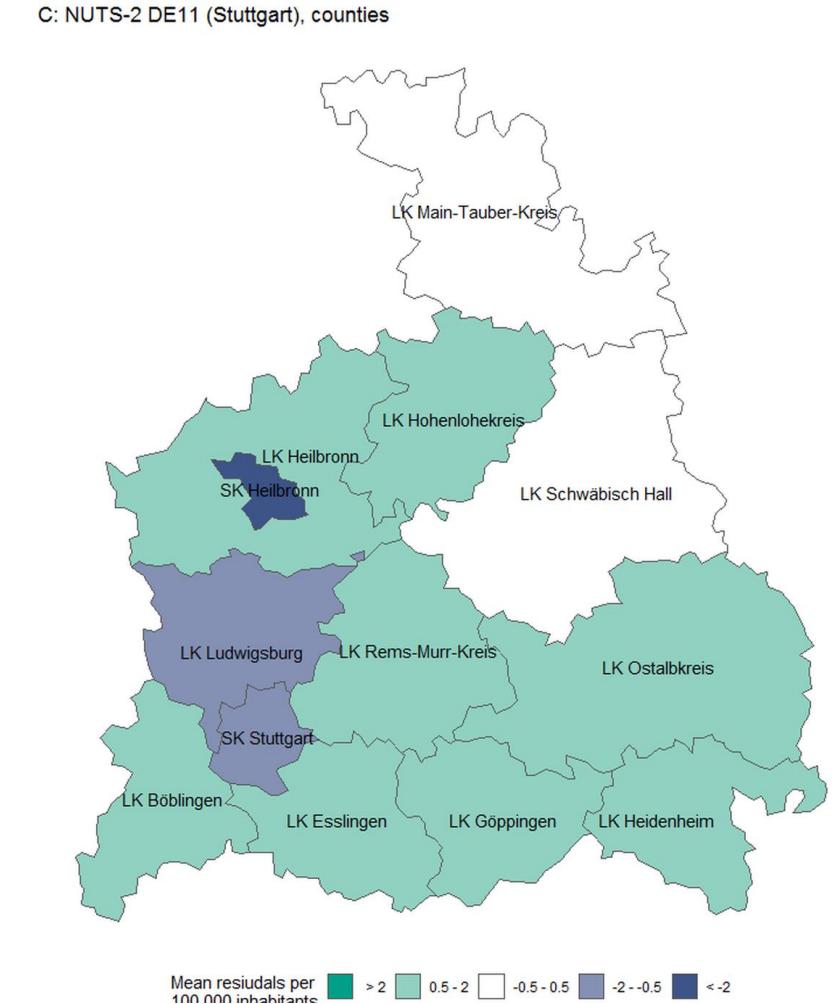
ICU and Deaths - Germany



NUTS regions

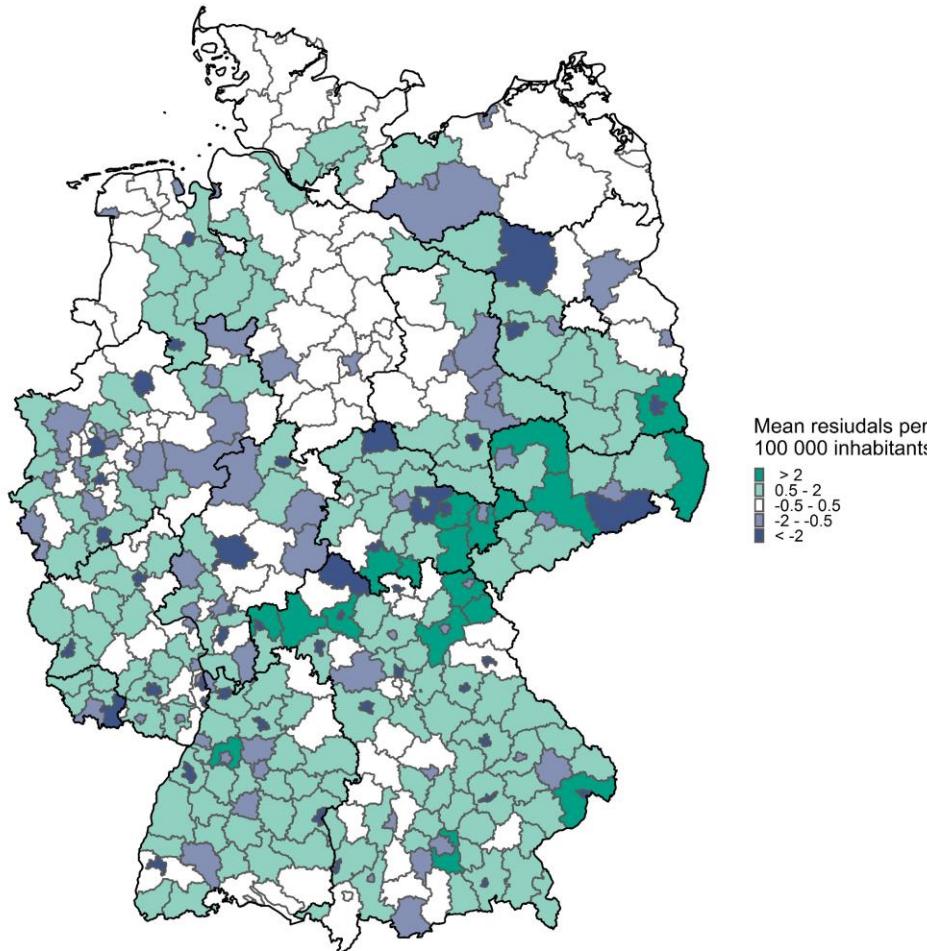


NUTS: Nomenclature of
Territorial Units for Statistics

