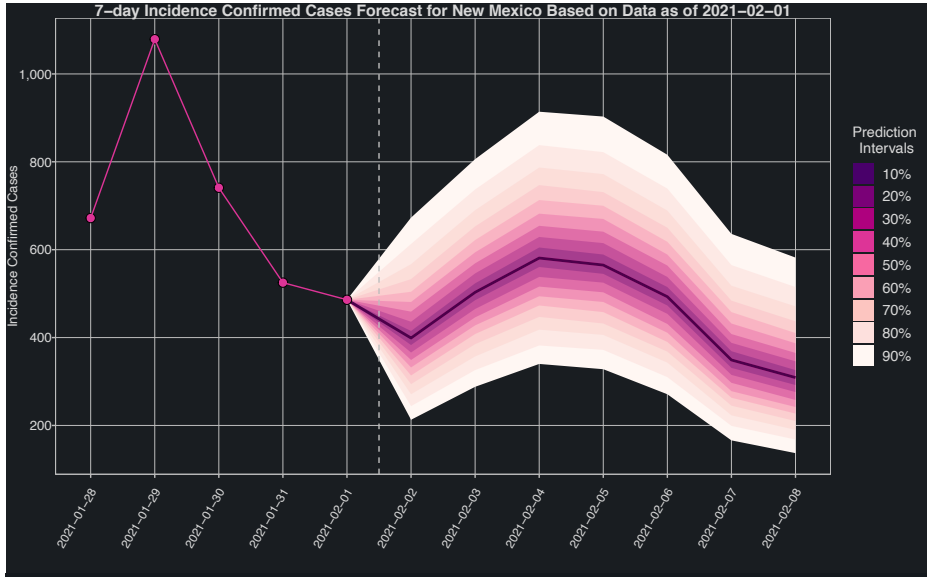
Modeling & Forecasting COVID-19 in NM

February 1, 2021

NNSA
National Nuclear Security Administration

Short- & Long-Term Forecast for NM: Cases



6–Week Forecast of Confirmed Cases for New Mexico Based on Data as of 2021–02–01

Week	Best Case (5th Percentile)	Middle Case (50th Percentile)^	Worst Case (95th Percentile)
2021–02–01		174,550*	
2021–02–08	176,306	177,757	179,847
2021–02–15	177,672	180,727	185,233
2021–02–22	178,908	183,733	191,122
2021–03–01	180,232	187,052	197,738
2021–03–08	181,658	190,726	205,001
2021–03–15	183,290	194,512	213,427

*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 2021–02–01

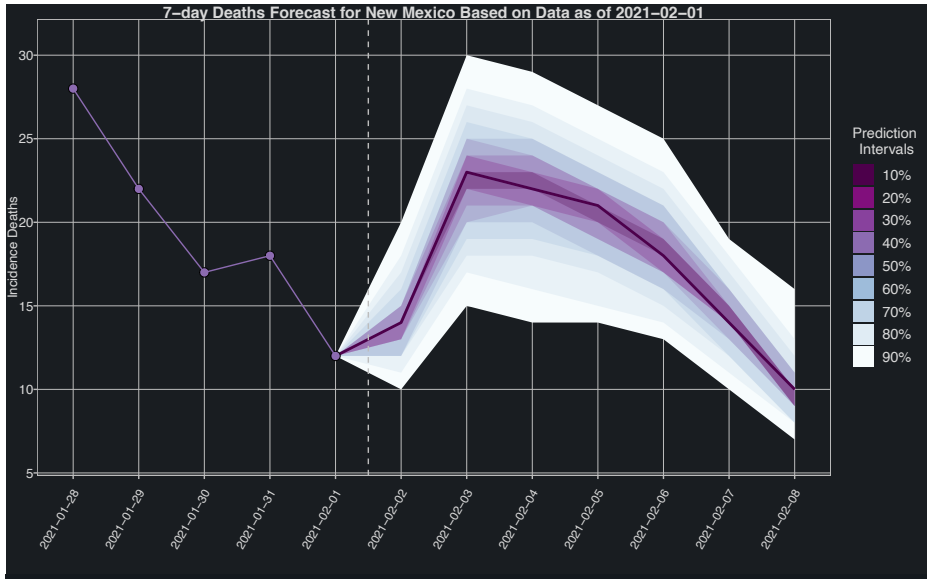
Week	Best Case (5th Percentile)	Middle Case (50th Percentile)^	Worst Case (95th Percentile)
2021–02–01		693*	
2021–02–08	251	458	757
2021–02–15	195	424	769
2021–02–22	177	429	841
2021–03–01	189	474	945
2021–03–08	204	525	1,038
2021–03–15	233	541	1,204

*Last reported confirmed cases count
^Closest–matching scenario

So what?

The daily number of cases are expected to range between 424 and 458 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 2021–02–01

Week	Best Case (5th Percentile)	Middle Case (50th Percentile)^	Worst Case (95th Percentile)
2021–02–01		3,295*	
2021–02–08	3,386	3,419	3,445
2021–02–15	3,457	3,519	3,573
2021–02–22	3,516	3,604	3,696
2021–03–01	3,569	3,683	3,840
2021–03–08	3,615	3,759	4,014
2021–03–15	3,659	3,840	4,230

*Last reported deaths count
^Closest–matching scenario

6–Week Forecast of Daily Average of Deaths for New Mexico Based on Data as of 2021–02–01

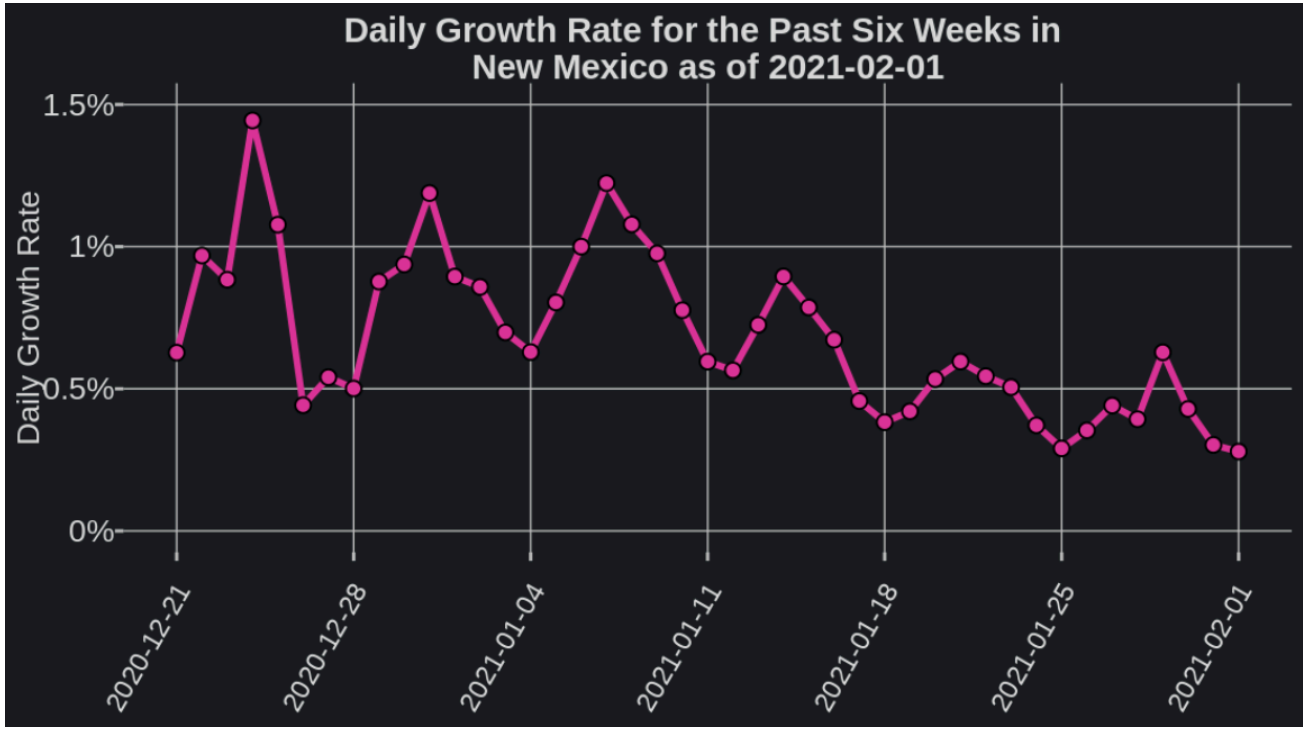
Week	Best Case (5th Percentile)	Middle Case (50th Percentile)^	Worst Case (95th Percentile)
2021–02–01		20*	
2021–02–08	13	18	21
2021–02–15	10	14	18
2021–02–22	8	12	18
2021–03–01	8	11	21
2021–03–08	7	11	25
2021–03–15	6	12	31

*Last reported confirmed deaths
^Closest–matching scenario

So what?

The daily number of deaths are expected to range between 12 and 18 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 2021-02-01

Week	Best Case (5th Percentile)	Middle Case (50th Percentile)^	Worst Case (95th Percentile)
2021-02-01		0.40%*	
2021-02-08	0.14%	0.26%	0.43%
2021-02-15	0.11%	0.24%	0.42%
2021-02-22	0.099%	0.24%	0.45%
2021-03-01	0.11%	0.26%	0.49%
2021-03-08	0.11%	0.28%	0.52%
2021-03-15	0.13%	0.28%	0.58%

*Last weekly mean daily growth rate

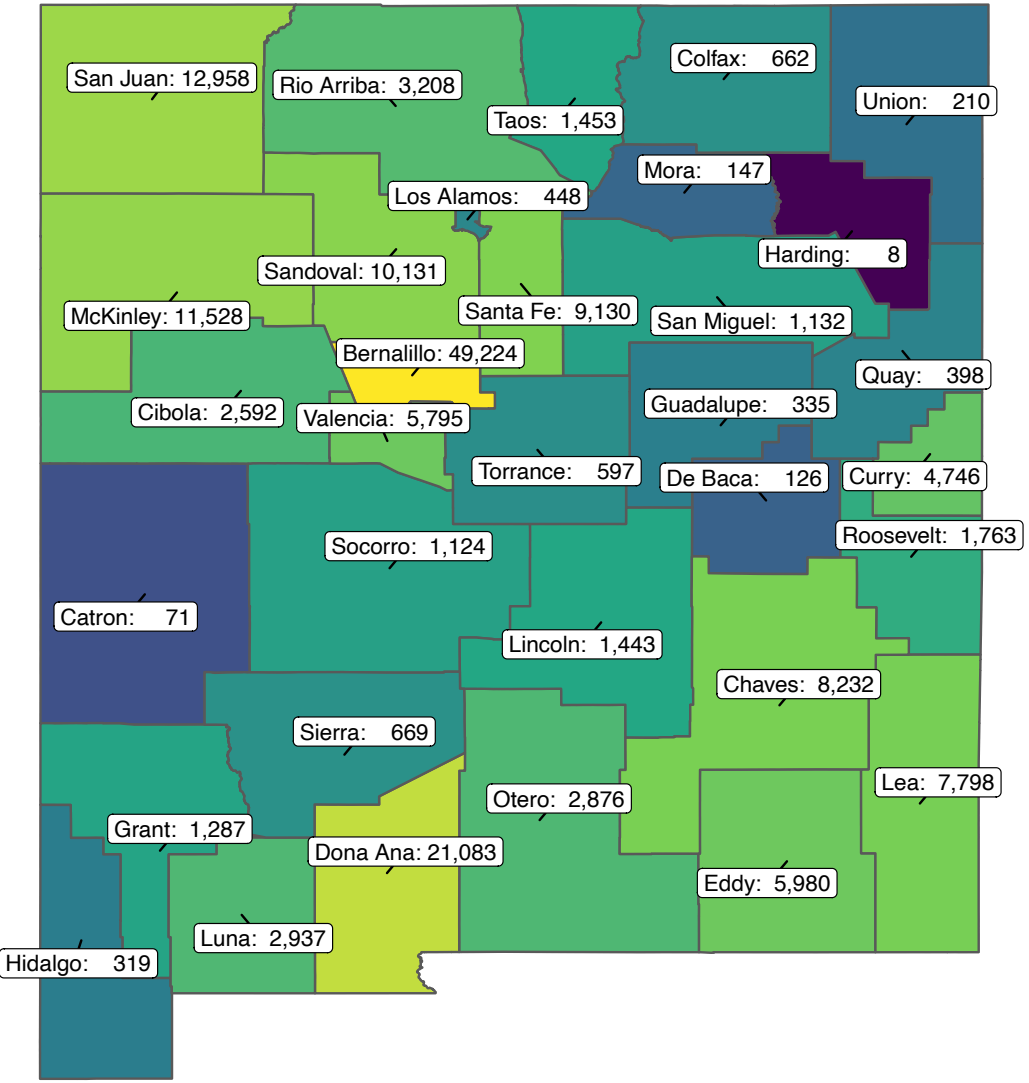
^Closest-matching scenario

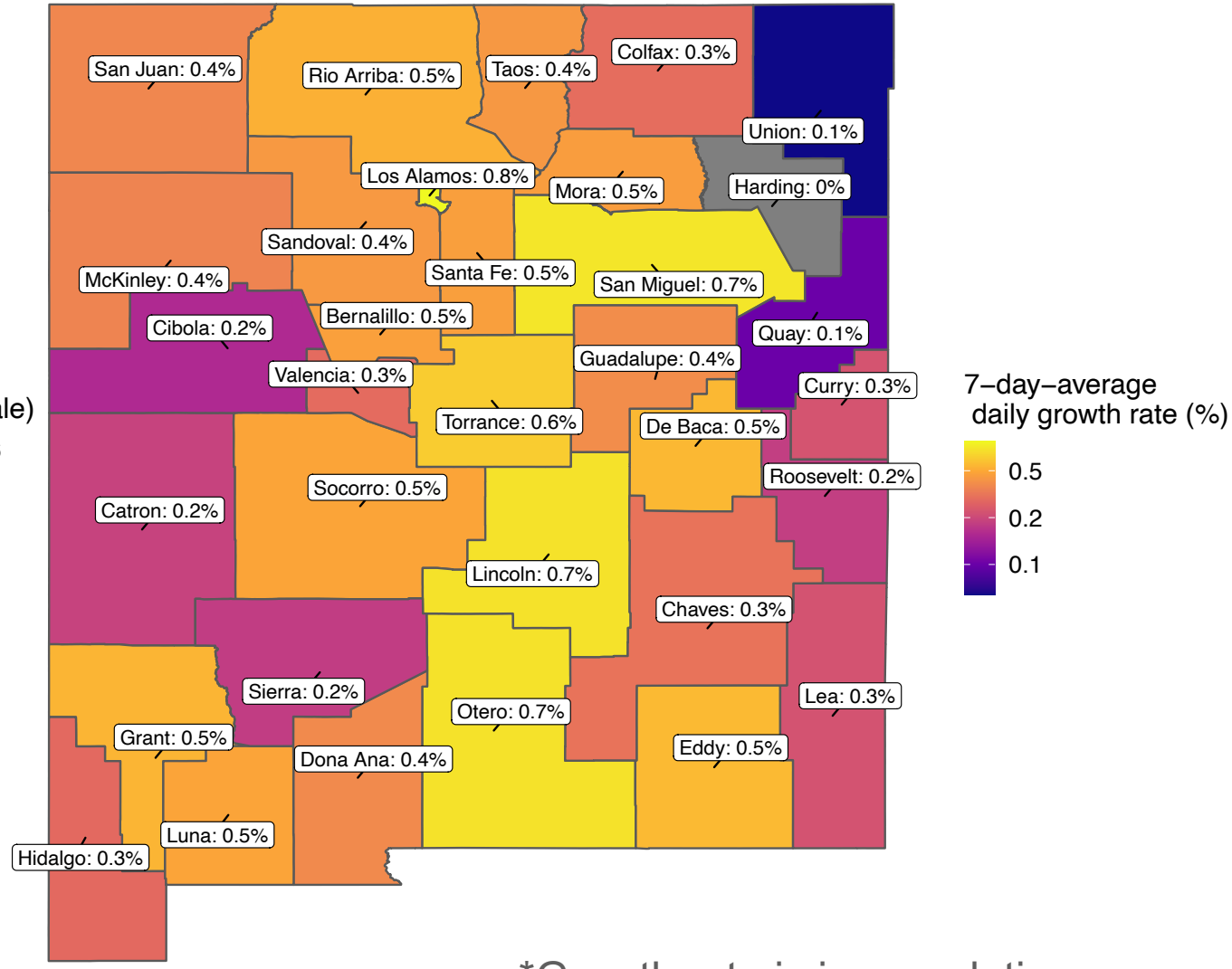
So what?

