Modeling & Forecasting COVID-19 in NM

Copyright Notice And Disclaimer

March 16, 2021

NNSA
National Nuclear Security Administration

Short- & Long-Term Forecast for NM: Cases

7–day Incidence Confirmed Cases Forecast for New Mexico Based on Data as of 2021–03–15

Prediction Intervals: 10% 20% 30% 40% 50% 60% 70% 80% 90%

6–Week Forecast of Confirmed Cases for New Mexico Based on Data as of 2021–03–15

Week	Best Case (5th Percentile)	Middle Case (50th Percentile)^	Worst Case (95th Percentile)
2021–03–15		188,488*	
2021–03–22	188,903	189,452	190,412
2021–03–29	189,248	190,316	192,217
2021–04–05	189,591	191,220	194,131
2021–04–12	189,942	192,270	196,486
2021–04–19	190,349	193,478	199,074
2021–04–26	190,807	194,850	202,155

*Last reported confirmed cases count
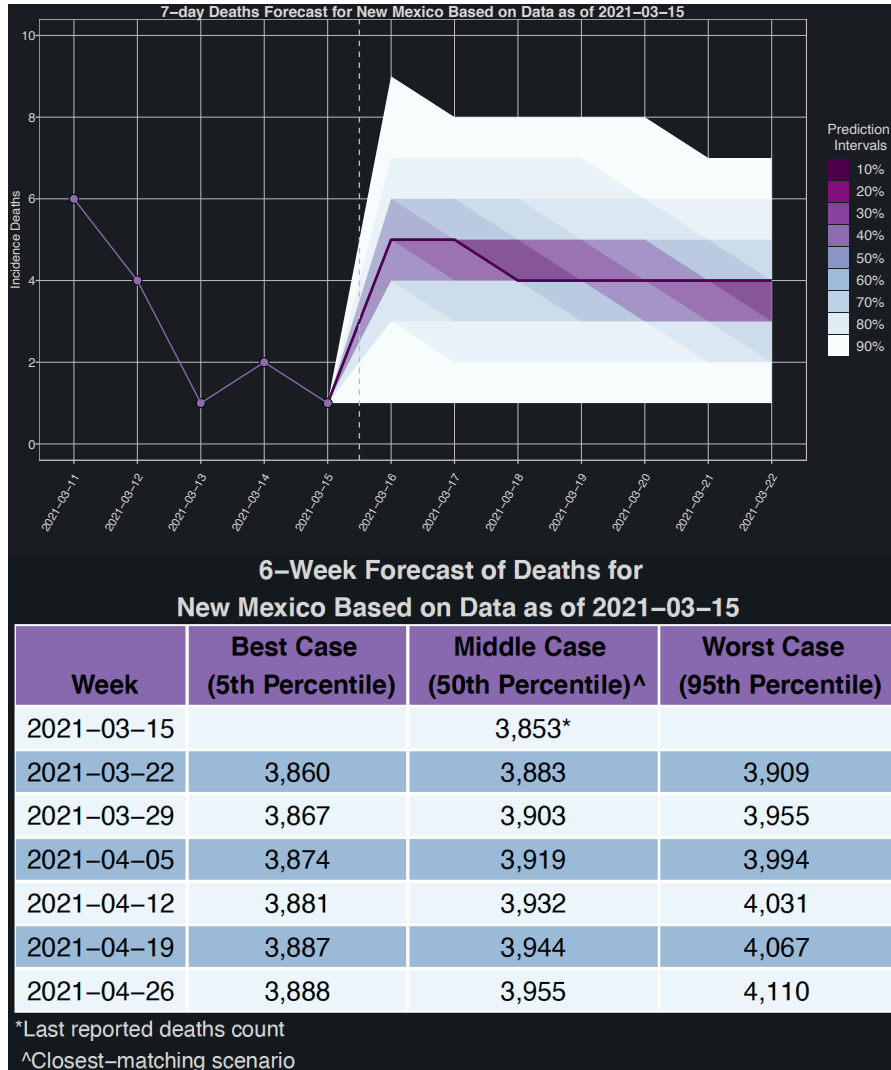^Closest–matching scenario

6–Week Forecast of Daily Average of Confirmed Cases for New Mexico Based on Data as of 2021–03–15

Week	Best Case (5th Percentile)	Middle Case (50th Percentile)^	Worst Case (95th Percentile)
2021–03–15		207*	
2021–03–22	59	138	275
2021–03–29	49	124	258
2021–04–05	49	129	273
2021–04–12	50	150	336
2021–04–19	58	172	370
2021–04–26	65	196	440

*Last reported confirmed cases count
^Closest–matching scenario

So what?
The <u>daily</u> number of cases are expected to range between 49 and 275 in the next few weeks

Short- & Long-Term Forecast for NM: Deaths

7–day Deaths Forecast for New Mexico Based on Data as of 2021–03–15

Prediction Intervals: 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%

6–Week Forecast of Deaths for New Mexico Based on Data as of 2021–03–15

Week	Best Case (5th Percentile)	Middle Case (50th Percentile)^	Worst Case (95th Percentile)
2021–03–15		3,853*	
2021–03–22	3,860	3,883	3,909
2021–03–29	3,867	3,903	3,955
2021–04–05	3,874	3,919	3,994
2021–04–12	3,881	3,932	4,031
2021–04–19	3,887	3,944	4,067
2021–04–26	3,888	3,955	4,110

*Last reported deaths count
^Closest–matching scenario

6–Week Forecast of Daily Average of Deaths for New Mexico Based on Data as of 2021–03–15

Week	Best Case (5th Percentile)	Middle Case (50th Percentile)^	Worst Case (95th Percentile)
2021–03–15		6*	
2021–03–22	1	4	8
2021–03–29	1	3	7
2021–04–05	1	2	6
2021–04–12	1	2	5
2021–04–19	1	2	5
2021–04–26	0	2	6

*Last reported confirmed deaths
^Closest–matching scenario

So what?
The daily number of deaths are expected to range between 1 and 8 in the next few weeks

Growth Rate for NM

Daily Growth Rate for the Past Six Weeks in New Mexico as of 2021-03-15
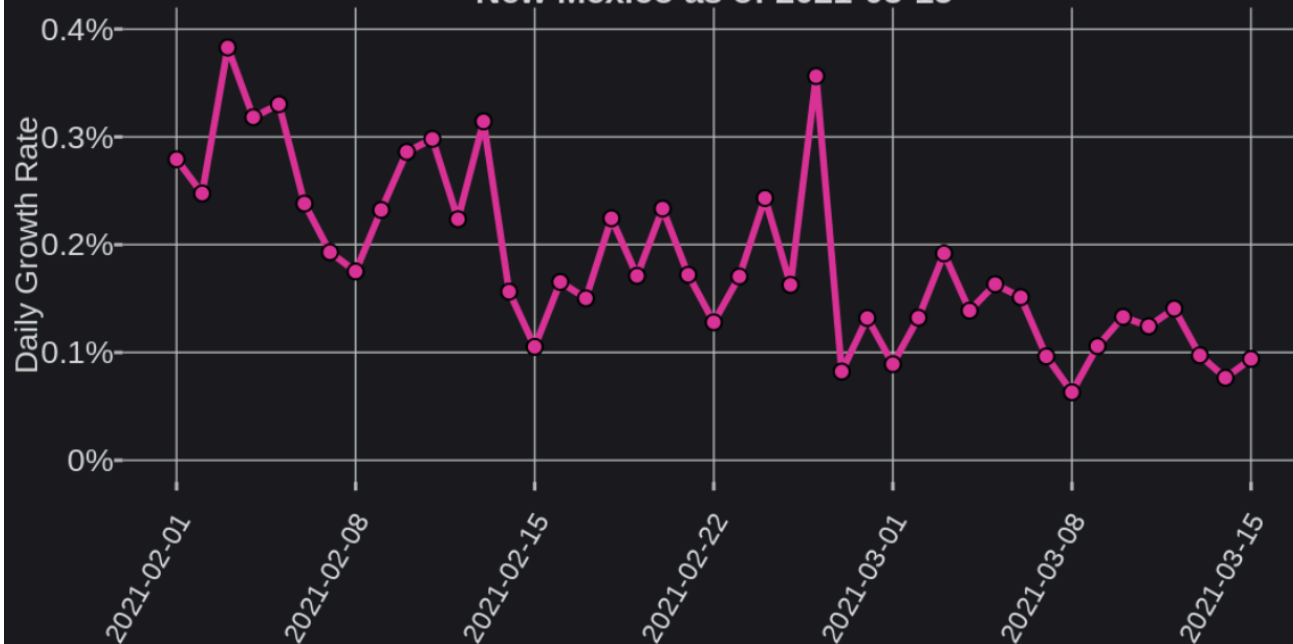
6-Week Forecast of the Average Weekly Growth Rate for New Mexico Based on Data as of 2021-03-15

| Week	Best Case (5th Percentile)	Middle Case (50th Percentile)^	Worst Case (95th Percentile)
2021-03-15		0.11%*	
2021-03-22	0.031%	0.073%	0.15%
2021-03-29	0.026%	0.065%	0.13%
2021-04-05	0.026%	0.068%	0.14%
2021-04-12	0.026%	0.078%	0.17%
2021-04-19	0.031%	0.089%	0.19%
2021-04-26	0.034%	0.10%	0.22%

*Last weekly mean daily growth rate
^Closest-matching scenario

So what?
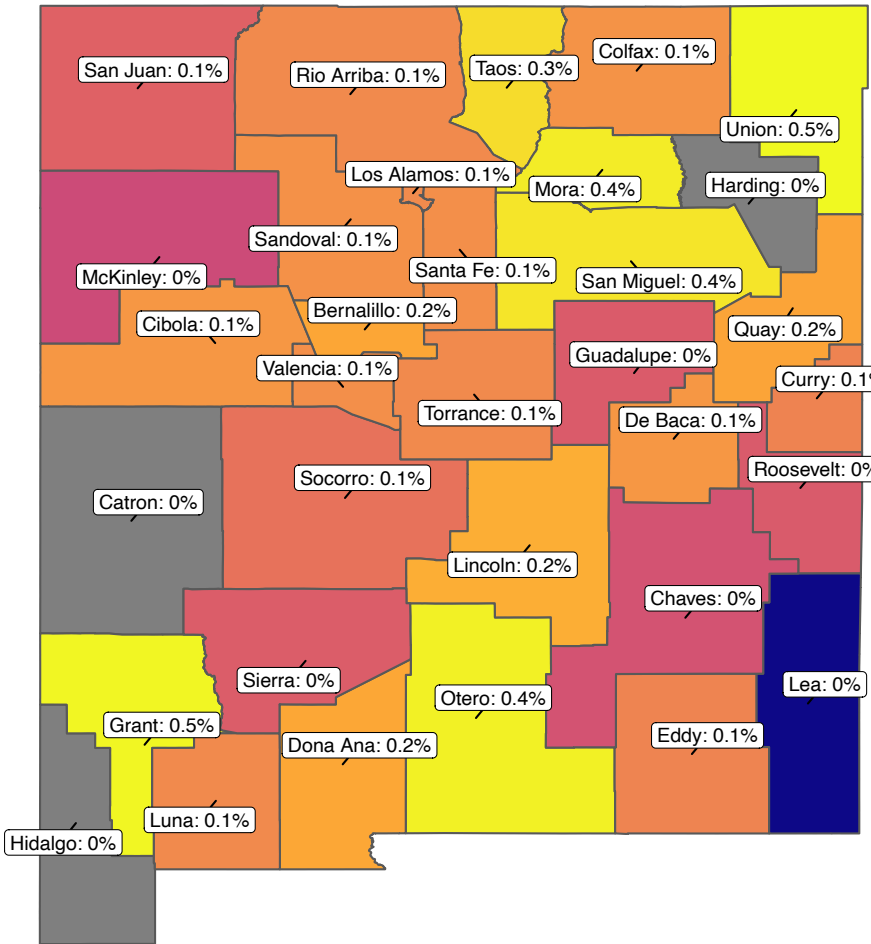### As of March 15th, the average growth rate in NM is at 0.11% (down from 0.13%)

> Regional Forecasts, Growth Rates, & Hospitalizations
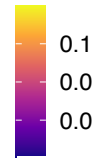
Cumulative Cases & Daily Growth Rate for NM: March 15