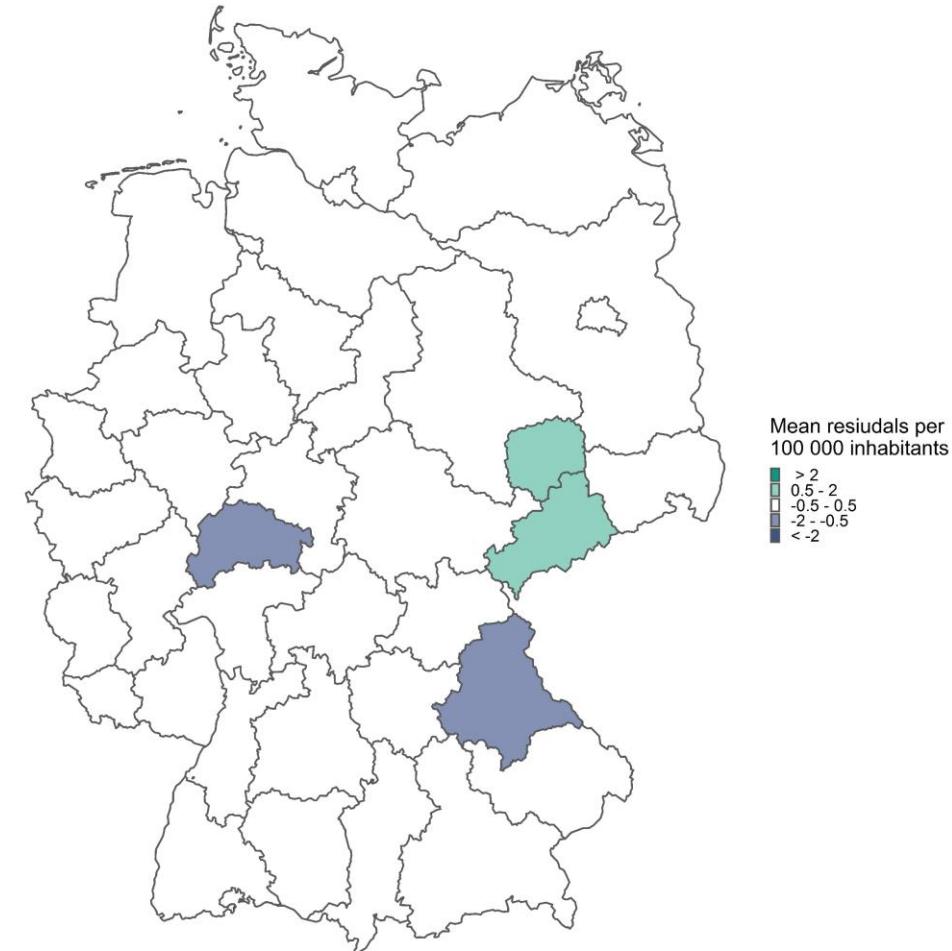


NUTS regions

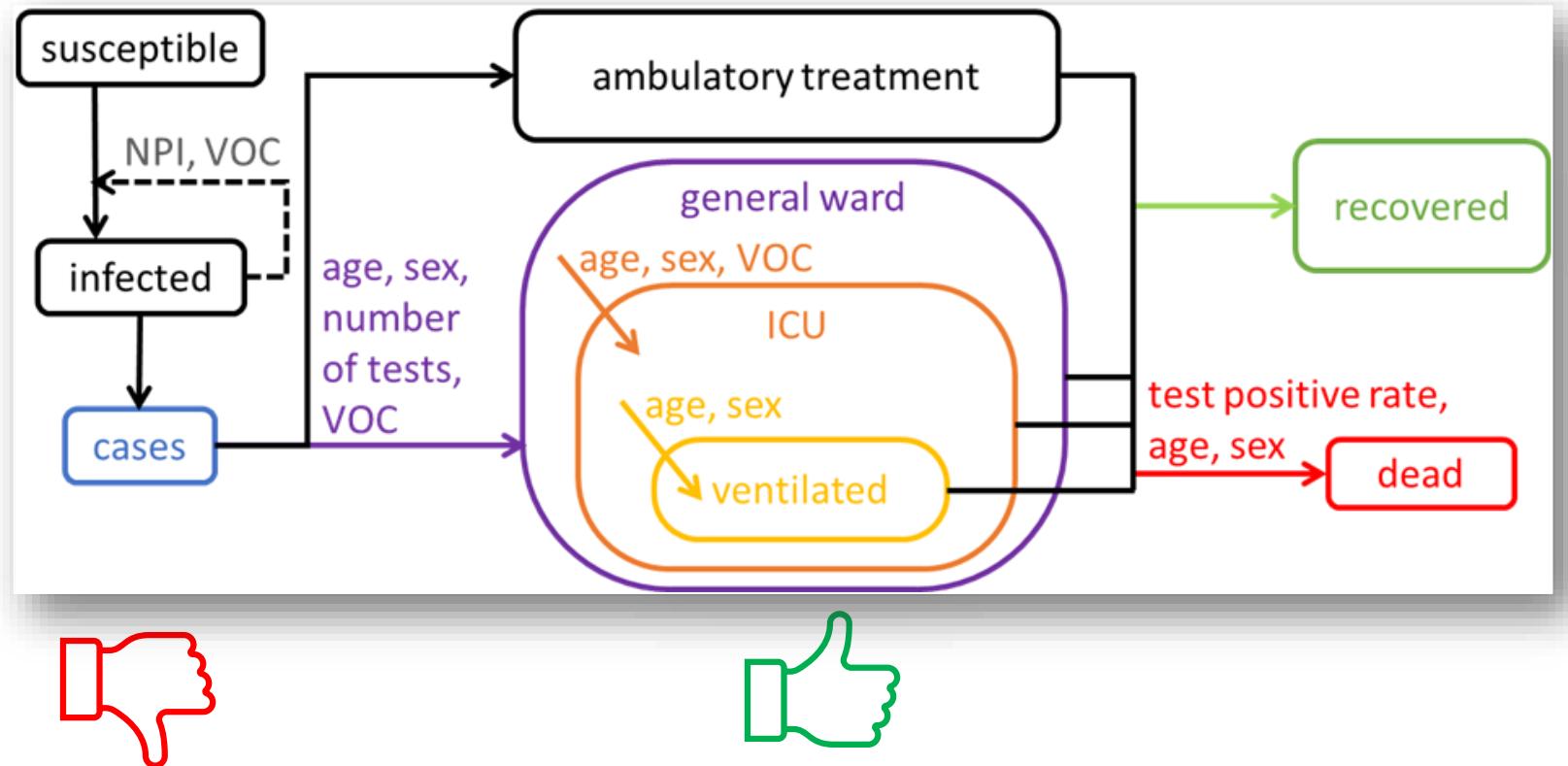
Germany, counties



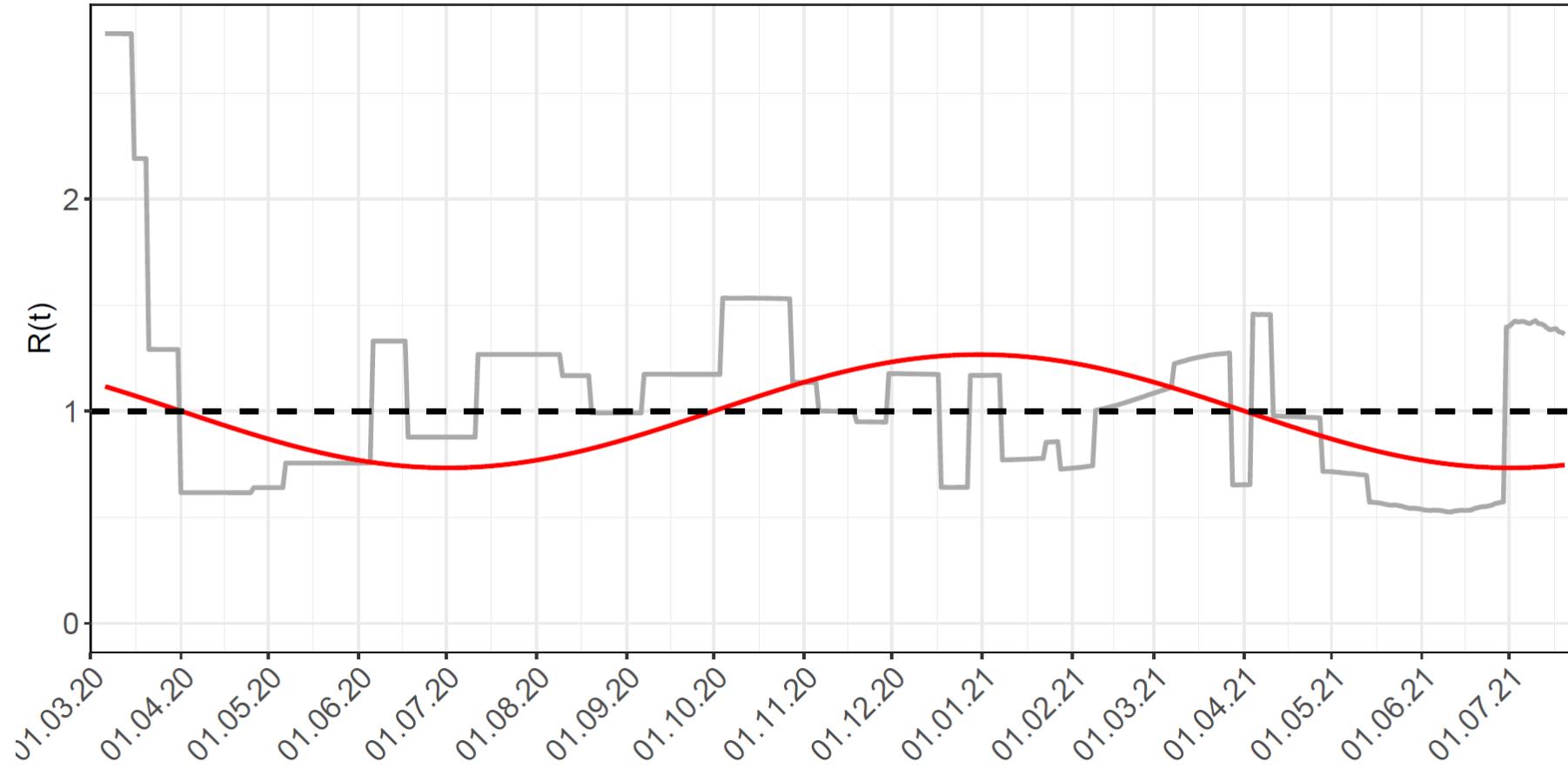
Germany, NUTS-2



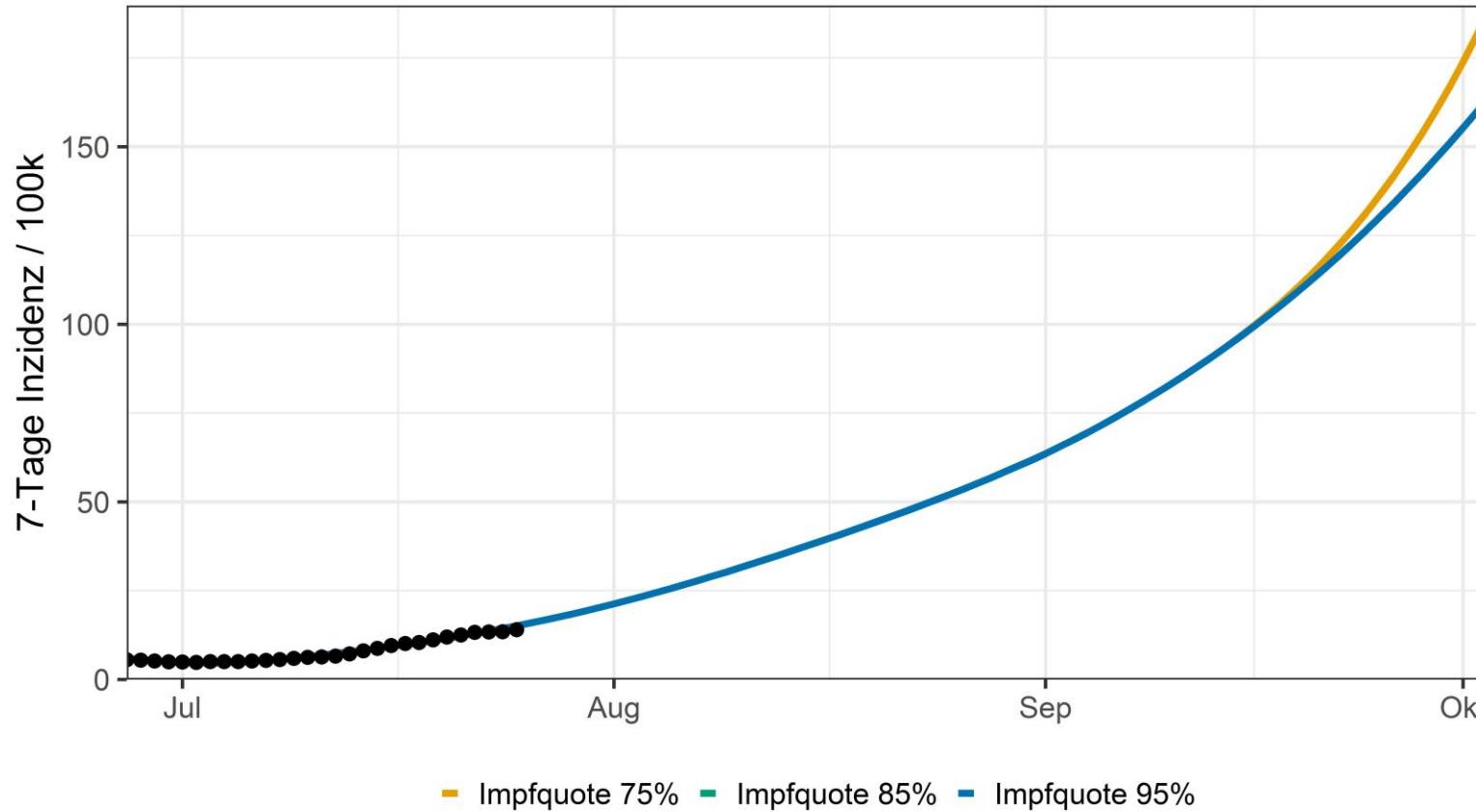