As of February 1st, the average growth rate in NM is at 0.4% (down from 0.47%)

> Regional Growth Rates, Hospitalizations, & Shelter Forecasts

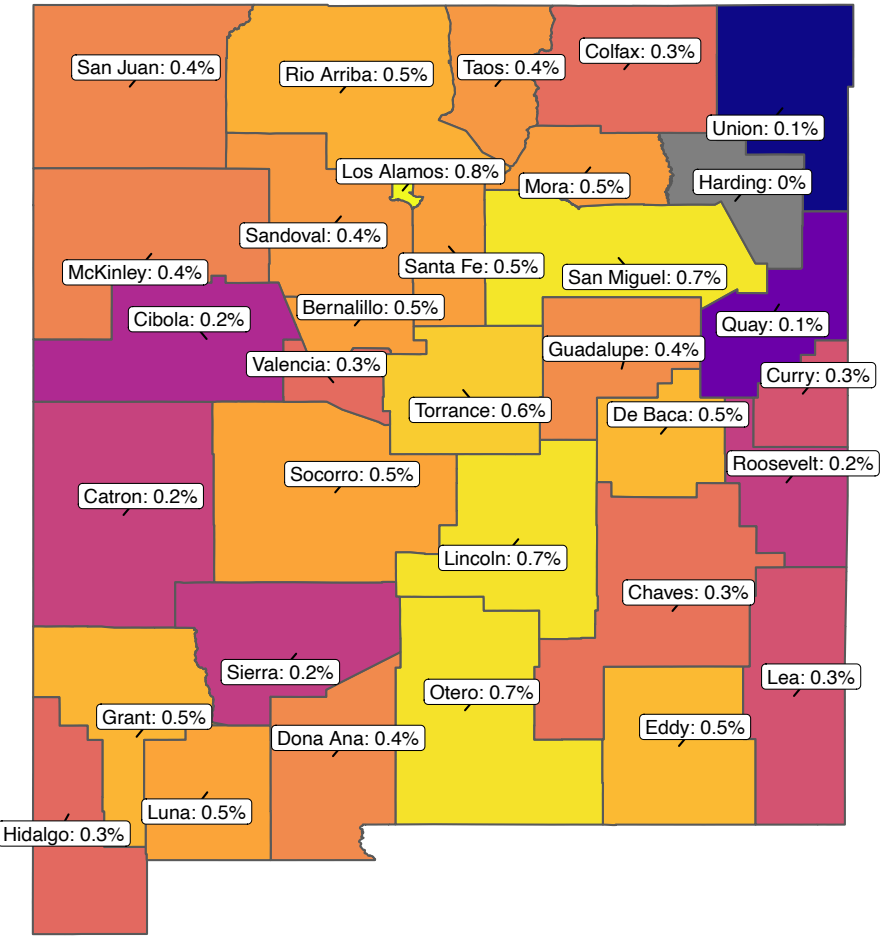
Cumulative Cases & Daily Growth Rate for NM: Feb 1





*Growth rate is in cumulative cases

Daily Growth Rate for NM Feb 1



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

Socorro 0.5% =
Mora 0.5% =
Roosevelt 0.2% =
DeBaca 0.5% =
Los Alamos 0.8% =
Catron 0.2% =
Quay 0.1% =
Union 0.1% =
Colfax 0.3% =
Harding 0.0% =
Hidalgo 0.3% ↓

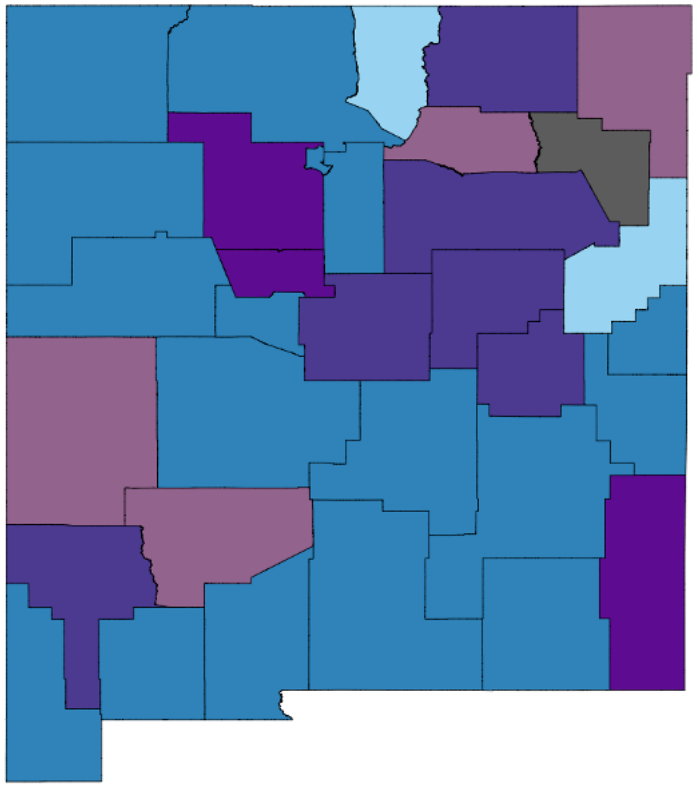
County	Daily Growth Rate	Change
San Juan	0.4%	=
Rio Arriba	0.5%	=
Sierra	0.2%	=
McKinley	0.4%	=
Sandoval	0.4%	=
Santa Fe	0.5%	=
Cibola	0.2%	=
Bernalillo	0.5%	=
Valencia	0.3%	=
Torrance	0.6%	=
Lincoln	0.7%	↓
San Miguel	0.7%	=
Chaves	0.3%	=
Dona Ana	0.4%	=
Otero	0.7%	=
Lea	0.3%	=
Eddy	0.5%	=
Curry	0.3%	=
Grant	0.5%	=
Luna	0.5%	↓
Taos	0.7%	=

Weekly Growth Rate for NM: Another View (Feb 1)

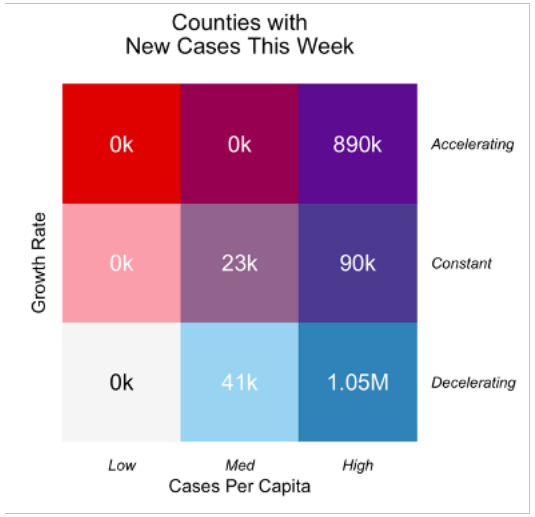
COVID-19 across New Mexico

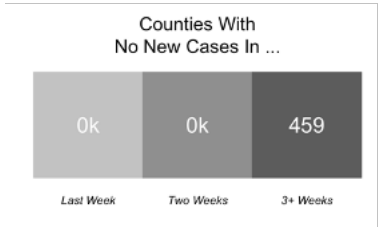
A 7-day moving window comparison

February 1, 2020



mpacted New
Mexicans





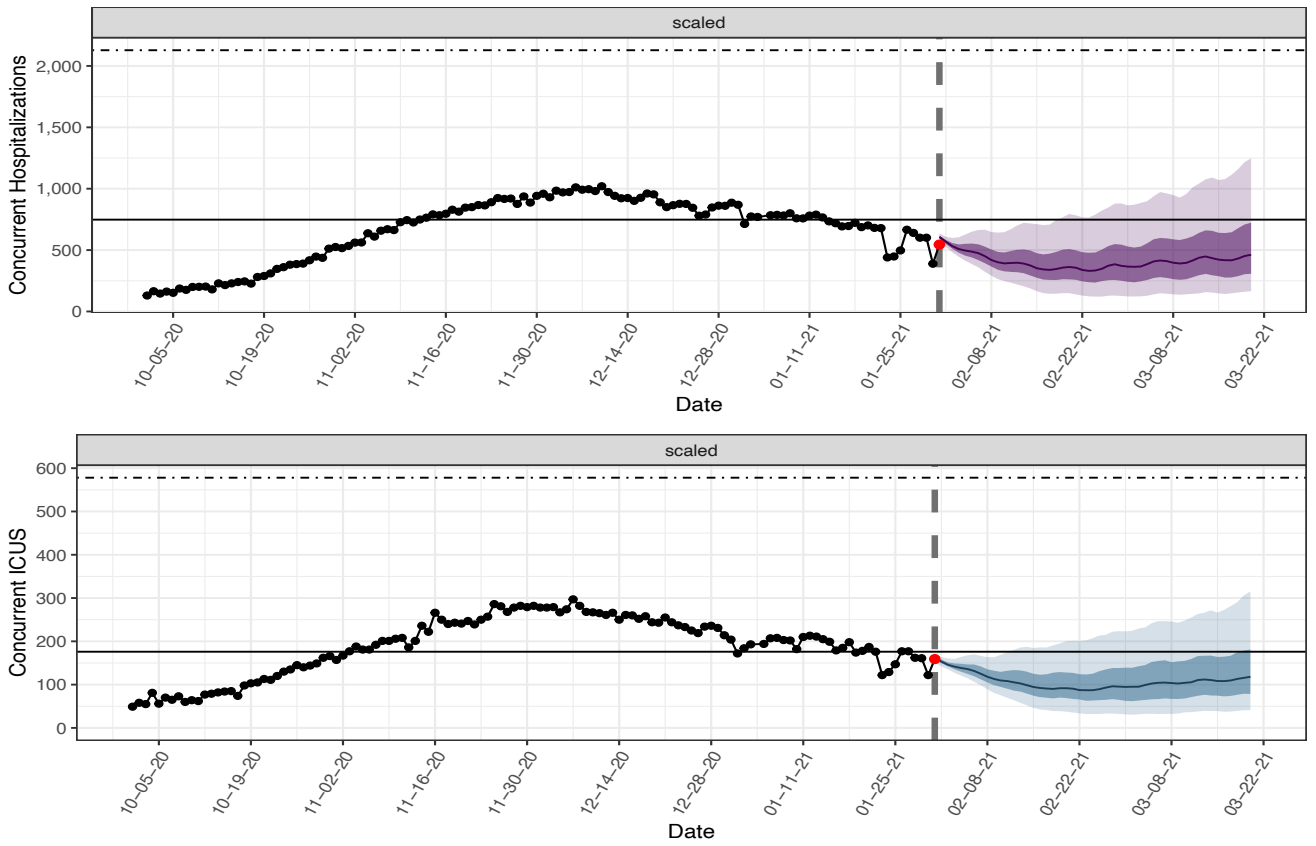
So what?

- Most people in New Mexico are living in a county that is decelerating with high per-capita case counts
- Counties with >500 weekly cases per 100k: None
- Sandoval, Bernalillo, and Lea are 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 ICUs beds

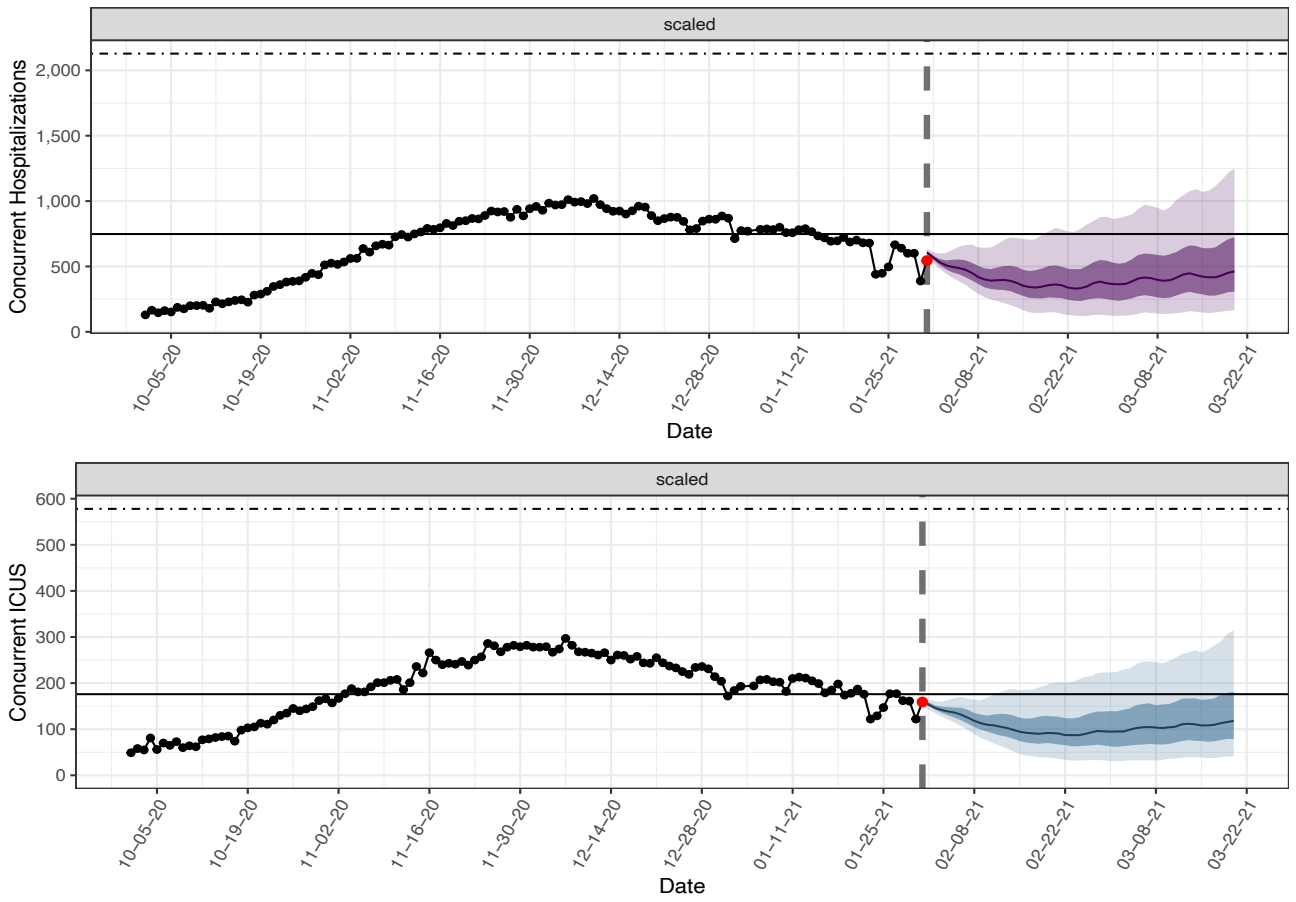
Week	Qu. 5% (best case)	Qu. 50% (median)	Qu. 95% (worst case)
2/7	99	125	166
2/14	52	99	187
2/21	36	91	201
2/28	32	95	223
3/7	32	105	247
3/14	39	111	272

"Scaled" Scenario

So what?

