NIPH
Norwegian Institute of Public Health

Situational awareness and forecasting for Norway

FHI COVID-19 modelling team

Week 8, 23 February 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 1.4 from 31 January. We note that the model captures only part of the effect from the easement of measures in February. There is substantial uncertainty related to the development in the next weeks.

It is challenging currently to model the epidemic evolution due to severe limitations in the available data. These include changes in reporting of test delay, uncertain data on importations, and reporting delay of newly hospitalised patients due to covid-19, affecting the latest data points. We also refer to trend analysis results 18 based on various data sources. There is considerable uncertainty in the recent hospital data, and we are currently unable to get a good correspondence between the hospital incidence and hospital prevalence data. For this reason, concerning projections of hospital prevalence, we refer to the regional results.

- **National epidemiological situation:**

  The most recent reproduction numbers:

Model	Median	2.5%	97.5%	Prob>1	period/day	More info
Changepoint	1.4	1.23	1.6	100%	from 31 Jan	Section 1

- **Regional epidemiological situation:**

  The newest regional reproduction numbers for Oslo:

Model	Median	2.5%	97.5%	Prob>1	day	Info other counties
SMC	1.32	0.81	2.24	0.87	1 Feb - 4 Feb	Table 2

- **Telenor mobility data and the number of foreign visitors:** The most recent mobility development is found in Figures 12 and 13 for the largest municipality in each county and for each county, respectively. Figure 14 shows the total number of roamers per day per county. Inter-county mobility and the number of foreign roamers have increased during 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
2.74/2.73(2.2-3.24)	From Feb 17 to Mar 14
0.54/0.54(0.41-0.64)	From Mar 15 to Apr 19
0.64/0.65(0.04-1.34)	From Apr 20 to May 10
0.8/0.81(0.25-1.27)	From May 11 to Jun 30
1.08/1.06(0.3-1.68)	From Jul 01 to Jul 31
1.03/1.02(0.63-1.39)	From Aug 01 to Aug 31
0.88/0.87(0.48-1.23)	From Sep 01 to Sep 30
1.14/1.17(0.81-1.68)	From Oct 01 to Oct 25
1.07/1.1(0.56-1.79)	From Oct 26 to Nov 04
0.94/0.94(0.77-1.1)	From Nov 05 to Nov 30
0.96/0.96(0.84-1.08)	From Dec 01 to Jan 03
0.71/0.71(0.45-0.95)	From Jan 04 to Jan 21
0.82/0.83(0.56-1.15)	From Jan 22 to Feb 07
1.4/1.4(1.14-1.64)	From Feb 08 to Mar 01
1.07/1.07(0.95-1.21)	From Mar 02 to Mar 24
0.81/0.81(0.66-0.95)	From Mar 25 to Apr 12
0.8/0.8(0.59-1.03)	From Apr 13 to May 05
1.04/1.04(0.71-1.36)	From May 06 to May 26
0.83/0.82(0.56-1.08)	From May 27 to Jun 20
0.78/0.78(0.53-1.03)	From Jun 21 to Aug 04
1.27/1.26(1.05-1.45)	From Aug 05 to Aug 31
0.76/0.76(0.65-0.9)	From Sep 01 to Sep 24
1.07/1.07(1.02-1.12)	From Sep 25 to Dec 12
1.1/1.1(1.04-1.16)	From Dec 13 to Jan 30
1.4/1.4(1.23-1.6)	From Jan 31

Median/Mean (95% credible intervals)

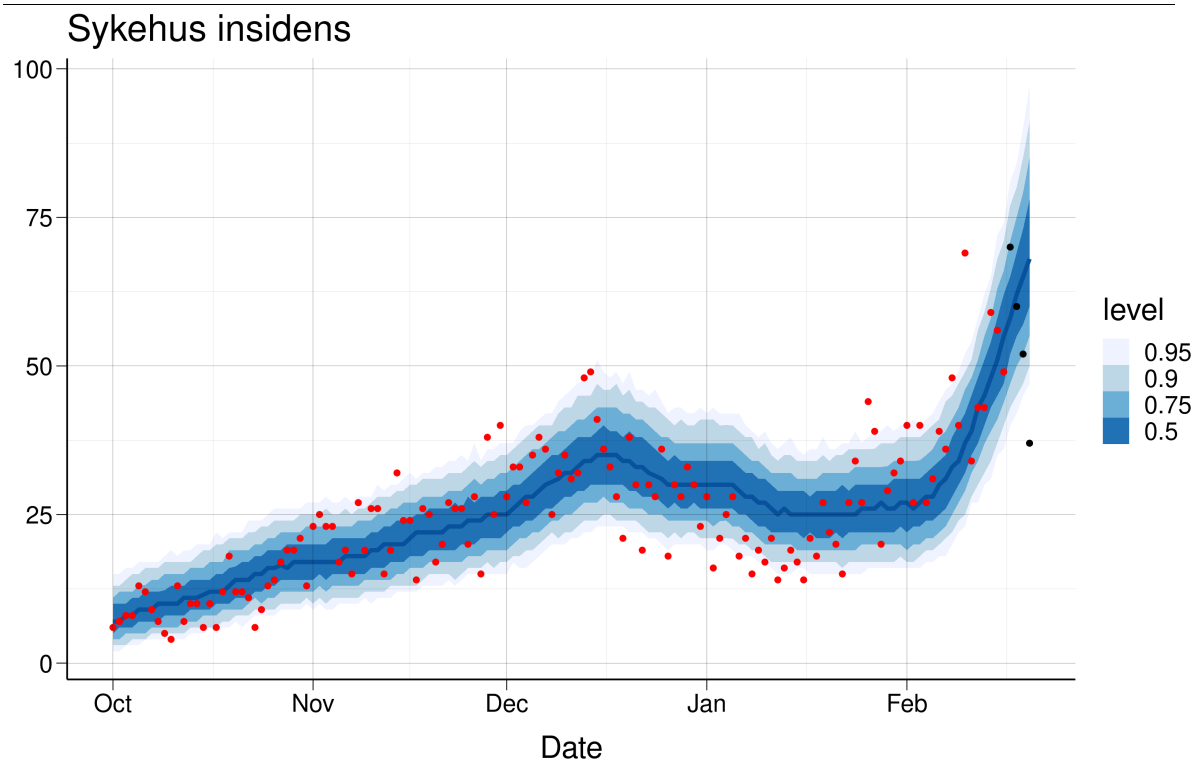
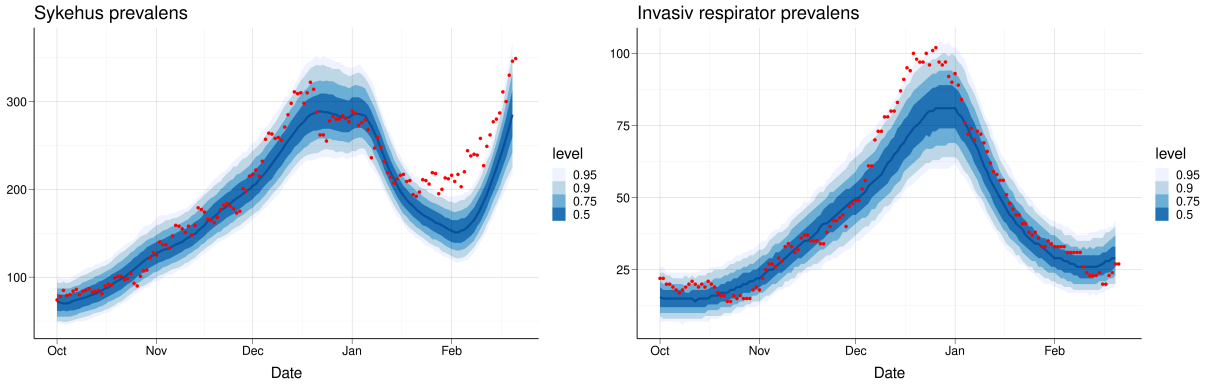


Figure 1: A comparison of true data (red) and predicted values (blue) for hospital admissions . The last four data points (black) are assumed to be affected by reporting delay. The uncertainty captures the uncertainty in the calibrated parameters, in addition to the stochastic elements of our model and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

Calibration of our regional SMC model to hospitalisation incidence data leads to the following estimates for current regional reproduction numbers by county (Table 2).
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 2: Regional estimates, 1 Feb-4 Feb

County	Median	95CI	Prob>1
Oslo	1.32	0.81-2.24	0.87
Rogaland	0.98	0.59-1.6	0.47
Møre og Romsdal	1.48	0.92-2.61	0.94
Nordland	1.37	0.81-2.41	0.88
Viken	1.34	0.88-2.19	0.91
Innlandet	1.10	0.63-2	0.64
Vestfold og Telemark	1.41	0.92-2.31	0.94
Agder	1.07	0.64-1.83	0.6
Vestland	1.44	0.91-2.38	0.94
Trøndelag	1.48	0.92-2.36	0.95
Troms og Finnmark	1.33	0.75-2.34	0.83

