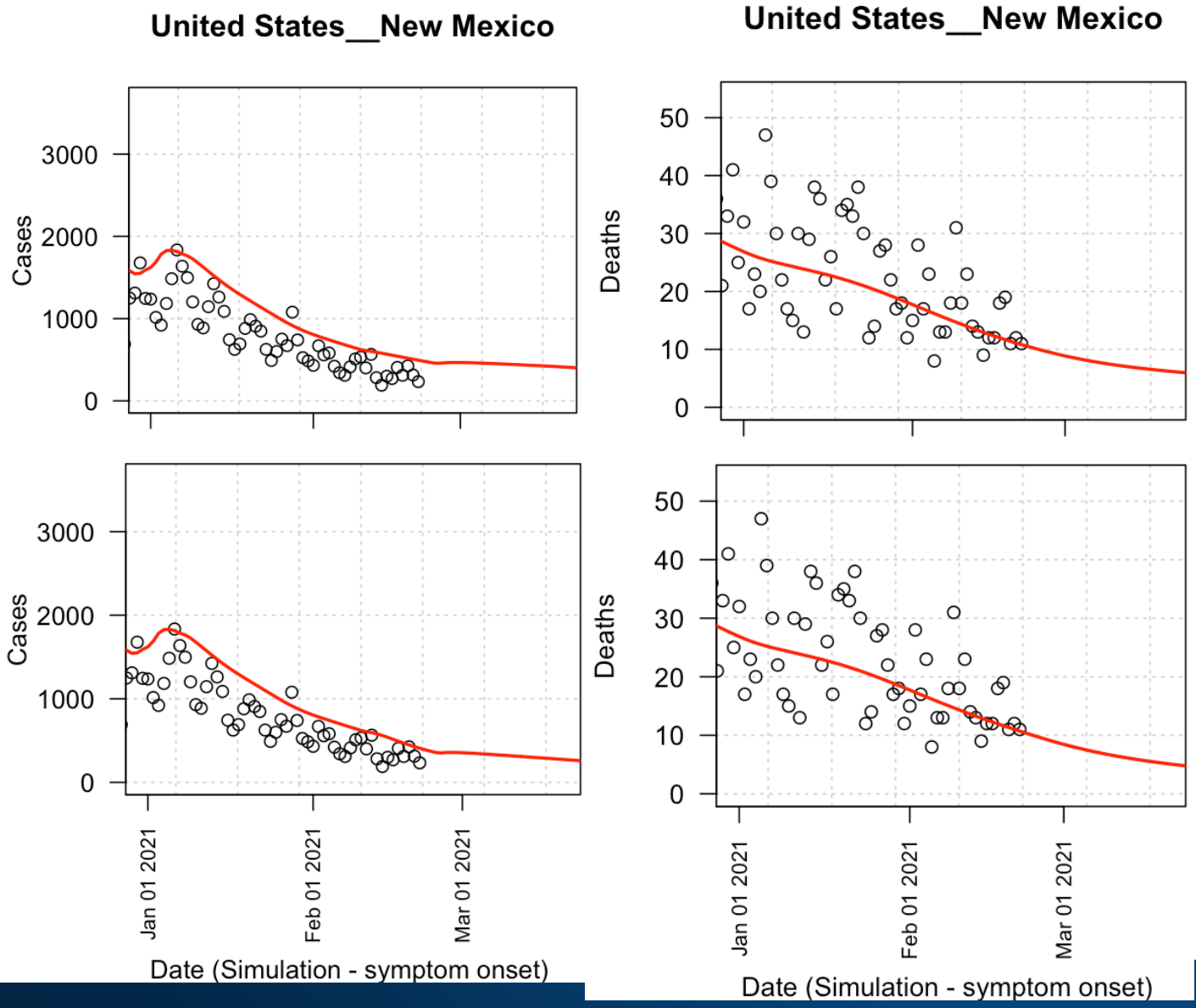
Modeling & Forecasting COVID-19 in NM

February 23, 2021

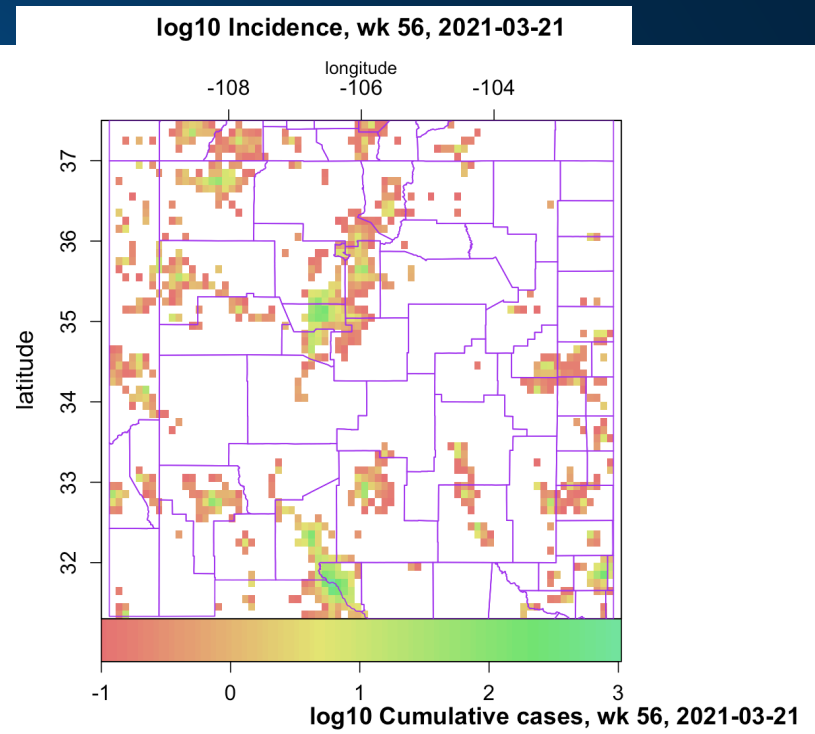
NNSA
National Nuclear Security Administration

23 Feb 2021: EpiGrid modeling



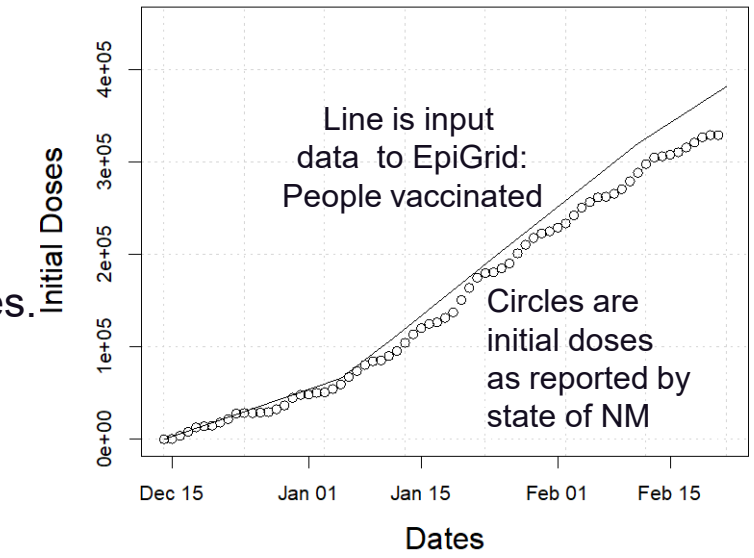
Last week

This week



16 February 2021 Model (EpiGrid) – more details and information

- **See Figure for historical prime-dose vaccinations.**
  - Federal doses are partly accounted for (reflected by line above dots for NM data)
  - State vaccination rate decreased recently.
- **Transmission is based on mobility with modifications due to PHO's and the red/yellow/green framework.**
  - Public health orders (PHO) and public behavior similar to previous models. Human choices.
  - Assumes most counties are yellow or green starting Feb. 24th. Human choices.
- **Daily reported cases in El Paso are approximately constant, slight decrease.**



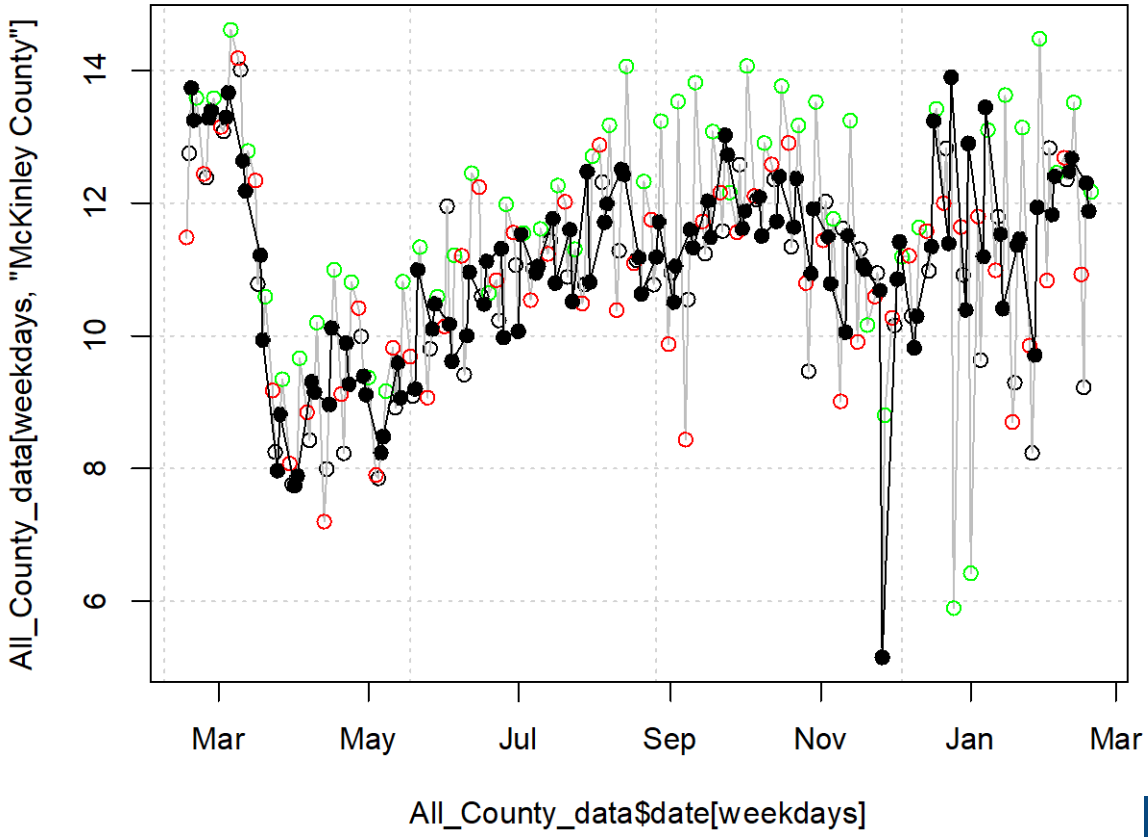
- **Death rates include some of the inhomogeneity by-county.**
  - Counties with larger at-risk populations have higher death rates. Not a human choice.
  - Starting to model the expected change in death rate due to vaccination of older population. Partly a human choice.
- **Isolation and quarantine 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%. Mostly human choice.
- **Baseline results reflect novel variants of SARS-CoV-2. The effect is numerically small at this time.**
  - Potential for a 50% increase in contagion/force of infection *in the future*. Not a human choice *per se,* **this is *biology*.**
  - No epidemiological evidence yet for strain replacement in New Mexico. Good infection control helps ***change*** **the biology.**
  - Without vaccination, an increased daily incidence in March *would have* been a distinct possibility (with red/yellow/green changes, *and* increasing mobility in some counties).
  - Properties of novel viral variants are not fully characterized.

T-80 Mobility – northern counties (Data only)

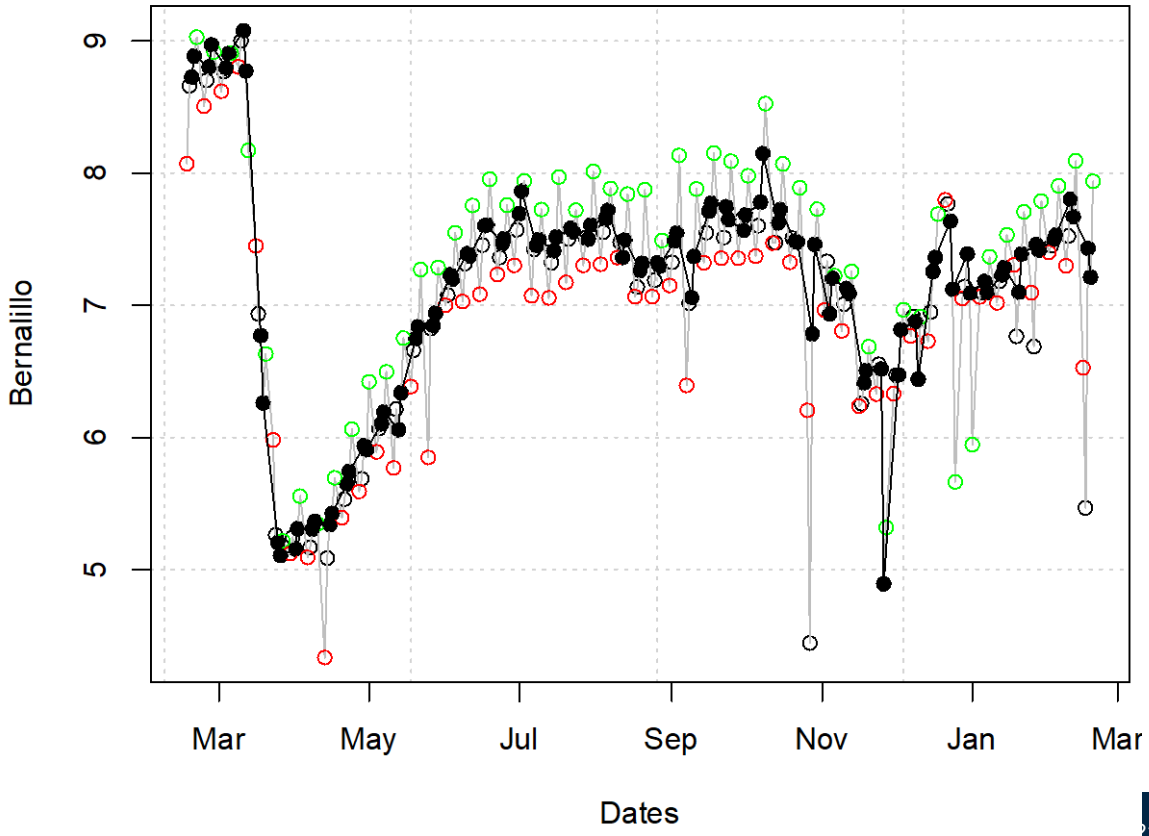
- **Cold weather and precipitation decreased mobility in the last week.**
- Bernalillo, Los Alamos, Taos, Sandoval, Santa Fe had decreased mobility last week.
- McKinley, Rio Arriba, Valencia had slightly decreased mobility last week.
- San Juan was stable.