We are <u>at ICU bed capacity</u> for concurrent COVID-19 patients; our model is tracking with the median this week. Model is predicting a <u>decrease</u> over the next 3 weeks and then leveling off

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

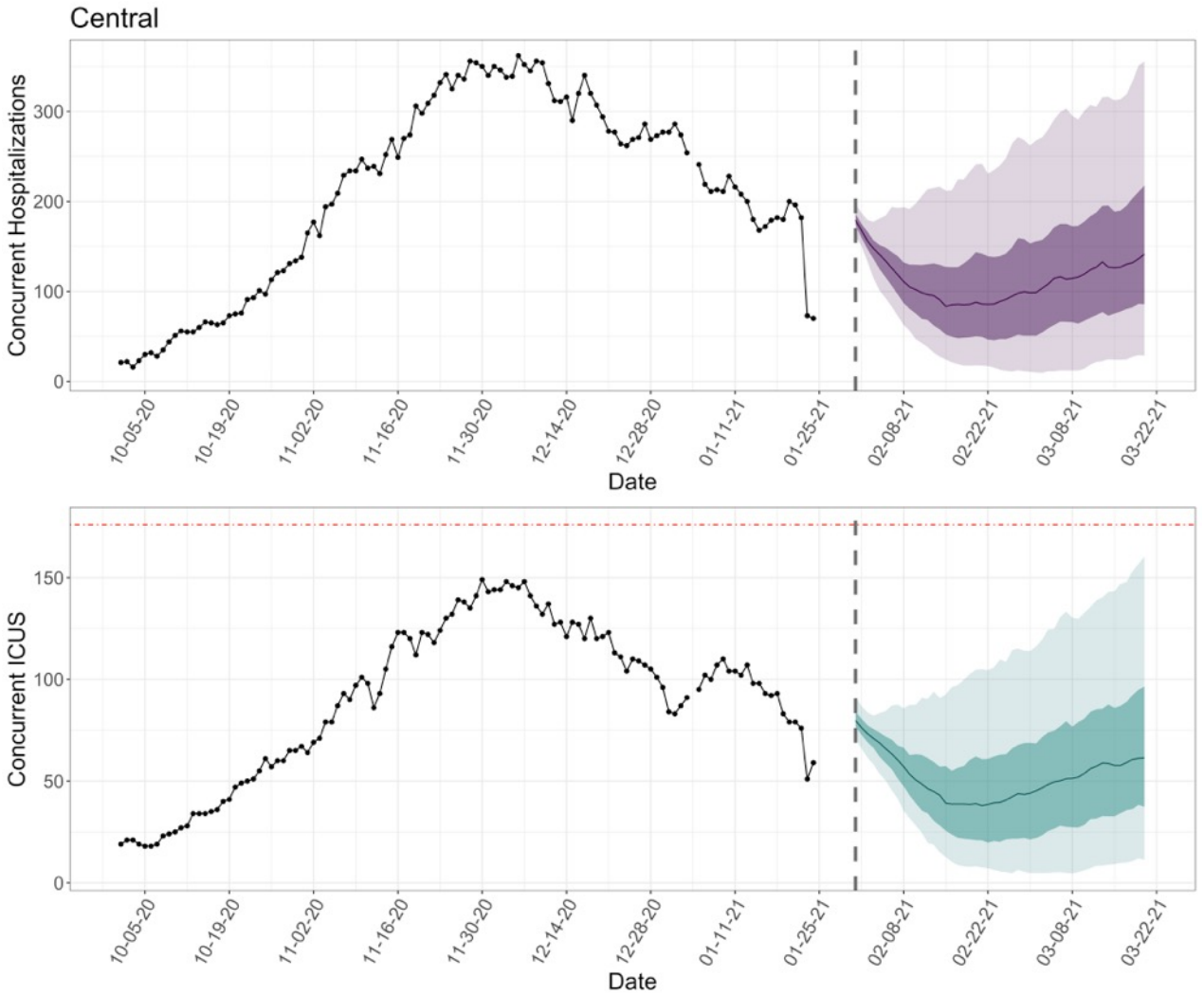
Week	Qu. 5% (best case)	Qu. 50% (median)	Qu. 95% (worst case)
2/7	225	326	500
2/14	135	276	530
2/21	104	266	582
2/28	94	277	657
3/7	112	305	715
3/14	115	324	819

"Scaled" Scenario

So what?

Med-surge general bed needs are tracking with the median case scenario this week; med-surge beds predicted to decrease during the next 3 weeks

Regional Hospitalization Forecasts: Central



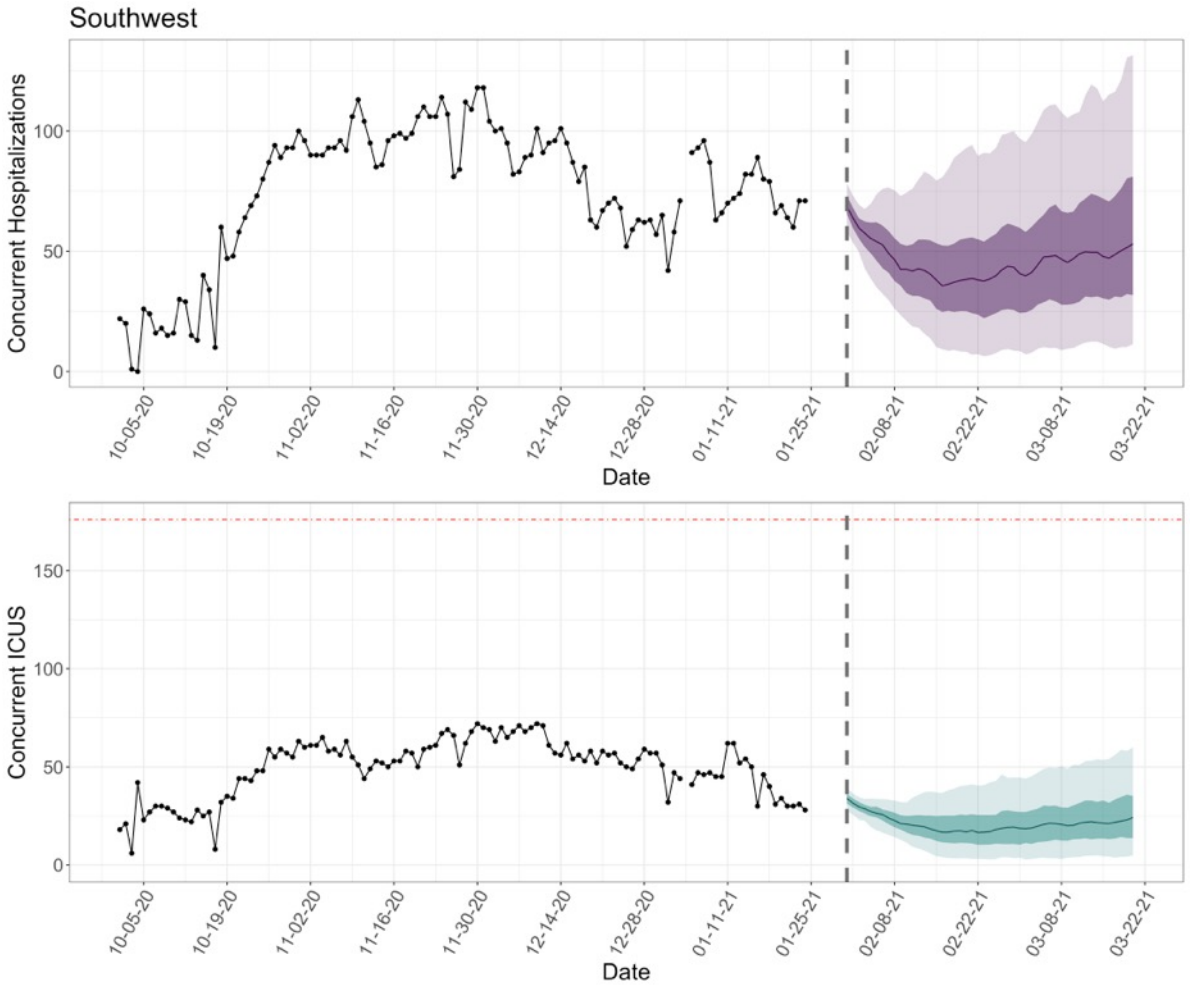
Concurrent COVID-19 ICUs beds: Central

Week	Qu. 5% (best case)	Qu. 50% (median)	Qu. 95% (worst case)
2/7	41	60	88
2/14	15	43	91
2/21	8	38	105
2/28	5	43	114
3/7	5	51	133
3/14	9	59	143

So what?

ICU bed usage is expected to <u>decrease</u>; some under-reporting the past two weeks

Regional Hospitalization Forecasts: Southwest



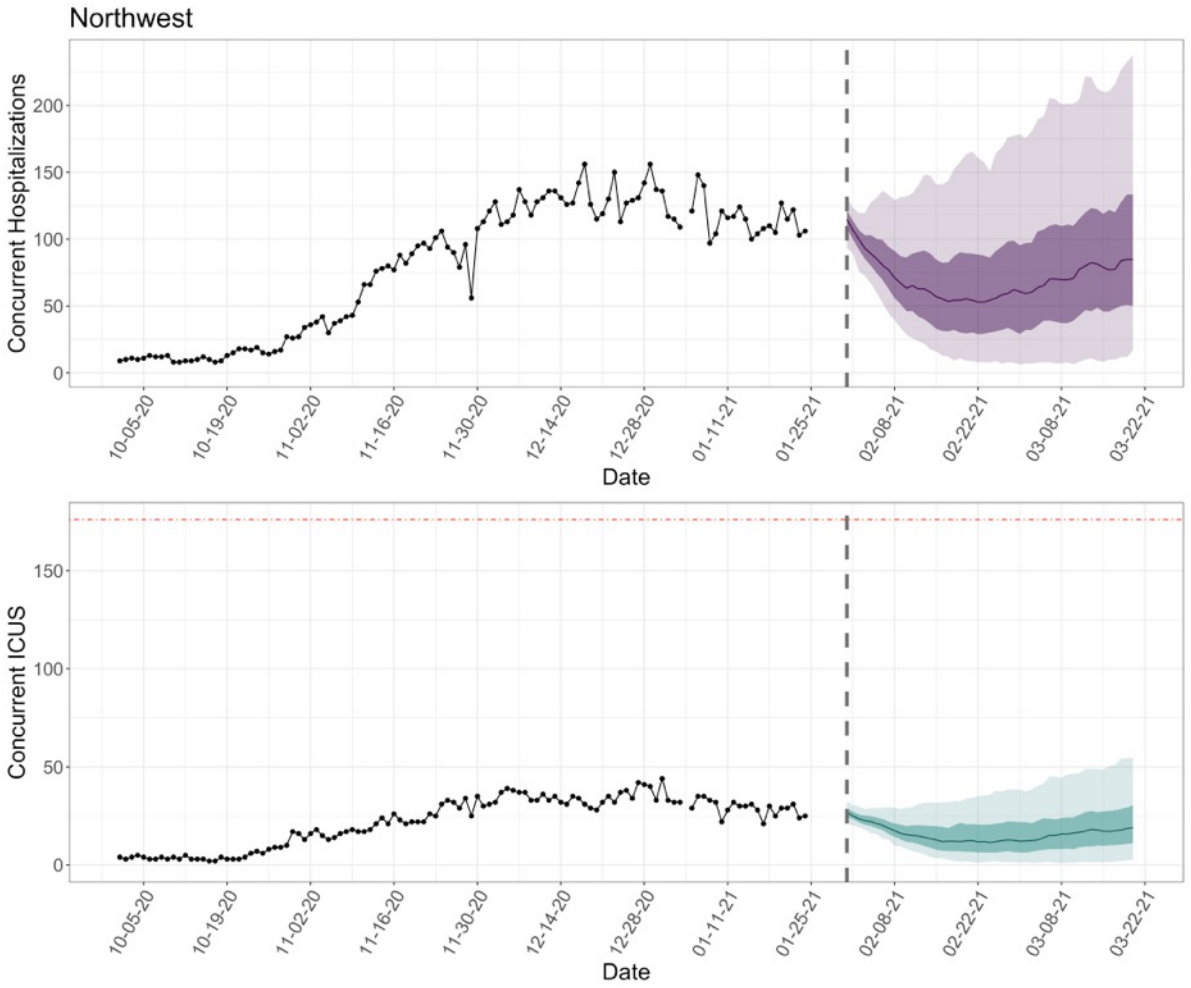
Concurrent COVID-19 ICUs beds: Southwest

Week	Qu. 5% (best case)	Qu. 50% (median)	Qu. 95% (worst case)
2/7	15	24	33
2/14	6	18	37
2/21	3	18	41
2/28	3	19	45
3/7	3	21	49
3/14	5	22	54

So what?

ICU bed usage is expected to slowly decline in the Southwest region.