Forecasting



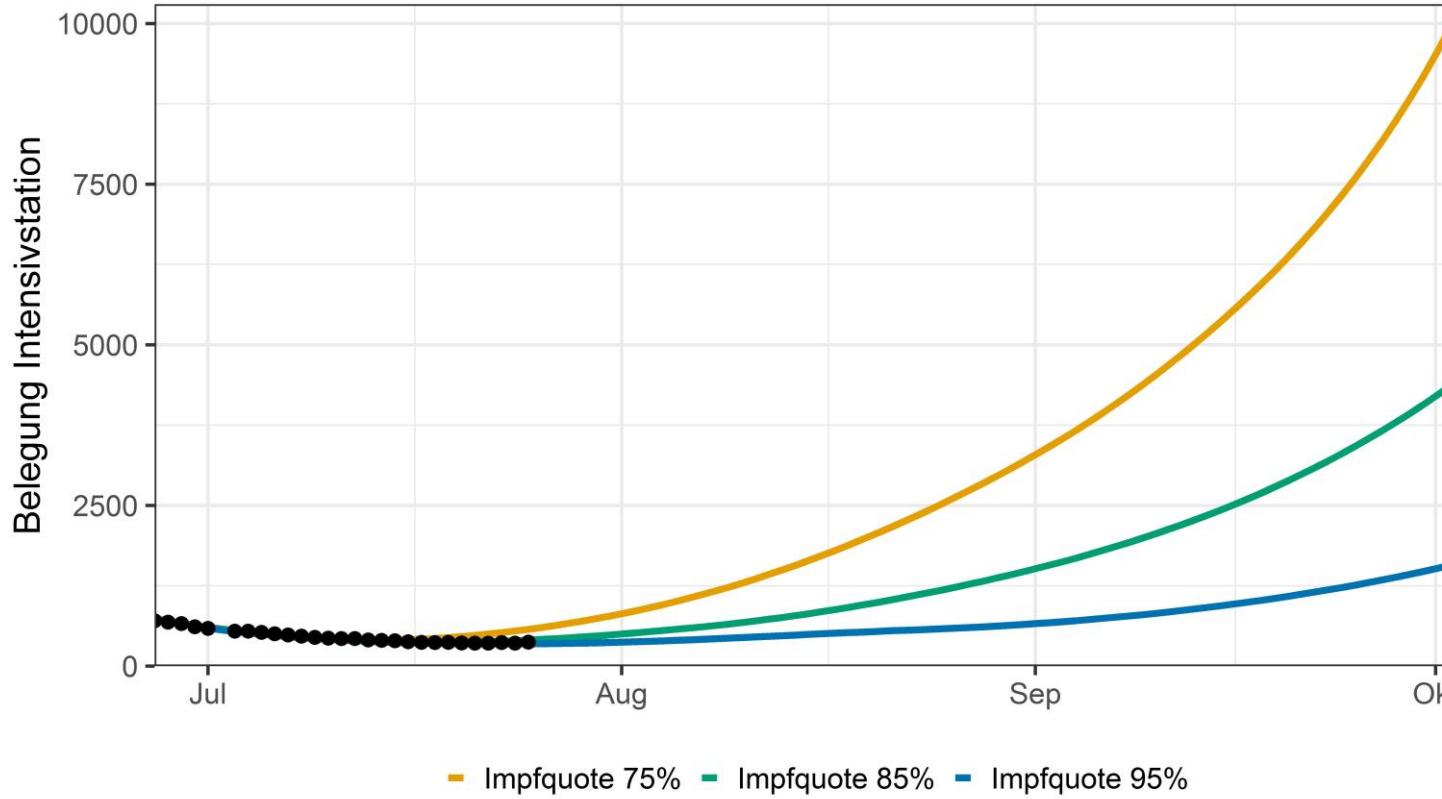
Saisonalität



Scenario – Different vaccination rates

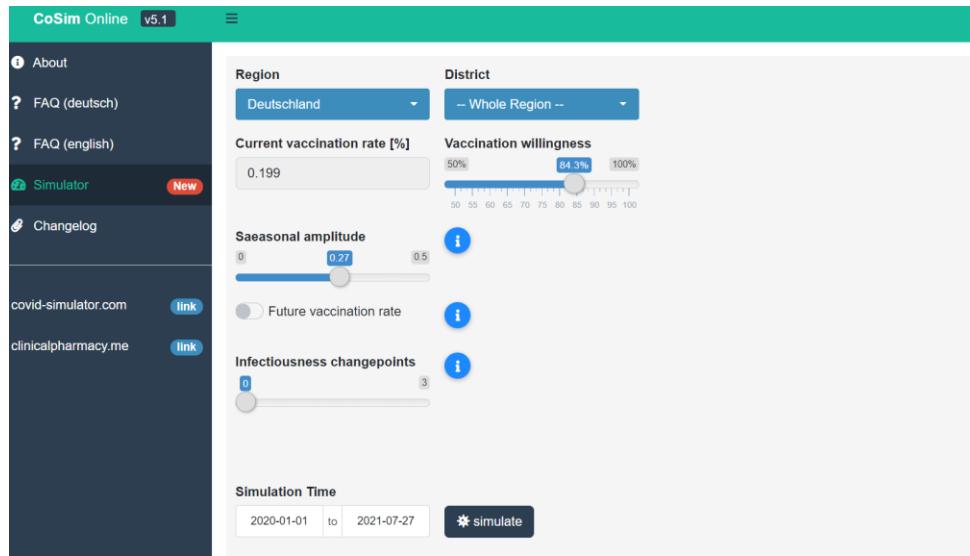


Scenario – Different vaccination rates