Cases (Log Scale)
22,026
2,981
403
55

7−day−average daily growth rate (%)
0.1
0.0
0.0
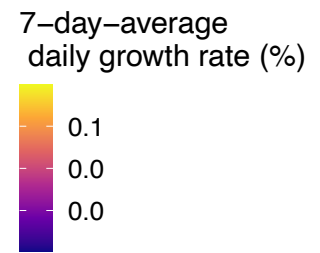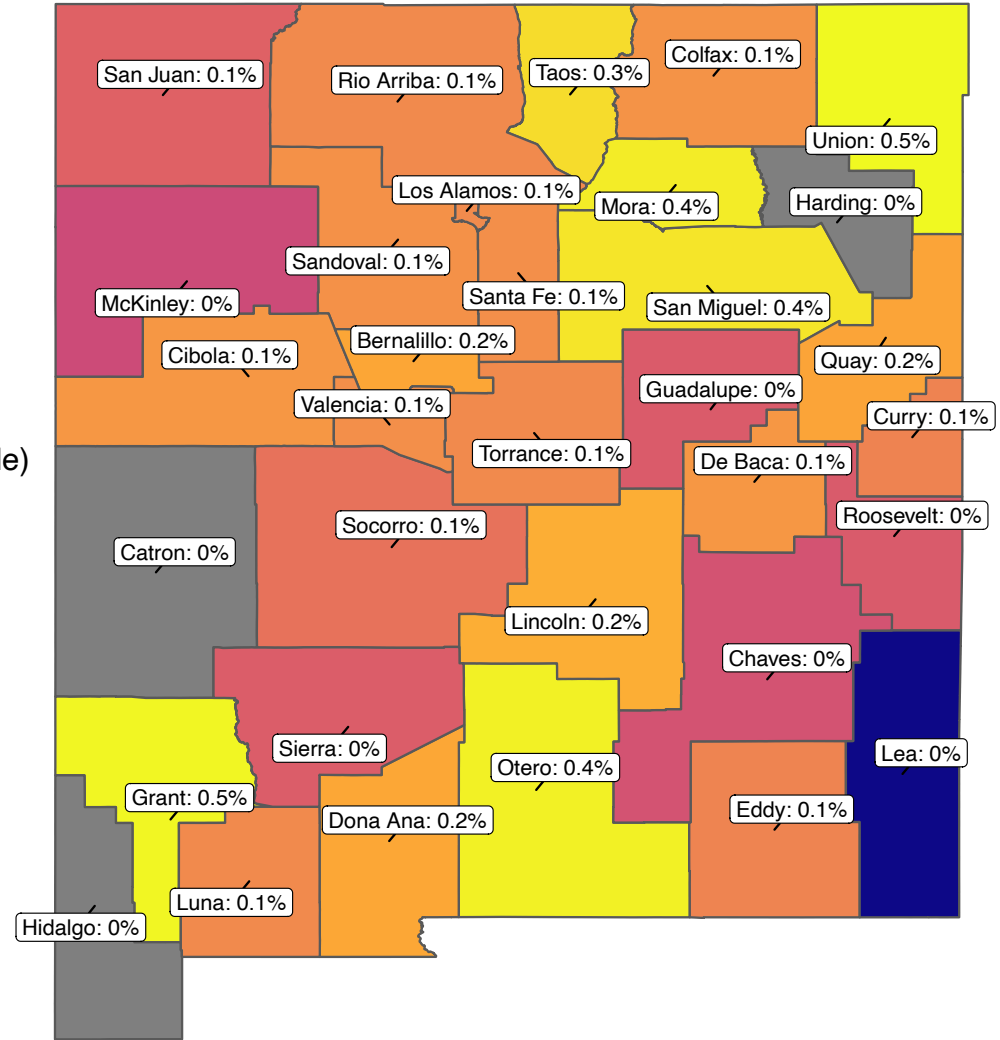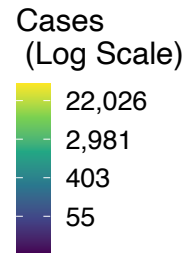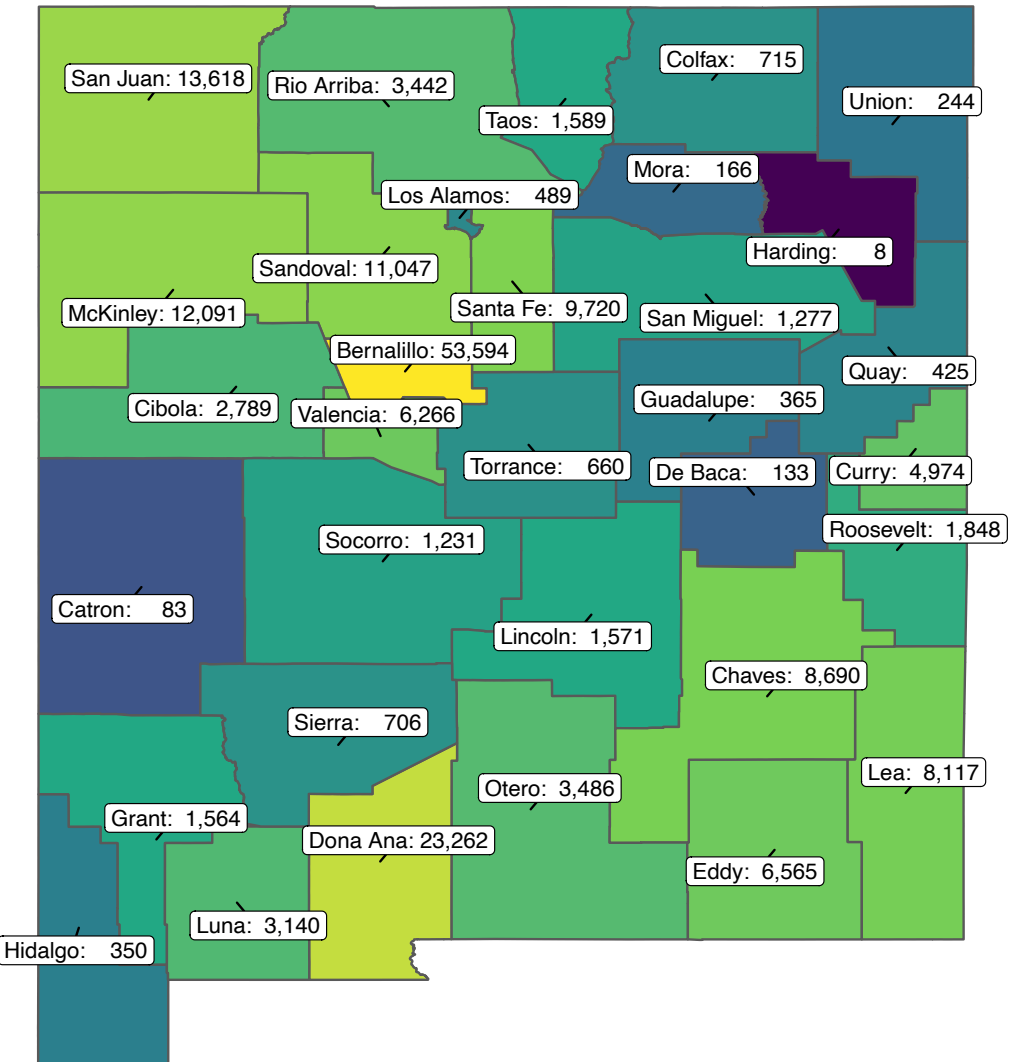
*Growth rate is in cumulative cases

Daily Growth Rate for NM Mar 15

7–day–average
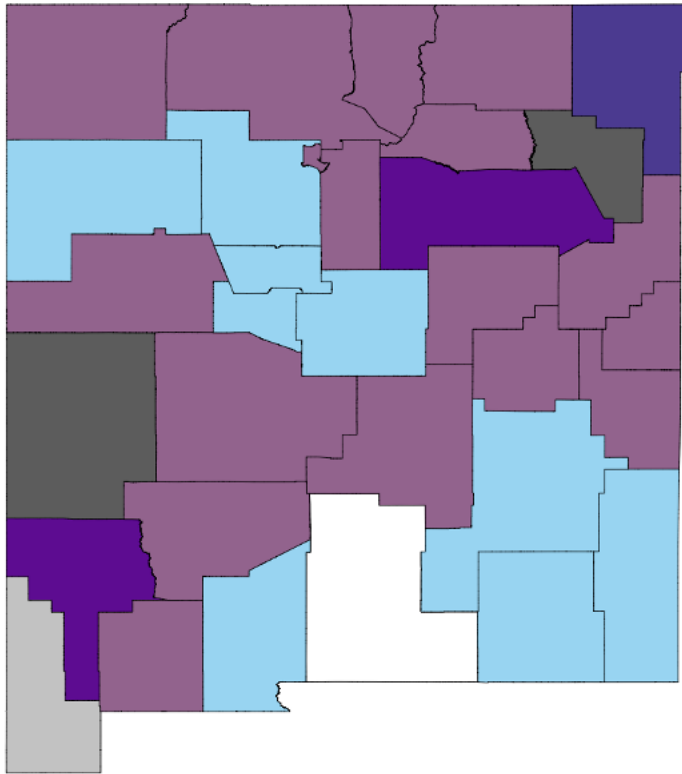daily growth rate (%)

0.1
0.0
0.0

Socorro 0.1% =
Roosevelt 0.0% =
DeBaca 0.1% =
Los Alamos 0.1% =
Quay 0.0% =
Colfax 0.1% =
Harding 0.0% =
Hidalgo 0.0% =
Guadalupe 0.0% =
Catron 0.0% =
Union 0.0% ↓
Mora 0.4% ↓

*arrows indicate more than 0.5% difference in growth rate from last week's analysis; growth rate is in cumulative cases
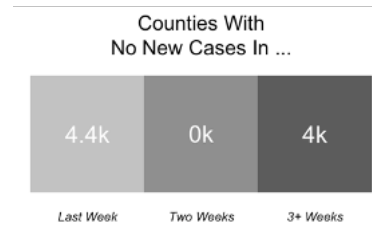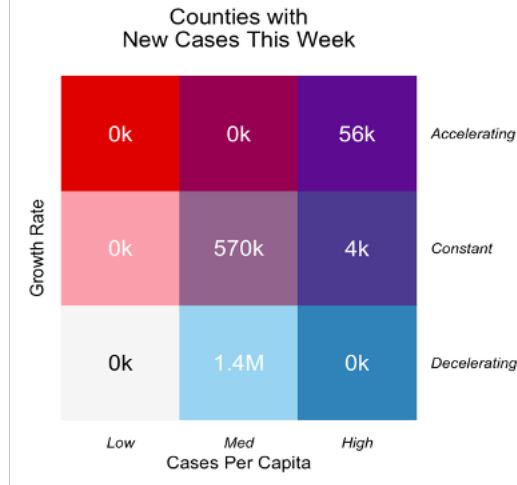
Los Alamos National Laboratory

County	Daily Growth Rate	Change
San Juan	0.1%	=
Rio Arriba	0.1%	=
Sierra	0.0%	=
McKinley	0.0%	=
Sandoval	0.1%	=
Santa Fe	0.1%	=
Cibola	0.1%	=
Bernalillo	0.2%	=
Valencia	0.1%	=
Torrance	0.1%	=
Lincoln*	0.2%	=
San Miguel*	0.4%	=
Chaves	0.0%	=
Dona Ana	0.2%	=
Otero	0.4%	=
Lea	0.0%	=
Eddy	0.1%	=
Curry	0.1%	=
Grant	0.5%	=
Luna	0.1%	=
Taos	0.3%	=

COVID-19 across New Mexico
A 7-day moving window comparison
March 15, 2021

Impacted New Mexicans

Counties with New Cases This Week

	Low	Med	High	
	0k	0k	56k	Accelerating
Growth Rate	0k	570k	4k	Constant
	0k	1.4M	0k	Decelerating

Cases Per Capita

Counties With No New Cases In ...

|		
4.4k	0k	4k
Last Week	Two Weeks	3+ Weeks

So what?

- **Most people in New Mexico are living in a county that is decelerating with medium per-capita case counts**

- **Counties with high per capita case counts: Otero, San Miguel, Union**

- **Sandoval is accelerating**

Number of New Mexicans living in regions with particular combinations of per capita case counts and 7-day growth rates

Low <10 cases/100k per week
Med   10-99 cases/100k per week
High   >100   cases/100k per week