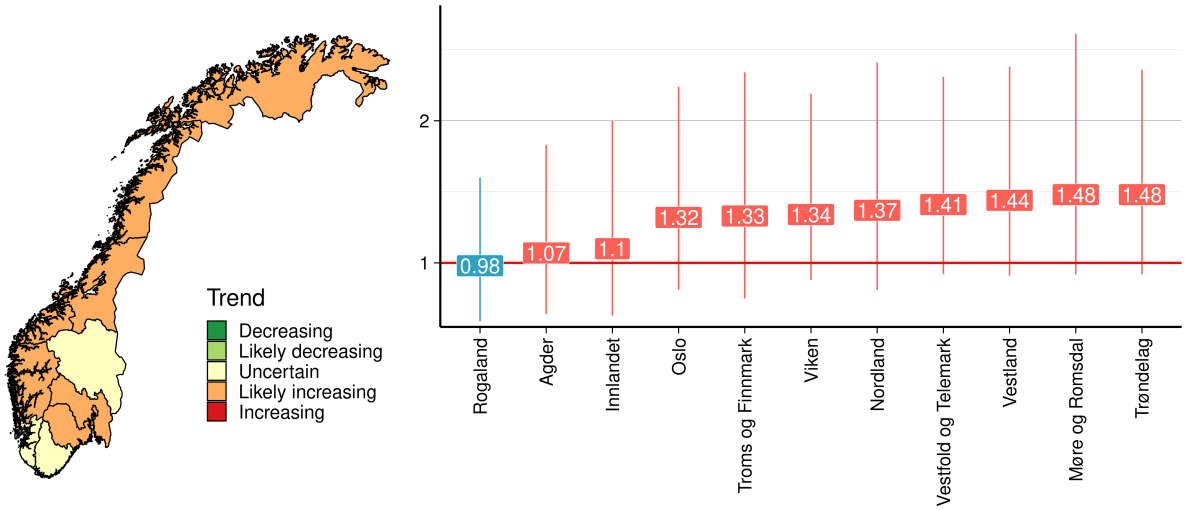
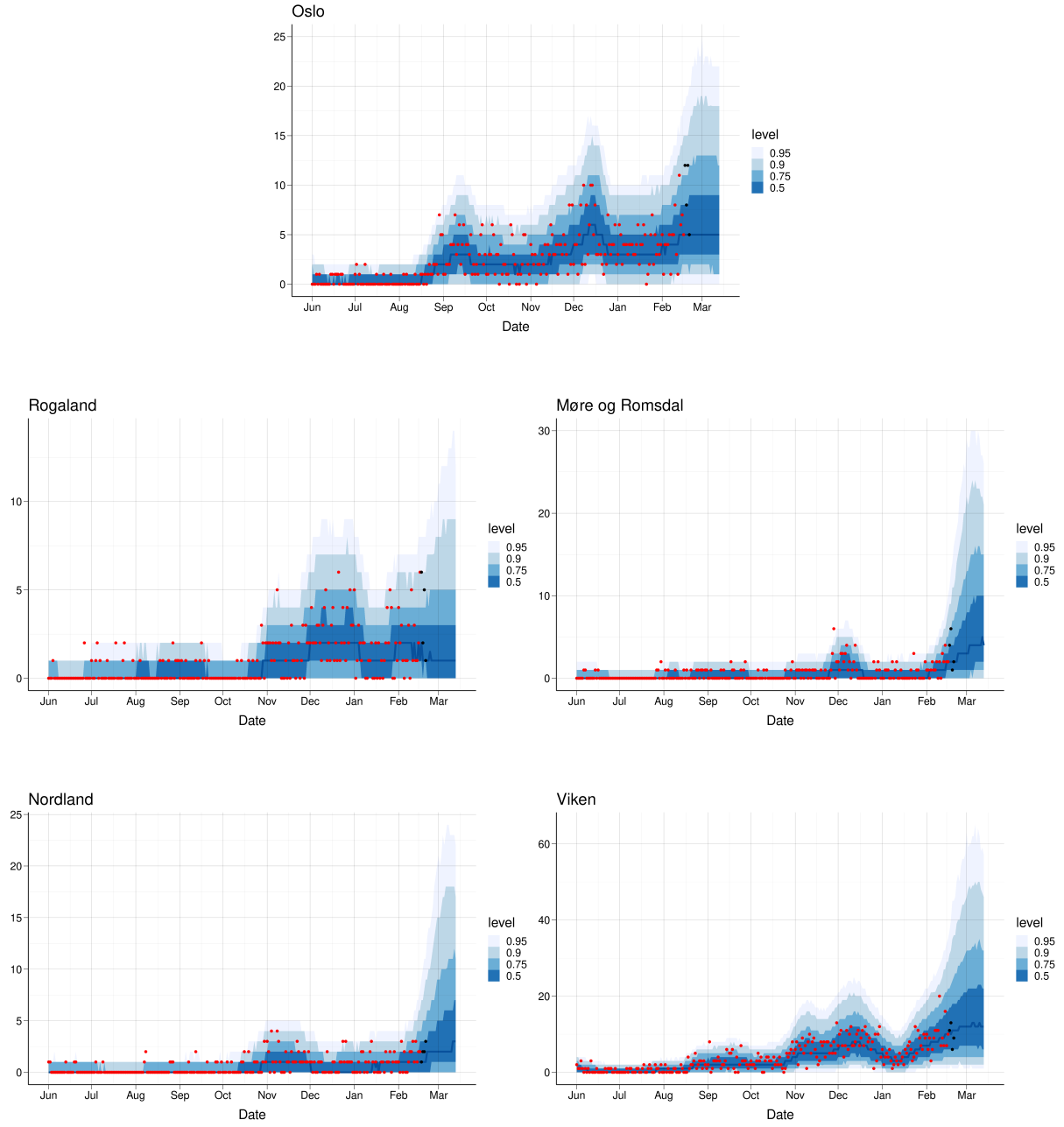
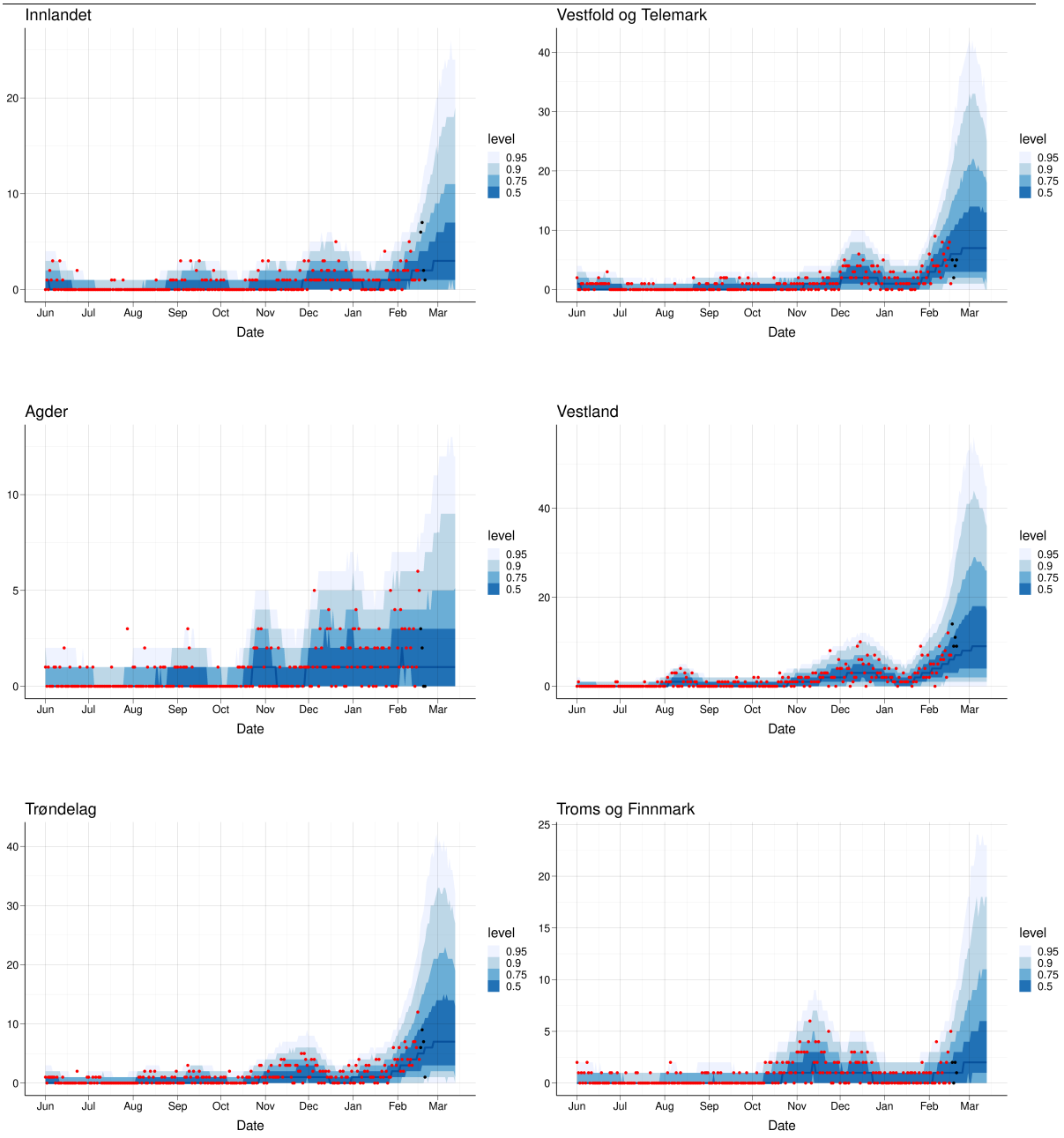


Figure 3: The map shows the direction of the trend in incidence in the counties based on the latest reproduction numbers shown in the other chart. The trend is increasing if the probability that the latest reproduction number is above one is above 95%, the trend is likely increasing if this probability 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 2.

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

Below is shown the daily incidence (table 3) and prevalence (table 4) for each county.

Table 3: Predicted incidence per day: Median/Mean (CI)

Region	1 week prediction (27 Feb)	2 weeks prediction (06 Mar)	3 weeks prediction (13 Mar)
Agder	507/831 (100-3787)	490/839 (86-3952)	472/780 (77-3306)
Innlandet	1090/1603 (227-6777)	1165/1662 (219-6372)	1092/1530 (203-5097)
Møre og Romsdal	1492/2396 (228-8377)	1770/2378 (221-6308)	1799/2002 (213-4506)
Nordland	816/1508 (120-6511)	948/1583 (110-5544)	1026/1429 (104-4015)
Oslo	1787/2119 (701-5248)	1676/1950 (641-4530)	1527/1690 (593-3432)
Rogaland	564/883 (131-3786)	531/905 (116-4268)	501/876 (108-4216)
Troms og Finnmark	653/1235 (88-5821)	778/1387 (85-5431)	866/1332 (79-4149)
Trøndelag	3359/4214 (510-11841)	3299/3724 (450-9098)	2752/2931 (387-6550)
Vestfold og Telemark	2465/3211 (469-9239)	2373/2769 (393-6831)	2017/2163 (324-4689)
Vestland	3579/4934 (578-15208)	3723/4461 (495-11351)	3339/3597 (414-8128)
Viken	4642/5870 (1435-17400)	4609/5637 (1260-14729)	4333/4936 (1111-10878)

Table 4: 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	27 Feb	06 Mar	13 Mar	low CI, 13 Mar	high CI, 13 Mar
Agder	2330/3682	2266/3779	2188/3586	434	15296
Innlandet	4749/6903	5220/7409	5033/7008	1049	23938
Møre og Romsdal	6353/10179	7655/10631	8161/9301	1044	21285
Nordland	3567/6434	4139/7027	4589/6562	577	18771
Oslo	9882/11334	9488/10758	8875/9704	4671	18127
Rogaland	2874/4199	2735/4339	2616/4261	862	19175
Troms og Finnmark	2800/5185	3376/6037	3812/5995	417	19120
Trøndelag	14638/18546	14903/17062	12927/13846	1902	30567
Vestfold og Telemark	11062/14400	10876/12881	9548/10363	1757	22649
Vestland	15614/21691	16657/20410	15568/16958	2169	38610
Viken	21328/26669	21520/26252	20531/23609	6263	52594

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

Below is shown the estimated short-term forecasting of expected hospital prevalence (table 5) and patients on ventilator treatment for each county (table 6). These estimates do not take into account imported cases from abroad that may be admitted to hospital.

