Modeling & Forecasting COVID-19 in NM

December 22, 2020

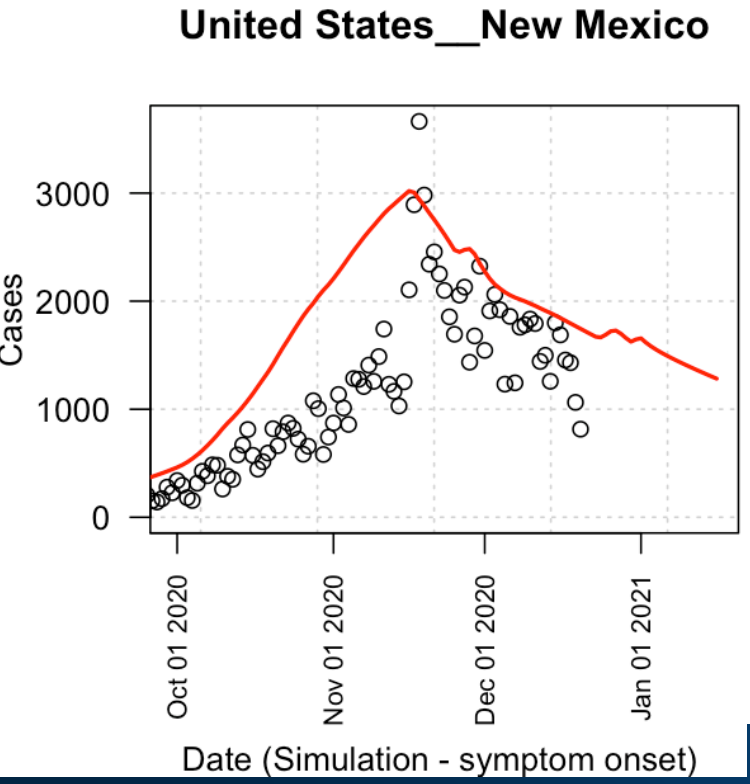
NNSA
National Nuclear Security Administration

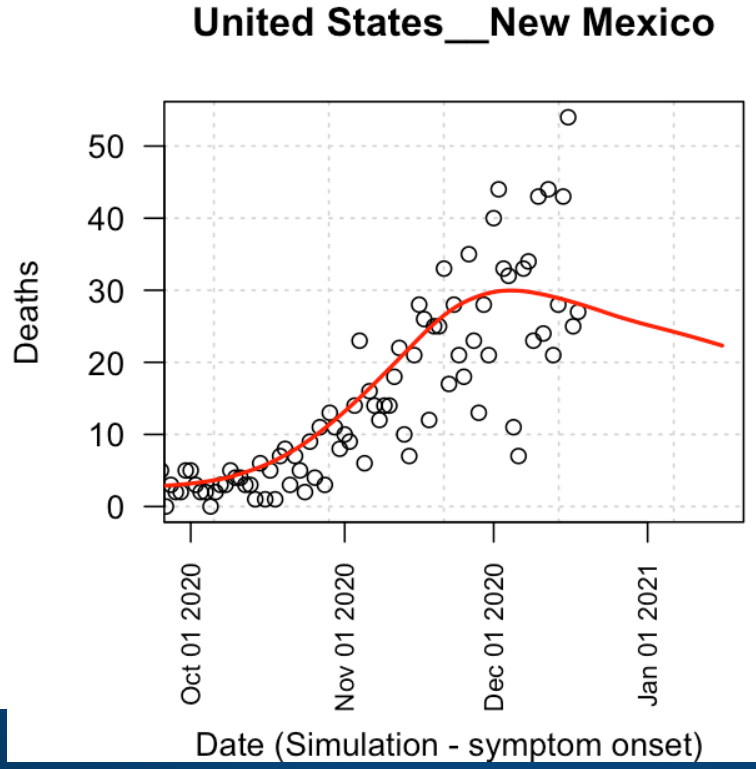
22 Dec 2020: EpiGrid modeling

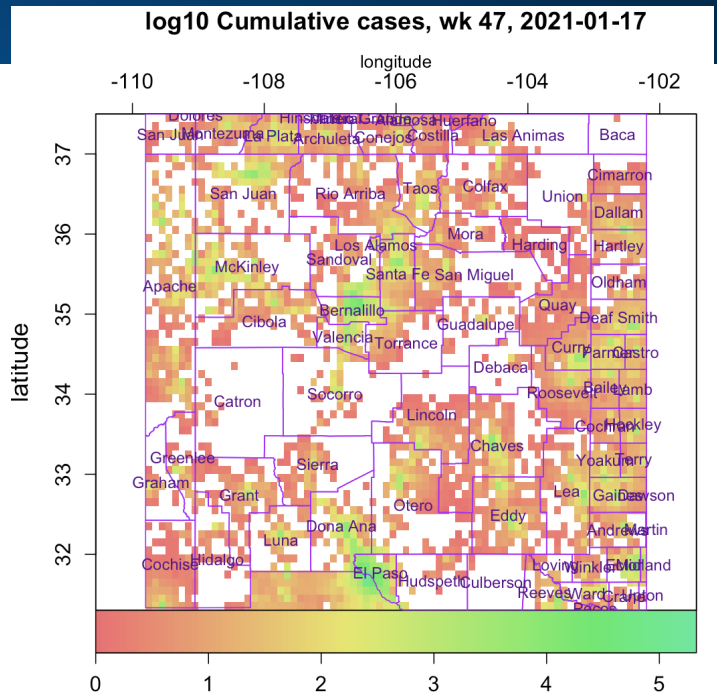
- Assumes all counties remain in their current (almost all “red”) category under the new county-by-county system. (More precisely we assume that transmission parameters stay as they are.)

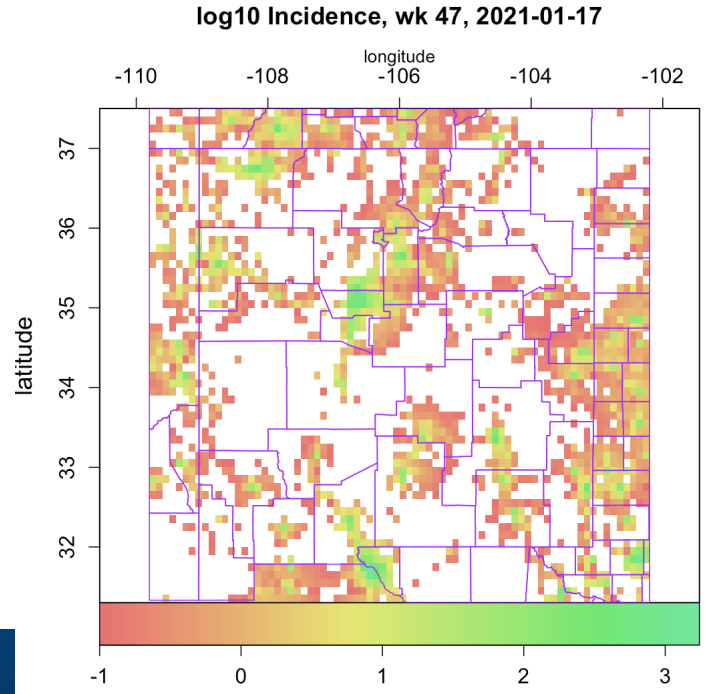
- Quarantine mostly modeled at 42% with more counties being high exceptions than last week, a few at ~50%.

- Small increases in transmission are parameterized for Thanksgiving, and assumed for Christmas and New Year’s.



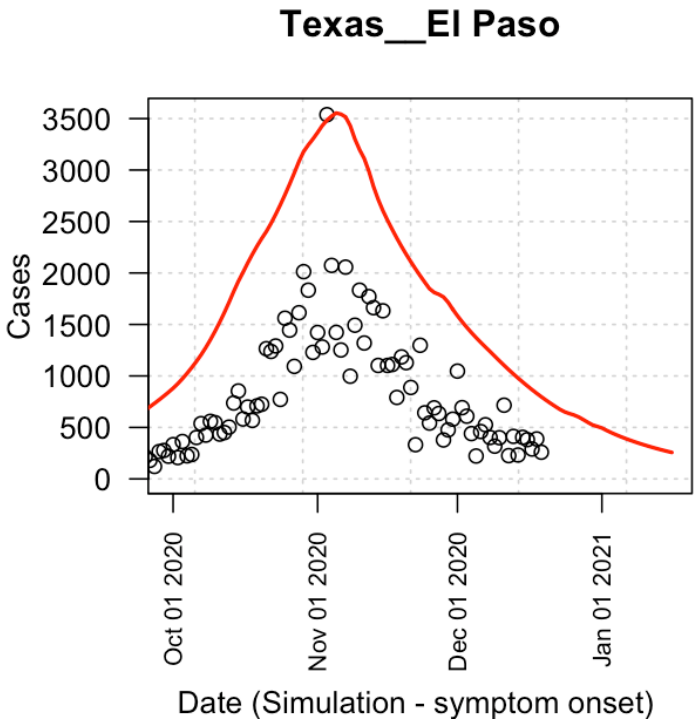






22 December 2020 Model (EpiGrid) – more details and information

- **Reported cases in El Paso are roughly constant; positivity is up slightly ~13.5%.**
  - ➢ Due to delays in the release of non-NM Descartes Lab data, we do not have current mobility data for El Paso or other counties in Texas, Colorado or Arizona.



- **Transmission is based on mobility with modifications due to PHO's.**
  - 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 higher-risk populations have higher death rates.

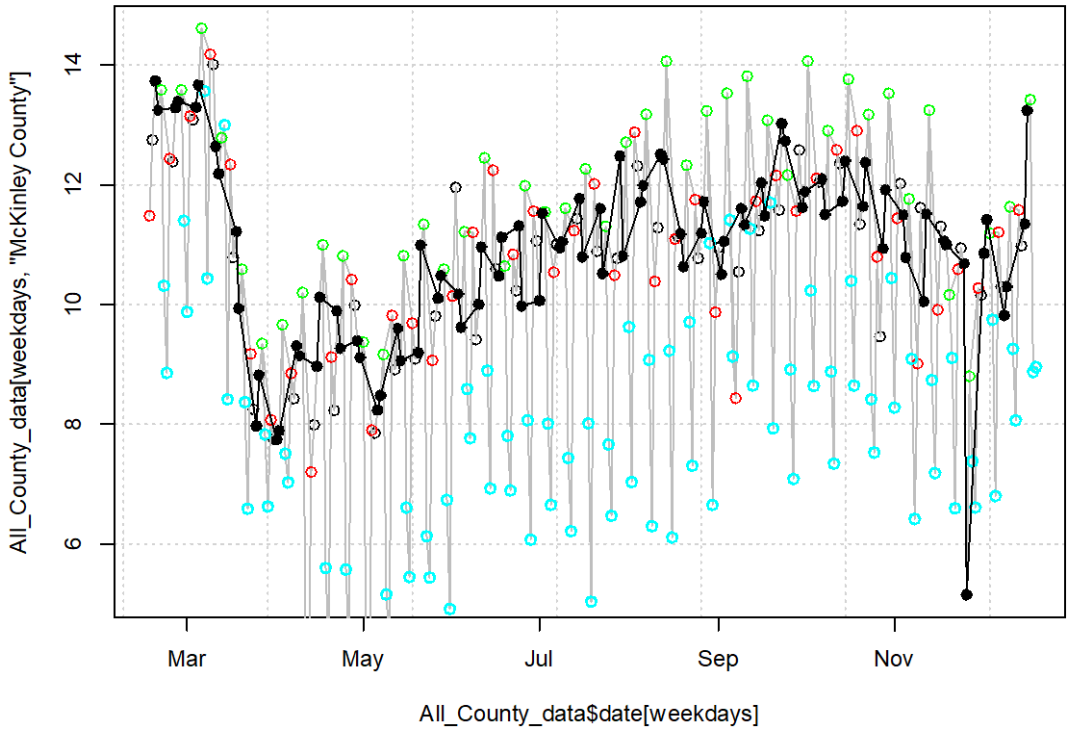
- **Isolation and quarantine rates are assumed to be stable.**
  - Swab to results times: Assuming 1-3 days
  - Base isolation rate is 0.42 for NM.
  - Quarantine slowly recovering, some counties at 0.50 (i.e. 50%).

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

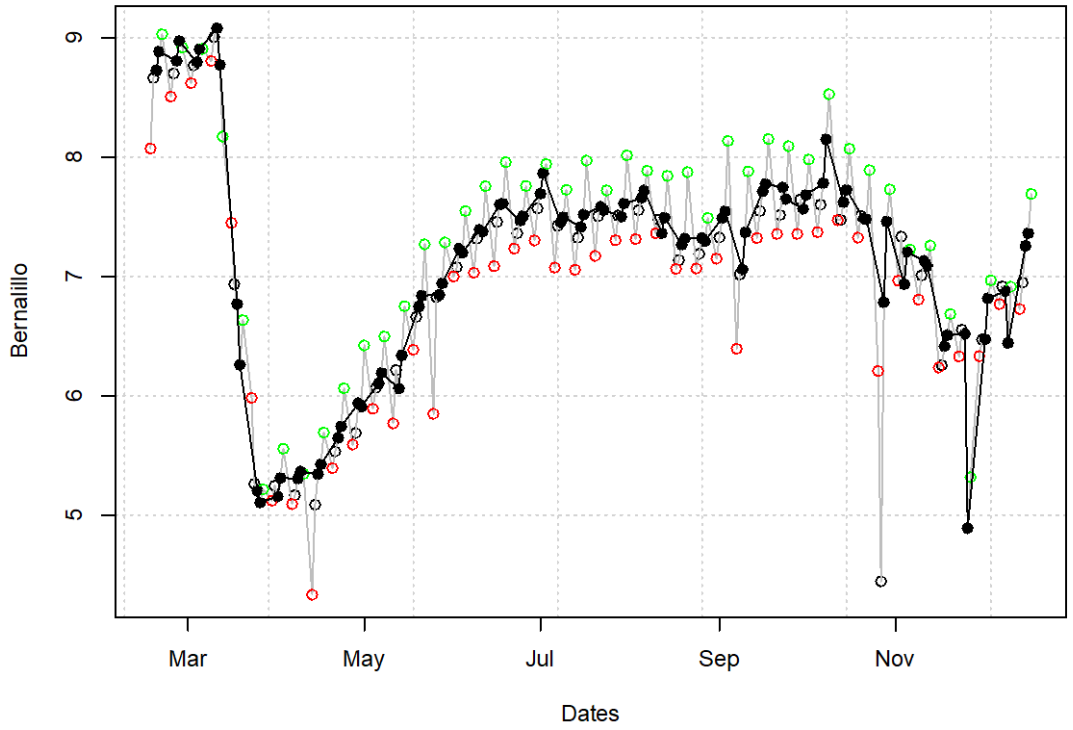
Bernalillo, McKinley, San Juan, Taos, Valencia have *clearly increasing* mobility
Los Alamos, Rio Arriba, Sandoval, Santa Fe also have increasing mobility (but less so)

McKinley – weekend curfew changed from 32 hrs to 57 hrs, starting Sept. 25th

- Weekends shown, sometimes
- Monday
- Wednesday/Thursday
- Friday (usually higher)
- Sat/Sun



