COVID-19 Results Briefing

The European Union

October 15, 2021

This document contains summary information on the latest projections from the IHME model on COVID-19 in the European Union. The model was run on October 13, 2021, with data through October 11, 2021.

For the EU as a whole, transmission is increasing more rapidly than suggested by reported cases. Rapid increases in transmission in Romania and other countries that have lower infection-detection rates mean these Delta surges are not having the same impact on reported cases overall as increases in the western part of the EU. There are also small increases in transmission in Denmark, the Netherlands, and Ireland. These latter increases, while so far small, may be an early indication of increased transmission due to school openings and return to work combined with early impacts of seasonality. The magnitude of the winter increase in transmission will be determined by the balance of increasing vaccination (including the use of boosters), the fraction of the population that will continue wearing a mask, and the increase in transmission due to seasonality. Our reference scenario suggests that daily deaths will steadily increase to 1,500 by mid-December. Mask use is well below 50% in most countries, suggesting that this winter hospital systems will face the combined impact of a moderate level of COVID-19 hospitalization and flu. Our reference scenario does not take into account waning natural or vaccine-derived immunity, and thus may be optimistic. The emergence of a new variant with substantial immune escape could dramatically alter the trajectory of the pandemic in the region.

Current situation

- Estimated daily infections in the last week increased to 233,700 per day on average compared to 217,600 the week before (Figure 1).
- Daily hospital census in the last week (through October 11) increased to 53,900 per day on average compared to 48,500 the week before.
- Daily reported cases in the last week decreased to 46,000 per day on average compared to 48,400 the week before (Figure 2).
- Reported deaths due to COVID-19 in the last week increased to 690 per day on average compared to 610 the week before (Figure 3).
- Total deaths due to COVID-19 in the last week increased to 1,100 per day on average compared to 970 the week before (Figure 3). Note that this week we have changed from reporting excess deaths related to the pandemic to total COVID-19 deaths. This makes COVID-19 the number 3 cause of death in the EU this week (Table 1). Estimated total daily deaths due to COVID-19 in the past week were 1.6 times larger than the reported number of deaths.

- The daily rate of reported deaths due to COVID-19 is greater than 4 per million in Bulgaria, Latvia, Lithuania, and Romania (Figure 4).
- The daily rate of total deaths due to COVID-19 is greater than 4 per million in Bulgaria, Estonia, Latvia, Lithuania, and Romania (Figure 4).
- We estimate that 27% of people in the EU have been infected as of October 11 (Figure 6).
- Effective R, computed using cases, hospitalizations, and deaths, is greater in many of the eastern countries of the EU. Romania reports the most rapid increase in transmission along with the Baltic countries (Figure 7).
- The infection-detection rate in the EU was close to 28% on October 11 (Figure 8).
- Based on the GISAID and various national databases, combined with our variant spread model, we estimate the current prevalence of variants of concern (Figure 9). We estimate that the Beta variant is circulating in one country, that the Delta variant is circulating in 22 countries, and that the Gamma variant is circulating in three countries.

Trends in drivers of transmission

- Mobility last week was 2% lower than the pre-COVID-19 baseline (Figure 11). Mobility was near baseline (within 10%) in 22 countries. Mobility was lower than 30% of baseline in no locations.
- As of October 11, in the COVID-19 Trends and Impact Survey, 43% of people self-report that they always wore a mask when leaving their home (Figure 13).
- There were 483 diagnostic tests per 100,000 people on October 11 (Figure 15).
- As of October 11, nine countries have reached 70% or more of the population who have received at least one vaccine dose and six countries have reached 70% or more of the population who are fully vaccinated (Figure 17). First does coverage remains below 50% of the population in Slovakia, Romania, Bulgaria, Croatia, Lithuania, and Cyprus.
- In the EU, 79.6% of the population that is 12 years and older say they would accept or would probably accept a vaccine for COVID-19. Note that vaccine acceptance is calculated using survey data from the 18+ population. This is unchanged from last week. The proportion of the population who are open to receiving a COVID-19 vaccine ranges from 37% in Bulgaria to 93% in Portugal (Figure 19).
- In our current reference scenario, we expect that 304 million people will be vaccinated with at least one dose by January 1 (Figure 20). We expect that 66% of the population will be fully vaccinated by January 1.

- Based on the estimate of the population that have been infected with COVID-19 and vaccinated to date, combined with assumptions on protection against infection with the Delta variant provided by either natural infection, vaccination, or both, we estimate that 50% of the region is immune to the Delta variant. In our current reference scenario, we expect that by January 1, 57% of people will be immune to the Delta variant (Figure 21). These two calculations do not take into account waning of natural or vaccine-derived immunity.

Projections

- In our **reference scenario**, which represents what we think is most likely to happen, our model projects 891,000 cumulative reported deaths due to COVID-19 on January 1. This represents 105,000 additional deaths from October 11 to January 1. Daily reported deaths will rise to near 1,700 by the end of the year (Figure 22).
- Under our **reference scenario**, our model projects 1,276,000 cumulative total deaths due to COVID-19 on January 1. This represents 164,000 additional deaths from October 11 to January 1 (Figure 22).
- If **universal mask coverage (95%)** were attained in the next week, our model projects 46,000 fewer cumulative reported deaths compared to the reference scenario on January 1.
- Under our **worse scenario**, our model projects 981,000 cumulative reported deaths on January 1, an additional 90,000 deaths compared to our reference scenario. Daily reported deaths in the **worse scenario** will rise to 4,900 on January 1, 2022 (Figure 22).
- Daily infections in the **reference scenario** will rise to 340,000 by the end of the year (Figure 23). Daily infections in the **worse scenario** will rise to 1.4 million by mid-December (Figure 23).
- Daily cases in the **reference scenario** will rise to 157,000 on January 1, 2022 (Figure 24). Daily cases in the **worse scenario** will rise to 750,000 by December 31, 2021 (Figure 24).
- Daily hospital census in the **reference scenario** will rise to 104,790 by December 16, 2021 (Figure 25). Daily hospital census in the **worse scenario** will rise to 470,620 on January 1, 2022 (Figure 25).
- Figure 26 compares our reference scenario forecasts to other publicly archived models. The ECDC ensemble, MIT model, and IHME model have similar forecasts through to mid-November. The Imperial model forecasts steady declines until the end of the year.
- At some point from October through January 1, six countries will have high or extreme stress on hospital beds (Figure 27). At some point from October through January 1, 19 countries will have high or extreme stress on intensive care unit (ICU) capacity (Figure 28).

Model updates

In this new release, we have introduced three major changes. First, we have very substantially updated the data and methods used to estimate excess mortality related to the pandemic. Second, we are now estimating the fraction of excess mortality in each country that is directly related to COVID-19 and the fraction that is increased mortality in individuals who were not PCR-positive at the time of death. Third, the estimation of past infection triangulating on cases, hospitalizations, deaths, and the infection-detection rate, infection-hospitalization rate, and infection-fatality rate has been revised to capture multiple sources of uncertainty. Below, we provide more detail on these revisions.

In addition to the methods changes, we have also made a change in the indicators we report. We now show in our tools and briefs reported and total COVID-19 deaths, while previously we were showing reported and excess.

1. *Revisions to estimating excess mortality.* For this analysis, countries can be divided into two groups: a) countries that have reported monthly or weekly deaths due to all causes before and during the pandemic, and b) countries that have not reported deaths during the pandemic. Most countries are in group b.

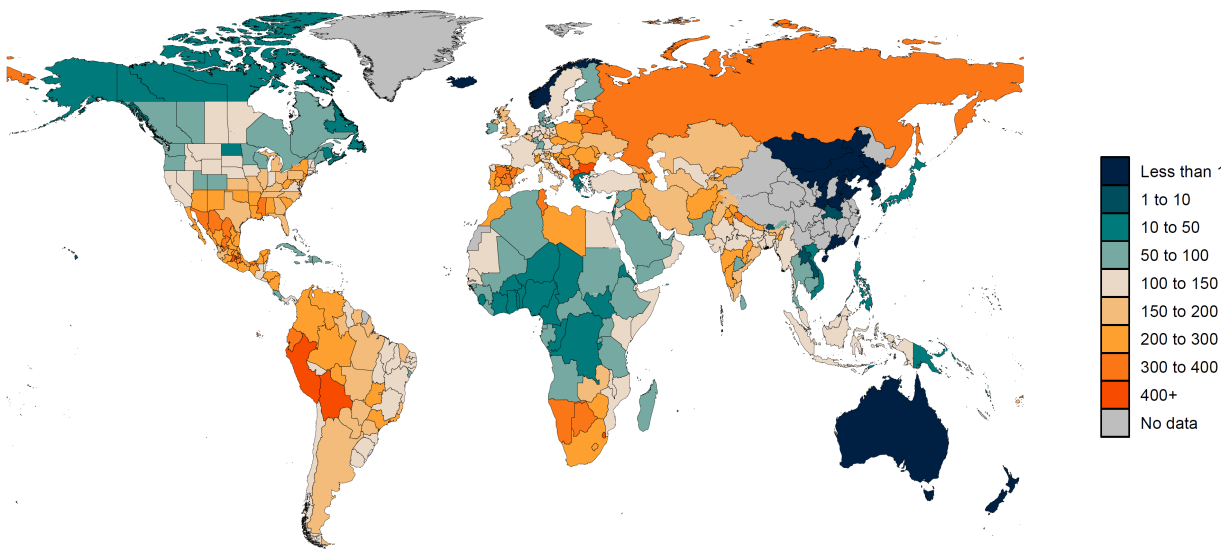
As previously described, we provide estimates of excess mortality for countries that report all-cause mortality data which are based on an ensemble of six different models. These six models are weighted by their root mean squared errors from an out-of-sample predictive validity test. As in our previous analysis, late registration is evaluated by comparing successive releases of weekly or monthly all-cause mortality data. The more recent weeks/months where reported all-cause mortality is less than 99% complete were excluded from our analysis. In addition, we also included provincial-level excess mortality rate estimates provided by the Medical Research Council of South Africa and excess mortality based on reported deaths in the civil registration system for periods during the first and second waves of COVID-19 from nine states in India. Inclusion of civil registration data for these states in India very substantially increases estimates of excess mortality for India, particularly during the Delta variant surge. In total, we have data for 163 countries and 220 states/provinces within countries.

To predict excess mortality for all locations without directly measured all-cause mortality, we evaluated the relationship between the excess mortality rate and a list of COVID-19-related covariates such as infection-detection rate and covariates suggested by meta-analysis conducted by the US Centers for Disease Control and Prevention. To arrive at a parsimonious model with covariates with sensible direction of effect on excess mortality rate, we run our model using Least Absolute Shrinkage and Selection Operator (LASSO) regression to help identify covariates to be included in our analysis. Through our model selection process, the list of covariates included are:

- Cumulative seroprevalence (lagged)
- Mobility (lagged)
- Infection-detection rate (lagged)
- Reported COVID-19 mortality rate
- Crude death rate
- Prevalence of diabetes
- Prevalence of smoking
- HIV death rate
- Inpatient admission rate
- Quality of death registration
- Average latitude
- Proportion of population over age 75
- Prevalence of hypertension
- Healthcare Access and Quality Index

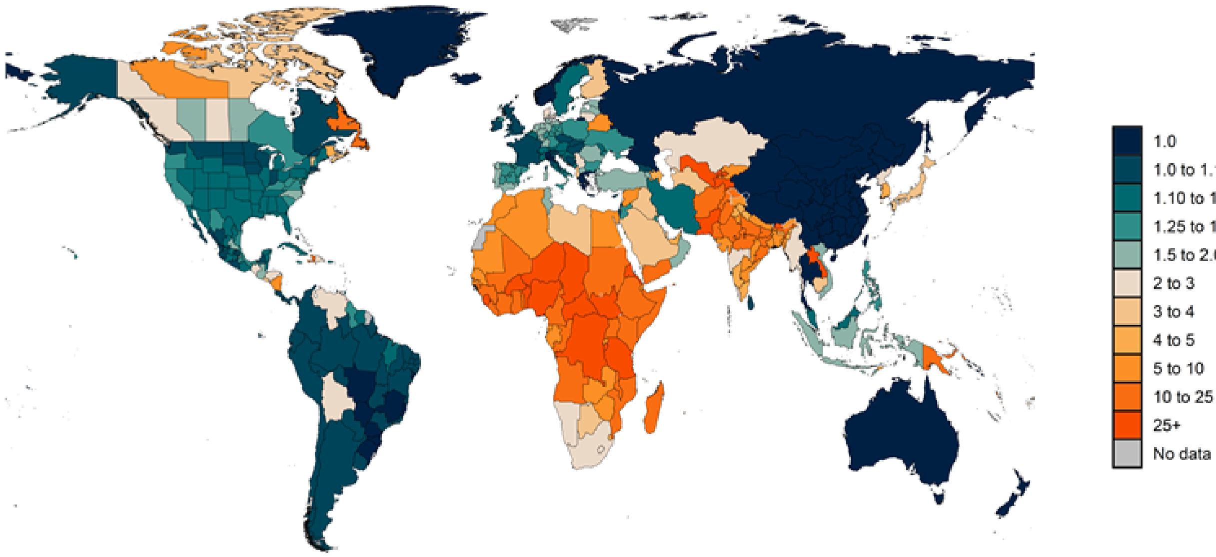
To account for uncertainty in both directly estimated excess mortality based on registered deaths and the selected covariates, we run our estimation 100 times based on draw-level excess mortality and draw-level covariates. We use the draw-level residuals not explained by the fixed effects of the selected covariates in making predictions for locations with all-cause mortality to match the observed data. Regional and super-region-level residuals are generated as the mean of locations included in those aggregated location hierarchies. Given the diverse and incomplete time period covered by the civil registration data from India, the average of state-level residuals is used for all states in India. We predict excess mortality from March 1, 2020, to September 26, 2021, using 100 draws of covariates for this cumulative period and the draw-level model coefficients and residuals estimated in the previous step. Figure 1 shows the estimated excess mortality rate (deaths per 100,000) for the aforementioned time period.

Figure 1: Estimated excess mortality rate (deaths per 100,000) from March 1, 2020, to September 26, 2021



2. *Estimating the fraction of excess mortality directly attributable to COVID-19 infection.* Estimating the deaths in individuals that occurred when actively infected with COVID-19 is challenging. Some jurisdictions within countries and some countries, such as the Russian Federation, have reported deaths where COVID-19 is reported on the death certificate as the underlying cause of death and, in addition, PCR-positive patients who have another cause of death listed as underlying cause on the death certificate. Following WHO recommendations, we define in principle total COVID-19 deaths as all deaths where the individual was actively infected at the time of death. The number of jurisdictions reporting this sort of detailed data, however, is very limited. We have had to use a statistical estimation approach to approximate the fraction of excess deaths that are total COVID-19 deaths. In particular, we use the regression analysis for excess mortality and compute a counterfactual level of excess mortality where the infection-detection rate is set to the observed maximum level and set mobility to the pre-COVID-19 baseline. These are meant to correct excess mortality for changes due to under-reporting and changes in behavior such as care-seeking related to mobility. In a given location, if reported COVID-19 deaths are higher than estimated total COVID-19 deaths, we use reported COVID-19 as the estimate of total COVID-19 deaths. Figure 2 shows the ratio of estimated total COVID-19 deaths to reported COVID-19 deaths by location.