Concurrent Hosp & ICU Beds Based on Forecasts – Average Stay of 8 Hosp, 15 Days for ICU/vent & 25% ICU rate
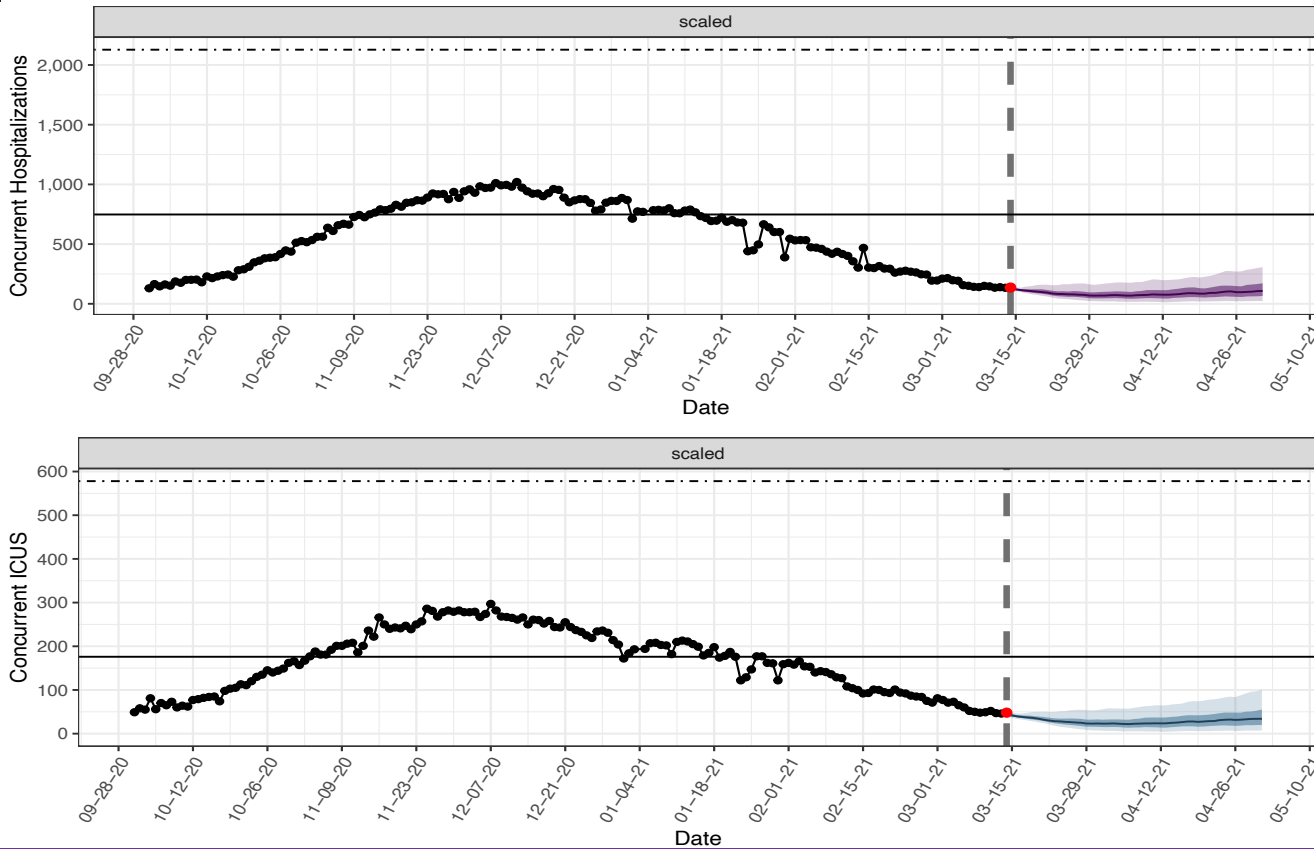
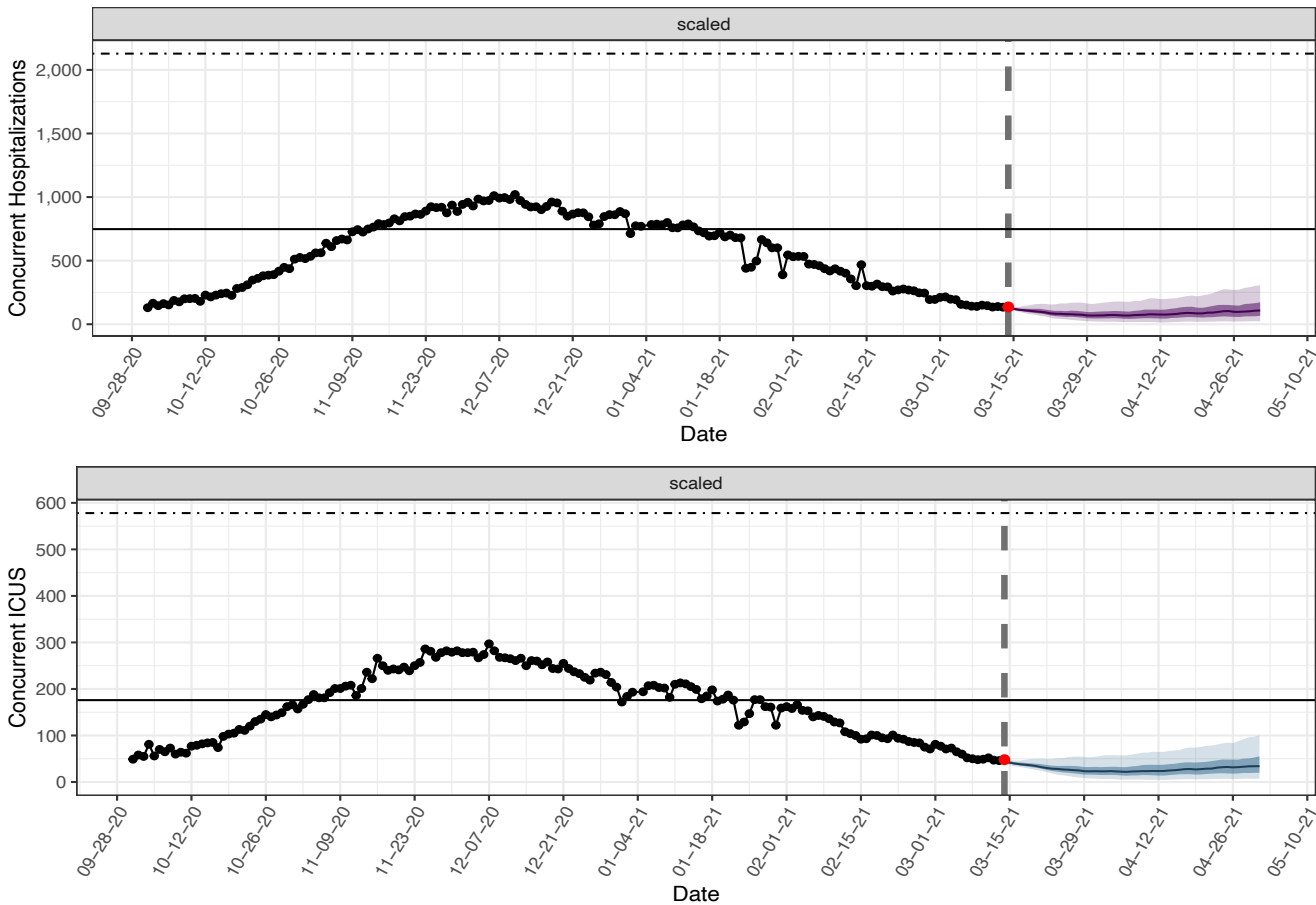

Concurrent COVID-19 ICU beds

Week	Qu. 5% (best case)	Qu. 50% (median)	Qu. 95% (worst case)
3/21	24	32	50
3/28	10	25	55
4/4	6	23	57
411	5	24	65
4/18	6	28	74
4/25	7	32	85

"Scaled" Scenario

...?

...OVID-19 patients. Model is predicting a
...ser to best case scenario.

Concurrent Hosp & ICU Beds Based on Forecasts – Average Stay of 8 Hosp, 15 Days for ICU/vent & 25% ICU rate

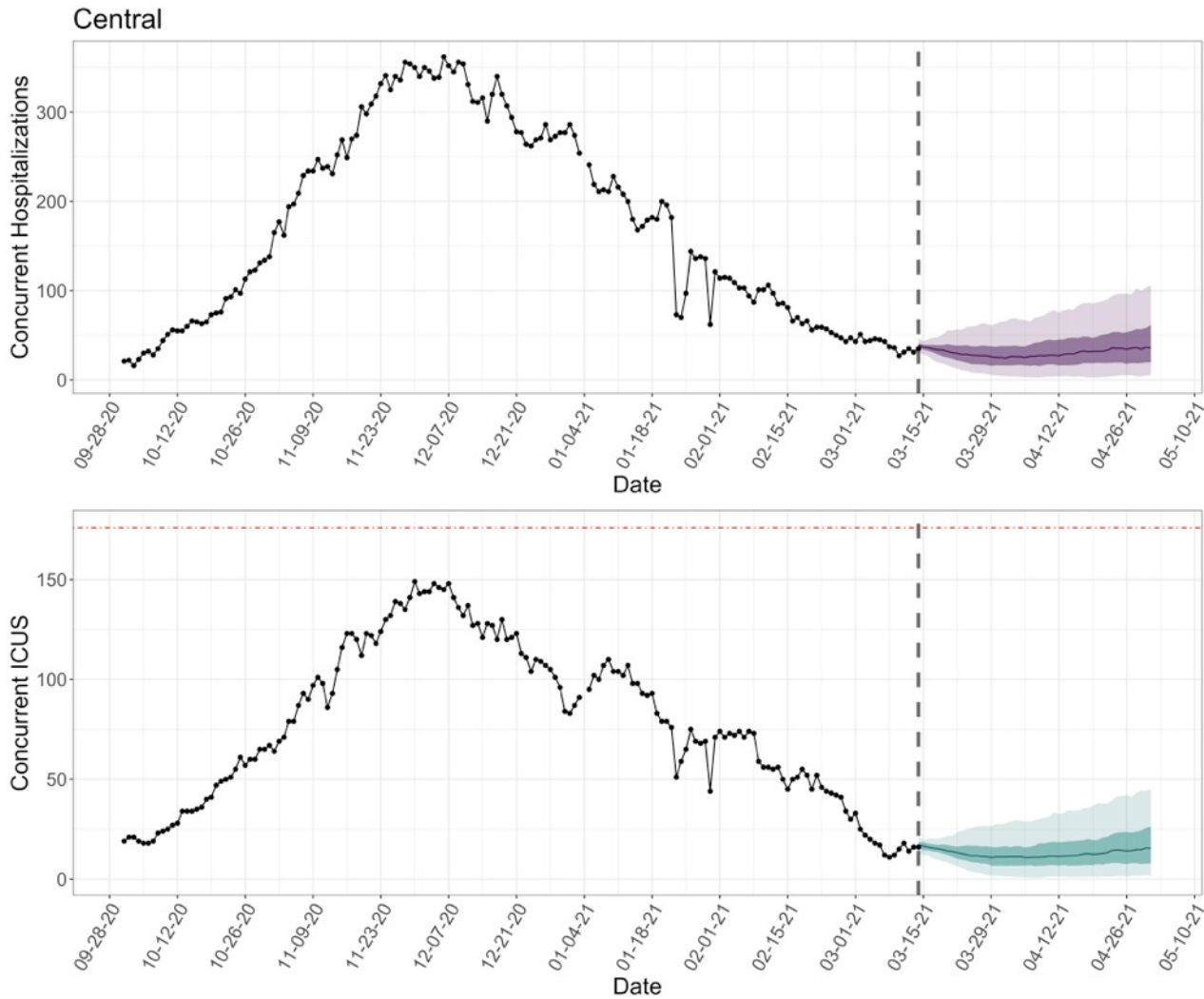

Concurrent COVID-19 non-ICU "med-surge" beds

Week	Qu. 5% (best case)	Qu. 50% (median)	Qu. 95% (worst case)
3/21	37	62	110
3/28	18	50	116
4/4	13	48	122
411	11	54	138
4/18	15	60	151
4/25	15	72	189

"Scaled" Scenario

...at?

... **decrease** during the next 3 weeks. It is

Regional Hospitalization Forecasts: Central

Concurrent COVID-19 ICUs beds: Central

Week	Qu. 5% (best case)	Qu. 50% (median)	Qu. 95% (worst case)
3/21	7	14	22
3/28	2	11	27
4/4	1	11	29
411	1	12	33
4/18	1	13	36
4/25	2	14	42

So what?

ICU bed usage is expected to <u>decrease.</u>
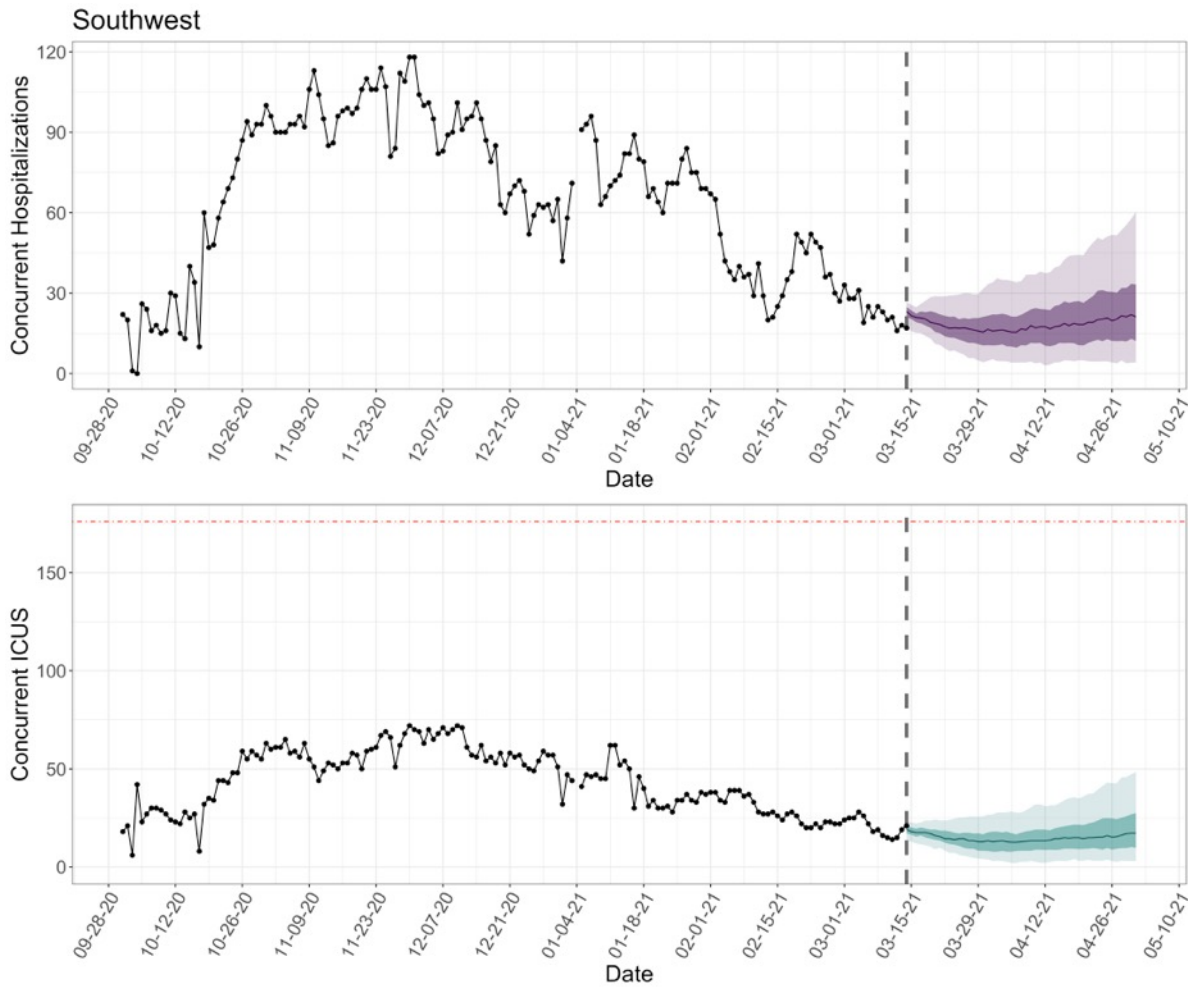
Concurrent COVID-19 ICUs beds: Southwest

Week	Qu. 5% (best case)	Qu. 50% (median)	Qu. 95% (worst case)
3/21	10	15	24
3/28	5	13	26
4/4	3	13	28
411	2	13	32
4/18	4	15	36
4/25	4	16	43

So what?

ICU bed usage is expected to <u>decline</u> in the Southwest region.