Regional Hospitalization Forecasts: Northwest



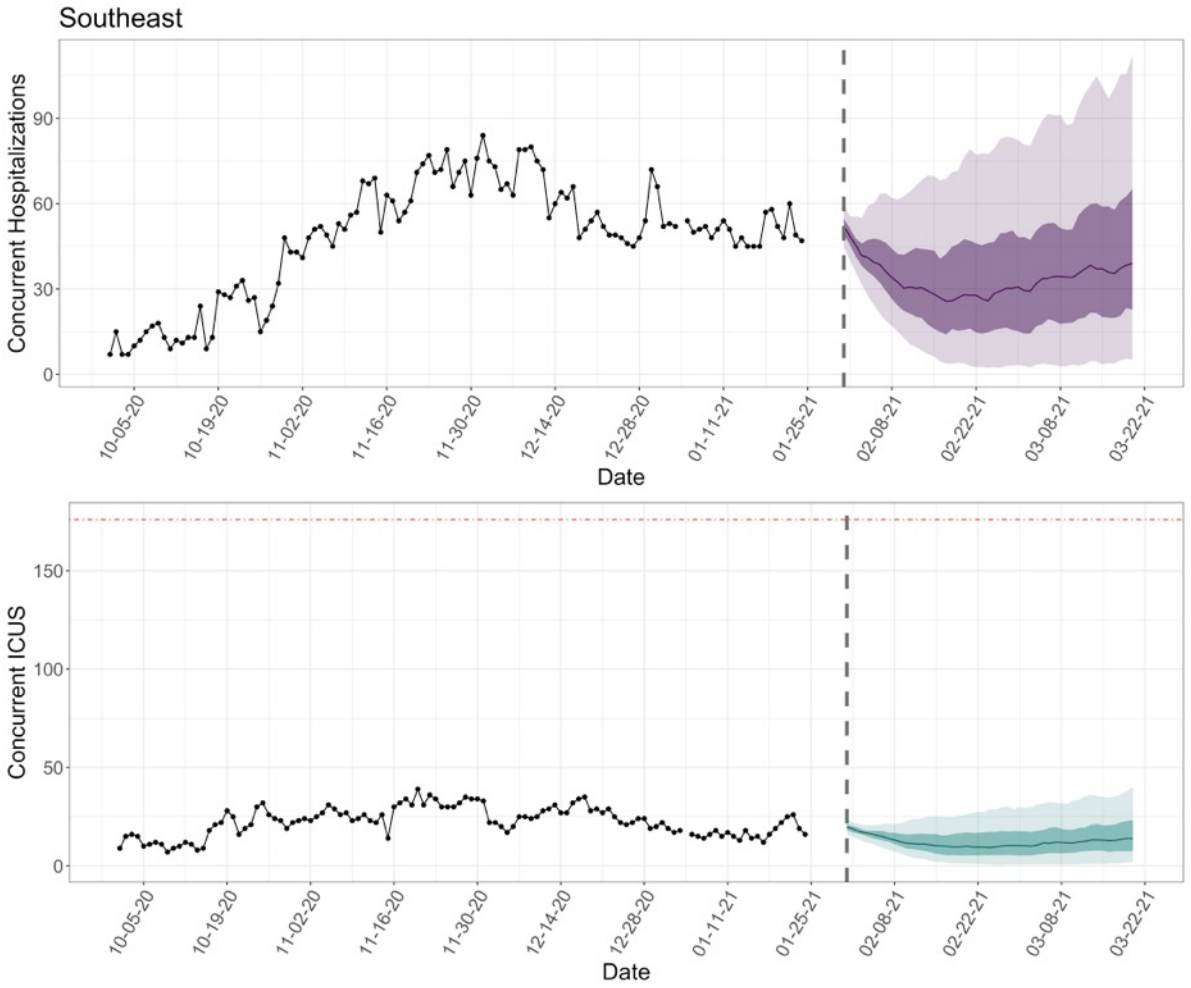
Concurrent COVID-19 ICUs beds: Northwest

Week	Qu. 5% (best case)	Qu. 50% (median)	Qu. 95% (worst case)
2/7	13	19	29
2/14	4	13	32
2/21	1	12	34
2/28	1	13	38
3/7	1	15	45
3/14	1	18	49

So what?

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

Regional Hospitalization Forecasts: Southeast



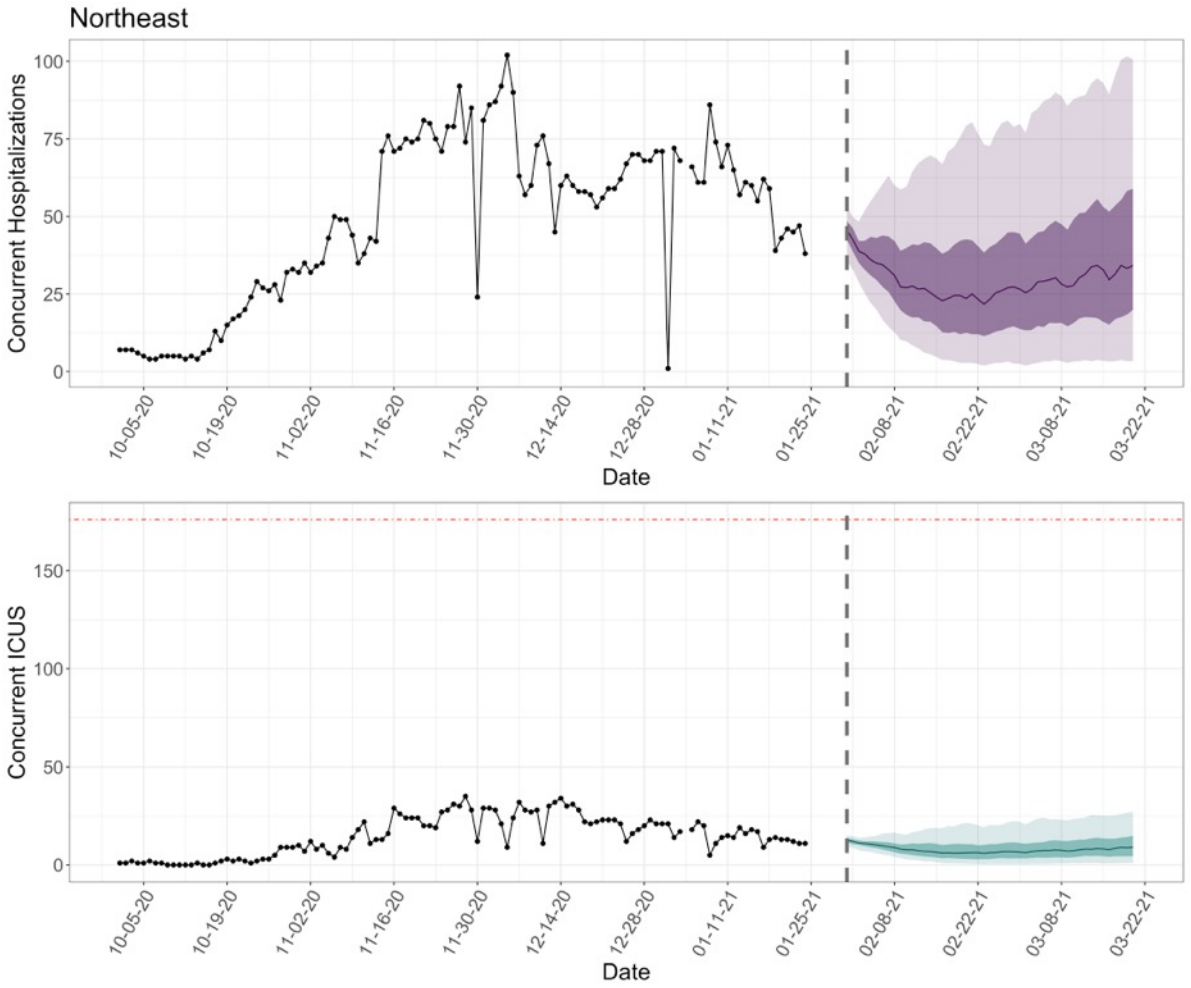
Concurrent COVID-19 ICUs beds: Southeast

Week	Qu. 5% (best case)	Qu. 50% (median)	Qu. 95% (worst case)
2/7	8	14	21
2/14	2	11	25
2/21	1	10	27
2/28	1	10	29
3/7	1	12	32
3/14	1	13	36

So what?

ICU bed usage is expected to <u>decrease</u> 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)
2/7	5	9	16
2/14	2	7	19
2/21	1	6	21
2/28	1	7	22
3/7	1	8	23
3/14	1	8	25

So what?

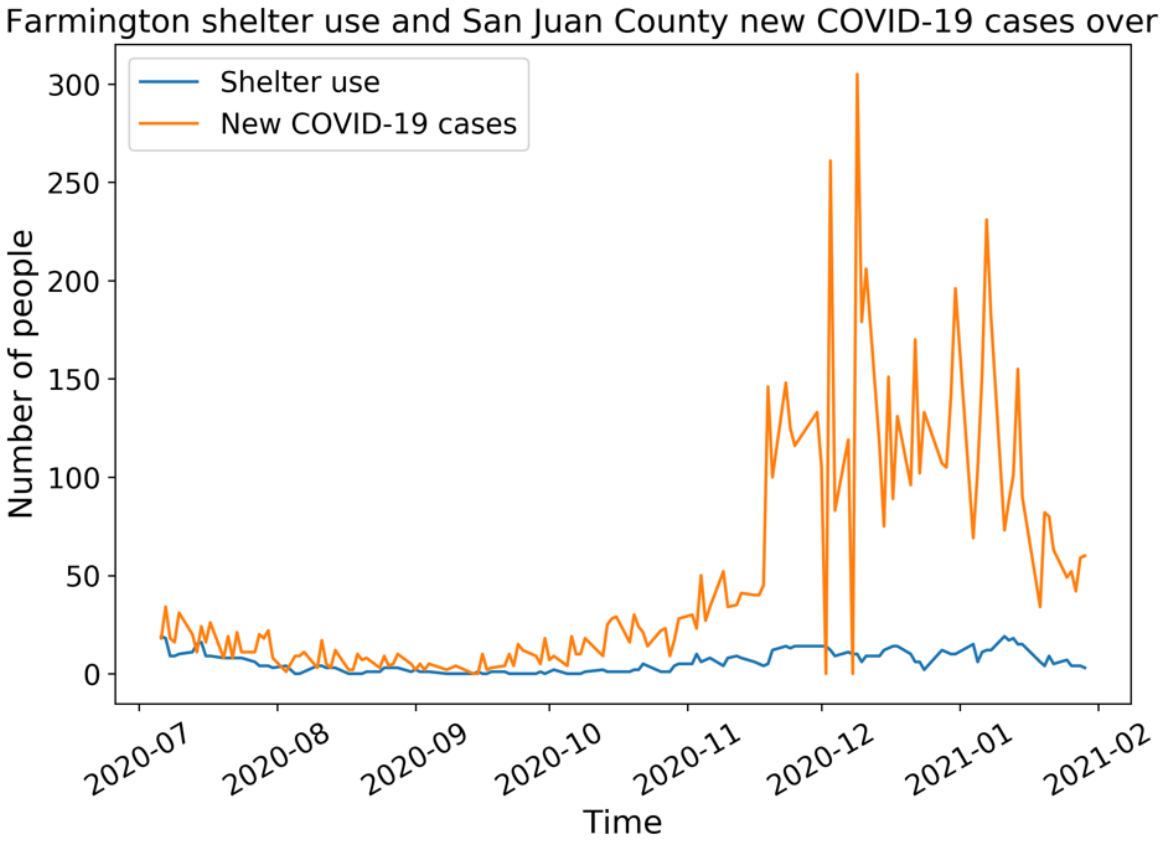
ICU bed usage is expected to graduatlly decrease in the Northeast region

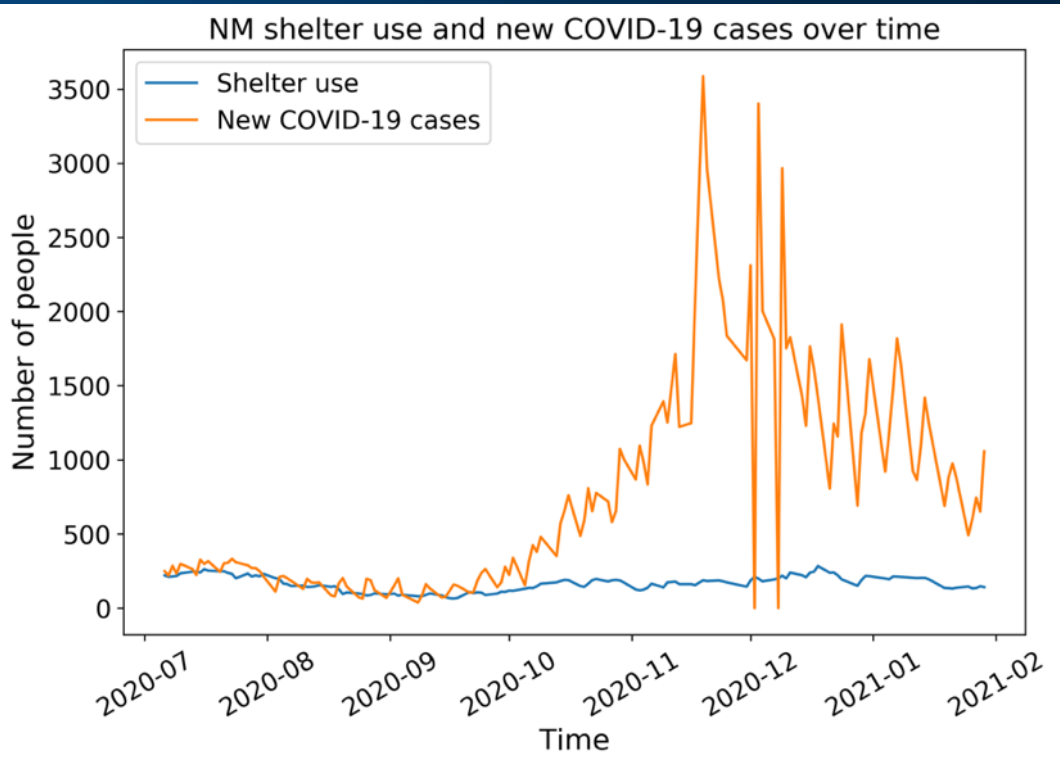
> Non-Congregational Shelter Forecast

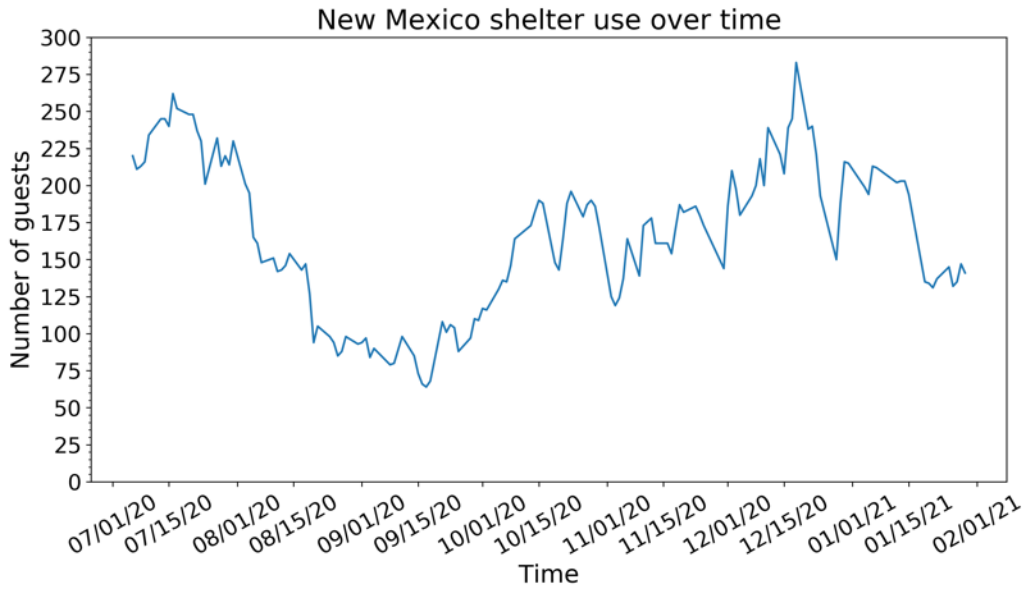
Non-Congregate Shelter Forecast

- **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**

Patterns Through Time

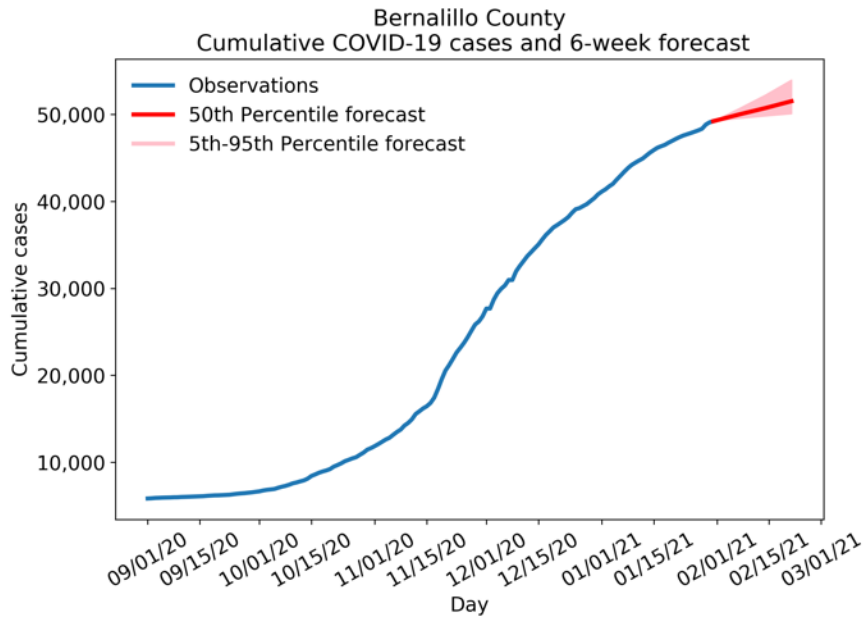






Non-Congregate Shelter Forecast: Bernalillo

Number of cases as of 1/31/21: **49,224**
Number of shelter rooms available: **221**
Total number of patients/medical workers (including specialty): **44**
Number of patients: **41**
Number of medical workers: **3**
Occupied rooms:new cases ratio: **0.21**
2-week avg. new cases per day: **205**