Bernalillo

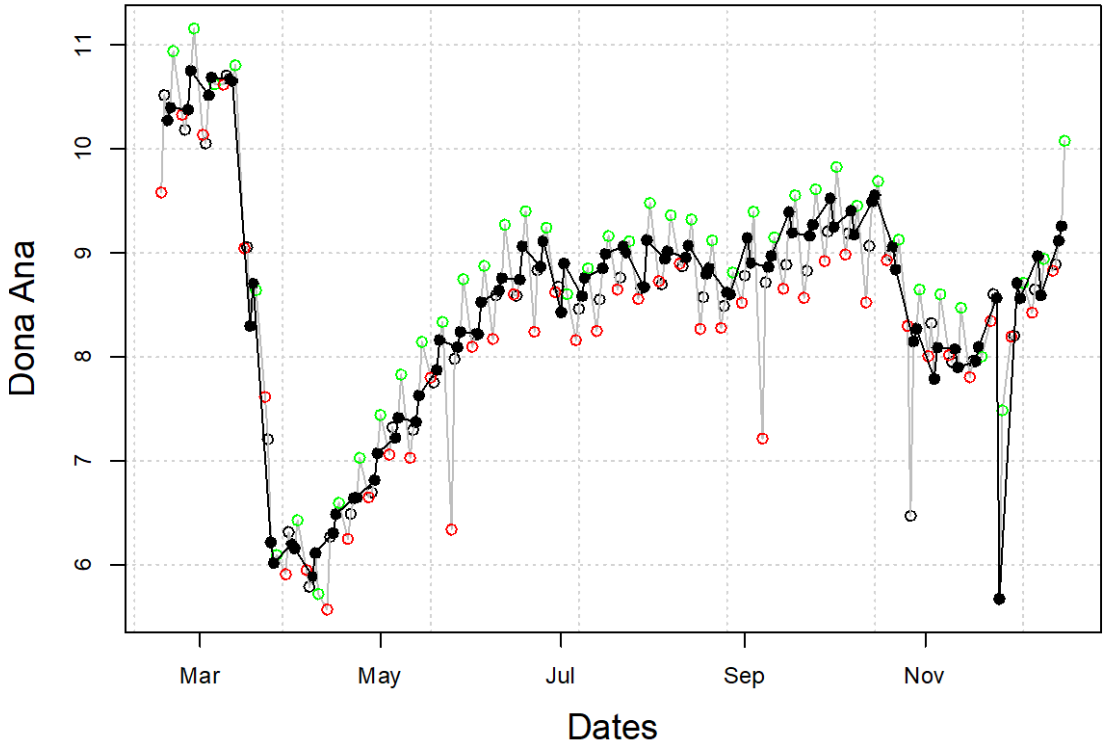


T-80 Mobility – southern counties (and Curry) (Data only)

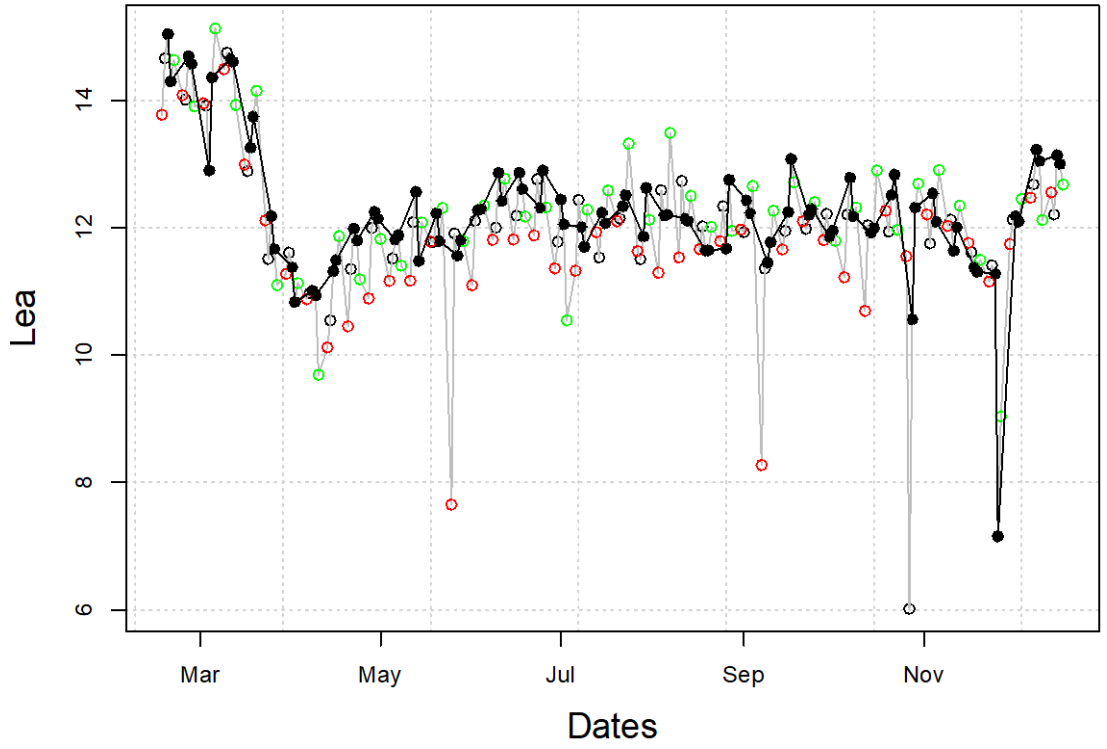
- Curry, Eddy, Grant, Lea, Luna stable
- Roosevelt, Socorro slightly increasing
- Chaves, Dona Ana, Lincoln have increasing mobility

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

Dona Ana



Lea



Fundamental Considerations for Vaccination Objectives. Effects Modeled.

1. EpiGrid reflects vaccination going forward.

- Analysis greatly aided by access to by-time and by-location data (county, or finer resolution).

2. Reduce the death rate. Time frame ~4 weeks to initial effects with Pfizer

- Early administration to high-risk populations and individuals at elevated risk of mortality (immediately after 1a).
  - Along with SNFs and residential living facilities, and people living with pre-existing conditions, some Pueblo and the Navajo Nation residents share some of these same underlying risks of congregation and mortality.
  - People living with ESRD, DMII, COPD, etc.
  - Over-65 years, *see recent TX directives for vaccination* after group 1a.
- *At risk populations are driving hospital load, and mortality.*
- High risk-for-mortality populations are *widely distributed* and preferential administration is unlikely to inhibit other objectives.

3. Lower the rate of spread. Connectivity-based, and geographically-based. Time frame ~3 weeks to see initial effects with Pfizer.

- The existence of geographical hot-spots (N.B. Top 10 Zip Code list) allows targeting of other demographic contributors to risk of transmission.
- Employment description is correlated with daily contact rate and associated demographic risk factors (i.e. income, etc.).
  - Targeting job that are *high-transmission* will automatically select for the most significant risk during stemming from high-contact work.
  - ”Front-line” vs. “essential”

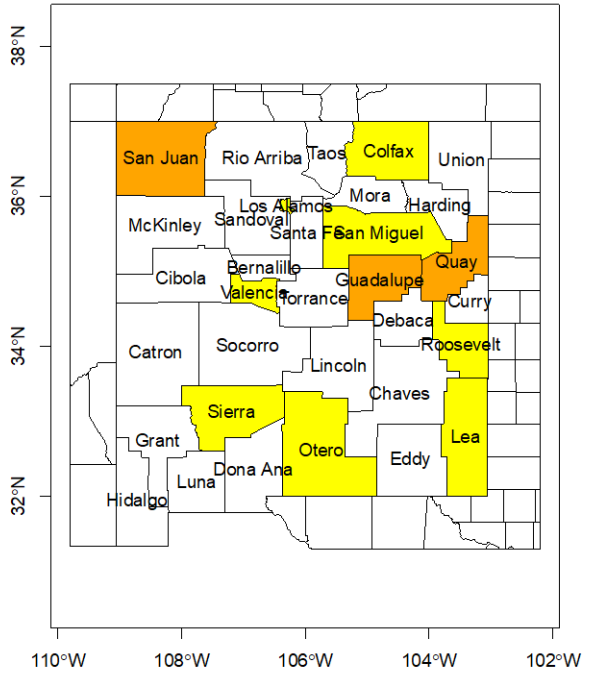
4. Achieve vaccine-mediated herd immunity. Time frame determined by integrated vaccine production and administration.

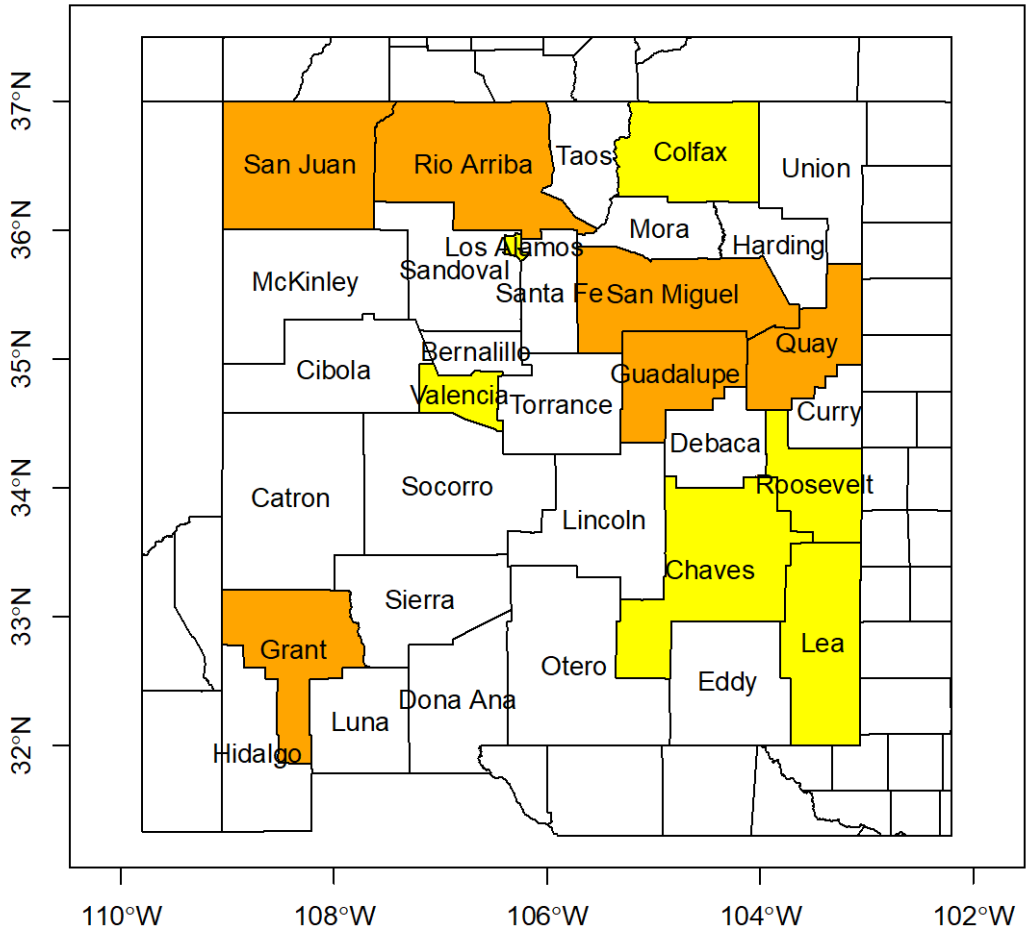
- Because vaccine-mediated herd immunity can go well beyond the extinction threshold, this creates an opportunity for the elimination of COVID.
- Recent events in the UK (N501Y & assoc. mutations) point out the extraordinary utility of elimination as distinct from epidemic control.

Situational Awareness:
Some counties may not be slowing down as fast as others

- Grant, Guadalupe, Quay, Rio Arriba, San Miguel, San Juan appear to not have decreasing daily case counts
- DeBaca , Colfax, Los Alamos, Socorro, Roosevelt, and Valencia may also be failing to see decreasing daily incidence.