Table 5: Number of hospitalisation beds occupied by Covid-19 patients: Median/Mean (CI)

Region	1 week prediction (27 Feb)	2 weeks prediction (06 Mar)	3 weeks prediction (13 Mar)
Agder	8/11 (1-40)	8/12 (1-51)	8/13 (0-56)
Innlandet	13/18 (2-66)	17/24 (2-94)	19/27 (2-108)
Møre og Romsdal	14/22 (2-86)	19/30 (2-112)	24/34 (2-106)
Nordland	10/15 (1-63)	12/20 (1-90)	13/23 (1-91)
Oslo	27/31 (8-77)	28/32 (8-82)	27/31 (7-80)
Rogaland	9/12 (1-39)	9/13 (1-48)	8/13 (1-57)
Troms og Finnmark	9/13 (1-58)	10/19 (1-87)	13/23 (0-96)
Trøndelag	35/45 (6-146)	41/52 (6-158)	43/52 (5-140)
Vestfold og Telemark	36/46 (7-144)	39/51 (6-161)	41/50 (5-138)
Vestland	40/55 (8-181)	47/65 (7-213)	51/66 (6-190)
Viken	64/77 (23-207)	69/86 (21-246)	72/88 (19-249)

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

Region	1 week prediction (27 Feb)	2 weeks prediction (06 Mar)	3 weeks prediction (13 Mar)
Agder	1/1 (0-5)	1/1 (0-6)	1/2 (0-7)
Innlandet	1/2 (0-6)	2/2 (0-9)	2/3 (0-11)
Møre og Romsdal	1/2 (0-7)	2/3 (0-11)	2/3 (0-13)
Nordland	1/1 (0-5)	1/2 (0-8)	1/2 (0-10)
Oslo	3/3 (0-8)	3/3 (0-9)	3/3 (0-9)
Rogaland	1/2 (0-5)	1/2 (0-6)	1/2 (0-7)
Troms og Finnmark	1/1 (0-5)	1/2 (0-8)	1/2 (0-10)
Trøndelag	3/4 (0-13)	4/5 (0-17)	5/6 (0-18)
Vestfold og Telemark	4/4 (0-13)	4/5 (0-17)	5/6 (0-18)
Vestland	4/5 (0-15)	5/7 (0-21)	6/8 (0-23)
Viken	7/8 (2-19)	8/9 (2-25)	9/10 (2-29)

5 14-day trend analysis of confirmed cases and hospitalisations by county

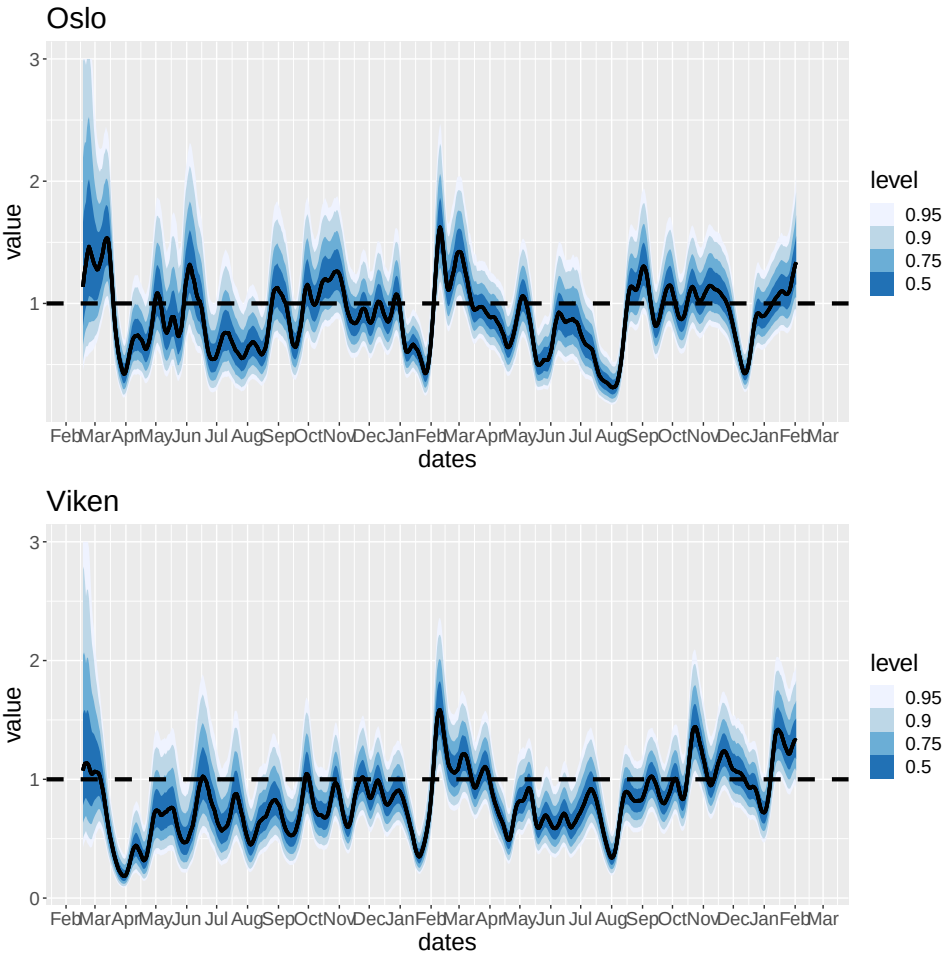
To estimate recent trends in hospitalisation and number of positive tests, we present results in table 7 based on a negative binomial regression where we account for weekend effects. We exclude the last three days to avoid problems of reporting delay and fit the model using data from 17 days to 3 days 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.

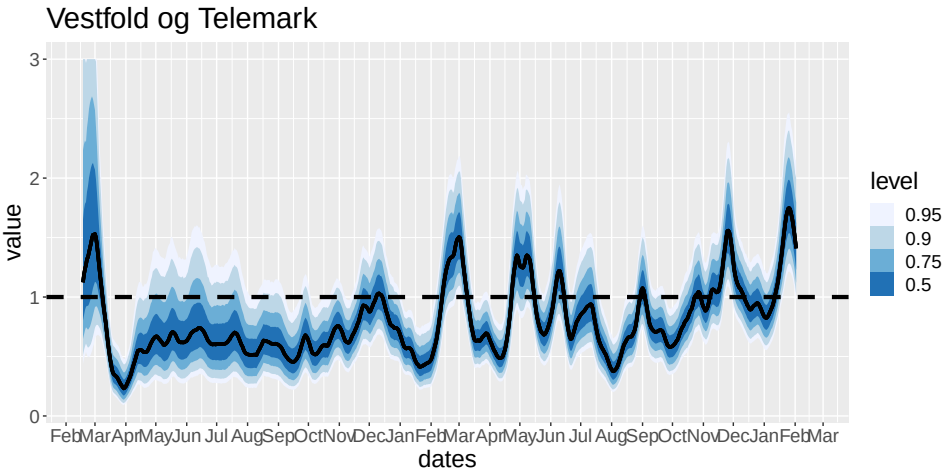
Table 7: Trend analysis for the last 14 days

	Average daily increase last 14 days		Doubling Time (days)	
County	Hospitalisations	Cases	Hospitalisations	Cases
Agder	4.3 (-6, 16) %	1.6 (-2.7, 6) %	16.6 (-11.2, 4.7)	44.6 (-25.6, 11.9)
Innlandet	1 (-12.4, 16.8) %	8.7 (3.8, 13.9) %	66.5 (-5.2, 4.5)	8.3 (18.6, 5.3)
Møre og Romsdal	-3.5 (-17, 11.6) %	5.7 (0.6, 11) %	-19.6 (-3.7, 6.3)	12.5 (111.2, 6.6)
Nordland	-5.8 (-18.3, 7.9) %	3.9 (-1.6, 9.8) %	-11.7 (-3.4, 9.2)	17.9 (-41.7, 7.4)
Norge	-3.1 (-5.7, -0.4) %	5.7 (2.5, 9) %	-22.2 (-11.8, -181.7)	12.6 (28.5, 8.1)
Oslo	0.3 (-5.5, 6.5) %	7.5 (4.8, 10.2) %	215.4 (-12.3, 11)	9.6 (14.7, 7.1)
Rogaland	-3.5 (-11.9, 5.4) %	5.5 (2.2, 9) %	-19.3 (-5.5, 13.1)	12.9 (32.4, 8)
Troms og Finnmark	Not enough data	6.2 (1.6, 11) %	Not enough data	11.6 (44.3, 6.6)
Trøndelag	Not enough data	9.7 (5.4, 14.1) %	Not enough data	7.5 (13.2, 5.2)
Vestfold og Telemark	-0.2 (-11, 12) %	4.1 (1.4, 6.9) %	-434.6 (-6, 6.1)	17.2 (49, 10.4)
Vestland	-5.9 (-14.3, 2.9) %	4.2 (0.5, 8.1) %	-11.4 (-4.5, 23.9)	16.9 (153.9, 8.9)
Viken	-7.2 (-13, -1.3) %	4.8 (1.5, 8.2) %	-9.2 (-5, -55)	14.8 (45.8, 8.8)

6 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.