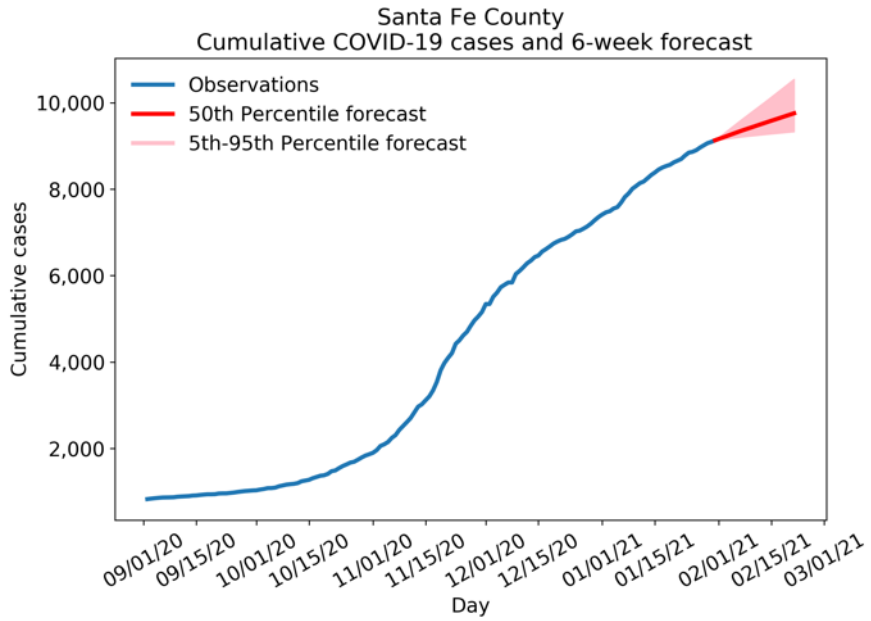
	2/7/21	2/14/21	2/21/21
Total cases	50,007 (49,568-50,699)	49,843 (52,242-51,525)	51,525 (50,102-53,966)
# of rooms needed	24 (11-45)	22 (8-47)	24 (8-53)
Deficit (-) or surplus of rooms	197	199	197

2-week avg. new cases per day decreased from 235 last week to 205 this week

Last week we forecasted 18 shelter rooms needed [10-31] and 44 are currently in use, so we are under forecasting; the Central Desert has 20 guests, which may be biasing the shelter use forecast too high based on our methods

Non-Congregate Shelter Forecast: Santa Fe

Number of cases as of 1/31/21: **9,130**
Number of shelter rooms available: **52**
Total number of patients/medical workers (including specialty): **30**
Number of patients: **29**
Number of medical workers: **1**
Occupied rooms:new cases ratio: **0.67**
2-week avg. new cases per day: **45**



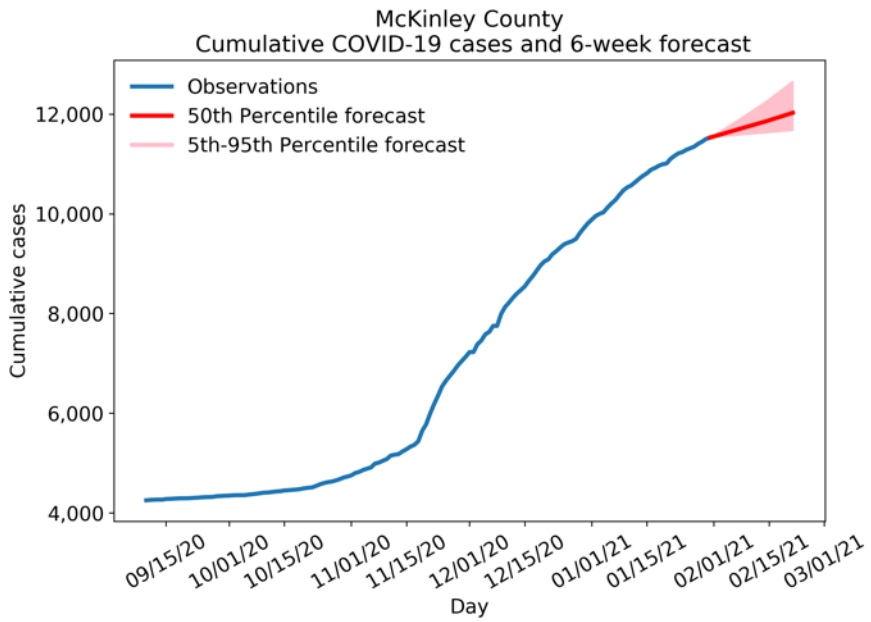
	2/7/21	2/14/21	2/21/21
Total cases	9,351 (9,208-9,606)	9,555 (9,273-10,066)	9,755 (9,331-10,543)
# of rooms needed	21 (7-45)	19 (6-44)	19 (5-46)
Deficit (-) or surplus of rooms	31	33	33

2-week avg. new cases per day decreased from 55 last week to 45 this week

We are still forecasting too low: Caution to follow the higher side of this forecast to measure shelter usage

Non-Congregate Shelter Forecast: McKinley

Number of cases as of 1/31/21: **11,528**
Number of shelter rooms available: **160**
Total number of patients/medical workers (including specialty): **32**
Number of patients: **27**
Number of medical workers: **5**
Occupied rooms:new cases ratio: **0.73**
2-week avg. new cases per day: **44**



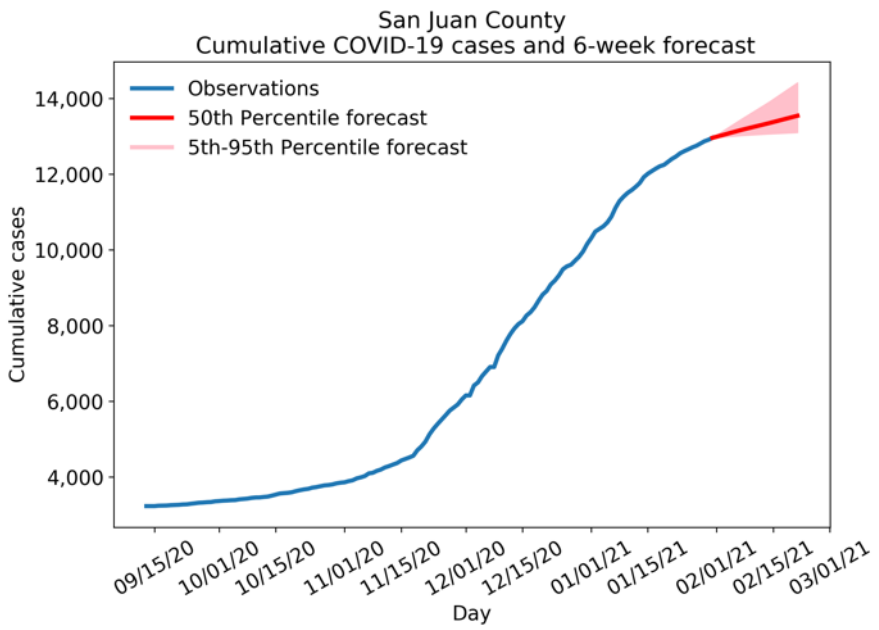
	2/7/21	2/14/21	2/21/21
Total cases	11,690 (11,581-11,877)	11,849 (11,626-12,243)	12,025 (11,675-12,661)
# of rooms needed	17 (6-37)	17 (5-38)	18 (5-44)
Deficit (-) or surplus of rooms	143	143	142

2-week avg. new cases per day decreased from 51 last week to 44 this week

Last week we forecasted 20 shelter rooms needed [4-56] and 32 are currently in use, so we are under forecasting

Non-Congregate Shelter Forecast: San Juan

Number of cases as of 1/31/21: **12,958**
Number of shelter rooms available: **21**
Total number of patients/medical workers (including specialty): **4**
Number of patients: **4**
Number of medical workers: **0**
Occupied rooms:new cases ratio: **0.07**
2-week avg. new cases per day: **58**



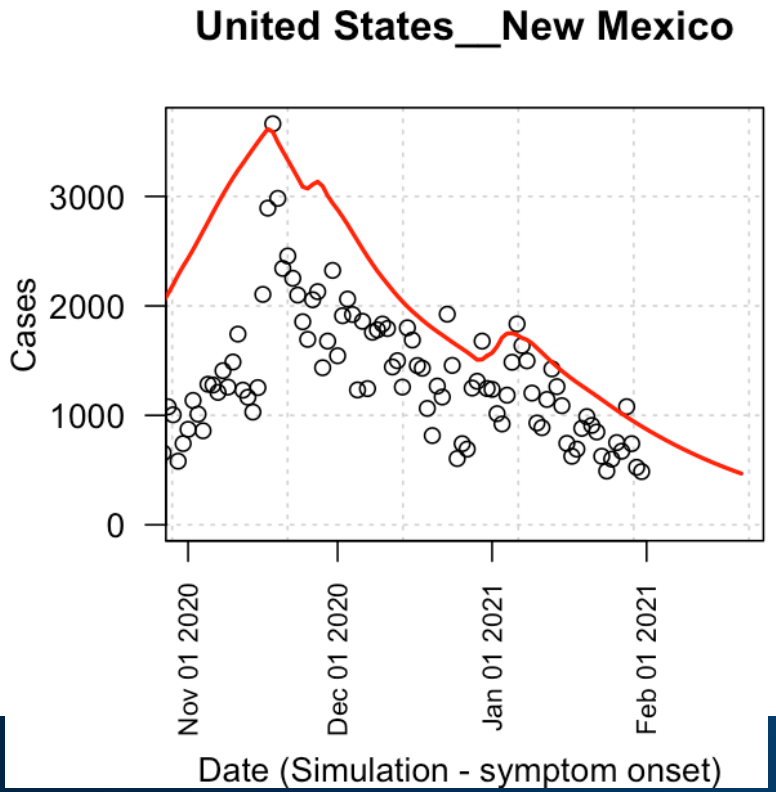
	2/7/21	2/14/21	2/21/21
Total cases	13,163 (13,020-13,438)	13,346 (13,065-13,901)	13,541 (13,102-14,409)
# of rooms needed	2 (1-5)	2 (0-5)	2 (0-5)
Deficit (-) or surplus of rooms	19	19	19

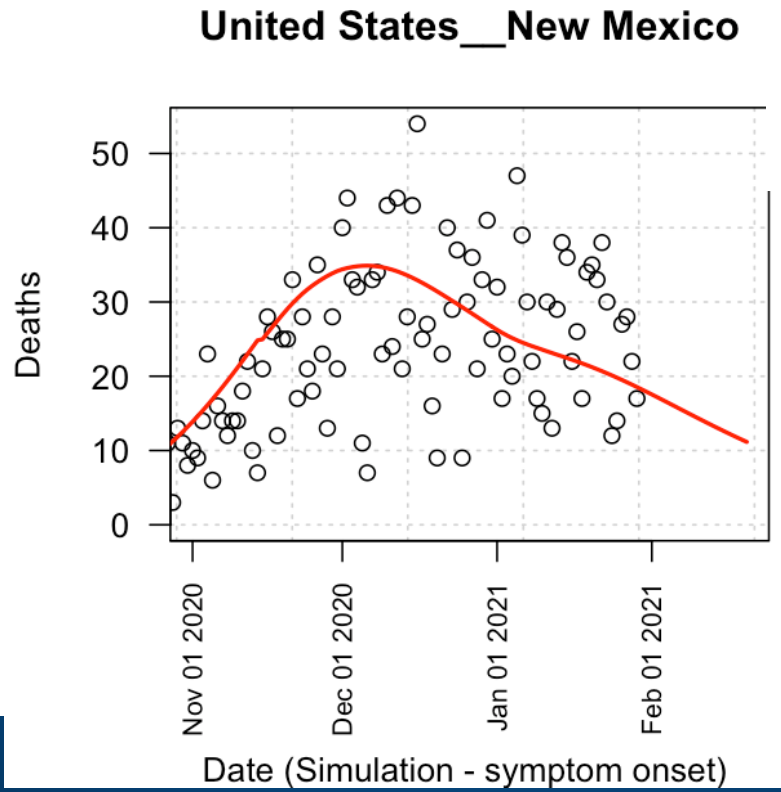
2-week avg. new cases per day decreased from 79 last week to 58 this week.