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

McKinley



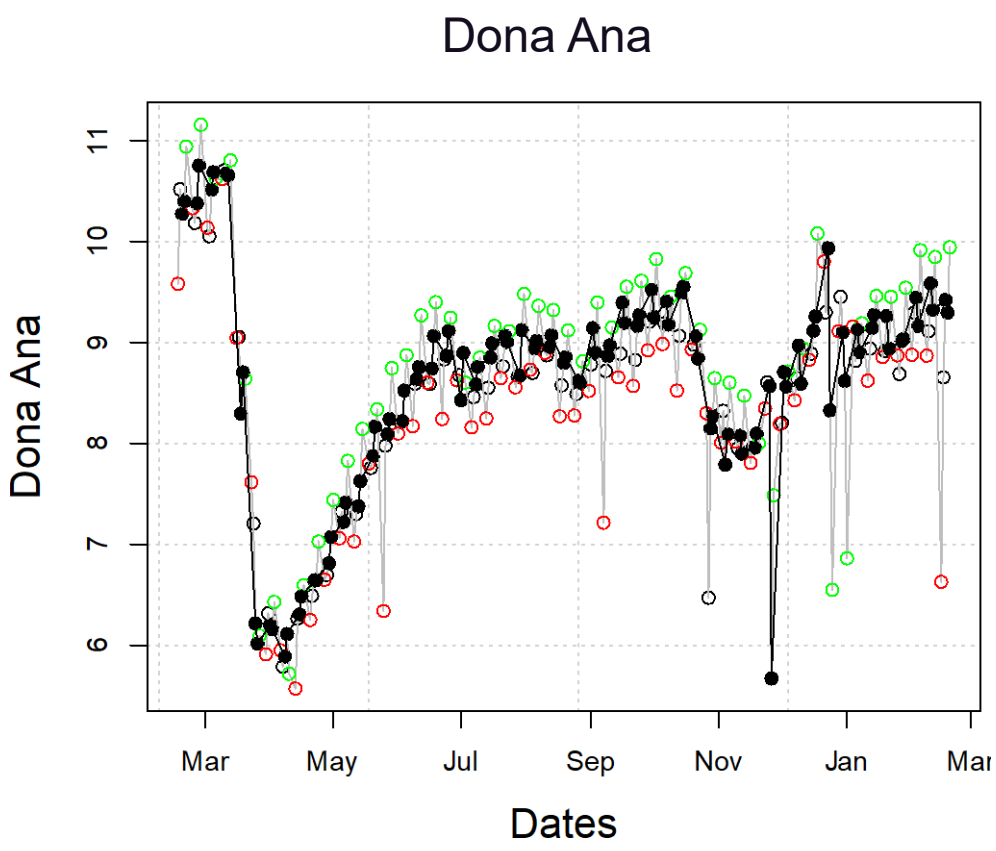
Bernalillo

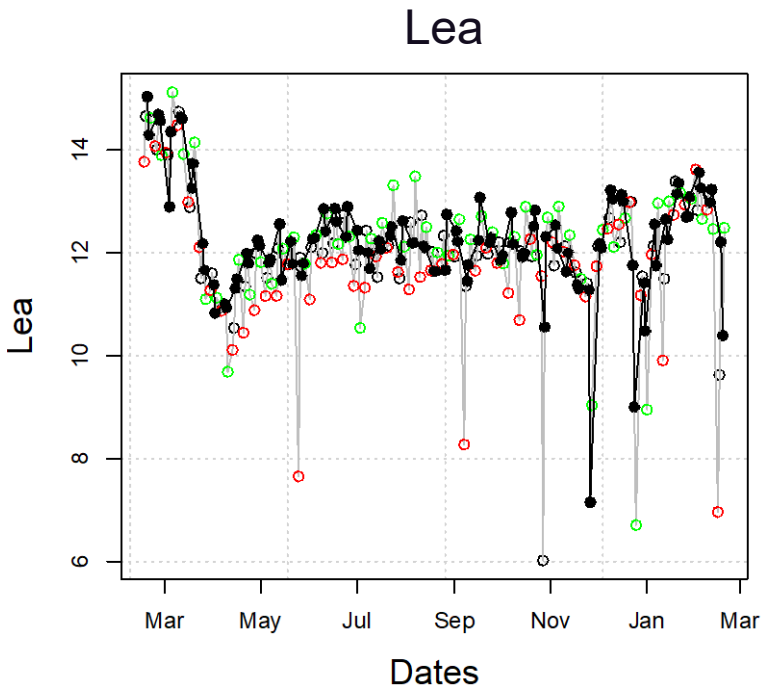


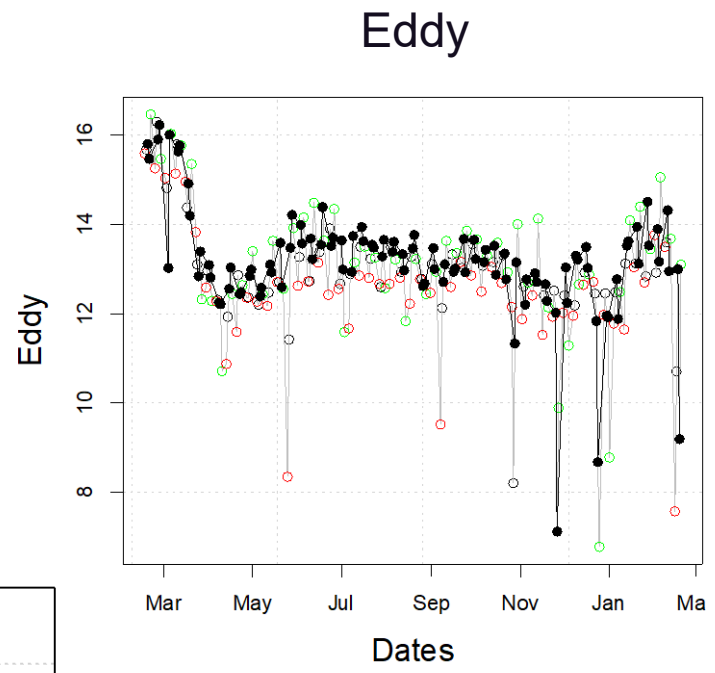
T-80 Mobility – southern counties and Curry (Data only)

- Weather decreased mobility.
- Chaves, Curry , Eddy, Lea, Lincoln, and Roosevelt decreased.
- Dona Ana , Grant, Luna, Otero, Socorro were stable or decreased slightly.

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

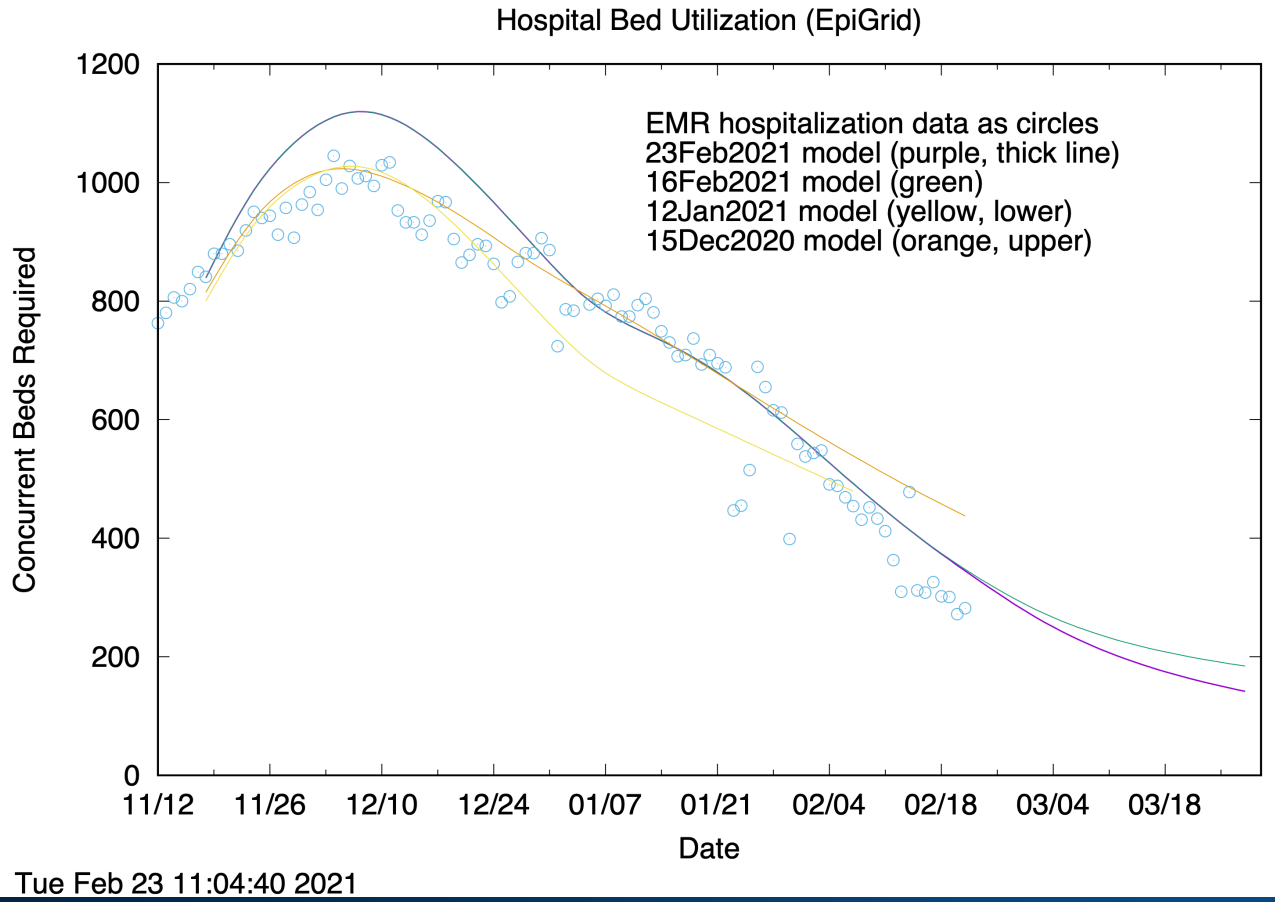


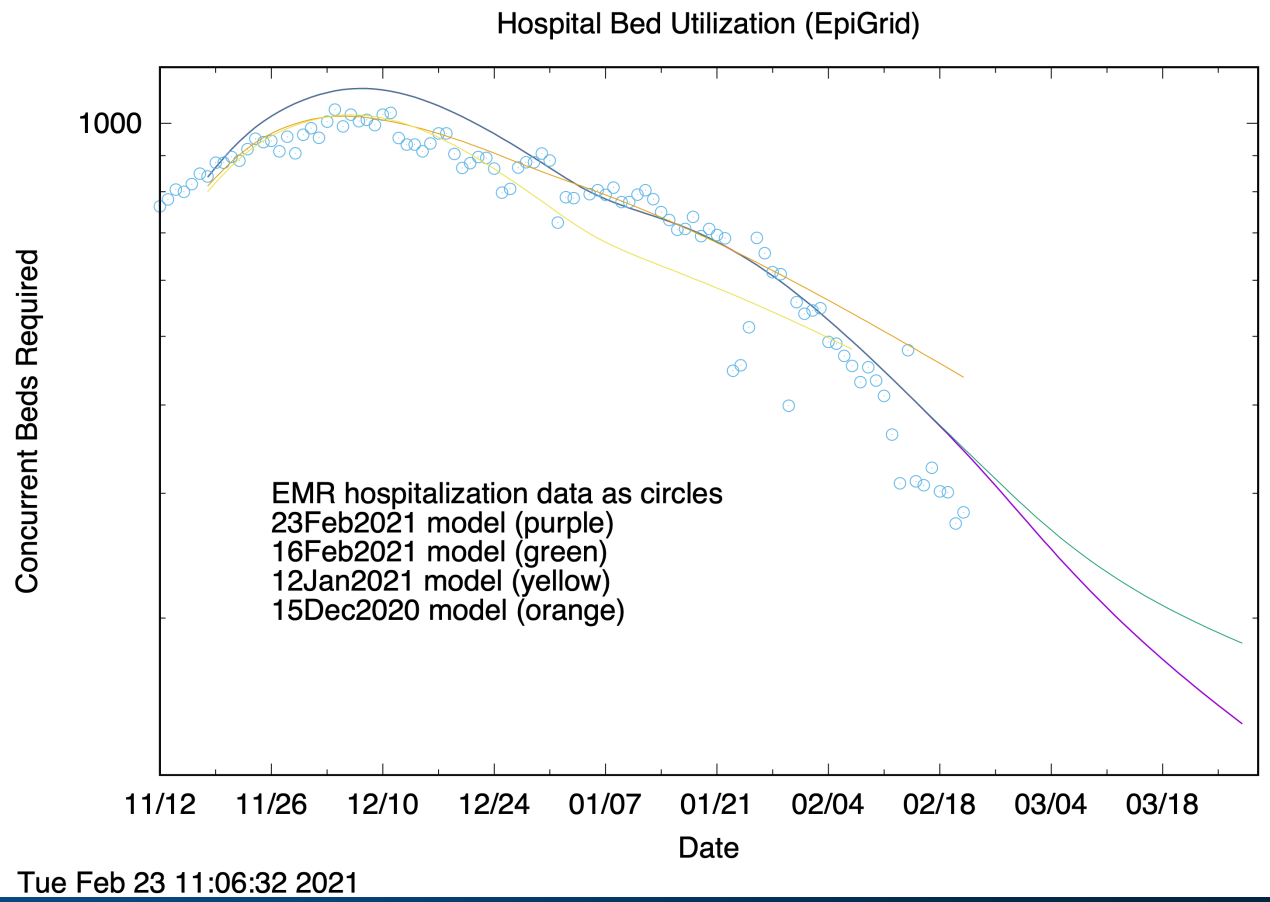




Hospital bed concurrent usage by COVID-19 patients (Statewide)

