NIPH
Norwegian Institute of Public Health

Situational awareness and forecasting for Norway

FHI COVID-19 modelling team

Week 14, 6 April 2022

Main results:

This week, we report the estimated national reproduction number from our changepoint model. The model estimates an average effective reproduction number of around 0.85 from 14 March. Due to a lack of reliable test data, we base our estimates on hospitalisation data only, which have a longer delay. We also refer to trend analysis results Figure 21 based on various data sources, suggesting a decreasing trend of the epidemic curve.

- **National epidemiological situation:**

  The most recent reproduction numbers:

Model	Median	2.5%	97.5%	Prob>1	period/day	More info
Changepoint	0.85	0.49	1.18	19%	from Mar 14	Section 1

- **National forecasting:**

  One-week-ahead national forecasts from changepoint model:

Indicator	Median/Mean 95% PI	day	Info 2-3 weeks forecasts
Hospital beds	148/139 (69-278)	10 Apr	Table 2
Ventilator beds	14/13 (6-25)	10 Apr	Table 2

  Three-weeks-ahead national forecasts can be found in Tables 2. Age-specific hospital prevalence predictions are provided in Figures 4 and 5.

- **Regional epidemiological situation:**

  The newest regional effective reproduction number for Oslo:

Model	Median	2.5%	97.5%	Prob>1	day	Info other counties
SMC	0.72	0.45	1.2	0.1	16 Mar - 19 Mar	Table 3

- **Telenor mobility data and the number of foreign visitors:** The most recent mobility development is found in Figures 15 and 16 for the largest municipality in each county and for each county, respectively. Figure 17 shows the total number of roamers per day per county. Inter-county mobility and the number of foreign roamers have been quite stable the last weeks.

1 Estimated national reproduction numbers

Table 1 shows the estimated reproductive number of our national changepoint model. Figure 1 shows the estimated daily number of COVID-19 patients admitted to hospital, with blue medians and interquantile bands, which are compared to the actual true data, provided in red. The uncertainty captures the uncertainty in the calibrated parameters in addition to the stochastic elements of our model and the variability of other model parameters.

Table 1: Calibration results

Reff	Period
2.63/2.63(2.02-3.33)	From Feb 17 to Mar 14
0.67/0.67(0.49-0.83)	From Mar 15 to Apr 19
0.49/0.5(0.05-1.05)	From Apr 20 to May 10
0.5/0.52(0.04-1.16)	From May 11 to Jun 30
0.61/0.64(0.04-1.43)	From Jul 01 to Jul 31
1.06/1.04(0.33-1.6)	From Aug 01 to Aug 31
1.01/1(0.74-1.25)	From Sep 01 to Oct 25
1.15/1.16(0.56-1.86)	From Oct 26 to Nov 04
0.98/0.98(0.77-1.19)	From Nov 05 to Nov 30
0.84/0.84(0.67-0.99)	From Dec 01 to Jan 03
0.72/0.72(0.34-1.13)	From Jan 04 to Jan 21
0.91/0.91(0.52-1.31)	From Jan 22 to Feb 07
1.29/1.3(1.01-1.6)	From Feb 08 to Mar 01
0.98/0.98(0.83-1.15)	From Mar 02 to Mar 24
0.86/0.85(0.72-0.97)	From Mar 25 to May 05
0.84/0.84(0.5-1.21)	From May 06 to May 26
0.68/0.67(0.16-1.12)	From May 27 to Jun 20
0.68/0.67(0.17-1.17)	From Jun 21 to Aug 04
1.07/1.07(0.79-1.33)	From Aug 05 to Aug 31
0.78/0.77(0.59-0.95)	From Sep 01 to Sep 24
1.01/1.01(0.93-1.09)	From Sep 25 to Dec 14
1.02/1.01(0.86-1.17)	From Dec 15 to Jan 13
1.51/1.5(1.21-1.76)	From Jan 14 to Jan 31
1.17/1.18(1.08-1.28)	From Feb 01 to Mar 13
0.85/0.84(0.49-1.18)	From Mar 14

Median/Mean (95% credible intervals)

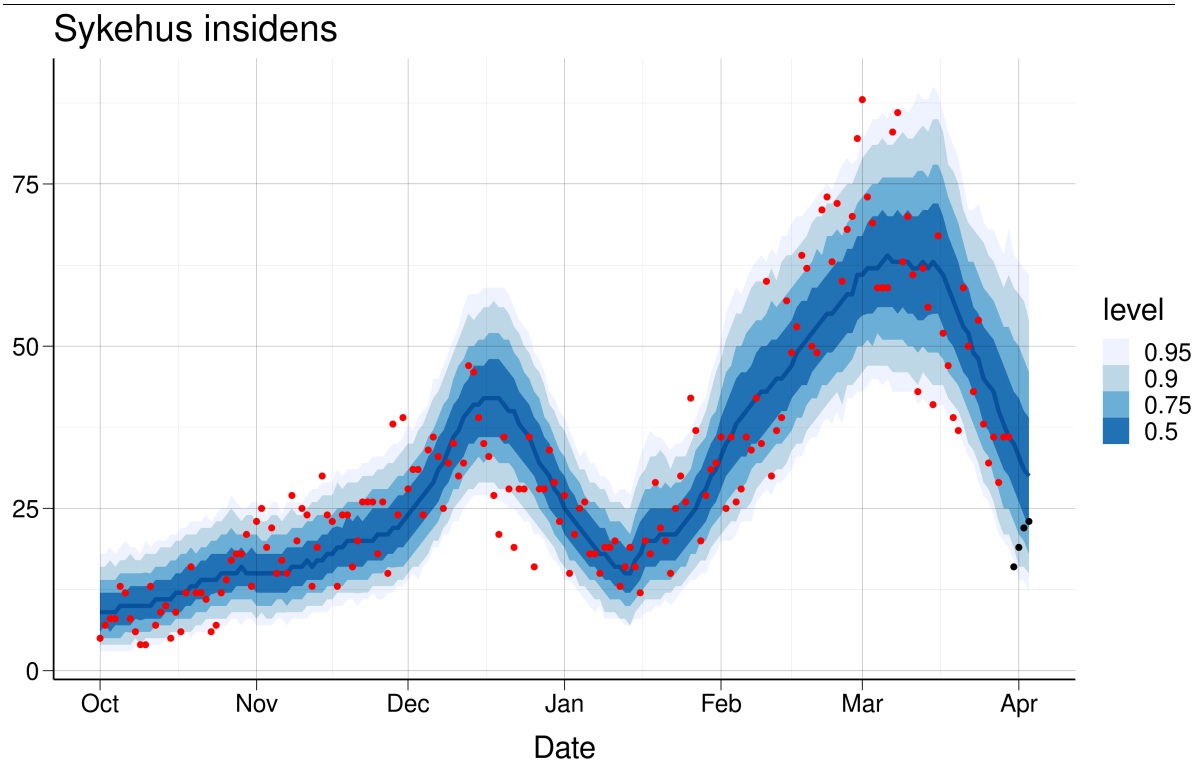
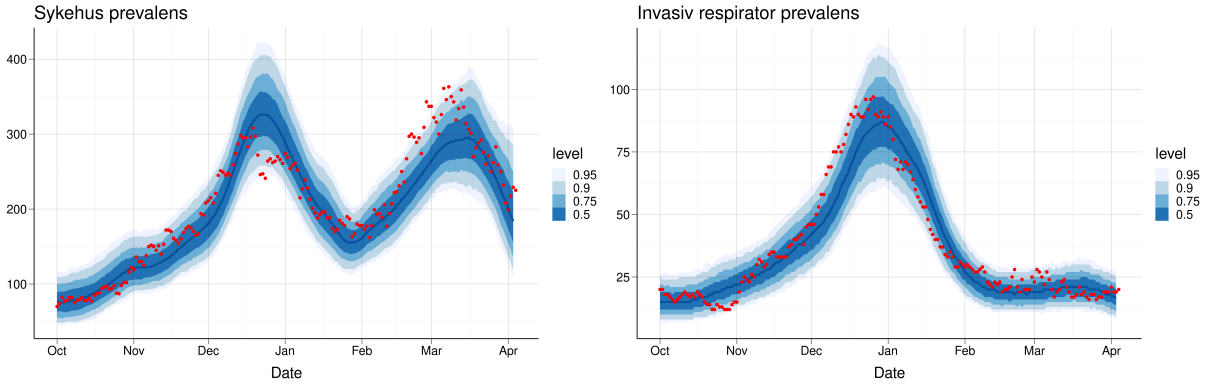


Figure 1: A comparison of true data (red) and predicted values (blue) for hospital admissions . The last four data points (black) are assumed to be affected by reporting delay. The uncertainty captures the uncertainty in the calibrated parameters, in addition to the stochastic elements of our model and the variability of other model parameters.

In figure 2, we show how our national model fits the national hospital prevalence data (2a) and the daily number of patients receiving ventilator treatment (2b). Those data sources are not used to estimate the parameters, and can therefore be seen as a validation of the model assumptions.



(a) Hospital prevalence

(b) Ventilator prevalence

Figure 2: A comparison of true data (red) and predicted values (blue) for hospital and respirator prevalence. Prevalence data is based on NIPaR and may be different to the data from Helsedirektoratet.

2 National 3-week predictions: Hospital beds and Ventilator bed

In this section we show the projected national prevalence of hospitalised patients (hospital beds) and prevalence of patients receiving ventilator treatment (ventilator beds). The projected epidemic and healthcare burden are illustrated in table 2.

Age-specific hospital prevalence predictions are provided in Figures 4 and 5.

Table 2: Estimated national prevalence hospital beds and ventilator beds. Median/Mean (CI)

	1 week prediction (Apr 10)	2 week prediction (Apr 17)	3 week prediction (Apr 24)
Hospital beds	148/139 (69-278)	116/105 (44-253)	94/80 (33-240)
Ventilator beds	14/13 (6-25)	11/10 (4-22)	9/8 (2-20)

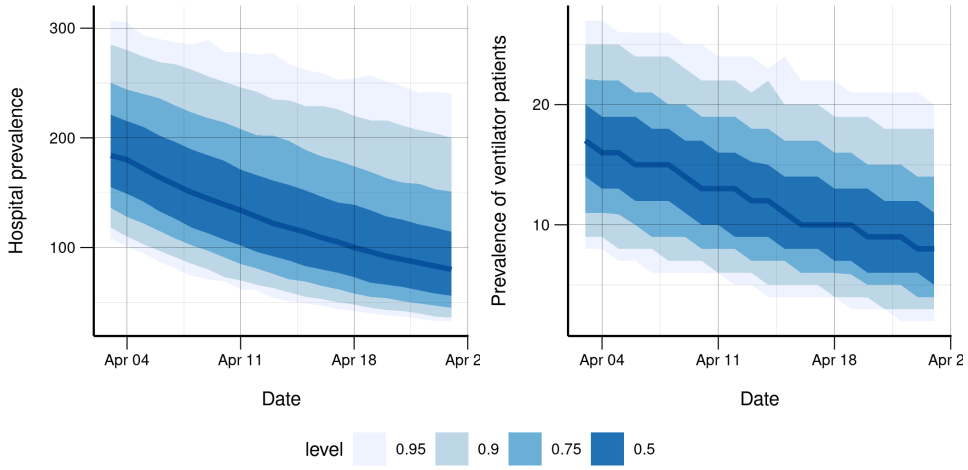


Figure 3: National 3 week predictions for hospital beds (left) and ventilator beds (right)

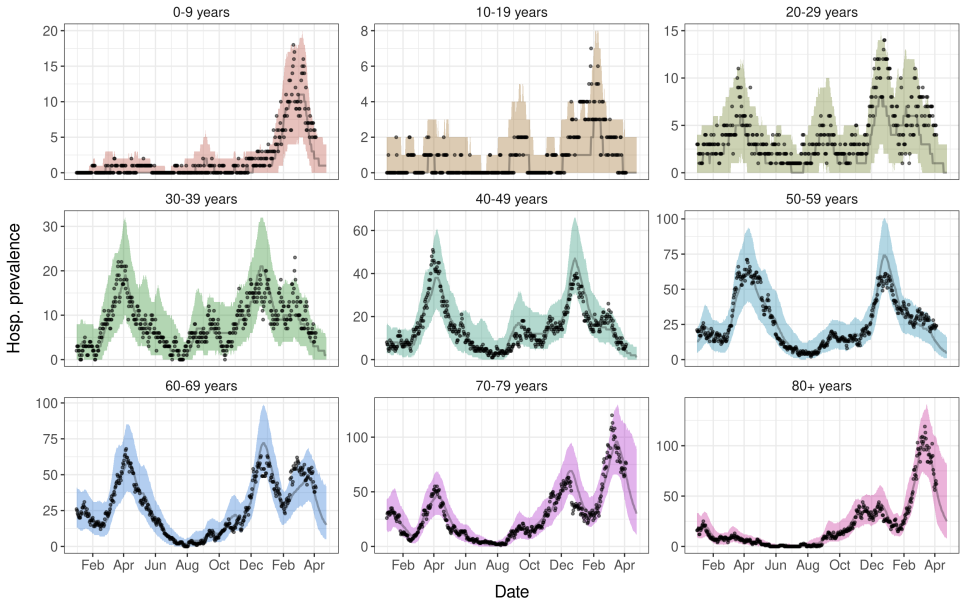


Figure 4: Simulated hospital prevalence by age group taking into account the omicron takeover. Real data is shown as black dots.