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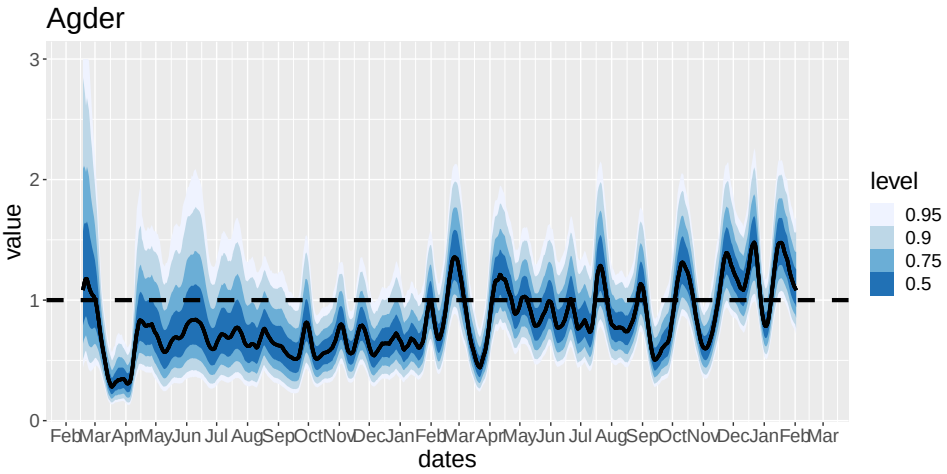
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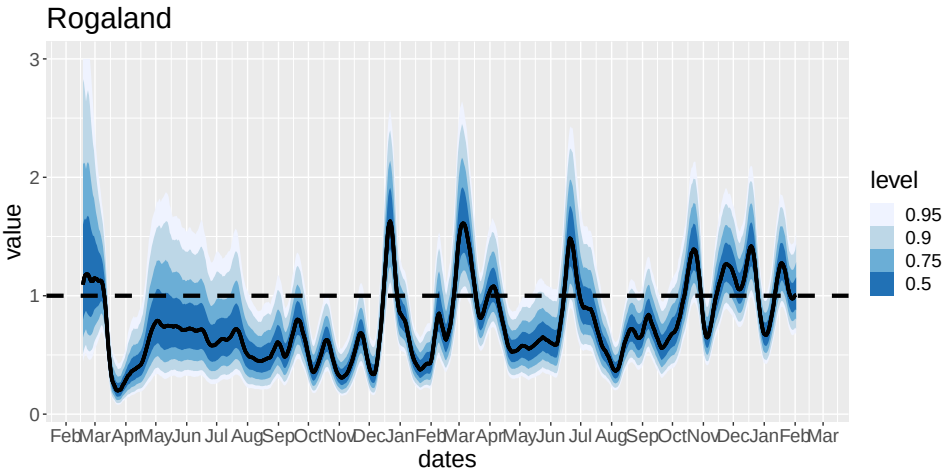
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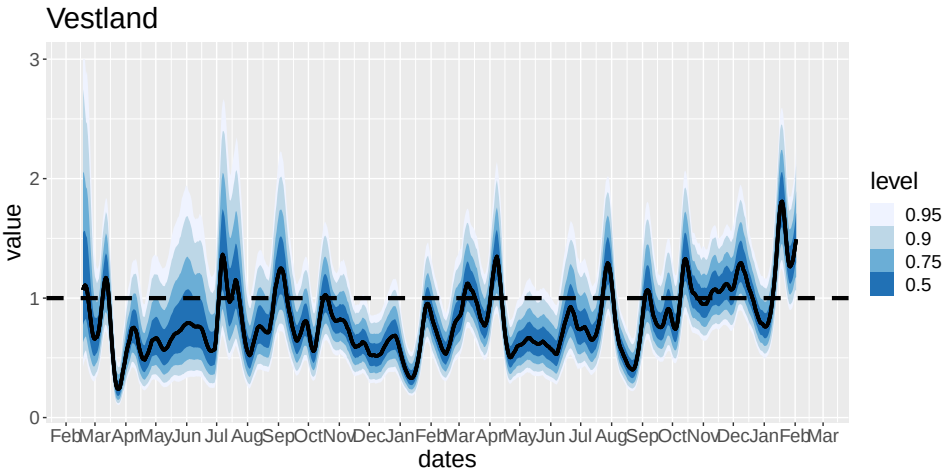
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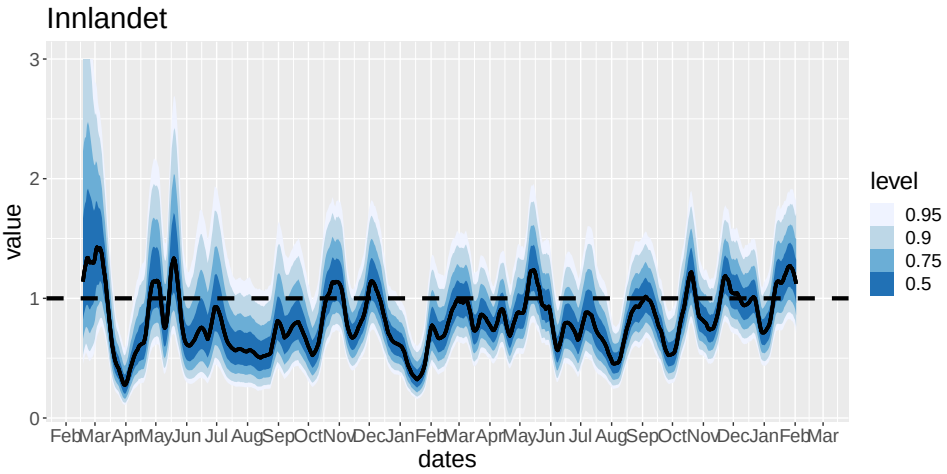
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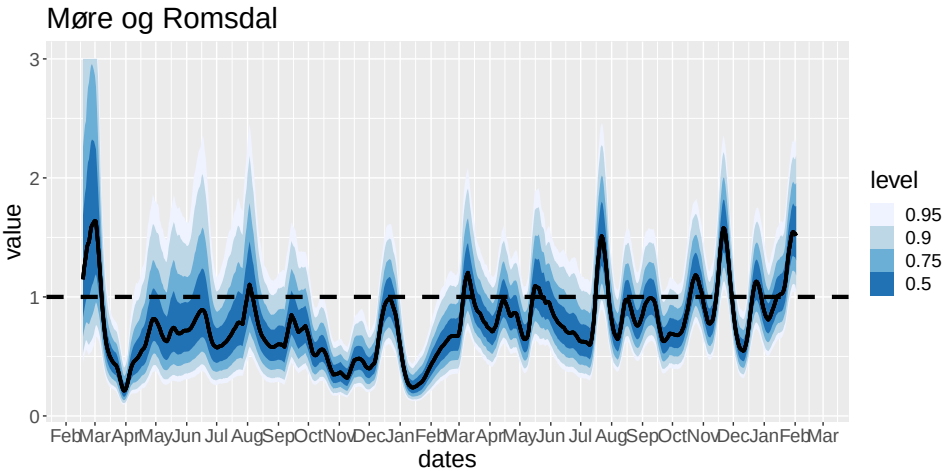
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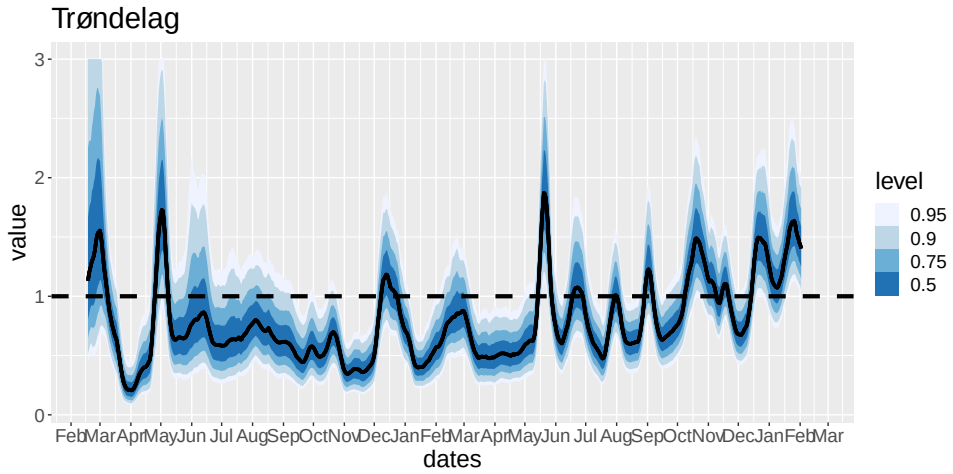
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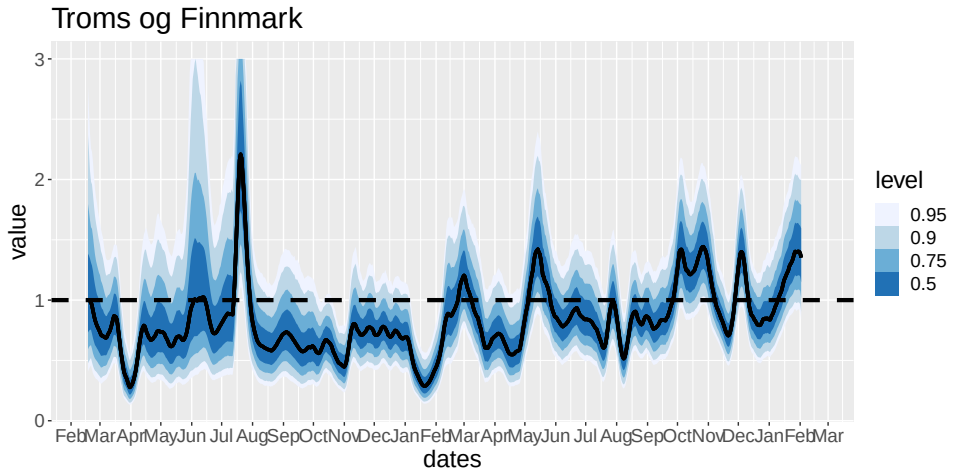
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7 Short-term predictions per health trust ("helseforetak"): number of occupied covid-19 beds and number of patients receiving ventilator treatment

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

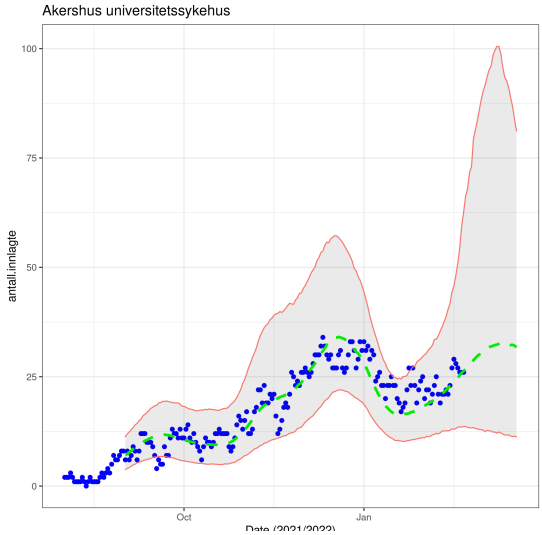
Table 8: Number of hospitalisation beds occupied by Covid-19 patients: Median/Mean (CI)

Helseforetak	1 week prediction (27 Feb)	2 weeks prediction (06 Mar)	3 weeks prediction (13 Mar)
Akershus universitetssykehus	29/34 (13-81)	32/37 (13-95)	33/38 (12-96)
Finnmarksykehuset	2/4 (0-18)	3/6 (0-27)	4/7 (0-29)
Helse Bergen	29/40 (6-130)	34/47 (6-151)	36/47 (5-134)
Helse Fonna	7/9 (2-25)	8/10 (2-29)	9/10 (2-28)
Helse Førde	7/9 (2-31)	8/11 (1-36)	9/11 (1-32)
Helse Møre og Romsdal	14/22 (2-83)	19/30 (2-110)	24/34 (2-102)
Helse Nord Trøndelag	11/14 (2-46)	13/17 (2-49)	14/17 (2-43)
Helse Stavanger	7/9 (2-29)	7/10 (2-36)	6/10 (1-43)
Nordlandssykehuset	6/9 (1-36)	7/12 (1-51)	8/13 (1-52)
Oslo universitetssykehus	23/26 (8-63)	23/27 (8-67)	23/26 (8-65)
St. Olavs hospital	24/31 (5-99)	28/35 (5-106)	30/35 (4-93)
Sykehuset Innlandet	13/17 (3-57)	15/22 (3-85)	17/24 (3-94)
Sykehuset Telemark	15/19 (4-59)	16/21 (3-66)	17/21 (3-55)
Sykehuset i Vestfold	21/27 (5-84)	23/30 (5-94)	24/29 (4-79)
Sykehuset Østfold	16/20 (6-53)	18/22 (6-62)	18/22 (5-63)
Sørlandet sykehus	9/11 (1-39)	8/12 (1-49)	8/13 (1-55)
Universitetssykehuset i Nord-Norge	7/11 (1-42)	9/15 (1-64)	11/18 (1-70)
Vestre Viken	25/30 (10-81)	27/34 (9-96)	28/35 (8-98)