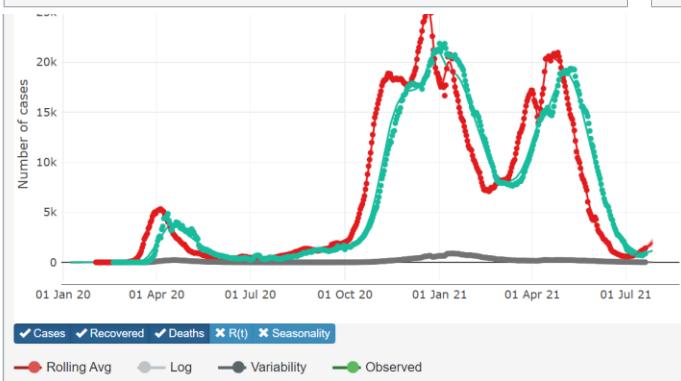
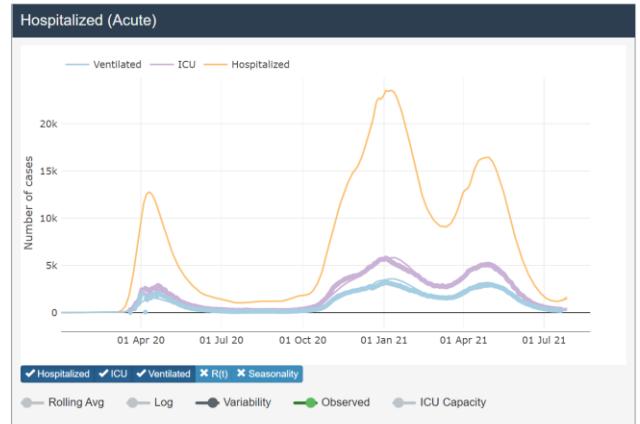
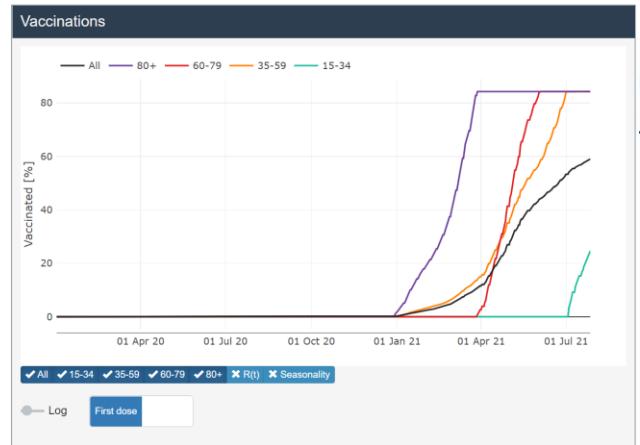
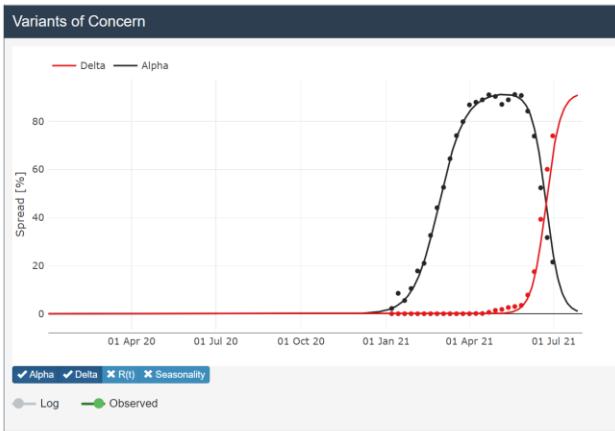
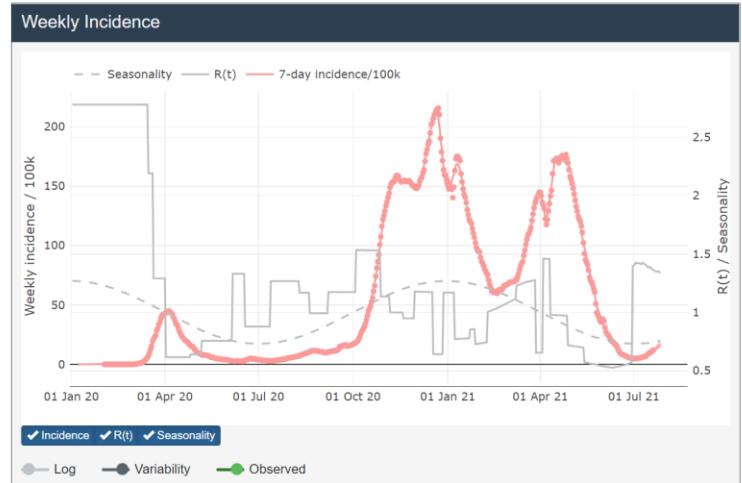