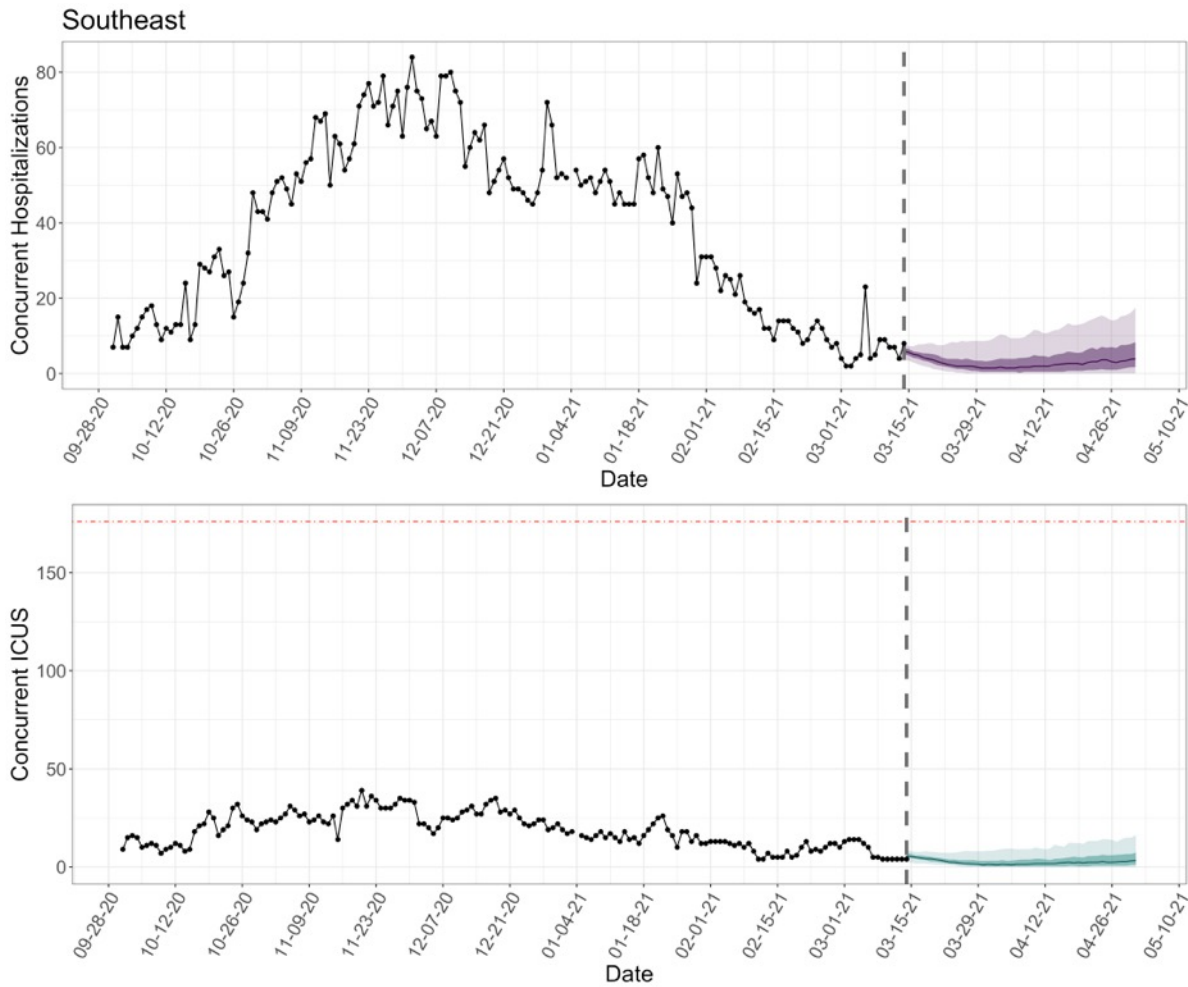# Regional Hospitalization Forecasts: Northwest
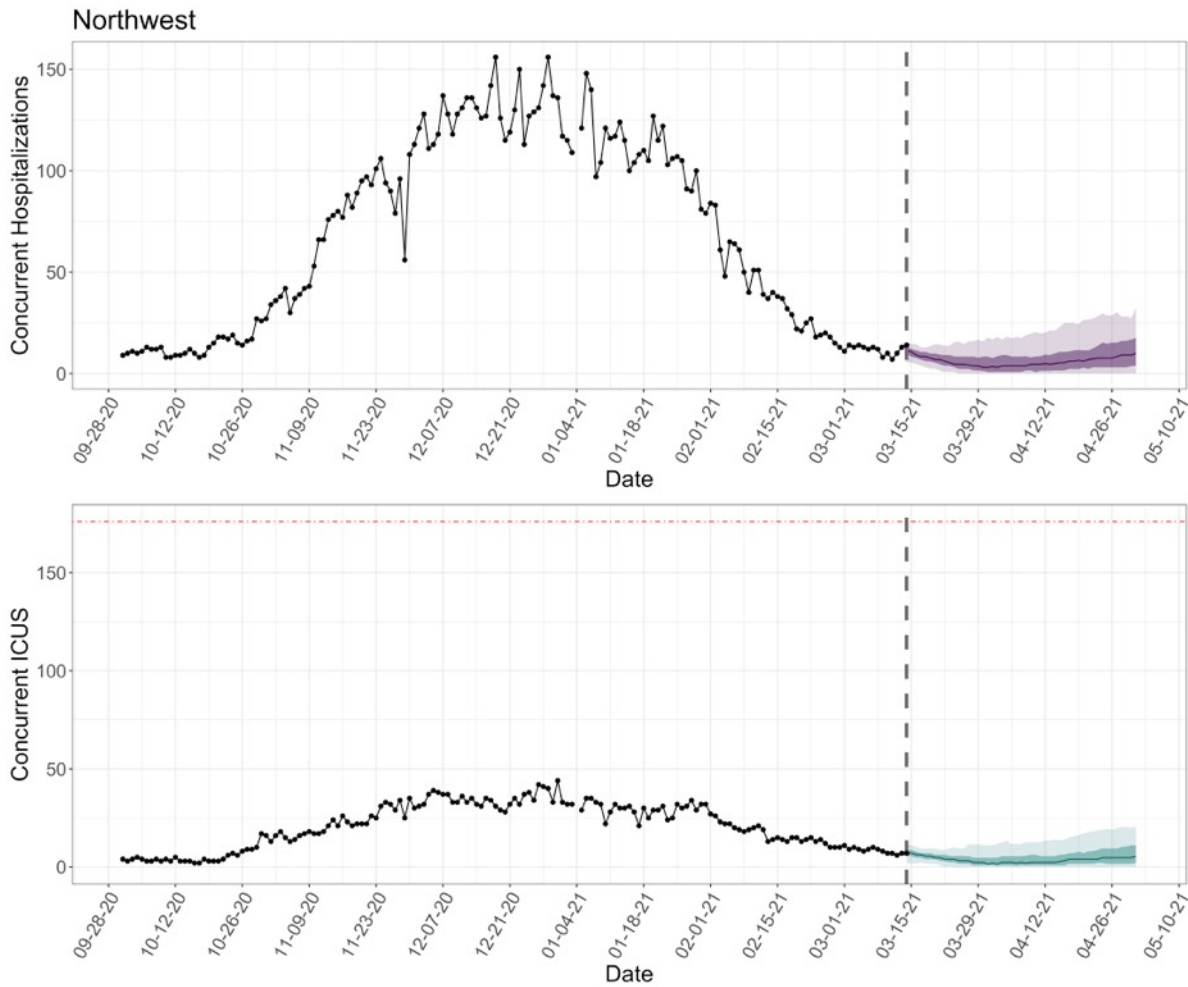
Northwest

Concurrent COVID-19 ICUs beds: Northwest

Week	Qu. 5% (best case)	Qu. 50% (median)	Qu. 95% (worst case)
3/21	1	5	9
3/28	0	2	12
4/4	0	2	13
411	0	2	13
4/18	0	4	16
4/25	0	5	19

So what?

ICU bed usage is expected to <u>stay low</u> in the Northwest region
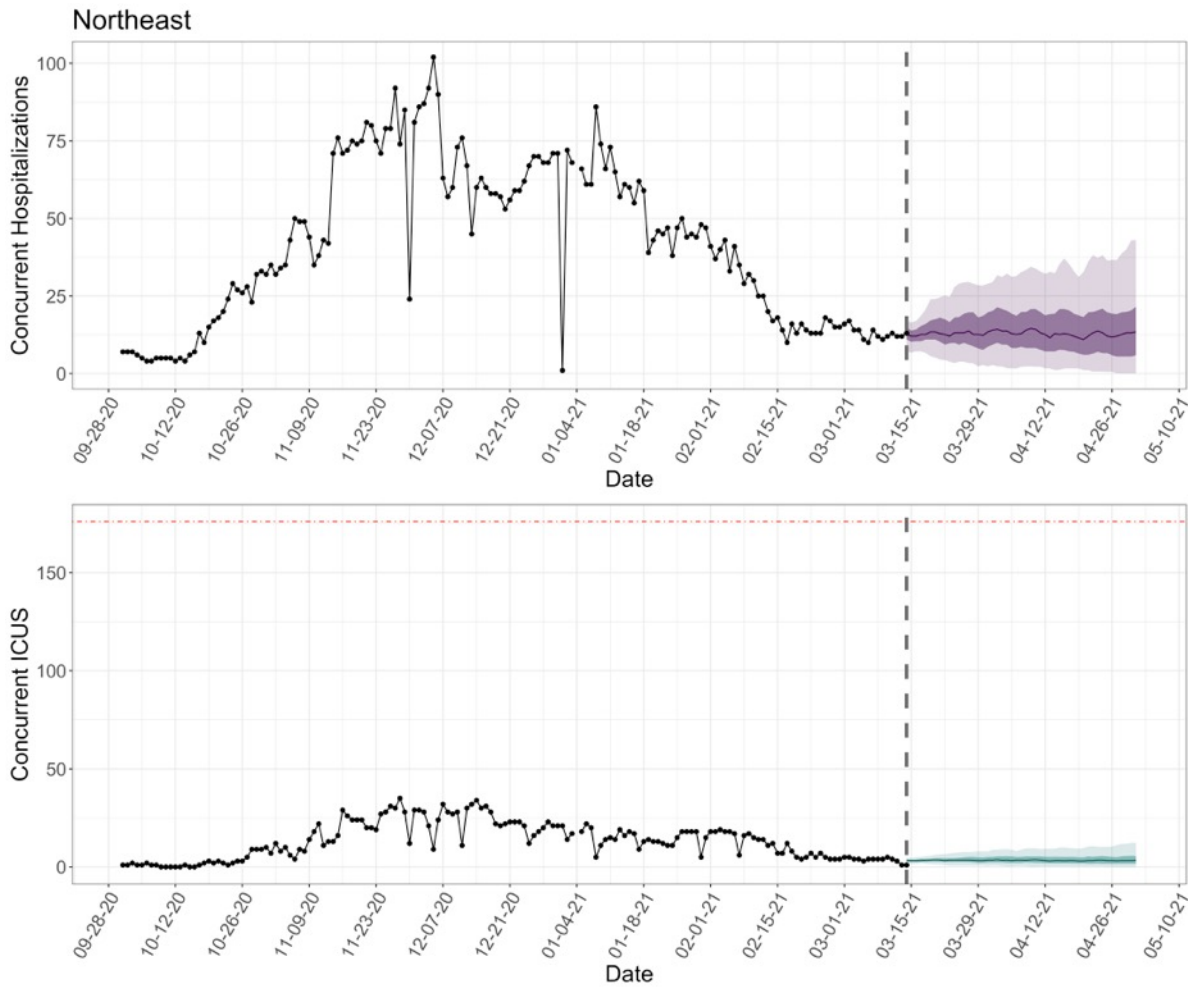
Regional Hospitalization Forecasts: Southeast

Concurrent COVID-19 ICUs beds: Southeast

Week	Qu. 5% (best case)	Qu. 50% (median)	Qu. 95% (worst case)
3/21	1	3	7
3/28	0	2	8
4/4	0	1	9
411	0	2	9
4/18	0	2	12
4/25	0	2	14

So what?

ICU bed usage is expected to <u>be low</u> in the Southeast region

Regional Hospitalization Forecasts: Northeast

Northeast

Concurrent COVID-19 ICUs beds: Northeast

Week	Qu. 5% (best case)	Qu. 50% (median)	Qu. 95% (worst case)
3/21	1	3	6
3/28	1	3	8
4/4	0	3	9
411	0	3	9
4/18	0	3	10
4/25	0	3	10

So what?

