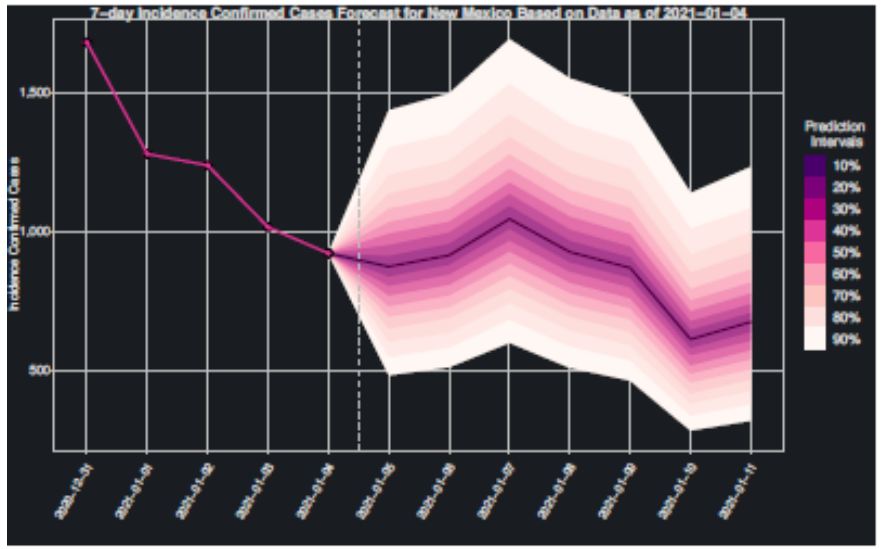
Modeling & Forecasting COVID-19 in NM

January 5, 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 2021–01–04

Week	Best Case (5th Percentile)	Middle Case (50th Percentile)^	Worst Case (95th Percentile)
2021–01–04		147,315*	
2021–01–11	150,518	153,234	157,262
2021–01–18	153,480	159,098	167,627
2021–01–25	156,308	165,364	178,772
2021–02–01	159,298	172,368	191,315
2021–02–08	162,600	180,122	205,438
2021–02–15	166,099	188,735	221,971

*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 2021–01–04

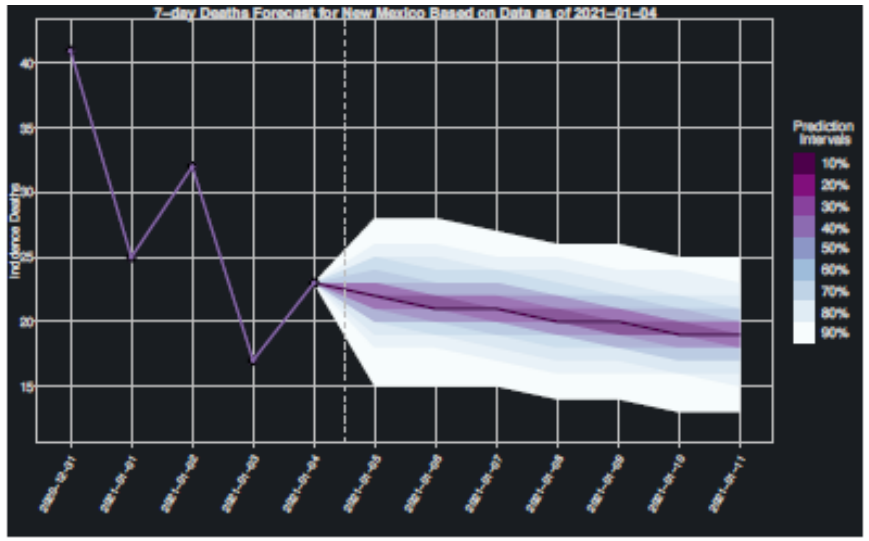
Week	Best Case (5th Percentile)	Middle Case (50th Percentile)^	Worst Case (95th Percentile)
2021–01–04		1,237*	
2021–01–11	458	846	1,421
2021–01–18	423	838	1,481
2021–01–25	404	895	1,592
2021–02–01	427	1,001	1,792
2021–02–08	472	1,108	2,018
2021–02–15	500	1,230	2,362

*Last reported confirmed cases count
^Closest–matching scenario

So what?