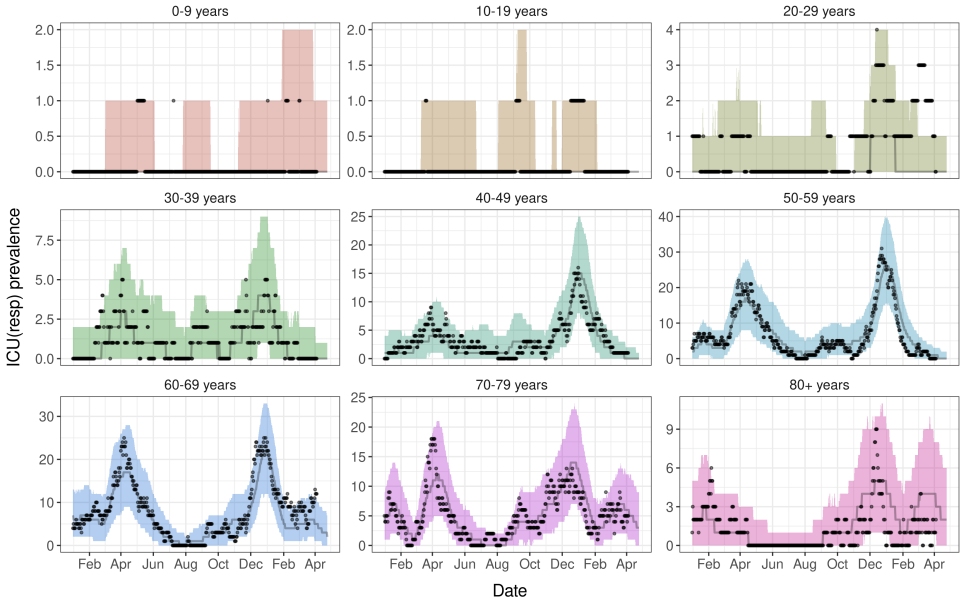


Figure 5: Simulated respirator prevalence by age group taking into account the omicron takeover. Real data is shown as black dots.

3 Estimated regional reproduction numbers

Calibration of our regional SMC model to hospitalisation incidence data leads to the following estimates for current regional effective reproduction numbers by county (Table 3).
Below we show the estimated daily number of COVID-19 patients admitted to hospital in each county. Model estimates are shown with blue medians and interquantile bands, which are compared to the actual true data, provided in red. The blue bands describe the uncertainty in the calibrated parameters, in addition to the stochastic elements of our model. Last four data points are shown in black as they may be affected by reporting delay.

Table 3: Regional estimates, 16 Mar-19 Mar

County	Median	95CI	Prob>1
Oslo	0.72	0.45-1.2	0.1
Rogaland	0.67	0.34-1.18	0.08
Møre og Romsdal	0.63	0.37-1	0.02
Nordland	0.70	0.37-1.23	0.1
Viken	0.80	0.47-1.31	0.18
Innlandet	0.56	0.29-0.98	0.02
Vestfold og Telemark	0.79	0.46-1.38	0.18
Agder	0.85	0.49-1.59	0.29
Vestland	0.64	0.34-1.1	0.05
Trøndelag	0.59	0.33-1	0.03
Troms og Finnmark	0.65	0.31-1.19	0.08

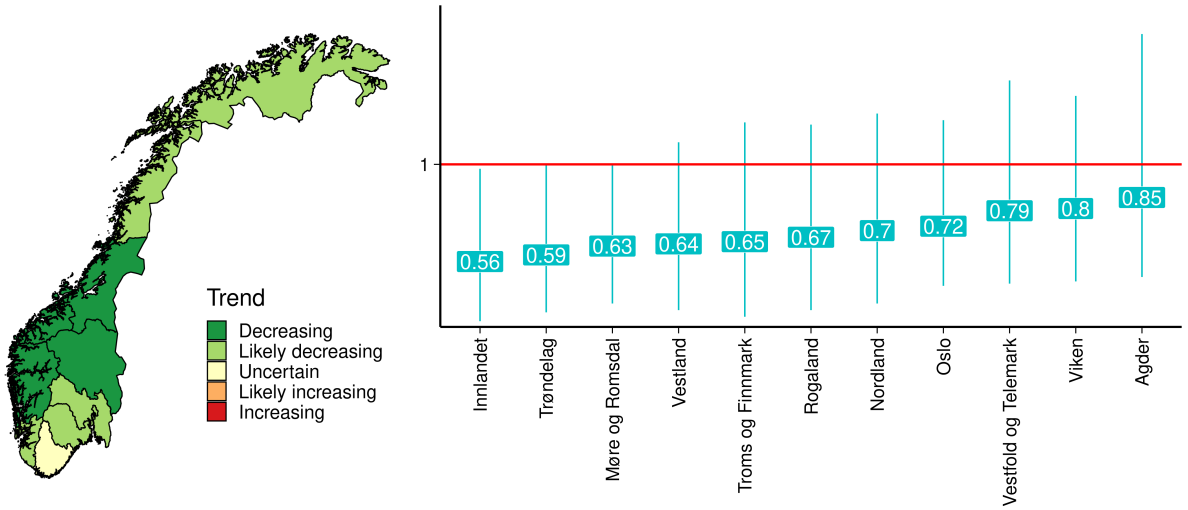
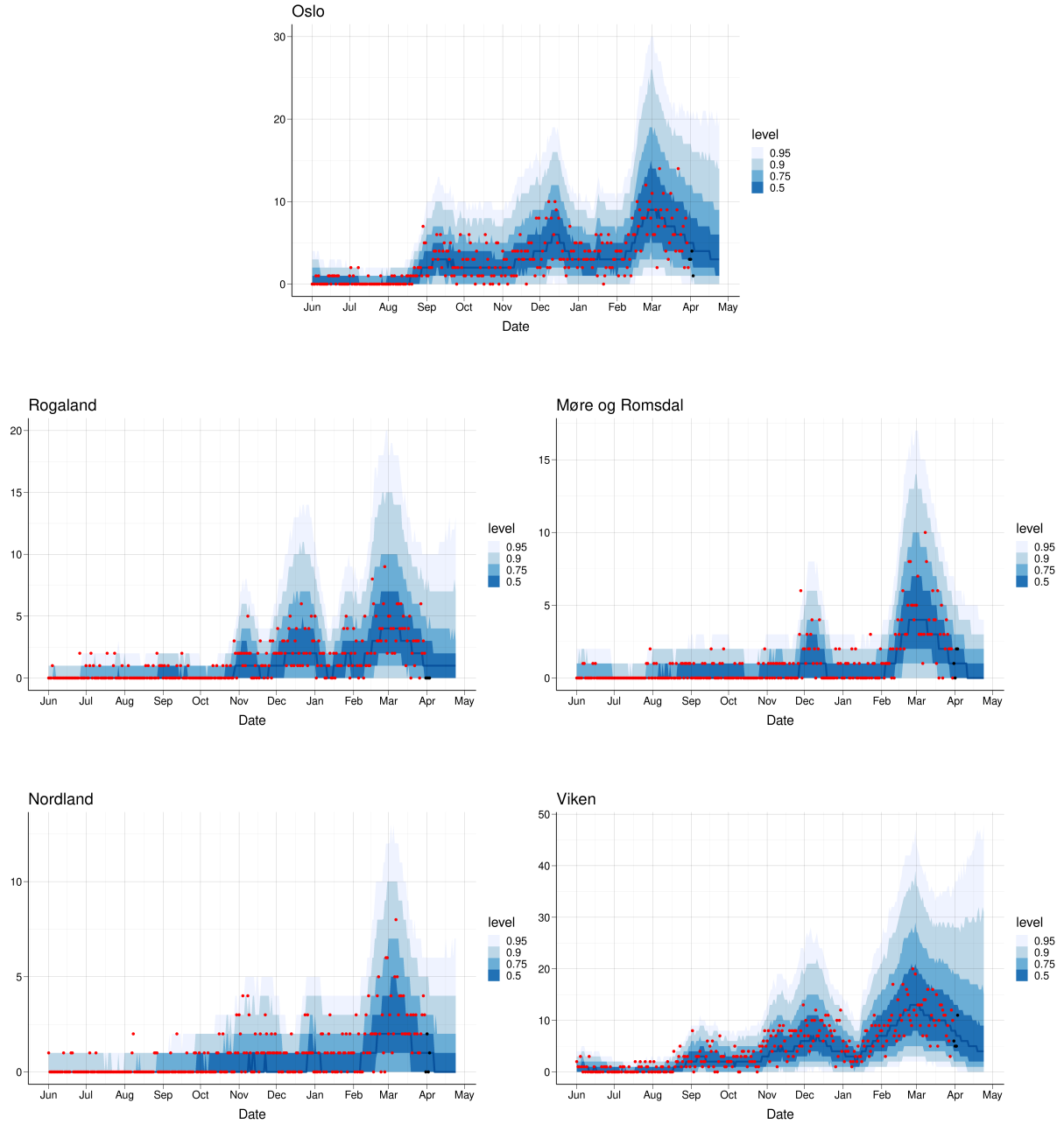
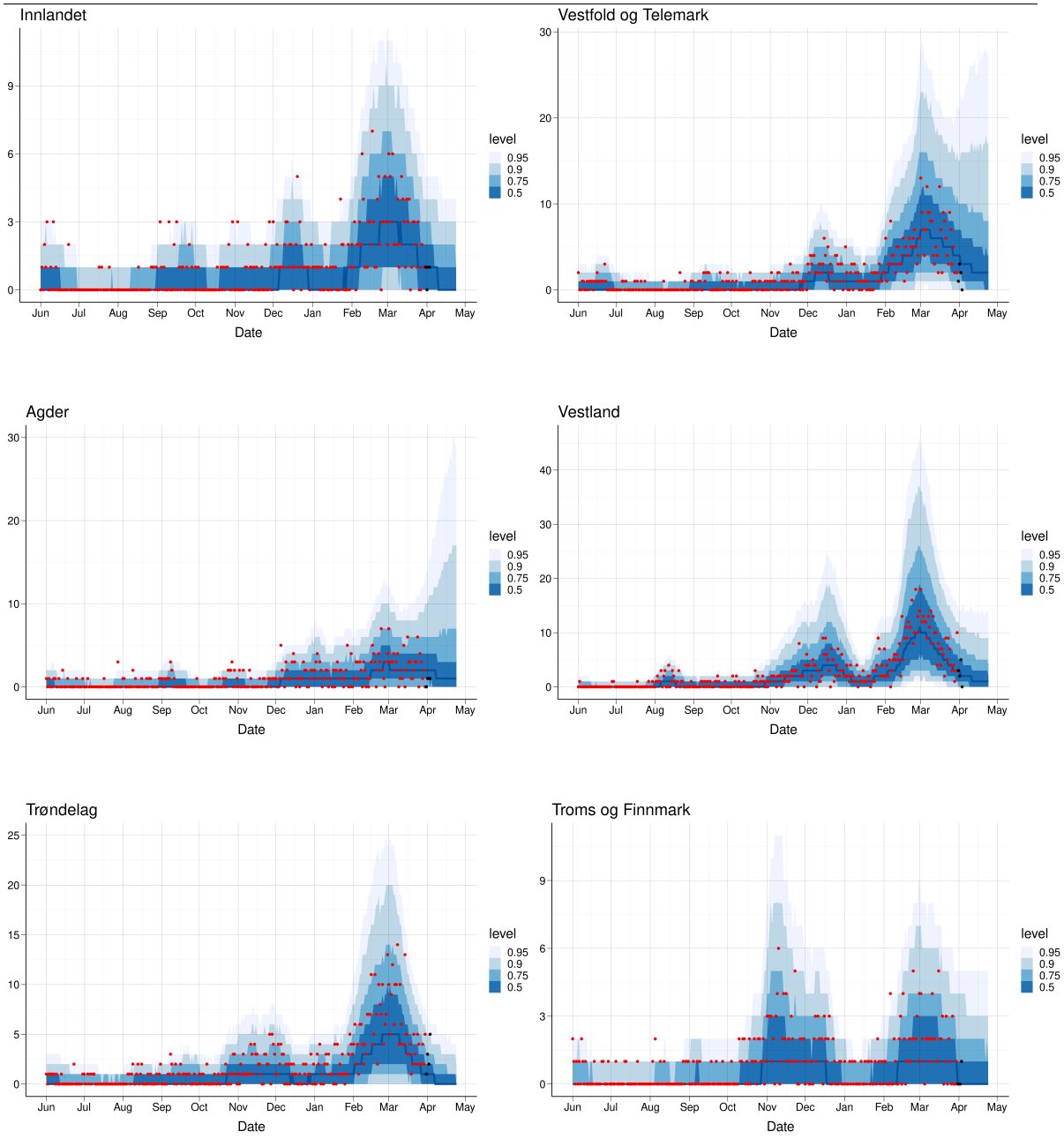


Figure 6: The map shows the direction of the trend in incidence in the counties based on the latest effective reproduction numbers shown in the other chart. The trend is increasing if the probability that the latest reproduction number is above one is above 95%, the trend is likely increasing if this probability is between 80% and 95%, the trend is uncertain if the probability is between 20% and 80%, the trend is likely decreasing if the probability is between 5% and 20% and is decreasing if the probability that the latest R is above one is less than 5%.