Figure 2: Estimated ratio of total COVID-19 deaths to reported COVID-19 deaths from March 1, 2020, to September 26, 2021



3. We have improved how we estimate past COVID-19 infections to better reflect the various sources of uncertainty that impact that estimation process. This includes the following changes which were introduced in this week's release:

a) We have implemented an ensemble model for our infection-fatality rate and infection-hospitalization rate models that uses the 100 most predictive combinations of the following covariates (in addition to time). These covariates were based on a US CDC meta-analysis of factors related to COVID-19 infection.

i. Obesity prevalence
ii. Cardiovascular disease prevalence
iii. Cancer prevalence
iv. Chronic kidney disease prevalence
v. Diabetes prevalence
vi. Chronic obstructive pulmonary disease prevalence
vii. Smoking prevalence
viii. Universal health care coverage
ix. Healthcare Access and Quality Index

b) We also used an ensemble model for infection-detection rate based on the following covariates (one used in each model, along with testing capacity):

i. Universal health care coverage
ii. Healthcare Access and Quality Index
iii. Proportion of the population 65 years and older

c) We generated 100 samples of each seroprevalence observation based on the reported error in seroprevalence studies, and then created bootstrapped samples from those 100 sets of seroprevalence data to include in each model in the ensemble.

d) When correcting seroprevalence studies for under-reporting due to seroreversion, we sampled curves from the assay-specific sensitivity decay functions based on the error reported in those studies rather than using the point estimates only.

e) Rather than assuming a single fixed value of cross-variant immunity at 0.5, we sampled from a uniform distribution ranging from 0.3 to 0.7 (as is already done in our Susceptible–Exposed–Infectious–Recovered [SEIR] model).

f) Rather than assuming a single fixed value of increased risk of hospitalization and mortality for non-ancestral variants relative to ancestral, we use an estimate found in the literature (https://www.bmj.com/content/372/bmj.n579) of 1.64 (95% CI: 1.32–2.04) – an increase from the previous source we drew from, which reported 1.29.
g) When triangulating infections based on cases, deaths, and hospitalizations, we give more weight to one of those three input series in each sub-model to better capture heterogeneity among these data.

Figure 1. Daily COVID-19 hospital census and infections

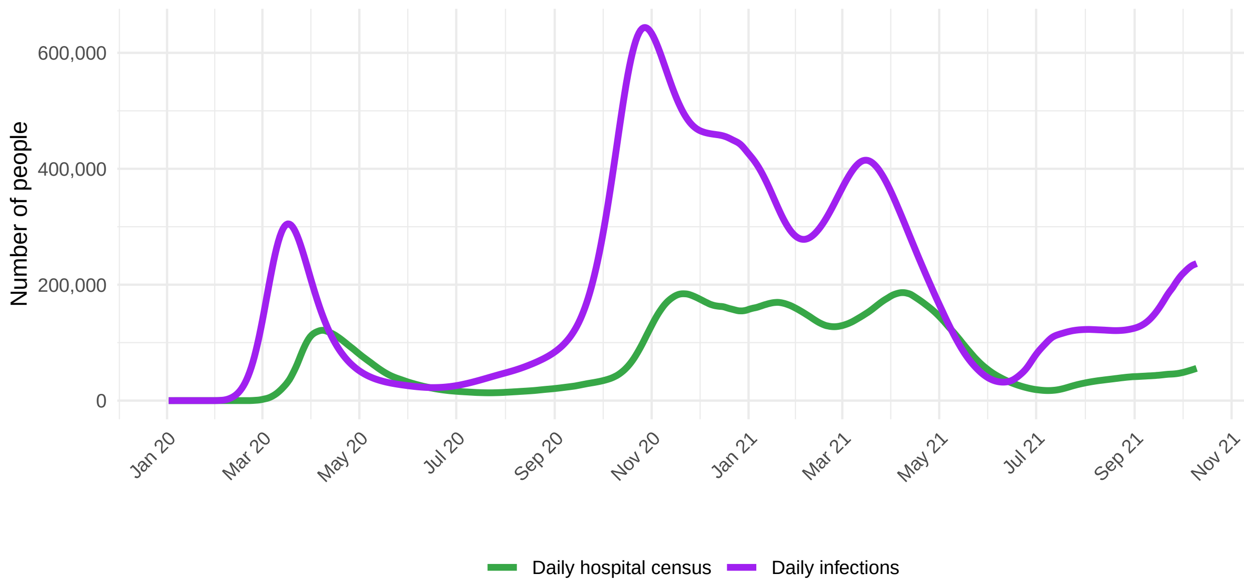


Figure 2. Reported daily COVID-19 cases, moving average

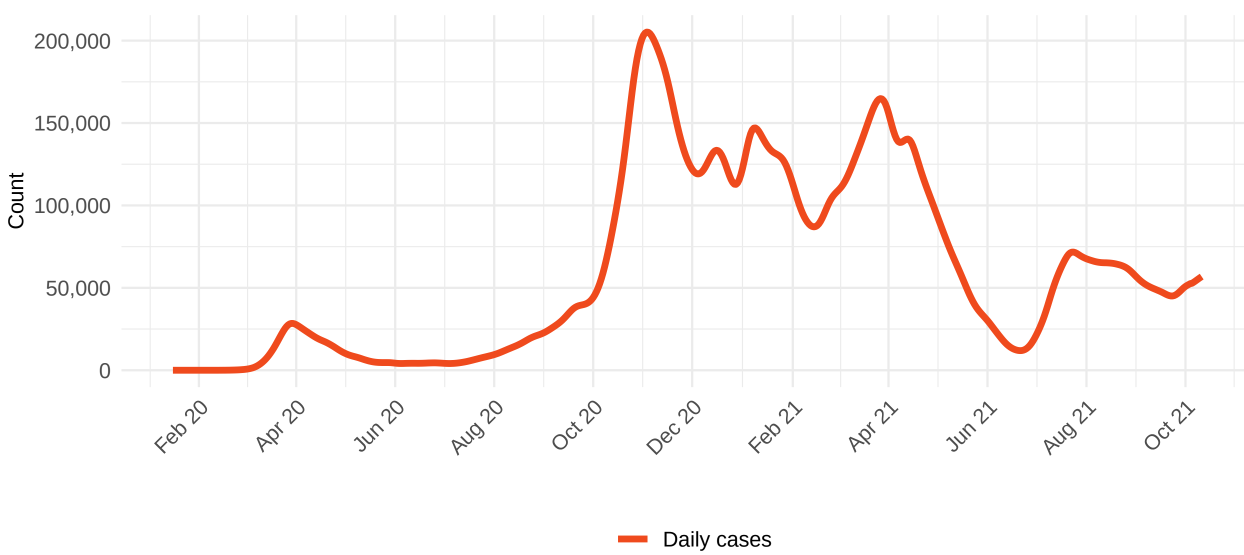


Table 1. Ranking of total deaths due to COVID-19 among the leading causes of mortality this week, assuming uniform deaths of non-COVID causes throughout the year

Cause name	Weekly deaths	Ranking
Ischemic heart disease	18,714	1
Stroke	10,303	2
COVID-19	7,920	3
Tracheal, bronchus, and lung cancer	6,216	4
Alzheimer's disease and other dementias	5,827	5
Chronic obstructive pulmonary disease	4,608	6
Colon and rectum cancer	4,100	7
Lower respiratory infections	3,503	8
Hypertensive heart disease	2,797	9
Chronic kidney disease	2,430	10

Figure 3. Smoothed trend estimate of reported daily COVID-19 deaths (blue) and total daily deaths due to COVID-19 (orange)

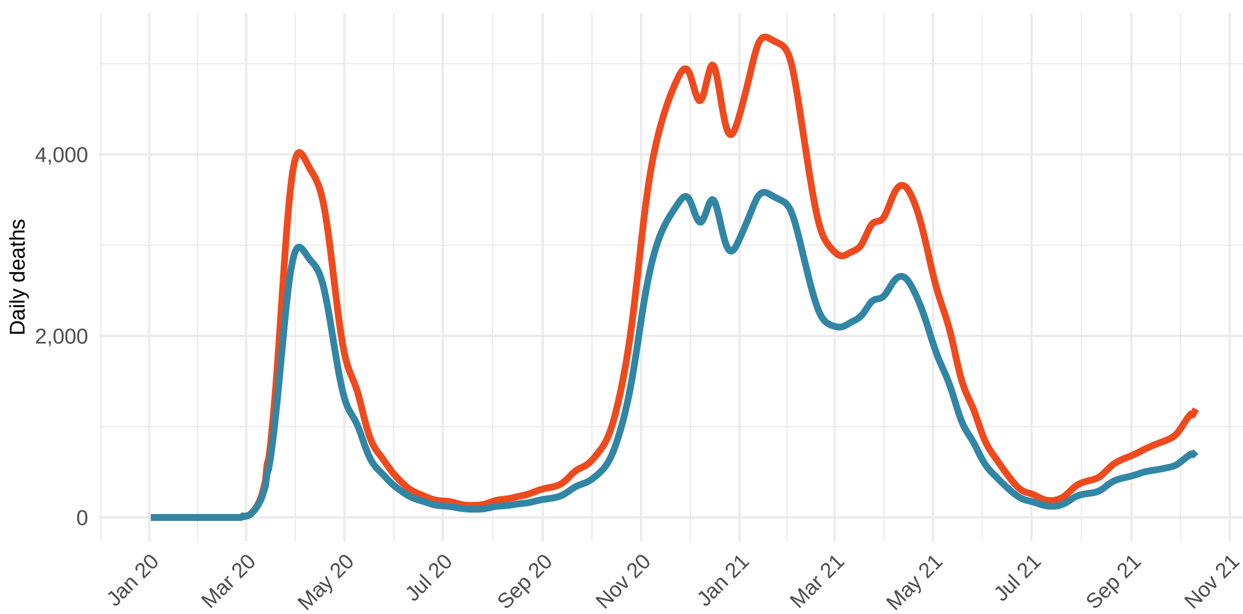
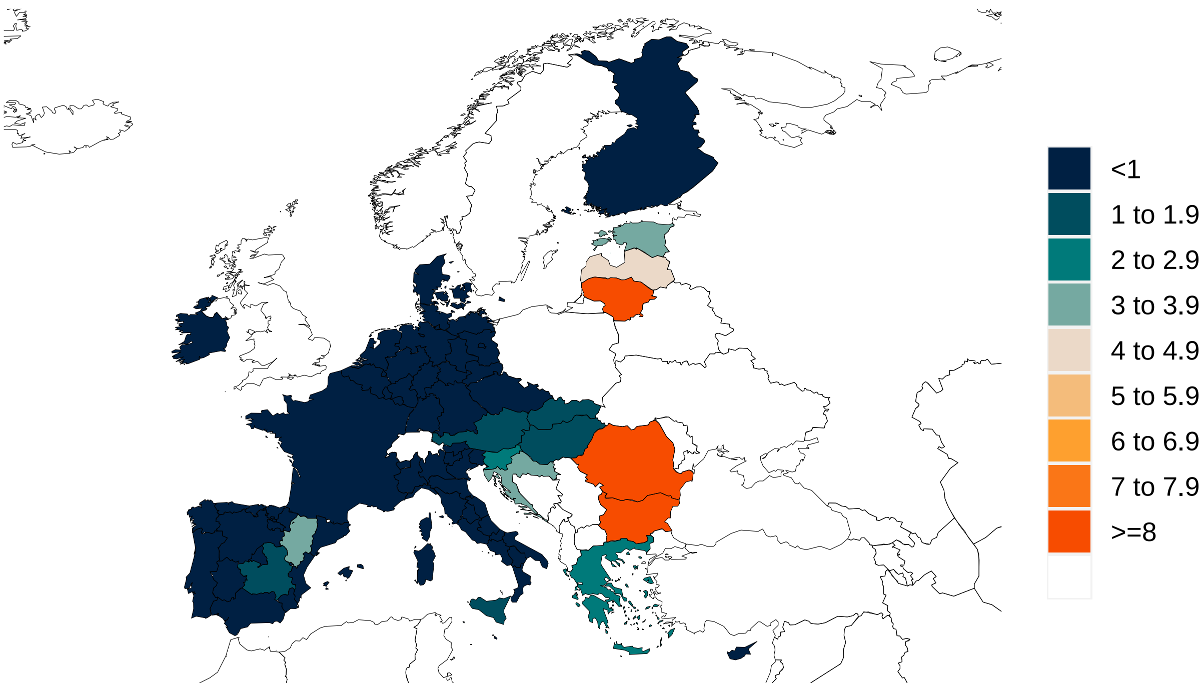