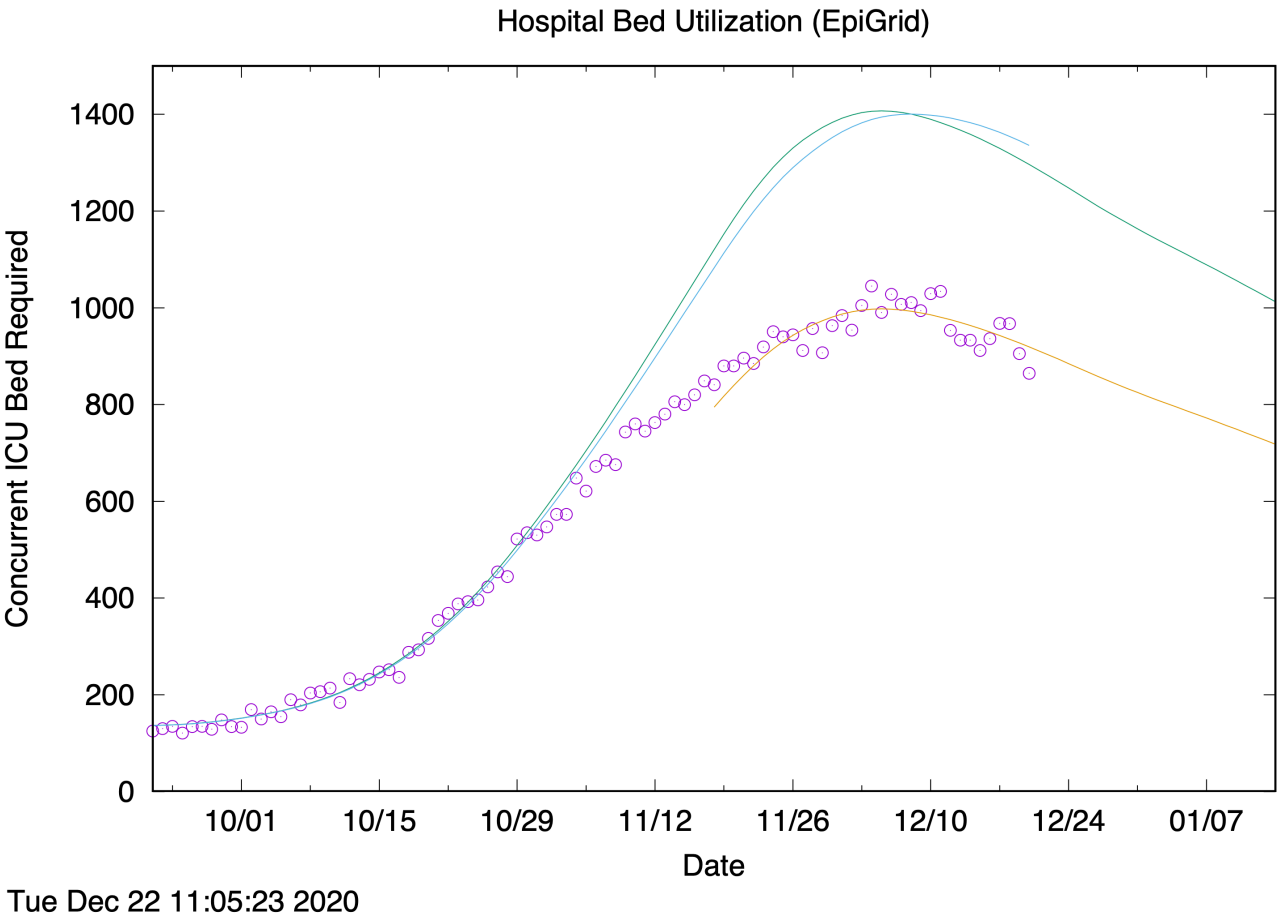
Last week

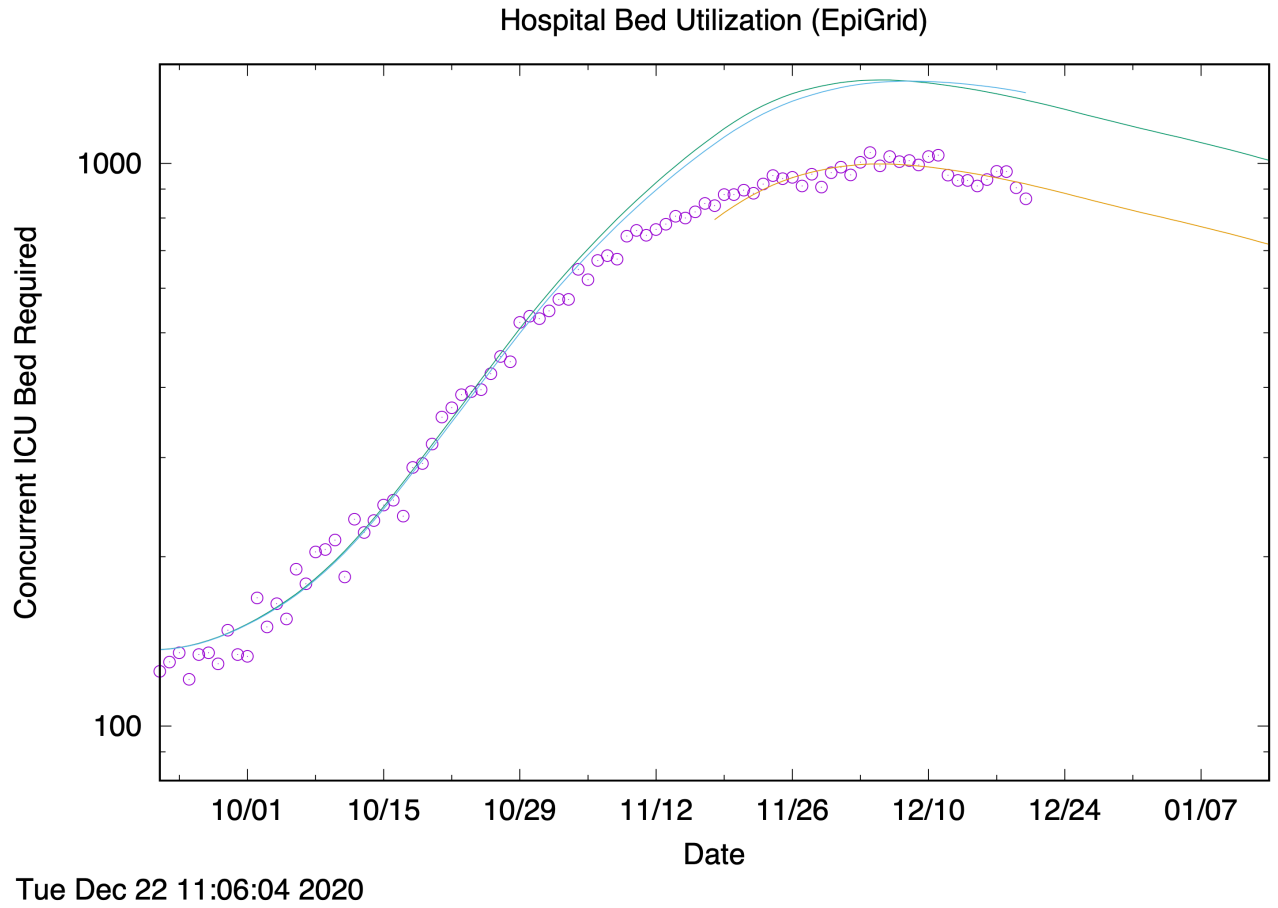




Hospital bed concurrent usage by COVID-19 patients

- Left panel: Linear vs. time shows hospital utilization and capacity. Current model and two week ago.
- Right panel: Log vs. time, same data and models.
- November 16th PHO and Thanksgiving are now parameterized, Christmas and New Year's replicate earlier behavior.
- Parameterized a hospital model going forward for the lower curve.

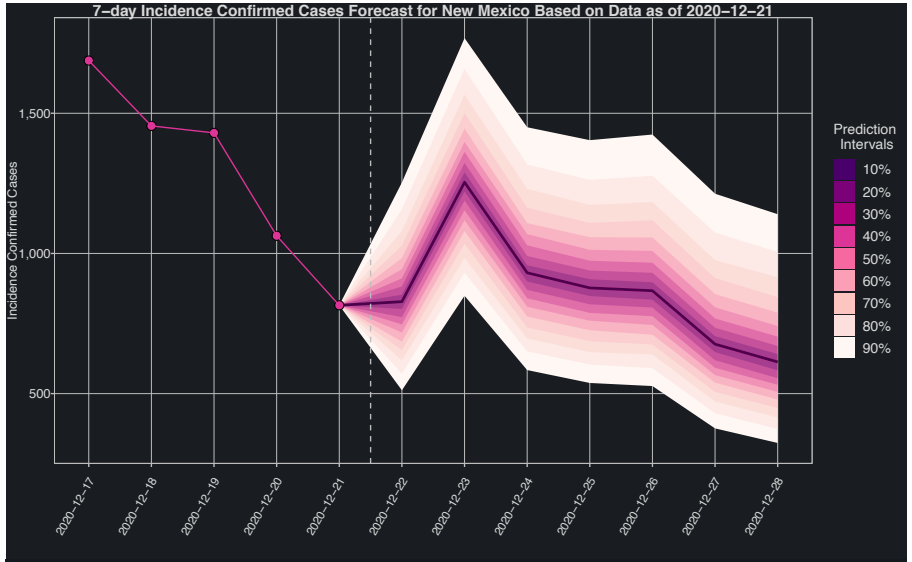




Conclusions and Discussion

- **New Mexico's epidemic spread is improving *very* slowly. Probably unstable to any significant perturbation.**
- **The New Mexico epidemic is geographically dispersed for the foreseeable future.**
- **Nationwide geographical dispersion requires that state-to-state travel plays an important role.**
- **Bernalillo's role driving ICU need/requirements might be less dominant in the near future.**
- **NM Test positivity remains well above 7%. >~10% recently.**
- **El Paso's daily incidence continues to decline.**
- **Vaccination will not alter these results the first week of January.**
- **Targeting vaccine to high-mortality areas and populations will have the largest immediate effect on this model.**
- **Changes in care continue to lower the hospital load.**
- **Discussion:**
  - Vaccinating high risk-of-mortality populations will lower the mortality rate *and* lower hospital loading.
  - Schools are highly mitigated, elementary school provides little evidence for in-school spread.
  - School staff as a boost to case investigation and tracing?
  - Indoor, un-masked activities are inherently risky (meals). How to mitigate? Airflow in addition to distance? For re-opening…
  - Qualitatively higher testing rates (i.e. 10x) can substantially offset local epidemics (i.e. South Korea) by facilitating tracing and quarantine.

Short- & Long-Term Forecast for NM: Cases



6–Week Forecast of Confirmed Cases for New Mexico Based on Data as of 2020–12–21

Week	Best Case (5th Percentile)	Middle Case (50th Percentile)^	Worst Case (95th Percentile)
2020–12–21		130,808*	
2020–12–28	134,562	136,891	140,291
2021–01–04	137,160	141,960	150,195
2021–01–11	139,225	147,198	161,598
2021–01–18	141,202	153,331	173,641
2021–01–25	143,848	160,515	187,093
2021–02–01	147,444	168,458	202,200

*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 2020–12–21

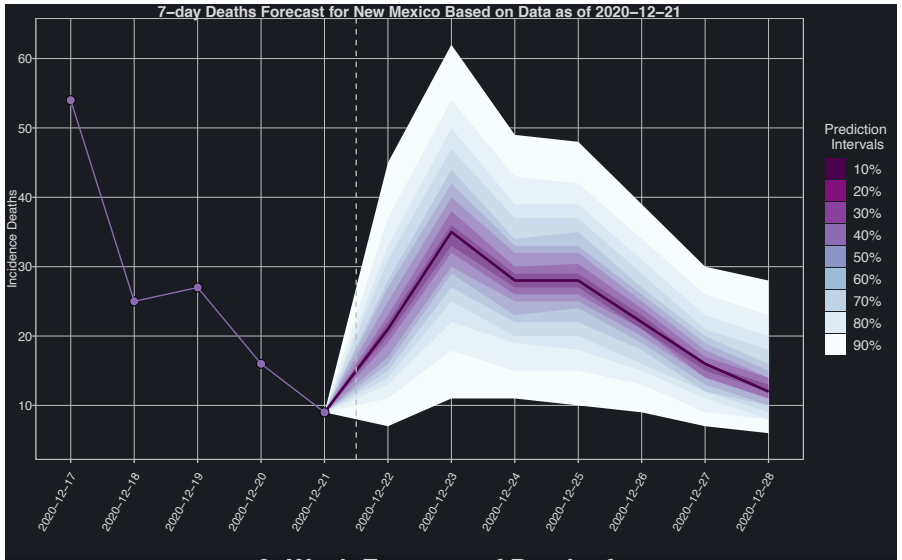
Week	Best Case (5th Percentile)	Middle Case (50th Percentile)^	Worst Case (95th Percentile)
2020–12–21		1,358*	
2020–12–28	536	869	1,355
2021–01–04	371	724	1,415
2021–01–11	295	748	1,629
2021–01–18	282	876	1,720
2021–01–25	378	1,026	1,922
2021–02–01	514	1,135	2,158

*Last reported confirmed cases count
^Closest–matching scenario

So what?

The daily number of cases are expected to range between 371 and 1,415 in the next two weeks

Short- & Long-Term Forecast for NM: Deaths



6–Week Forecast of Deaths for New Mexico Based on Data as of 2020–12–21

Week	Best Case (5th Percentile)	Middle Case (50th Percentile)^	Worst Case (95th Percentile)
2020–12–21		2,180*	
2020–12–28	2,253	2,348	2,442
2021–01–04	2,309	2,487	2,664
2021–01–11	2,357	2,601	2,878
2021–01–18	2,398	2,701	3,118
2021–01–25	2,437	2,802	3,415
2021–02–01	2,482	2,912	3,819

*Last reported deaths count
^Closest–matching scenario

6–Week Forecast of Daily Average of Deaths for New Mexico Based on Data as of 2020–12–21

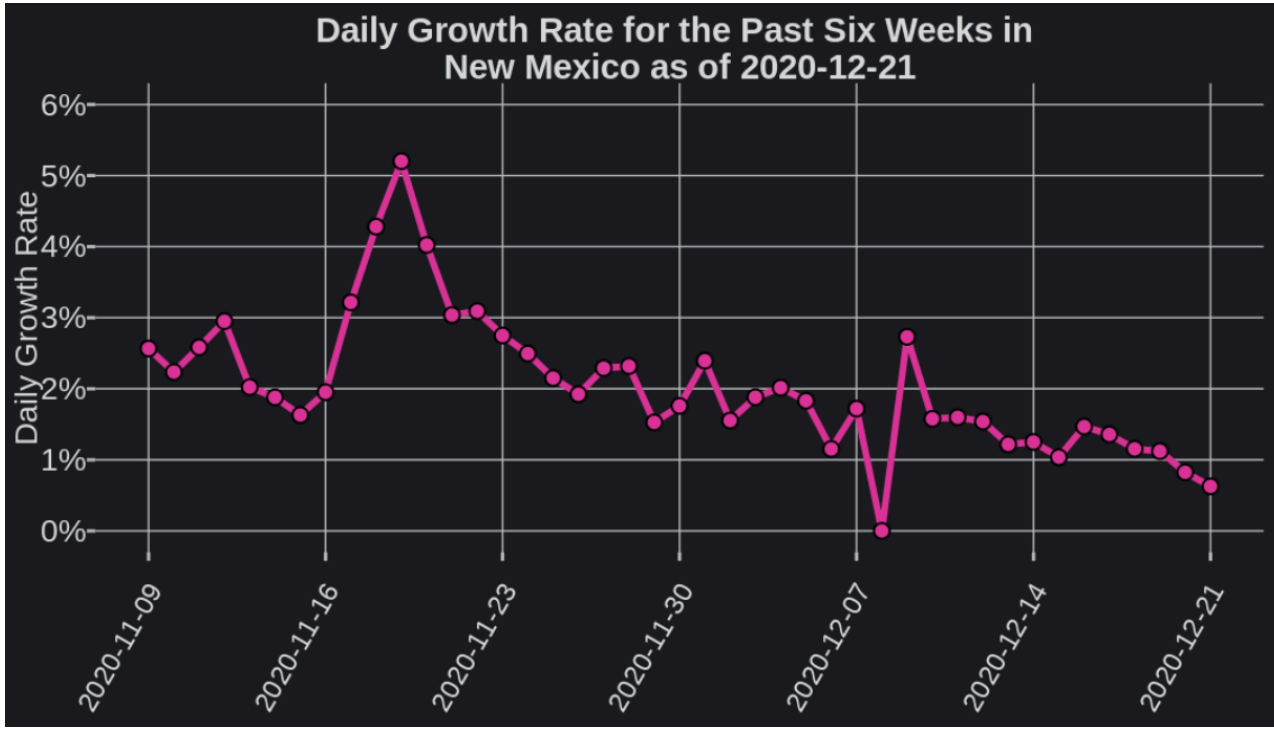
Week	Best Case (5th Percentile)	Middle Case (50th Percentile)^	Worst Case (95th Percentile)
2020–12–21		29*	
2020–12–28	10	24	37
2021–01–04	8	20	32
2021–01–11	7	16	31
2021–01–18	6	14	34
2021–01–25	6	14	42
2021–02–01	6	16	58

*Last reported confirmed deaths
^Closest–matching scenario

So what?

The daily number of deaths are expected to range between 8 and 37 in the next two weeks

Growth Rate for NM



6-Week Forecast of the Average Weekly Growth Rate for New Mexico Based on Data as of 2020-12-21

Week	Best Case (5th Percentile)	Middle Case (50th Percentile)^	Worst Case (95th Percentile)
2020-12-21		1.1%*	
2020-12-28	0.41%	0.65%	1.0%
2021-01-04	0.27%	0.52%	0.98%
2021-01-11	0.21%	0.52%	1.1%
2021-01-18	0.20%	0.58%	1.0%
2021-01-25	0.27%	0.66%	1.1%
2021-02-01	0.35%	0.69%	1.1%

*Last weekly mean daily growth rate

^Closest-matching scenario

So what?