Estimated vs observed hospital incidence and 3 weeks forecast by county:

Forecasts are now based on the estimated reproduction numbers obtained by our regional SMC model, for each county. In the forecasted period of three weeks, we use the reproductive numbers showed on Table 3.




Innlandet
Vestfold og Telemark
Agder
Vestland
Trøndelag
Troms og Finnmark
level
0.95
0.9
0.75
0.5
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Date

4 Regional 3-week predictions: Cumulative (total) incidence and Prevalence

Below is shown the daily incidence (table 4) and prevalence (table 5) for each county.

Table 4: Predicted incidence per day: Median/Mean (CI)

Region	1 week prediction (10 Apr)	2 weeks prediction (17 Apr)	3 weeks prediction (24 Apr)
Agder	148/368 (20-2362)	124/389 (14-2925)	105/384 (9-3089)
Innlandet	54/78 (13-286)	39/65 (8-278)	31/58 (7-273)
Møre og Romsdal	58/88 (12-343)	43/74 (9-324)	35/65 (8-301)
Nordland	47/99 (6-515)	36/93 (4-551)	29/88 (3-581)
Oslo	421/552 (158-1770)	372/510 (135-1757)	338/472 (125-1688)
Rogaland	94/201 (15-1067)	77/202 (11-1181)	65/204 (10-1324)
Troms og Finnmark	34/70 (3-374)	25/67 (2-389)	20/64 (2-416)
Trøndelag	40/81 (5-401)	23/64 (1-384)	14/54 (0-351)
Vestfold og Telemark	258/489 (44-2561)	205/449 (30-2821)	166/405 (23-2699)
Vestland	150/269 (26-1219)	112/244 (18-1240)	90/225 (15-1257)
Viken	613/988 (148-4190)	505/939 (111-4697)	426/885 (91-4985)

Table 5: Predicted prevalence. Number of infectious individuals (asymptomatic plus pre-symptomatic plus symptomatic) per day. Median/Mean and 95 perc. CI for three weeks prediction.

Region	10 Apr	17 Apr	24 Apr	low CI, 24 Apr	high CI, 24 Apr
Agder	695/1604	588/1714	500/1715	68	13802
Innlandet	284/388	212/324	168/287	60	1241
Møre og Romsdal	329/463	258/393	216/349	92	1380
Nordland	245/462	190/434	156/412	38	2580
Oslo	2438/2994	2196/2798	2037/2629	1078	7981
Rogaland	489/936	403/937	345/943	97	5738
Troms og Finnmark	164/321	125/302	99/290	15	1791
Trøndelag	205/385	117/299	69/247	5	1563
Vestfold og Telemark	1252/2219	999/2056	817/1864	152	11942
Vestland	778/1290	596/1163	480/1072	134	5573
Viken	3088/4659	2586/4428	2199/4197	665	21955

5 Regional 3-week predictions: Hospital beds and ventilator beds

Below is shown the estimated short-term forecasting of expected hospital prevalence (table 6) and patients on ventilator treatment for each county (table 7). These estimates do not take into account imported cases from abroad that may be admitted to hospital.

Table 6: Number of hospitalisation beds occupied by Covid-19 patients: Median/Mean (CI)

Region	1 week prediction (10 Apr)	2 weeks prediction (17 Apr)	3 weeks prediction (24 Apr)
Agder	9/15 (1-78)	6/16 (0-109)	5/17 (0-132)
Innlandet	4/5 (0-17)	3/4 (0-16)	2/3 (0-15)
Møre og Romsdal	4/6 (0-21)	3/5 (0-19)	2/4 (0-17)
Nordland	3/6 (0-23)	2/5 (0-25)	2/5 (0-26)
Oslo	23/29 (7-82)	20/26 (5-83)	18/24 (4-84)
Rogaland	6/10 (0-43)	4/9 (0-46)	3/9 (0-51)
Troms og Finnmark	2/4 (0-19)	2/4 (0-20)	1/3 (0-20)
Trøndelag	4/6 (0-23)	2/4 (0-20)	1/3 (0-18)
Vestfold og Telemark	16/24 (3-102)	12/22 (1-112)	10/20 (1-125)
Vestland	11/16 (2-59)	8/13 (1-57)	7/12 (0-58)
Viken	33/45 (8-154)	27/42 (5-176)	22/40 (4-199)

Table 7: Number of ICU beds occupied by Covid-19 patients: Median/Mean (CI)

Region	1 week prediction (10 Apr)	2 weeks prediction (17 Apr)	3 weeks prediction (24 Apr)
Agder	1/1 (0-5)	0/1 (0-6)	0/1 (0-8)
Innlandet	0/0 (0-2)	0/0 (0-2)	0/0 (0-2)
Møre og Romsdal	0/1 (0-3)	0/0 (0-2)	0/0 (0-2)
Nordland	0/0 (0-2)	0/0 (0-2)	0/0 (0-2)
Oslo	1/2 (0-5)	1/2 (0-5)	1/1 (0-5)
Rogaland	0/1 (0-4)	0/1 (0-3)	0/1 (0-4)
Troms og Finnmark	0/0 (0-2)	0/0 (0-2)	0/0 (0-2)
Trøndelag	0/1 (0-3)	0/0 (0-2)	0/0 (0-2)
Vestfold og Telemark	1/2 (0-7)	1/2 (0-7)	1/2 (0-8)
Vestland	1/1 (0-5)	1/1 (0-5)	1/1 (0-5)
Viken	3/3 (0-10)	2/3 (0-12)	2/3 (0-13)

6 14-day trend analysis of confirmed cases and hospitalisations by county

To estimate recent trends in hospitalisation and number of positive tests, we present results in table 8 based on a negative binomial regression where we account for weekend effects. We exclude the last three days to avoid problems of reporting delay and fit the model using data from 17 days to 3 days before the current date. We fit a separate trend model for confirmed cases and for hospital incidence. We only fit a trend model if there has been more than 5 cases or hospitalisations in the 14-day period.

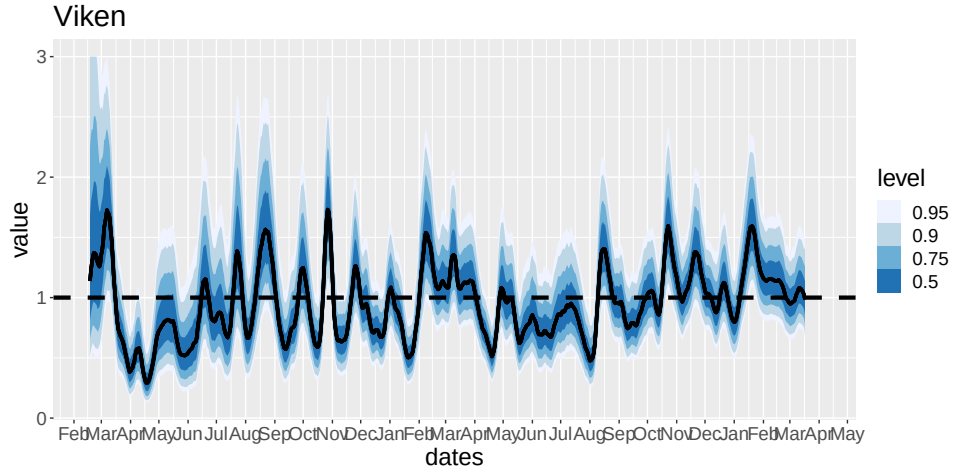
Table 8: Trend analysis for the last 14 days

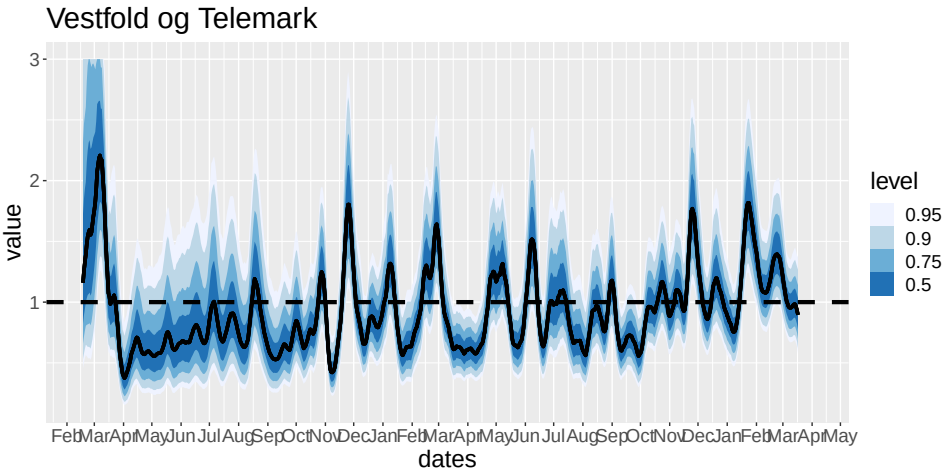
	Average daily increase last 14 days		Doubling Time (days)	
County	Hospitalisations	Cases	Hospitalisations	Cases
Agder	-3.3 (-10, 3.8) %	-7.5 (-9.5, -5.5) %	-20.8 (-6.6, 18.7)	-8.8 (-6.9, -12.2)
Innlandet	-7.6 (-14.9, 0) %	-6.8 (-9, -4.7) %	-8.8 (-4.3, -2496.4)	-9.8 (-7.4, -14.6)
Møre og Romsdal	-4.8 (-11.9, 2.8) %	-8.9 (-11.3, -6.4) %	-14.1 (-5.4, 25.5)	-7.5 (-5.8, -10.5)
Nordland	-6.5 (-14.5, 1.8) %	-8.2 (-11.5, -4.8) %	-10.2 (-4.4, 38.3)	-8.1 (-5.7, -14)
Norge	-3.7 (-5.6, -1.8) %	-7 (-8.8, -5.1) %	-18.2 (-12, -37.4)	-9.6 (-7.5, -13.3)
Oslo	-2.4 (-7.6, 3) %	-6.1 (-7.5, -4.6) %	-28.2 (-8.8, 23.6)	-11.1 (-8.8, -14.8)
Rogaland	-9 (-16.1, -1.7) %	-8 (-9.5, -6.5) %	-7.3 (-3.9, -39.8)	-8.3 (-7, -10.3)
Troms og Finnmark	-11.5 (-20.3, -2.5) %	-8.2 (-10.9, -5.4) %	-5.7 (-3, -27.3)	-8.1 (-6, -12.5)
Trøndelag	-7.1 (-14.1, 0.3) %	-6.7 (-9.6, -3.7) %	-9.5 (-4.6, 257.7)	-10 (-6.9, -18.5)
Vestfold og Telemark	-0.1 (-4.8, 4.8) %	-4.6 (-8.2, -0.9) %	-502.2 (-14.1, 14.9)	-14.6 (-8.1, -76.6)
Vestland	-2.1 (-6.9, 3) %	-7.2 (-9.2, -5.1) %	-32.8 (-9.6, 23.7)	-9.3 (-7.2, -13.3)
Viken	-2.2 (-5.9, 1.7) %	-6.6 (-8.6, -4.5) %	-31.6 (-11.3, 40.3)	-10.2 (-7.7, -15.1)

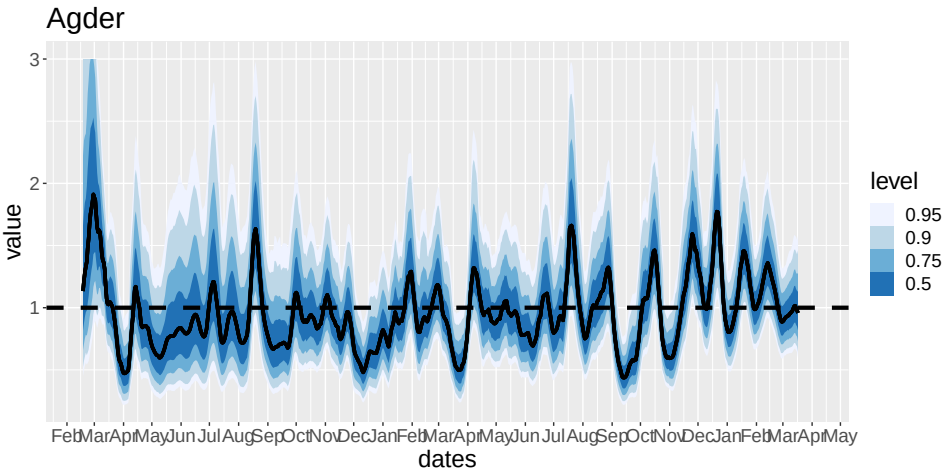
7 Regional SMC-model: Estimated daily reproduction numbers

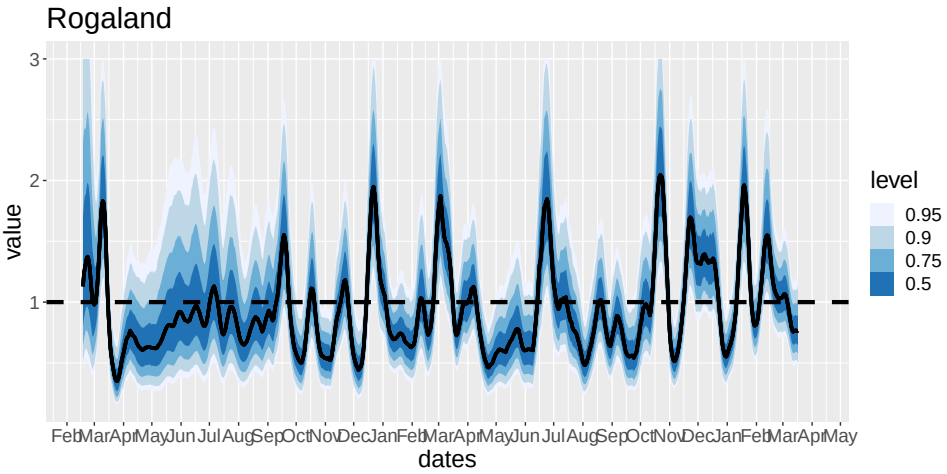
In the figures below we plot the 95% credibility interval and quantiles of the estimated posterior distribution of the regional, daily reproduction numbers. For some counties, uncertainty is large towards the most recent time, because there are very few data and possibly reporting delays which are different in each county.