Covid-19 Simulator

RSITÄT
ANDES



Deutschland



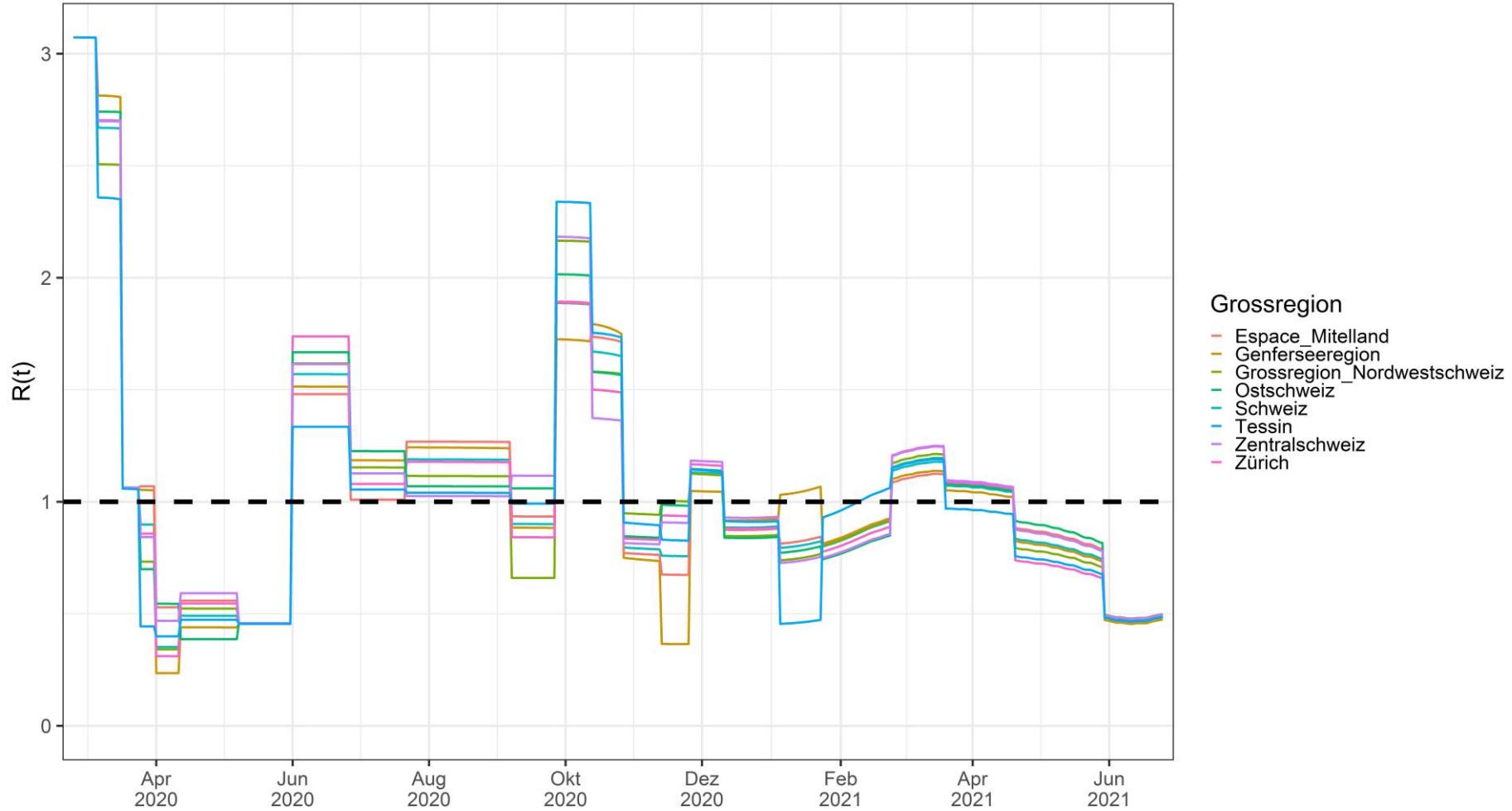
<https://covid-simulator.com/>

Was machen die Schweizer besser?

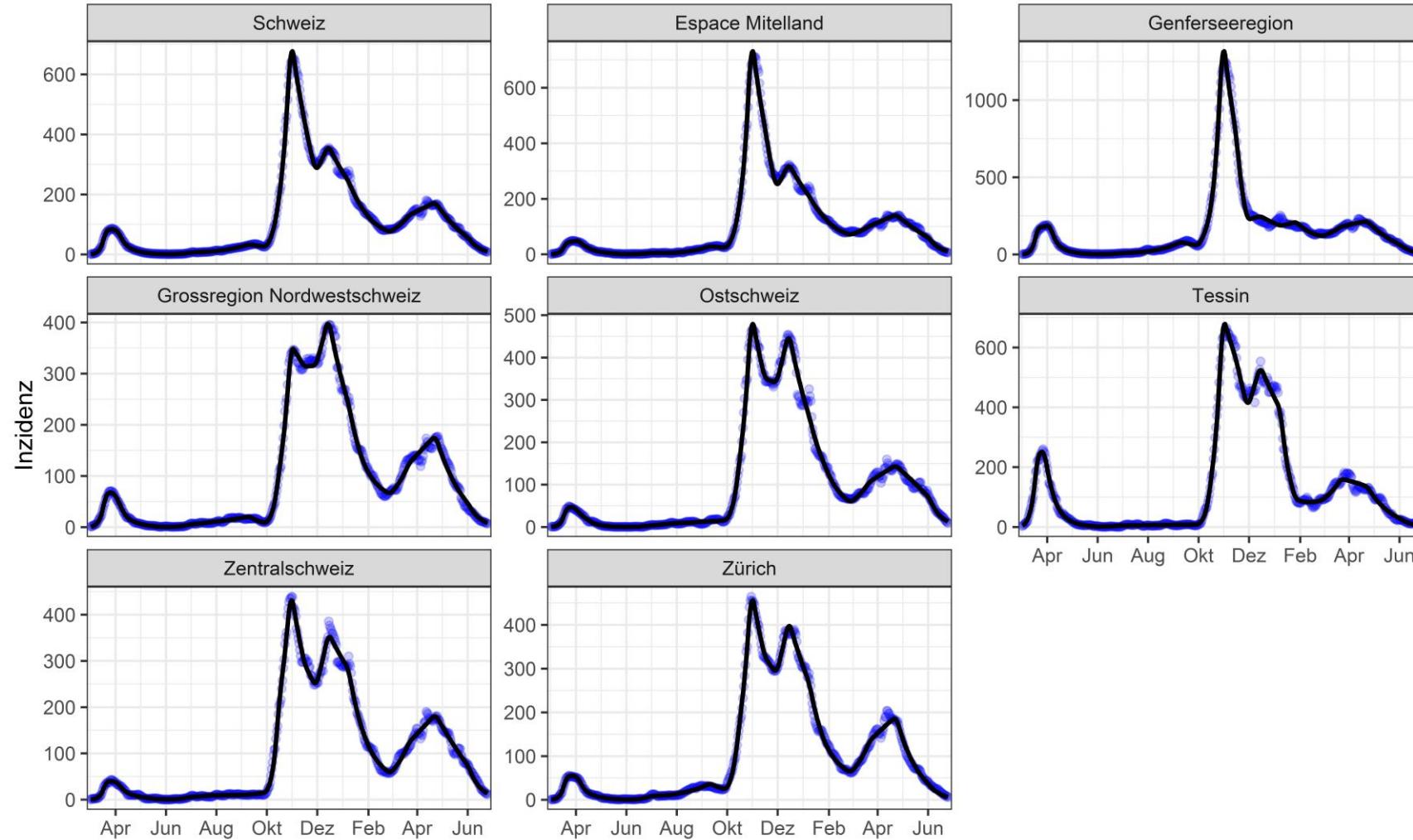


Nicht nur wandern in den Bergen, auch Restaurantbesuche sind in der Schweiz seit einem Monat möglich. Foto: imago images/YAY Micro