The daily number of cases are expected to range between 400 and 1,500 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 2021–01–04

Week	Best Case (5th Percentile)	Middle Case (50th Percentile)^	Worst Case (95th Percentile)
2021–01–04		2,574*	
2021–01–11	2,674	2,717	2,758
2021–01–18	2,758	2,840	2,920
2021–01–25	2,835	2,953	3,076
2021–02–01	2,905	3,061	3,235
2021–02–08	2,973	3,174	3,421
2021–02–15	3,041	3,292	3,639

*Last reported deaths count
^Closest–matching scenario

6–Week Forecast of Daily Average of Deaths for New Mexico Based on Data as of 2021–01–04

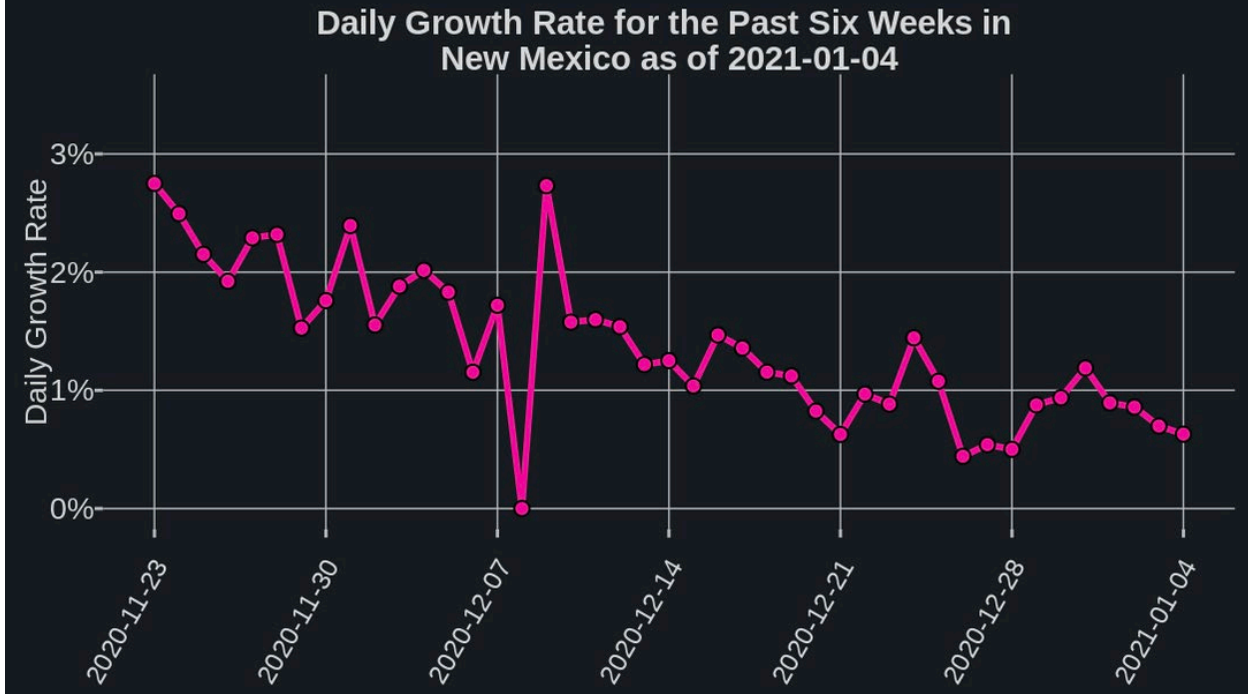
Week	Best Case (5th Percentile)	Middle Case (50th Percentile)^	Worst Case (95th Percentile)
2021–01–04		27*	
2021–01–11	14	20	26
2021–01–18	12	18	23
2021–01–25	11	16	22
2021–02–01	10	15	23
2021–02–08	10	16	27
2021–02–15	10	17	31

*Last reported confirmed deaths
^Closest–matching scenario

So what?