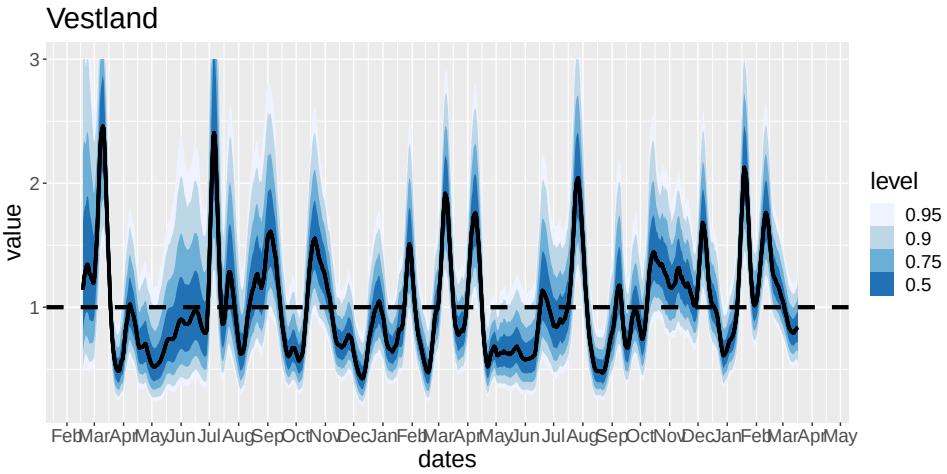
fig_Apr_06_smo/R_CAR157_rest_smoD_w150w20_B20000_20220501Oslo_nodat_14.pdf

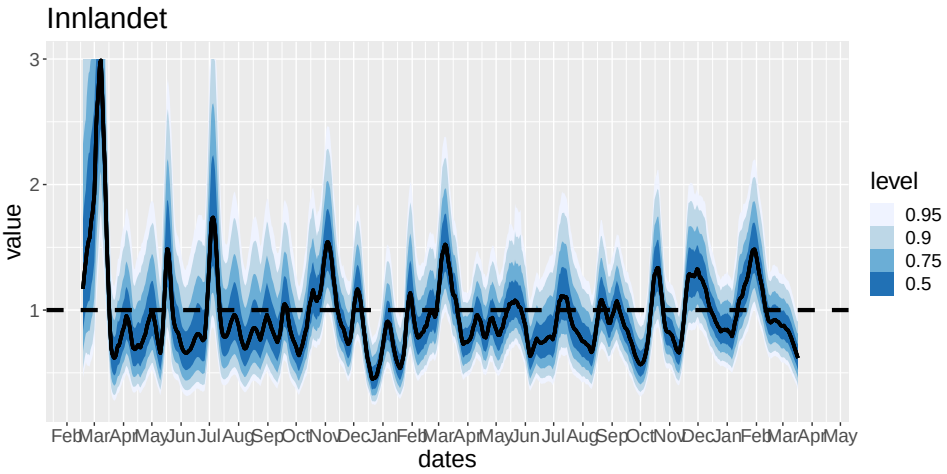


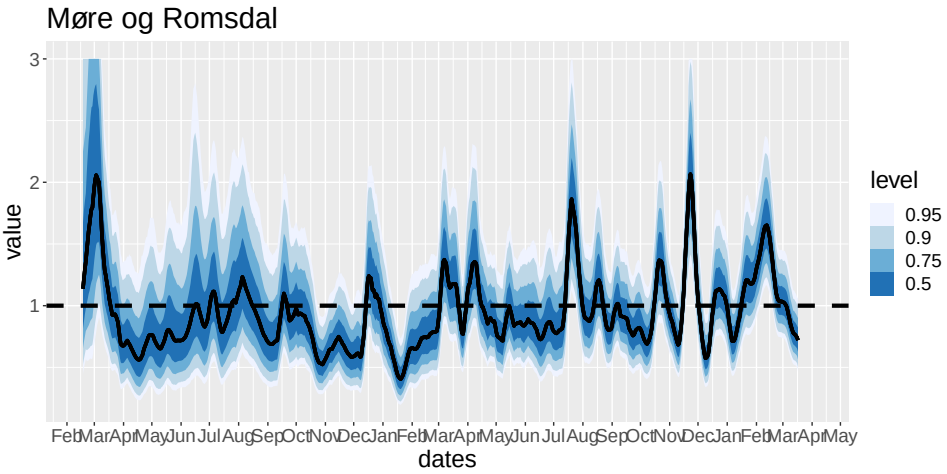

Vestfold og Telemark
value
dates
level
0.95
0.9
0.75
0.5

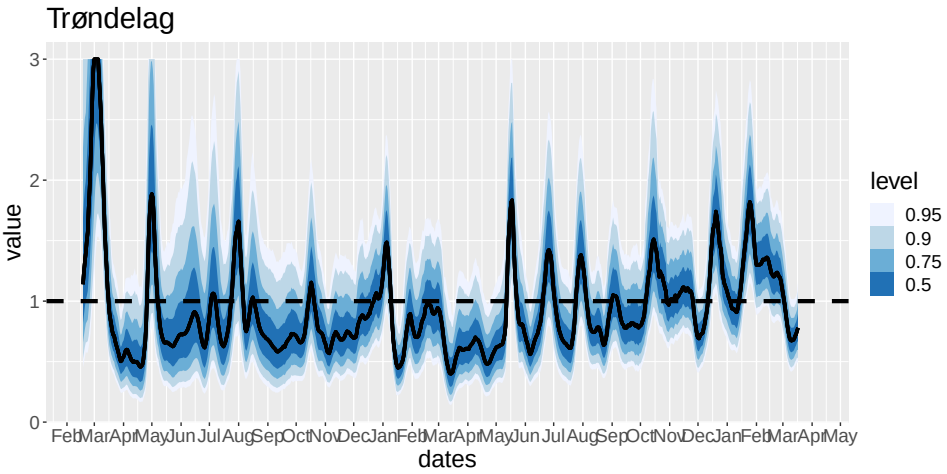

Agder
value
dates
level
0.95
0.9
0.75
0.5

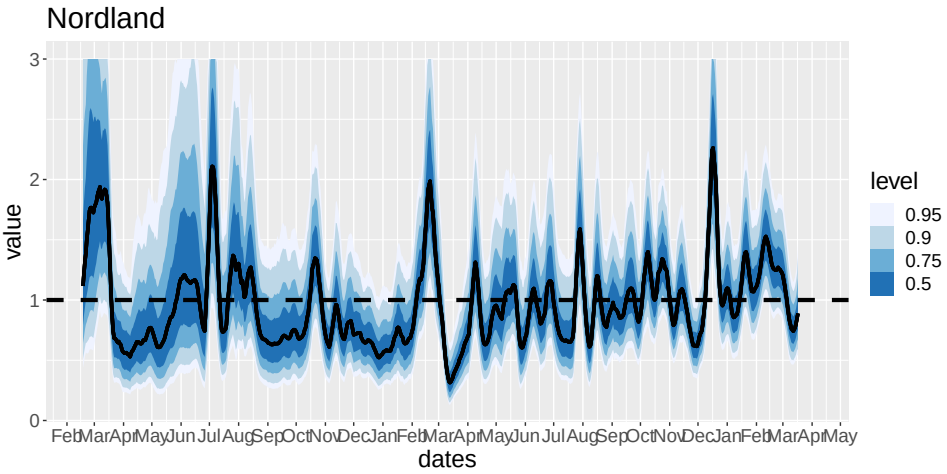

Rogaland
value
dates
level
0.95
0.9
0.75
0.5

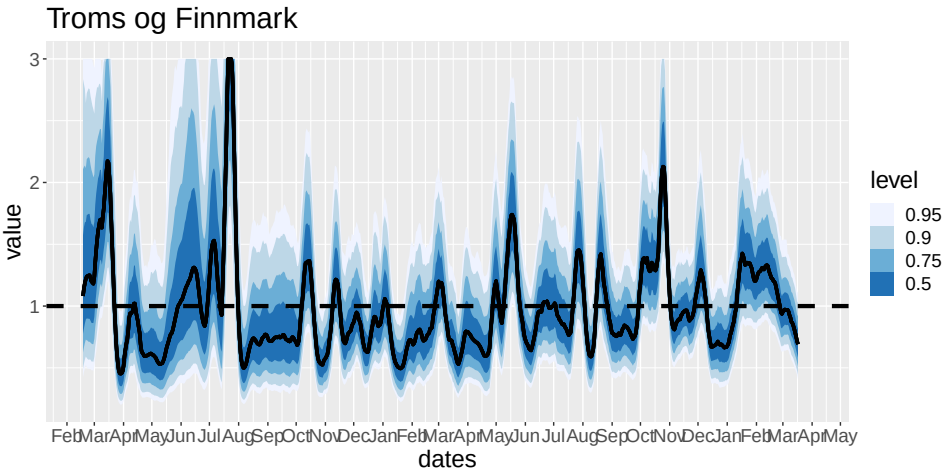

Vestland
value
dates
level
0.95
0.9
0.75
0.5
Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May


Innlandet
value
dates
level
0.95
0.9
0.75
0.5
Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May


Møre og Romsdal
value
dates
level
0.95
0.9
0.75
0.5
Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May


Trøndelag
value
dates
level
0.95
0.9
0.75
0.5
0
1
2
3
Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May


Nordland
value
dates
level
0.95
0.9
0.75
0.5
0
1
2
3
Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May


Troms og Finnmark
value
dates
level
0.95
0.9
0.75
0.5
1
2
3
Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May

8 Short-term predictions per health trust ("helseforetak"): number of occupied covid-19 beds and number of patients receiving ventilator treatment

In the table below we distribute our short-term predictions to the Norwegian health trusts ("helseforetak"), on the basis of their areas of responsibility.

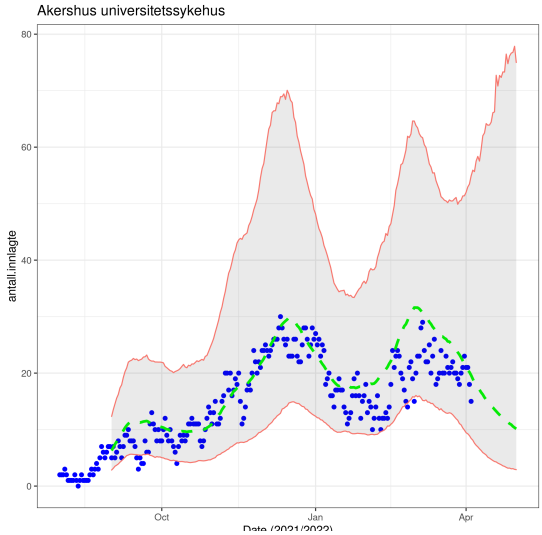
Table 9: Number of hospitalisation beds occupied by Covid-19 patients: Median/Mean (CI)

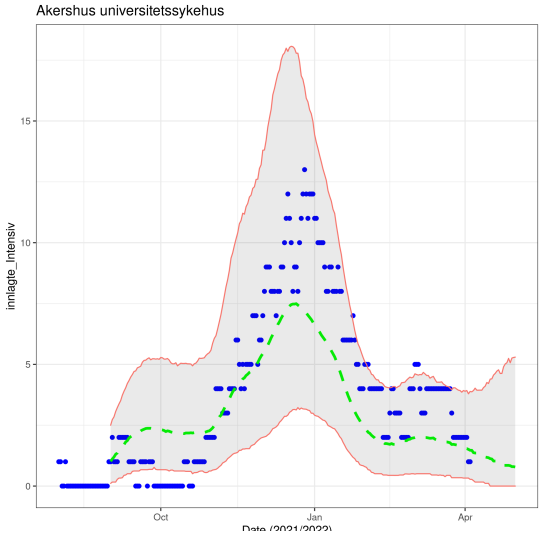
Helseforetak	1 week prediction (10 Apr)	2 weeks prediction (17 Apr)	3 weeks prediction (24 Apr)
Akershus universitetssykehus	17/21 (6-60)	14/19 (5-66)	12/18 (3-73)
Finnmarksykehuset	1/1 (0-6)	1/1 (0-6)	0/1 (0-6)
Helse Bergen	8/11 (1-40)	6/10 (1-39)	4/8 (0-41)
Helse Fonna	3/4 (1-13)	2/4 (0-15)	2/3 (0-17)
Helse Førde	2/3 (0-10)	1/2 (0-9)	1/2 (0-10)
Helse Møre og Romsdal	5/6 (0-20)	3/5 (0-18)	2/4 (0-17)
Helse Nord Trøndelag	1/2 (0-7)	1/1 (0-6)	0/1 (0-6)
Helse Stavanger	5/7 (0-31)	4/7 (0-36)	3/7 (0-39)
Nordlandssykehuset	2/3 (0-13)	2/3 (0-14)	1/3 (0-15)
Oslo universitetssykehus	20/24 (7-66)	17/22 (5-69)	15/20 (4-69)
St. Olavs hospital	3/4 (0-15)	2/3 (0-13)	1/2 (0-12)
Sykehuset Innlandet	4/5 (0-15)	3/4 (0-14)	2/3 (0-13)
Sykehuset Telemark	7/10 (1-41)	5/9 (1-46)	4/8 (0-52)
Sykehuset i Vestfold	9/14 (2-59)	8/13 (1-65)	6/12 (1-73)
Sykehuset Østfold	8/11 (3-39)	7/11 (2-45)	6/10 (1-50)
Sørlandet sykehus	8/15 (1-77)	7/16 (0-105)	6/17 (0-131)
Universitetssykehuset i Nord-Norge	2/3 (0-14)	2/3 (0-15)	1/3 (0-15)
Vestre Viken	13/18 (4-59)	11/16 (2-69)	9/16 (2-77)