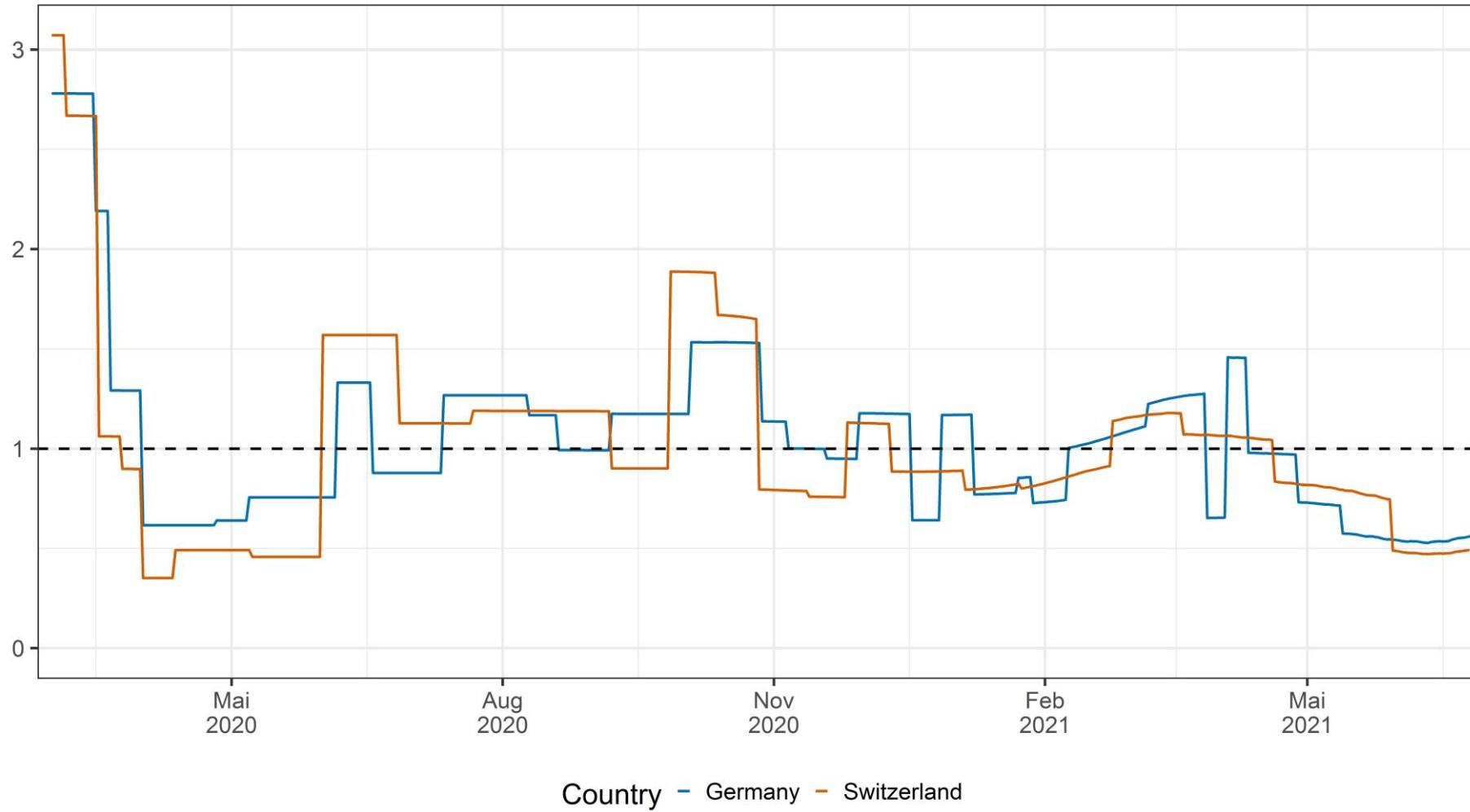
$R(t)$ values



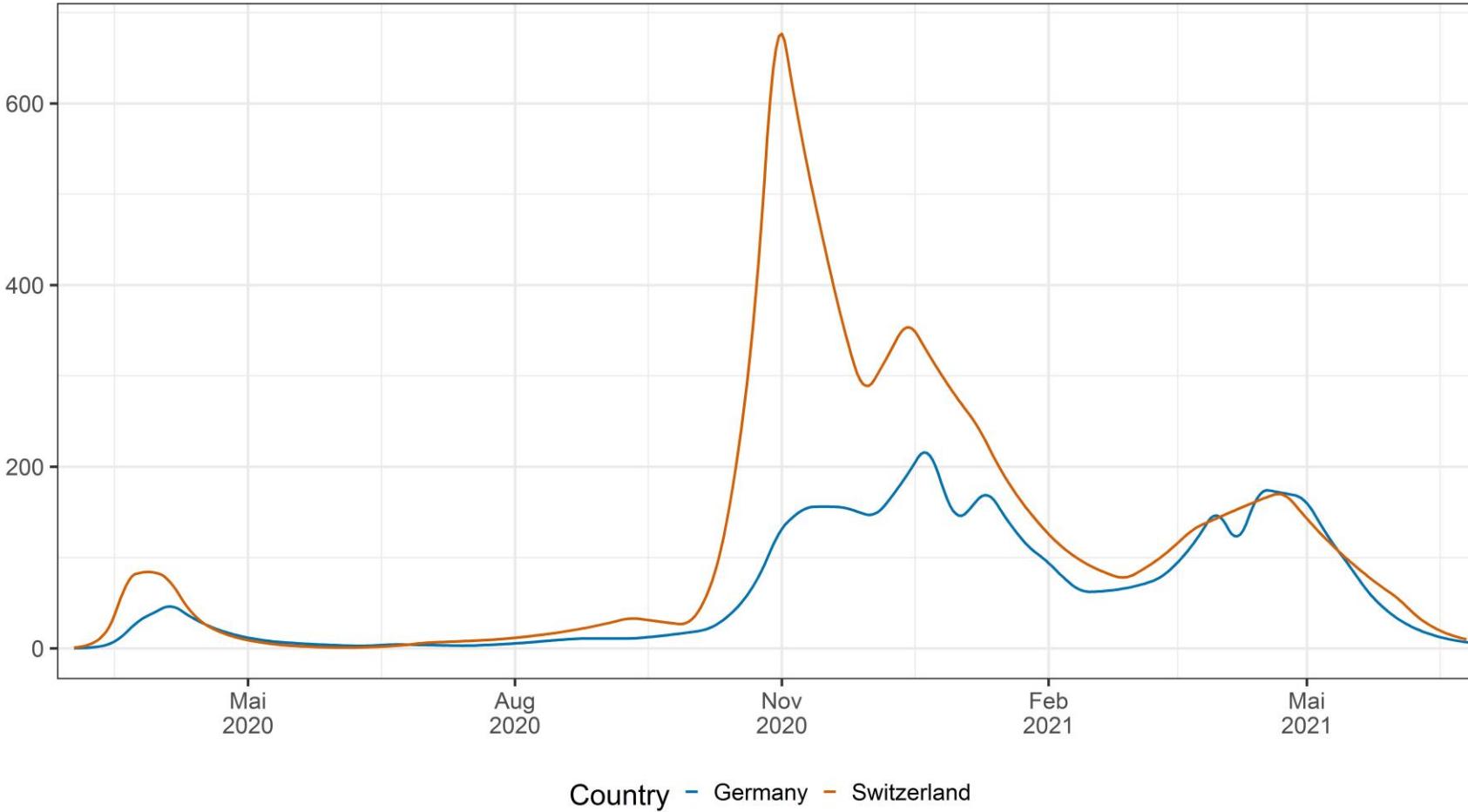
Incidence



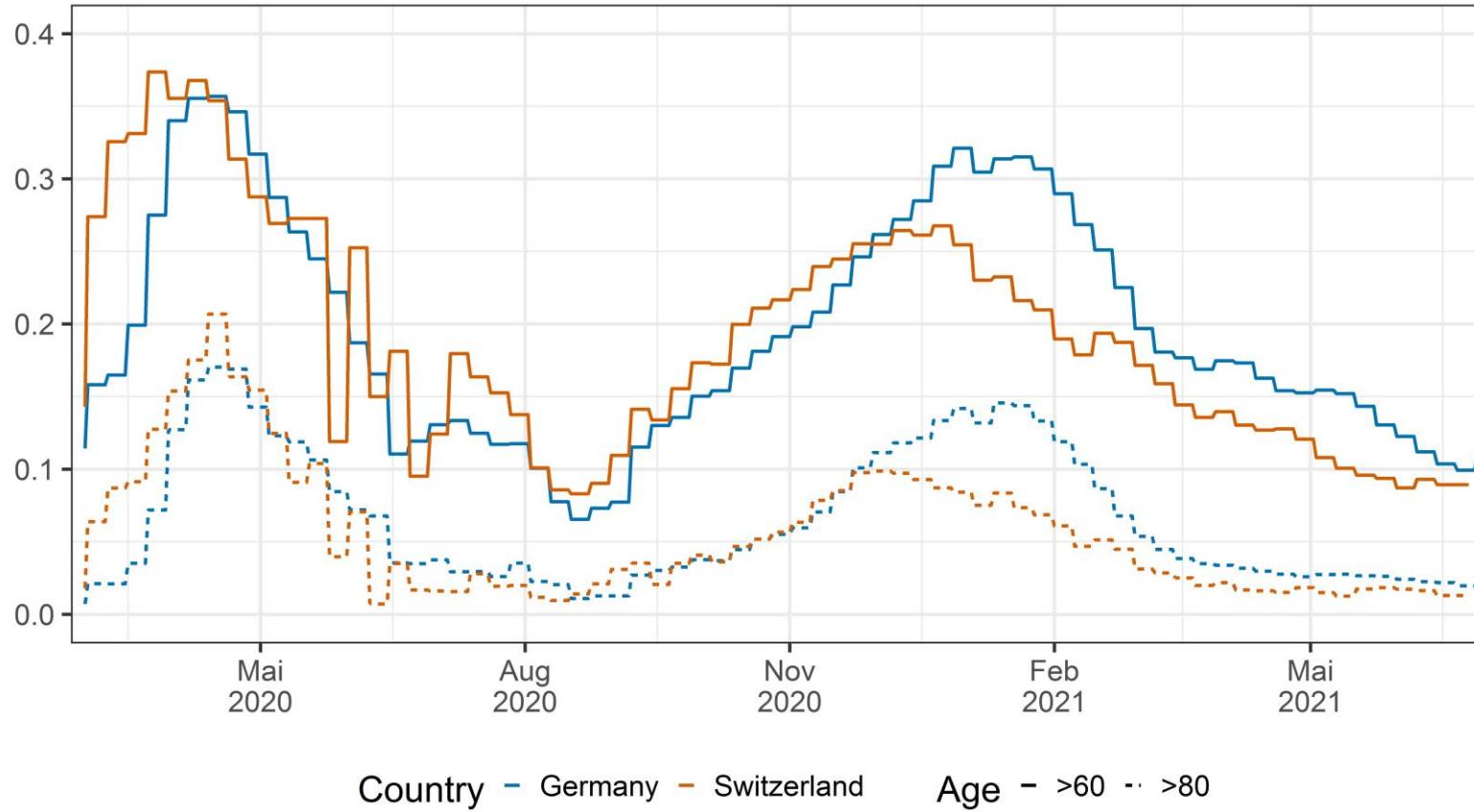
$R(t)$ values



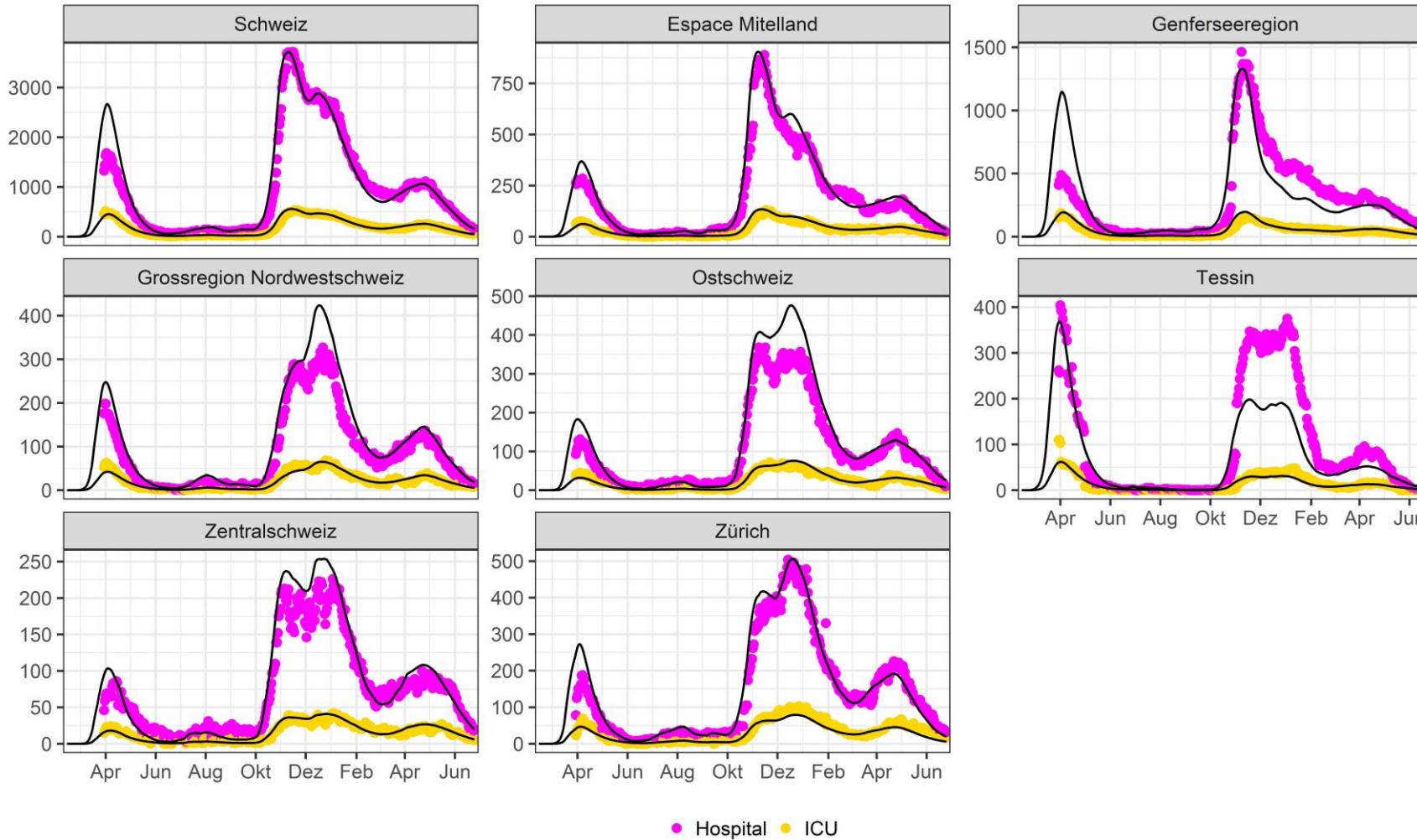
Incidence



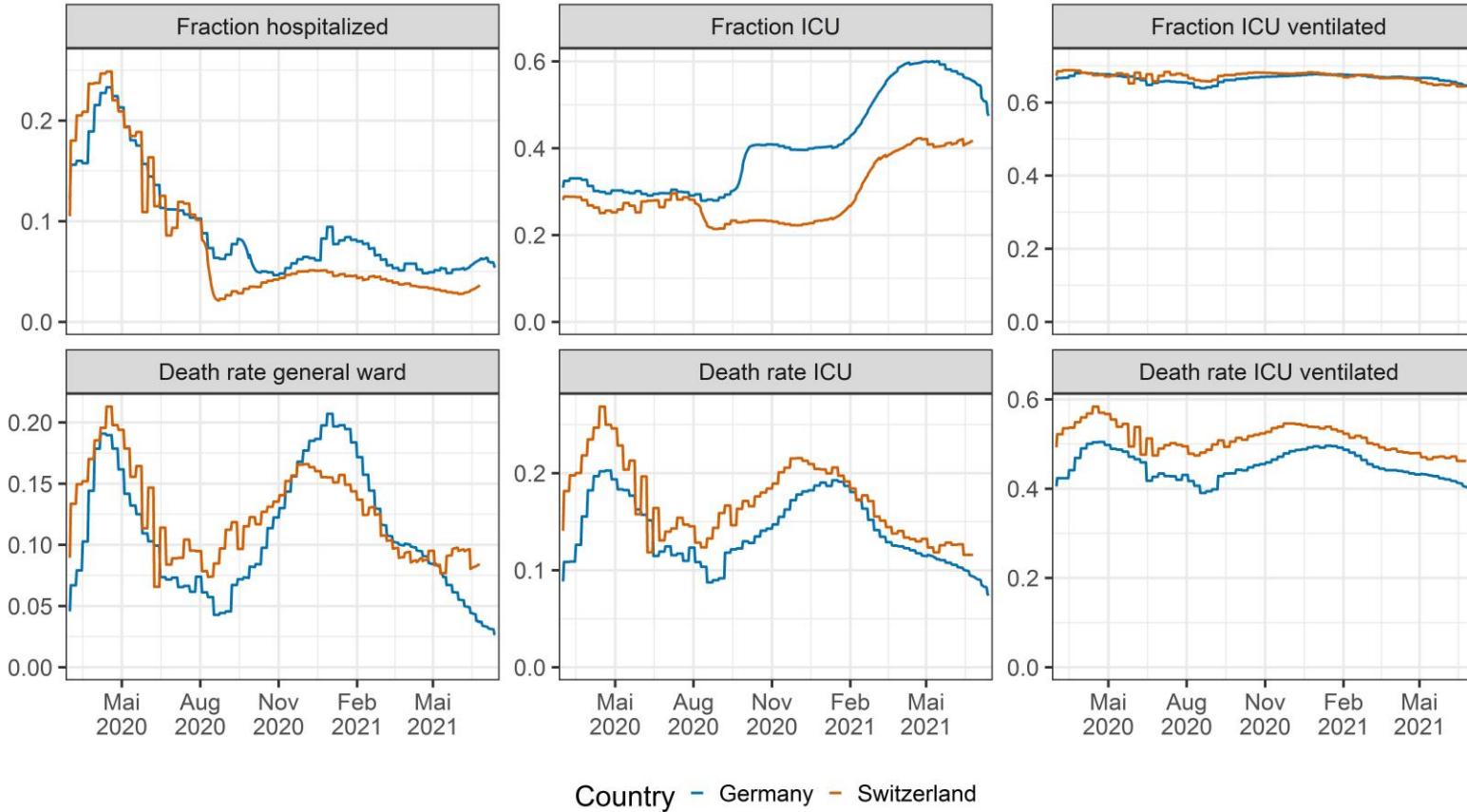
Age – Switzerland vs Germany



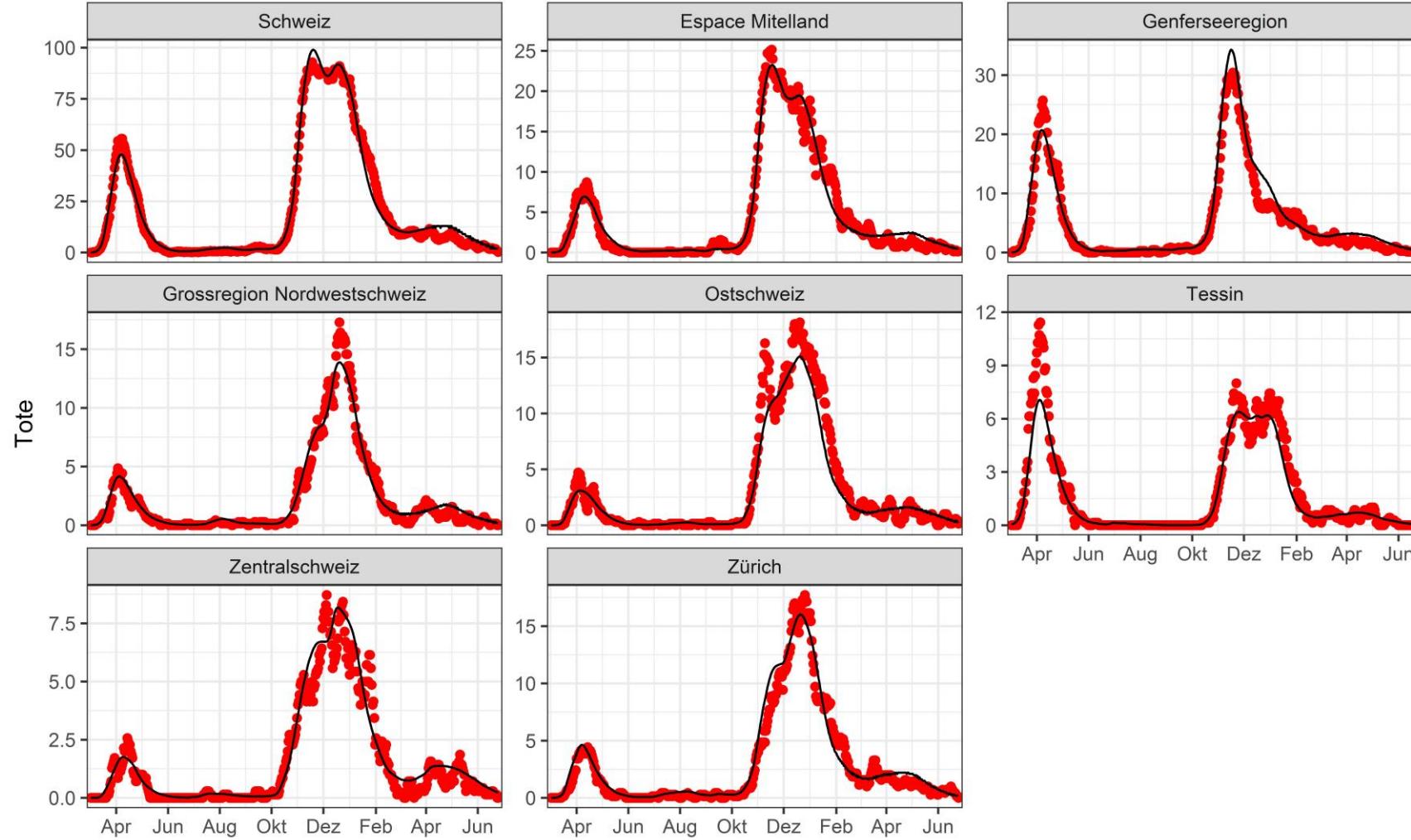