Figure 4. Daily COVID-19 death rate per 1 million on October 11, 2021

A. Daily reported COVID-19 death rate per 1 million



B. Daily total COVID-19 death rate per 1 million

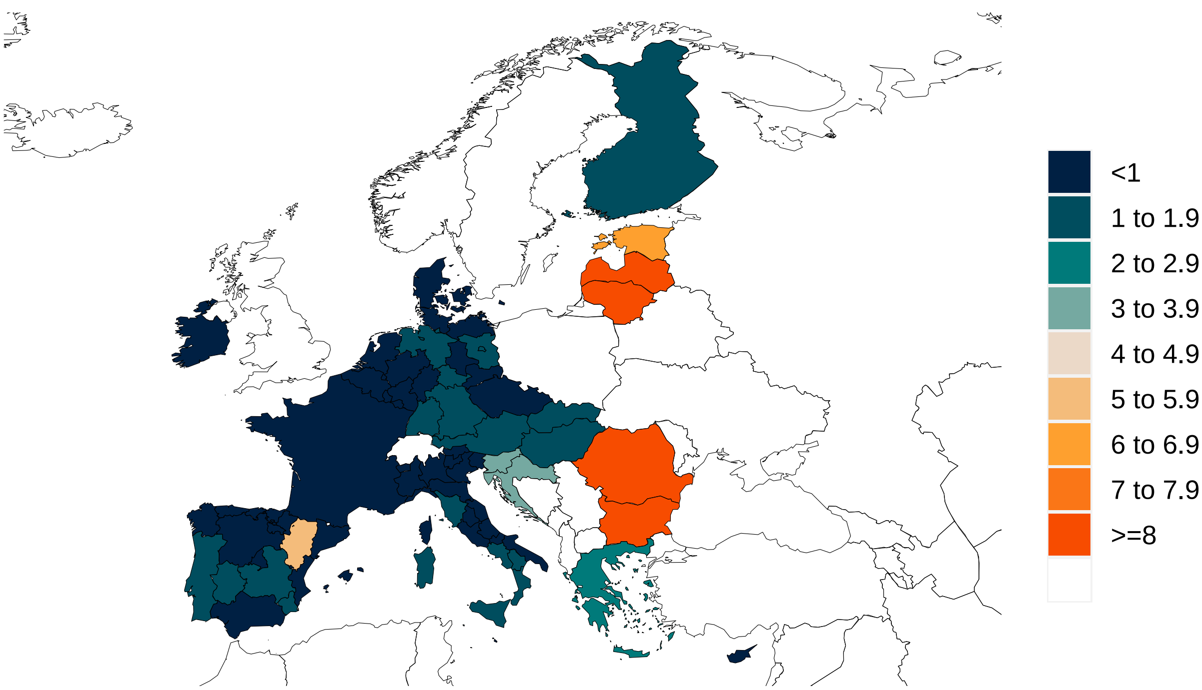
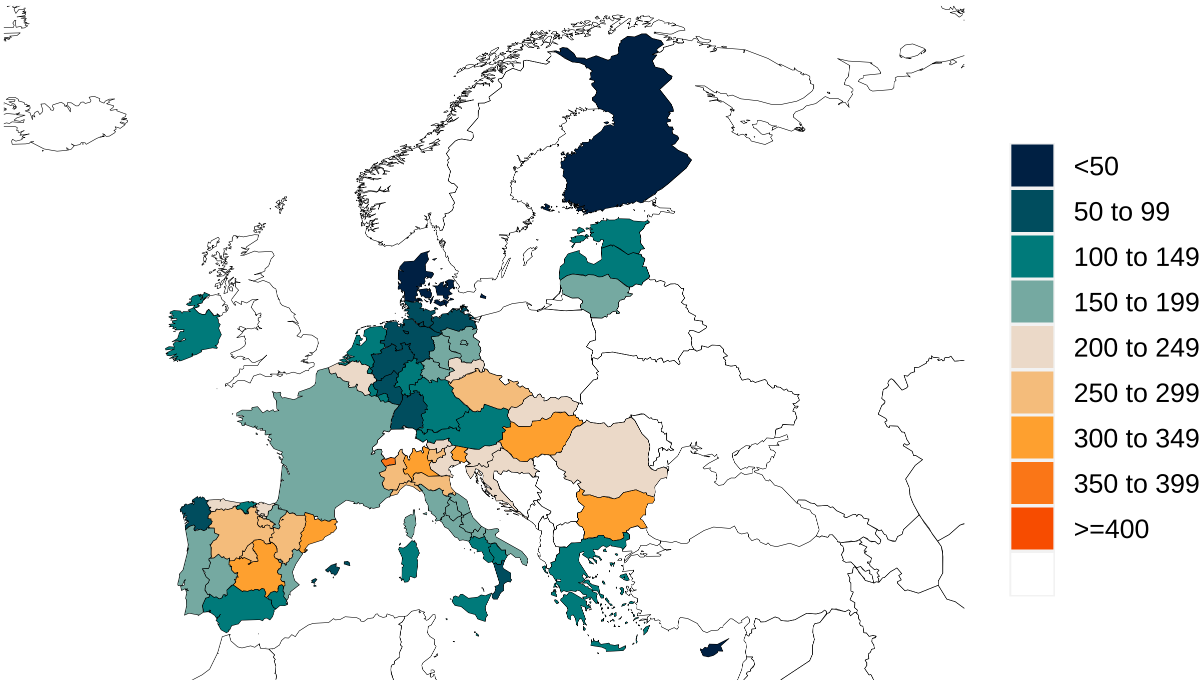


Figure 5. Cumulative COVID-19 deaths per 100,000 on October 11, 2021

A. Reported cumulative COVID-19 deaths per 100,000



B. Total cumulative COVID-19 deaths per 100,000

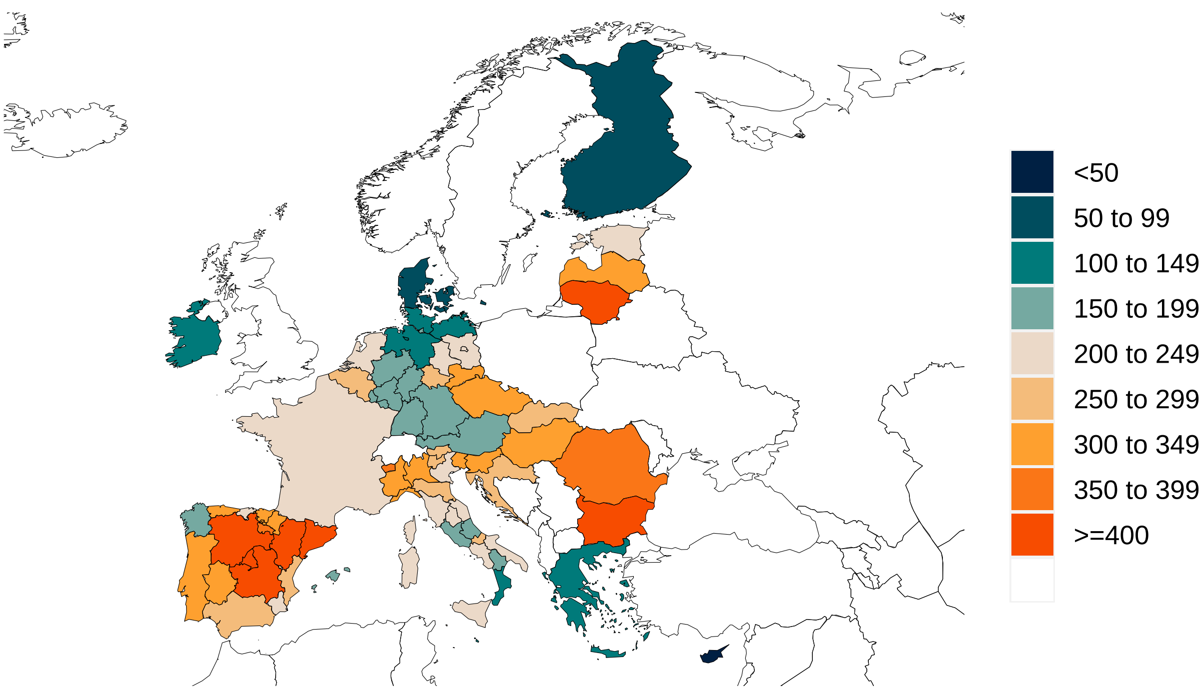


Figure 6. Estimated percent of the population infected with COVID-19 on October 11, 2021

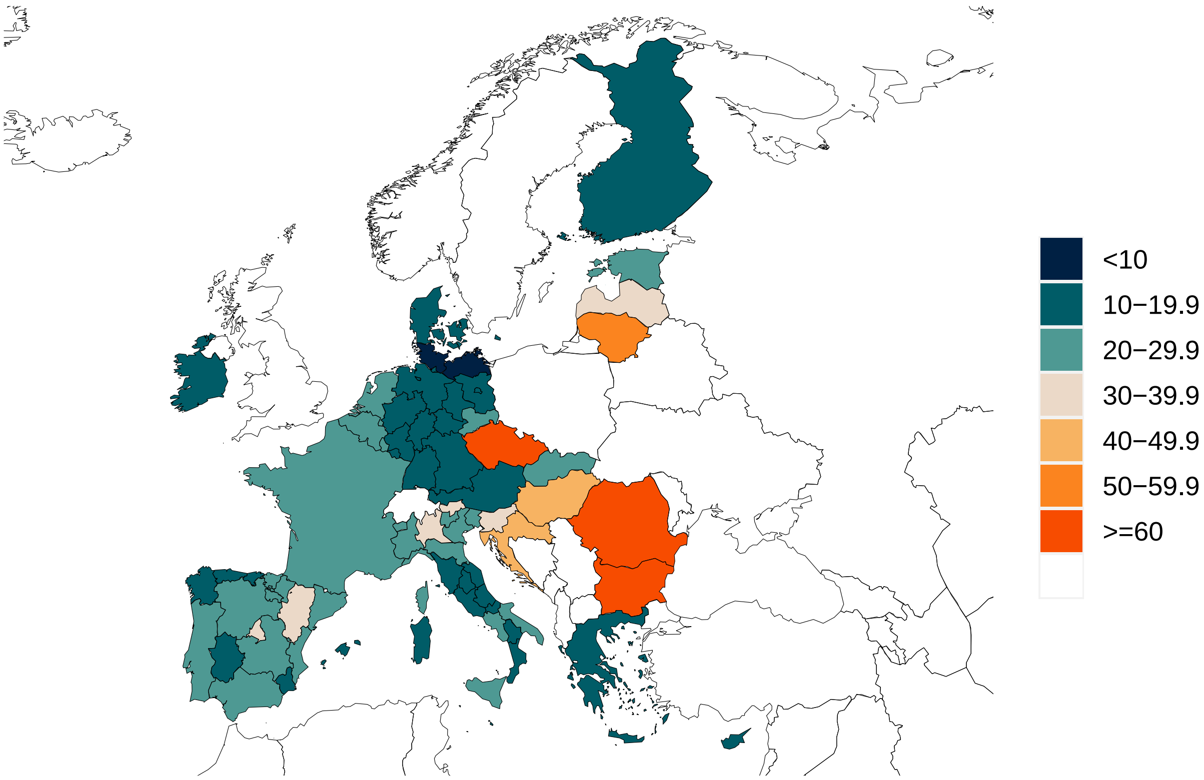


Figure 7. Mean effective R on September 30, 2021. Effective R less than 1 means that transmission should decline, all other things being held the same. The estimate of effective R is based on the combined analysis of deaths, case reporting, and hospitalizations where available. Current reported cases reflect infections 11-13 days prior, so estimates of effective R can only be made for the recent past.

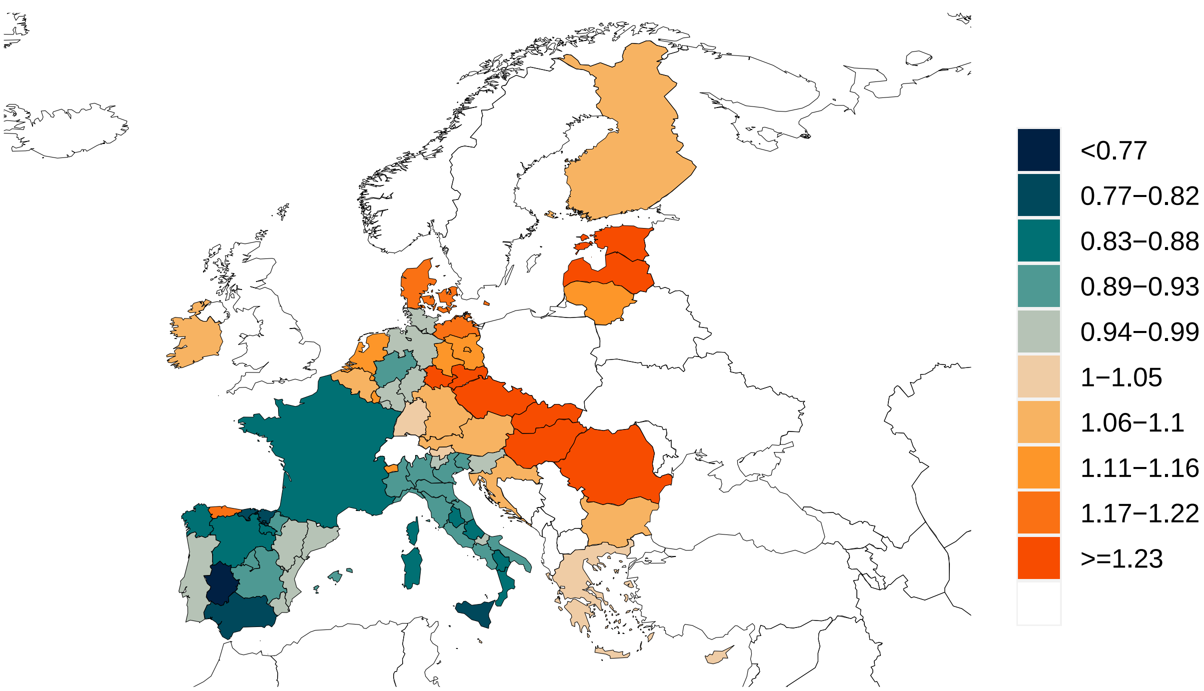


Figure 8. Percent of COVID-19 infections detected. This is estimated as the ratio of reported daily COVID-19 cases to estimated daily COVID-19 infections based on the SEIR disease transmission model. Due to measurement errors in cases and testing rates, the infection-detection rate can exceed 100% at particular points in time.