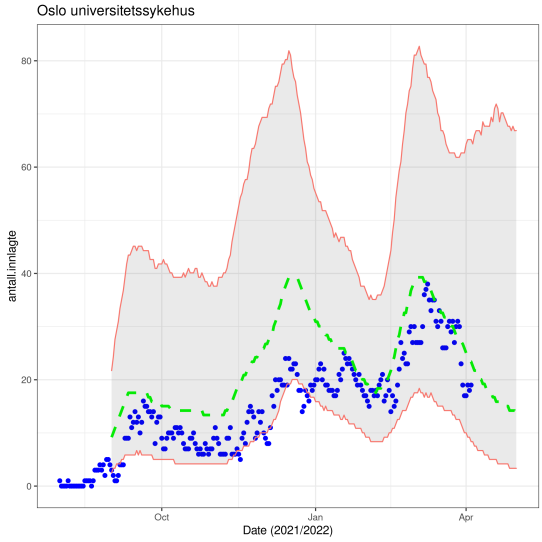
Table 10: Number of respirator beds occupied by Covid-19 patients: Median/Mean (CI)

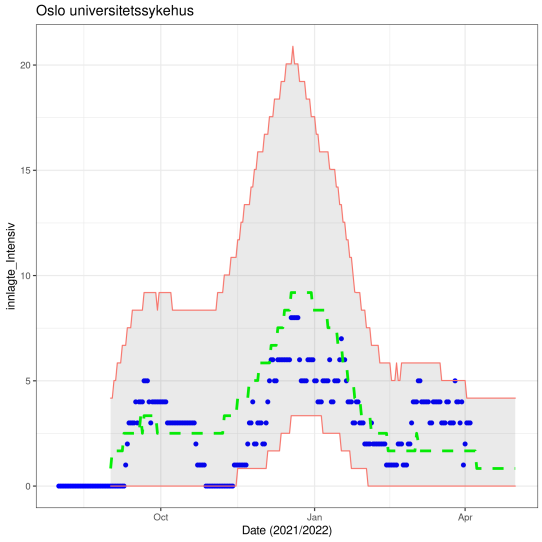
Helseforetak	1 week prediction (10 Apr)	2 weeks prediction (17 Apr)	3 weeks prediction (24 Apr)
Akershus universitetssykehus	1/2 (0-4)	1/1 (0-4)	1/1 (0-5)
Finnmarksykehuset	0/0 (0-1)	0/0 (0-1)	0/0 (0-1)
Helgelandssykehuset	0/0 (0-1)	0/0 (0-1)	0/0 (0-1)
Helse Bergen	1/1 (0-4)	1/1 (0-4)	1/1 (0-4)
Helse Fonna	0/0 (0-1)	0/0 (0-1)	0/0 (0-1)
Helse Førde	0/0 (0-1)	0/0 (0-1)	0/0 (0-1)
Helse Møre og Romsdal	0/1 (0-3)	0/0 (0-2)	0/0 (0-2)
Helse Nord Trøndelag	0/0 (0-1)	0/0 (0-1)	0/0 (0-1)
Helse Stavanger	0/1 (0-3)	0/1 (0-2)	0/0 (0-3)
Nordlandssykehuset	0/0 (0-1)	0/0 (0-1)	0/0 (0-1)
Oslo universitetssykehus	1/1 (0-4)	1/1 (0-4)	1/1 (0-4)
St. Olavs hospital	0/0 (0-2)	0/0 (0-1)	0/0 (0-1)
Sykehuset Innlandet	0/0 (0-2)	0/0 (0-2)	0/0 (0-2)
Sykehuset Telemark	0/1 (0-3)	0/1 (0-3)	0/1 (0-3)
Sykehuset i Vestfold	1/1 (0-4)	1/1 (0-4)	1/1 (0-5)
Sykehuset Østfold	1/1 (0-3)	1/1 (0-3)	1/1 (0-3)
Sørlandet sykehus	1/1 (0-5)	0/1 (0-6)	0/1 (0-8)
Universitetssykehuset i Nord-Norge	0/0 (0-1)	0/0 (0-1)	0/0 (0-1)
Vestre Viken	1/1 (0-4)	1/1 (0-5)	1/1 (0-5)

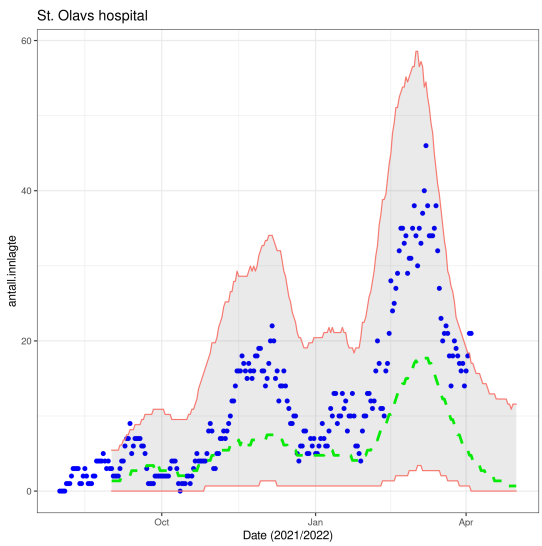
In the figures below, we plot the 95% credibility interval and quantiles of the estimated posterior distribution of the daily number of occupied covid-19 beds and the number of patients receiving ventilator treatment for a few health trusts. The others are available on request. In blue are actual data, in green our median prediction and in gray the 95% credibility interval. For some counties, uncertainty is considerable towards the most recent time because there is little data and possibly reporting delays that are different in each county.

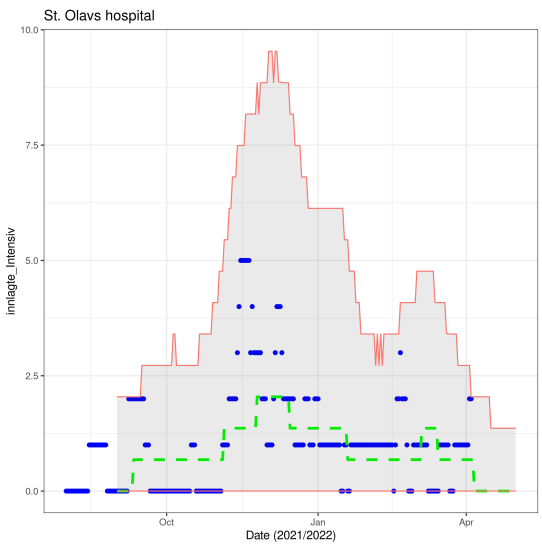

Akershus universitetssykehus
antall.innlagte
0
20
40
60
80
Oct
Jan
Apr


Akershus universitetssykehus
innlagte_Intensiv
0
5
10
15
Oct
Jan
Apr


Oslo universitetssykehus
antall.innlagte
0
20
40
60
80
Oct
Jan
Apr
Date (2021/2022)


Oslo universitetssykehus
innlagte_Intensiv
0
5
10
15
20
Oct
Jan
Apr
Date (2021/2022)


St. Olavs hospital
antall.innlagte
0
20
40
60
Oct
Jan
Apr
Date (2021/2022)


St. Olavs hospital
innlagte_Intensiv
0.0
2.5
5.0
7.5
10.0
Oct
Jan
Apr
Date (2021/2022)

9 Mobility

Number of trips out from each municipality during each day is based on Telenor mobility data. The reference level is set to 100 on March 2nd 2020 for all the figures in this section, and we plot the seven-day, moving average of the daily mobility. Figure 13 shows an overview of the mobility since March 2020 for the largest municipalities in each county, and Figure 14 shows the total mobility out from all municipalities in each county, including Oslo. Figure 15 and 16, zooms in on mobility from August 16 2021, for municipalities and counties, respectively.

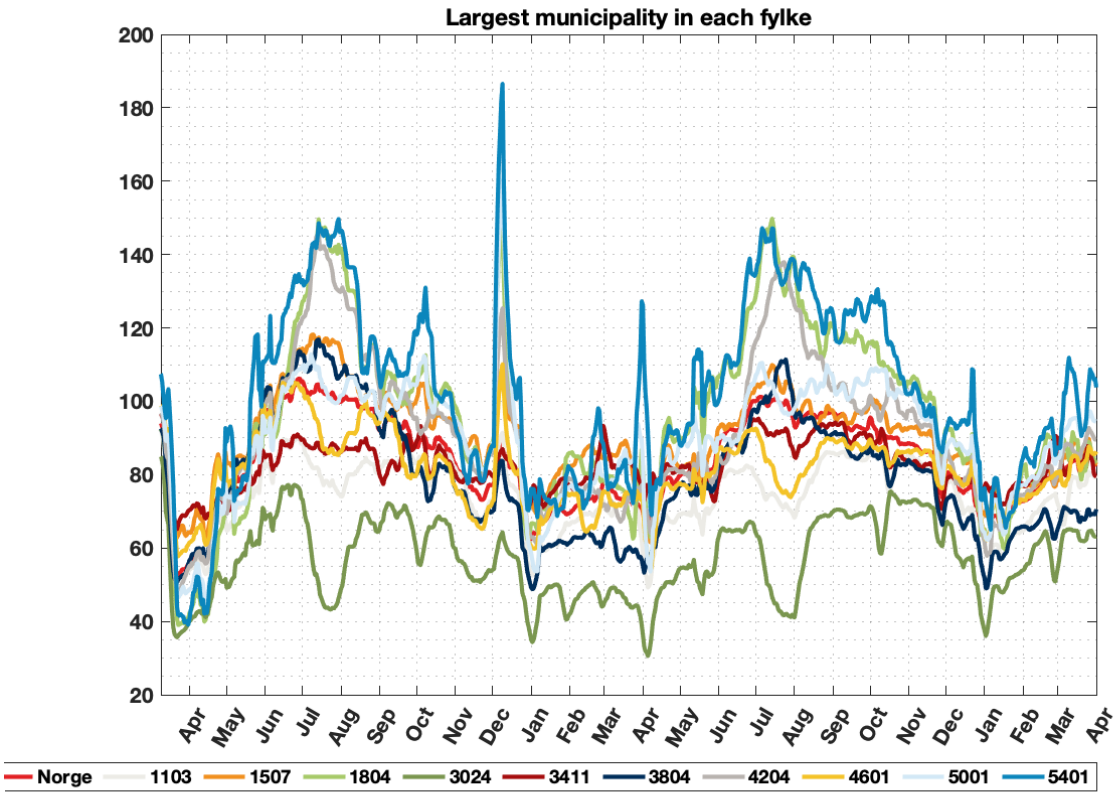


Figure 13: Mobility for selected municipalities since March 2020: Nationally (Norge), Stavanger (1103), Ålesund (1507), Bodø (1804), Bærum (3024), Ringsaker (3411), Sandefjord (3804), Kristiansand (4204), Bergen (4601), Trondheim (5001), Tromsø (5401).