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

Helseforetak	1 week prediction (27 Feb)	2 weeks prediction (06 Mar)	3 weeks prediction (13 Mar)
Akershus universitetssykehus	3/4 (1-7)	4/4 (1-10)	4/4 (1-11)
Finnmarksykehuset	0/0 (0-2)	0/1 (0-2)	0/1 (0-3)
Helgelandssykehuset	0/0 (0-2)	0/1 (0-3)	0/1 (0-3)
Helse Bergen	3/4 (0-11)	4/5 (0-15)	4/5 (0-16)
Helse Fonna	1/1 (0-2)	1/1 (0-3)	1/1 (0-3)
Helse Førde	1/1 (0-3)	1/1 (0-4)	1/1 (0-4)
Helse Møre og Romsdal	1/2 (0-7)	2/3 (0-11)	2/3 (0-13)
Helse Nord Trøndelag	1/1 (0-4)	1/2 (0-5)	2/2 (0-6)
Helse Stavanger	1/1 (0-4)	1/1 (0-5)	1/1 (0-5)
Nordlandssykehuset	1/1 (0-3)	1/1 (0-5)	1/1 (0-6)
Oslo universitetssykehus	3/3 (0-7)	3/3 (0-8)	3/3 (0-8)
St. Olavs hospital	2/3 (0-9)	3/4 (0-12)	3/4 (0-12)
Sykehuset Innlandet	1/2 (0-5)	2/2 (0-8)	2/3 (0-10)
Sykehuset Telemark	2/2 (0-5)	2/2 (0-7)	2/2 (0-7)
Sykehuset i Vestfold	2/3 (0-8)	2/3 (0-10)	3/4 (0-11)
Sykehuset Østfold	2/2 (1-5)	2/2 (1-6)	2/3 (1-7)
Sørlandet sykehus	1/1 (0-5)	1/1 (0-6)	1/2 (0-7)
Universitetssykehuset i Nord-Norge	1/1 (0-4)	1/1 (0-6)	1/2 (0-8)
Vestre Viken	3/3 (1-7)	3/4 (1-10)	4/4 (1-11)

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.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75
50
25
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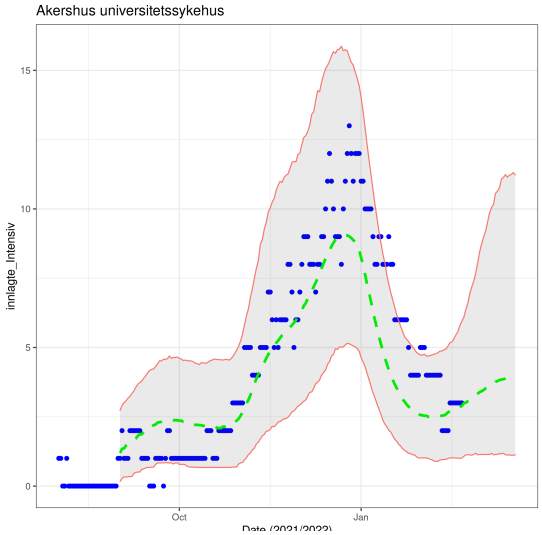
Oct
Jan


Akershus universitetssykehus
innlagte_Intensiv
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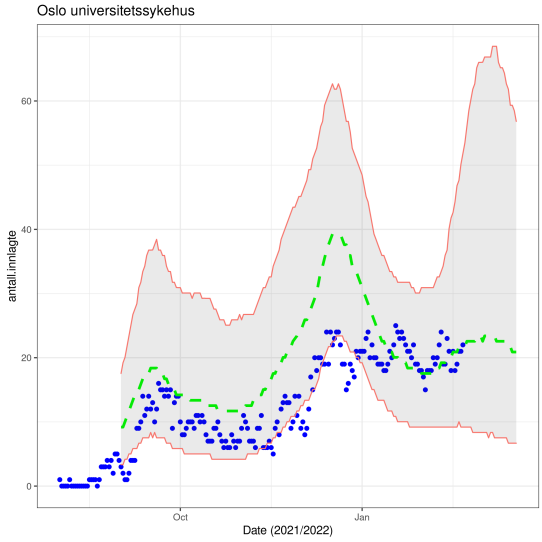
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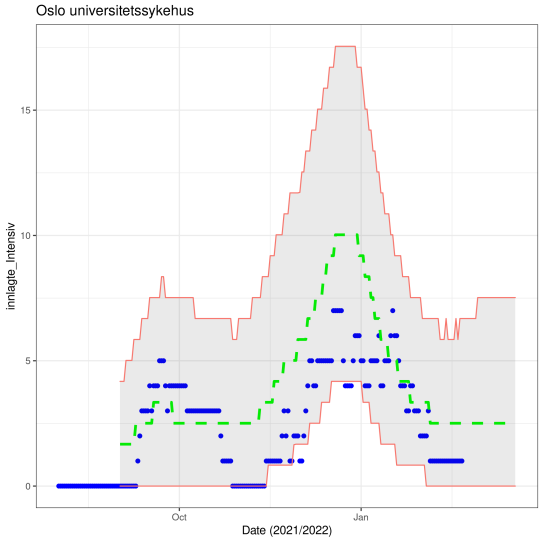
Date (2021/2022)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Date (2021/2022)


St. Olavs hospital
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Date (2021/2022)


St. Olavs hospital
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0.0
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Jan
Date (2021/2022)

8 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 10 shows an overview of the mobility since March 2020 for the largest municipalities in each county, and Figure 11 shows the total mobility out from all municipalities in each county, including Oslo. Figure 12 and 13, zooms in on mobility from August 16 2021, for municipalities and counties, respectively.

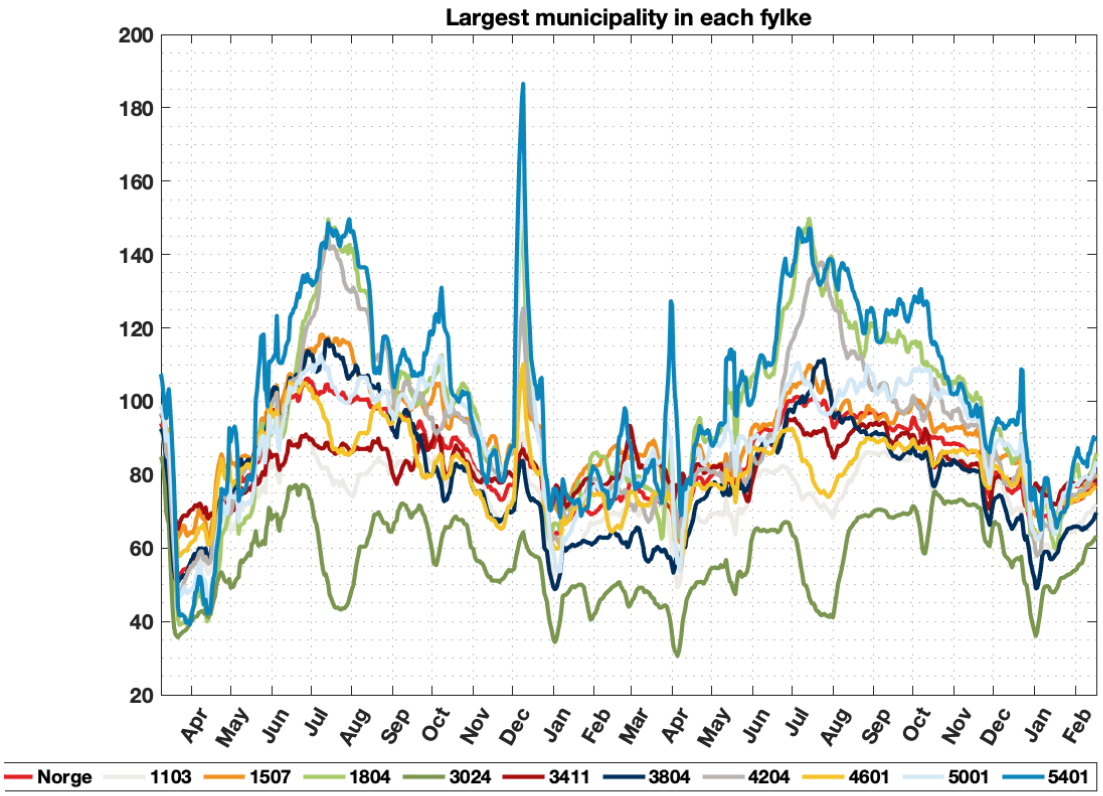


Figure 10: Mobility for selected municipalities since March 2020: Nationally (Norge), Stavanger (1103), Ålesund (1507), Bodø (1804), Bærum (3024), Ringsaker (3411), Sandefjord (3804), Kristiansand (4204), Bergen (4601), Trondheim (5001), Tromsø (5401).

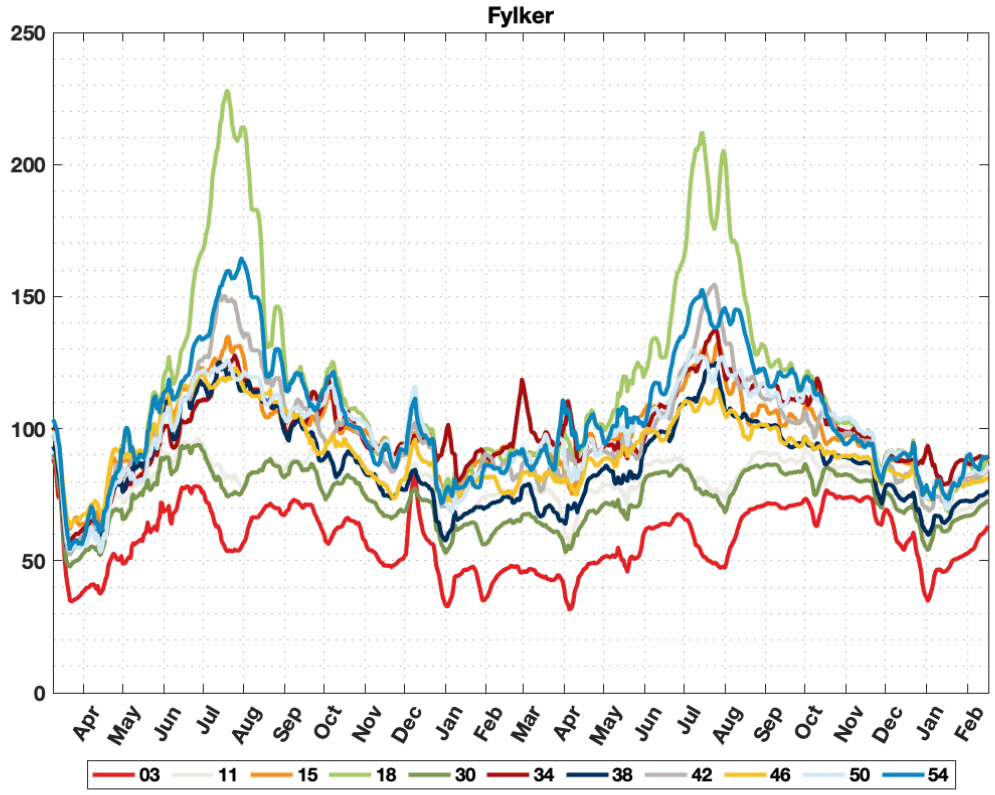


Figure 11: Mobility for fylker since March 2020: Oslo (03), Rogaland (11), Møre og Romsdal (15), Nordland (18), Viken (30), Innlandet (34), Vestfold og Telemark (38), Agder (42), Vestland (46), Trøndelag (50), Troms og Finmark (54).