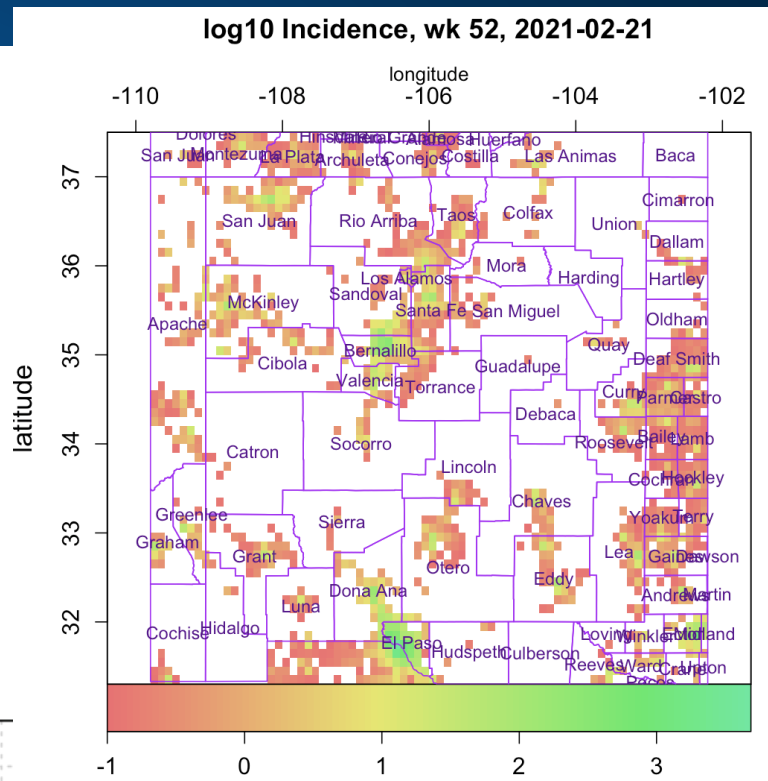
Last week we forecasted 4 shelter rooms needed [1-10] and 4 are currently in use

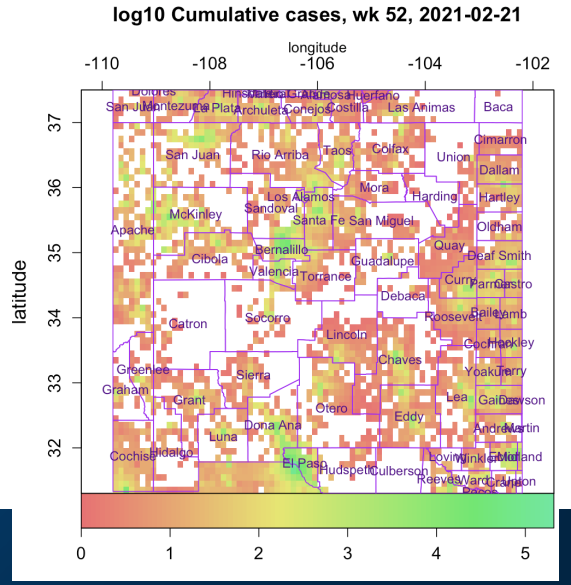
02 Feb 2021: EpiGrid modeling

- A 20% increase in transmissibility is assumed for yellow/green counties as compared with red counties.
- Transmission increases due to Christmas and New Year's are significantly increased over Thanksgiving (>~4x) and reflect a transient 3-4 day reporting delay.









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

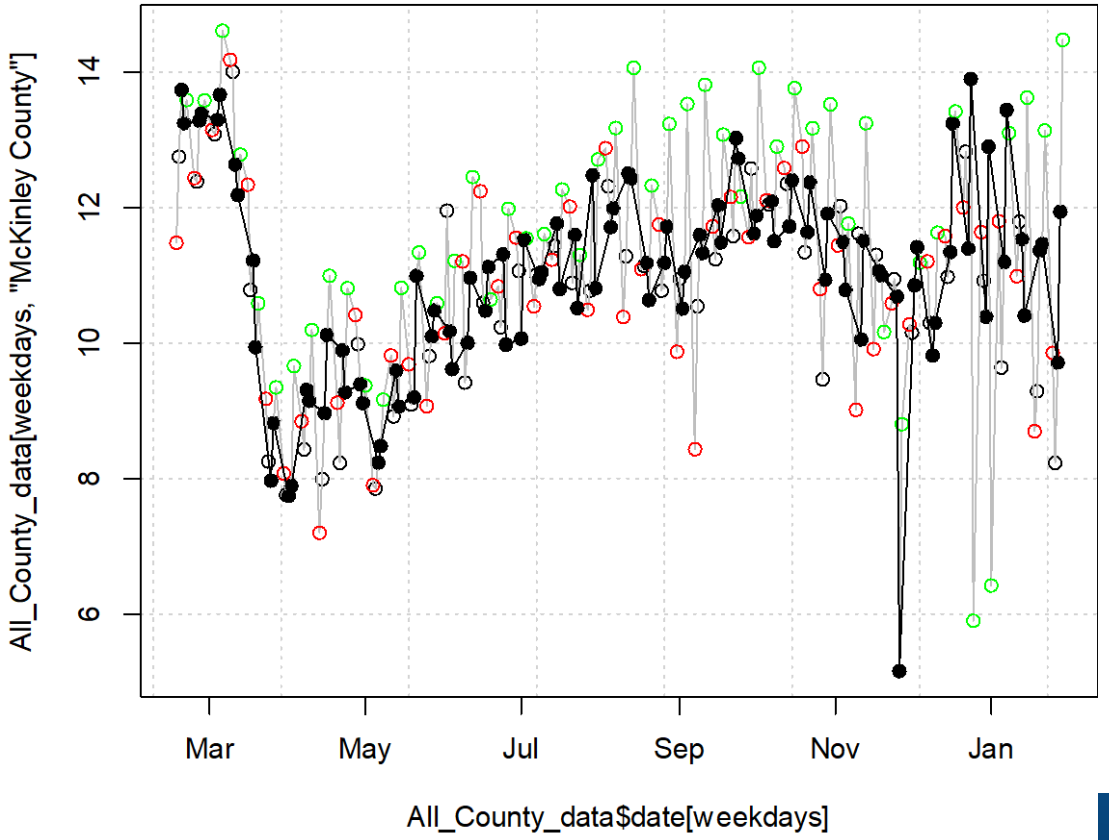
- Daily reported cases in El Paso are approximately constant.
- Vaccination starts Dec. 15th with 2700 people per day changing to 3500 (was 3200) people per day on Jan 4th, and changing to 6000 per day on Jan 10th, **and 7000 per day on Jan 25th** and 90% vaccine effectiveness. **This results in 214,000 people vaccinated (1 or 2 doses) on Feb 2nd. The NM report has ~214,000.**
- **Vaccination rates by are implemented such that the cumulative numbers match by-county for the Feb 1st state of NM numbers.** The time sequence increases the same way for each county.
- **Transmission is based on mobility with modifications due to PHO's and red/yellow/green.**
  - Modeling of public reaction and public health orders (PHO) is similar to previous models.
  - Geographical heterogeneity of mobility accounts for the majority of variations in the force of infection from county-to-county.
- **Death rates now include more 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.**
  - Swab to results times: Assuming 1-3 days
  - 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 numerically very small at this time.**
  - Potential for a 50% increase in contagion/force of infection *in the future*.
  - No epidemiological evidence yet for strain replacement in New Mexico.
  - Properties of novel viral variants are not fully characterized.

T-80 Mobility – northern counties (Data only).

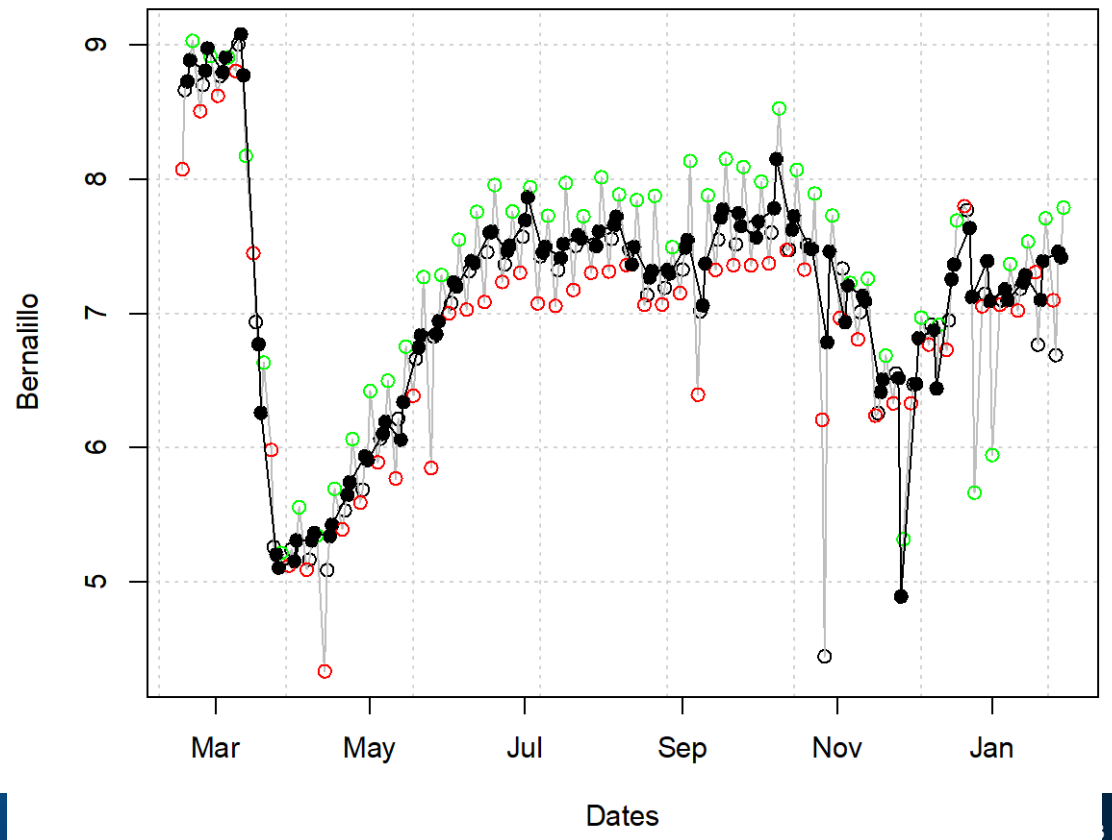
- Bernalillo and Sandoval have increasing mobility over the last 3-4 weeks.
- San Juan and Taos have (slightly) lower mobility than in the summer which is stable .
- Los Alamos, McKinley, Santa Fe have similar mobility to the summer.
- Rio Arriba and Valencia have had increasing mobility which now roughly same as summer peak.

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

McKinley



Bernalillo

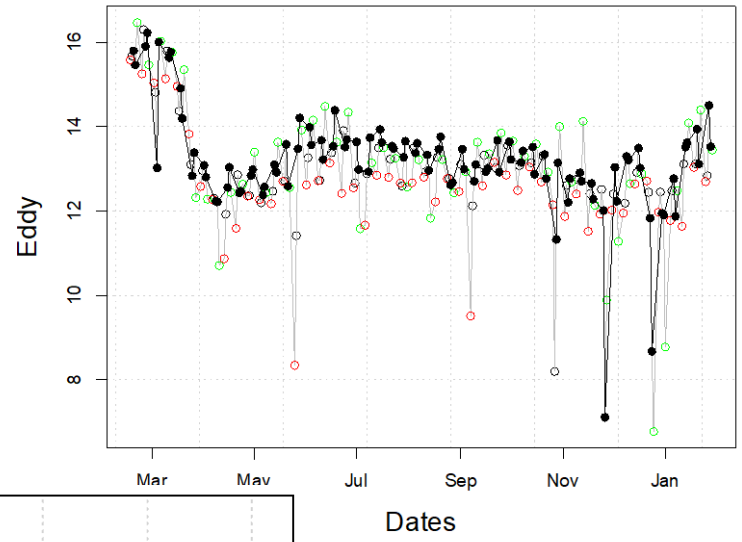


T-80 Mobility – southern counties and Curry (Data only)

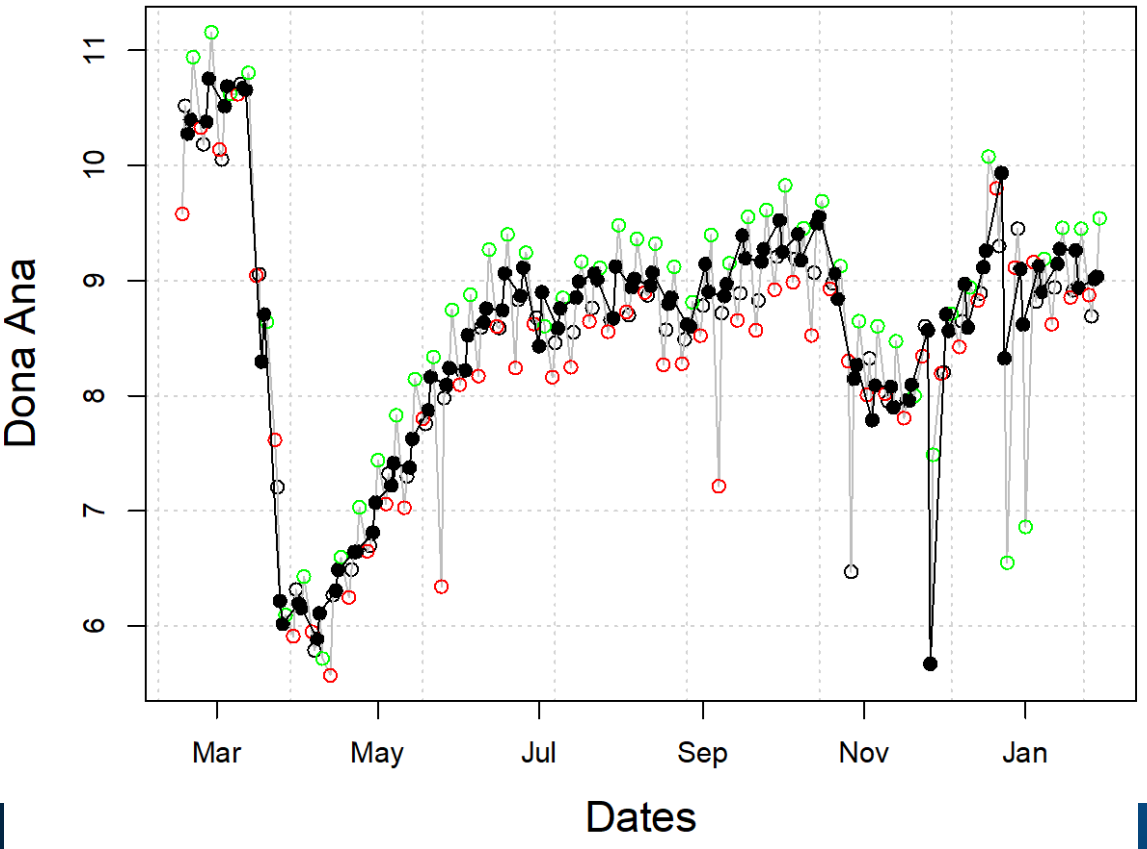
- Chaves, Curry, Dona Ana, Grant , Lincoln, Luna, Roosevelt, Socorro similar to summer
- Eddy and Lea continue to have mobility as high as their summer peaks.