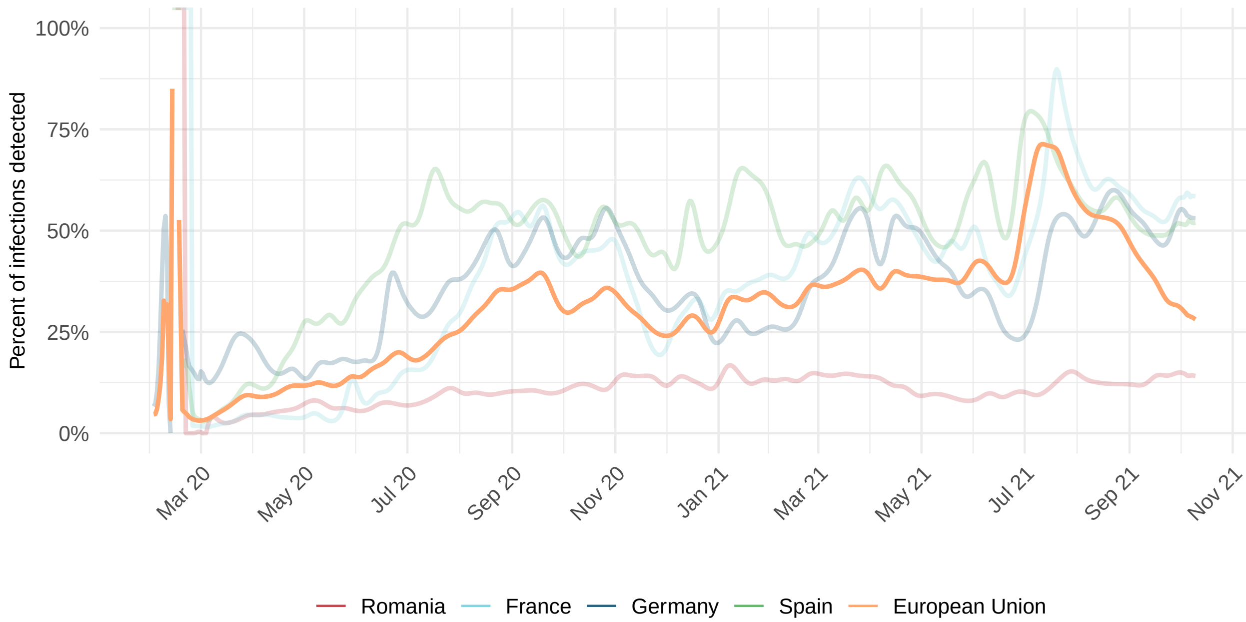
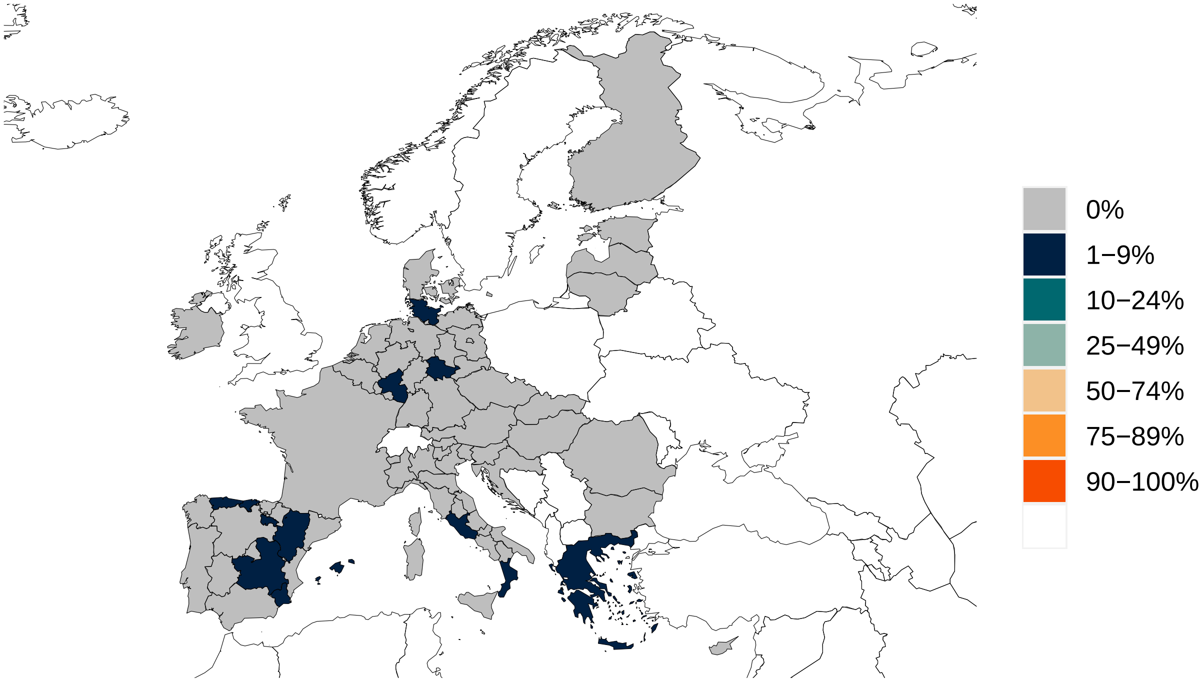
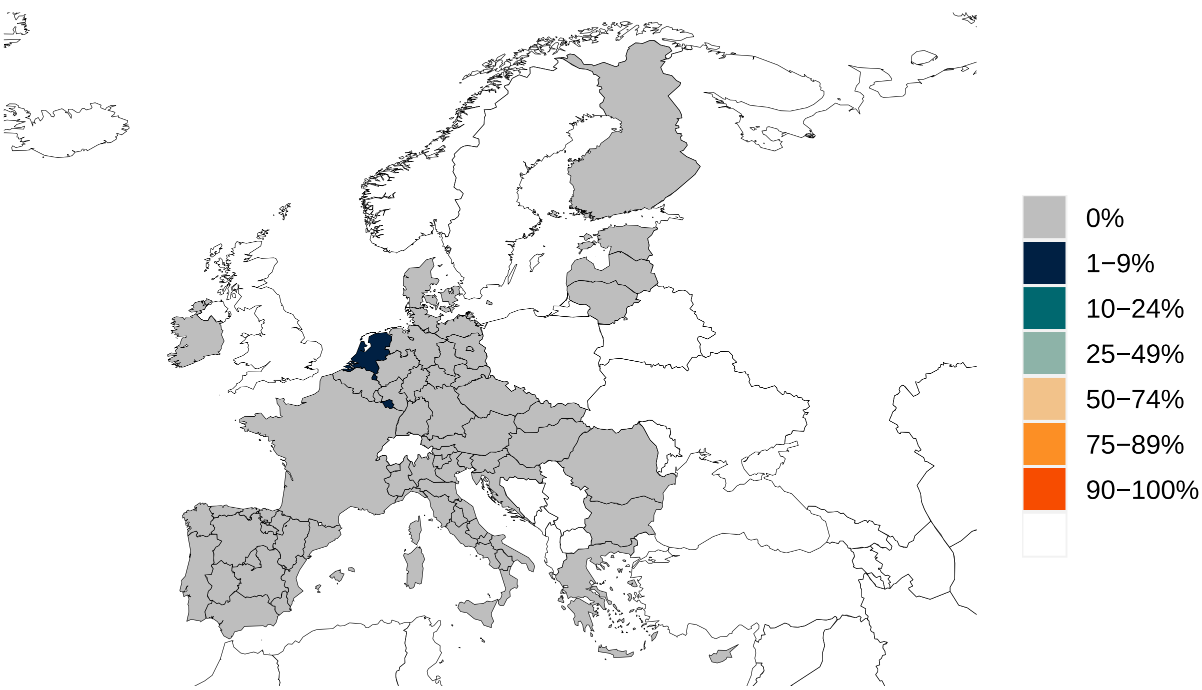


Figure 9. Estimated percent of circulating SARS-CoV-2 for primary variant families on October 11, 2021

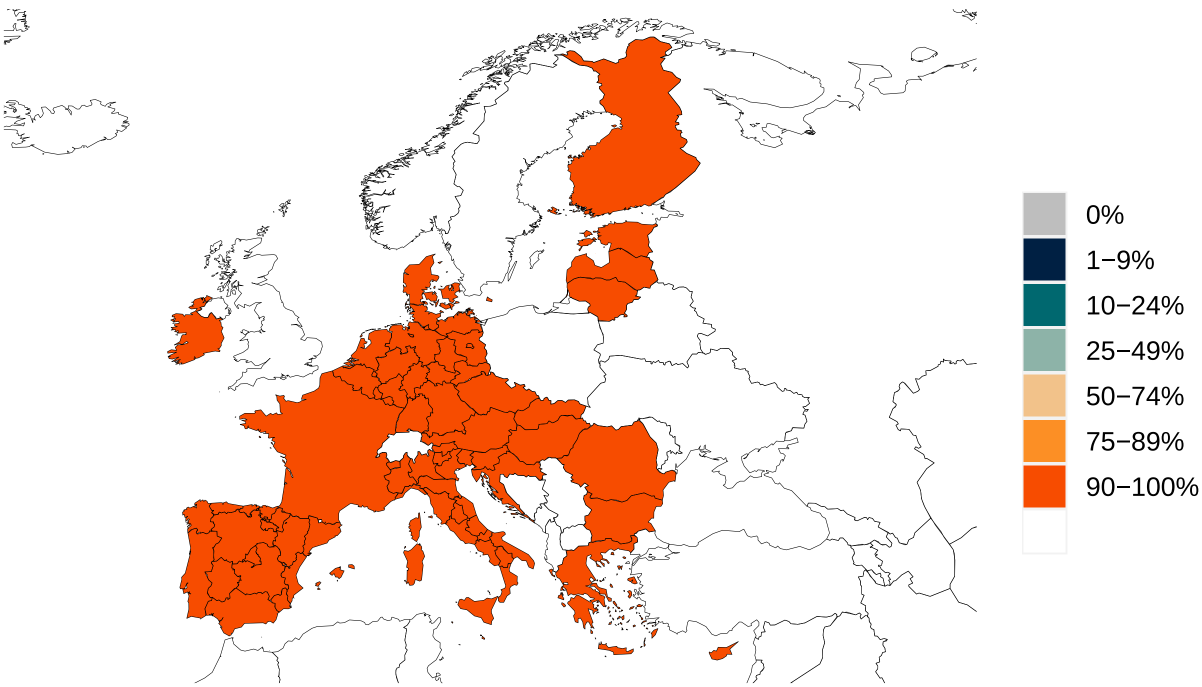
A. Estimated percent Alpha variant



B. Estimated percent Beta variant



C. Estimated percent Delta variant



D. Estimated percent Gamma variant

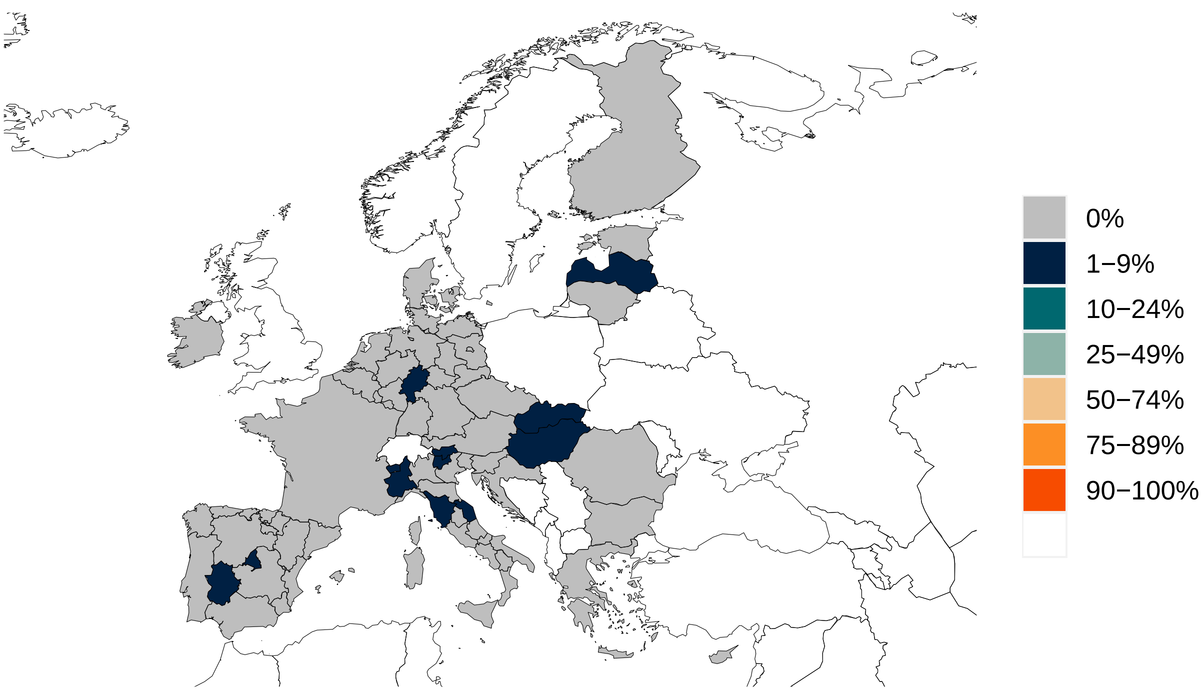


Figure 10. Infection-fatality rate on October 11, 2021. This is estimated as the ratio of COVID-19 deaths to estimated daily COVID-19 infections.

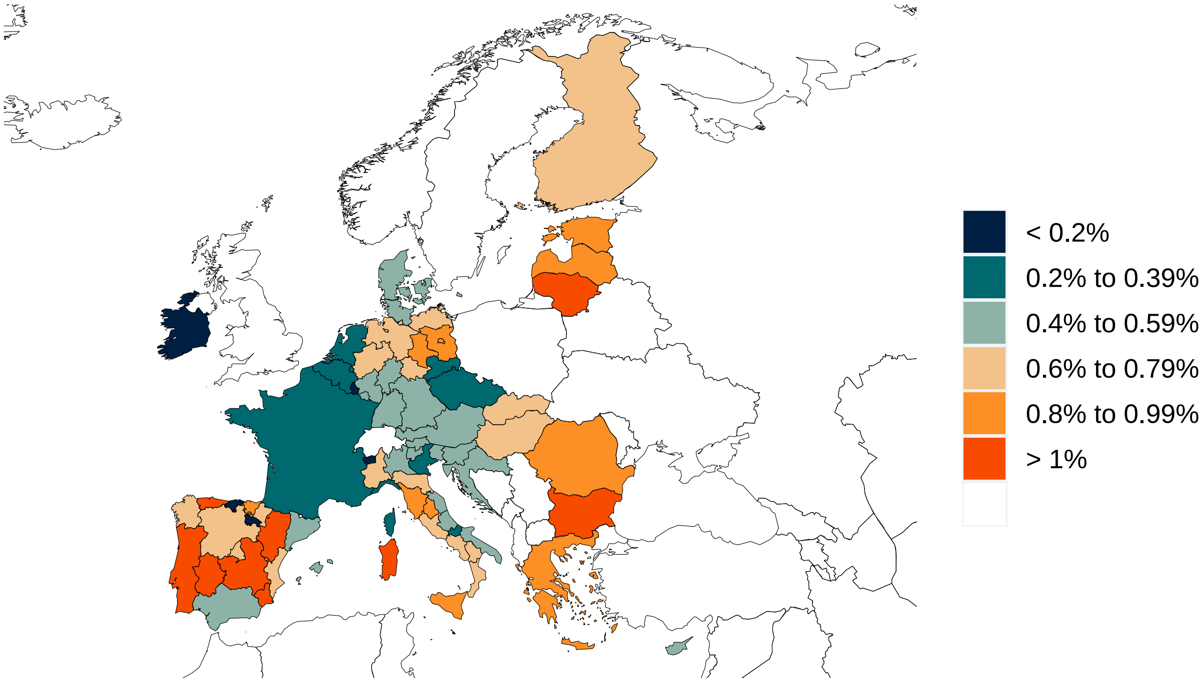


Figure 11. Trend in mobility as measured through smartphone app use, compared to January 2020 baseline