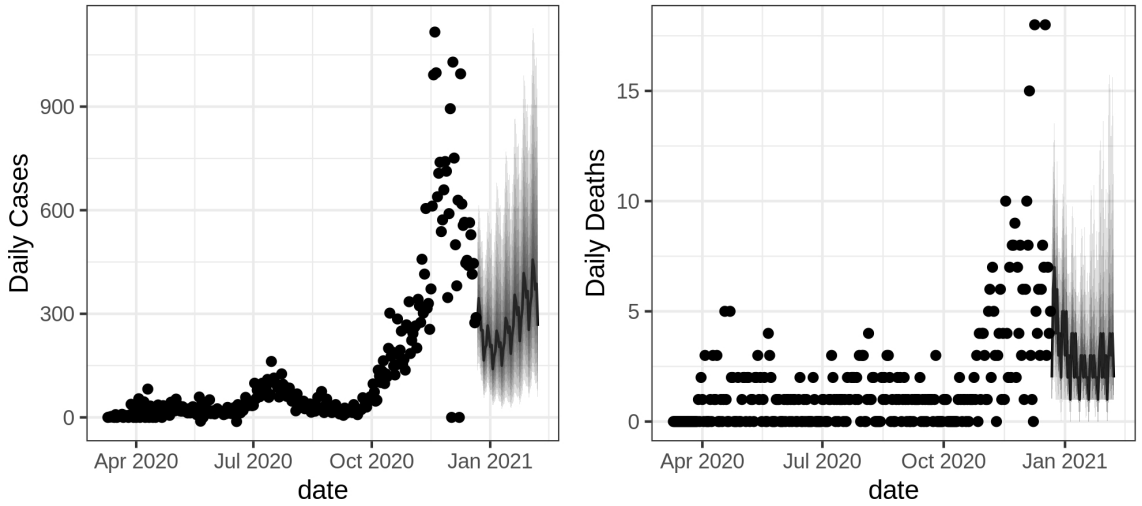
As of November 22nd, the average growth rate over the past week in NM is at 1.1% (down from 1.4%)

Deaths have been increasing by an average of 1.4% per day over the past week (down from 1.7%)

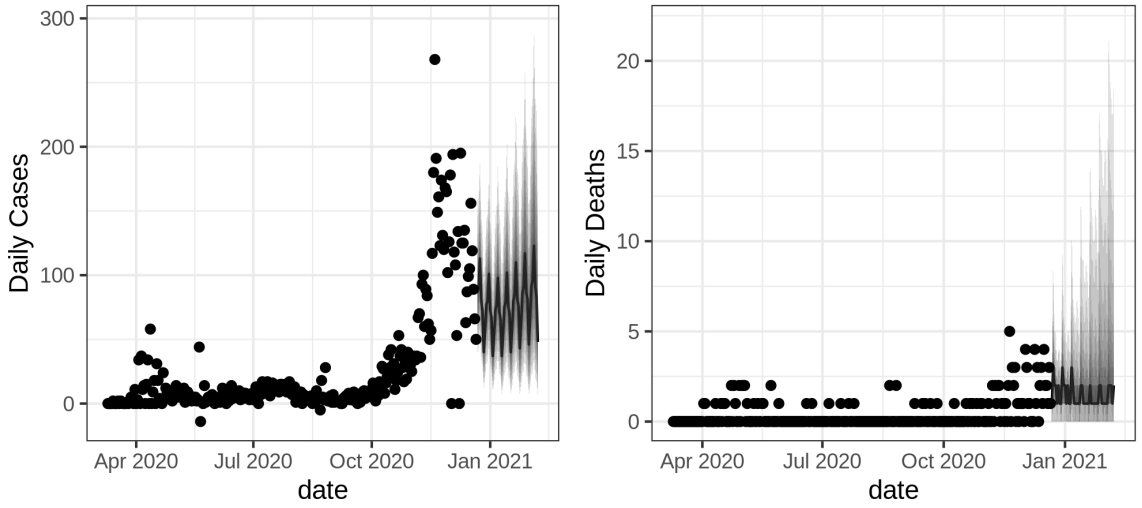
> Regional Forecasts, Growth Rates, & Hospitalizations

Central Region Forecasts

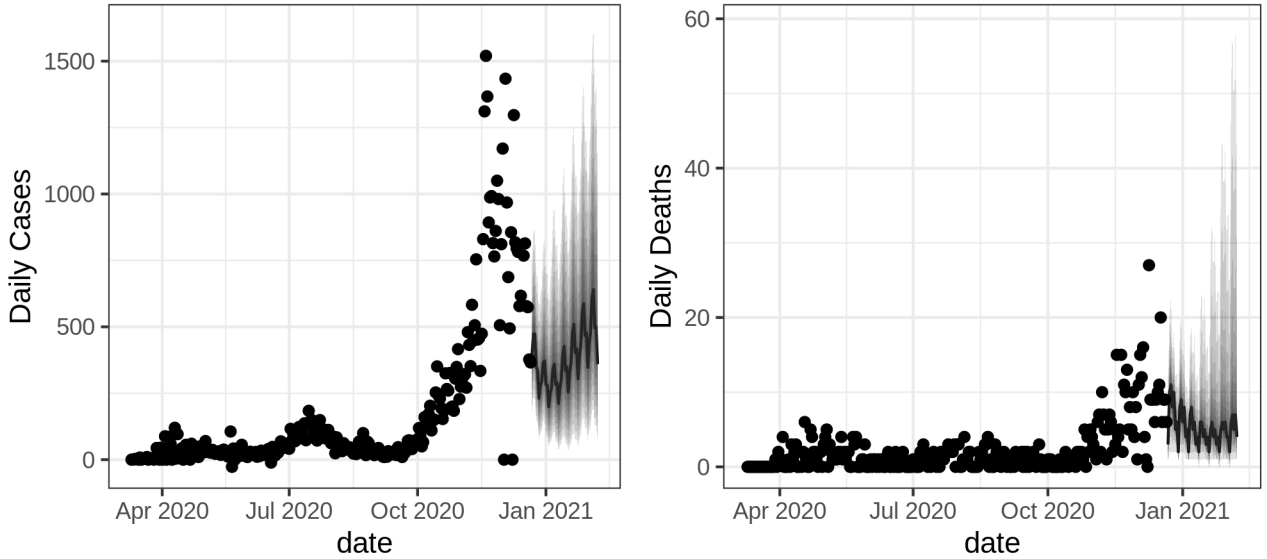
New Mexico - Bernalillo



New Mexico - Sandoval



Health Region - NM Central Region

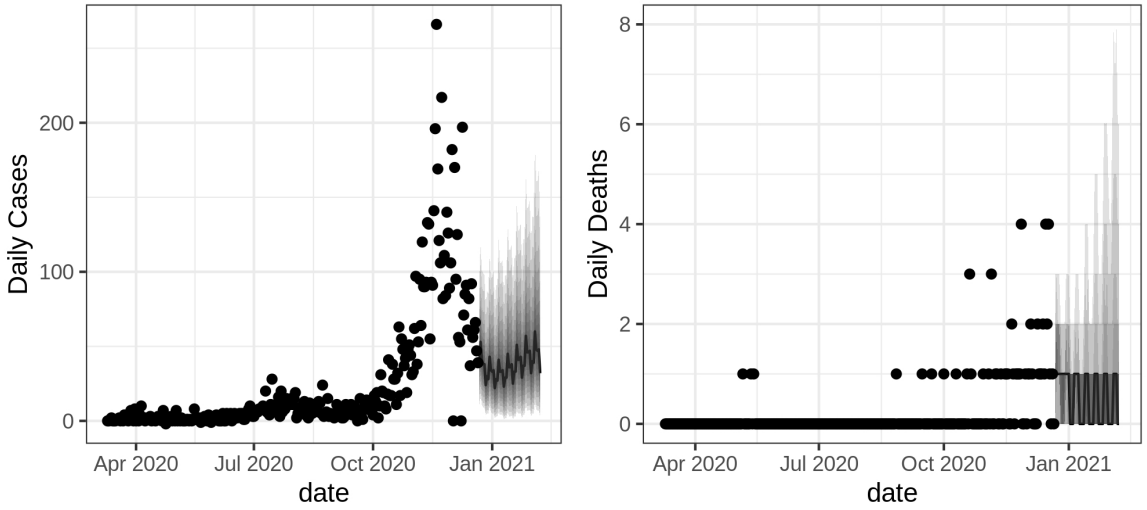


So what?

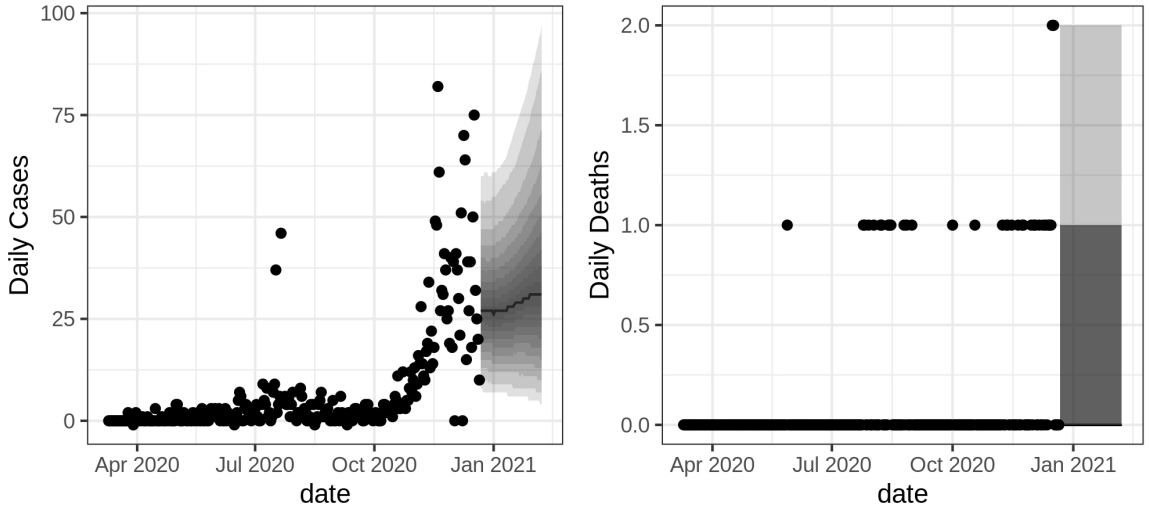
The average number of daily cases for the Central Region is expected to be around 300 next week

Northeast Region Forecasts

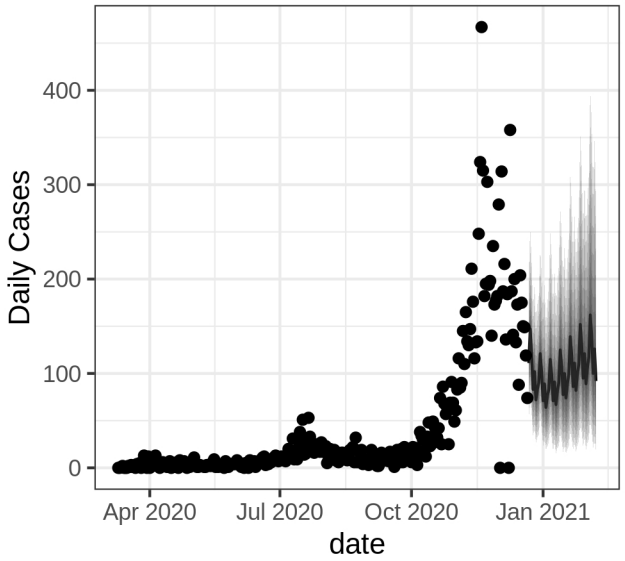
New Mexico - Santa Fe

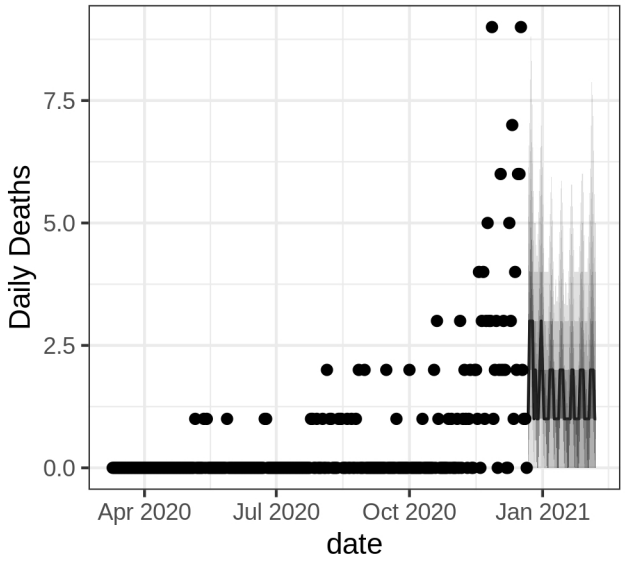


New Mexico - Rio Arriba



Health Region - NM Northeast Region



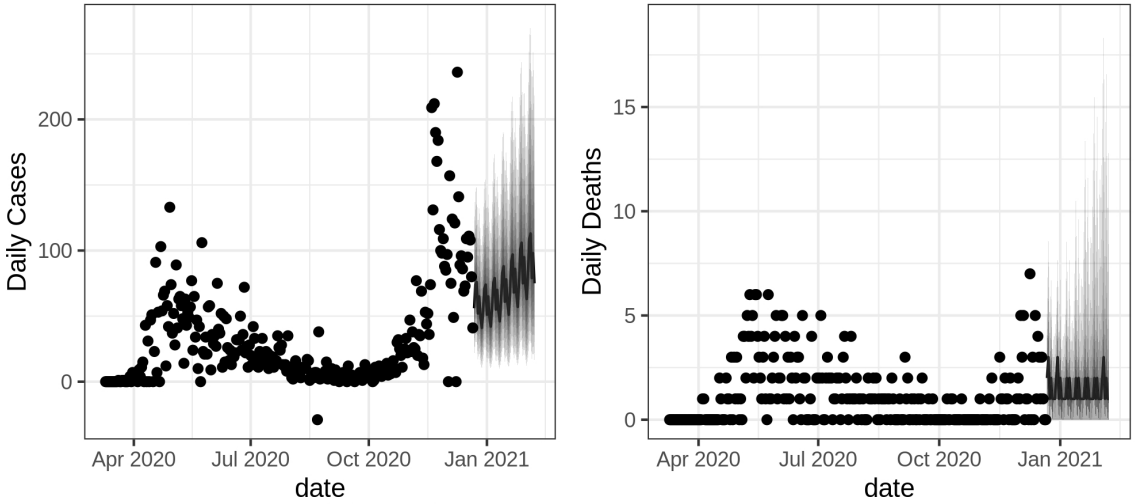


So what?

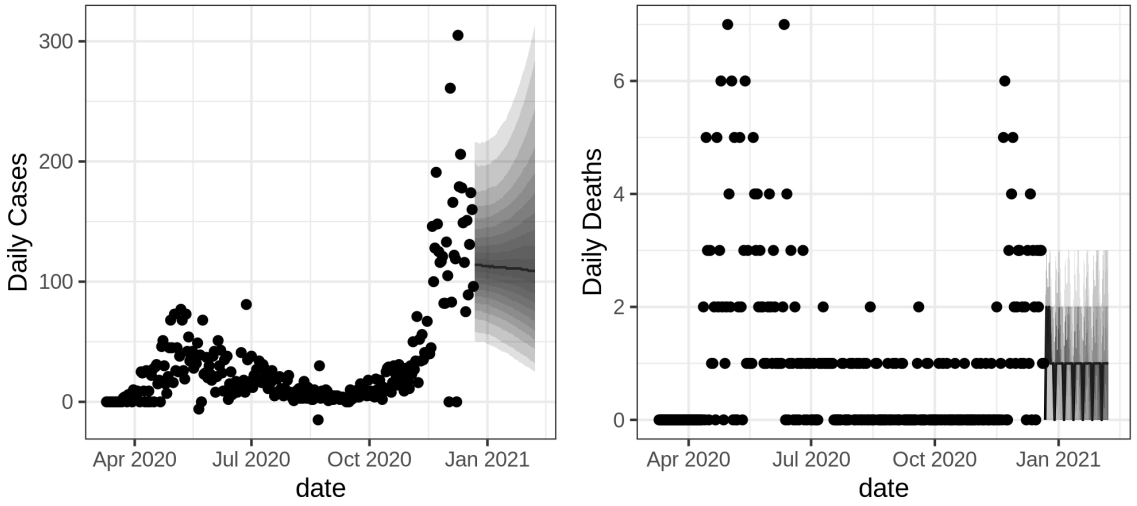
The average number of daily cases for the Northeast Region is expected to be around 90 next week