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

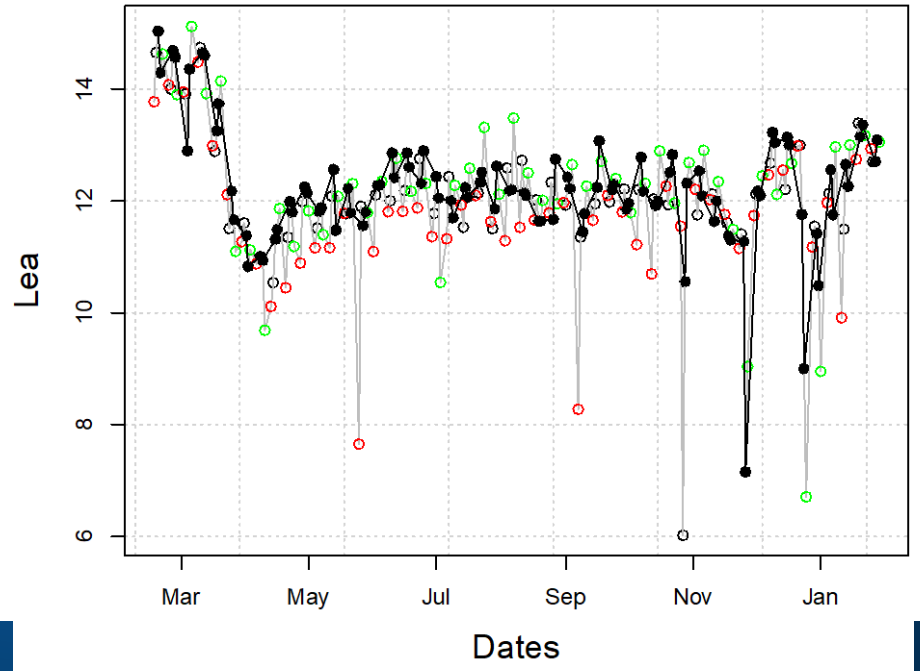
Eddy



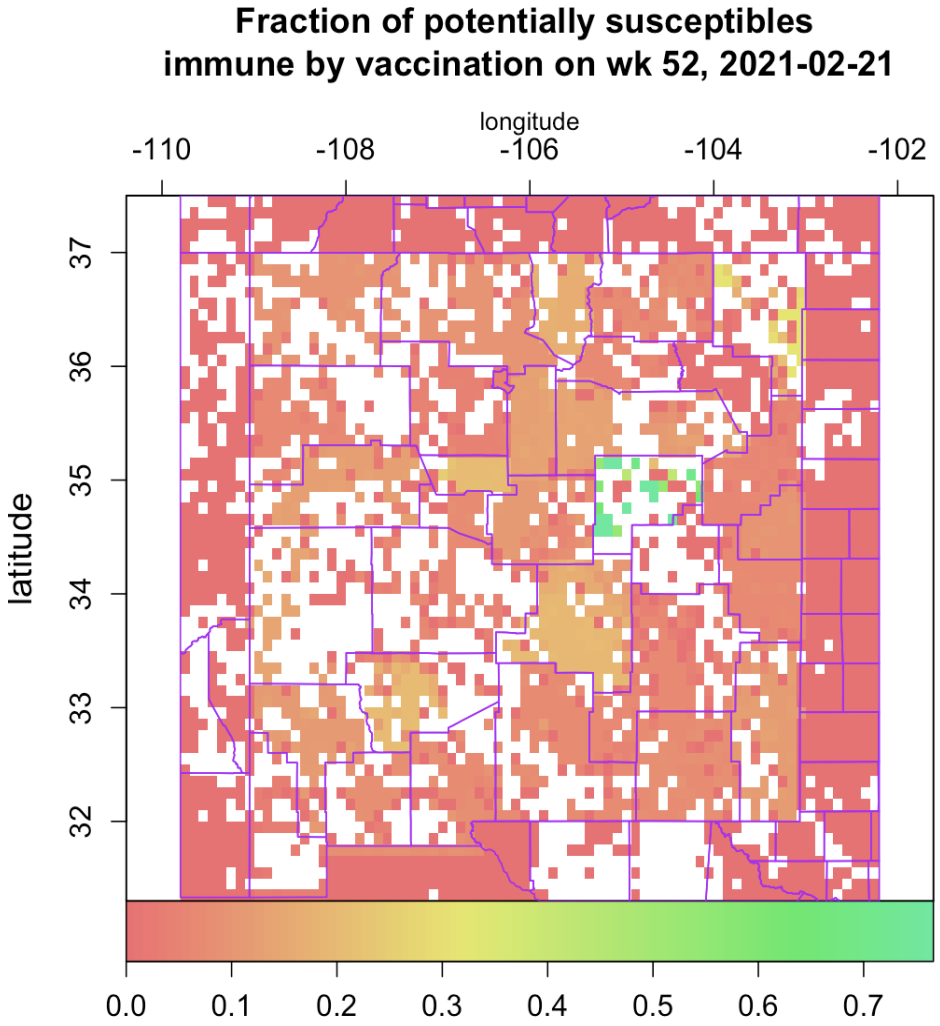
Dona Ana



Lea

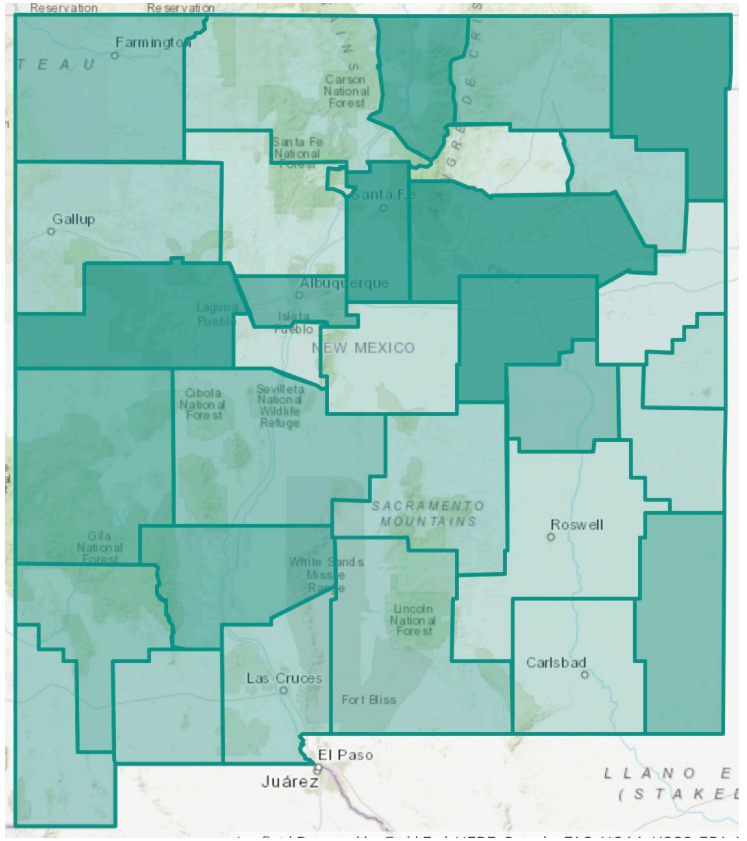


Likely Geography of the Vaccinated Population in NM (Fractional, on 2/21/21)



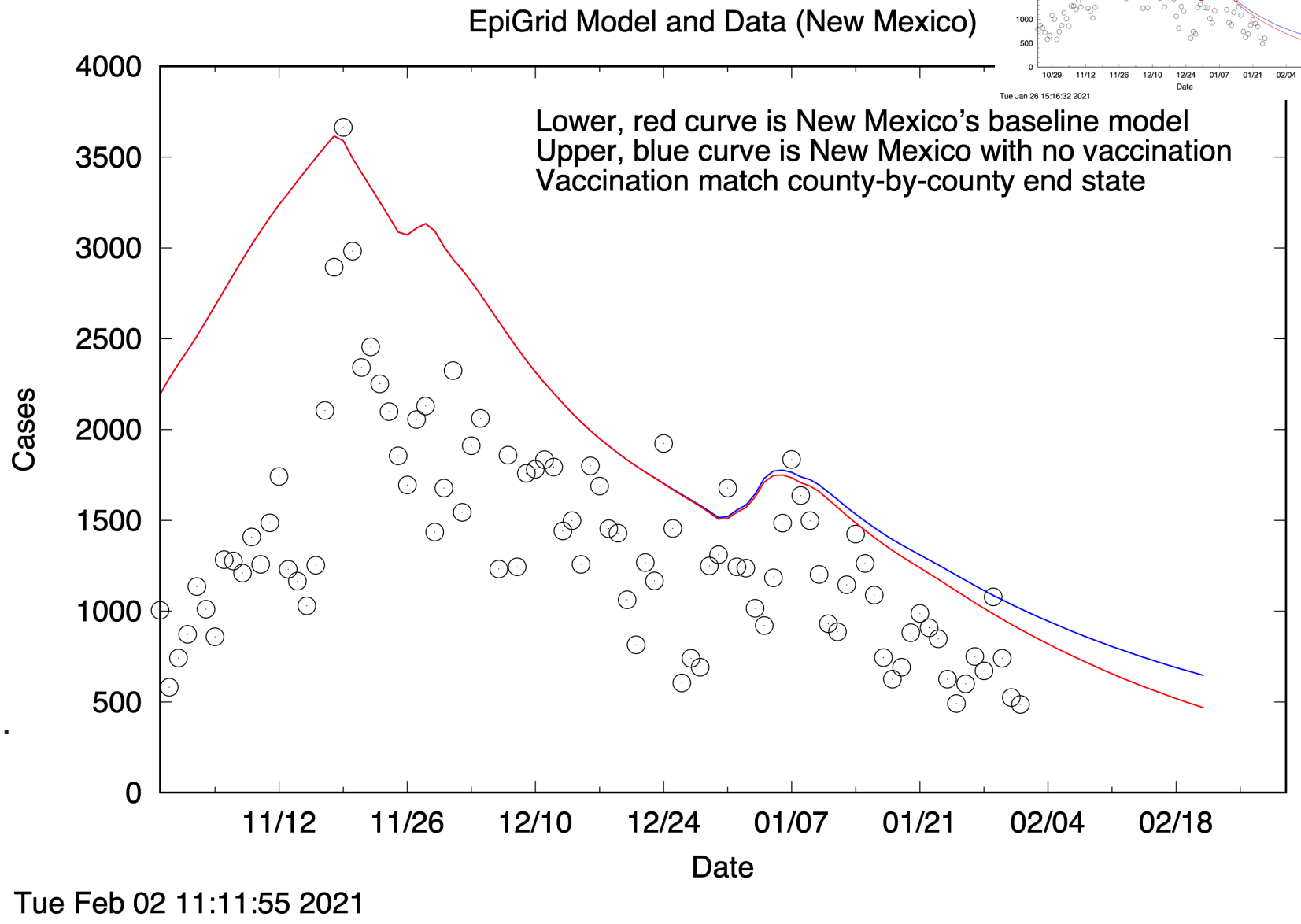
Some within-county inhomogeneity undoubtedly exists, but actual inhomogeneity may differ from image

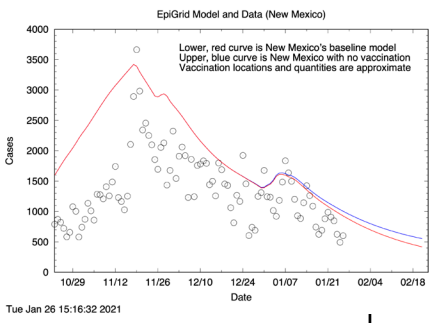
Comparison with state vaccination per 100 residents, 2Feb2020. Note different (inverted) color scale. Dark is more vaccination.



Effect of Vaccination on Daily Incidence

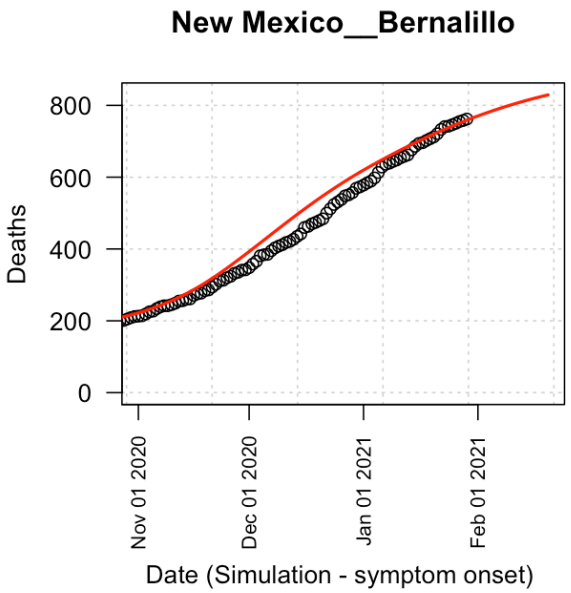
- Vaccination is lowering daily incidence ~10%.
- Infection control and quarantine *currently* play larger roles in epidemic control than vaccination.
- Dec 15th start 2700 people/day
- Jan 4th to 3500 people/day
- Jan 10th to 6000 people/day
- Jan 25th to 7000 people/day
- Currently modeling 90% vaccine effectiveness.
- Feb 2nd Model as 214,000 people vaccinated (1 or 2 doses).
- NM & CDC data report ~214,000 people vaccinated.
- By-county matching to vaccination.

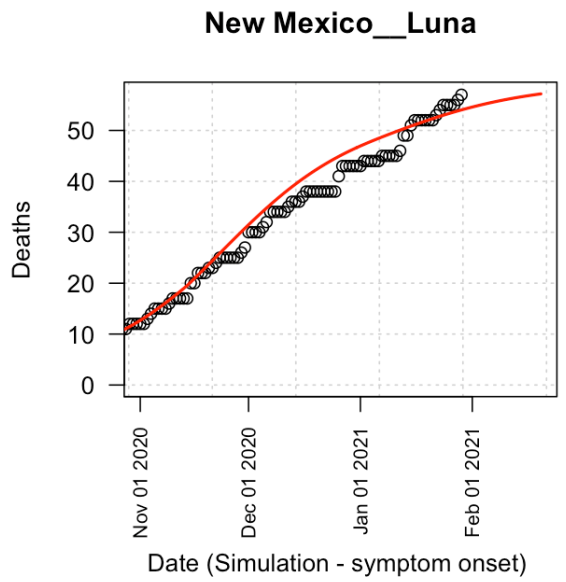


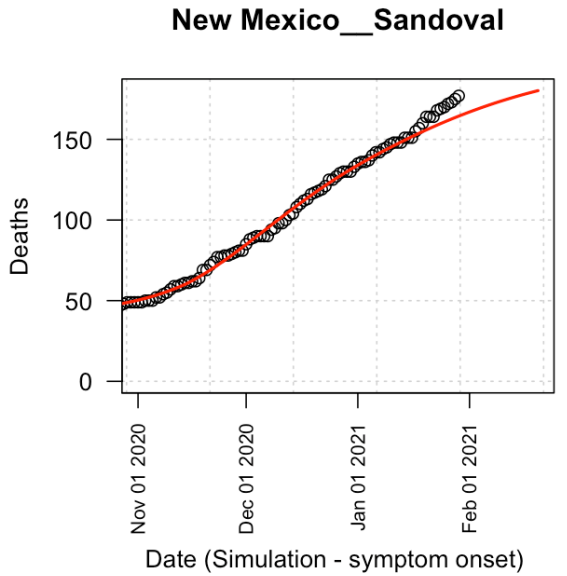


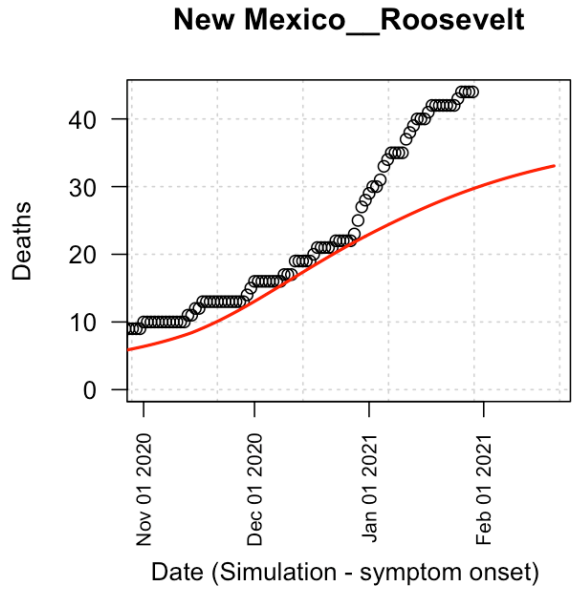
Death Rates vary by county

- EpiGrid uses a lower death rate for Bernallillo than other counties.
- EpiGrid uses a higher death rate for Cibola, Colfax, McKinley, San Juan, Sierra, and Socorro
- The increase in deaths in Roosevelt in January is not explained by a previous increase in cases.