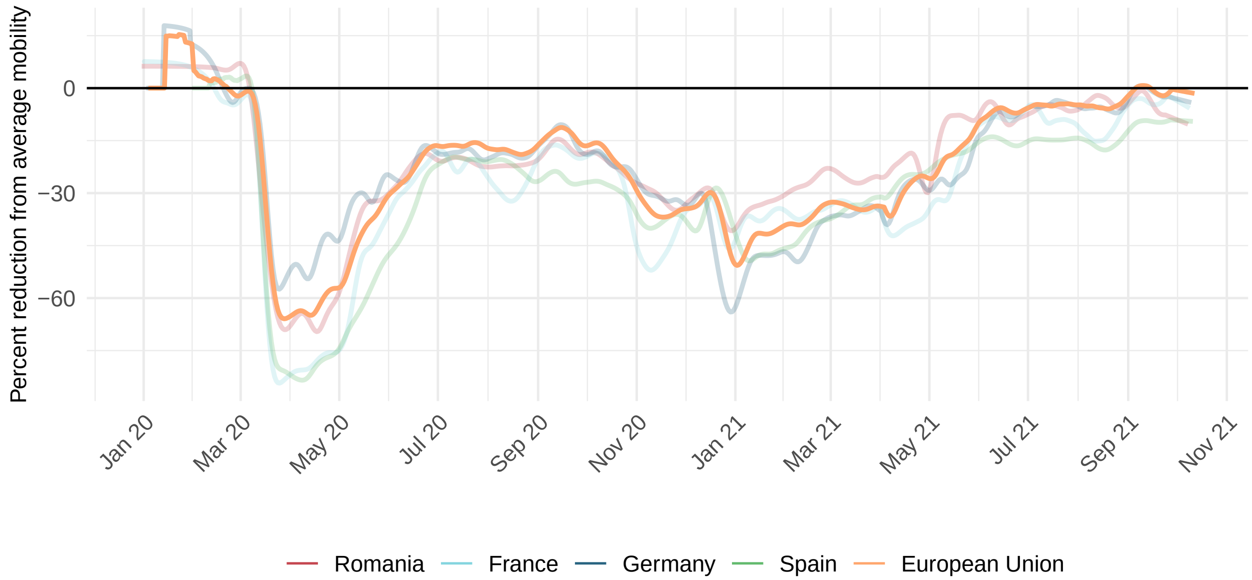


Figure 12. Mobility level as measured through smartphone app use, compared to January 2020 baseline (percent) on October 11, 2021

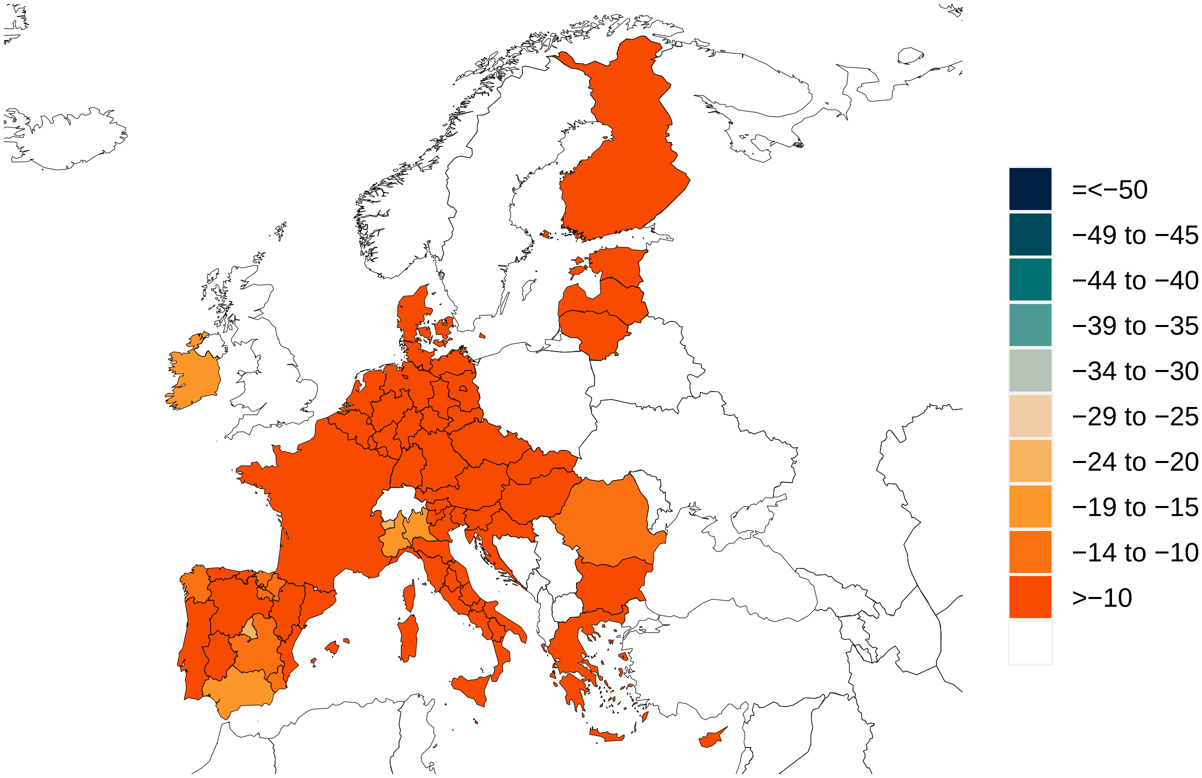


Figure 13. Trend in the proportion of the population reporting always wearing a mask when leaving home

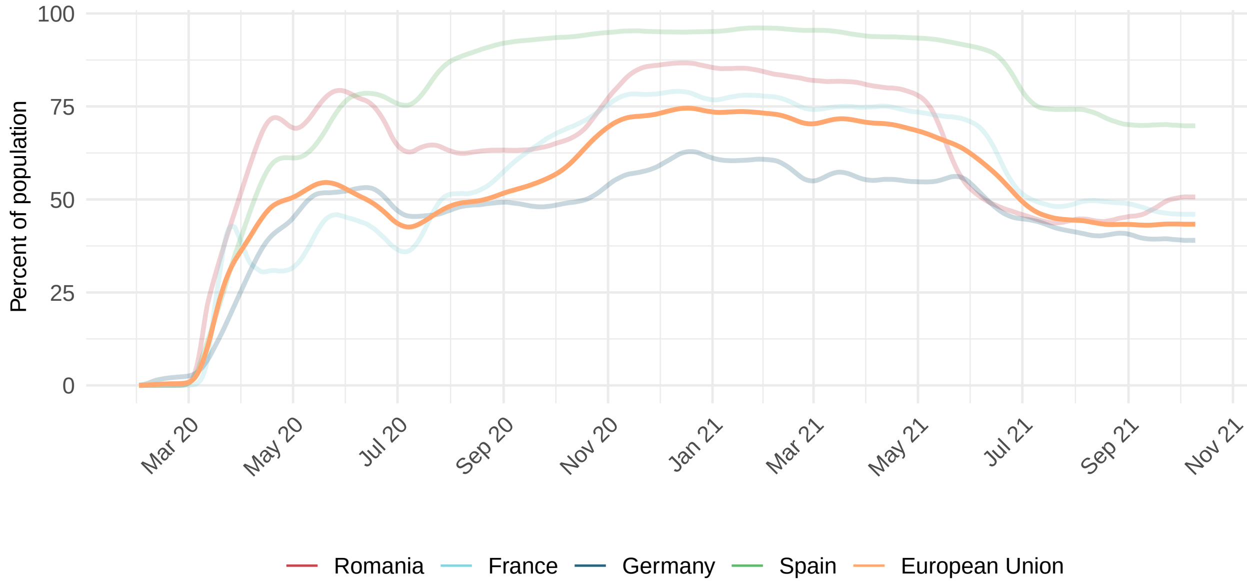


Figure 14. Proportion of the population reporting always wearing a mask when leaving home on October 11, 2021