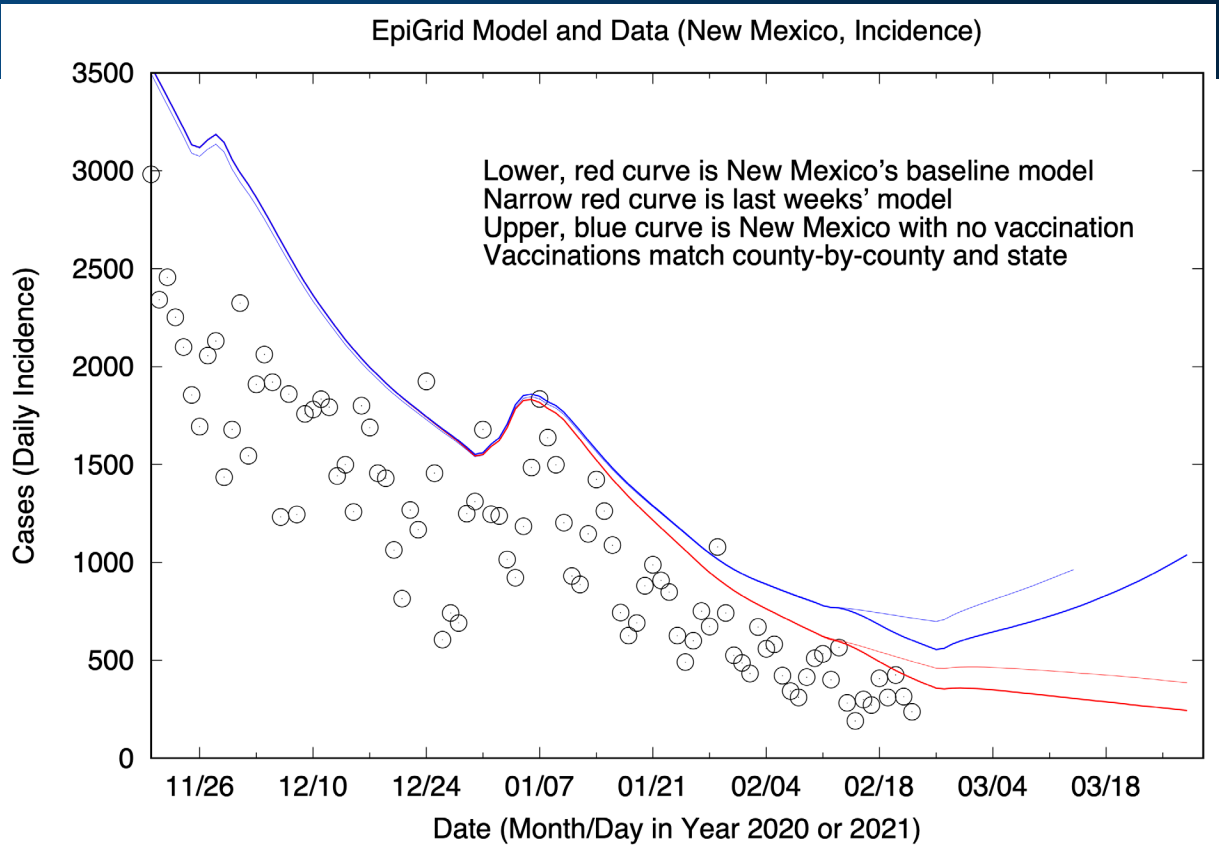
- Left panel: Linear vs. time (y-scale=0:1200) shows hospital beds.
- Right panel: Log vs. time, same data and models (y-scale = 120:1200, 10x).
- Divergence between 15Dec2020 model, subsequent EMR data, and later EG models reflects the impact of vaccination.

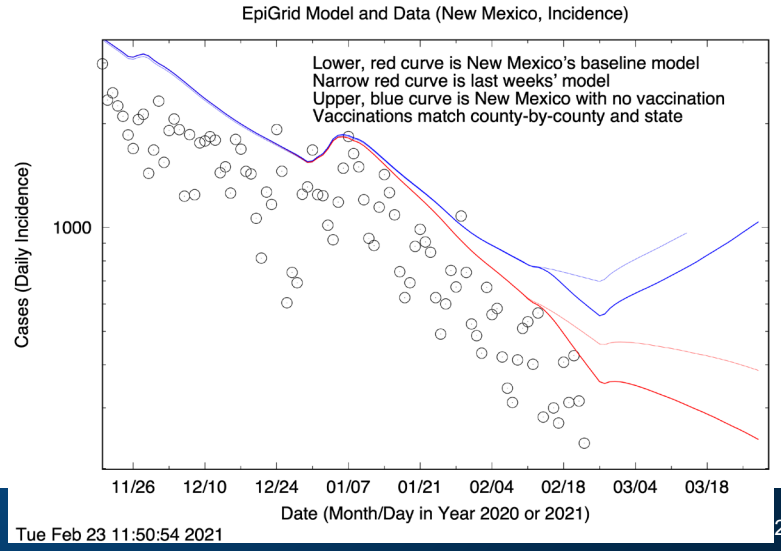




Effect of Vaccination on Incidence

- Vaccination is lowering daily incidence >20%.
- Quarantine *currently* plays a larger roles in epidemic control than vaccination.
- Infection control appears to be comparable to vaccination.
- Currently modeling 90% vaccine effectiveness.
- Feb 23rd model: 381,630 people vaccinated (1 or 2 doses).
- NM reports 329,054 people vaccinated. Additional Federal doses contribute too.
- By-county matching to vaccination.
- Flat red curve in March does not account for additional vaccine that may be available.
- Flattening of daily incidence is a consequence of red to green counties and increased mobility.
- NM is currently trading relaxed infection control for vaccination. This sets a “speed limit” to relaxation.
- Unchanged quarantine effectiveness assumed in all cases.



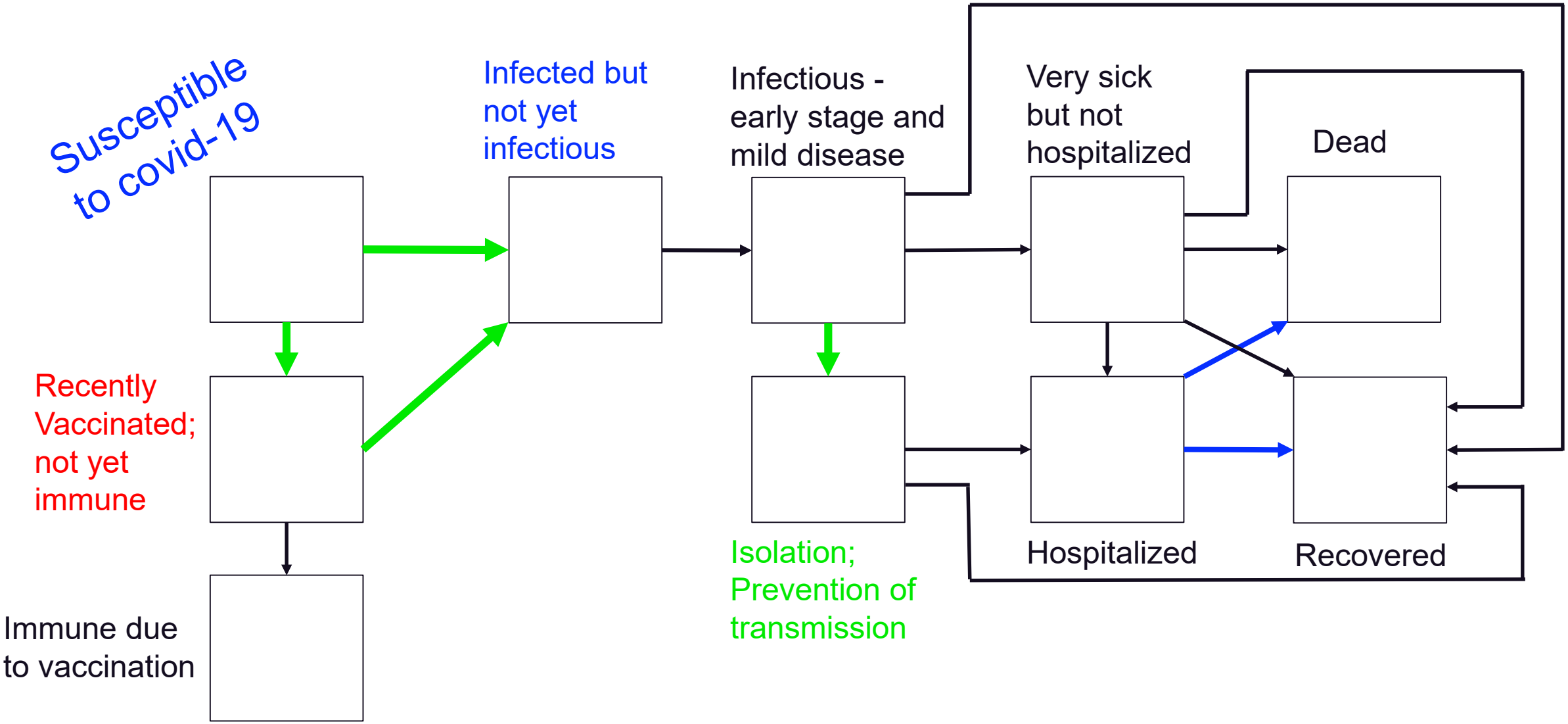


Situational Awareness:

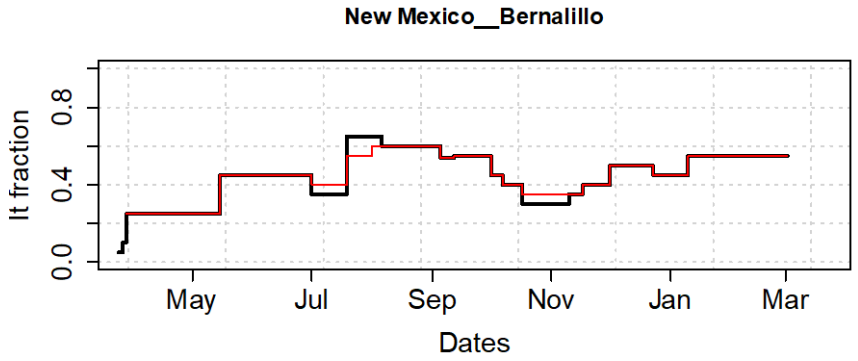
- Cases appear to no longer be decreasing in some of the more populace counties:
  - Bernalillo, Dona Ana, Santa Fe and Valencia

- Statewide there is no evidence of cases continuing to decrease in the last week.