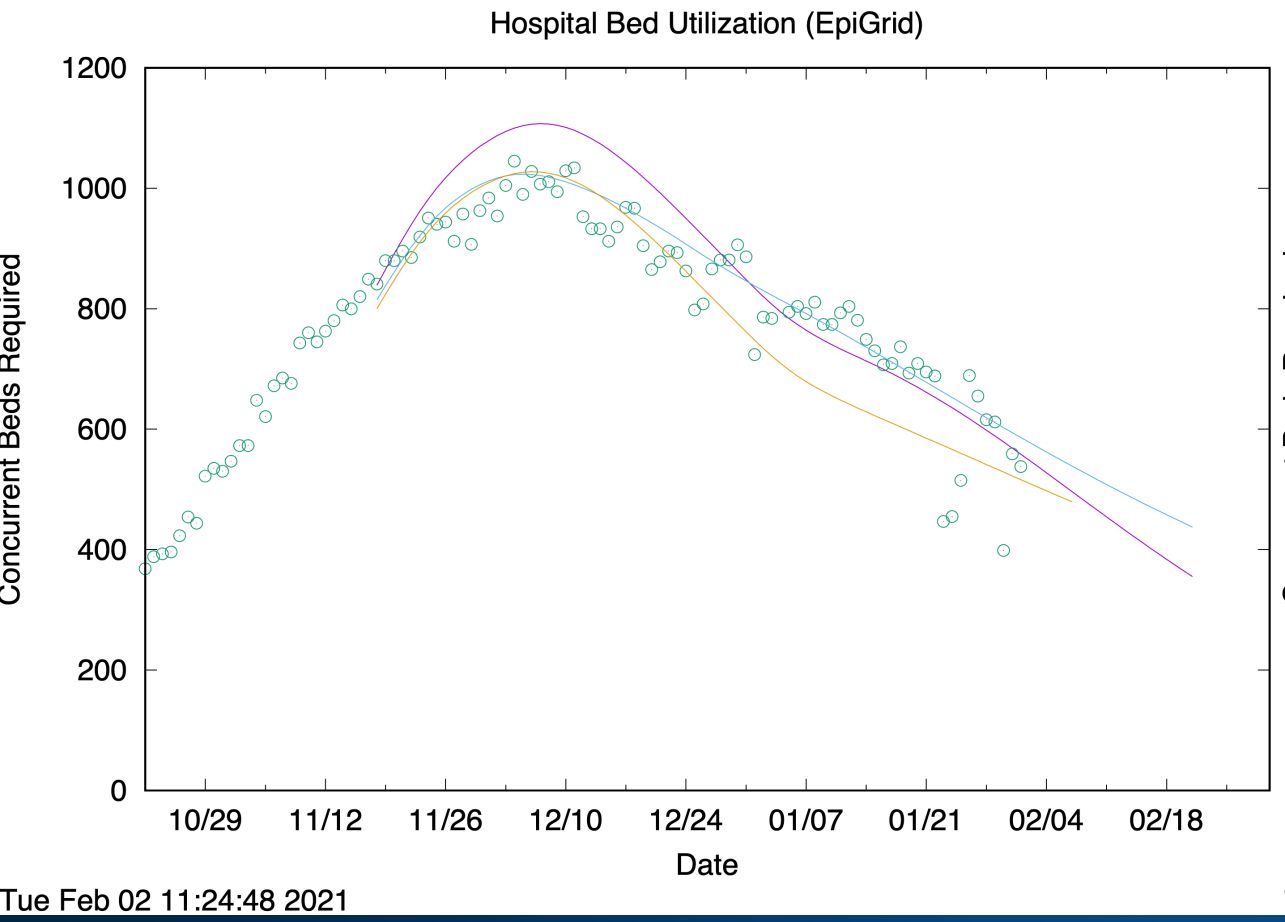


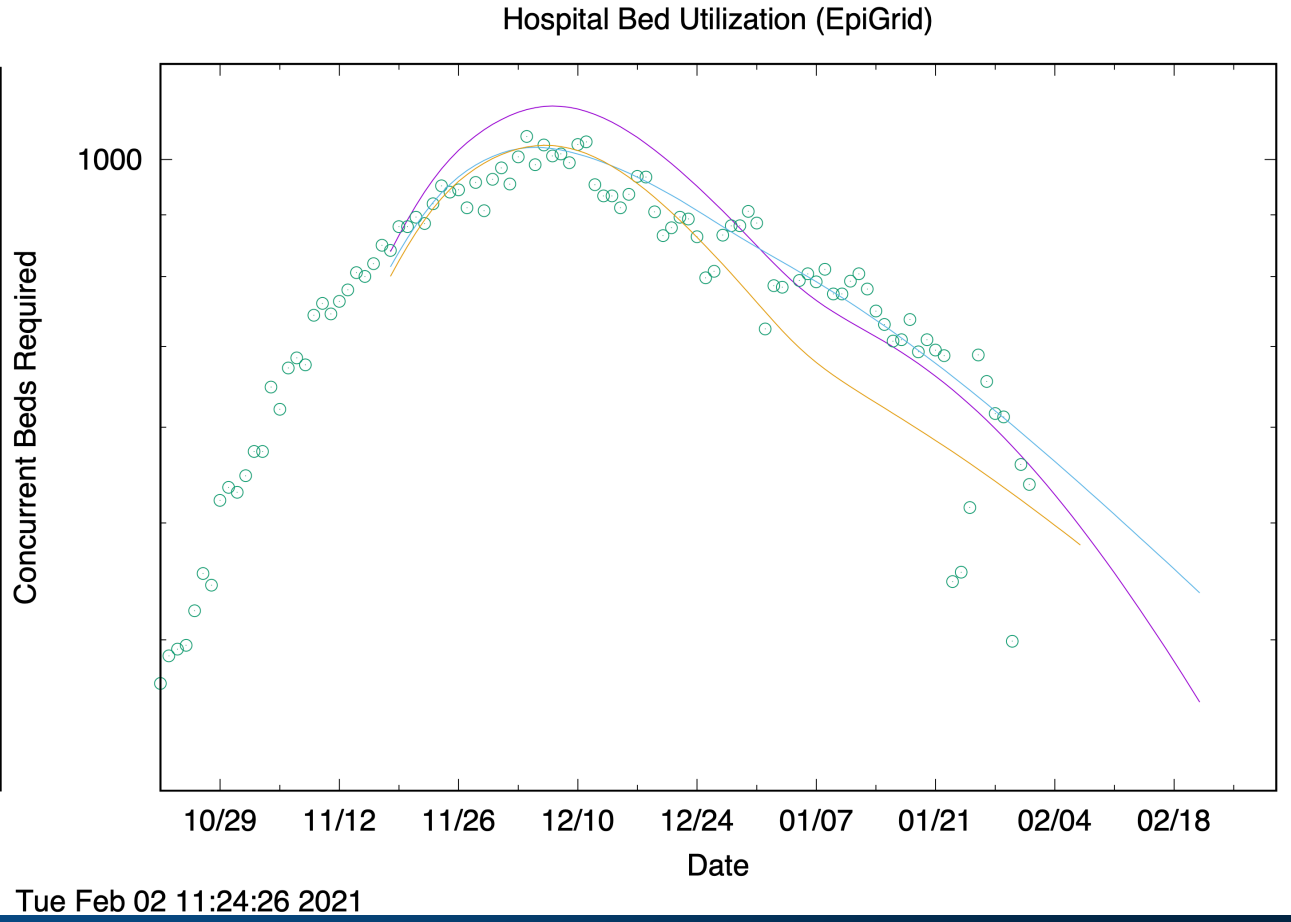




Hospital bed concurrent usage by COVID-19 patients (Statewide)

- Left panel: Linear vs. time (y-scale=0:1200) shows hospital beds. Models: 02Feb21 (purple), 12Jan21 (yellow), 15Dec20 (cyan).
- Right panel: Log vs. time, same data and models (y-scale = 300:1200).
- Christmas and New Year's are 4-5x Thanksgiving modulation of the force of infection/level of contagion.
- Thanksgiving no longer affects these curves. Christmas and New Year's will similarly clear their influence soon.
- Effects of COVID-19 vaccination on the hospitalization rate are not yet quantified.

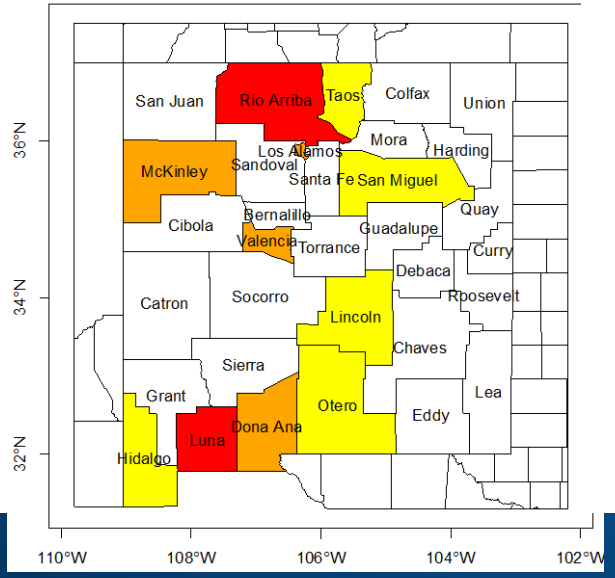


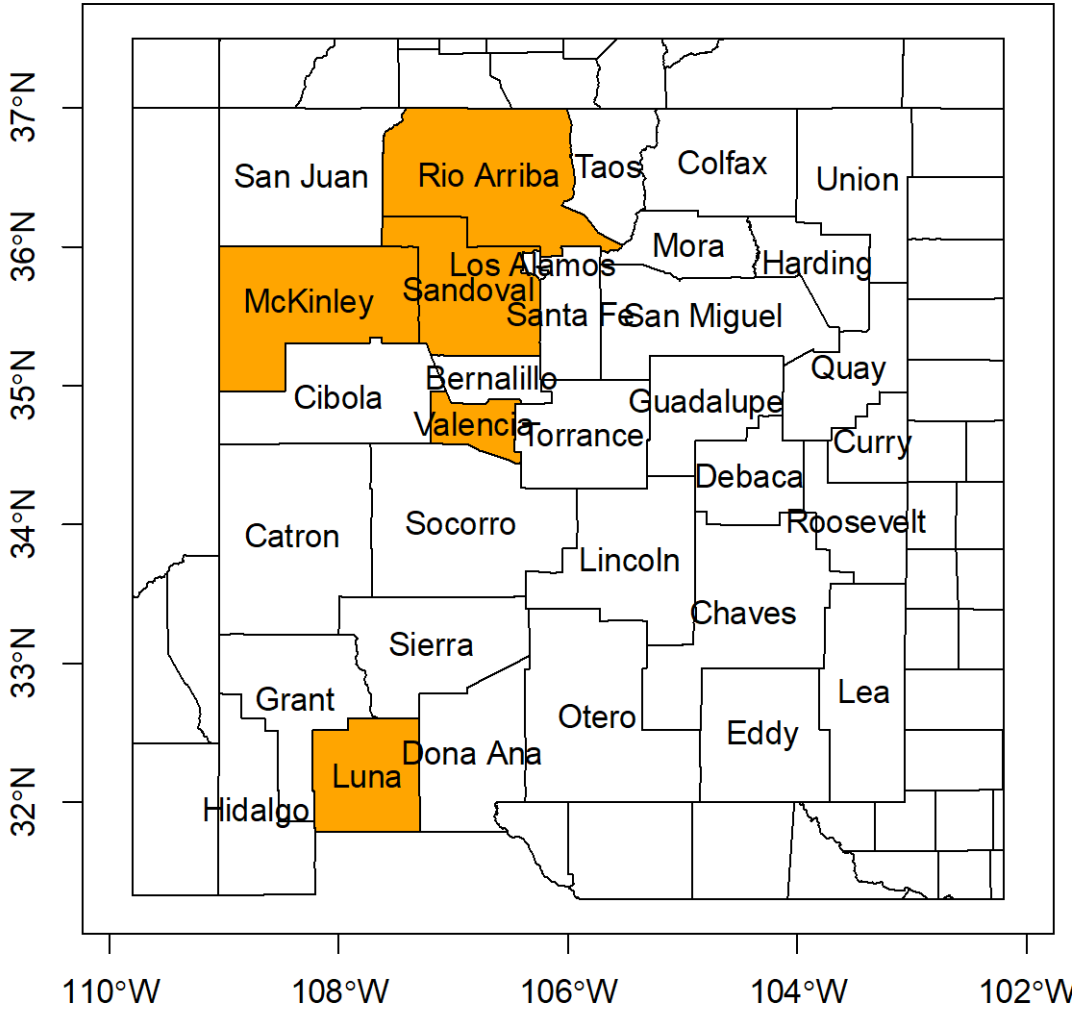


Situational Awareness:

- Cases in Rio Arriba are decreasing, but transmission/force of infection is still high.
- Cases in McKinley appear to be constant in time, not decreasing.
- Luna, Sandoval, and Valencia have decreasing cases, but higher transmission than expected from mobility.

Last week





Conclusions and Discussion

- **New Mexico's daily incidence is declining state-wide. Some counties may be flattening/no longer declining.**
- **COVID-19 vaccination reported by the State is responsible for an >~10% reduction in daily incidence.**
- **Infection control and quarantine continue to play significantly 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 will continue to be a need. Model is *assuming* about 1:1000 variant cases in late January.**
- **El Paso's daily incidence is roughly flat.**
- **Nationwide geographical dispersion is likely seeding local transmission and variants.**
- **The NM testing positivity rate is <~7%. Situational awareness is improving.**
- **Targeting vaccine to high-mortality areas and populations will have the largest immediate effect on this model.**
- **Schools are not included in this week's model. Updated with in-person/hybrid vs. distance data when available.**
- **Discussion:**
  - Vaccinating high risk-of-mortality populations will lower the mortality rate *and* further lower hospital loading.
  - Schools are highly mitigated if they comply with infection control guidance, elementary schools provides little evidence for in-school spread with the current viral strain. Improved PPE may be required in response to viral variant emergence. Meal times, busses, and passing periods are likely the riskiest school-related activities (in the presence of good in-class infection control).
  - 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.