ICU bed usage is expected to <u>be low</u> in the Northeast region

> Non-Congregational Shelter Forecast

Non-Congregate Shelter Forecast

- Our goal is to inform the capacity of shelters for forecasting the need of additional rooms
- We calculate a ratio between the mean number of daily new cases over the previous two weeks to current occupied rooms
  - We apply this ratio to the forecast of COVID-19 cases from the LANL COFFEE model to estimate the number of rooms needed
- We use the spread in the case forecast to report a subsequent spread in the shelter forecast
- We calculate the number of new rooms need by applying the ratio of occupied rooms:new cases to the number of cases forecasted in each county

- NEW AS OF 2/7/21: We added a second forecast method for comparison by averaging the shelter forecast with current shelters in use to smooth the forecast

Non-Congregate Shelter Forecast: Bernalillo

Number of cases as of 3/14/21: **53,594**
Number of shelter rooms available: **221**
Total number of patients/medical workers (including specialty): **8**
Number of patients: **4**
Number of medical workers: **4**
Occupied rooms:new cases ratio: **0.11**
2-week avg. new cases per day: **76**
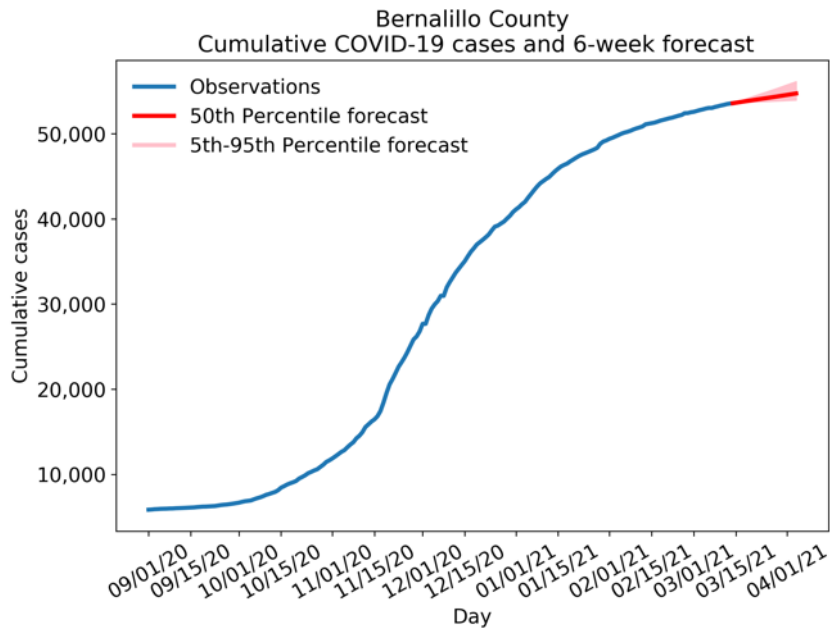
	3/14/21	3/21/21	3/28/21
Total cases	53,979 (53,735-54,426)	54,347 (53,859-55,252)	54,739 (53,976-56,131)
# of rooms needed	6 (2-12)	6 (2-12)	6 (2-13)
Deficit (-) or surplus of rooms	215	215	215
# of rooms needed (new forecast method)	7	6	6

Bernalillo County
Cumulative COVID-19 cases and 6-week forecast

— Observations
— 50th Percentile forecast
— 5th-95th Percentile forecast

2-week avg. new cases per day decreased from 86 last week to 76 this week

Last week we forecasted 9 (3-19) rooms in use, 11 rooms with the adjustment; there are 8 actually in use

Non-Congregate Shelter Forecast: Santa Fe

Number of cases as of 3/14/21: **9,720**
Number of shelter rooms available: **52**
Total number of patients/medical workers (including specialty): **22**
Number of patients: **22**
Number of medical workers: **0**
Occupied rooms:new cases ratio: **2.35**
2-week avg. new cases per day: **9**

Santa Fe County
Cumulative COVID-19 cases and 6-week forecast
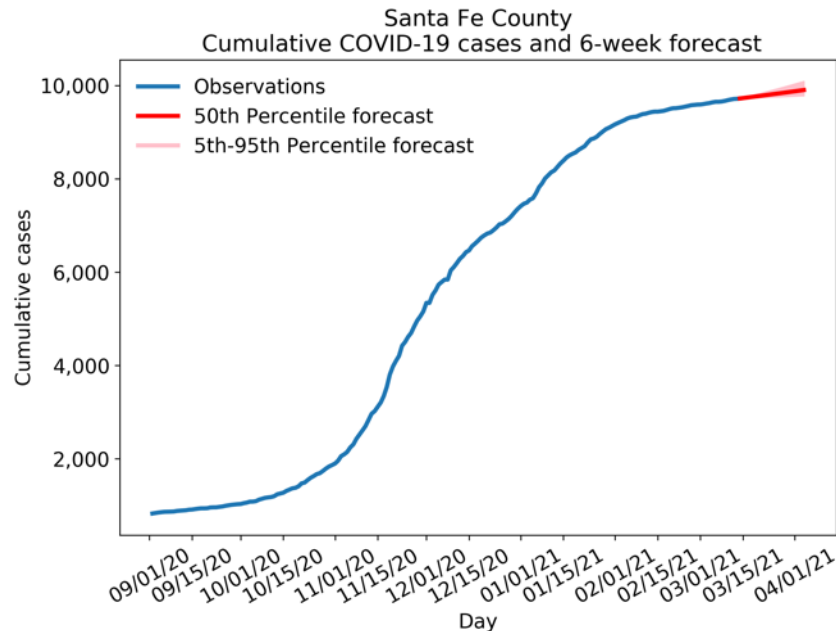
	3/14/21	3/21/21	3/28/21
Total cases	9,779 (9,741-9,836)	9,839 (9,761-9,957)	9,901 (9,782-10,086)
# of rooms needed	20 (7-39)	20 (7-41)	21 (7-43)
Deficit (-) or surplus of rooms	42	42	43
# of rooms needed (new forecast method)	21	21	21

2-week avg. new cases per day decreased from 10 last week to 9 this week

Last week we forecasted 4 (0-13) rooms in use, 7 rooms with the adjustment; there are 22 actually in use, so we are under forecasting

Non-Congregate Shelter Forecast: McKinley

Number of cases as of 3/14/21: **12,091**
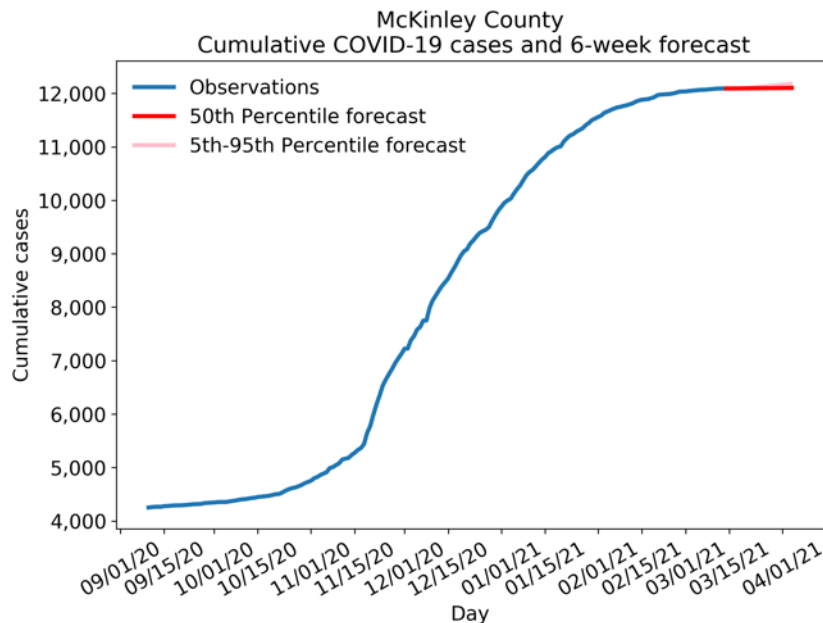Number of shelter rooms available: **160**
Total number of patients/medical workers (including specialty): **9**
Number of patients: **5**
Number of medical workers: **4**
Occupied rooms:new cases ratio: **2.2**
2-week avg. new cases per day: **4**

McKinley County
Cumulative COVID-19 cases and 6-week forecast

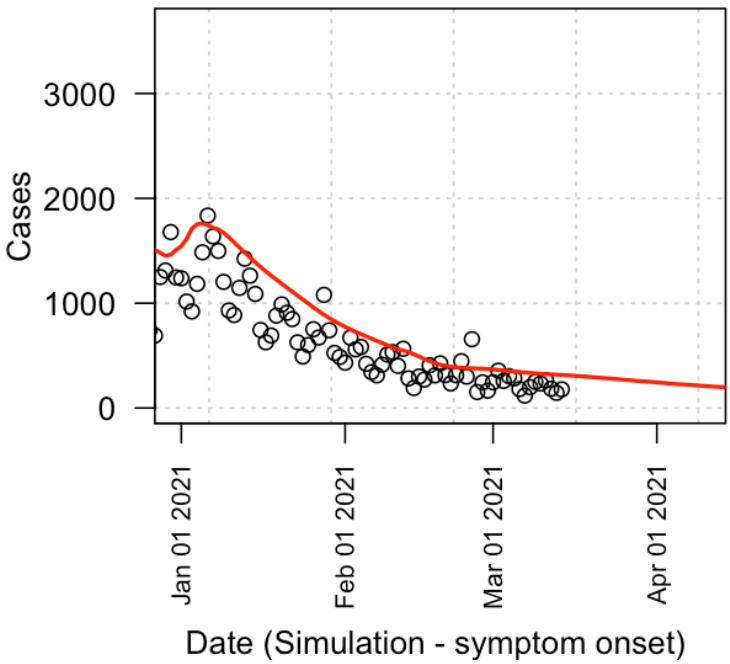|	3/14/21	3/21/21	3/28/21
Total cases	12,095 (12,091-12,131)	12,098 (12,091-12,168)	12,102 (12,091-12,211)
# of rooms needed	1 (0-13)	1 (0-12)	1 (0-14)
Deficit (-) or surplus of rooms	159	159	159
# of rooms needed (new forecast method)	5	4	3

2-week avg. new cases per day decreased from 6 last week to 4 this week

Last week we forecasted 1 (0-10) rooms in use, 5 rooms with the adjustment; there are 9 actually in use, so we are under forecasting

Non-Congregate Shelter Forecast: San Juan

Number of cases as of 3/14/21: **13,618**
Number of shelter rooms available: **21**
Total number of patients/medical workers (including specialty): **0**
Number of patients: **0**
Number of medical workers: **0**
Occupied rooms:new cases ratio: **0.0**
2-week avg. new cases per day: **7**

San Juan County
Cumulative COVID-19 cases and 6-week forecast
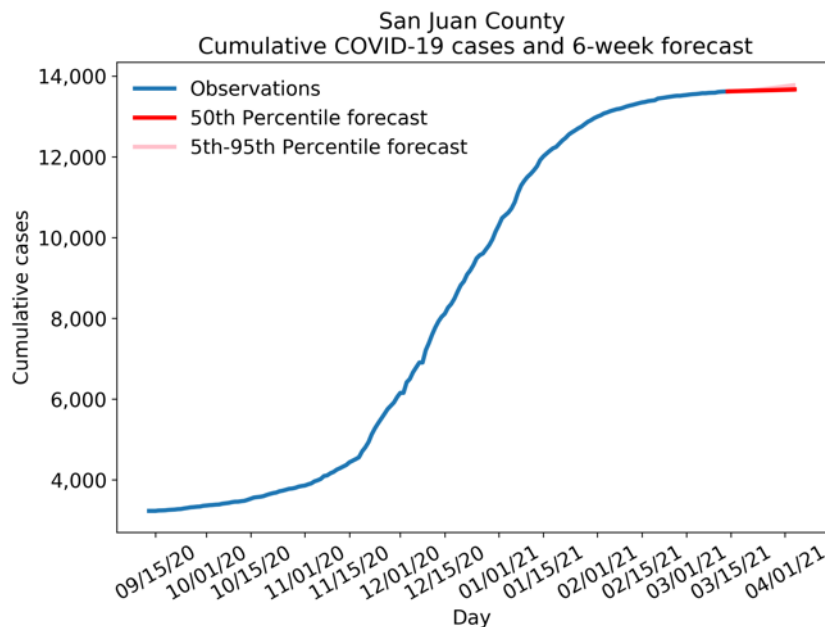
	3/14/21	3/21/21	3/28/21
Total cases	13,634 (13,618-13,678)	13,649 (13,618-13,740)	13,668 (13,618-13,814)
# of rooms needed	0 (0-0)	0 (0-0)	0 (0-0)
Deficit (-) or surplus of rooms	21	21	21
# of rooms needed (new forecast method)	0	0	0

2-week avg. new cases per day decreased from 9 last week to 7 this week.

Last week we forecasted 2 (0-5) rooms in use, 3 rooms with the adjustment; there are 0 actually in use so we are under forecasting. There are no shelters in use, so now the forecast ratio is 0 and subsequent use forecasts are 0
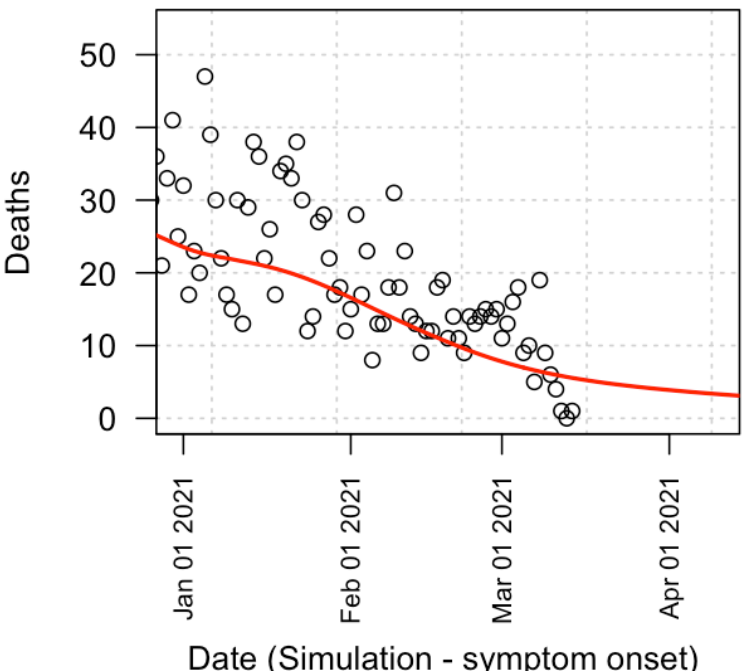
16 Mar 2021: EpiGrid modeling