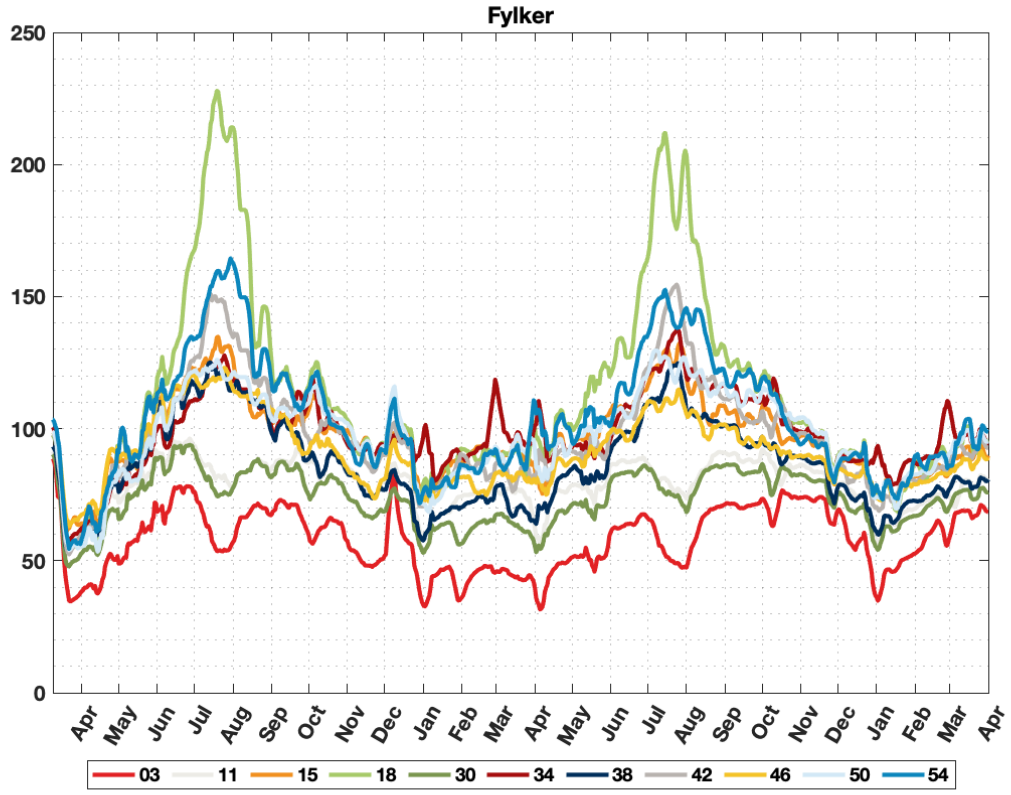


Figure 14: Mobility for fylker since March 2020: Oslo (03), Rogaland (11), Møre og Romsdal (15), Nordland (18), Viken (30), Innlandet (34), Vestfold og Telemark (38), Agder (42), Vestland (46), Trøndelag (50), Troms og Finmark (54).

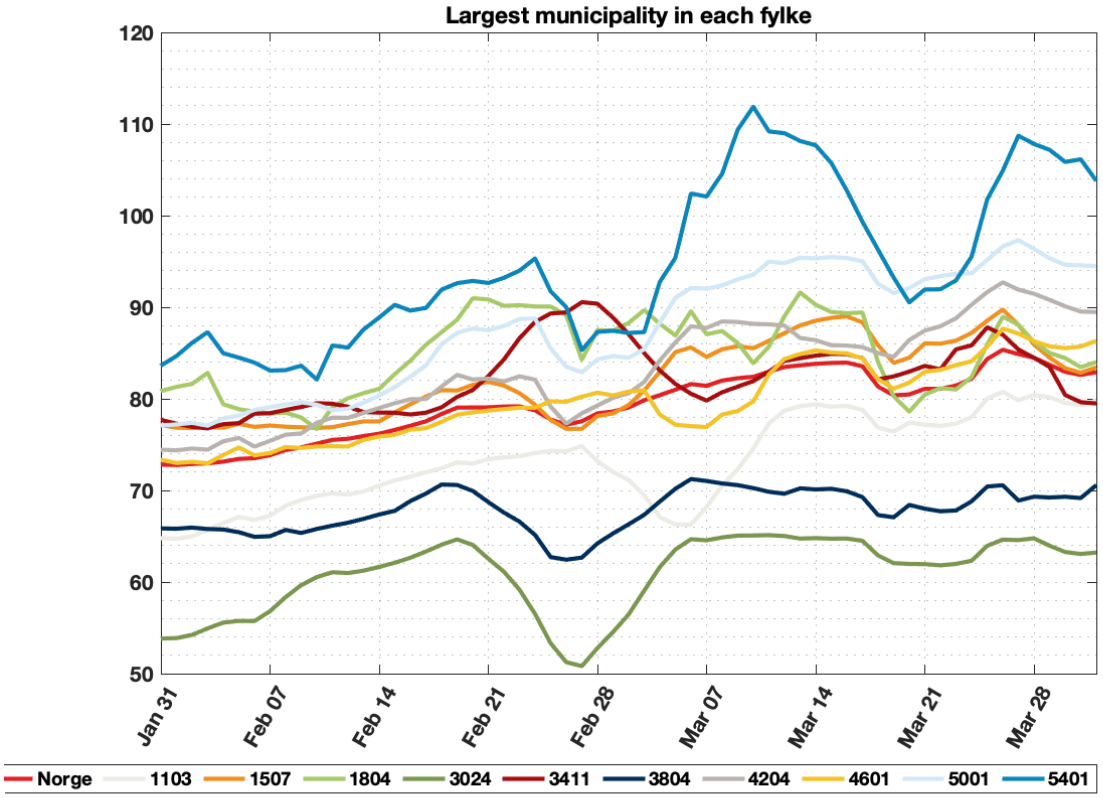


Figure 15: Zoom: Mobility from August 16, 2021 and onwards: Nationally (Norge), Stavanger (1103), Ålesund (1507), Bodø (1804), Bærum (3024), Ringsaker (3411), Sandefjord (3804), Kristiansand (4204), Bergen (4601), Trondheim (5001), Tromsø (5401).

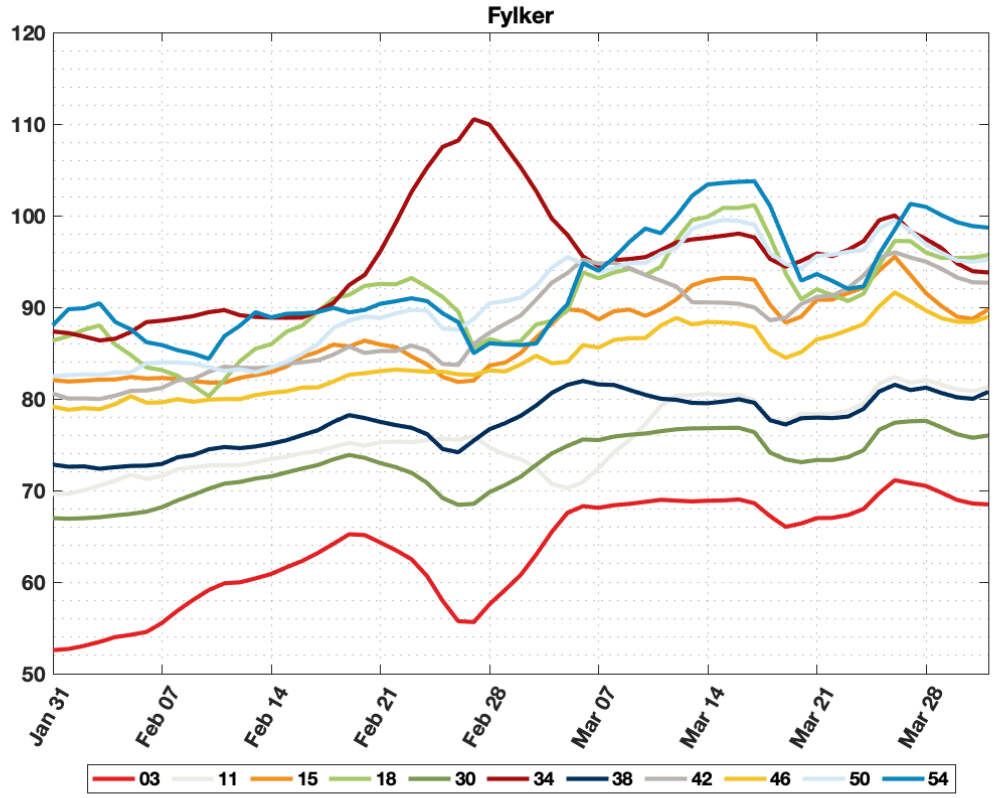


Figure 16: Zoom: Mobility from August 16, 2021 and onwards, per fylker: Oslo (03), Rogaland (11), Møre og Romsdal (15), Nordland (18), Viken (30), Innlandet (34), Vestfold og Telemark (38), Agder (42), Vestland (46), Trøndelag (50), Troms og Finnmark (54).

	10	11	12	13	14
Norge	78.4	81.4	83.8	81.1	84.5
Stavanger	73.2	68.2	79.4	77.2	80.4
Ålesund	78.1	84.6	88.5	86.0	85.9
Bodø	87.5	87.0	90.3	80.5	86.2
Bærum	52.8	64.6	64.8	62.0	64.8
Ringsaker	90.4	79.8	84.7	83.6	84.5
Sandefjord	64.2	71.0	70.1	68.0	69.3
Kristiansand	79.3	87.8	86.4	87.5	91.5
Bergen	80.7	76.9	85.3	83.0	86.3
Trondheim	84.3	92.0	95.3	93.1	96.4
Tromsø	87.3	102.1	107.7	91.9	107.8

Table 11: Municipalities

	10	11	12	13	14
Oslo	57.6	68.1	68.9	67.0	70.5
Rogaland	74.7	72.4	80.5	78.4	82.1
Møre og Romsdal	83.6	88.7	92.9	90.8	91.5
Nordland	86.5	93.2	99.9	92.0	96.0
Viken	69.8	75.5	76.8	73.3	77.6
Innlandet	109.9	94.5	97.6	95.9	97.4
Vestfold og Telemark	76.7	81.6	79.5	78.0	81.2
Agder	87.2	94.8	90.5	91.1	95.0
Vestlandet	83.1	85.6	88.4	86.5	89.6
Trøndelag	90.4	93.8	99.1	95.6	96.9
Troms og Finnmark	86.1	94.0	103.4	93.6	101.0

Table 12: Counties

Weekly mobility for Norway and selected municipalities is displayed in Table 11 and mobility for counties is displayed in Table 12. The percentages in the tables are to be interpreted towards the reference level of 100 for week 10 in March 2020. The color-coding encodes the following: 'Green' monotonic decrease in mobility, 'Yellow' almost monotonic decrease or flat mobility trend, 'Red' increasing mobility.

9.1 Foreign roamers on Telenor's network in Norway

An analysis of foreign roamers in Norway from January 2020 has been carried out, to better understand the potential virus importation. In Figure 17 the total number of roamers per day per county are displayed.

Figure 18 shows the levels of roamers from the following countries: Poland, Lithuania, Sweden, Netherlands, Denmark, Latvia, Germany, Spain, Finland and the rest of the world. These levels represent the total number of foreign, visiting roamers from each of the countries per day in Norway, since July 5 2021.

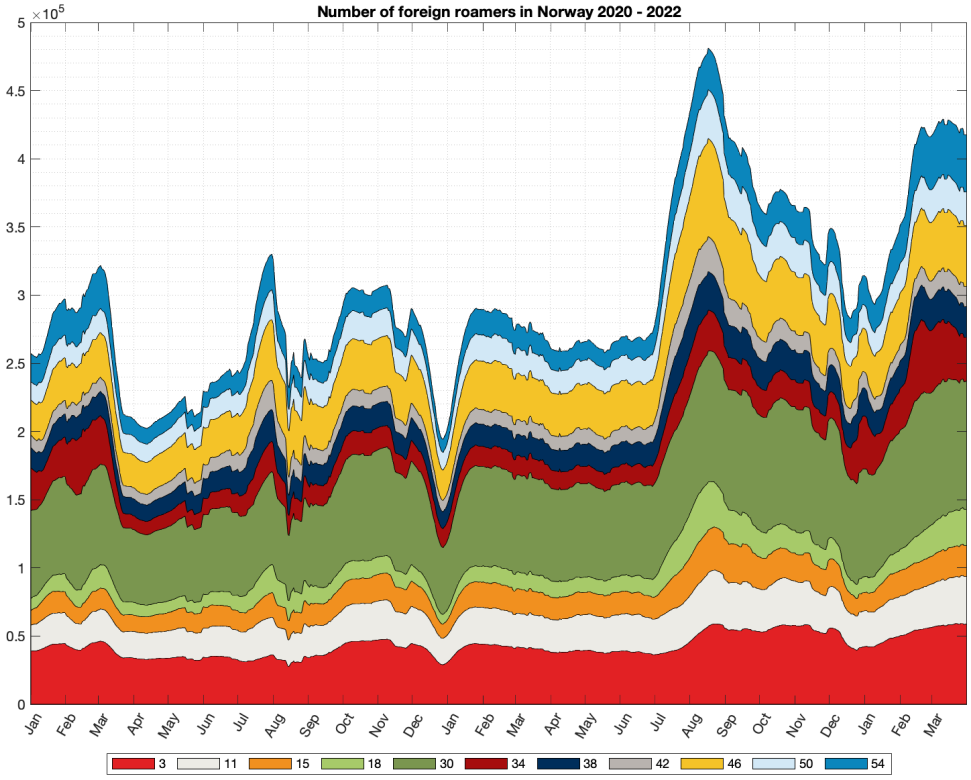


Figure 17: The total number of foreign roamers in Norway broken down on different fylker: Oslo (3), Rogaland (11), Møre og Romsdal (15), Nordland (18), Viken (30), Innlandet (34), Vestfold og Telemark (38), Agder (42), Vestland (46), Trøndelag (50), Troms og Finnmark (54).