Northwest Region Forecasts

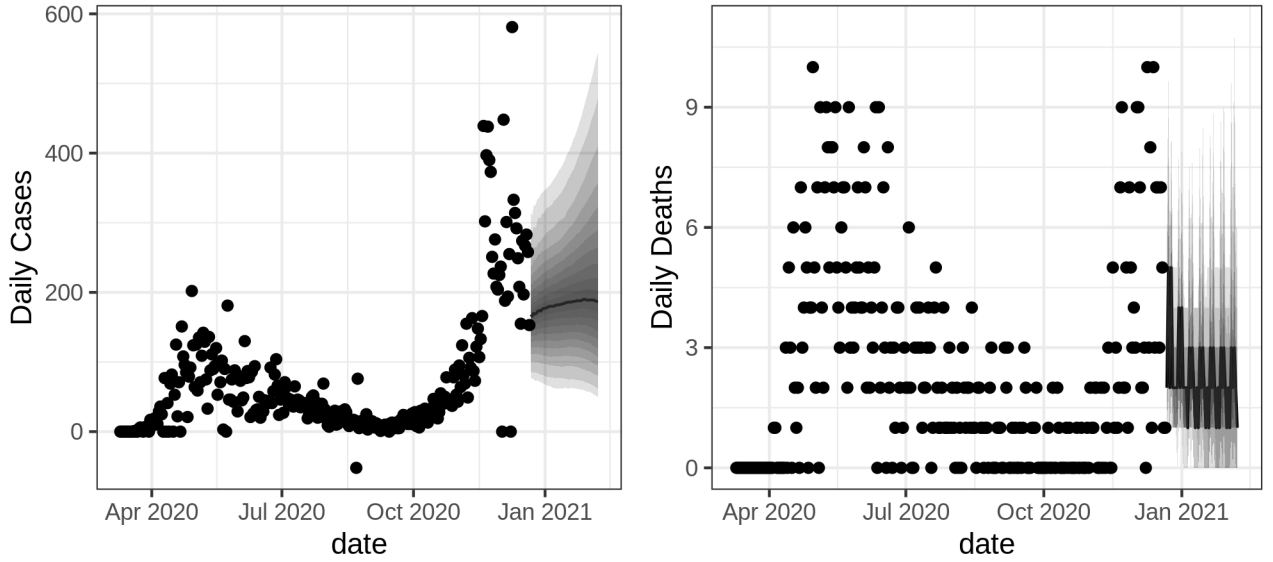
New Mexico - McKinley



New Mexico - San Juan



Health Region - NM Northwest Region

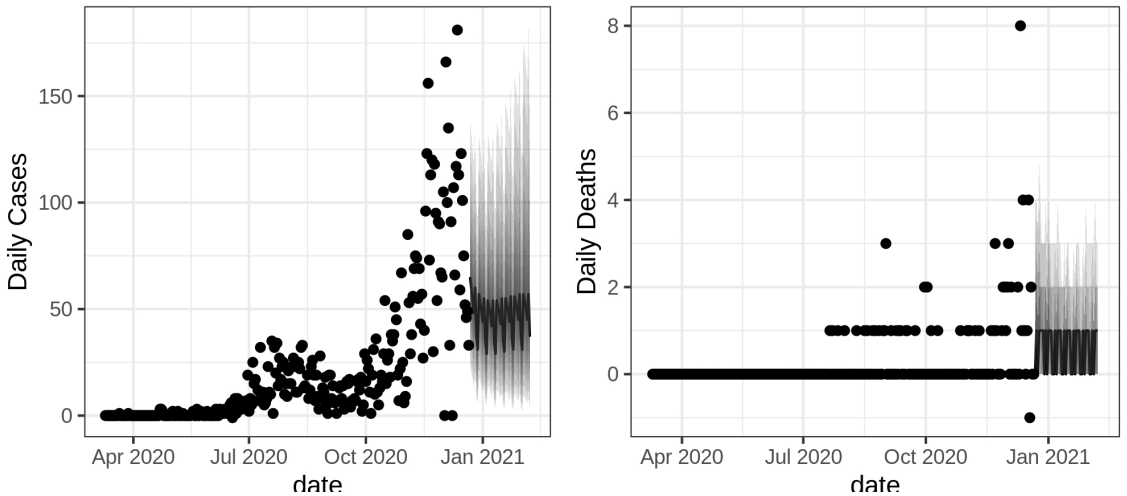


So what?

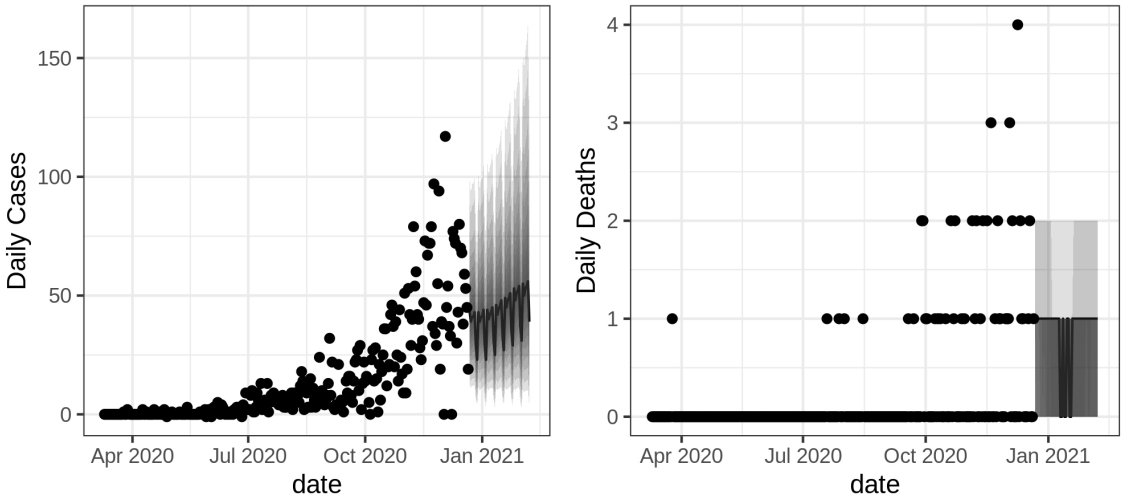
The average number of daily cases for the Northwest Region is expected to be around 170 next week

Southeast Region Forecasts

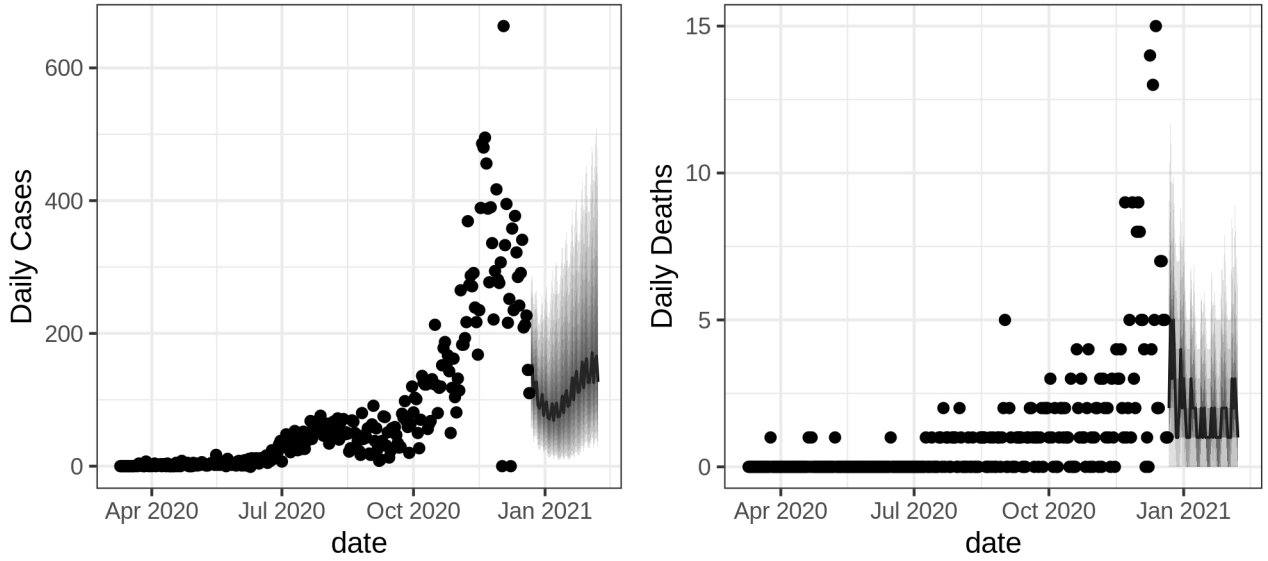
New Mexico - Lea



New Mexico - Eddy



Health Region - NM Southeast Region

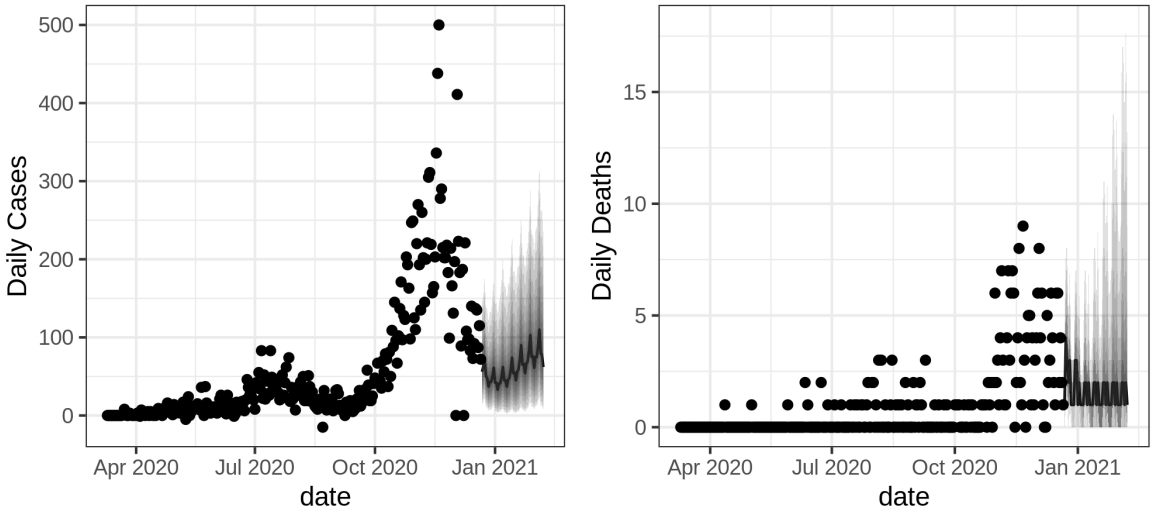


So what?

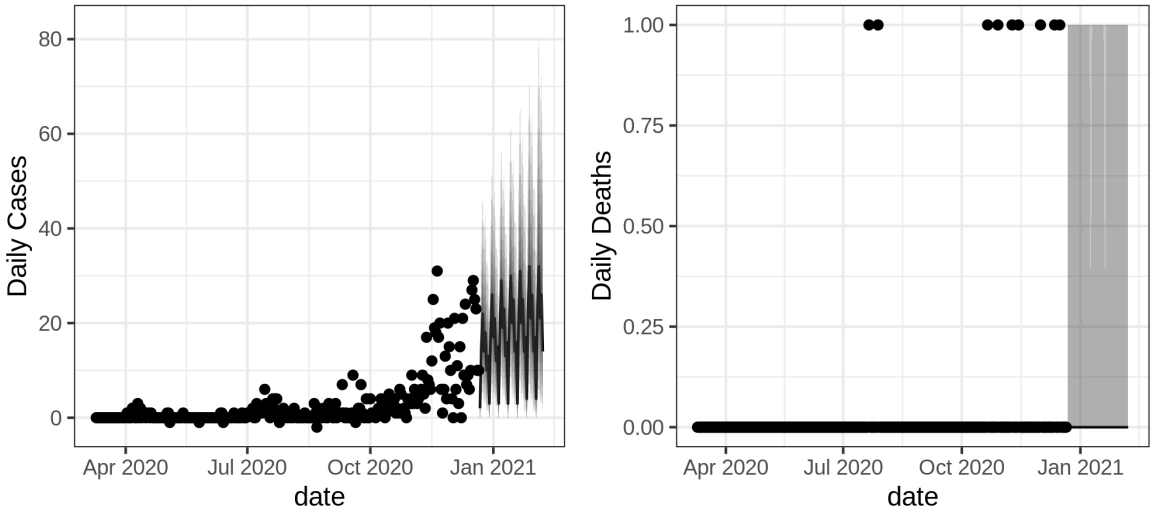
The average number of daily cases for the Southeast Region is expected to be around 90 next week

Southwest Region Forecasts

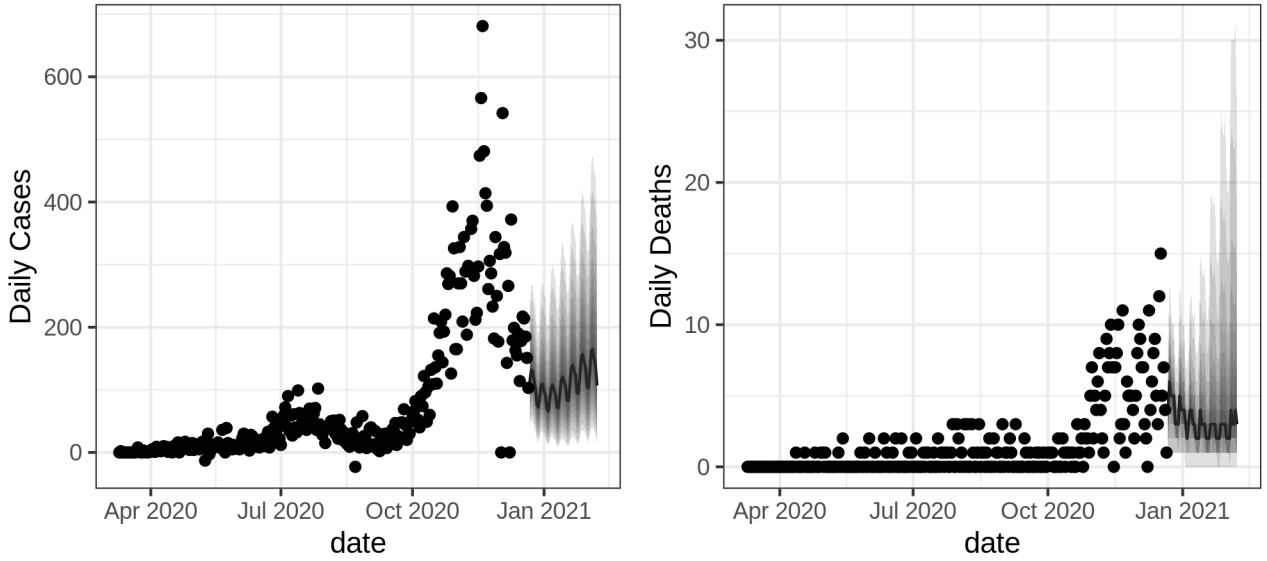
New Mexico - Dona Ana



New Mexico - Grant



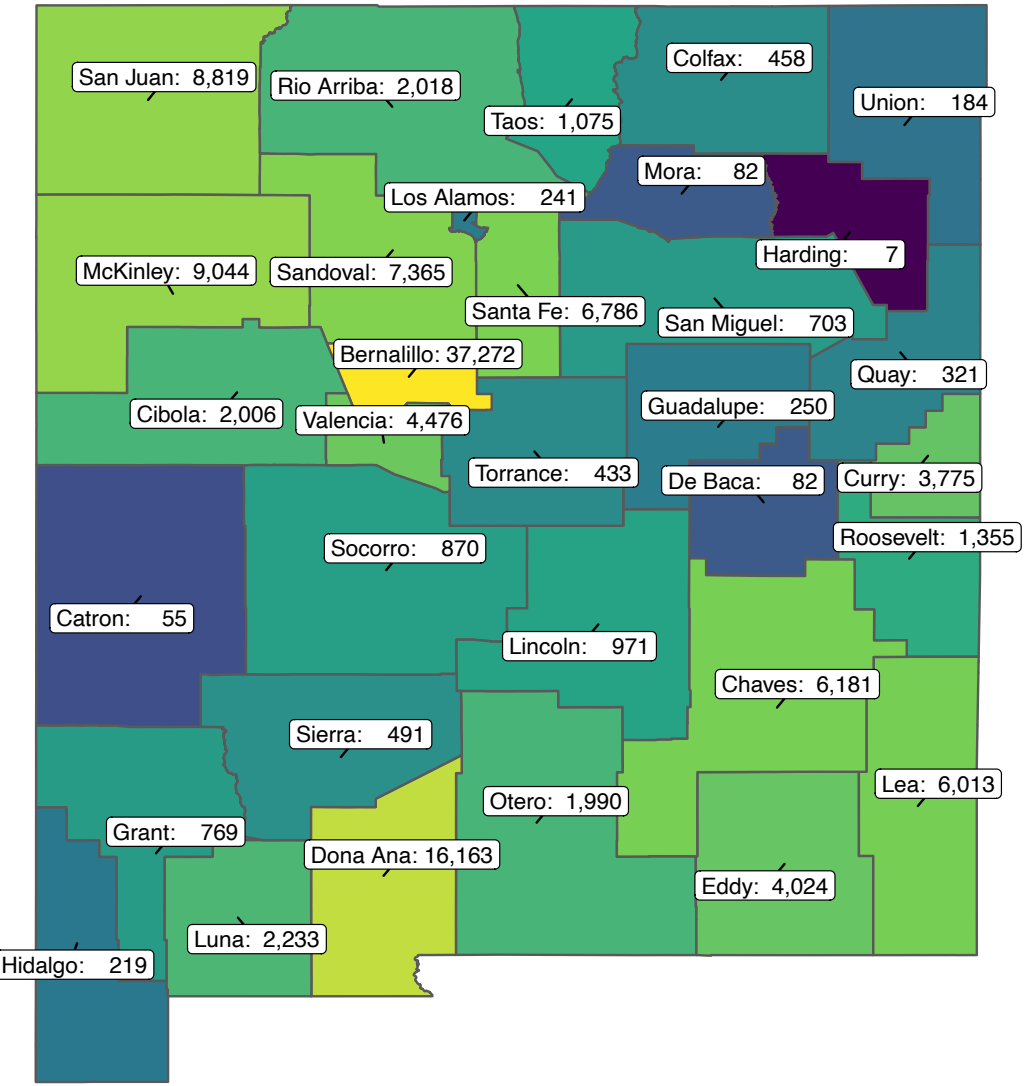
Health Region - NM Southwest Region



So what?