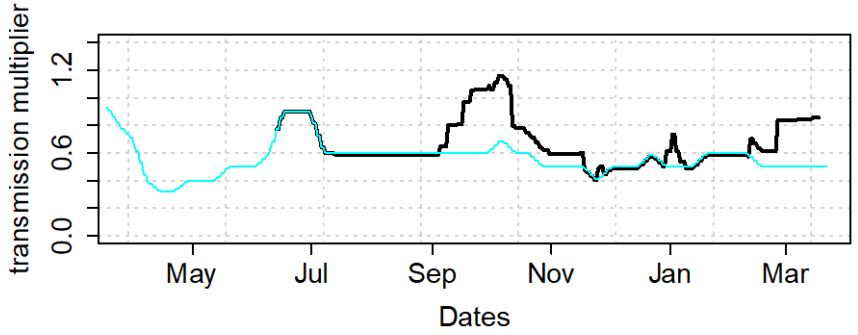
Healthy and disease states in EpiGrid: How we capture the effects of mitigations



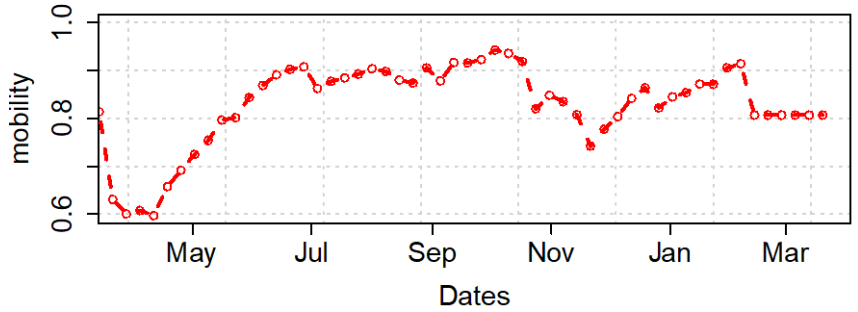
Separating mechanistic effects: Captured effects of mitigations



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



Fractional change in person-to-person transmission
Cyan - mobility based value without PHO modifications
Black – modified for PHO's, values used for Bernalillo
~20% improvement relative to unmitigated
Has been as large as ~60% in the past (rel. to unmitigated)

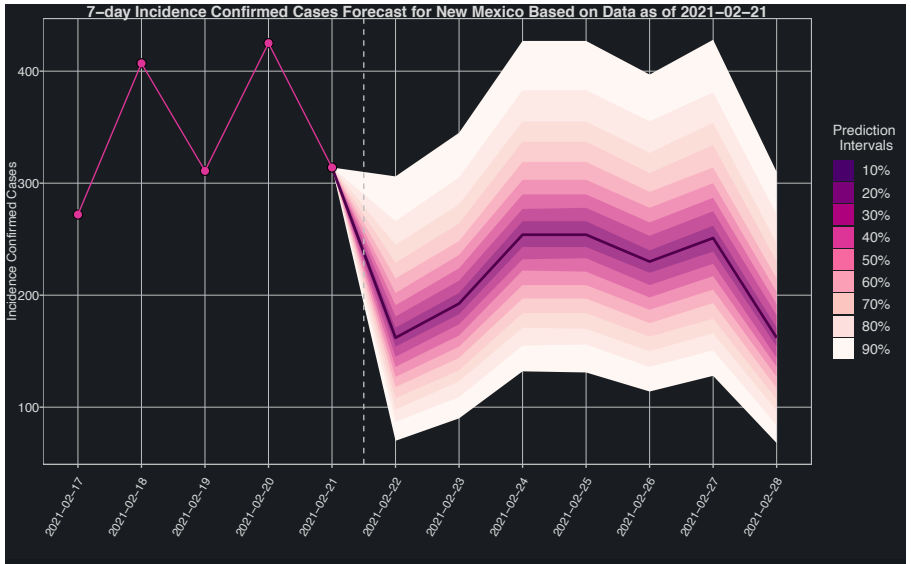


Mobility data: an input
Currently low because of snow storms last week …

Conclusions and Discussion

- **New Mexico's daily incidence is not increasing, possibly declining. Daily incidence could stop declining by March.**
- **Increased vaccine supply and administration and/or improved effective quarantine rates likely needed to see continued epidemic improvement in the context of great activity/mobility, opening, and contact.**
- **COVID-19 vaccination reported by the State is responsible for an >20% reduction in daily incidence.**
- **Infection control and quarantine continue to play larger roles than vaccination in epidemic control.**
- **Multiple viral variants continue to pose a risk to epidemic control. National and State monitoring for strain emergence is likely improving. Model is *assuming* about 1:1000 variant cases in late January, assumed <10:1000 currently.**
- **El Paso's daily incidence consistent with a slight decline.**
- **Nationwide geographical dispersion is seeding some local transmission and variants.**
- **Testing suggests that situational awareness is fair to good.**
- **Targeting vaccine to high-mortality areas and populations will have the largest immediate effect on this model.**
- **Change to contagion control in weeks of months?**
- **Discussion:**
  - Vaccinating high risk-of-mortality populations will lower the mortality rate *and* further lower hospital loading.
  - 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.
  - There is not yet clear *epidemiological* evidence for a more contagious variant of SARS-CoV-2 in New Mexico. This is not a warning system.
  - Qualitatively higher testing rates (i.e. 10x) can substantially offset local epidemics (i.e. South Korea) by facilitating tracing and quarantine. Sequencing can provide diagnostics, and provides variant-level information that is likely to become important in the near future, and is compatible with high testing rates.
  - Elimination of COVID-19 removes or reduces the risk of novel variant emergence.

Short- & Long-Term Forecast for NM: Cases



6–Week Forecast of Confirmed Cases for New Mexico Based on Data as of 2021–02–21

Week	Best Case (5th Percentile)	Middle Case (50th Percentile)^	Worst Case (95th Percentile)
2021–02–21		182,789*	
2021–02–28	183,524	184,291	185,413
2021–03–07	184,136	185,637	187,897
2021–03–14	184,683	187,066	190,679
2021–03–21	185,289	188,764	193,991
2021–03–28	185,914	190,737	197,902
2021–04–04	186,728	193,015	202,437

*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 2021–02–21

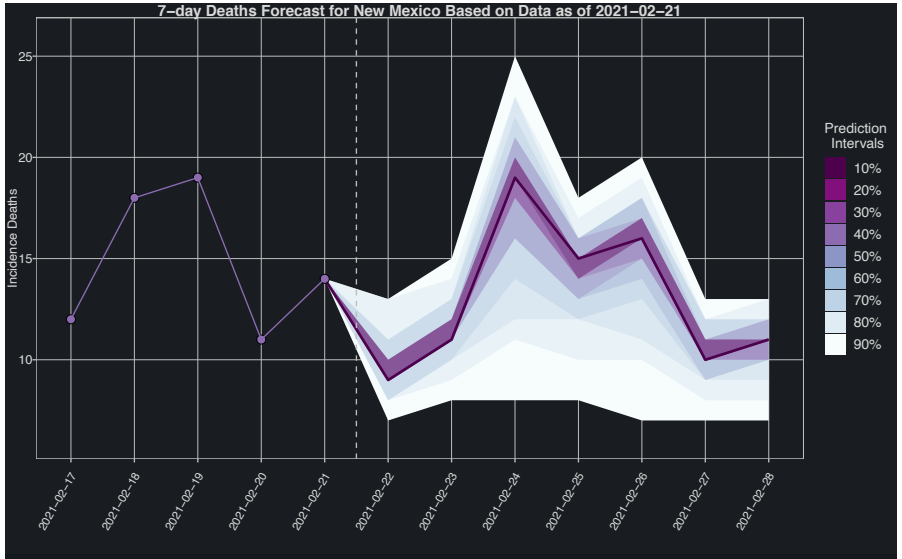
Week	Best Case (5th Percentile)	Middle Case (50th Percentile)^	Worst Case (95th Percentile)
2021–02–21		317*	
2021–02–28	105	215	375
2021–03–07	87	192	355
2021–03–14	78	204	397
2021–03–21	87	243	473
2021–03–28	89	282	559
2021–04–04	116	325	648

*Last reported confirmed cases count
^Closest–matching scenario

So what?

The daily number of cases are expected to range between 78 and 397 in the next few weeks

Short- & Long-Term Forecast for NM: Deaths



6–Week Forecast of Deaths for New Mexico Based on Data as of 2021–02–21

Week	Best Case (5th Percentile)	Middle Case (50th Percentile)^	Worst Case (95th Percentile)
2021–02–21		3,624*	
2021–02–28	3,677	3,717	3,734
2021–03–07	3,719	3,798	3,835
2021–03–14	3,754	3,871	3,934
2021–03–21	3,785	3,940	4,055
2021–03–28	3,814	4,013	4,217
2021–04–04	3,843	4,095	4,441

*Last reported deaths count
^Closest–matching scenario

6–Week Forecast of Daily Average of Deaths for New Mexico Based on Data as of 2021–02–21

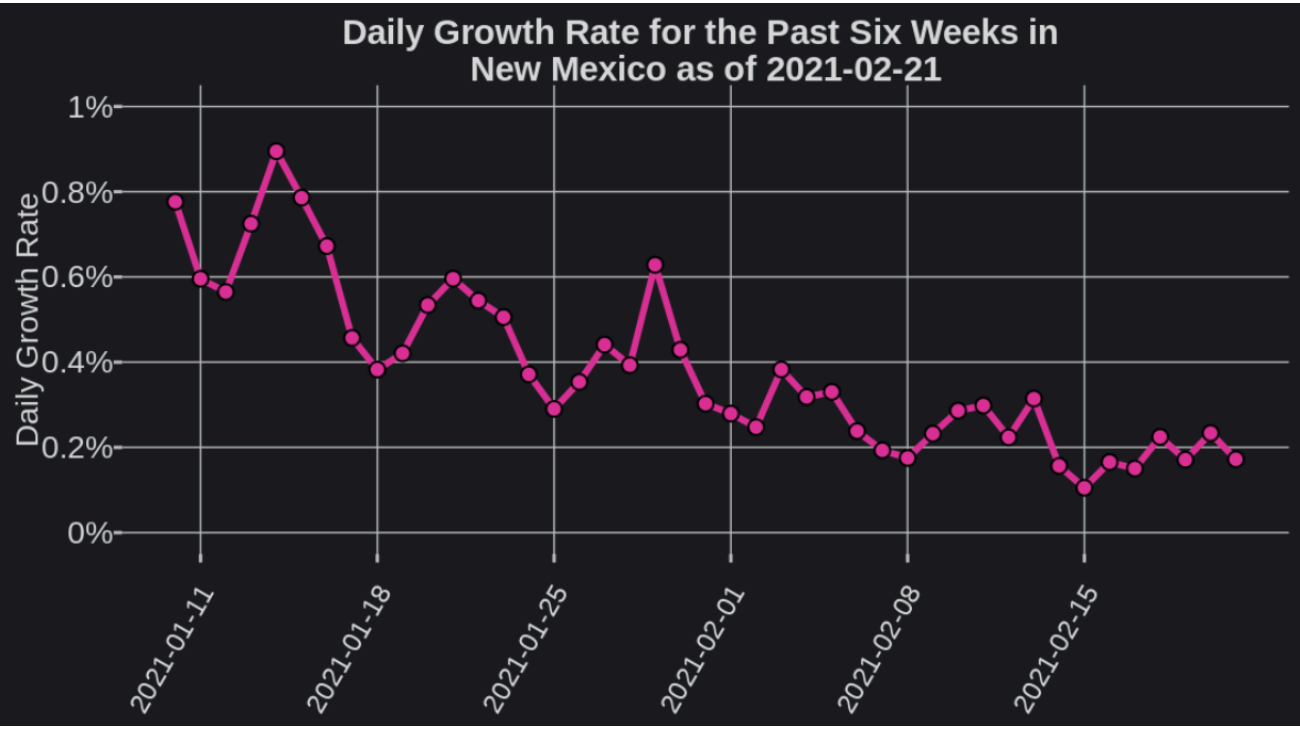
Week	Best Case (5th Percentile)	Middle Case (50th Percentile)^	Worst Case (95th Percentile)
2021–02–21		14*	
2021–02–28	8	13	16
2021–03–07	6	12	14
2021–03–14	5	10	14
2021–03–21	4	10	17
2021–03–28	4	10	23
2021–04–04	4	12	32

*Last reported confirmed deaths
^Closest–matching scenario

So what?

The <u>daily</u> number of deaths are expected to range between 5 and 16 in the next few weeks

Growth Rate for NM



6-Week Forecast of the Average Weekly Growth Rate for New Mexico Based on Data as of 2021-02-21

Week	Best Case (5th Percentile)	Middle Case (50th Percentile)^	Worst Case (95th Percentile)
2021-02-21		0.17%*	
2021-02-28	0.057%	0.12%	0.20%
2021-03-07	0.048%	0.10%	0.19%
2021-03-14	0.042%	0.11%	0.21%
2021-03-21	0.047%	0.13%	0.25%
2021-03-28	0.048%	0.15%	0.29%
2021-04-04	0.062%	0.17%	0.32%