Hospital and ICU



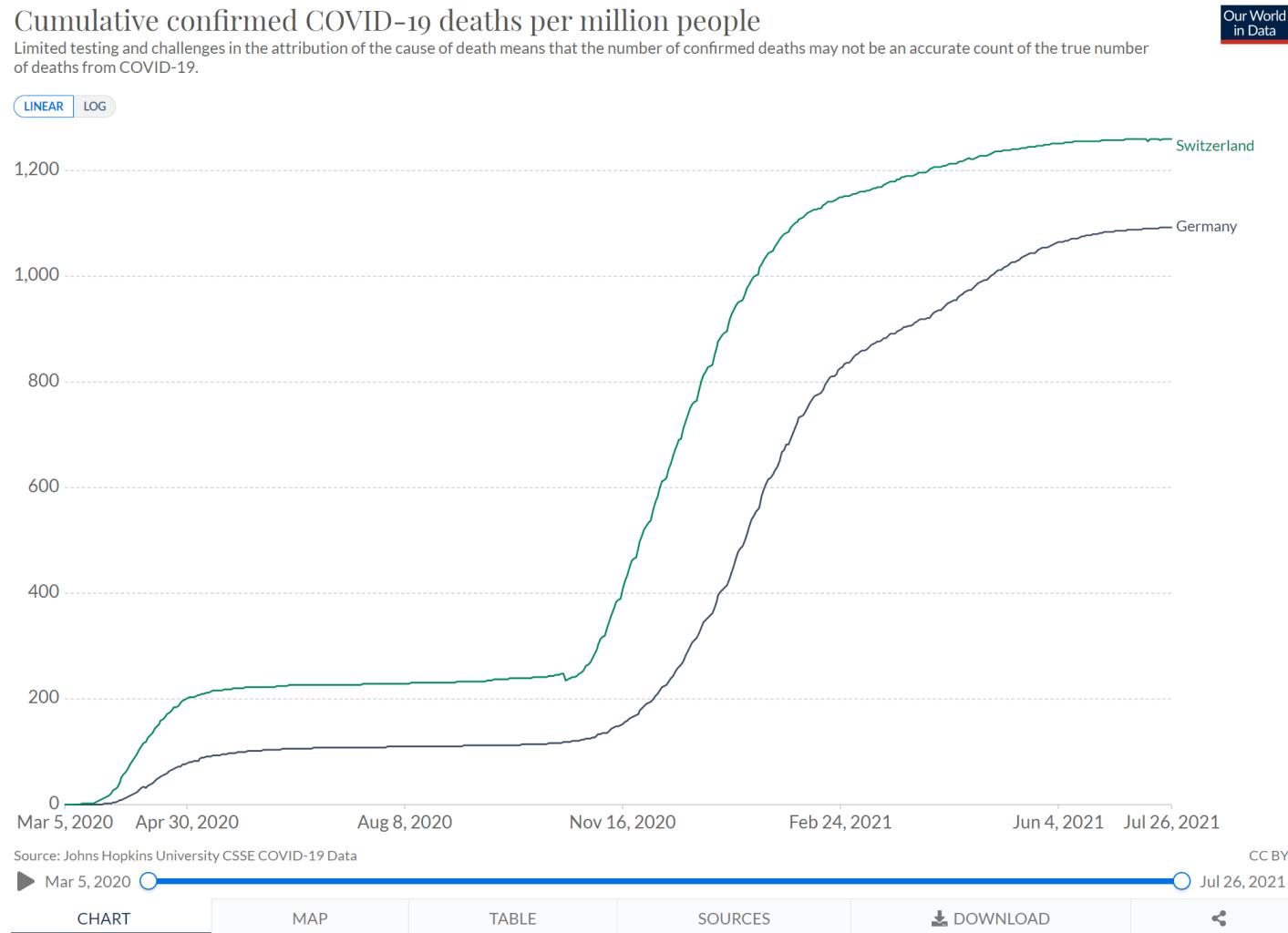
Rates – Switzerland vs Germany



Death



Death



Lessons learned

- Mathematical models are useful tools in the pandemic
- Difficult data and knowledge situation
 - Pandemic faster than science
- Long term prediction of infections impossible
 - Ir(?)rational human and politic behavior
- Hospital, ICU and outcome is predictable, if infections are known
- Simulations “what-if” scenarios important to assess interventions
 - “There is no glory in prevention”!!!
- Scientific communication to all stakeholders (public, politic, media, etc.) is a challenge – shitstorm guaranteed