9.1 Foreign roamers on Telenor's network in Norway

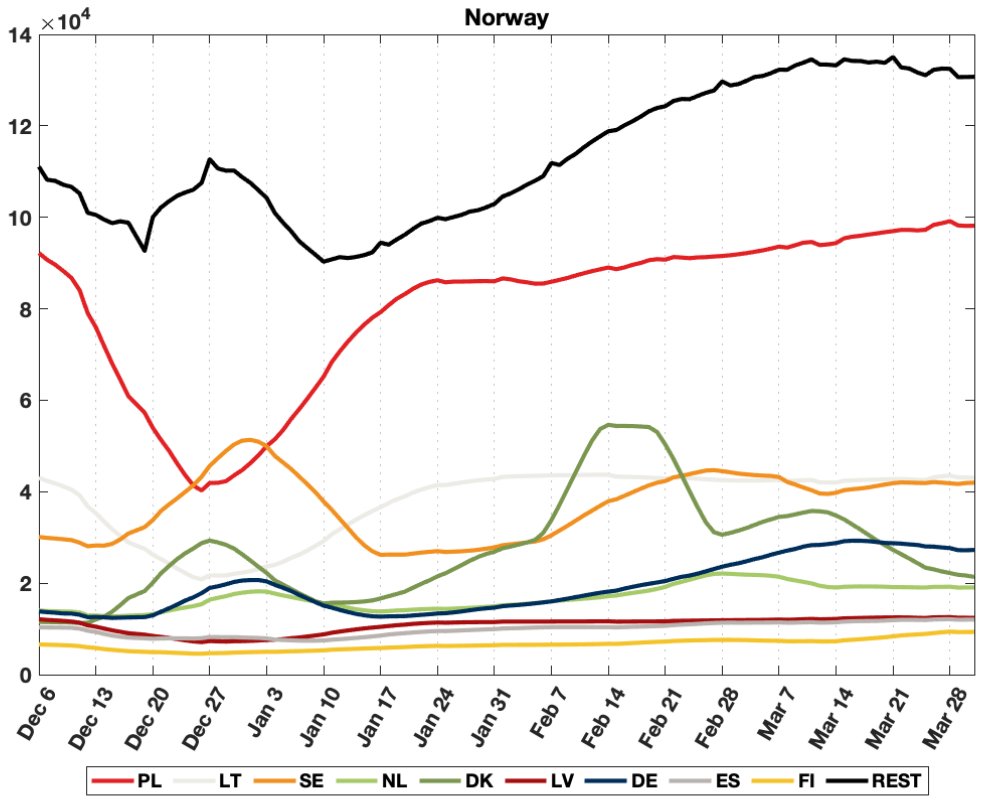
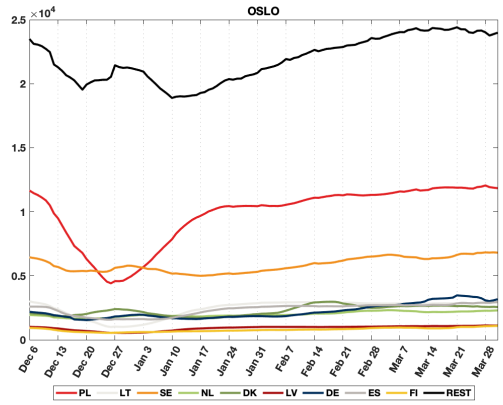
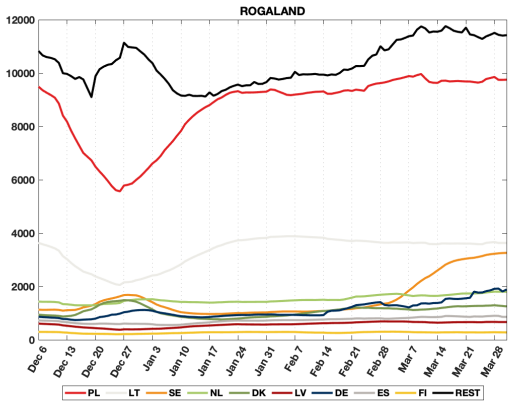
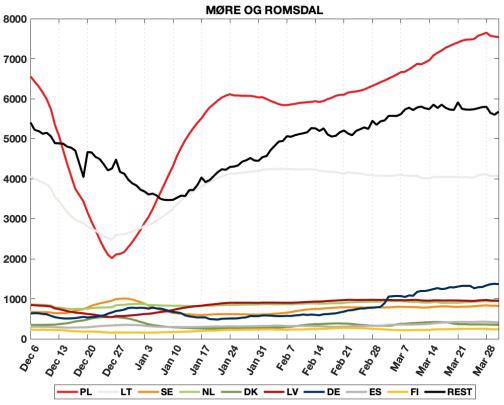


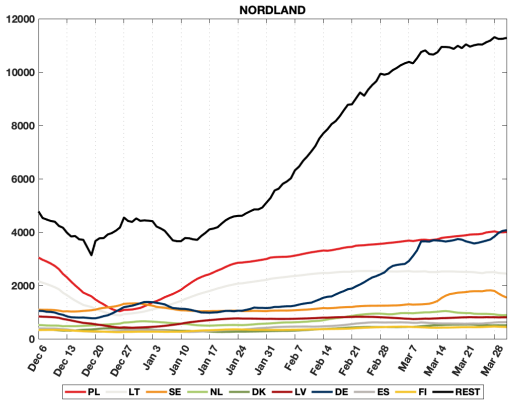
Figure 18: National overview of total number of foreign, visiting roamers from Poland, Lithuania, Sweden, Netherlands, Denmark, Latvia, Germany, Spain, Finland and the rest of the world.

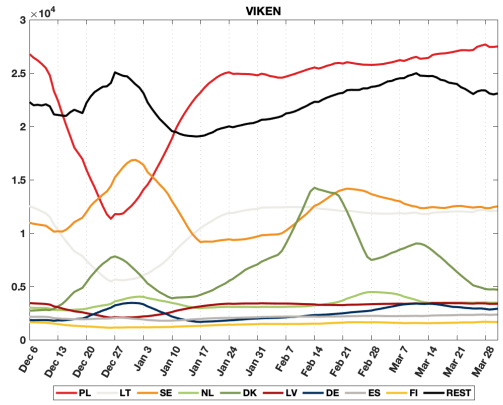
9.2 Foreign roamers per county (fylke) in Norway

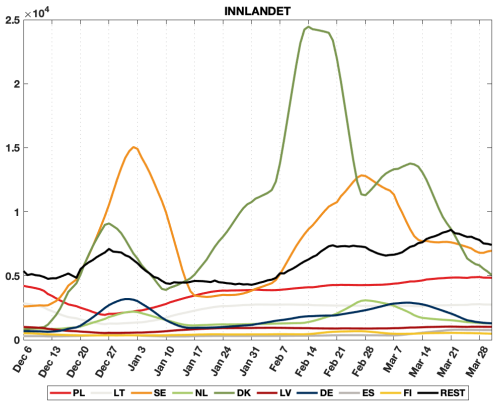




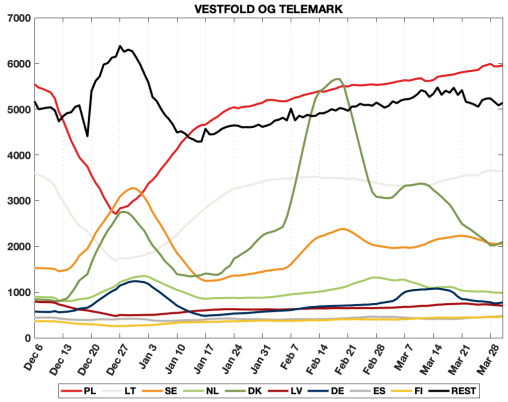


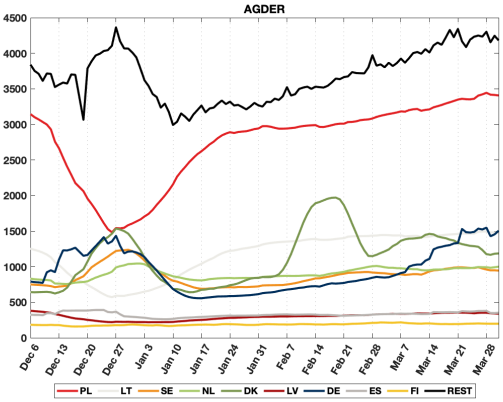


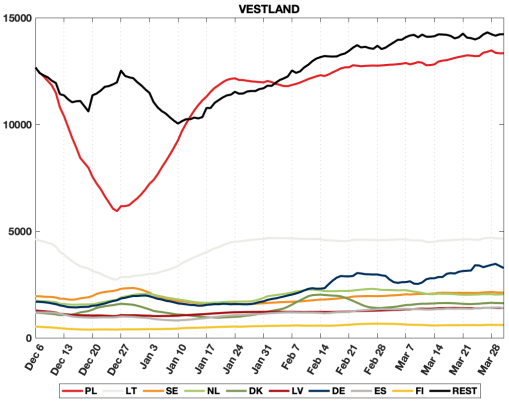


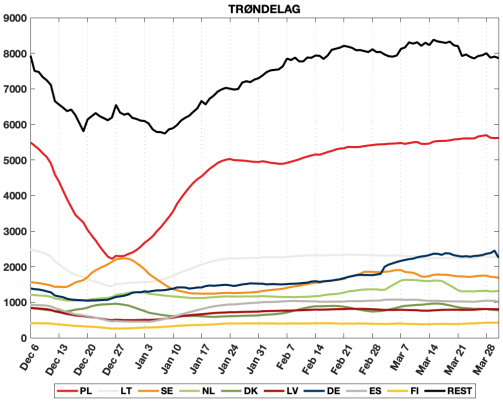


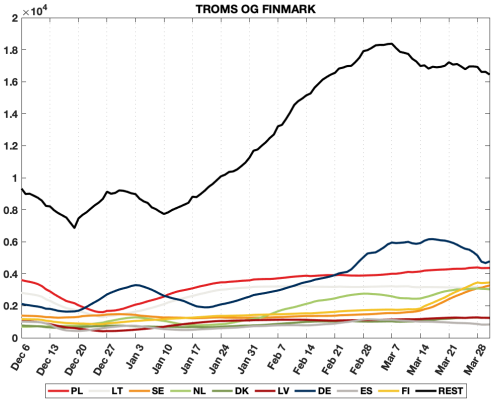
9.2 Foreign roamers per county (fylke) in Norway











10 Estimated parameters

Table 13: Estimated parameters

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	Period
R0s	1.777	2.409	2.628	2.635	2.85	3.644	Until March 14
R1s	0.386	0.611	0.668	0.667	0.725	0.907	From 15 March to 19 April
R2s	0.003	0.292	0.49	0.502	0.694	1.447	From 20 April to 10 May
R3s	0.001	0.264	0.5	0.516	0.724	1.503	From 11 May to 30 June
R4s	0.001	0.328	0.607	0.638	0.902	2.06	From 01 July to 31 July
R5s	0.05	0.828	1.058	1.036	1.258	1.782	From 01 August to 31 August
R6s	0.558	0.918	1.007	1.002	1.085	1.394	From 01 September to 25 October
R7s	0.117	0.945	1.148	1.162	1.388	2.261	From 26 October to 04 November
R8s	0.664	0.906	0.979	0.978	1.049	1.335	From 05 November to 30 November
R9s	0.554	0.783	0.837	0.838	0.895	1.133	From 01 December to 03 January
R10s	0.106	0.581	0.724	0.722	0.858	1.303	From 04 January to 21 January
R11s	0.338	0.78	0.91	0.914	1.05	1.501	From 22 January to 07 February
R12s	0.801	1.197	1.291	1.296	1.391	1.702	From 08 February to 01 March
R13s	0.675	0.928	0.984	0.985	1.043	1.231	From 02 March to 24 March
R14s	0.627	0.814	0.857	0.854	0.899	1.016	From 25 March to 05 May
R15s	0.283	0.713	0.841	0.841	0.961	1.498	From 06 May to 26 May
R16s	0.013	0.515	0.683	0.674	0.845	1.3	From 27 May to 20 June
R17s	0.005	0.487	0.678	0.673	0.854	1.459	From 21 June to 04 August
R18s	0.616	0.968	1.07	1.066	1.162	1.454	From 05 August to 31 August
R19s	0.457	0.71	0.777	0.774	0.834	1.092	From 01 September to 24 September
R20s	0.875	0.985	1.013	1.012	1.04	1.134	From 25 September to 14 December

Table 14: Assumptions

Assumptions	Mean	Distribution	Reference
Mobile Mobility Data			
Telenor coverage	48%		https://ekomstatistikken.nkom.no/
Data updated	Apr 3 rd		
Data used in the predictions	Apr 1 st	Fixed	Corrected to preserve population
Model parameters			
Exposed period ($1/\lambda_1$)	2 days	Exponential	changed from Feretti et al 2020
Pre-symptomatic period ($1/\lambda_2$)	2 days	Exponential	Feretti et al 2020
Symptomatic infectious period ($1/\gamma$)	3 days	Exponential	changed from Feretti et al 2020
Asymptomatic, infectious period ($1/\gamma$)	3 days	Exponential	changed from Feretti et al 2020
Infectiousness asympt. (r_{I_a})	0.1	Fixed	Feretti et al 2020
Infectiousness presymp (r_{E_2})	1.3	Fixed	guided by Feretti et al 2020
Prob. asymptomatic infection (p_a)	0.4		Feretti et al 2020
Healthcare			
Fraction asymptomatic infections	40%	Fixed	Mizumoto et al 2020 20% for the old population, Diamond Princess
% symptomatic and asymptomatic infections requiring hospitalization: 0-9 years 10 - 19 years 20 - 29 years 30 - 39 years 40 - 49 years 50 - 59 years 60 - 69 years 70 - 79 years 80+ years	 0.1% 0.1% 0.5% 1.1% 1.4% 2.9% 5.8% 9.3% 22.3%	Fixed	Saljie et al 2020 corrected for: % of elderly living in elderly homes in Norway (last two age groups) and corrected for presence among positive tested since May 1.
Probability that an admission has been reported on Monday From Sunday From Saturday From Friday From Thursday	 32% 49% 68% 86%	Fixed	Estimated from "Beredskapsregistret BeredtC19"
Probability that an admission has been reported From one day before From two days before From three days before From four days before	 53% 77% 82% 91%	Fixed	Estimated from "Beredskapsregistret BeredtC19"
Probability that a positive laboratory test has been reported From one day before From two days before From three days before From four days before	 6.7% 59% 90% 97%	Fixed	Estimated from MSIS
Probability that a negative laboratory test has been reported From one day before From two days before From three days before From four days before	 16% 74% 92% 98%	Fixed	Estimated from MSIS