*Last weekly mean daily growth rate

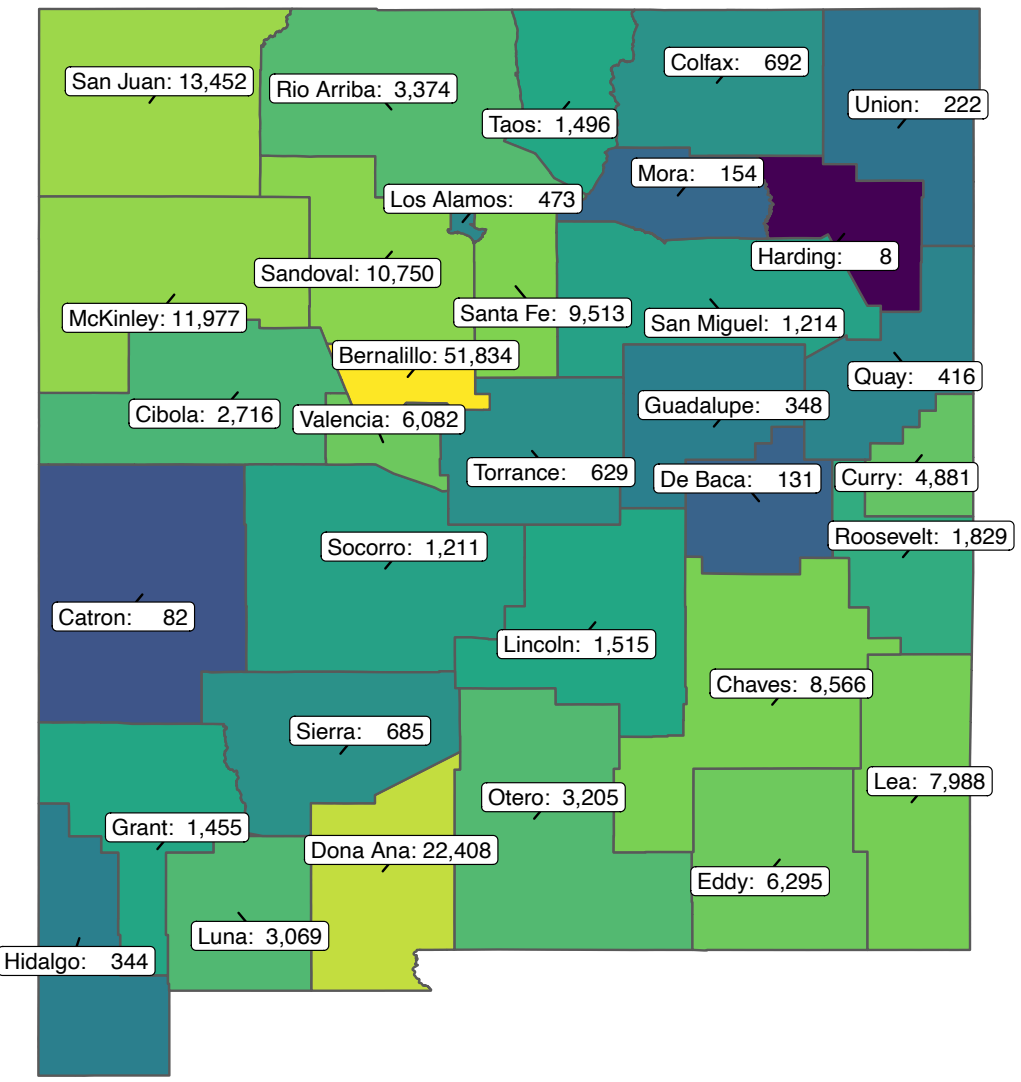
^Closest-matching scenario

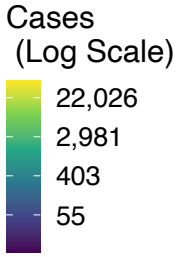
So what?

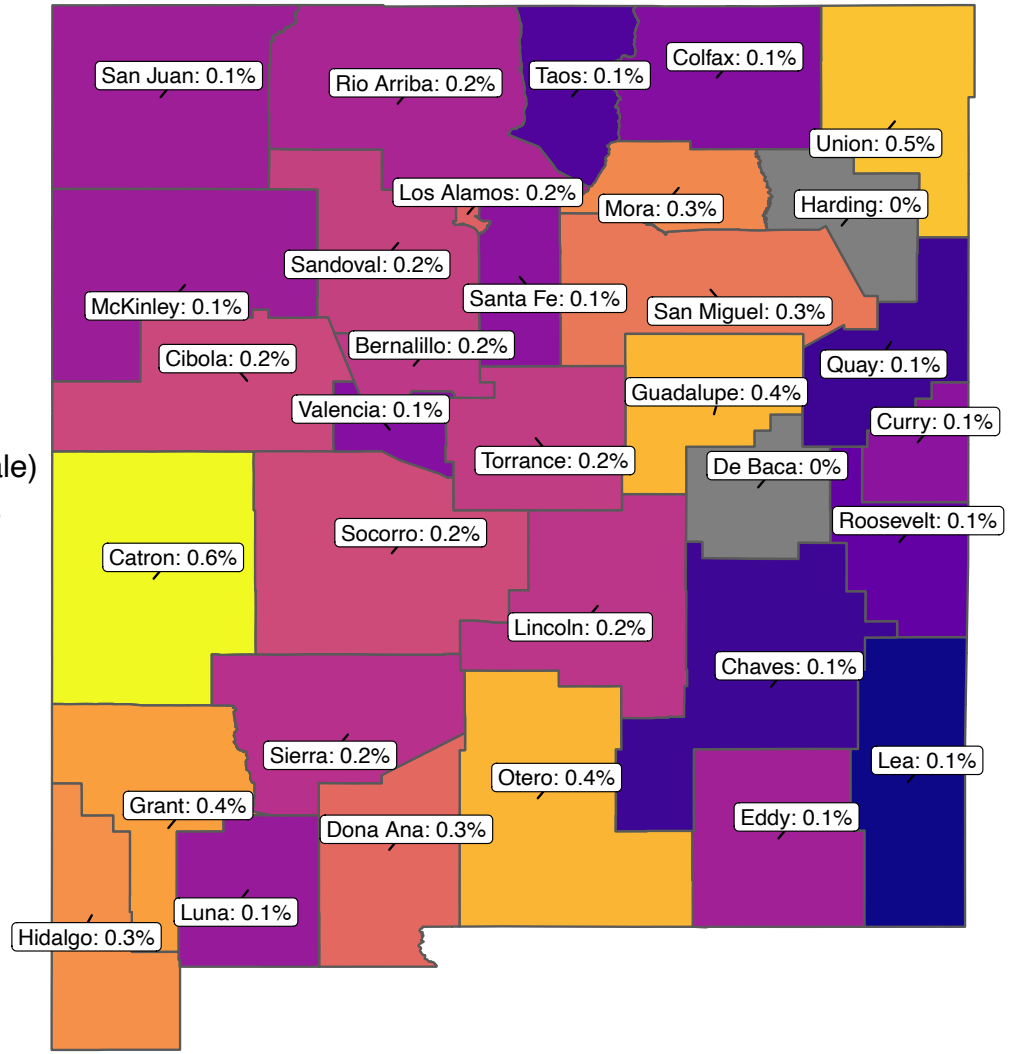
As of February 21st, the average growth rate in NM is at 0.17% (down from 0.23%)

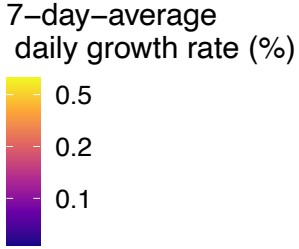
> Regional Growth Rates, Hospitalization & Shelter Forecasts

Cumulative Cases & Daily Growth Rate for NM: Feb 22



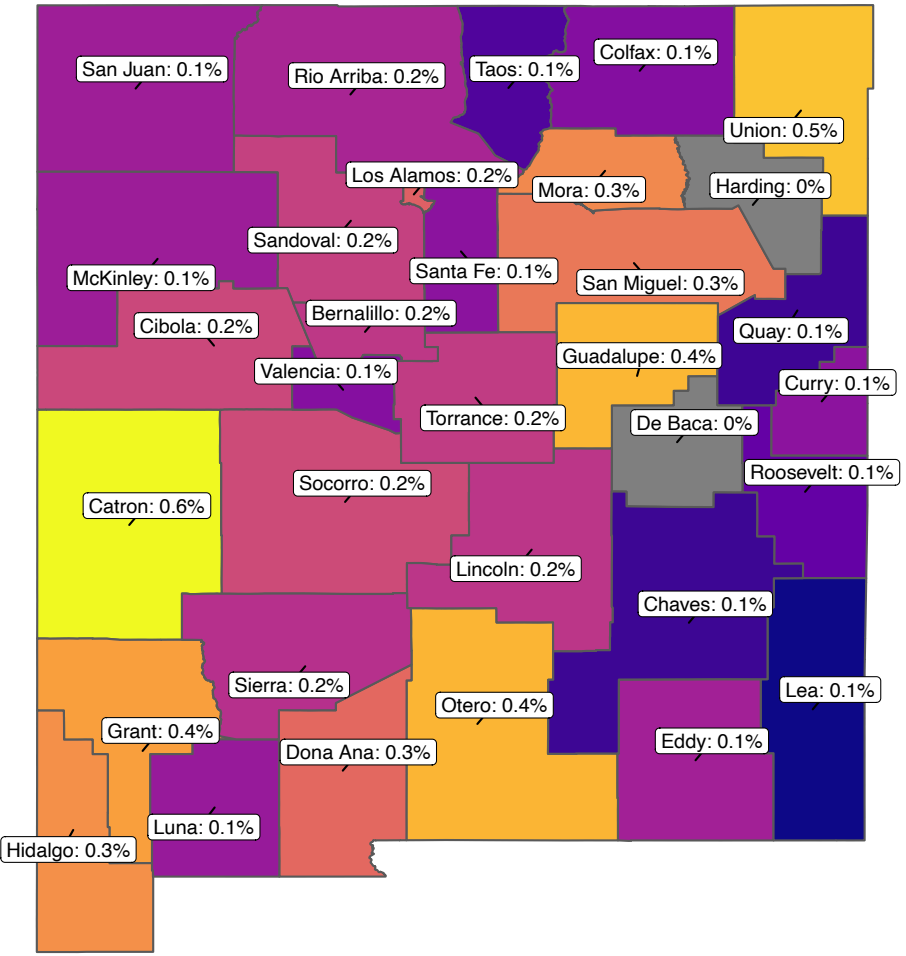


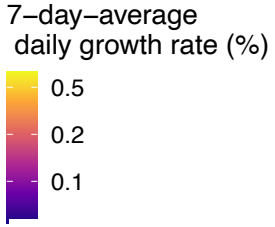




*Growth rate is in cumulative cases

Daily Growth Rate for NM Feb 22





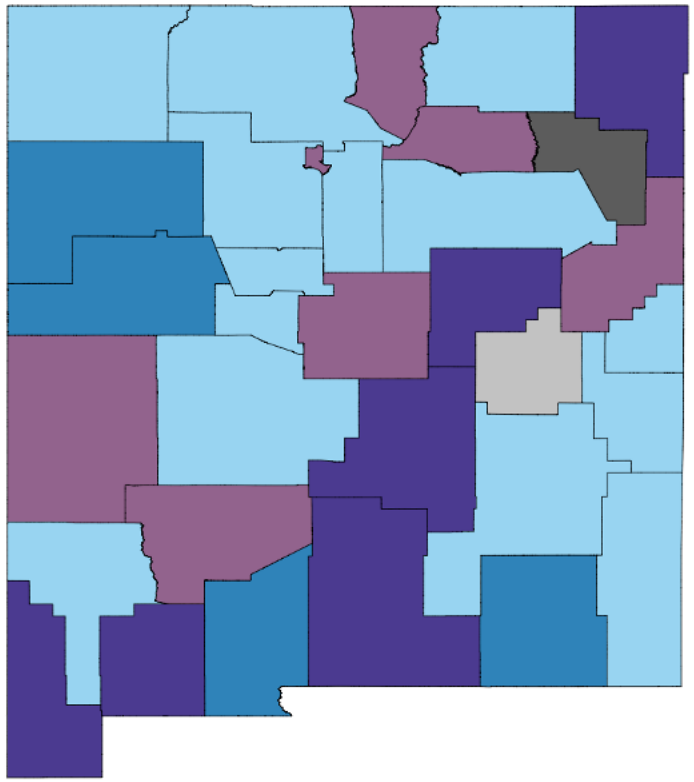
*arrows indicate more than 0.5% difference in growth rate from last week's analysis; growth rate is in cumulative cases

Socorro 0.2% =
Mora 0.3% =
Roosevelt 0.1% =
DeBaca 0.0% =
Los Alamos 0.2% =
Quay 0.1% =
Colfax 0.1% =
Harding 0.0% =
Hidalgo 0.3% =
Guadalupe 0.4% =
Catron 0.6% =
Union 0.5% ↑

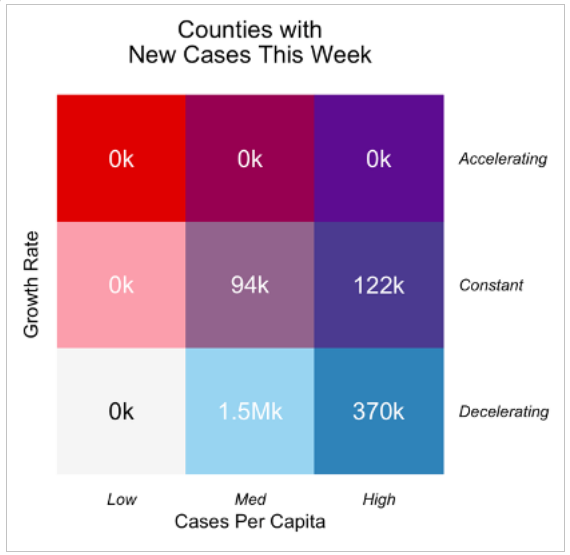
County	Daily Growth Rate	Change
San Juan	0.1%	=
Rio Arriba	0.2%	=
Sierra	0.2%	=
McKinley	0.1%	=
Sandoval	0.2%	=
Santa Fe	0.1%	=
Cibola	0.2%	=
Bernalillo	0.2%	=
Valencia	0.1%	=
Torrance	0.2%	=
Lincoln	0.2%	=
San Miguel	0.3%	=
Chaves	0.1%	=
Dona Ana	0.3%	=
Otero	0.4%	=
Lea	0.1%	=
Eddy	0.1%	=
Curry	0.1%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