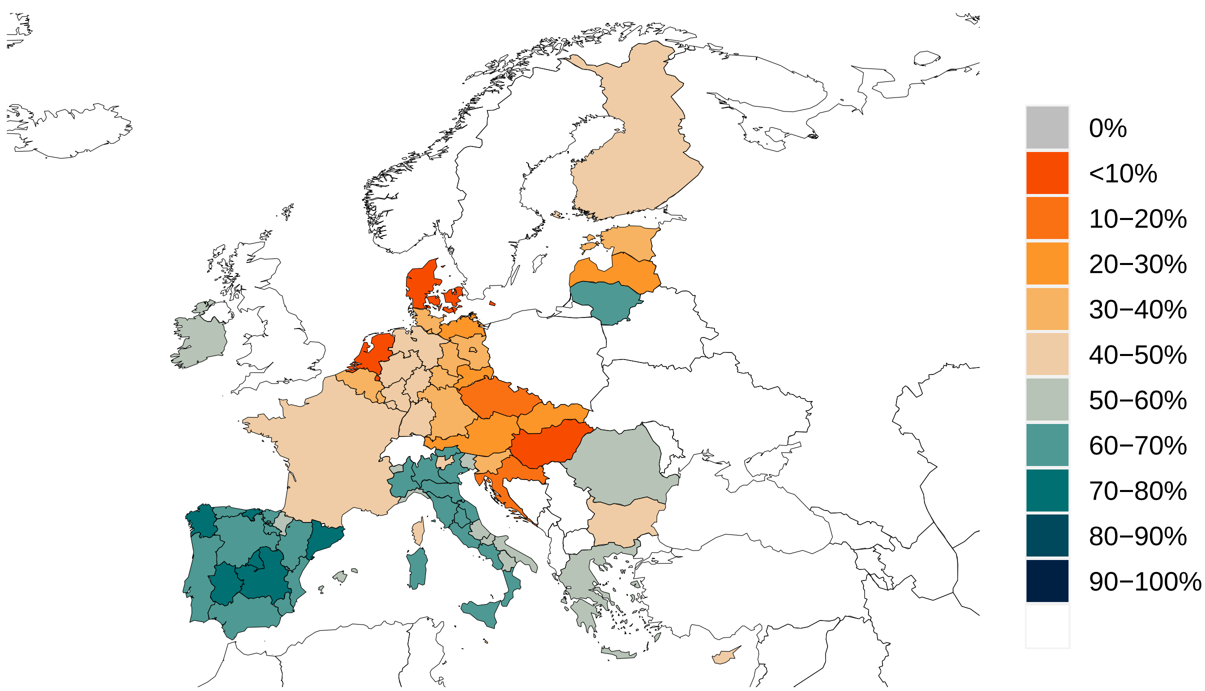


Figure 15. Trend in COVID-19 diagnostic tests per 100,000 people

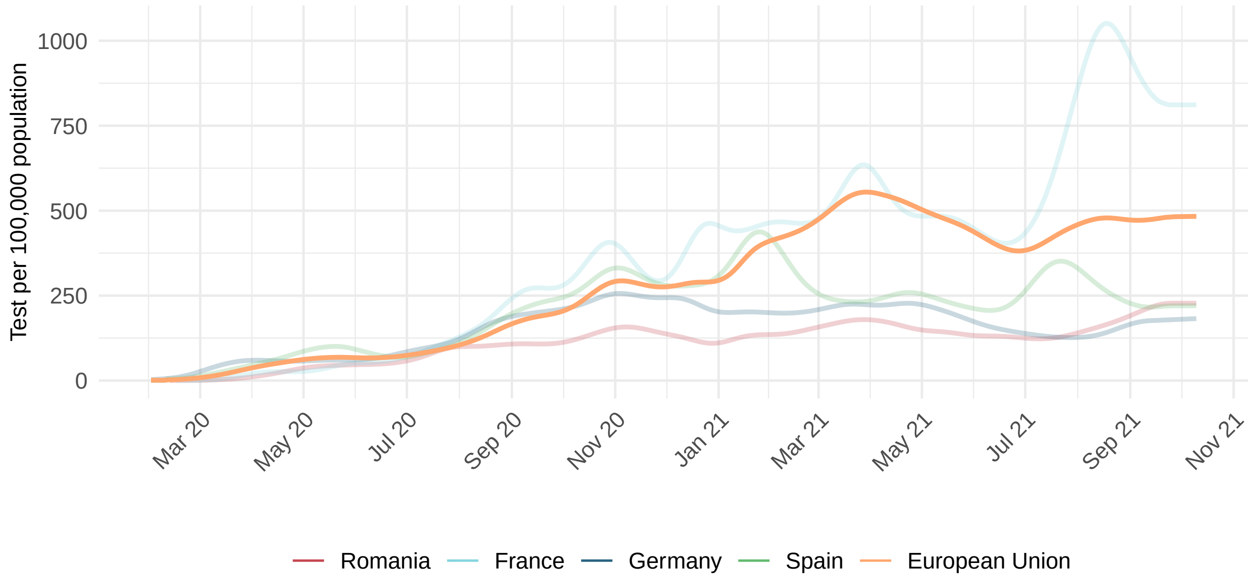


Figure 16. COVID-19 diagnostic tests per 100,000 people on October 11, 2021

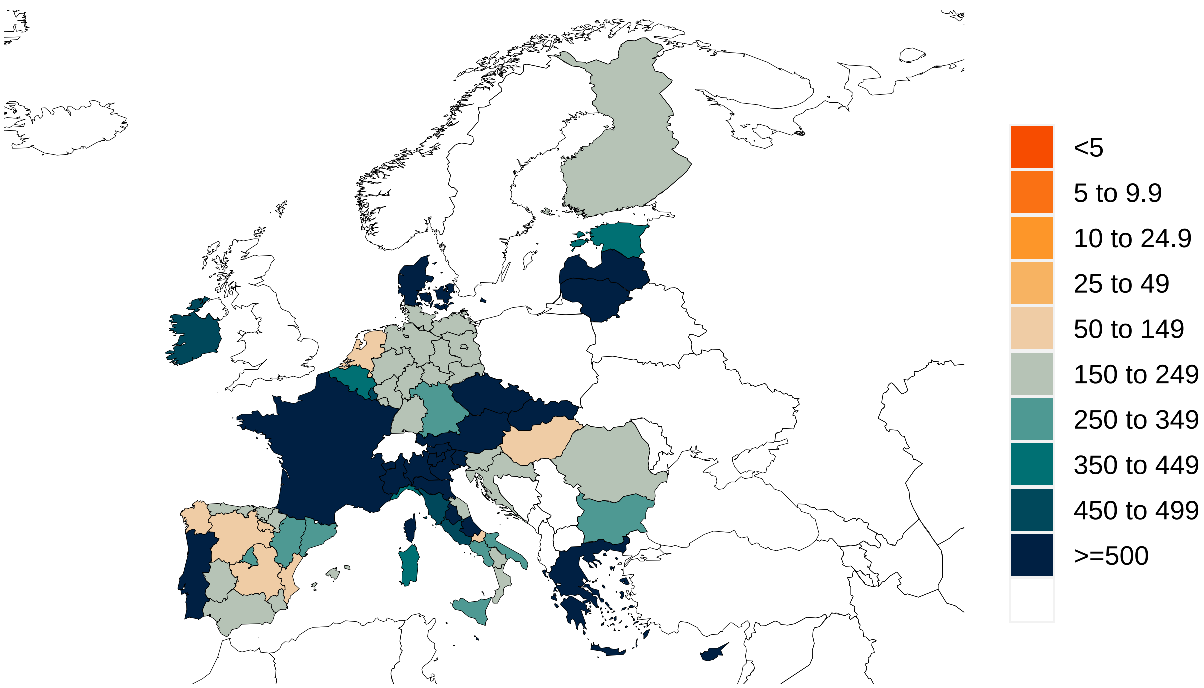
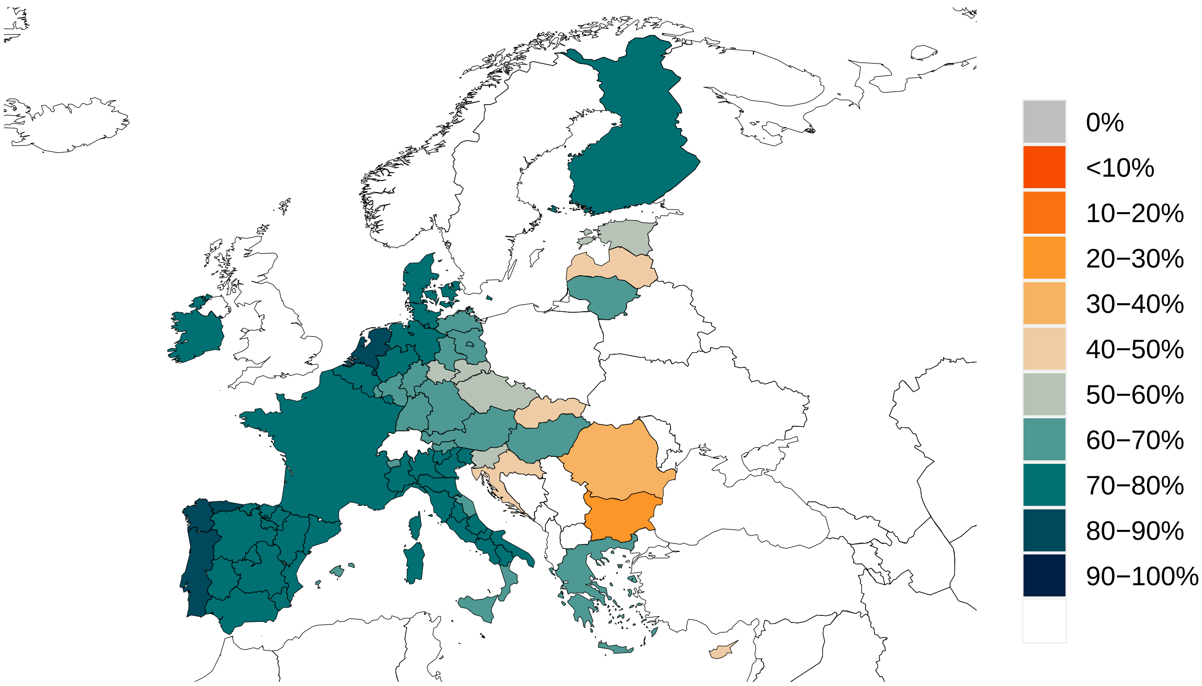


Table 3. Estimates of vaccine efficacy for specific vaccines used in the model at preventing disease and infection. The SEIR model uses variant-specific estimates of vaccine efficacy at preventing symptomatic disease and at preventing infection. We use data from clinical trials directly, where available, and make estimates otherwise. More information can be found on our website.

Vaccine	Efficacy at preventing disease: ancestral and Alpha	Efficacy at preventing infection: ancestral and Alpha	Efficacy at preventing disease: Beta, Delta, & Gamma	Efficacy at preventing infection: Beta, Delta, & Gamma
AstraZeneca	90%	52%	85%	49%
CoronaVac	50%	44%	43%	38%
Covaxin	78%	69%	68%	60%
Johnson & Johnson	86%	72%	60%	56%
Moderna	94%	89%	94%	80%
Novavax	89%	79%	79%	69%
Pfizer/BioNTech	94%	86%	85%	78%
Sinopharm	73%	65%	63%	56%
Sputnik-V	92%	81%	80%	70%
Tianjin CanSino	66%	58%	57%	50%
Other vaccines	75%	66%	65%	57%
Other vaccines (mRNA)	91%	86%	85%	78%

Figure 17. Percent of the population (A) having received at least one dose and (B) fully vaccinated against SARS-CoV-2 by October 11, 2021

A. Percent of the population having received one dose of a COVID-19 vaccine



B. Percent of the population fully vaccinated against SARS-CoV-2

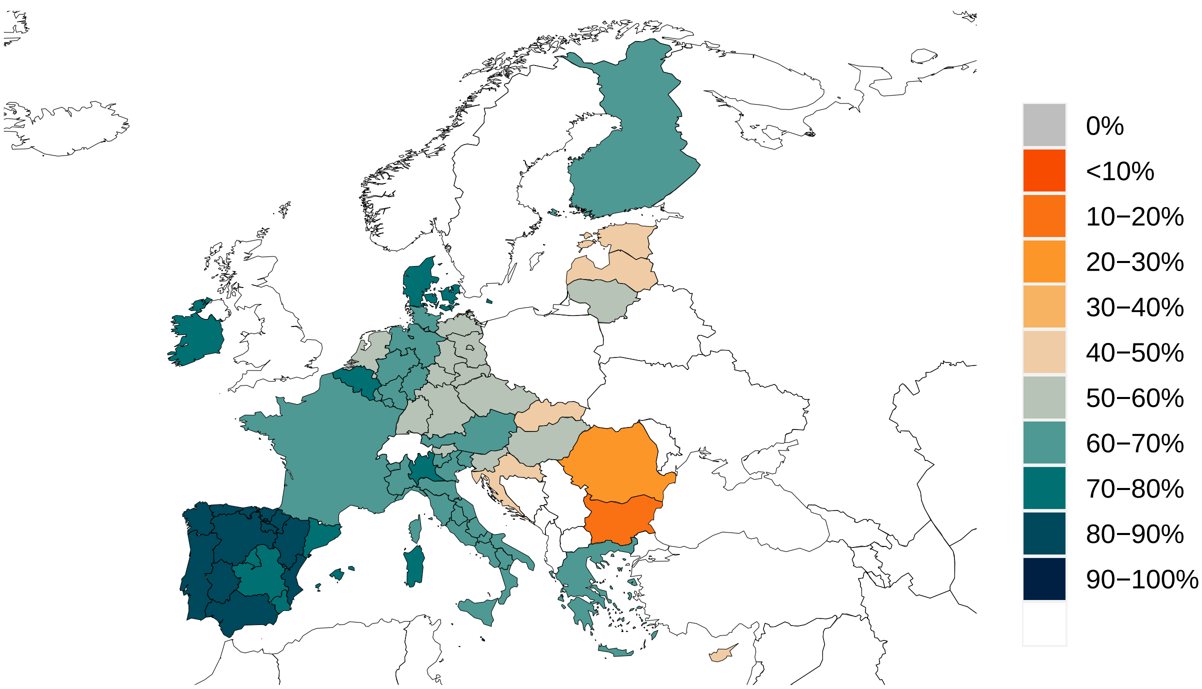


Figure 18. Trend in the estimated proportion of the population that is 12 years and older that has been vaccinated or would probably or definitely receive the COVID-19 vaccine if available. Note that vaccine acceptance is calculated using survey data from the 18+ population.

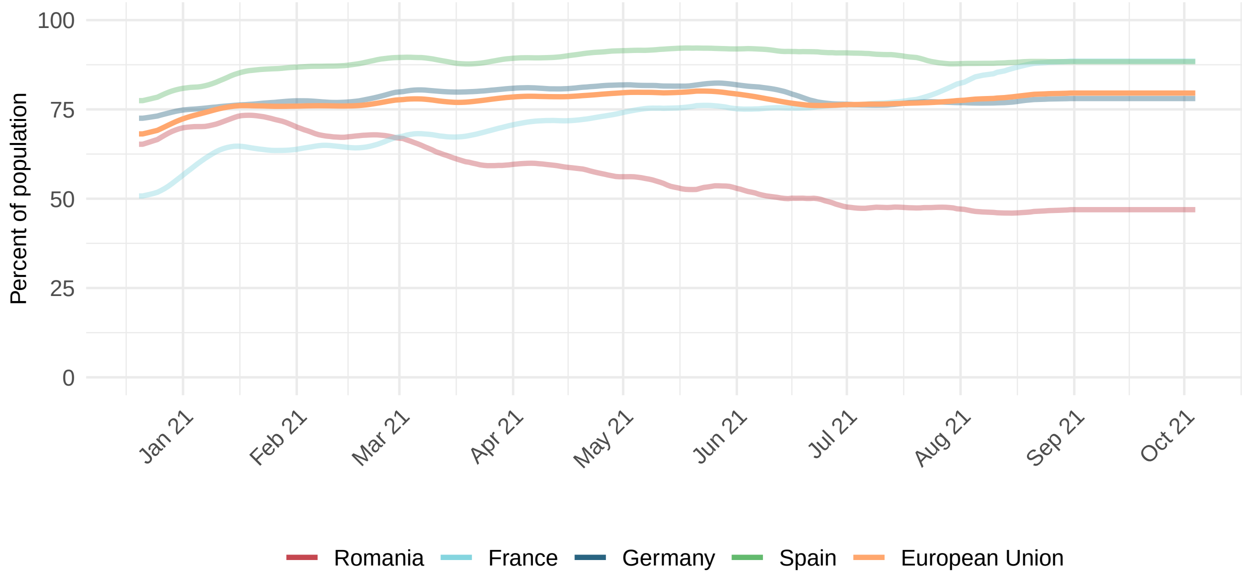


Figure 19. Estimated proportion of the population that is 12 years and older that has been vaccinated or would probably or definitely receive the COVID-19 vaccine if available. Note that vaccine acceptance is calculated using survey data from the 18+ population.

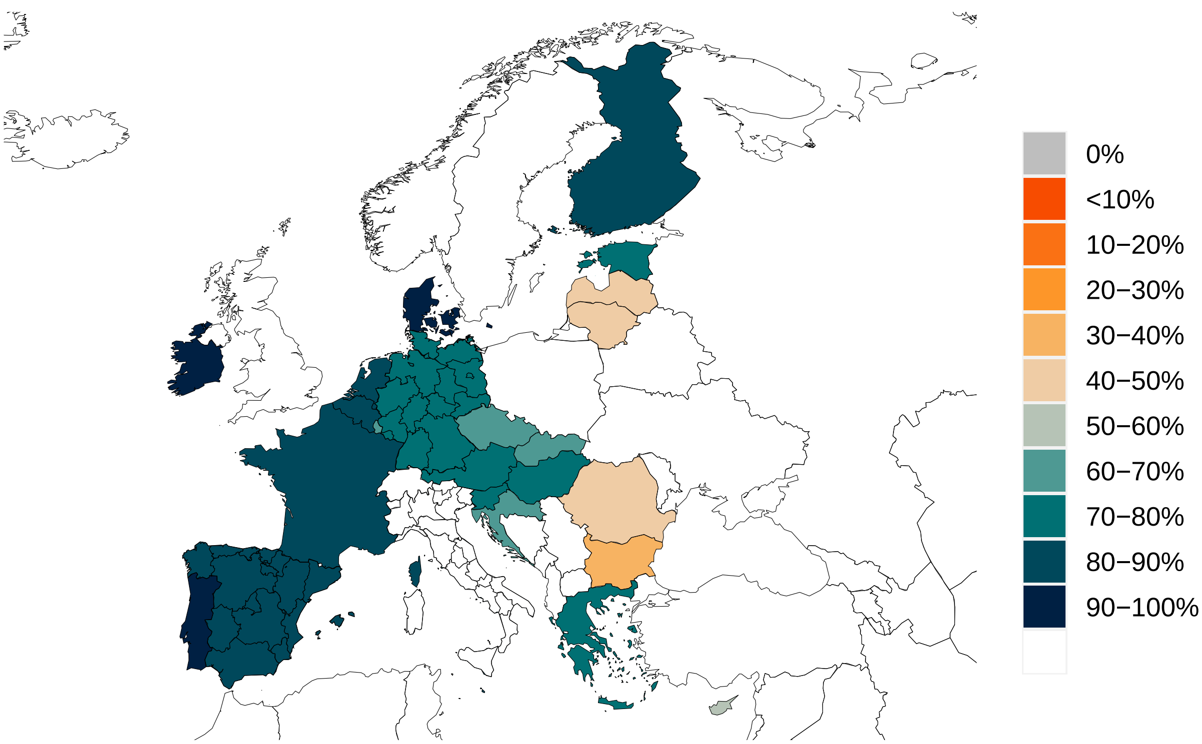


Figure 20. Percent of people who receive at least one dose of a COVID-19 vaccine and those who are fully vaccinated