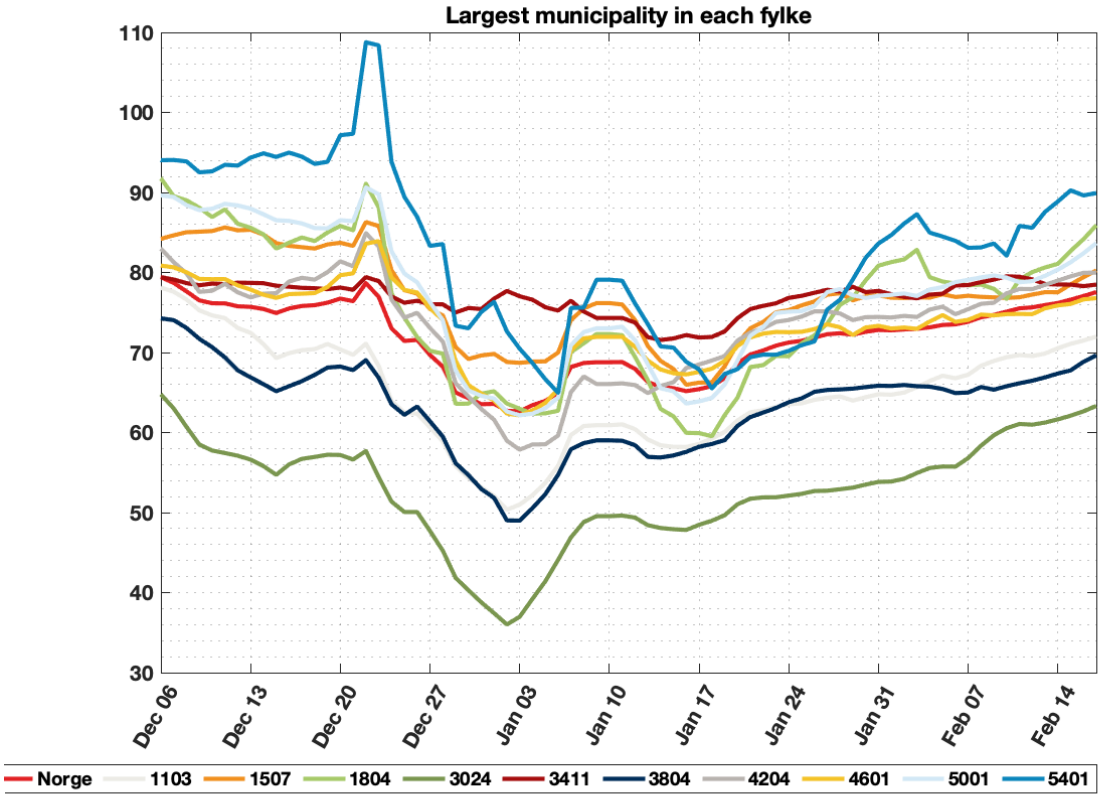


Figure 12: Zoom: Mobility from August 16, 2021 and onwards: Nationally (Norge), Stavanger (1103), Ålesund (1507), Bodø (1804), Bærum (3024), Ringsaker (3411), Sandefjord (3804), Kristiansand (4204), Bergen (4601), Trondheim (5001), Tromsø (5401).

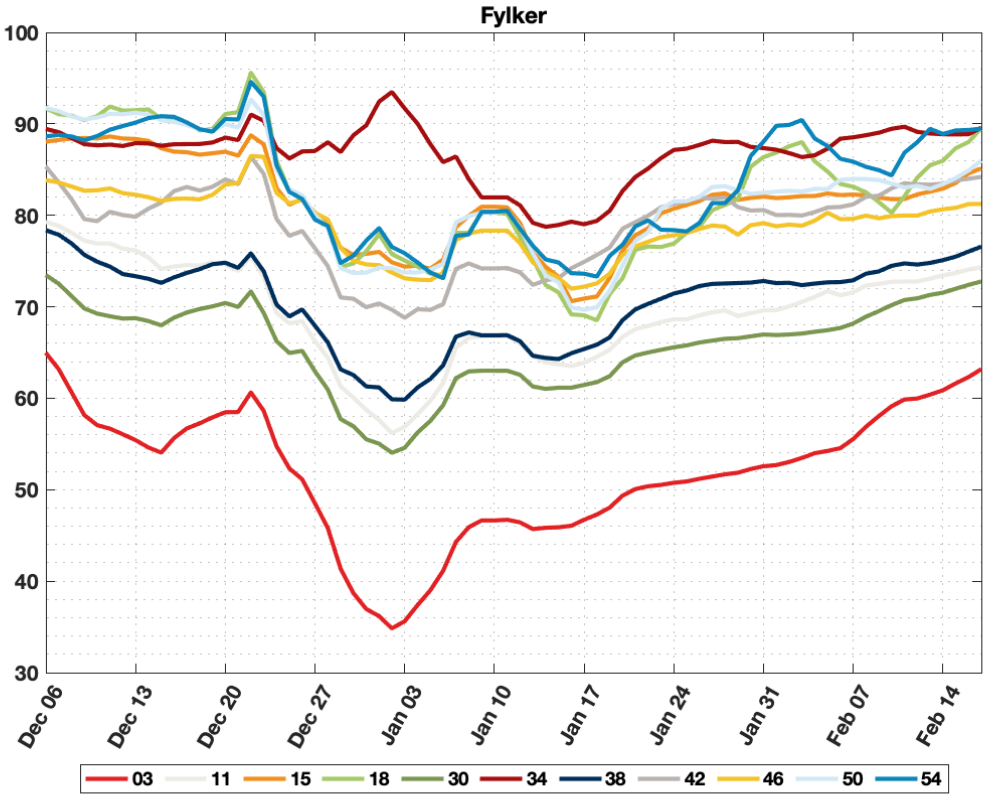


Figure 13: Zoom: Mobility from August 16, 2021 and onwards, per fylker: Oslo (03), Rogaland (11), Møre og Romsdal (15), Nordland (18), Viken (30), Innlandet (34), Vestfold og Telemark (38), Agder (42), Vestland (46), Trøndelag (50), Troms og Finnmark (54).

	4	5	6	7	8
Norge	65.4	71.2	72.8	73.8	76.2
Stavanger	58.6	63.5	64.8	67.2	70.5
Ålesund	66.2	75.3	77.1	77.1	77.5
Bodø	59.9	69.5	80.8	78.4	81.1
Bærum	48.5	52.1	53.8	56.8	61.6
Ringsaker	71.9	76.8	77.7	78.4	78.5
Sandefjord	58.2	63.8	65.8	65.0	67.4
Kristiansand	68.5	74.1	74.4	75.4	79.0
Bergen	67.6	72.5	73.3	74.1	75.9
Trondheim	63.9	75.1	77.1	79.1	80.3
Tromsø	67.9	70.2	83.6	83.1	88.9

Table 10: Municipalities

	4	5	6	7	8
Oslo	46.7	50.8	52.6	55.5	60.9
Rogaland	63.9	68.6	69.6	71.6	73.5
Møre og Romsdal	70.9	80.7	82.0	82.3	82.9
Nordland	69.1	76.9	86.4	83.1	86.0
Viken	61.5	65.6	67.0	68.2	71.5
Innlandet	79.0	87.2	87.3	88.5	88.9
Vestfold og Telemark	65.4	71.5	72.8	72.9	75.1
Agder	74.9	81.3	80.6	81.2	83.5
Vestlandet	72.2	77.8	79.1	79.6	80.7
Trøndelag	69.7	81.5	82.5	84.0	83.4
Troms og Finnmark	73.6	78.4	88.0	85.9	88.9

Table 11: Counties

Weekly mobility for Norway and selected municipalities is displayed in Table 10 and mobility for counties is displayed in Table 11. 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.

8.1 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 14 the total number of roamers per day per county are displayed.

Figure 15 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.

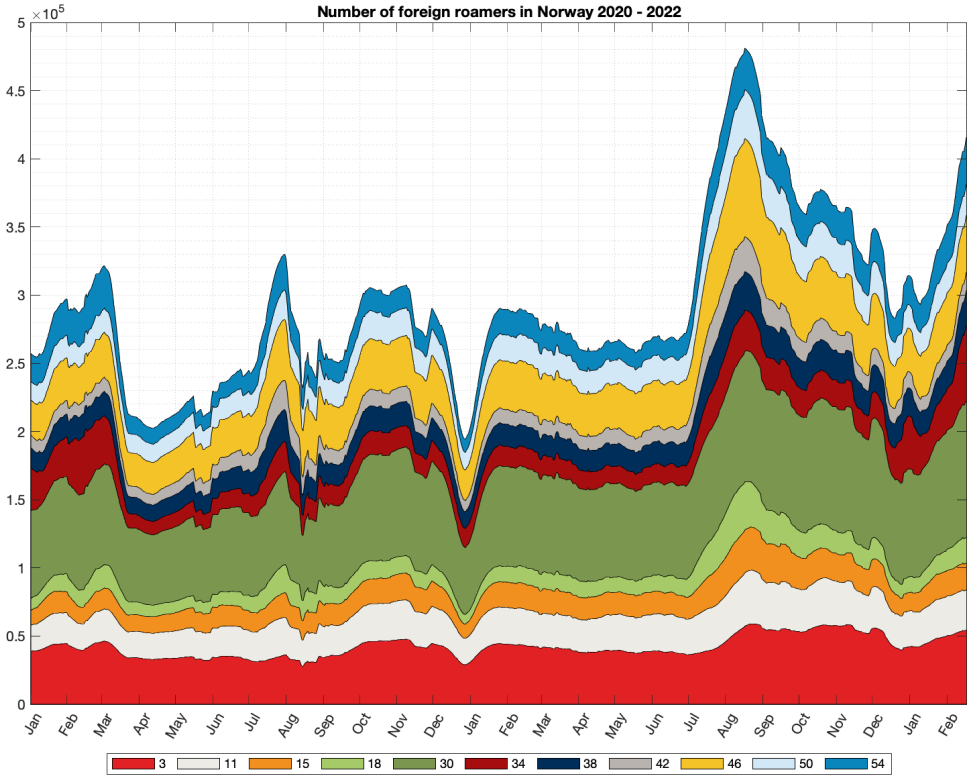


Figure 14: The total number of foreign roamers in Norway broken down on different fylker: Oslo (3), Rogaland (11), Møre og Romsdal (15), Nordland (18), Viken (30), Innlandet (34), Vestfold og Telemark (38), Agder (42), Vestland (46), Trøndelag (50), Troms og Finnmark (54).