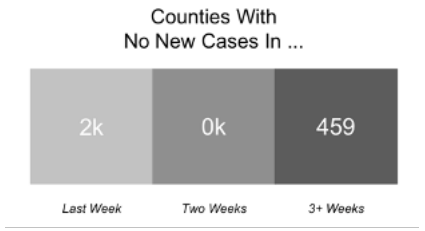
Weekly Growth Rate for NM: Another View (Feb 22)

COVID-19 across New Mexico
A 7-day moving window comparison
February 22, 2020



Impacted New Mexicans





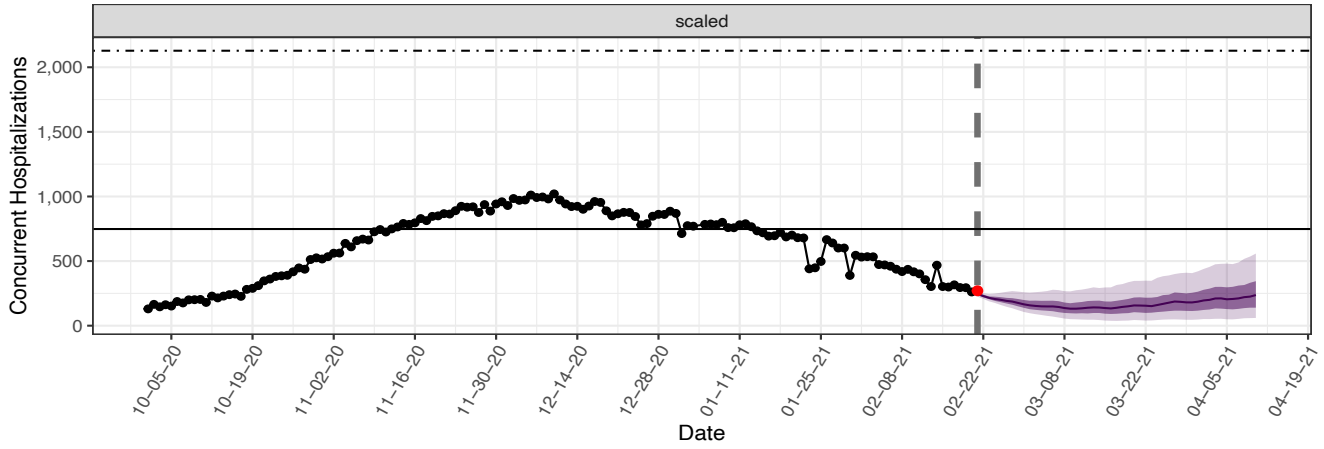
So what?

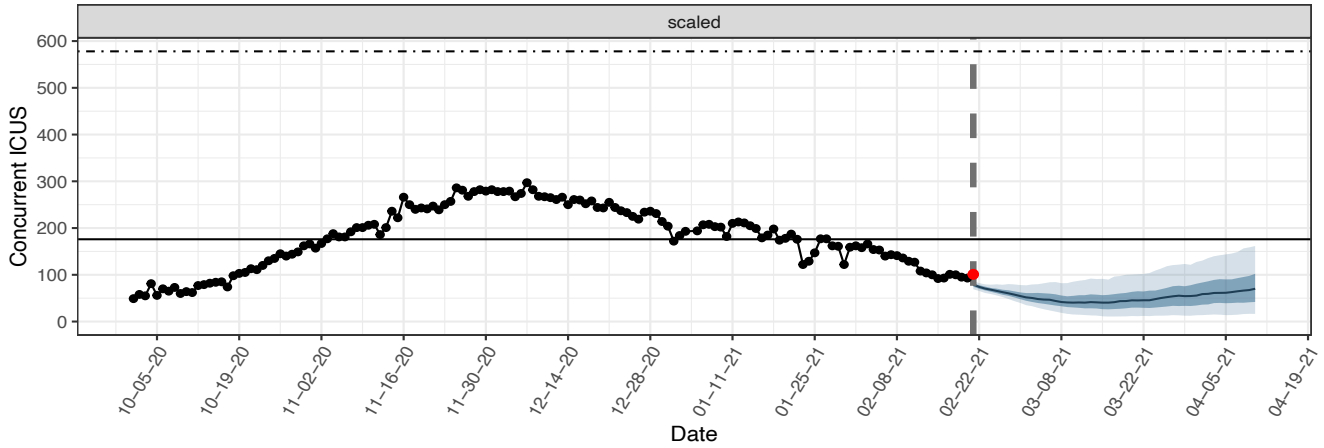
- Most people in New Mexico are living in a county that is decelerating with high per-capita case counts
- Counties with high per capita case counts: Cibola, Dona Ana, Eddy, Guadalupe, Hidalgo, Lincoln, Luna, McKinley, Otero, Union
- There are no accelerating counties from last week

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

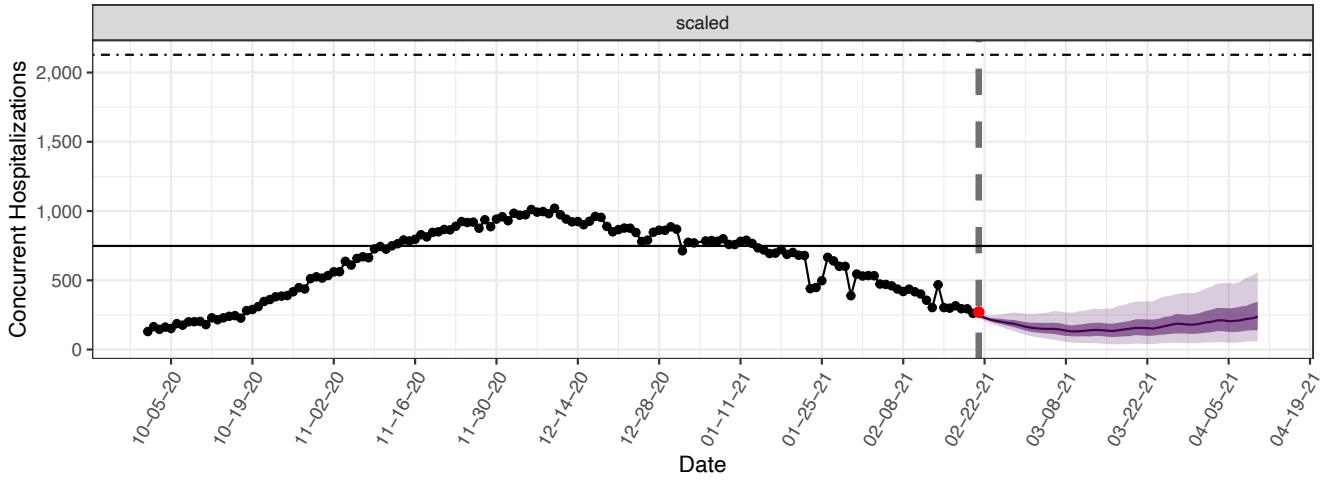
Week	Qu. 5% (best case)	Qu. 50% (median)	Qu. 95% (worst case)
2/28	44	58	79
3/7	21	44	84
3/14	13	41	91
3/21	11	45	101
3/28	13	55	122
4/4	15	61	142

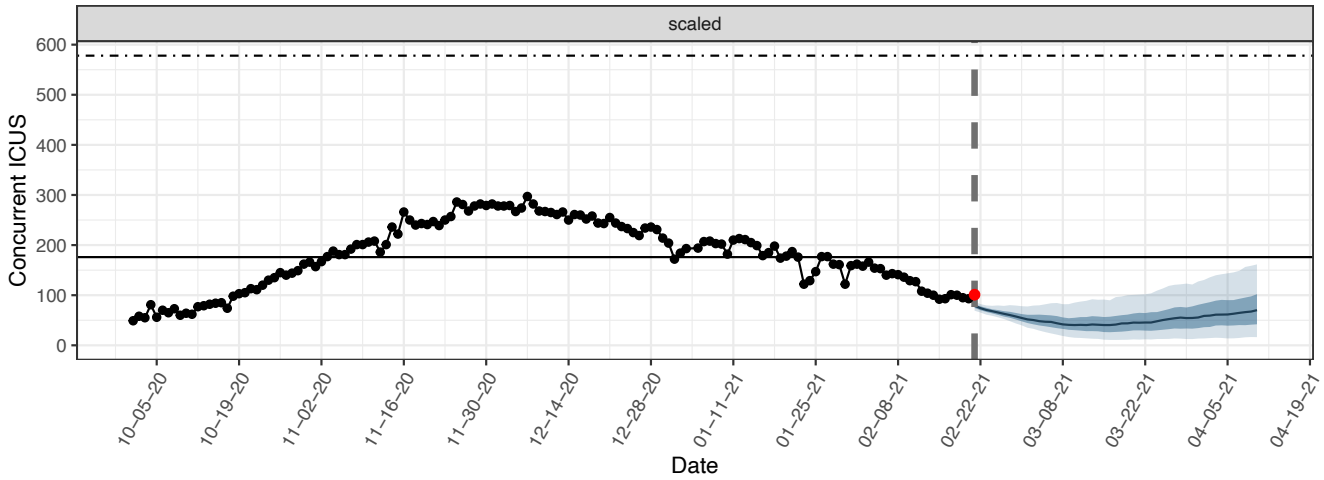
"Scaled" Scenario

So what?

We are below ICU bed capacity for concurrent COVID-19 patients. Model is predicting a decrease over the next 3 weeks

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

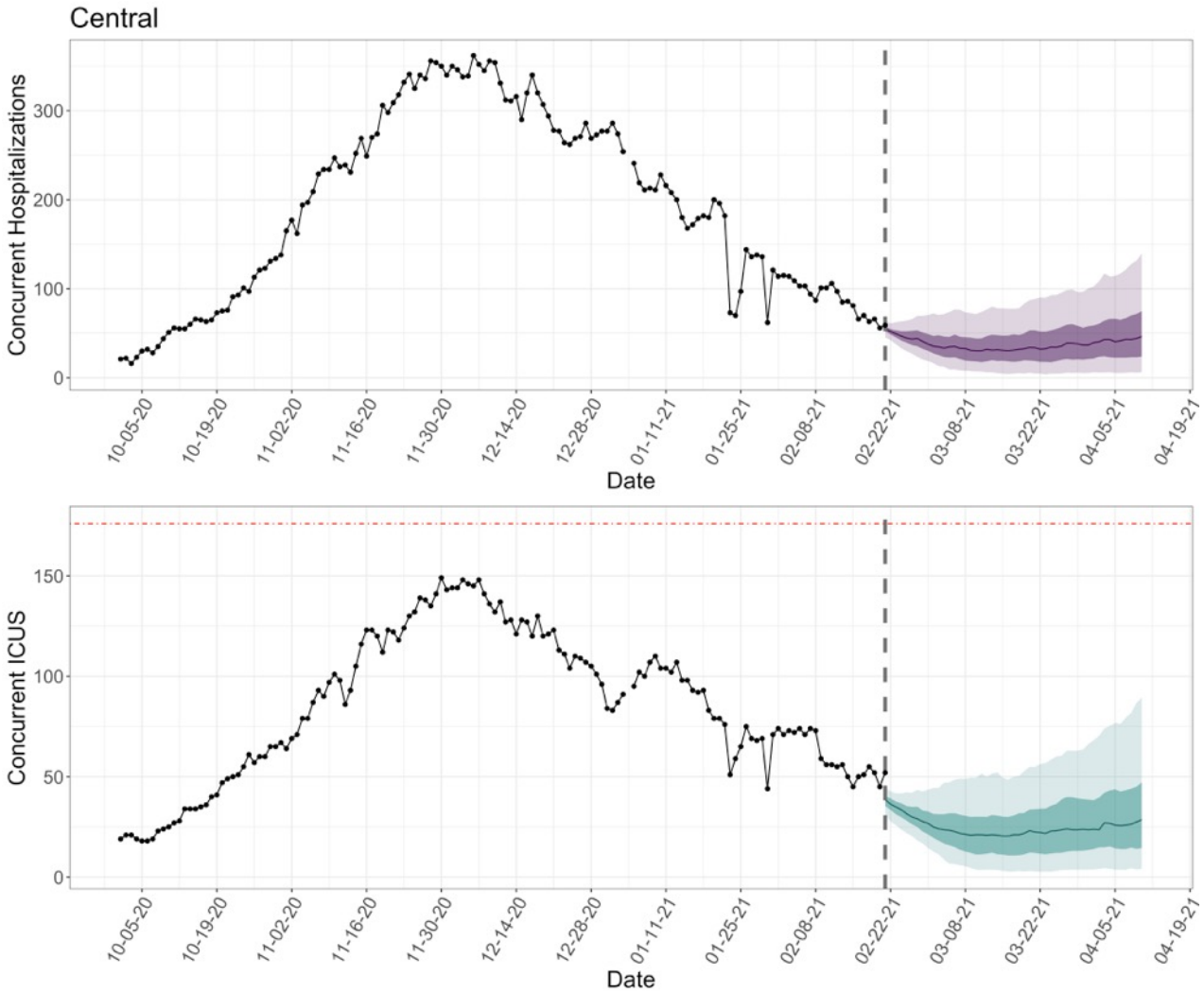
Week	Qu. 5% (best case)	Qu. 50% (median)	Qu. 95% (worst case)
2/28	76	118	184
3/7	42	101	191
3/14	31	100	201
3/21	30	111	246
3/28	34	129	285
4/4	39	150	337

"Scaled" Scenario

So what?