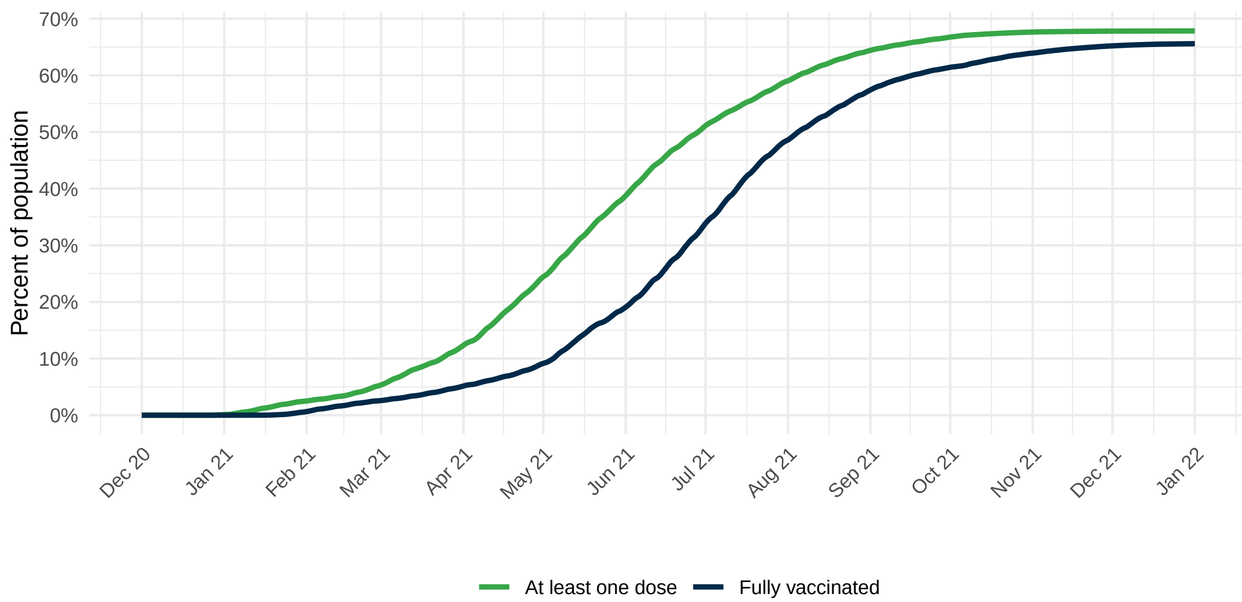
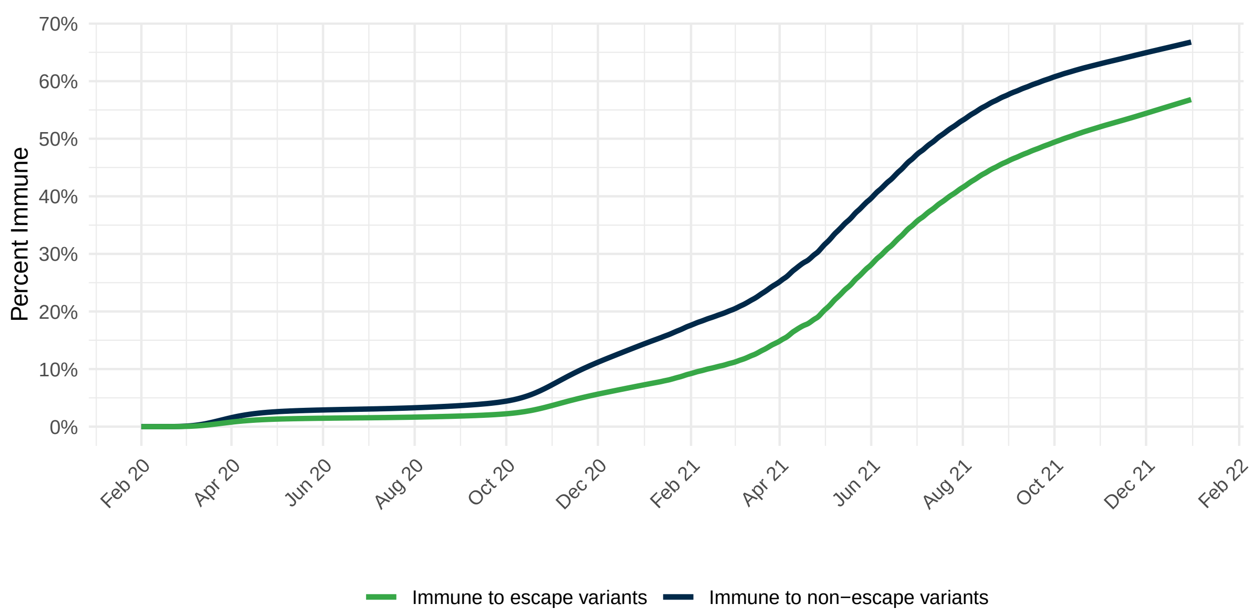


Figure 21. Percentage of people who are immune to non-escape variants and the percentage of people who are immune to escape variants



Projections and scenarios

We produce three scenarios when projecting COVID-19. The **reference scenario** is our forecast of what we think is most likely to happen:

- Vaccines are distributed at the expected pace. Brand- and variant-specific vaccine efficacy is updated using the latest available information from peer-reviewed publications and other reports.
- Future mask use is the mean of mask use over the last 7 days.
- Mobility increases as vaccine coverage increases.
- Governments adapt their response by re-imposing social distancing mandates for 6 weeks whenever daily deaths reach 8 per million, unless a location has already spent at least 7 of the last 14 days with daily deaths above this rate, and not yet re-imposed social distancing mandates. In this case, the reference scenario assumes that mandates are re-imposed when daily deaths reach 15 per million.
- Variants Alpha, Beta, Gamma, and Delta continue to spread regionally and globally from locations with sufficient transmission.

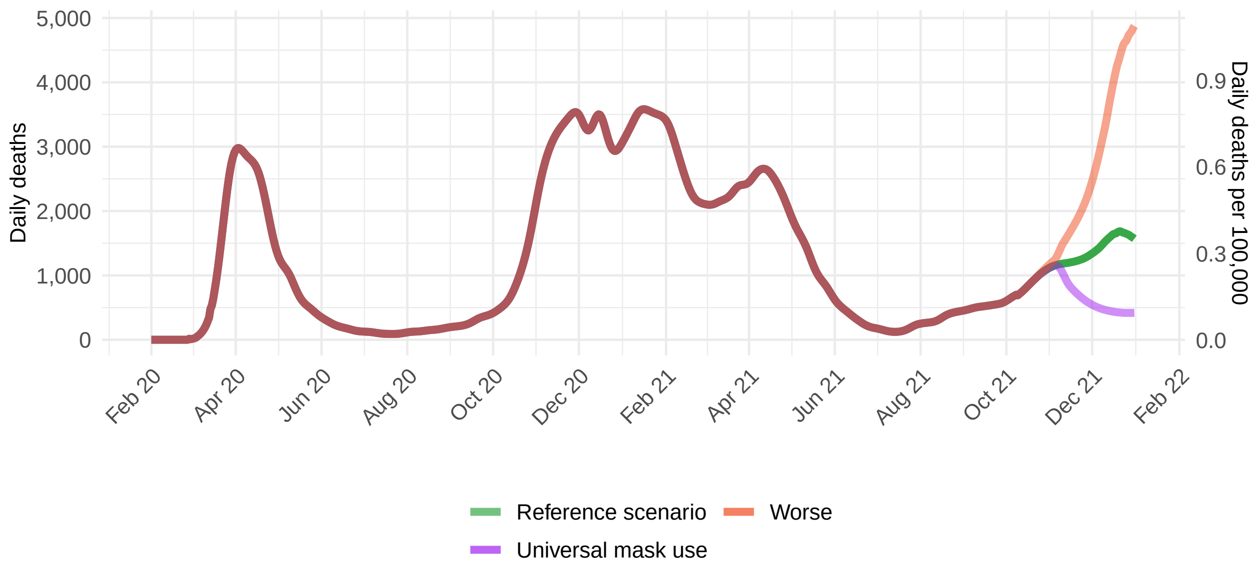
The **worse scenario** modifies the reference scenario assumption in four ways:

- 100% of vaccinated individuals stop using masks.
- Mobility increases in all locations to 25% above the pre-pandemic winter baseline, irrespective of vaccine coverage.
- Governments are more reluctant to re-impose social distancing mandates, waiting until the daily death rate reaches 15 per million, unless a location has already spent at least 7 of the last 14 days with daily deaths above this rate, and not yet re-imposed social distancing mandates. In this case, the reference scenario assumes that mandates are re-imposed when daily deaths reach 38 per million. In either case, we assume social distancing mandates remain in effect for 6 weeks.
- Variants Alpha, Beta, Gamma, and Delta spread between locations twice as fast when compared with our reference scenario.

The **universal masks scenario** makes all the same assumptions as the reference scenario but assumes all locations reach 95% mask use within 7 days.

Figure 22. Daily COVID-19 deaths until January 01, 2022 for three scenarios

A. Reported daily COVID-19 deaths per 100,000



B. Total daily COVID-19 deaths per 100,000

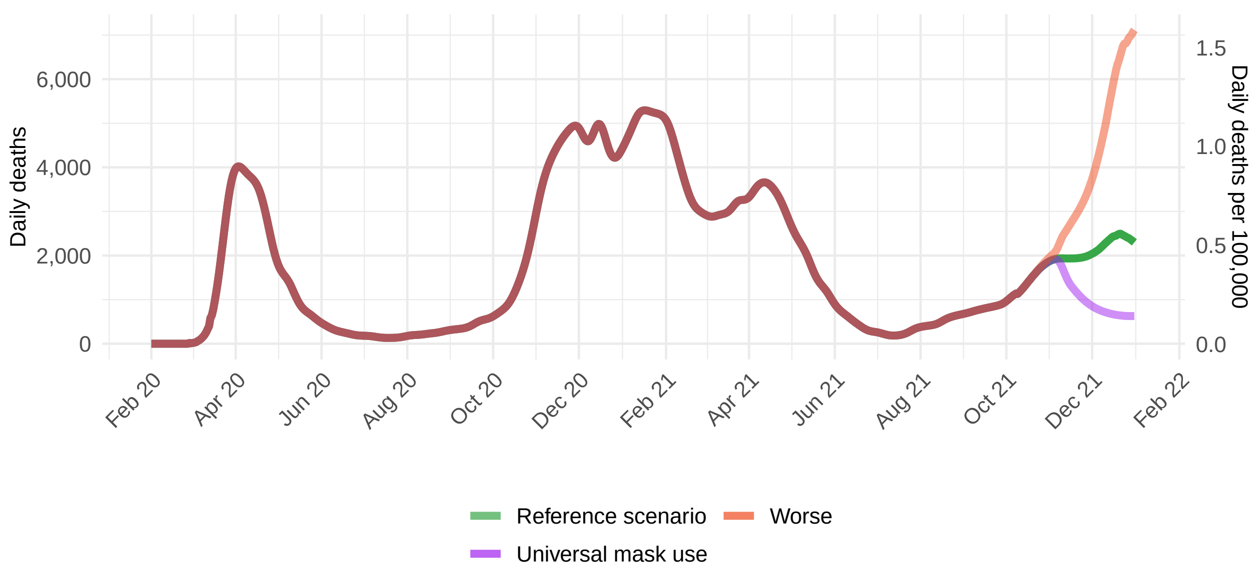


Figure 23. Daily COVID-19 infections until January 01, 2022 for three scenarios

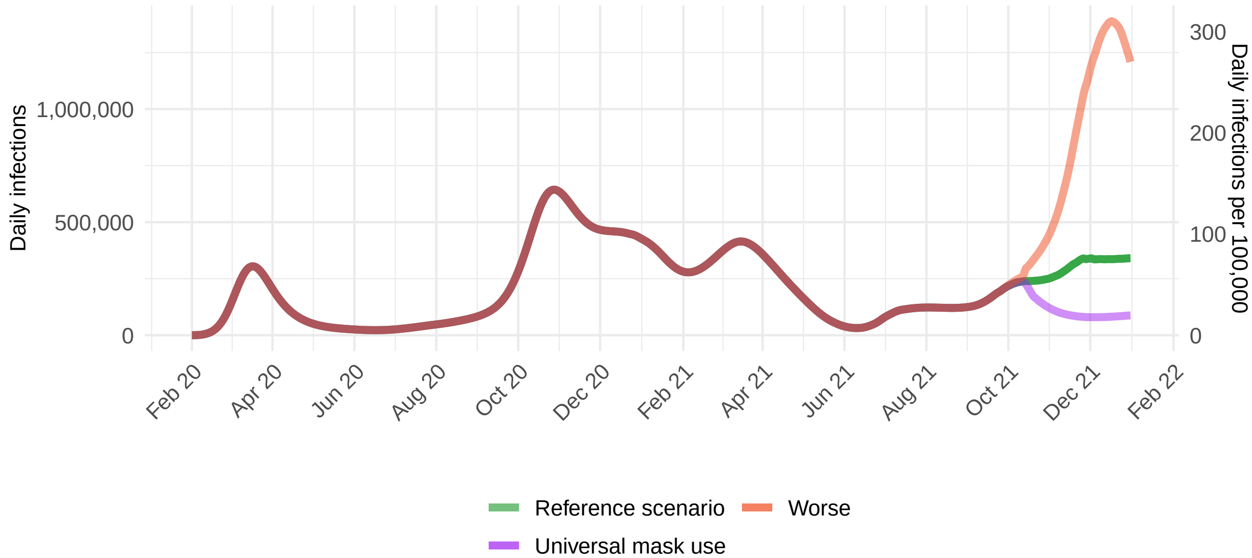


Figure 24. Daily COVID-19 reported cases until January 01, 2022 for three scenarios

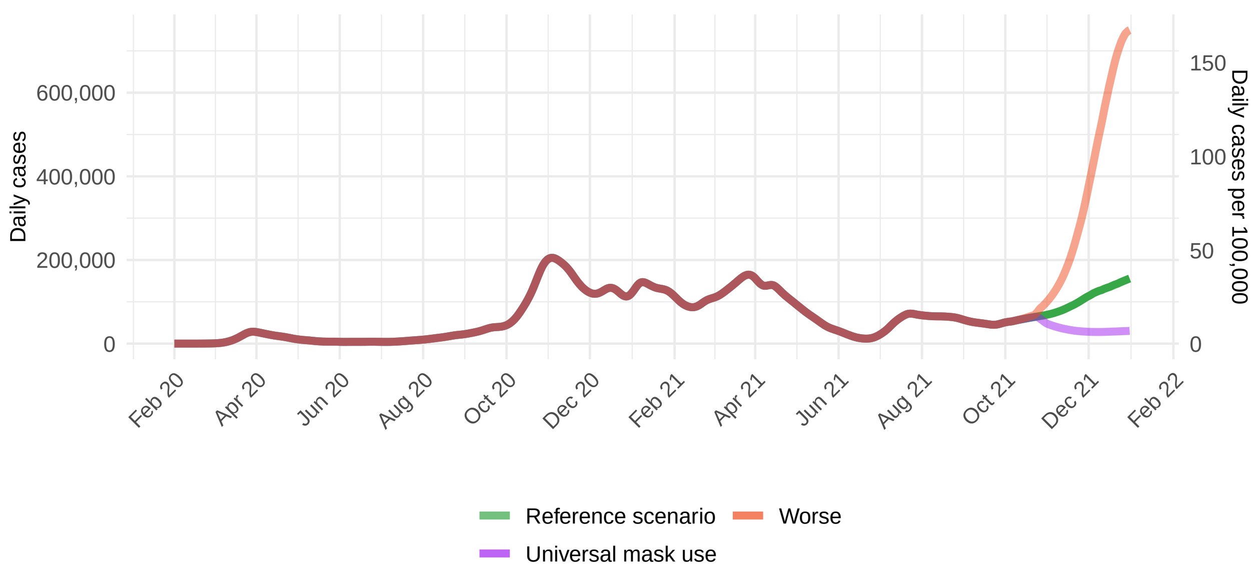


Figure 25. Daily COVID-19 hospital census until January 01, 2022 for three scenarios