The average number of daily cases for the Southwest Region is expected to be around 90 next week

Cumulative Cases & Daily Growth Rate for NM: Dec 21

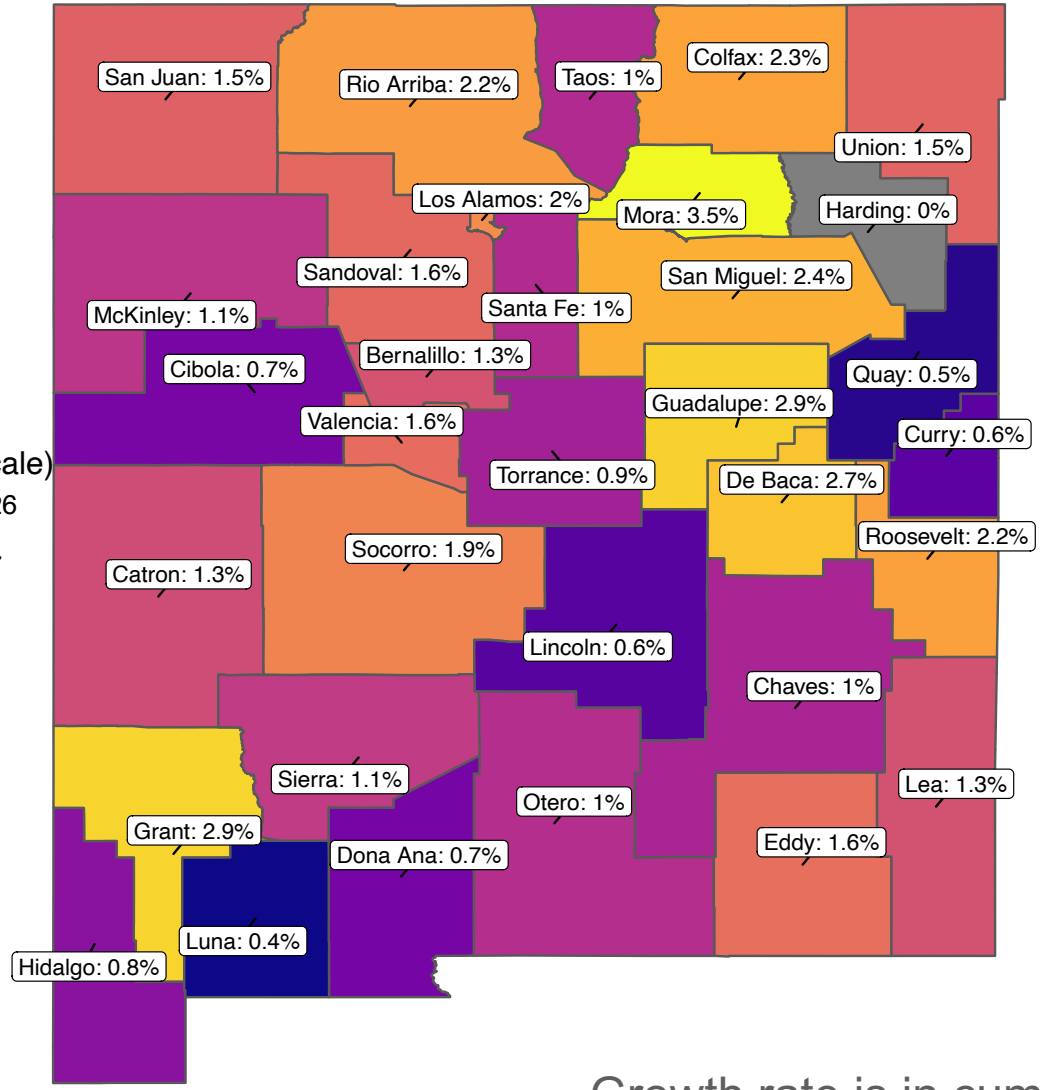


Cases (Log Scale)

22,026

1,097

55



7–day–average daily growth rate (%)

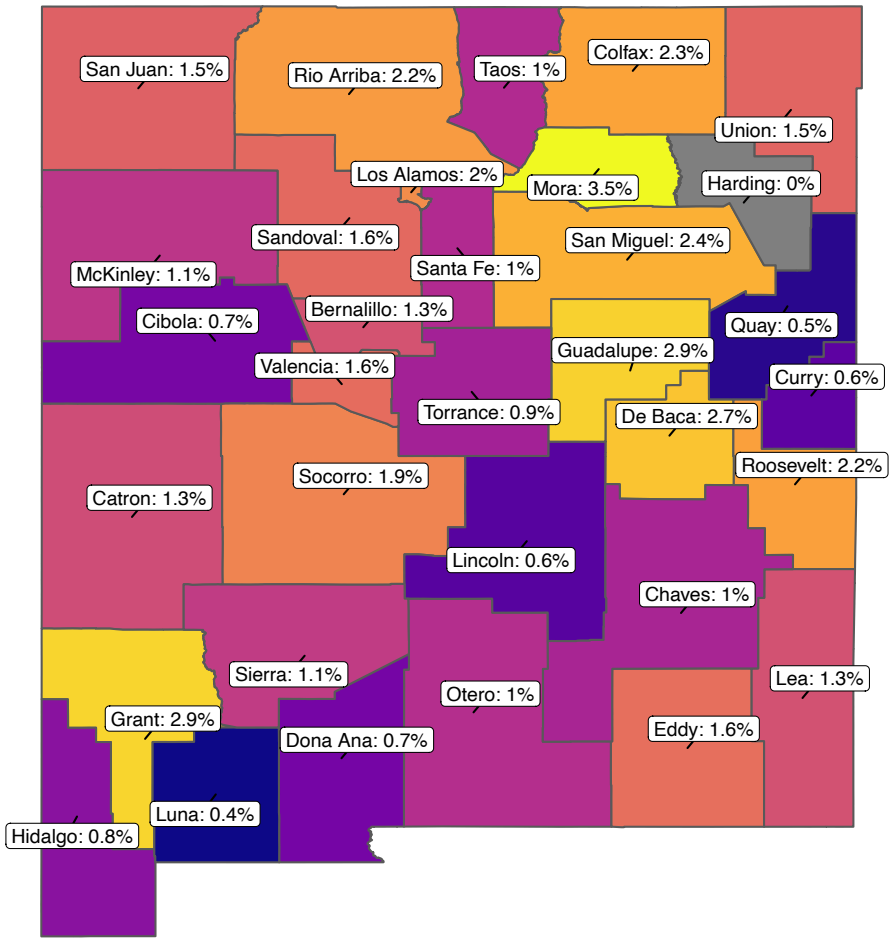
2.0

1.0

0.5

Growth rate is in cumulative cases

Daily Growth Rate for NM Dec 21



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

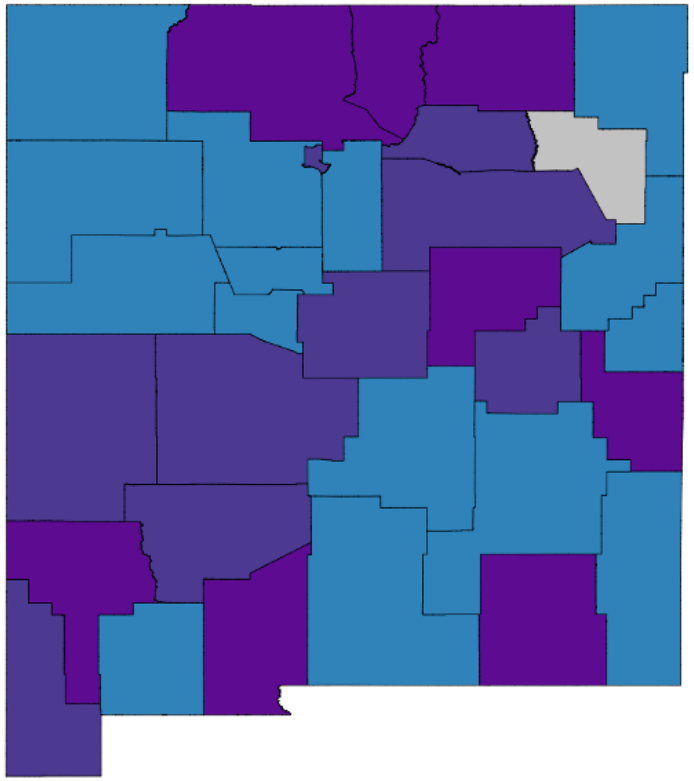
Socorro* **1.9%** =
Quay 0.5% ↓
Los Alamos **2.0%** ↓
Mora **3.5%** =
Catron* **1.3%** =
Union **1.5%** ↓
Hidalgo **0.8%** ↓
Colfax **2.3%** ↓

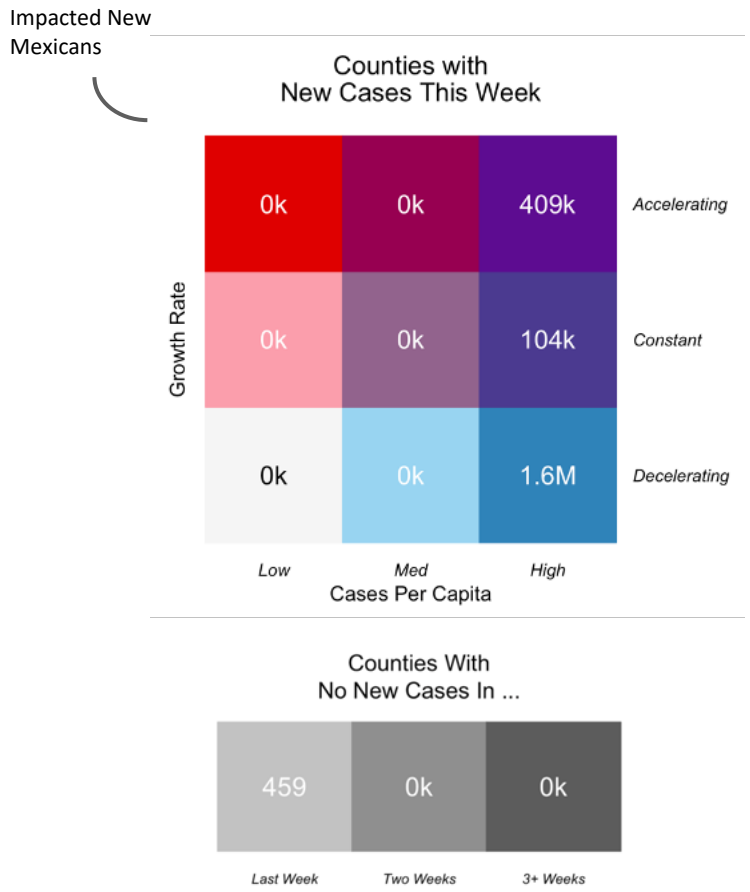
Roosevelt **2.2%** ↑
DeBaca **2.7%** ↑

County	Daily Growth Rate	Change
San Juan	**1.5%**	↓
Rio Arriba	**2.2%**	=
Sierra	**1.1%**	=
McKinley	**1.1%**	=
Sandoval	**1.6%**	=
Santa Fe	**1.0%**	=
Cibola	0.7%	=
Bernalillo	**1.3%**	↓
Valencia	**1.6%**	=
Torrance	0.9%	=
Lincoln	0.6%	=
San Miguel	**2.4%**	=
Chaves	**1.0%**	=
Dona Ana	0.7%	=
Otero	**1.0%**	↓
Lea	**1.3%**	↓
Eddy*	**1.6%**	=
Curry	0.6%	=
Grant	**2.9%**	↑
Luna	0.4%	=
Taos	**1.0%**	=

Weekly Growth Rate for NM: Another View (Dec 21)

COVID-19 across New Mexico
A 7-day moving window comparison
December 21, 2020





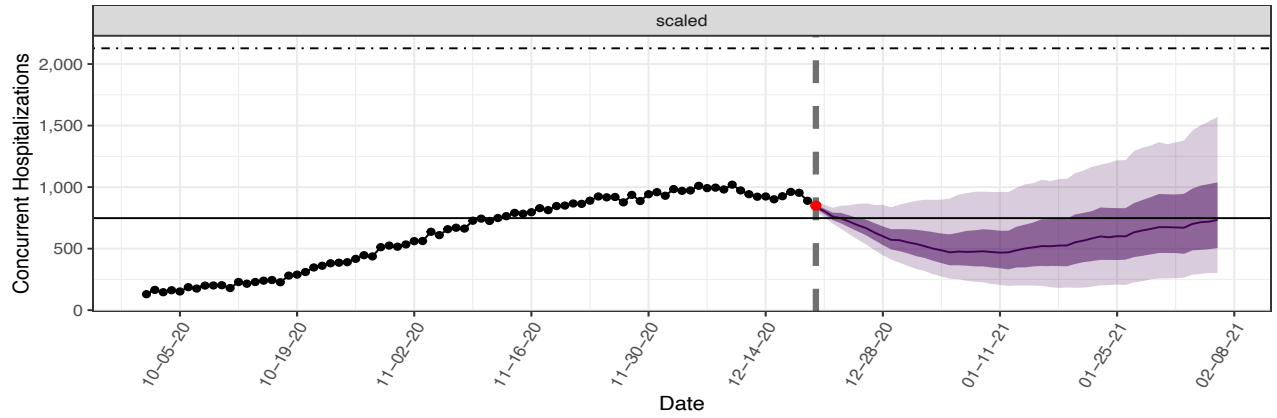
So what?