Med-surge general bed needs are predicted to decrease during the next 3 weeks

Regional Hospitalization Forecasts: Central



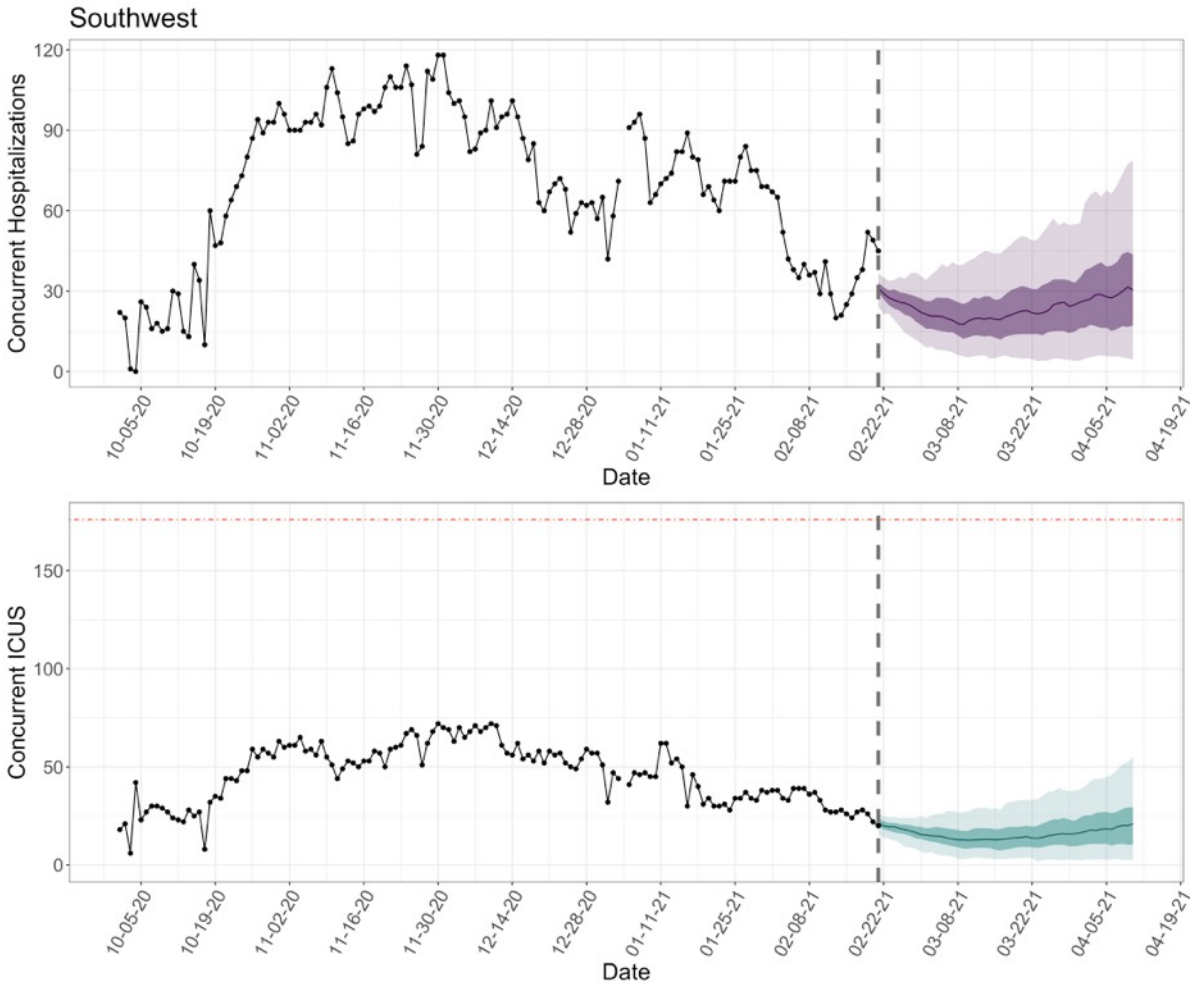
Concurrent COVID-19 ICUs beds: Central

Week	Qu. 5% (best case)	Qu. 50% (median)	Qu. 95% (worst case)
2/28	17	28	43
3/7	6	22	49
3/14	4	21	52
3/21	3	22	55
3/28	4	24	63
4/4	4	27	75

So what?

ICU bed usage is expected to decrease and level off

Regional Hospitalization Forecasts: Southwest



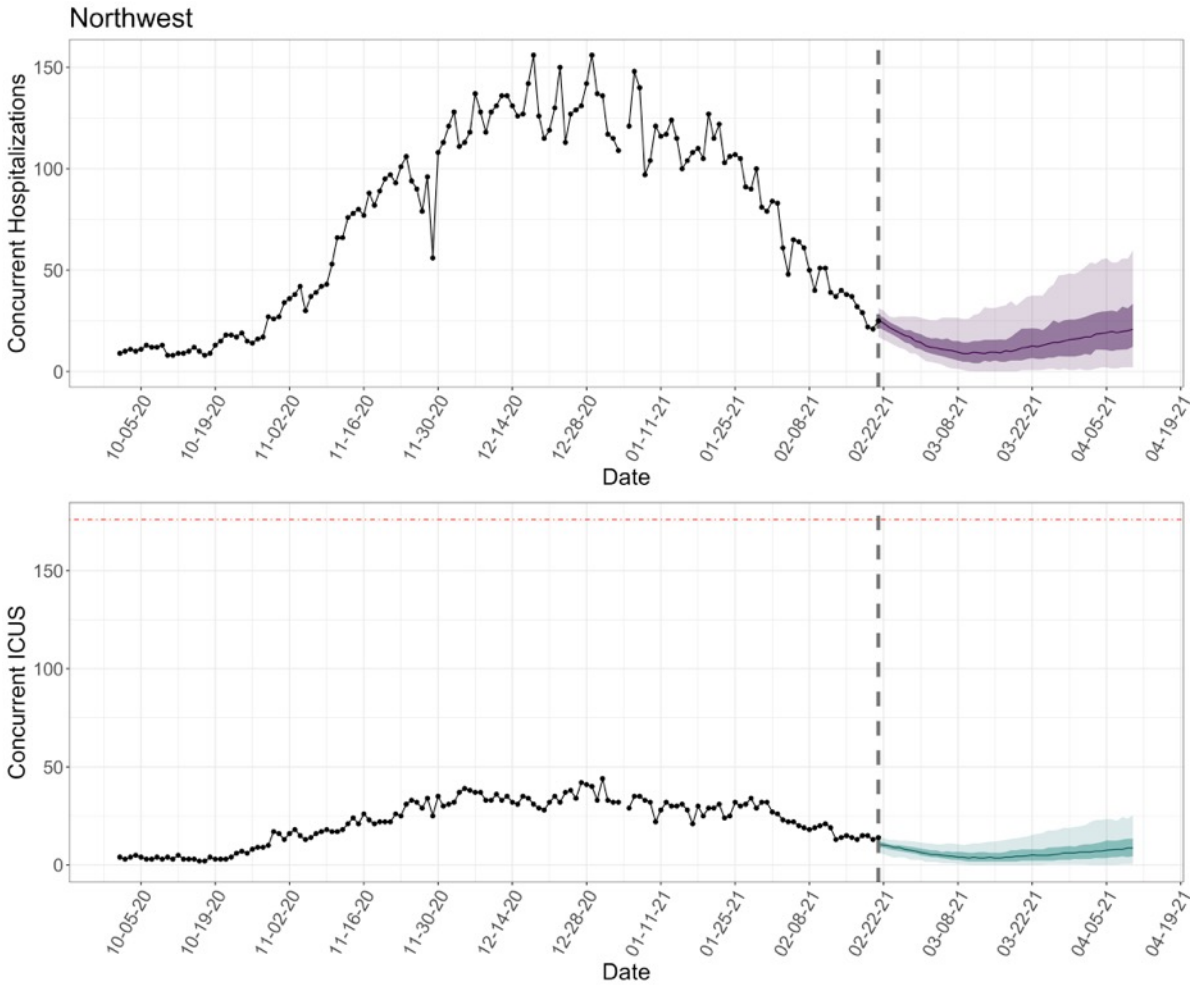
Concurrent COVID-19 ICUs beds: Southwest

Week	Qu. 5% (best case)	Qu. 50% (median)	Qu. 95% (worst case)
2/28	8	17	24
3/7	4	13	27
3/14	3	13	29
3/21	4	14	33
3/28	3	16	38
4/4	3	18	44

So what?

ICU bed usage is expected to decline and level off in the Southwest region.

Regional Hospitalization Forecasts: Northwest



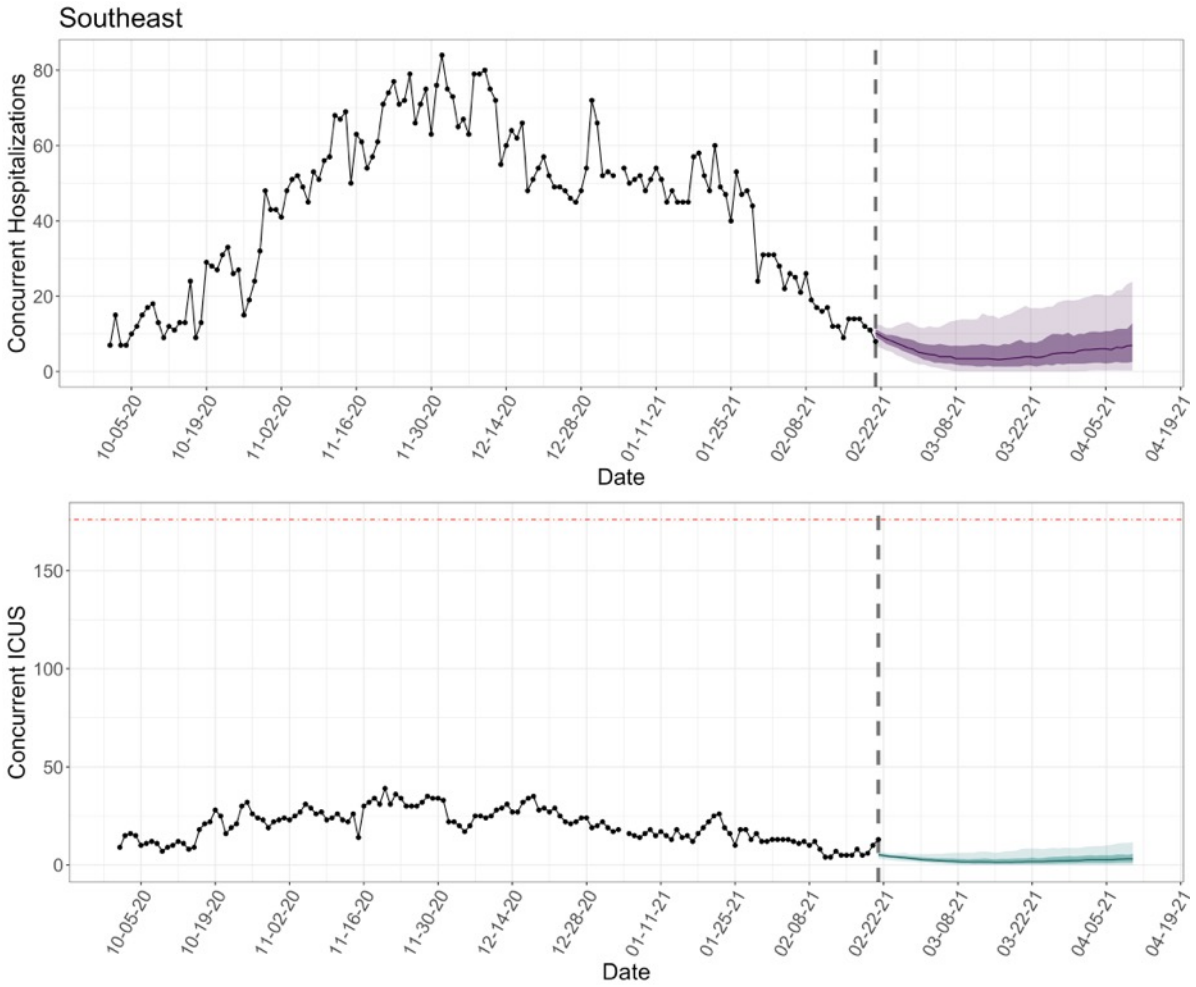
Concurrent COVID-19 ICUs beds: Northwest

Week	Qu. 5% (best case)	Qu. 50% (median)	Qu. 95% (worst case)
2/28	3	7	12
3/7	1	4	11
3/14	0	4	12
3/21	0	5	15
3/28	0	6	19
4/4	0	7	23

So what?