- Cases may continue to decrease very slowly.
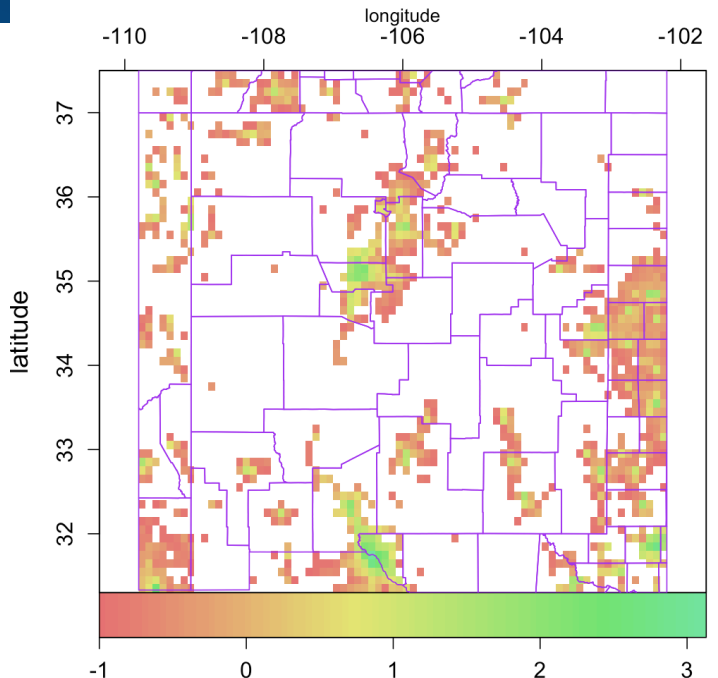- Deaths are decreasing.
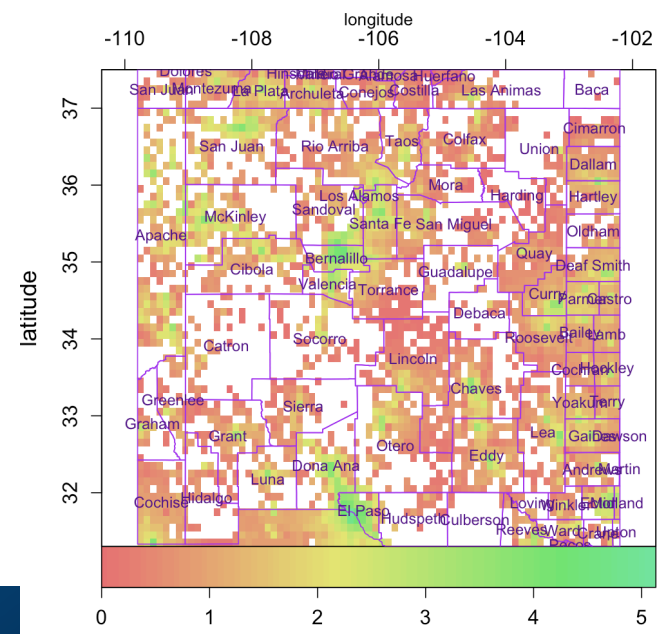

United States__New Mexico (Cases vs Date (Simulation - symptom onset))

United States__New Mexico (Deaths vs Date (Simulation - symptom onset))
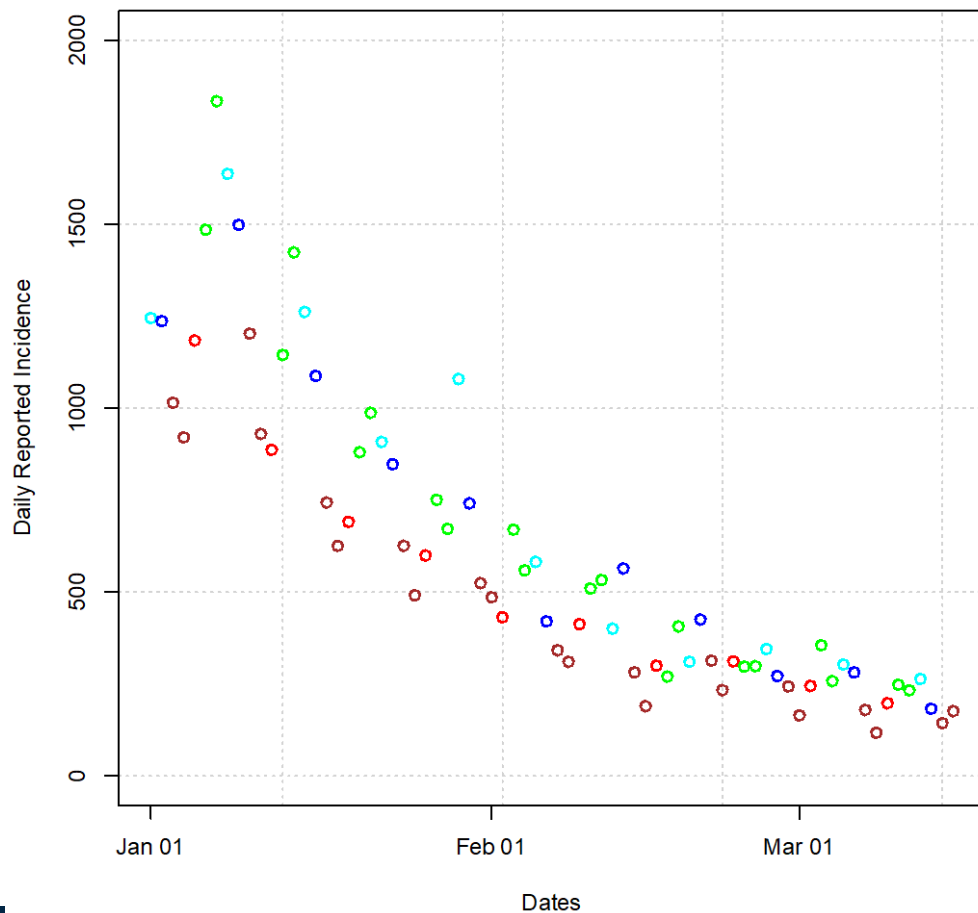

log10 Incidence, wk 58, 2021-04-04


log10 Cumulative cases, wk 58, 2021-04-04

A look at the raw incidence data

- Sunday, Monday
- Tuesday
- Wednesday/Thursday
- Friday
- Saturday

Probably still slowing, but not as rapidly as in January and early February

The 190 cases in the Lea county correctional facility are removed from data reported on the 26th. The 1/3 of reported cases that were > 2 weeks prior were removed from the 24th.

New Zealand-level of cases here on this plot
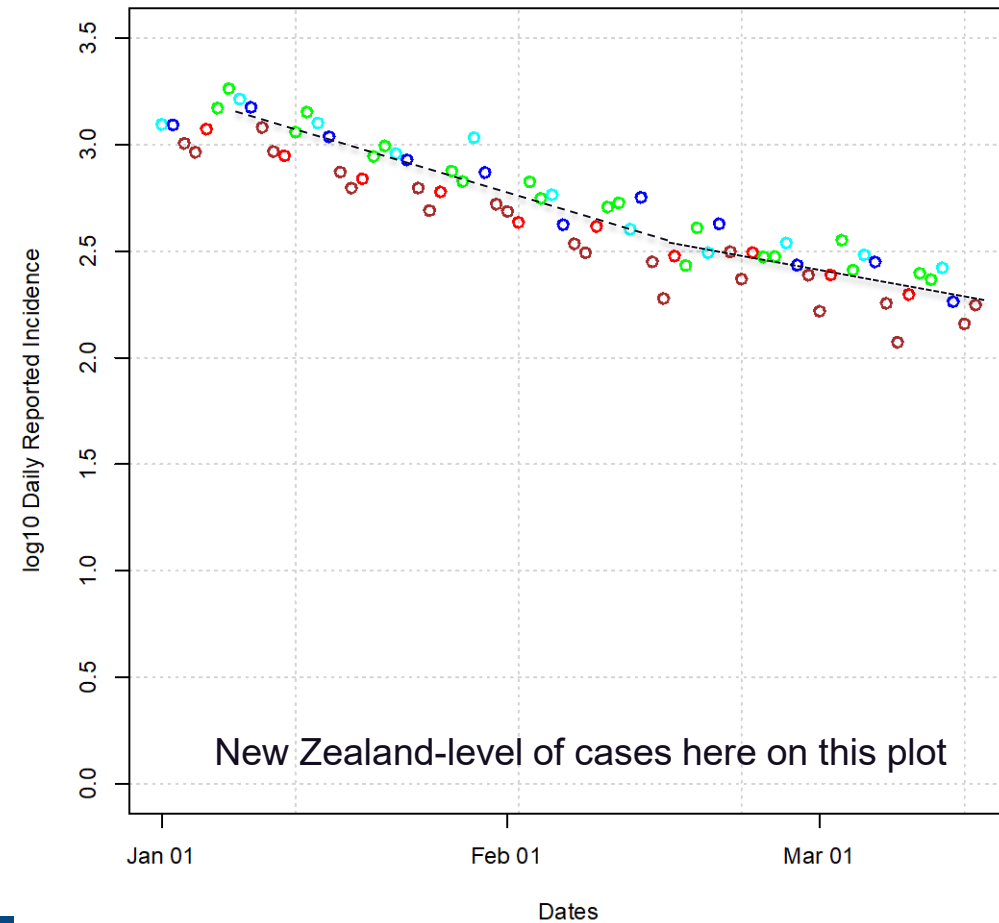
16 March 2021 Model (Mechanistic) – more details and information

- **See Figure for historical prime-dose vaccinations.**
  - Some Federal doses are uniformly distributed around the state, the rest are in McKinley, Cibola, and San Juan.
  - State vaccination rate is at a new high.
- **Transmission is based on mobility with modifications due to PHO's and the red/yellow/green/turquoise (RYGT) framework.**
  - Public health orders (PHO) and public behavior similar to previous models.
  - Using current RYGT assignments (no extrapolations).
- **Daily reported cases in El Paso are steady or declining.**

- **Death rates include some of the inhomogeneity by-county.**
  - Counties with larger at-risk populations have higher death rates.
  - Starting to model the expected change in death rate due to vaccination of older population.
- **Isolation and quarantine rates are assumed to be stable based on state-reported quarantine times.**
  - Base isolation rates mostly modeled as 50% Dec. 8th-22nd,45% until Jan 10th then are increased to 55%.
- **Baseline results reflect novel variants of SARS-CoV-2. The effect is possibly non-small at this time.**
  - Potential for a 50% increase in contagion/force of infection.
  - Epidemiological evidence does not discount strain replacement in New Mexico.
  - Without vaccination and with the current state of PHO opening, an increased daily incidence would likely be occurring.
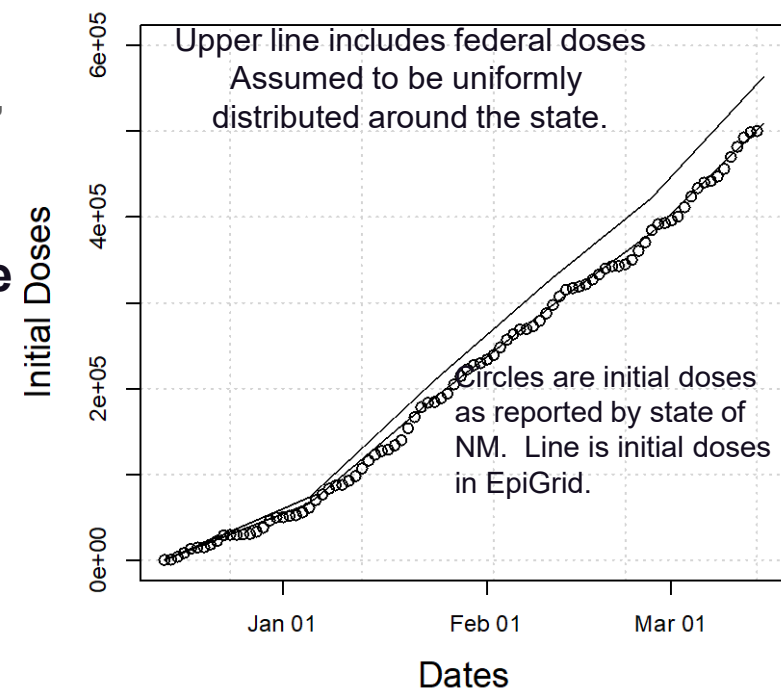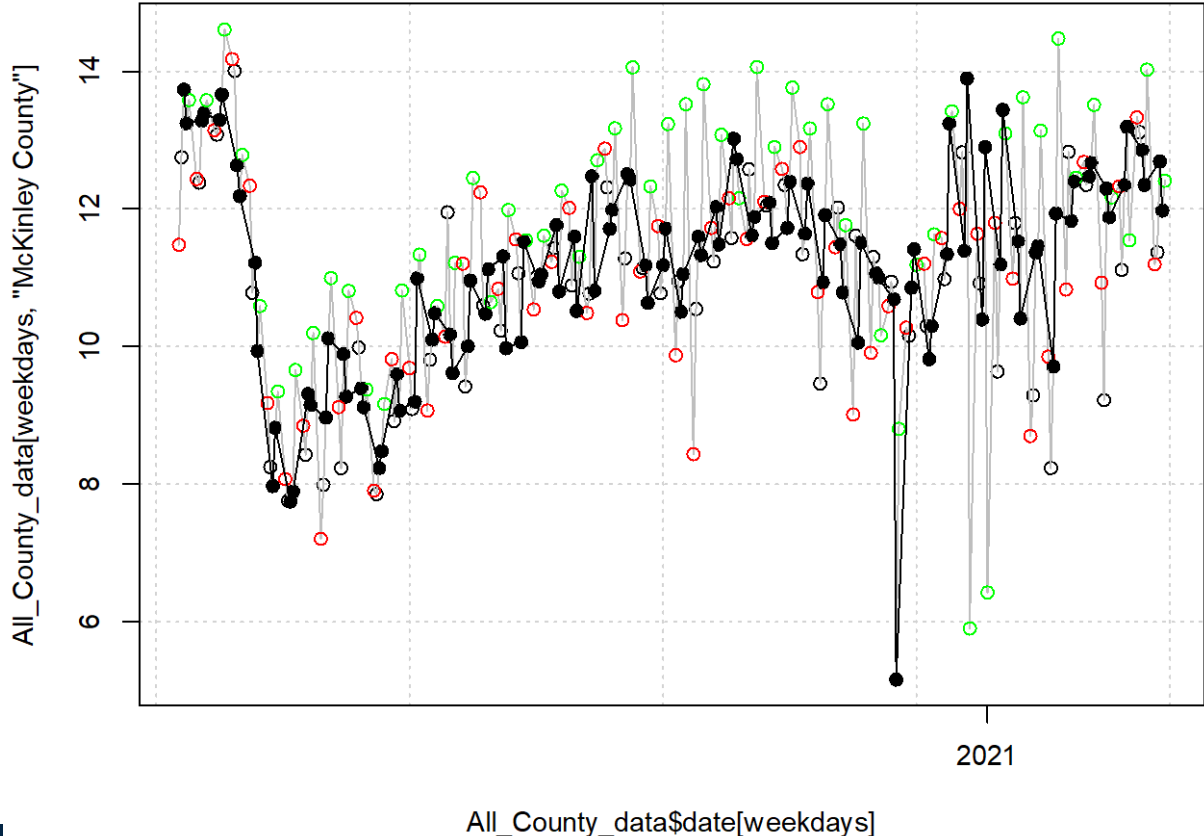
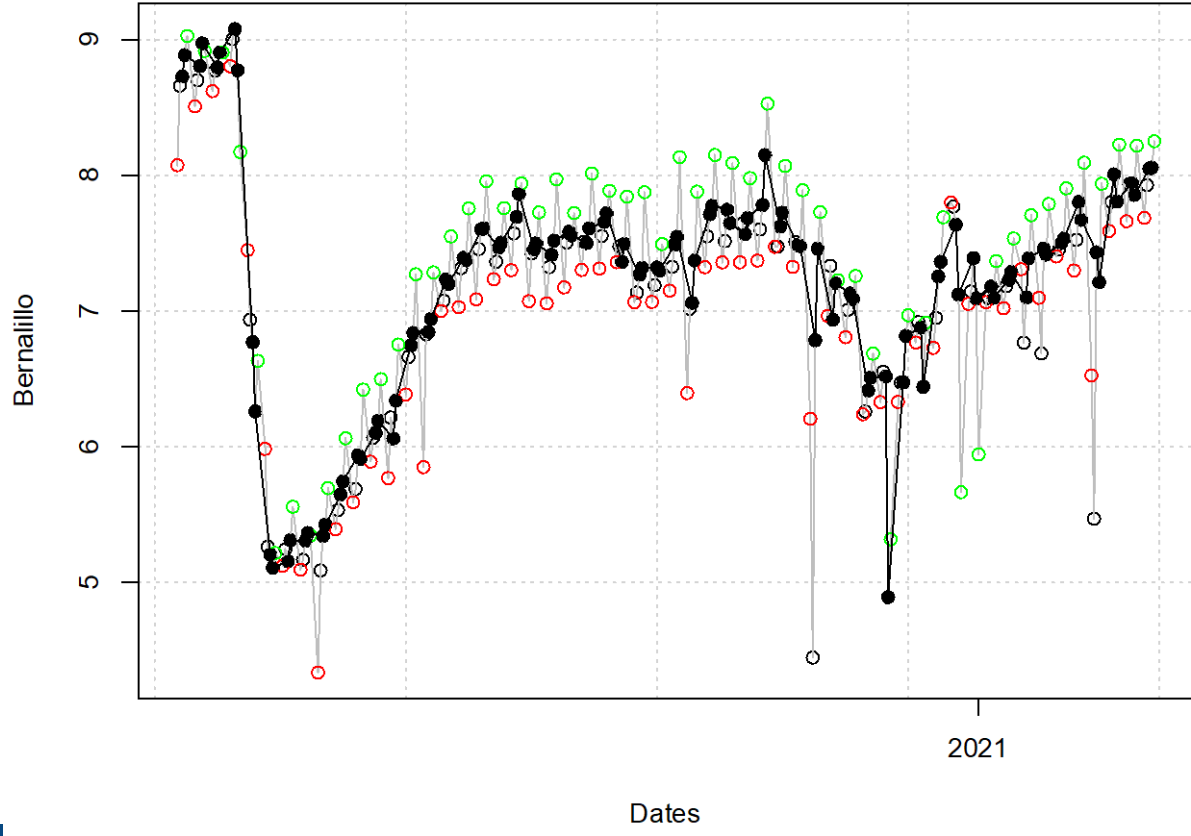# T-80 Mobility – northern counties (Data only)