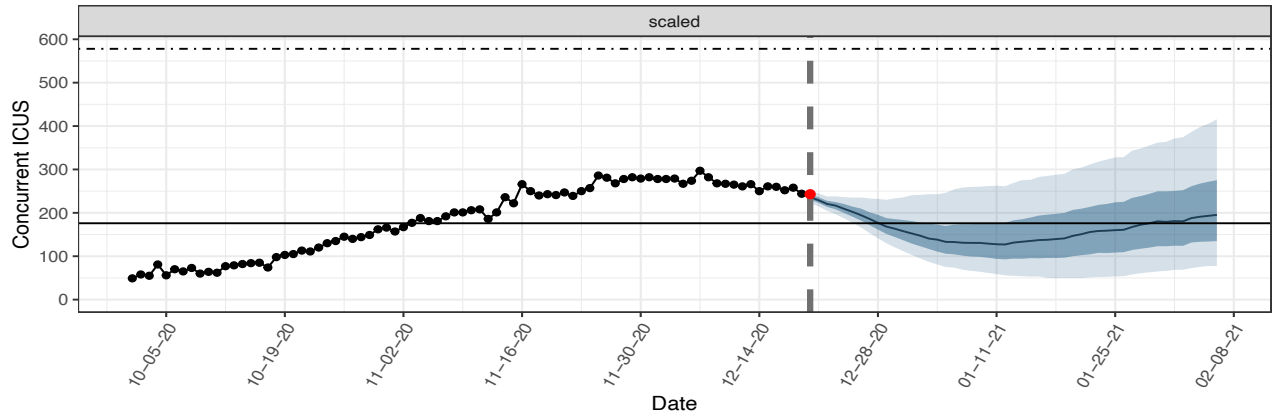
- Most people in New Mexico are living in a county that is decelerating but still high per capita case counts
- 8 counties are accelerating: Rio Arriba, Taos, Colfax, Eddy, Guadalupe, Roosevelt, Dona Ana, Grant
- Counties with >500 weekly cases per 100k: Colfax, Eddy, Guadalupe, Lea, McKinley, Rio Arriba, Roosevelt, San Juan, Union, Valencia

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

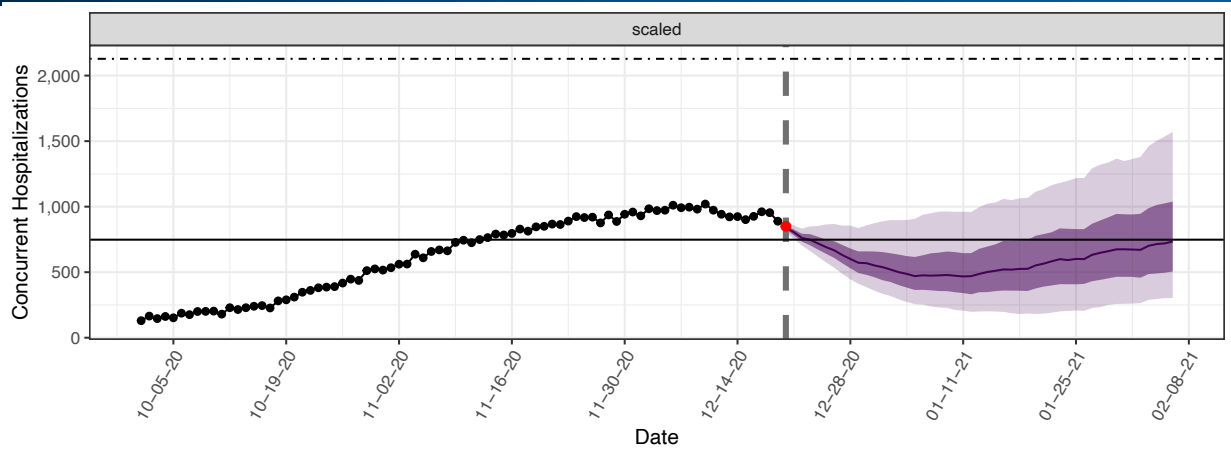
Week	Qu. 5% (best case)	Qu. 50% (median)	Qu. 95% (worst case)
12/27	154	186	233
1/3	87	141	243
1/10	62	129	262
1/17	50	138	285
1/24	53	159	323
1/31	66	179	363

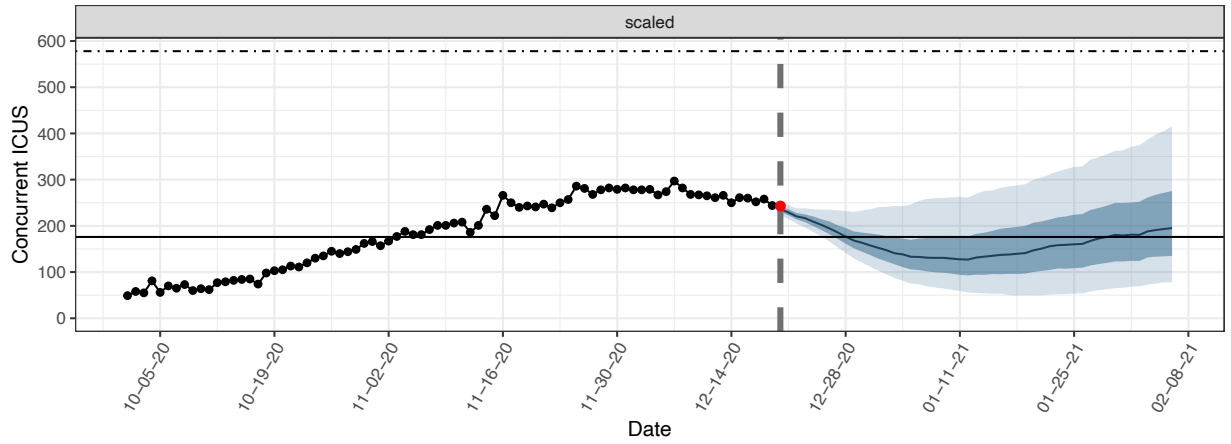
"Scaled" Scenario

So what?

We are over baseline ICU bed capacity for concurrent COVID-19 patients; our model is tracking with the median this week. Model is predicting a gradual decline over the next 3 weeks (129 concurrent COVID-19 ICU beds by January 10)

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

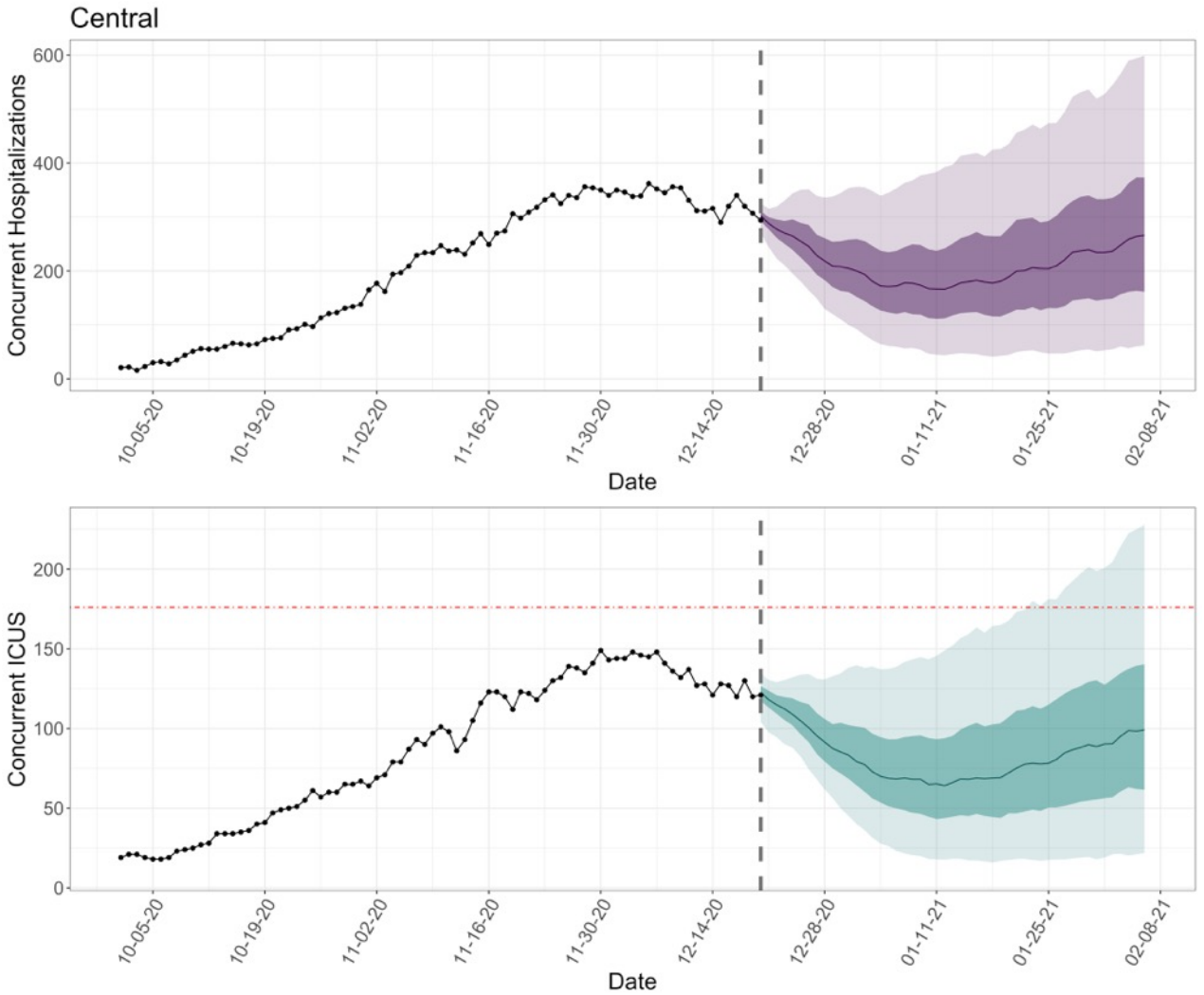
Week	Qu. 5% (best case)	Qu. 50% (median)	Qu. 95% (worst case)
12/27	334	445	622
1/3	205	359	653
1/10	150	344	699
1/17	138	382	765
1/24	151	434	875
1/31	193	495	985

"Scaled" Scenario

So what?

Med-surge general bed needs are tracking with the median case scenario this week; med-surge beds predicted to gradually decline, needing 344-699 beds by January 10

Regional Hospitalization Forecasts: Central



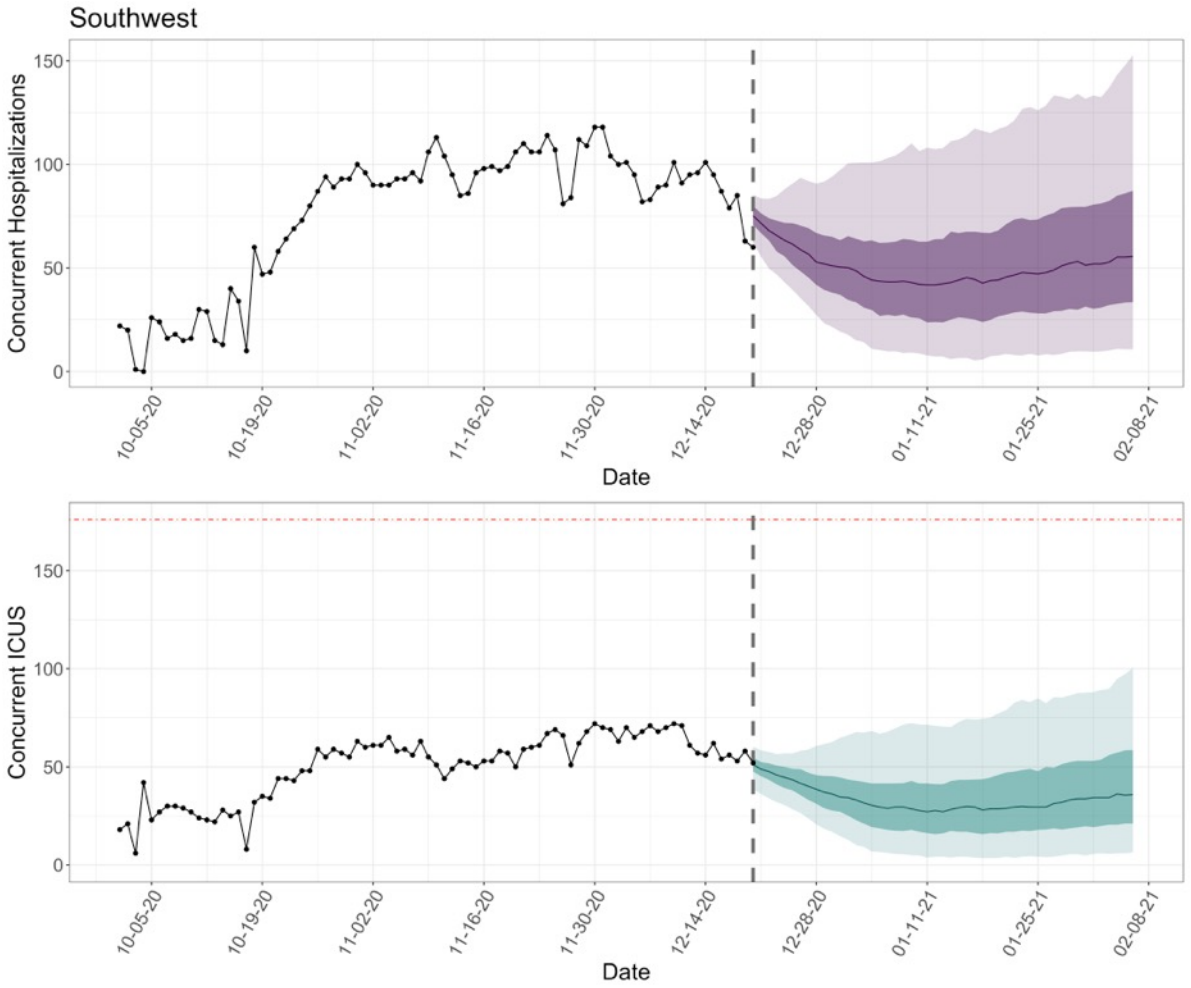
Concurrent COVID-19 ICUs beds: Central

Week	Qu. 5% (best case)	Qu. 50% (median)	Qu. 95% (worst case)
12/27	68	96	131
1/3	31	73	139
1/10	18	65	143
1/17	17	69	160
1/24	17	78	177
1/31	18	89	199

So what?

ICU bed usage is expected to gradually decline in the Central region; tracking with median

Regional Hospitalization Forecasts: Southwest



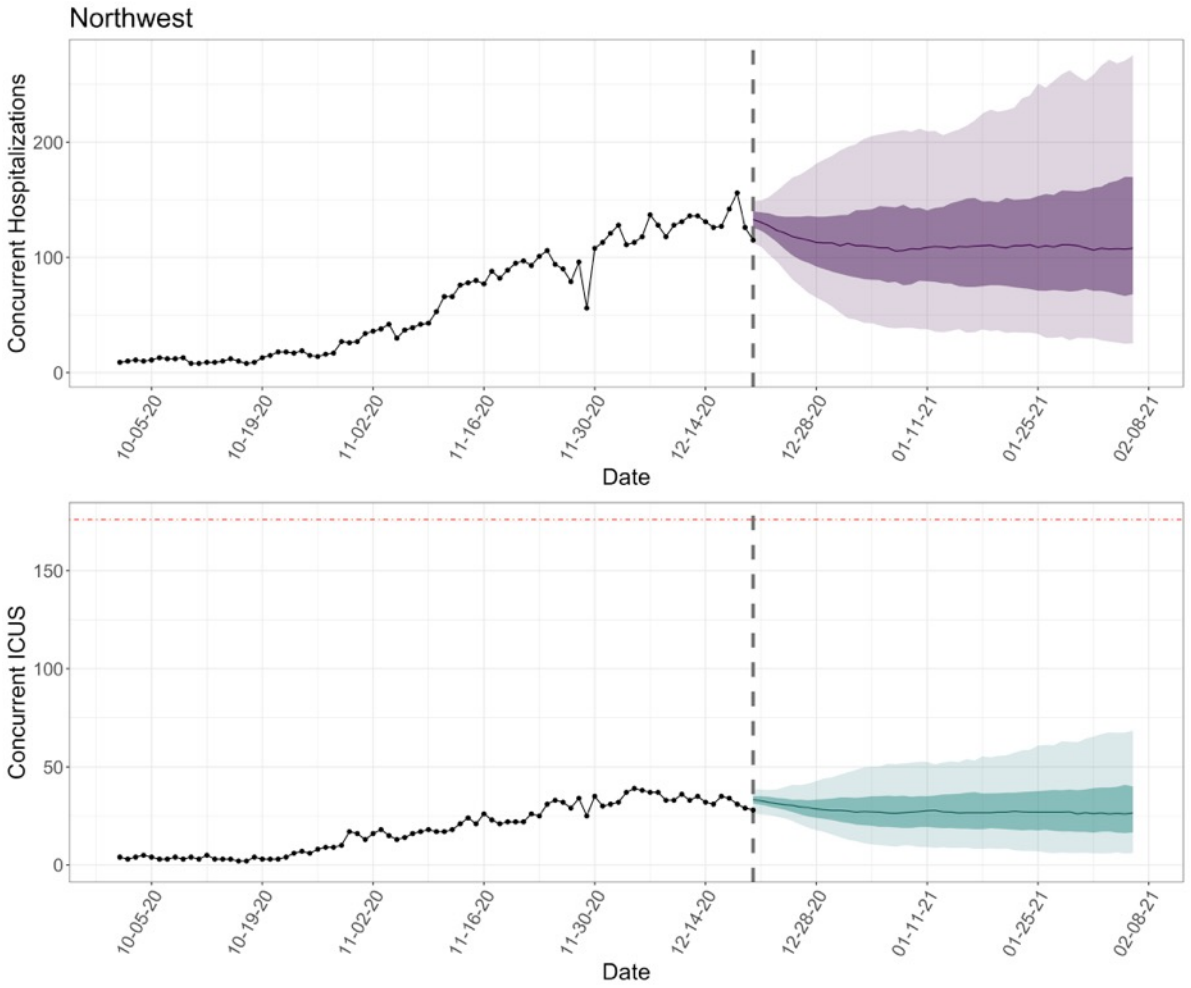
Concurrent COVID-19 ICUs beds: Southwest

Week	Qu. 5% (best case)	Qu. 50% (median)	Qu. 95% (worst case)
12/27	24	40	59
1/3	9	32	67
1/10	5	28	72
1/17	4	30	74
1/24	4	30	83
1/31	5	34	88

So what?