The daily number of deaths are expected to range between 11 and 26 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 2021-01-04

Week	Best Case (5th Percentile)	Middle Case (50th Percentile)^	Worst Case (95th Percentile)
2021-01-04		0.87%*	
2021-01-11	0.31%	0.56%	0.94%
2021-01-18	0.28%	0.54%	0.92%
2021-01-25	0.26%	0.55%	0.92%
2021-02-01	0.27%	0.59%	0.97%
2021-02-08	0.29%	0.63%	1.0%
2021-02-15	0.30%	0.67%	1.1%

*Last weekly mean daily growth rate

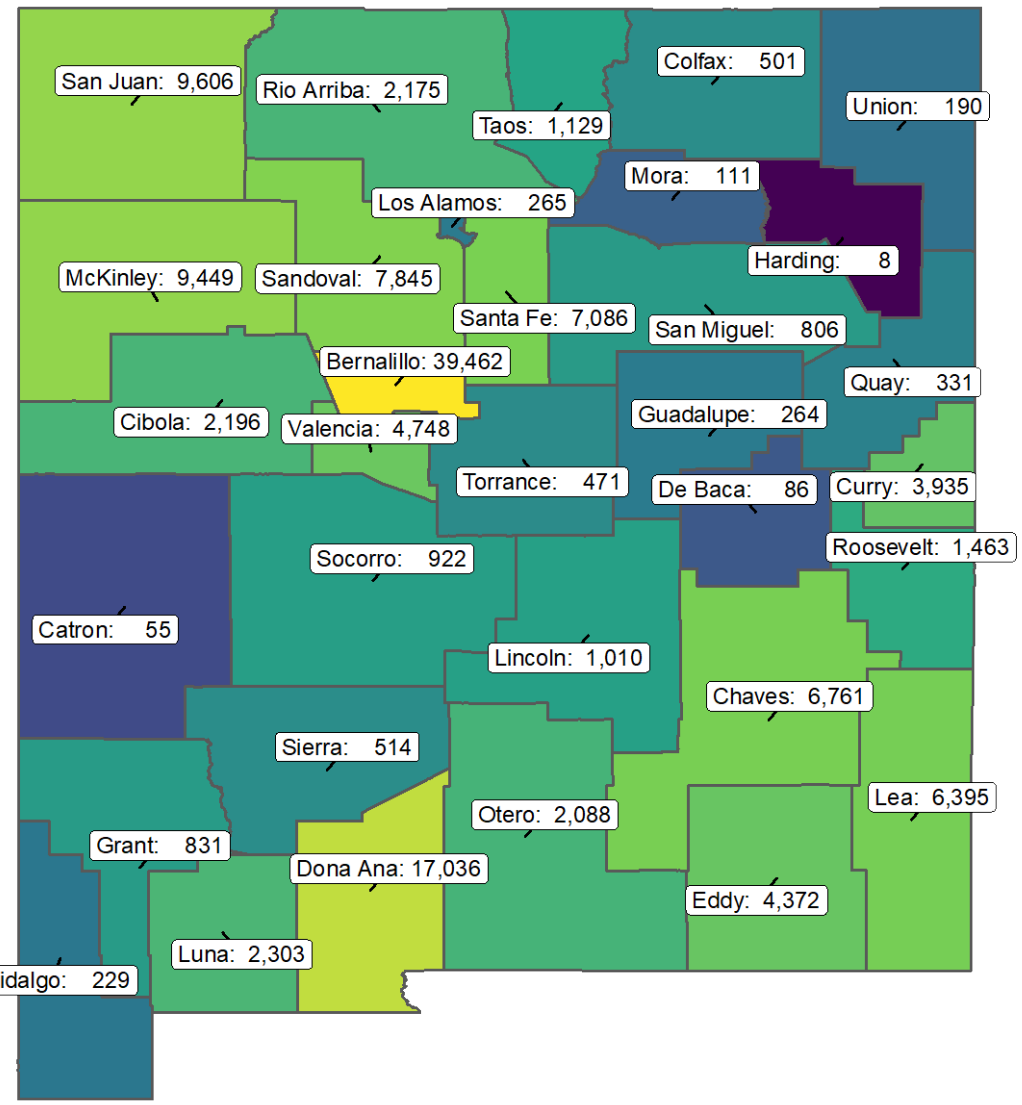
^Closest-matching scenario

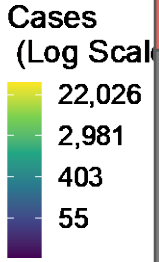
So what?