8.1 Foreign roamers on Telenor's network in Norway

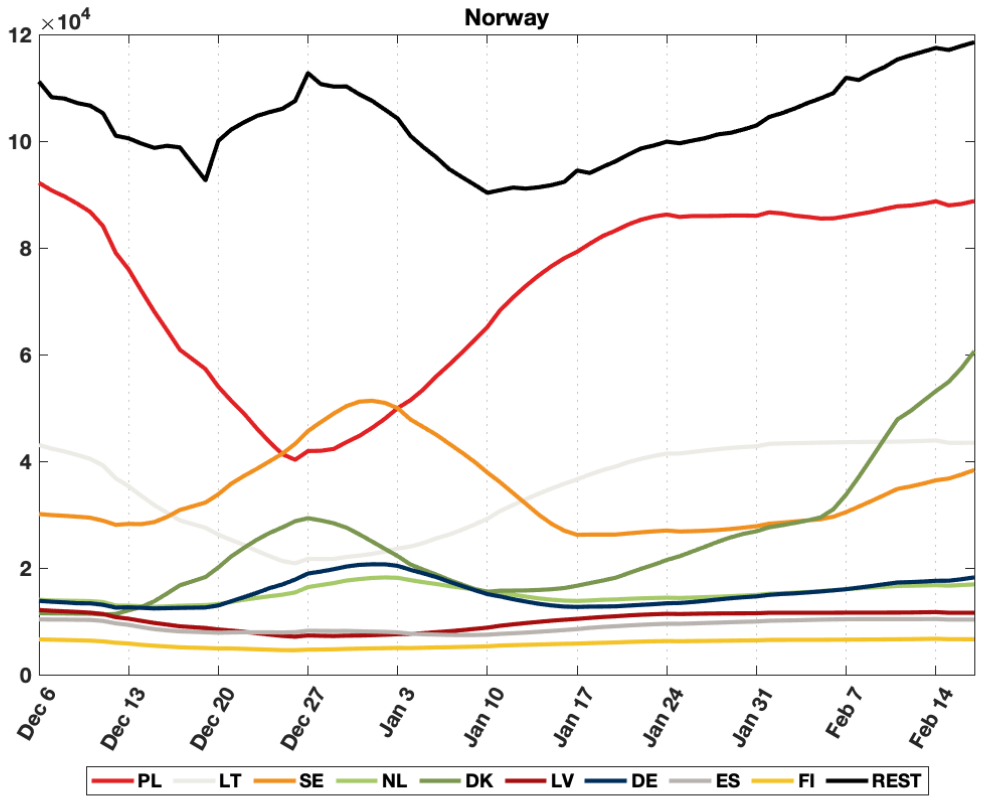
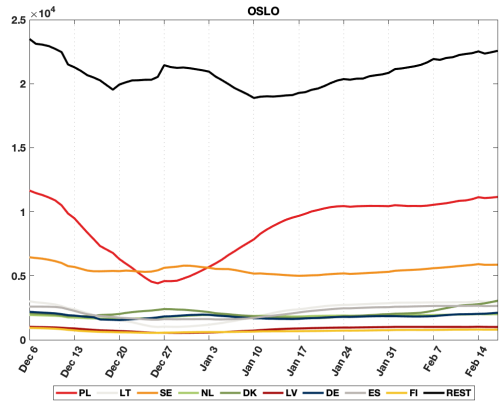
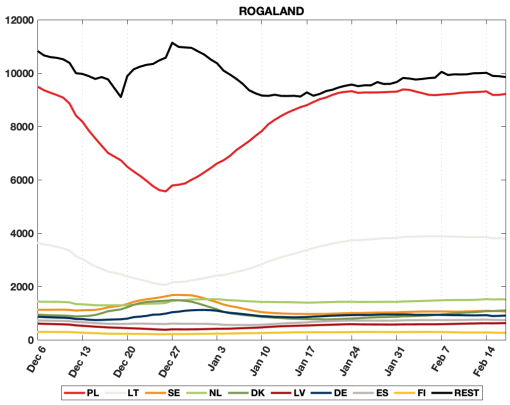
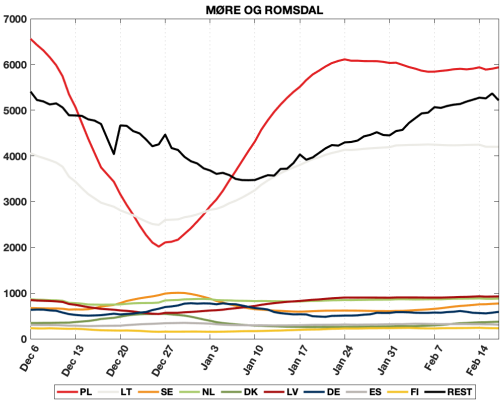


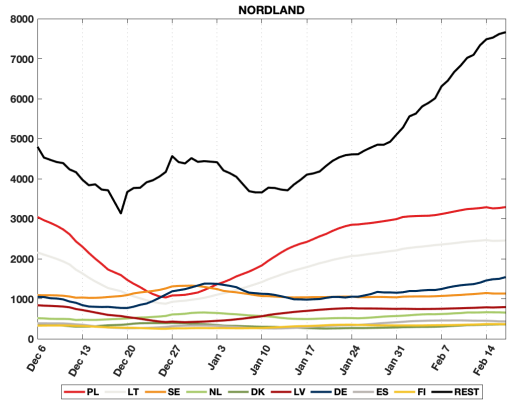
Figure 15: National overview of total number of foreign, visiting roamers from Poland, Lithuania, Sweden, Netherlands, Denmark, Latvia, Germany, Spain, Finland and the rest of the world.

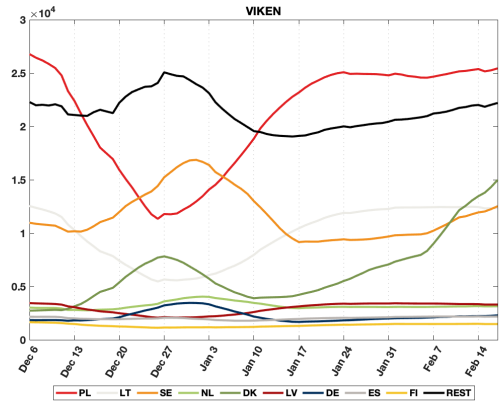
8.2 Foreign roamers per county (fylke) in Norway

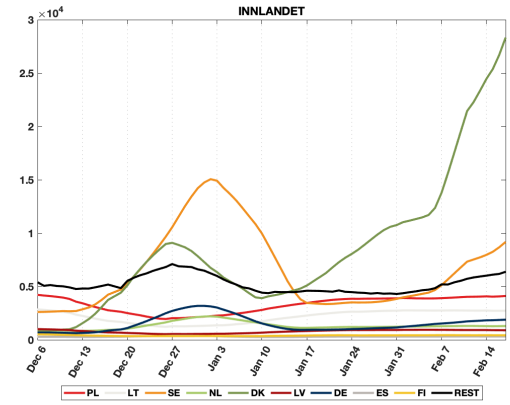




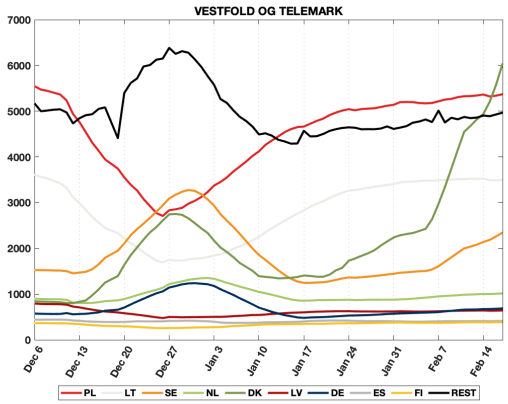


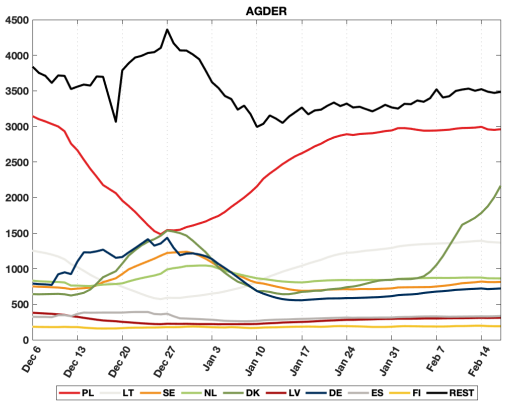


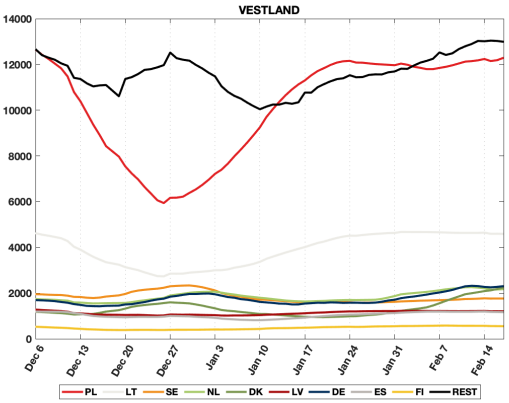


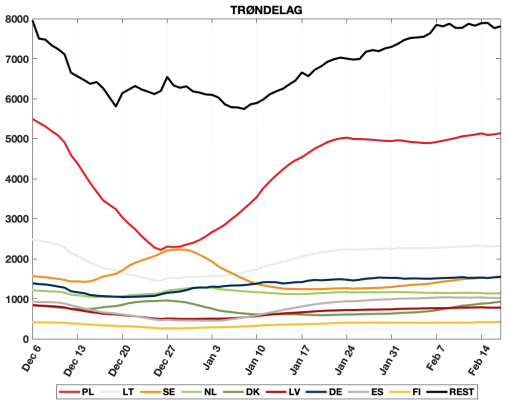


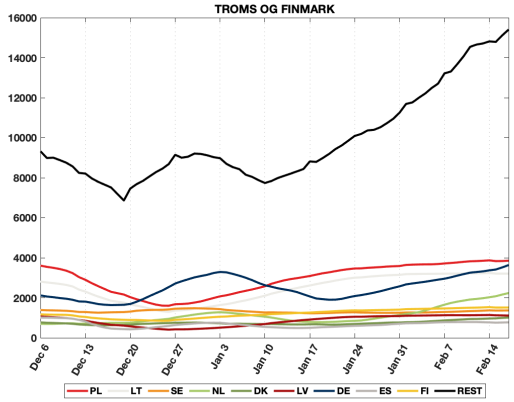
8.2 *Foreign roamers per county (fylke) in Norway*