ICU bed usage is expected to <u>decrease</u> slowly in the Southwest region. Estimates are tracking

Regional Hospitalization Forecasts: Northwest



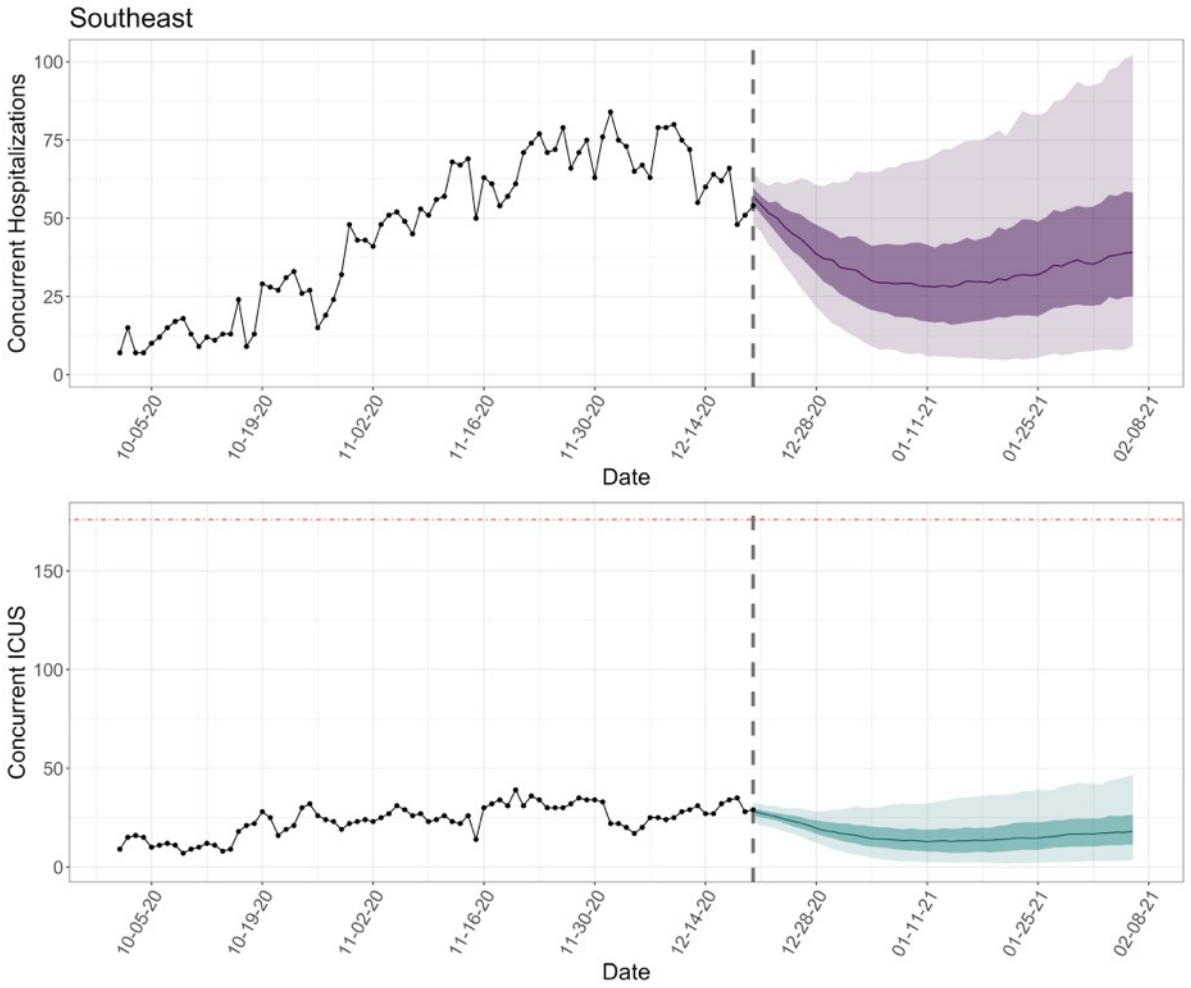
Concurrent COVID-19 ICUs beds: Northwest

Week	Qu. 5% (best case)	Qu. 50% (median)	Qu. 95% (worst case)
12/27	19	29	41
1/3	11	27	50
1/10	9	27	53
1/17	8	27	53
1/24	7	27	59
1/31	6	27	64

So what?

ICU bed usage is expected to slowly decrease or remain steady in the Northwest region;

Regional Hospitalization Forecasts: Southeast



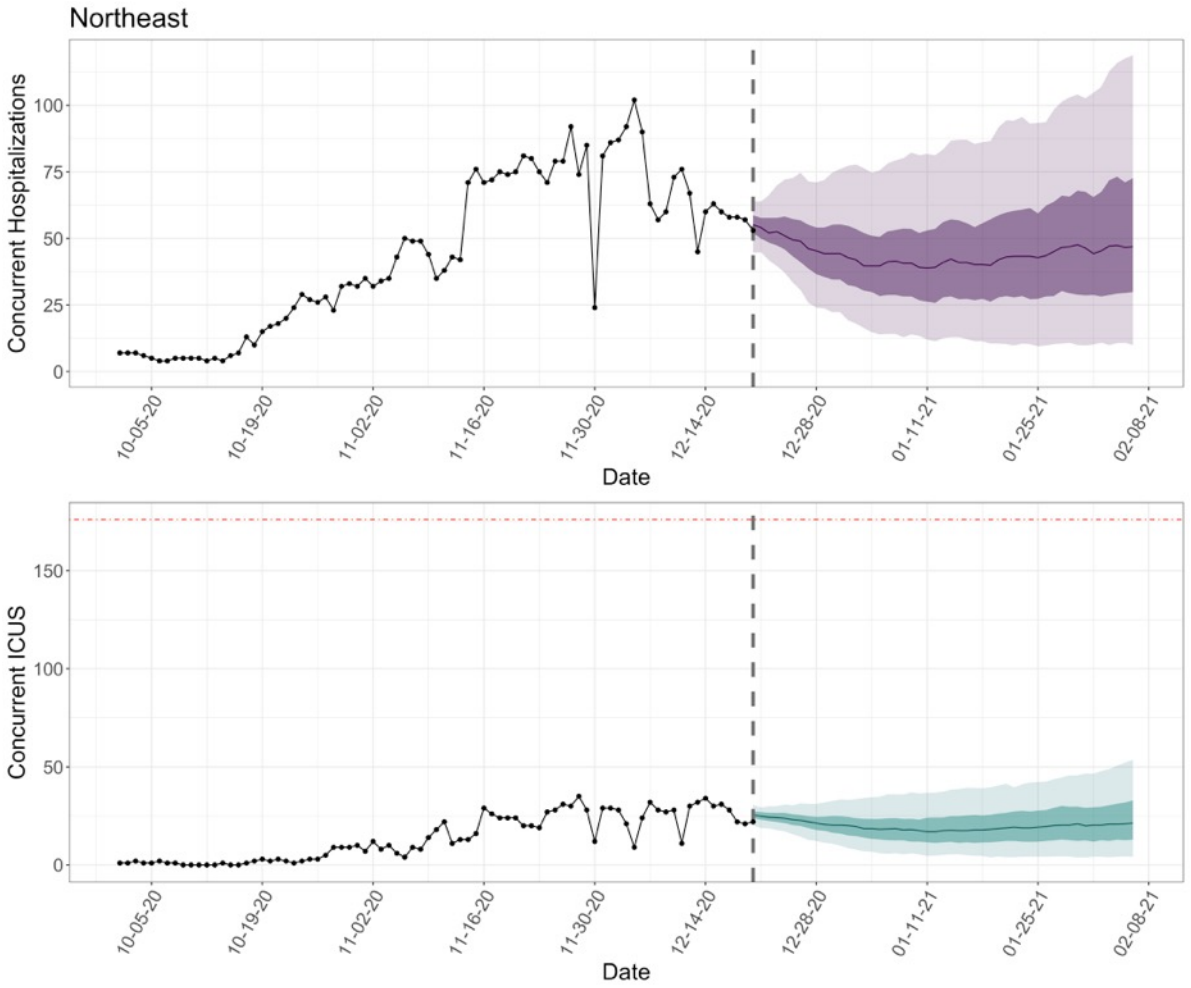
Concurrent COVID-19 ICUs beds: Southeast

Week	Qu. 5% (best case)	Qu. 50% (median)	Qu. 95% (worst case)
12/27	14	21	29
1/3	5	15	30
1/10	3	13	32
1/17	2	14	36
1/24	2	15	38
1/31	3	17	42

So what?

ICU bed usage is expected to slowly decrease in the Southeast region; tracking with median

Regional Hospitalization Forecasts: Northeast



Concurrent COVID-19 ICUs beds: Northeast

Week	Qu. 5% (best case)	Qu. 50% (median)	Qu. 95% (worst case)
12/27	13	22	31
1/3	7	19	34
1/10	5	17	36
1/17	5	18	39
1/24	4	19	42
1/31	4	20	47

So what?

ICU bed usage is expected to slowly decrease in the Northeast region; tracking between best

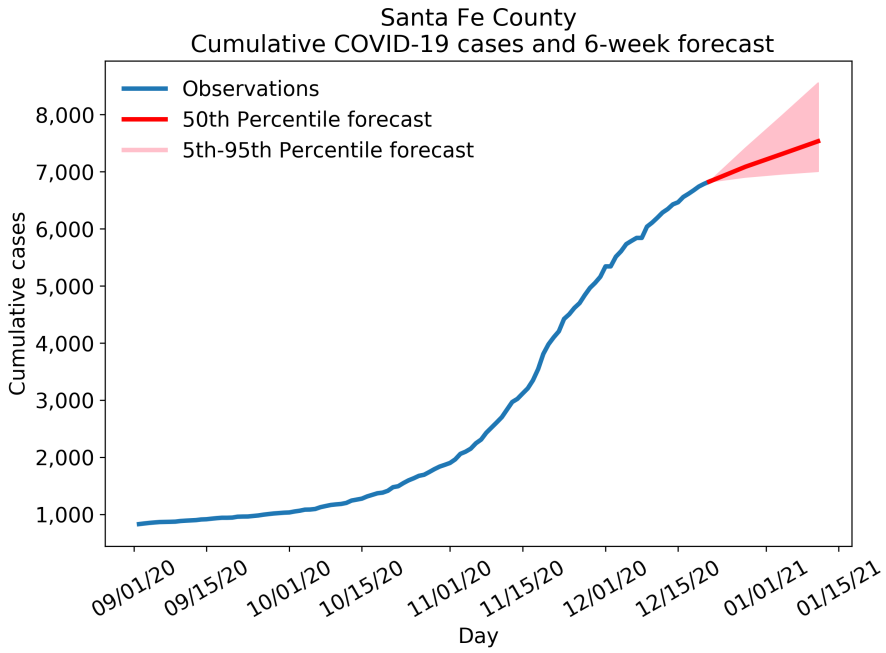
> Non-Congregational Shelter Forecast

Non-Congregate Shelter Forecast

- **Our goal is to inform the capacity of Santa Fe and Albuquerque shelters for forecasting the potential that Santa Fe becomes full and guests need to reroute to Albuquerque**
  - We also examine McKinley and San Juan Counties, which historically have had high shelter use
- **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**

Non-Congregate Shelter Forecast: Santa Fe

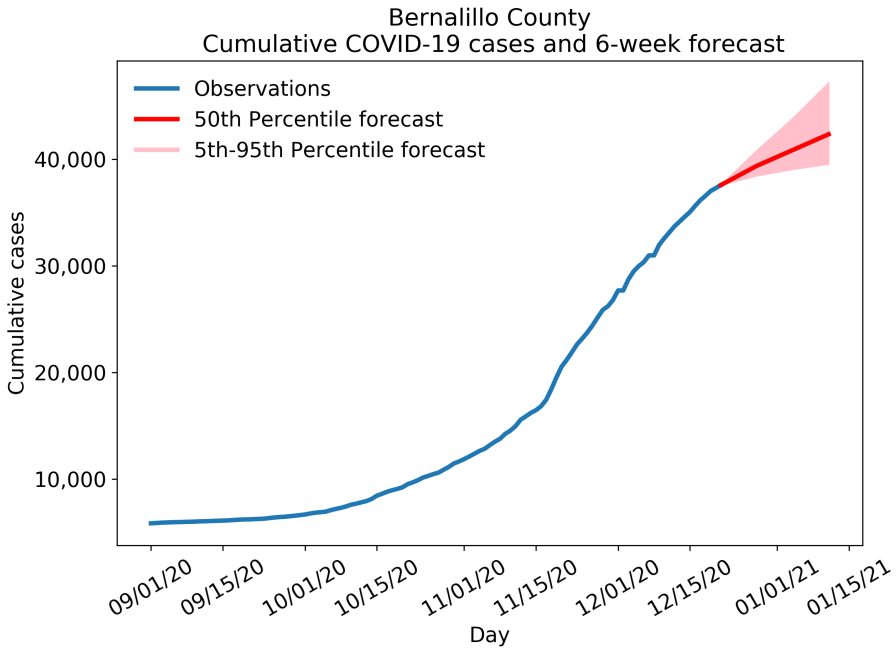
Number of cases as of 12/21/20: **6,825**
Number of shelter rooms available: **52**
Total number of patients/medical workers (including specialty): **20**
Number of patients: **19**
Number of medical workers: **1**
2-week avg. new cases per day: **70**



	12/28/20	1/4/20	1/11/20
Total cases	7,086 (6,909-7,415)	7,308 (6,964-7,979)	7,532 (7,009-8,554)
# of rooms needed	11 (3-24)	9 (2-23)	9 (2-23)
Deficit (-) or surplus of rooms	41	43	43

Non-Congregate Shelter Forecast: Bernalillo

Number of cases as of 12/21/20: **37,561**
Number of shelter rooms available: **213**
Total number of patients/medical workers (including specialty): **78**
Number of patients: **75**
Number of medical workers: **3**
2-week avg. new cases per day: **471**



	12/28/20	1/4/20	1/11/20
Total cases	39,366 (38,451-40,797)	40,846 (39,056-43,812)	42,330 (39,545-47,159)
# of rooms needed	43 (21-77)	35 (14-71)	35 (12-80)
Deficit (-) or surplus of rooms	170	178	178