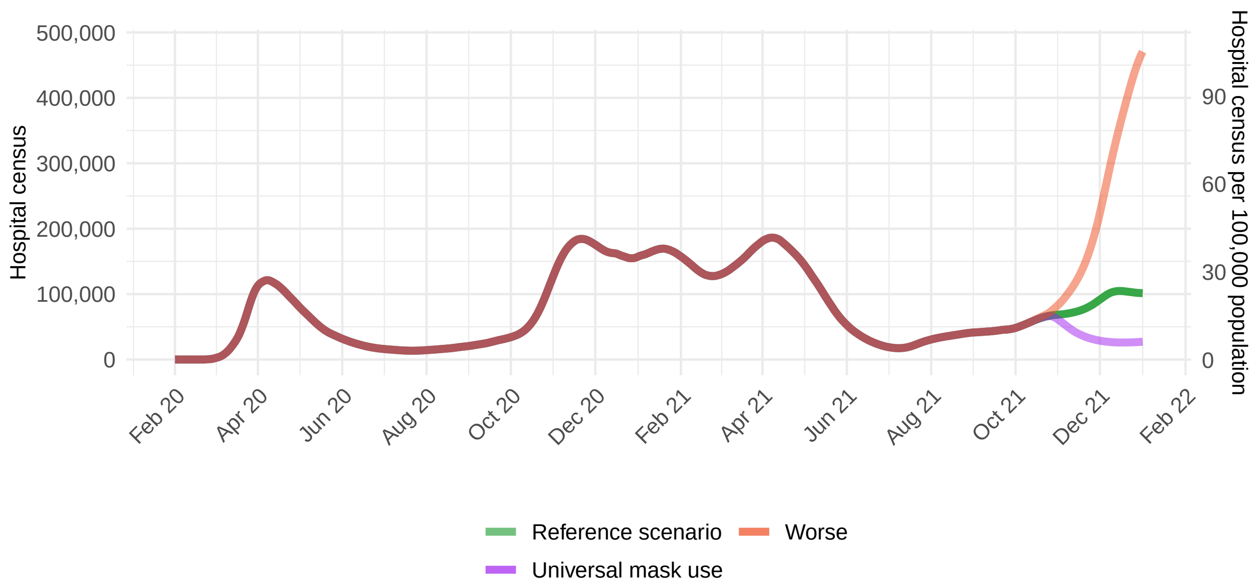


Figure 26. Comparison of reference model projections with other COVID modeling groups. For this comparison, we are including projections of daily COVID-19 deaths from other modeling groups when available, last model update in brackets: Delphi from the Massachusetts Institute of Technology (Delphi) October 15, 2021, Imperial College London (Imperial) [October 6, 2021], The Los Alamos National Laboratory (LANL) [September 26, 2021], the SI-KJalpha model from the University of Southern California (SIKJalpha) October 15, 2021, and the ECDC Ensemble Model (ECDC) [October 11, 2021]. Daily deaths from other modeling groups are smoothed to remove inconsistencies with rounding. Regional values are aggregates from available locations in that region.

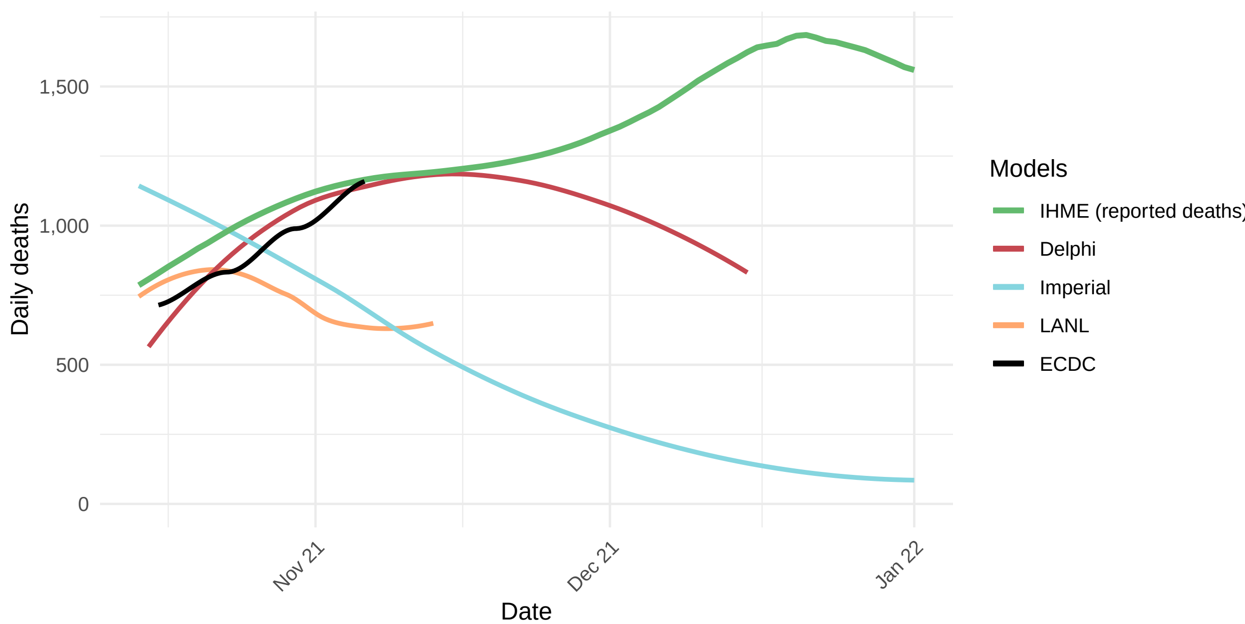


Figure 27. The estimated inpatient hospital usage is shown over time. The percent of hospital beds occupied by COVID-19 patients is color-coded based on observed quantiles of the maximum proportion of beds occupied by COVID-19 patients. Less than 5% is considered *low stress*, 5-9% is considered *moderate stress*, 10-19% is considered *high stress*, and 20% or greater is considered *extreme stress*.

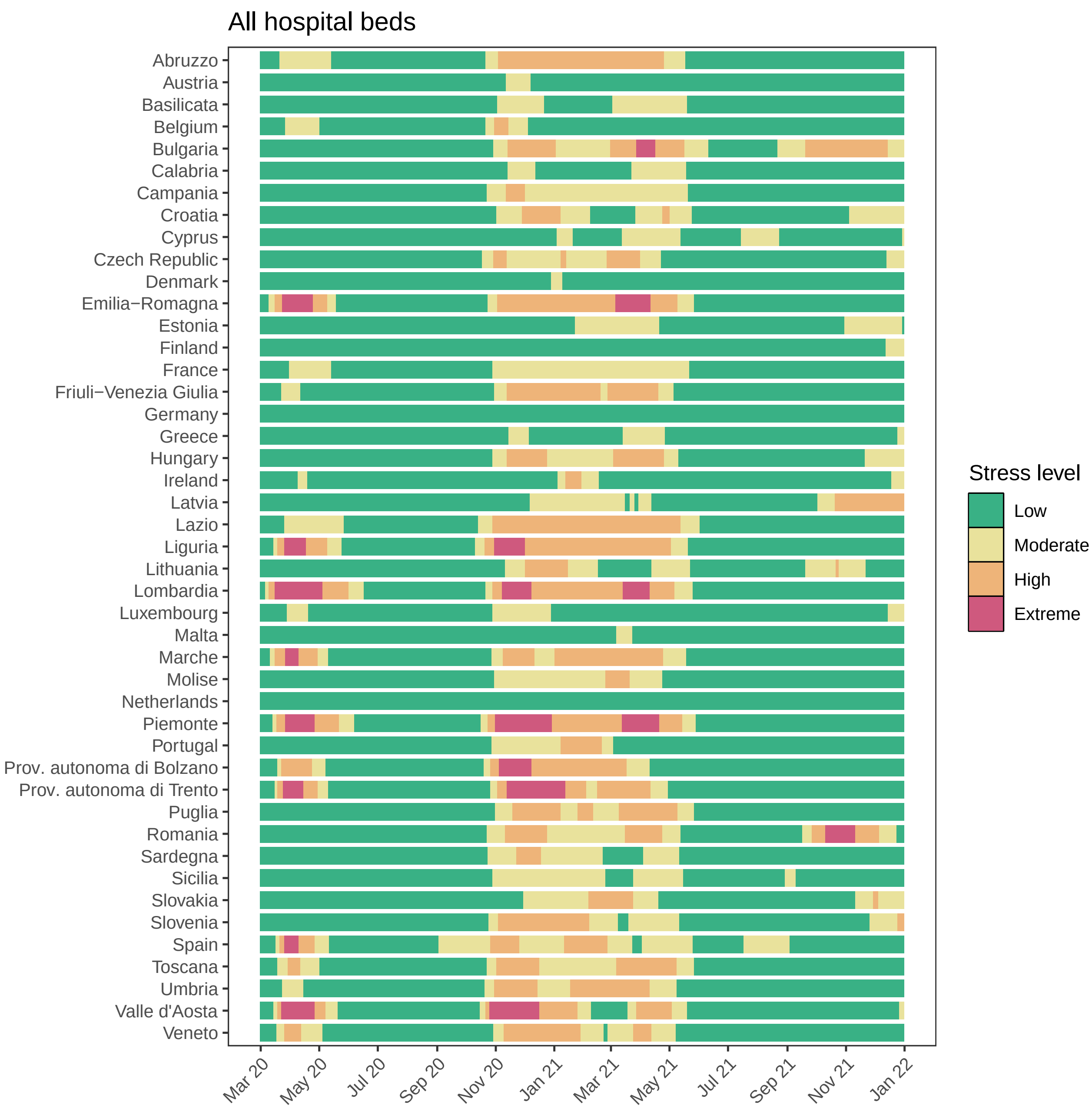
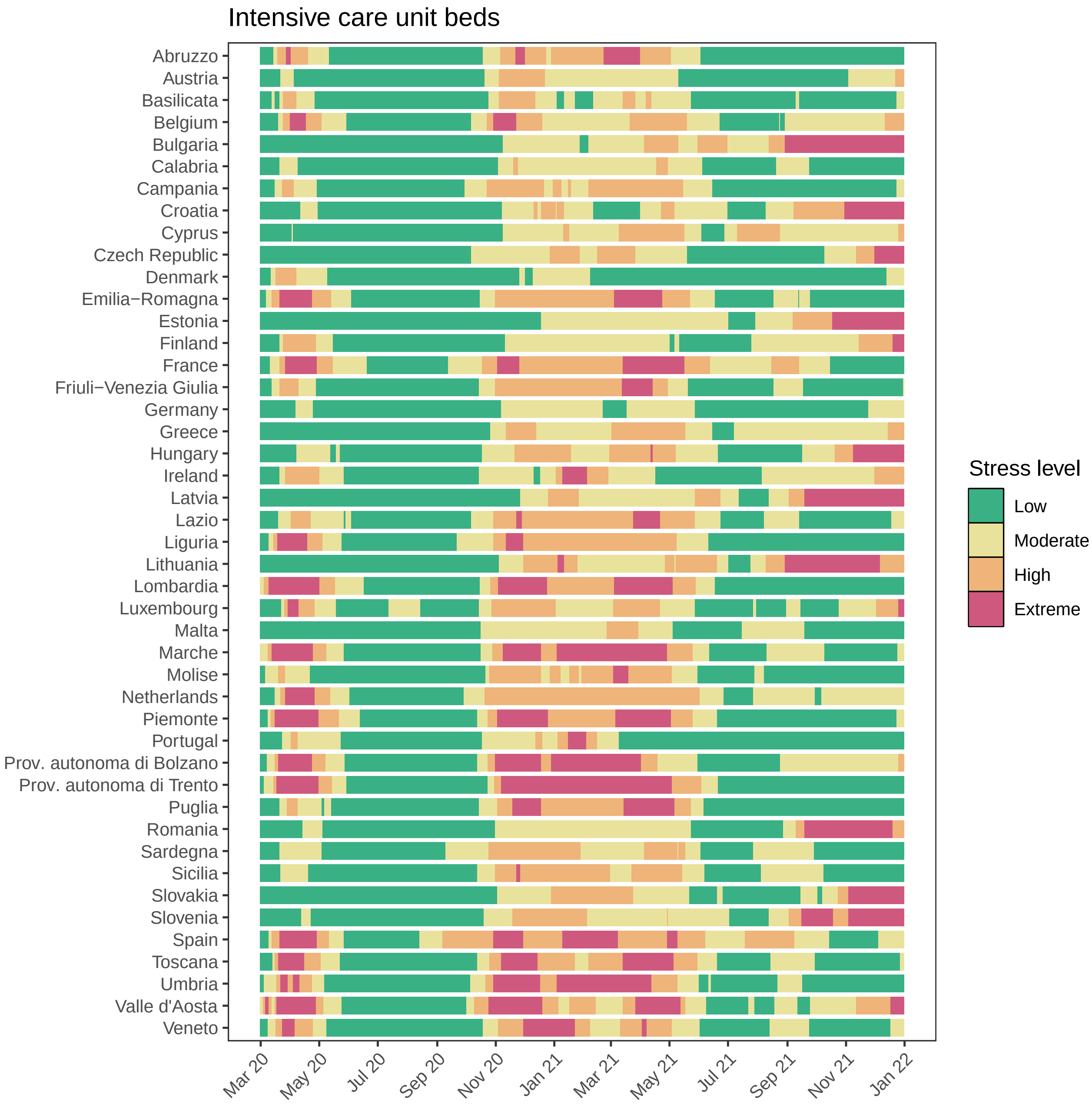


Figure 28. The estimated intensive care unit (ICU) usage is shown over time. The percent of ICU beds occupied by COVID-19 patients is color-coded based on observed quantiles of the maximum proportion of ICU beds occupied by COVID-19 patients. Less than 10% is considered *low stress*, 10-29% is considered *moderate stress*, 30-59% is considered *high stress*, and 60% or greater is considered *extreme stress*.



More information

Data sources:

Mask use and vaccine confidence data are from the The Delphi Group at Carnegie Mellon University and University of Maryland COVID-19 Trends and Impact Surveys, in partnership with Facebook. Mask use data are also from Premise, the Kaiser Family Foundation, and the YouGov COVID-19 Behaviour Tracker survey.

Genetic sequence and metadata are primarily from the GISAID Initiative. Further details available on the COVID-19 model FAQ page.

A note of thanks:

We wish to warmly acknowledge the support of these and others who have made our COVID-19 estimation efforts possible.

More information:

For all COVID-19 resources at IHME, visit http://www.healthdata.org/covid.

To download our most recent results, visit our Data downloads page.

Questions? Requests? Feedback? Please contact us at https://www.healthdata.org/covid/contact-us.