Supplementary analysis: Trend analysis using various data sources

Due to significant changes in test recommendations, we present trend calculations from several monitoring data sources. Seen together, they can give insights on the trend of new infections. The data sources include:

- MSIS - A trend calculated from the number of confirmed positive cases. Changes in test criteria in recent weeks will likely lead to underestimating the trend of new infections.
- NOPaR: Admissions with covid-19 as the main reason, the trend is calculated from daily numbers admissions with covid-19 as the main cause. It usually takes longer from infection to hospitalization than for testing'; therefore, this indicator lacks behind the trend of transmission at around 1-2 weeks. The major difference in severity between Delta and Omicron also makes this indicator more challenging to interpret in the transition phase between the two variants.
- Symptometer - From the Symptometer survey, we calculate the proportion of respondents who self-report symptoms and a positive test for covid-19. This indicator provides a measure of the prevalence of infection in society, but after conversion, it can also provide an estimate of a trend for new infections.
- sKUHR - We use the development of the number of consultations with confirmed covid-19 (R992) at GP offices and emergency rooms, adjusting for delayed reporting the last 14 days. After correction for the delay between onset and seeking a doctor, this indicator measures the incidence of infection.
- MoBa - The participants in MoBa are sent a mobile questionnaire form every other week, including questions about who has been "sick with respiratory symptoms/fever the last 14 days" and how many days ago the symptoms started. We calculate an approximate 14-day incidence of symptom onset from this indicator, which is used to estimate a trend in infection. The number of respondents is about 60-75,000 in each round.
- NPR and NoPaR: Proportion of all acute admissions with covid-19, including entries with other main causes than covid-19. This indicator measures the prevalence of infection in society and is then converted into incidence of infection.

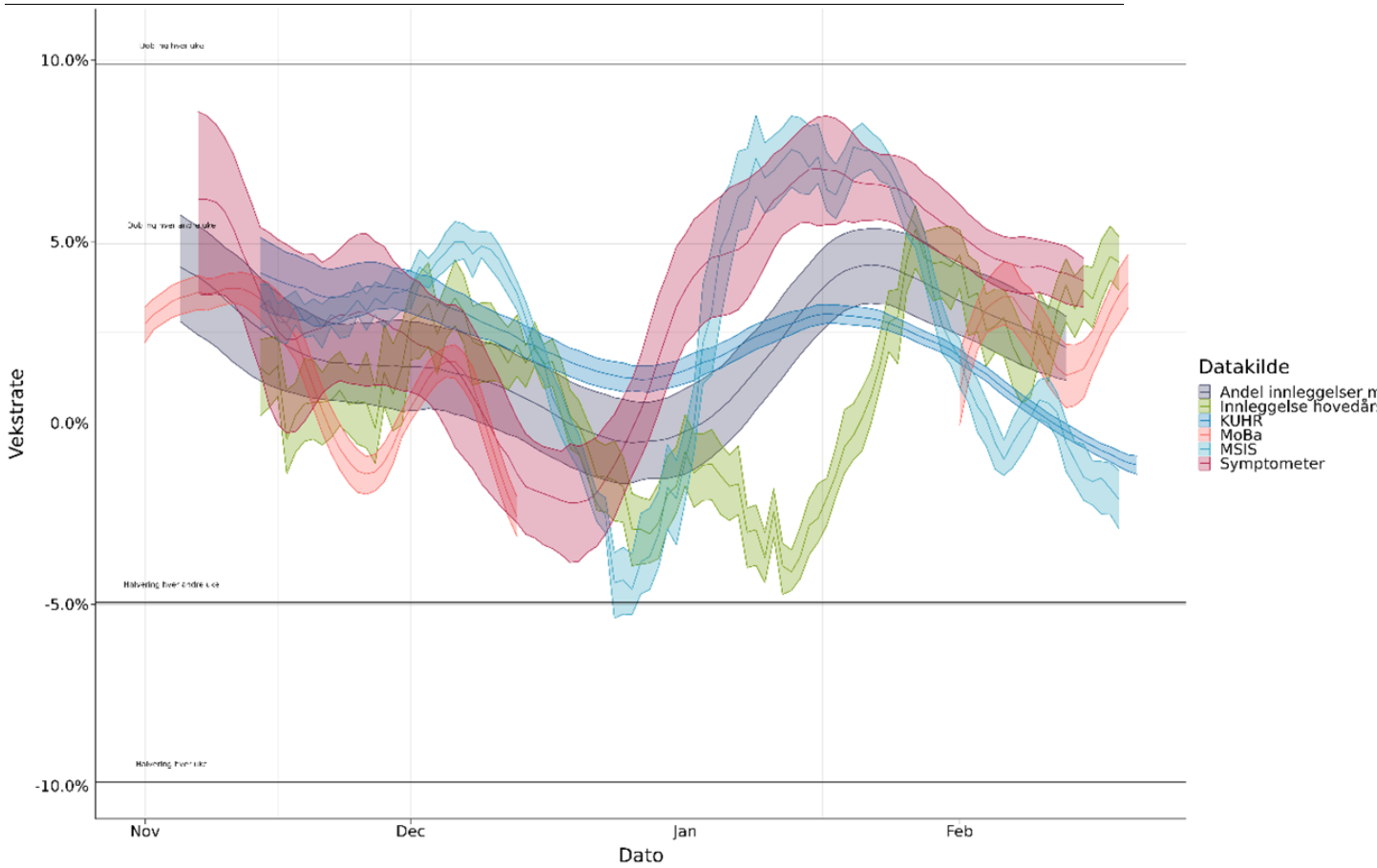


Figure 21: Trend analysis using various data sources

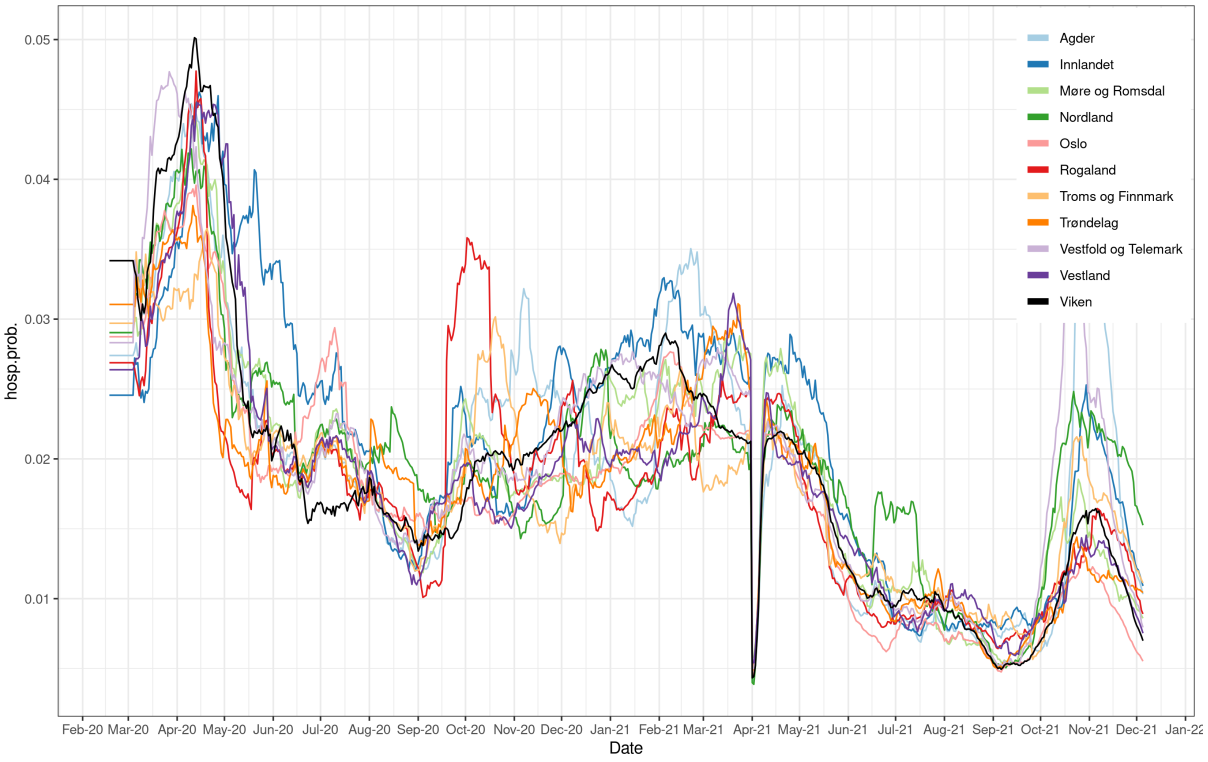


Figure 22: Regional hospitalisation probabilities per infection. The estimates are based on Salje et al., and regional data on the age distribution in the test data and the empirical case-hospitalisation rates.

Models and materials:

This report presents results based on a mathematical infectious disease model describing the geographical spread of COVID-19 in Norway. We use a metapopulation model for situational awareness and short-term forecasting and an individual-based model for long-term predictions. This report does not contain the long-term prediction results. Reproduction numbers of the metapopulation model are estimated in two ways: SMC-ABC is used to estimate a step-function in the transmissibility through prespecified changepoints, and SMC is used to estimate a daily varying reproduction number. We also provide estimates based on EpiEstim and a simple trend analysis. The models are described in previous reports and will not be explained here.

The metapopulation model takes daily varying Telenor mobility data as input. We also provide plots of the recent mobility for situational awareness.

How you should interpret the results: 3-week-ahead predictions and long-term scenarios We provide both 3-week-ahead predictions and long-term scenarios. These are simulations of the disease spread into the future, under specific assumptions.

In the 3-week-ahead predictions, we assume that all parameters are as today, and simulate disease spread 3-weeks-ahead in time. Hence, these predictions are conditional on the current situation, and specifically on the most recently estimated reproduction number. The 3-week-ahead predictions thus do not take into account changes in transmissibility that are not yet captured by the available data, for example due to the delay between transmission and hospitalisation. Hence one of the conditions for the predictions to be valid is that the intervention policies do not change significantly in the next weeks. Hence, it does not make sense to evaluate or use the predictions if there are big changes in factors like

- new interventions
- relaxation of interventions
- a combination of new interventions and relaxations
- a significant change in vaccination coverage
- new variants with new properties
- a significant change in the contact behaviour of individuals.

As these factors are not likely to stay constant in the long-term future, we do not produce predictions for longer than three weeks ahead in time. Hence, our 3-week-ahead predictions are predictions of what may happen in the future, if there were no significant changes in the assumptions.

In this report, the term patient in ventilator treatment includes only those patients that require either invasive mechanical ventilation or ECMO (Extracorporeal membrane oxygenation).

FHI COVID-19 modelling team:

- **Birgitte Freiesleben de Blasio** - Department of Method Development and Analytics. Norwegian Institute of Public Health and Oslo Centre for Biostatistics and Epidemiology, University of Oslo.
- **Francesco Di Ruscio** - Department of Method Development and Analytics. Norwegian Institute of Public Health.
- **Gunnar Øyvind Isaksson Rø** - Department of Method Development and Analytics. Norwegian Institute of Public Health.
- **Solveig Engebretsen** - Norsk Regnesentral.
- **Arnoldo Frigessi** - Oslo Centre for Biostatistics and Epidemiology, University of Oslo and Oslo University Hospital.
- **Alfonso Diz-Lois Palomares** - Department of Method Development and Analytics. Norwegian Institute of Public Health.
- **Magnus Nygård Osnes** - Department of Method Development and Analytics. Norwegian Institute of Public Health.
- **Anja Bråthen Kristoffersen** - Department of Method Development and Analytics. Norwegian Institute of Public Health.
- **Kenth Engø-Monsen** - Telenor Research.
- **Louis Yat Hin Chan** - Department of Method Development and Analytics. Norwegian Institute of Public Health.
- **Jonas Christoffer Lindstrøm** - Department of Method Development and Analytics. Norwegian Institute of Public Health.
- **Richard White** - Department of Method Development and Analytics. Norwegian Institute of Public Health.
- **Gry Marysol Grøneng** - Department of Method Development and Analytics. Norwegian Institute of Public Health.
- **Chi Zhang** - Department of Method Development and Analytics. Norwegian Institute of Public Health.
- **Jørgen Eriksson Midtbø** - Department of Method Development and Analytics. Norwegian Institute of Public Health.
- **Geir Storvik** - Department of Mathematics. University of Oslo.