- **McKinley, Valencia** had slightly decreasing mobility
- **Bernalillo, Rio Arriba, Sandoval, San Juan, Santa Fe** had slightly increasing mobility.
- **Los Alamos, Taos** had strongly increasing mobility.

- Weekends not shown
- Monday
- Wednesday/Thursday
- Friday (usually higher)

McKinley

Bernalillo

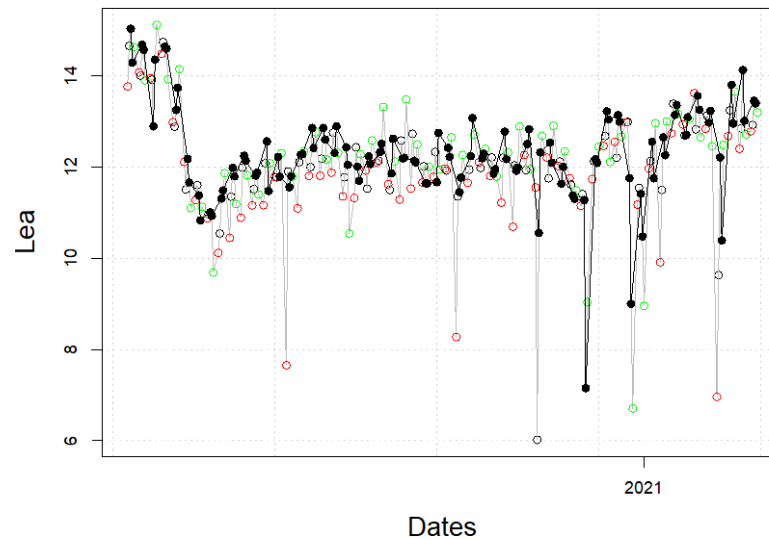# T-80 Mobility – southern counties and Curry (Data only)

- Eddy, Grant, Lea, Lincoln, Luna, Otero, Roosevelt had stable or slightly decreasing mobility.
- Chaves, Curry, and Socorro had slightly increasing mobility.
- Dona Ana had increasing mobility.

- Weekends NOT shown
- Monday
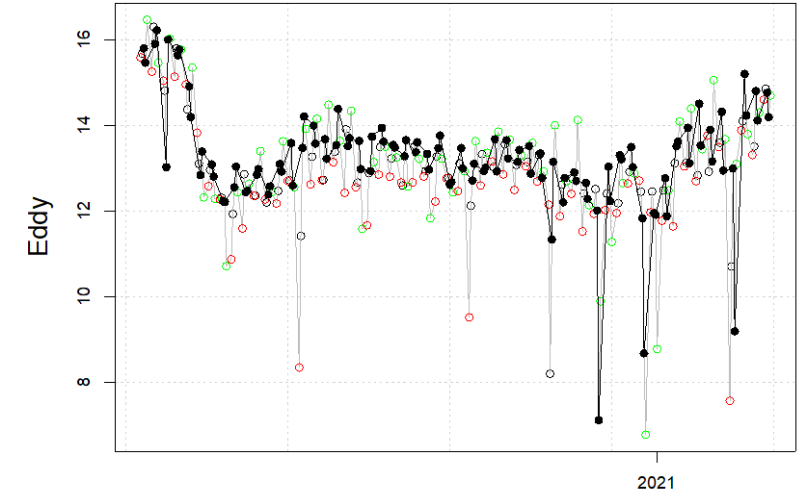- Wednesday/Thursday
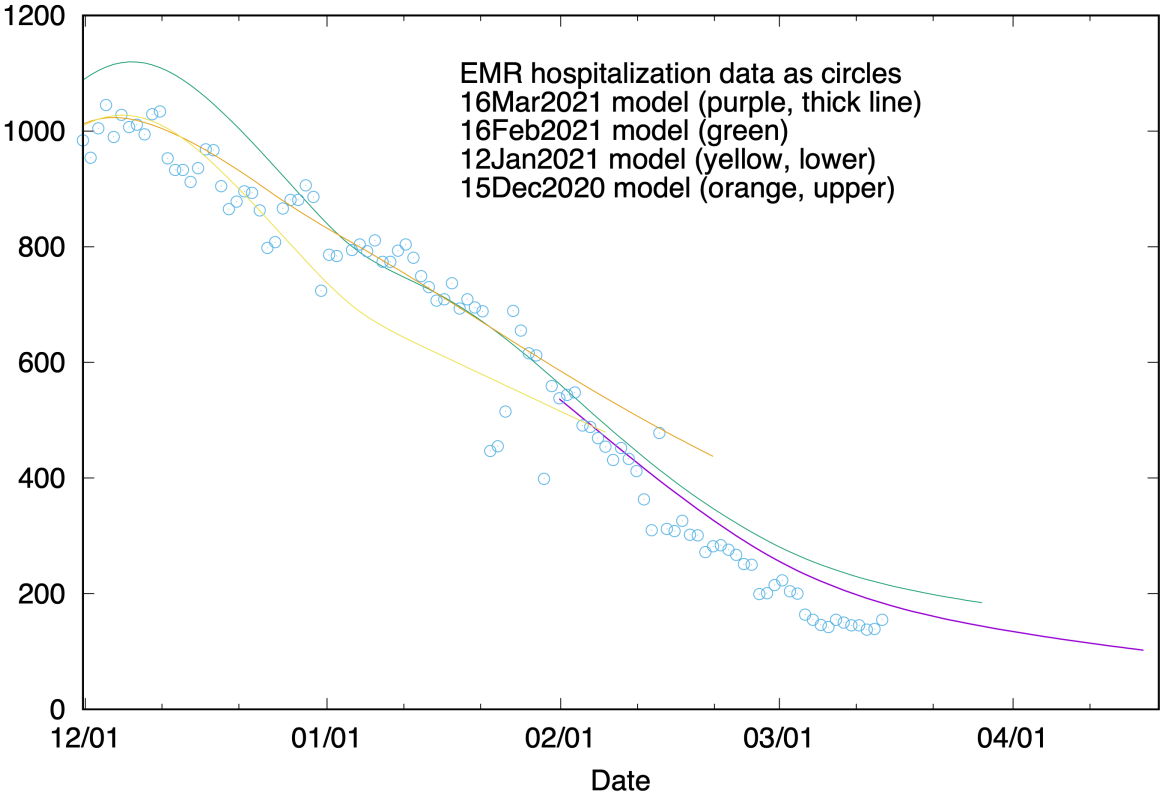- Friday (usually higher)
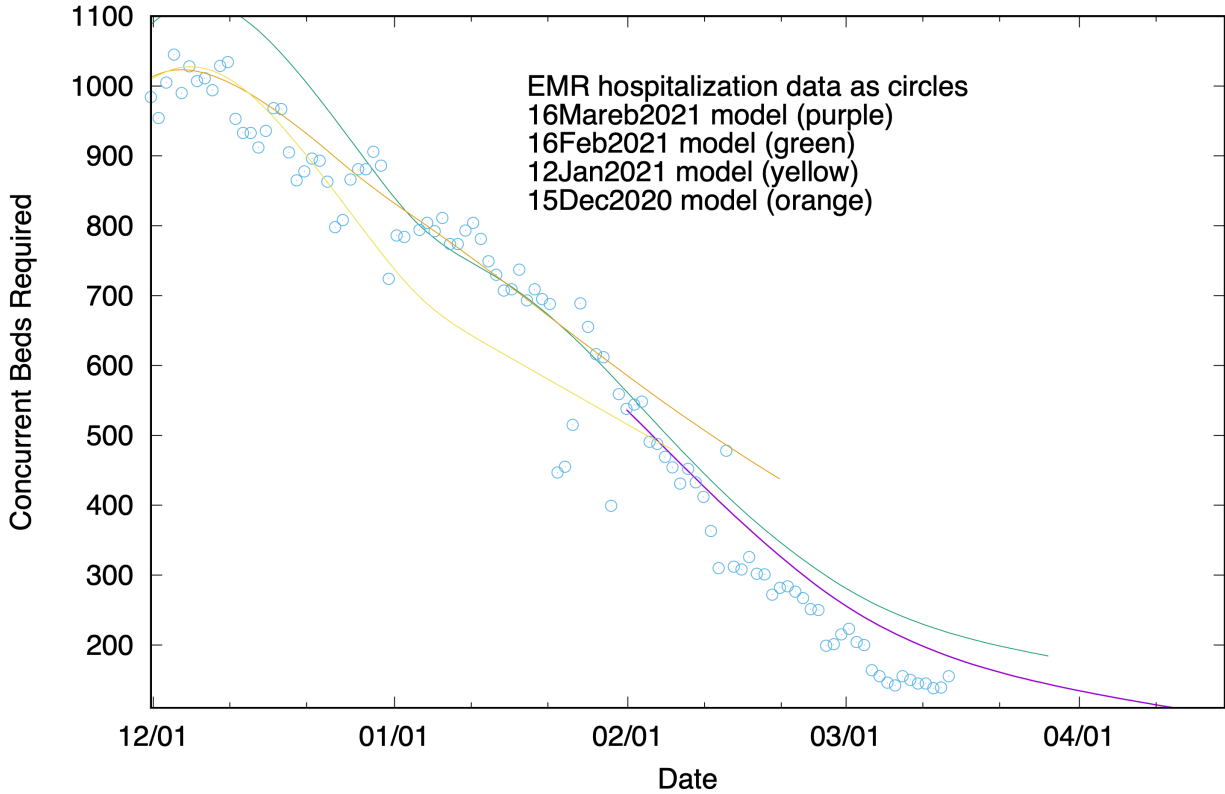