ICU bed usage is expected to <u>decrease</u> in the Northwest region

Regional Hospitalization Forecasts: Southeast



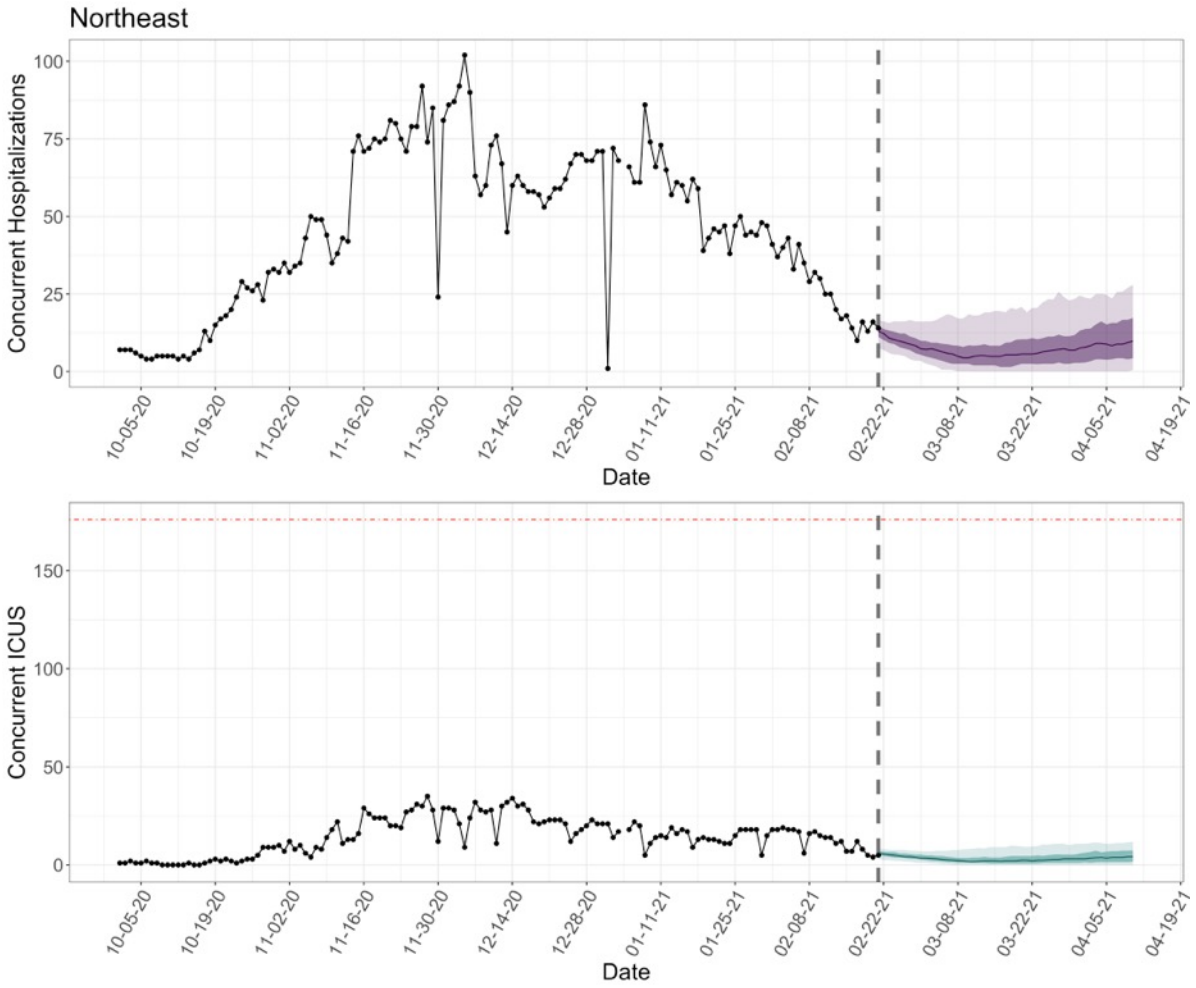
Concurrent COVID-19 ICUs beds: Southeast

Week	Qu. 5% (best case)	Qu. 50% (median)	Qu. 95% (worst case)
2/28	1	3	6
3/7	0	2	6
3/14	0	2	7
3/21	0	2	8
3/28	0	2	9
4/4	0	3	10

So what?

ICU bed usage is expected to be low in the Southeast region

Regional Hospitalization Forecasts: Northeast



Concurrent COVID-19 ICUs beds: Northeast

Week	Qu. 5% (best case)	Qu. 50% (median)	Qu. 95% (worst case)
2/28	0	2	8
3/7	0	2	9
3/14	0	2	9
3/21	0	3	11
3/28	0	4	11
4/4	0	2	8

So what?

ICU bed usage is expected to be low in the Northeast region

> Non-Congregational Shelter Forecast

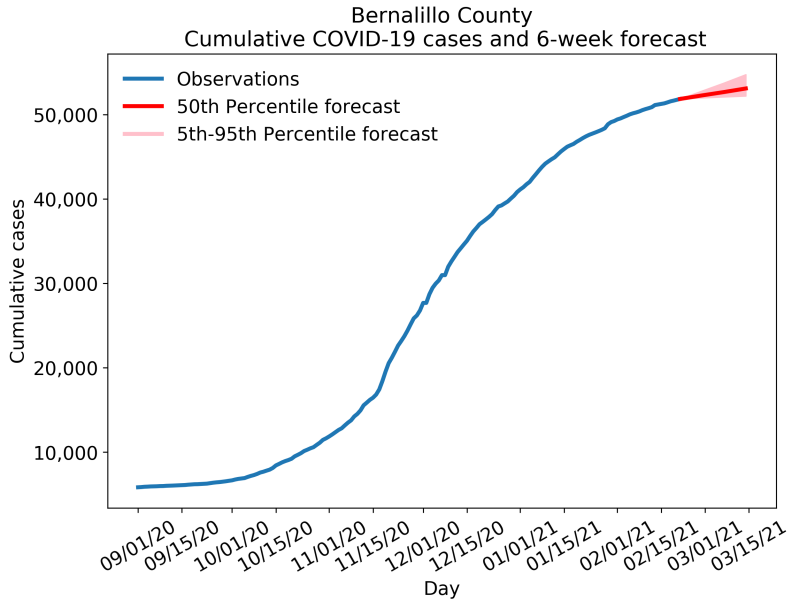
Non-Congregate Shelter Forecast

- **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 2/21/21: **51,834**
Number of shelter rooms available: **221**
Total number of patients/medical workers (including specialty): **46**
Number of patients: **43**
Number of medical workers: **3**
Occupied rooms:new cases ratio: **0.40**
2-week avg. new cases per day: **114**



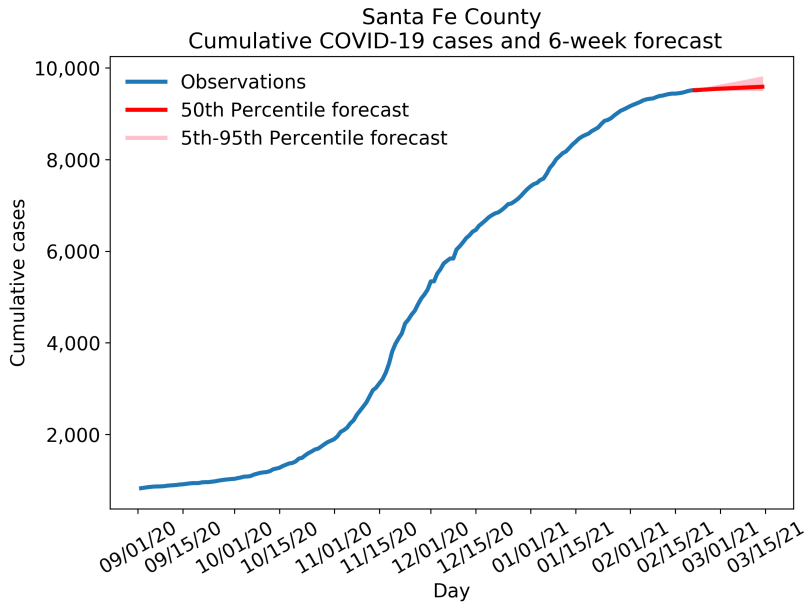
	2/21/21	2/28/21	3/7/21
Total cases	52,254 (51,972-52,783)	52,651 (52,086-53,724)	53,077 (52,194-54,725)
# of rooms needed	24 (8-55)	23 (7-54)	25 (6-58)
Deficit (-) or surplus of rooms	197	198	196
# of rooms needed (new forecast method)	35	31	29

2-week avg. new cases per day decreased from 140 last week to 114 this week

Last week we forecasted 19 (7-40) rooms in use, 27 rooms with the adjustment; there are 46 actually in use, so we are highly under forecasting.

Non-Congregate Shelter Forecast: Santa Fe

Number of cases as of 2/21/21: **9,513**
Number of shelter rooms available: **52**
Total number of patients/medical workers (including specialty): **17**
Number of patients: **17**
Number of medical workers: **0**
Occupied rooms:new cases ratio: **1.26**
2-week avg. new cases per day: **13**



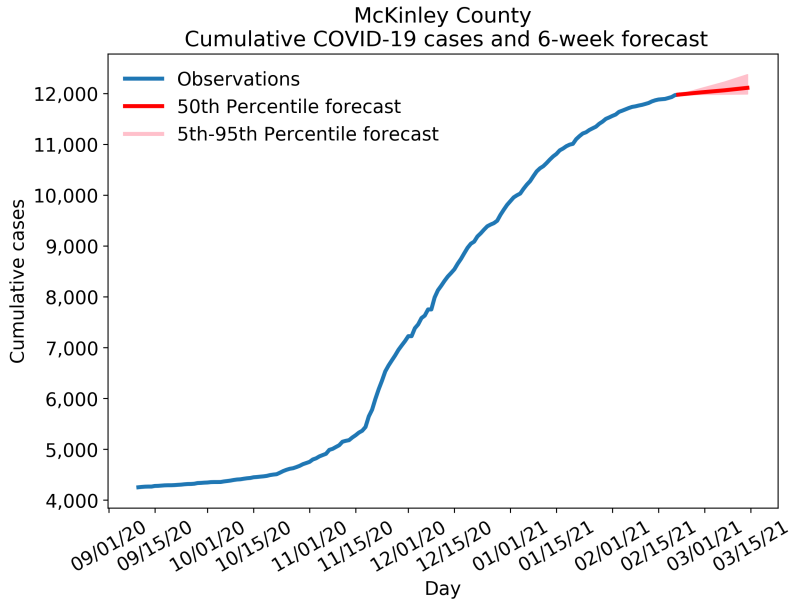
	2/21/21	2/28/21	3/7/21
Total cases	9,543 (9,515-9,613)	9,565 (9,515-9,703)	9,588 (9,516-9,802)
# of rooms needed	5 (0-18)	4 (0-16)	4 (0-18)
Deficit (-) or surplus of rooms	47	48	48
# of rooms needed (new forecast method)	11	9	8

2-week avg. new cases per day decreased from 22 last week to 13 this week

Last week we forecasted 6 (1-15) rooms in use, 9 rooms with the adjustment; there are 17 actually in use, so we are under forecasting

Non-Congregate Shelter Forecast: McKinley

Number of cases as of 2/21/21: **11,977**
Number of shelter rooms available: **160**
Total number of patients/medical workers (including specialty): **14**
Number of patients: **9**
Number of medical workers: **5**
Occupied rooms:new cases ratio: **0.81**
2-week avg. new cases per day: **17**



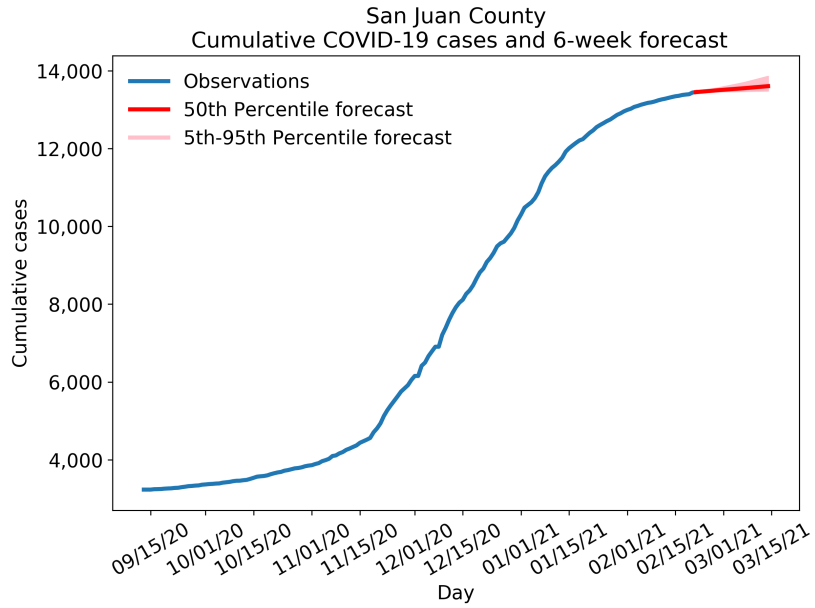
	2/21/21	2/28/21	3/7/21
Total cases	12,022 (11,984-12,102)	12,062 (11,989-12,226)	12,111 (11,994-12,372)
# of rooms needed	5 (0-15)	5 (1-14)	6 (1-17)
Deficit (-) or surplus of rooms	150	150	149
# of rooms needed (new forecast method)	10	8	7

2-week avg. new cases per day decreased from 24 last week to 17 this week

Last week we forecasted 9 (2-25) rooms in use, 16 rooms with the adjustment; there are 14 actually in use, so the adjustment may be a more accurate forecast

Non-Congregate Shelter Forecast: San Juan

Number of cases as of 2/21/21: **13,452**
Number of shelter rooms available: **21**
Total number of patients/medical workers (including specialty): **1**
Number of patients: **1**
Number of medical workers: **0**
Occupied rooms:new cases ratio: **0.05**
2-week avg. new cases per day: **20**



	2/21/21	2/28/21	3/7/21
Total cases	13,505 (13,467-13,573)	13,552 (13,475-13,698)	13,605 (13,485-13,858)
# of rooms needed	0 (0-1)	0 (0-1)	0 (0-1)
Deficit (-) or surplus of rooms	21	21	21
# of rooms needed (new forecast method)	1	1	1

2-week avg. new cases per day decreased from 26 last week to 20 this week.

Last week we forecasted 0 (0-1) rooms in use, 1 room with the adjustment; there is 1 actually in use