9 Estimated parameters

Table 12: Estimated parameters

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	Period
R0s	1.843	2.529	2.743	2.731	2.934	3.47	Until March 14
R1s	0.351	0.502	0.543	0.539	0.58	0.703	From 15 March to 19 April
R2s	0.002	0.345	0.638	0.646	0.926	1.785	From 20 April to 10 May
R3s	0.01	0.643	0.804	0.806	0.989	1.626	From 11 May to 30 June
R4s	0.067	0.839	1.08	1.059	1.294	1.987	From 01 July to 31 July
R5s	0.141	0.892	1.029	1.024	1.164	1.608	From 01 August to 31 August
R6s	0.227	0.747	0.884	0.875	1.012	1.453	From 01 September to 30 September
R7s	0.715	1.013	1.141	1.174	1.289	2.017	From 01 October to 25 October
R8s	0.337	0.866	1.073	1.103	1.33	2.191	From 26 October to 04 November
R9s	0.676	0.871	0.936	0.936	1.004	1.208	From 05 November to 30 November
R10s	0.787	0.913	0.959	0.958	1.001	1.15	From 01 December to 03 January
R11s	0.313	0.621	0.712	0.708	0.79	1.117	From 04 January to 21 January
R12s	0.3	0.72	0.823	0.83	0.937	1.313	From 22 January to 07 February
R13s	0.949	1.314	1.397	1.395	1.481	1.801	From 08 February to 01 March
R14s	0.905	1.031	1.069	1.072	1.11	1.294	From 02 March to 24 March
R15s	0.551	0.762	0.813	0.811	0.861	1.017	From 25 March to 12 April
R16s	0.519	0.719	0.799	0.803	0.88	1.154	From 13 April to 05 May
R17s	0.538	0.914	1.041	1.036	1.154	1.511	From 06 May to 26 May
R18s	0.333	0.732	0.826	0.824	0.919	1.212	From 27 May to 20 June
R19s	0.372	0.684	0.785	0.782	0.881	1.121	From 21 June to 04 August
R20s	0.9	1.192	1.268	1.263	1.34	1.557	From 05 August to 31 August
R21s	0.577	0.723	0.756	0.761	0.8	1.021	From 01 September to 24 September
R22s	0.987	1.056	1.074	1.073	1.091	1.145	From 25 September to 12 December
R23s	1.014	1.08	1.104	1.104	1.129	1.185	From 13 December to 30 January
R24s	1.109	1.334	1.402	1.402	1.468	1.722	From 31 January

Table 13: Assumptions

Assumptions	Mean	Distribution	Reference
Mobile Mobility Data			
Telenor coverage	48%		https://ekomstatistikken.nkom.no/
Data updated	February 20 th		
Data used in the predictions	February 18	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:		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.
0-9 years	0.1%		
10 - 19 years	0.1%		
20 - 29 years	0.5%		
30 - 39 years	1.1%		
40 - 49 years	1.4%		
50 - 59 years	2.9%		
60 - 69 years	5.8%		
70 - 79 years	9.3%		
80+ years	22.3%		
Probability that an admission has been reported on Monday		Fixed	Estimated from "Beredskapsregistret BeredtC19"
From Sunday	32%		
From Saturday	49%		
From Friday	68%		
From Thursday	86%		
Probability that an admission has been reported		Fixed	Estimated from "Beredskapsregistret BeredtC19"
From one day before	53%		
From two days before	77%		
From three days before	82%		
From four days before	91%		
Probability that a positive laboratory test has been reported		Fixed	Estimated from MSIS
From one day before	6.7%		
From two days before	59%		
From three days before	90%		
From four days before	97%		
Probability that a negative laboratory test has been reported		Fixed	Estimated from MSIS
From one day before	16%		
From two days before	74%		
From three days before	92%		
From four days before	98%		

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.

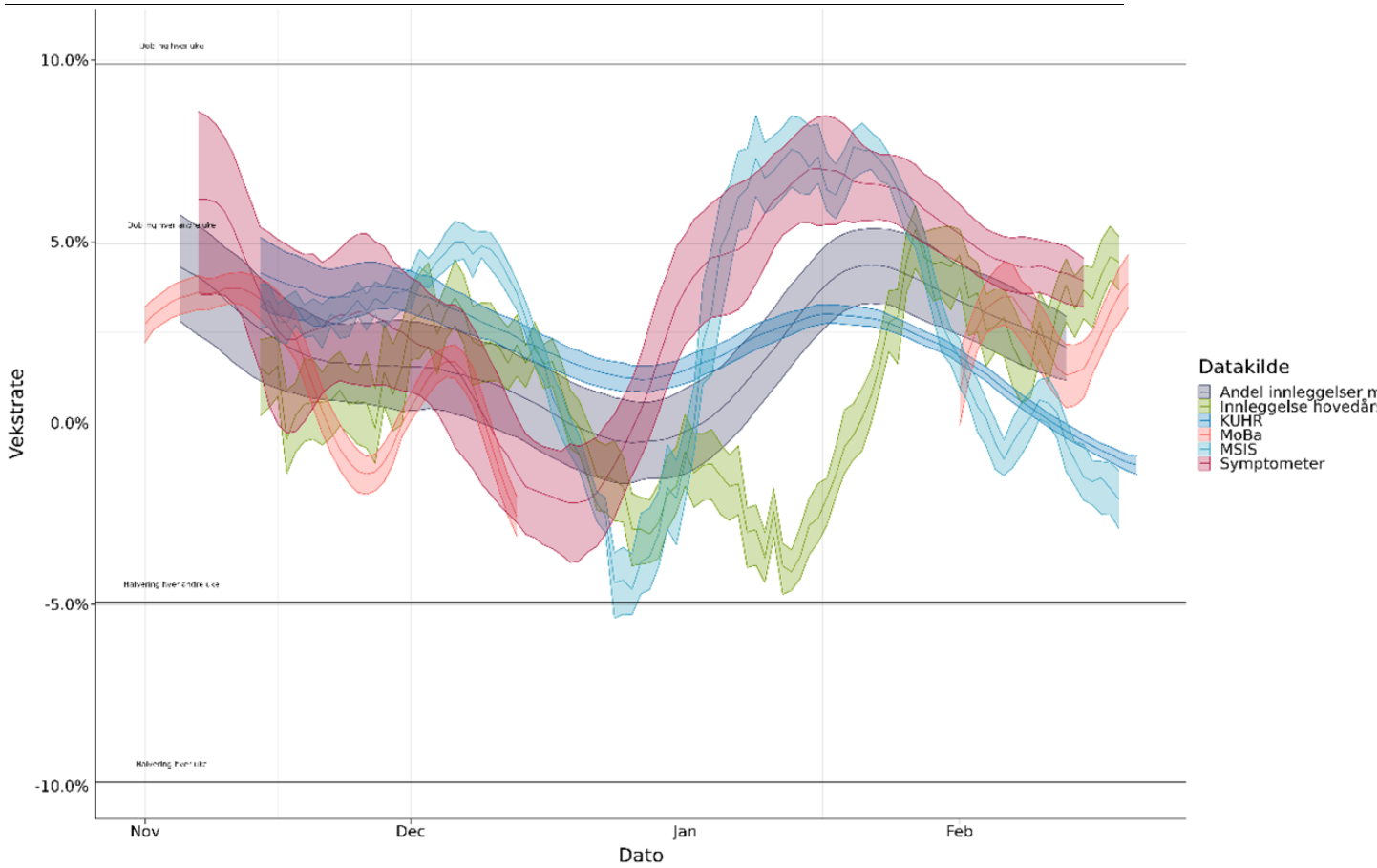


Figure 18: Trend analysis using various data sources

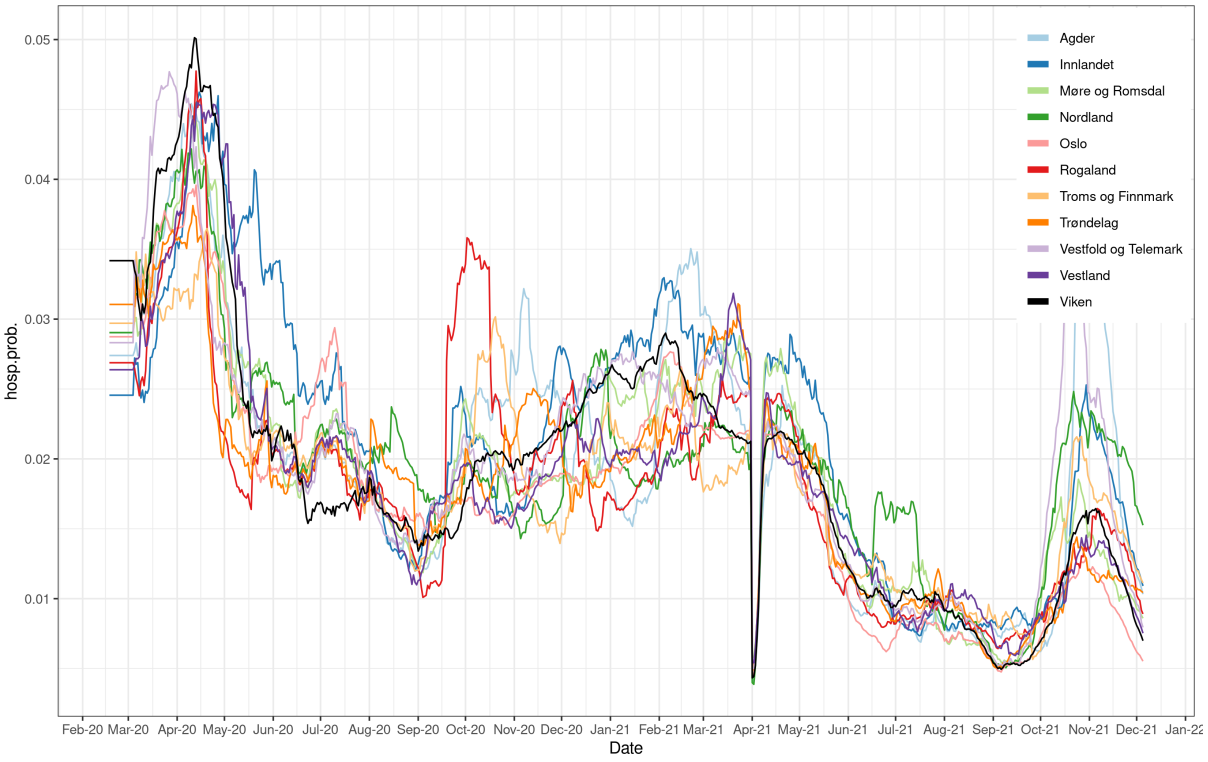


Figure 19: Regional hospitalisation probabilities per infection. The estimates are based on Salje et al., and regional data on the age distribution in the test data and the empirical case-hospitalisation rates.

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:

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