Eddy

Dona Ana

Lea
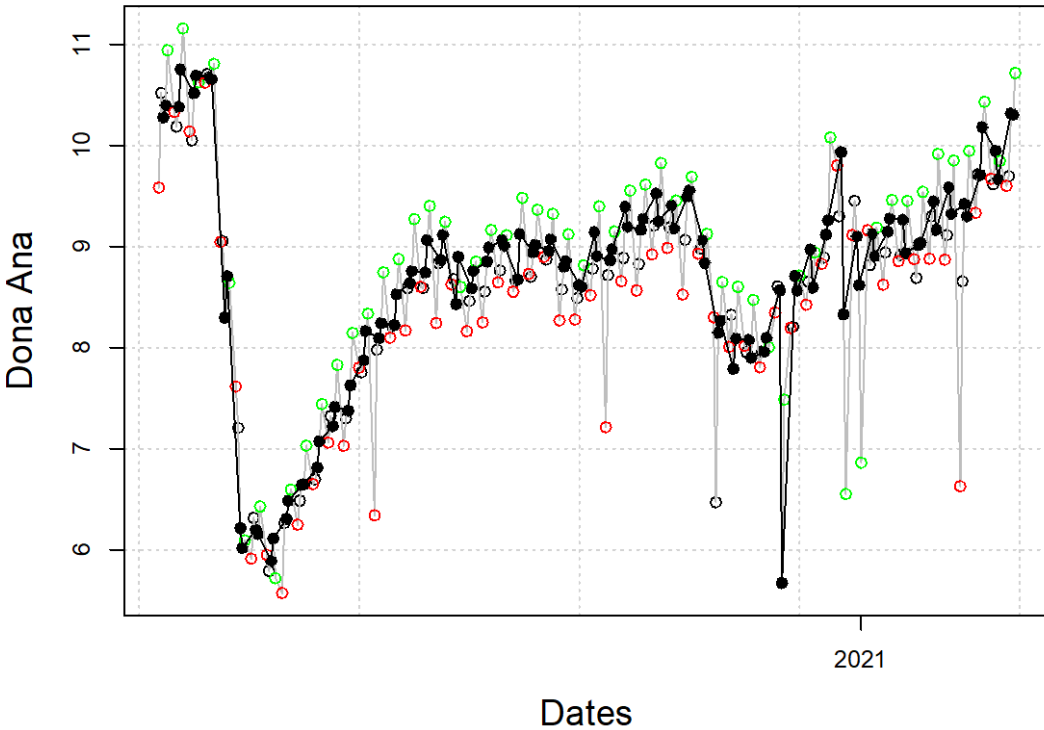
Hospital bed concurrent usage by COVID-19 patients (Statewide)

- Left panel: Linear vs. time (y-scale=0:1200) shows hospital beds.
- Right panel: Log vs. time, same data and models (y-scale = 110:1100, 10x).
- Divergence between 15Dec2020 model, subsequent EMR data, and later EG models reflects the impact of vaccination.
- Continued drops (purple) in the model as compared with 16Feb2021 reflect small adjustments of the model in late December, January, and February.

Hospital Bed Utilization

EMR hospitalization data as circles
16Mar2021 model (purple, thick line)
16Feb2021 model (green)
12Jan2021 model (yellow, lower)
15Dec2020 model (orange, upper)

Tue Mar 16 10:56:42 2021

Hospital Bed Utilization

EMR hospitalization data as circles
16Mareb2021 model (purple)
16Feb2021 model (green)
12Jan2021 model (yellow)
15Dec2020 model (orange)

Tue Mar 16 11:00:36 2021
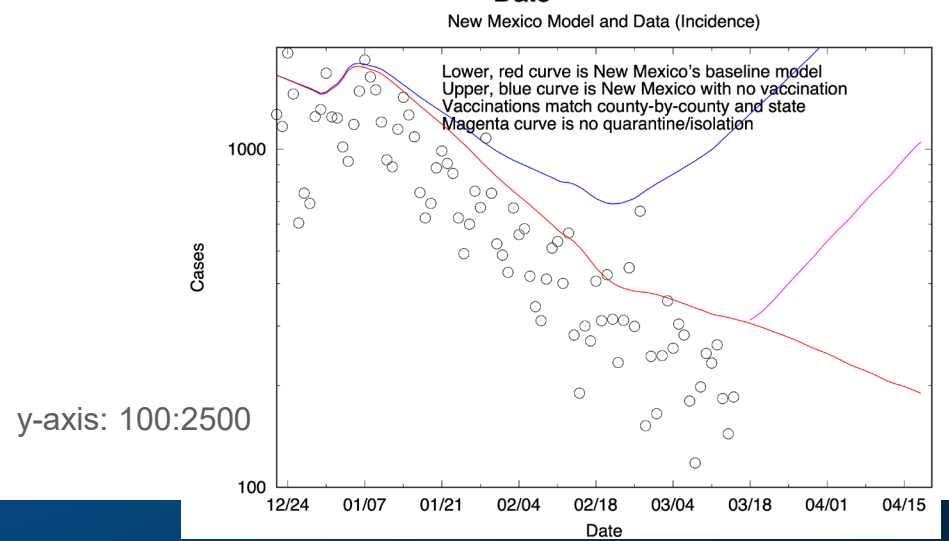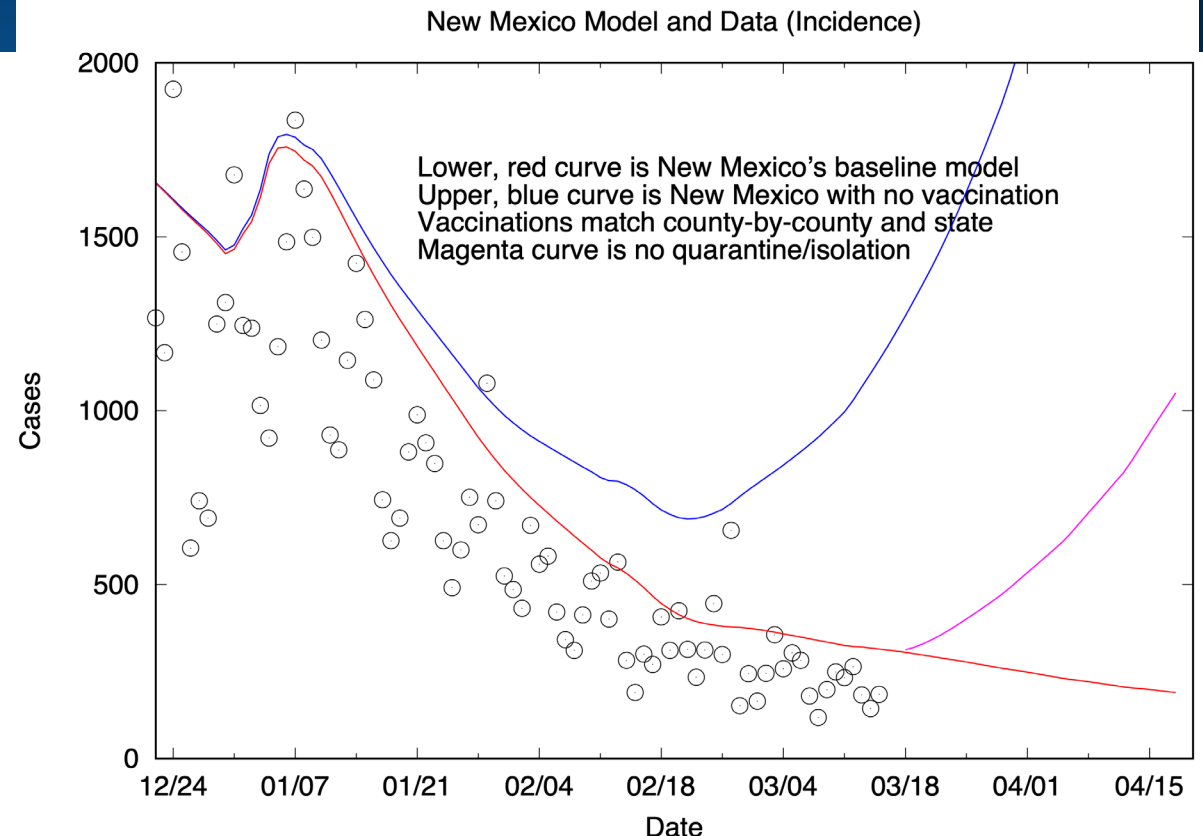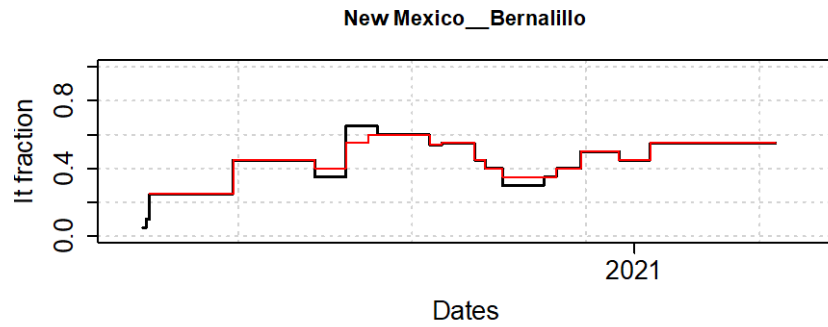
Effect of Vaccination on Incidence

- Vaccination is lowering daily incidence >60%.
- Quarantine *currently* plays a similar role in epidemic control to vaccination.
- Infection control appears to be comparable to vaccination.
- Currently modeling 90% vaccine effectiveness.
- Mar 16th model: >560k people vaccinated (1 or 2 doses).
- By-county matching to vaccination.
- Flattening of daily incidence is the anticipated effect of red to green and turquoise counties and increased mobility.
- Easily confused with variant virus replacement, but timing relative to by-county transitions suggests business opening is the most significant driver.
- NM is currently trading relaxed infection control for vaccination. NM appears to be at the "speed limit" for relaxation!
- Assuming only susceptible people are vaccinated.
- Unchanged quarantine effectiveness assumed in all cases.

New Mexico Model and Data (Incidence)

Lower, red curve is New Mexico's baseline model
Upper, blue curve is New Mexico with no vaccination
Vaccinations match county-by-county and state
Magenta curve is no quarantine/isolation

y-axis: 100:2500

Separating mechanistic effects: Captured effects of mitigations
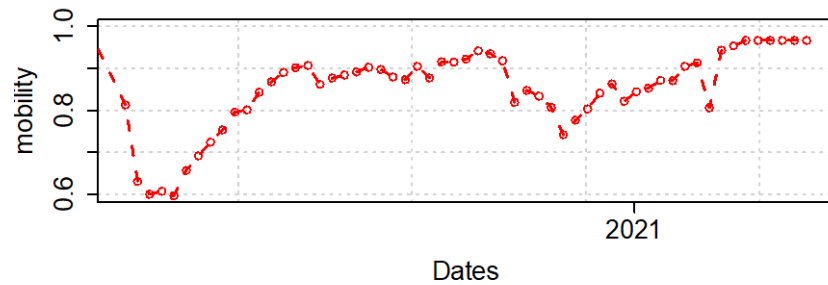

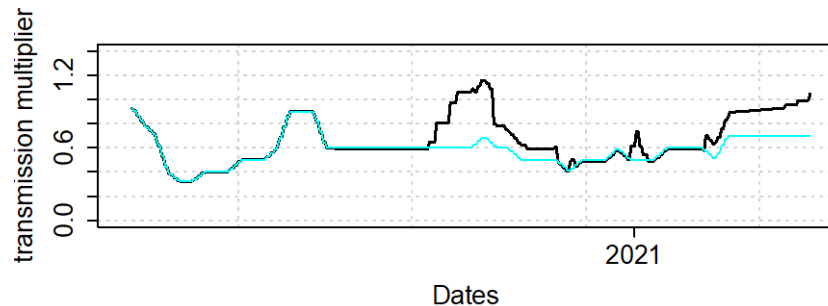New Mexico__Bernalillo

Quarantine
Red is base value
Black is values used for Bernalillo
~50% relative to unmitigated

Mobility data: an input
Last 5 points are extrapolation

Fractional change in person-to-person transmission
Cyan - mobility based value without PHO modifications (Aug. on)
Black – modified for PHO's, values used for Bernalillo

Conclusions and Discussion

- **New Mexico's daily incidence is slowly declining. Rapid vaccination is crucial to this success given reopening.**
- **Continued control may not be stable against strain replacement at current levels of mitigations.**
- **Increased vaccine supply and administration and/or improved effectiveness of investigation and quarantine are needed.**
- **Quarantine plays a comparable role to vaccination in epidemic control.**
- **Grant, Otero and Taos may be having outbreaks.**
- **National and State monitoring for strain emergence is likely improving. Model is *assuming* about 1:1000 variant cases in late January in NM, implies that currently variants might be ~10:1000.**
- **El Paso's daily incidence consistent with a slow decline in incidence.**
- **Nationwide geographical dispersion is seeding some local transmission and variants.**
- **Within-week variations returning to an established pattern.**
- **Begin shifting the vaccination strategy toward contagion-control in the weeks ahead?**
- **Discussion:**
  - Vaccinating high risk-of-mortality populations is likely lowering hospital loads since late January, 2021.
  - Good infection control in schools appears to be well-correlated with improved outcomes. Improved PPE may be required in response to viral variant emergence. Meal times, busses, and passing periods are likely the riskiest school-related activities.
  - *Epidemiological* evidence does not rule out a more contagious variant of SARS-CoV-2 in New Mexico (as compared with Milan-like variants).
  - Daily incidence is low enough that testing may soon be qualitatively larger than incidence, providing opportunities:
  - The importance of case investigation and quarantine might *rise* in reaction to vaccine-associated control (lower number of cases to track).
  - Geographical or ring-like vaccination might be feasible. ~<10 counties have single-digit or no reported cases on many days during the week.
  - Elimination of COVID-19 removes or reduces the risk of novel variant emergence.