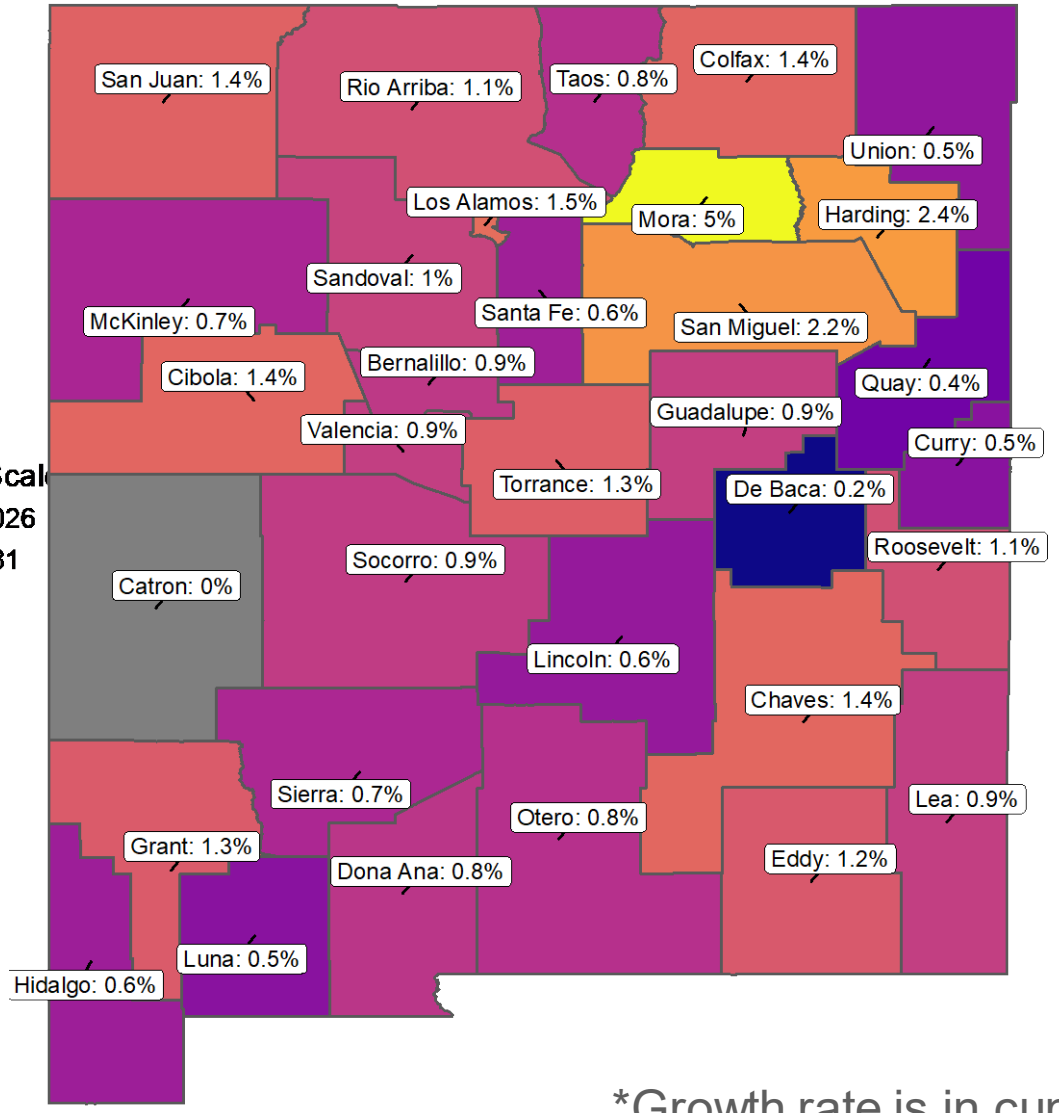
As of January 4th, the average growth rate in NM is at 0.87%

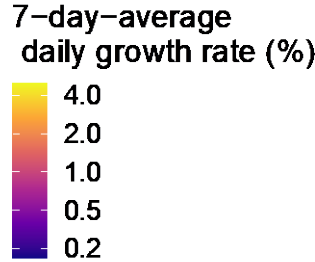
> Regional Forecasts, Growth Rates, & Hospitalizations

Cumulative Cases & Daily Growth Rate for NM: Dec 28



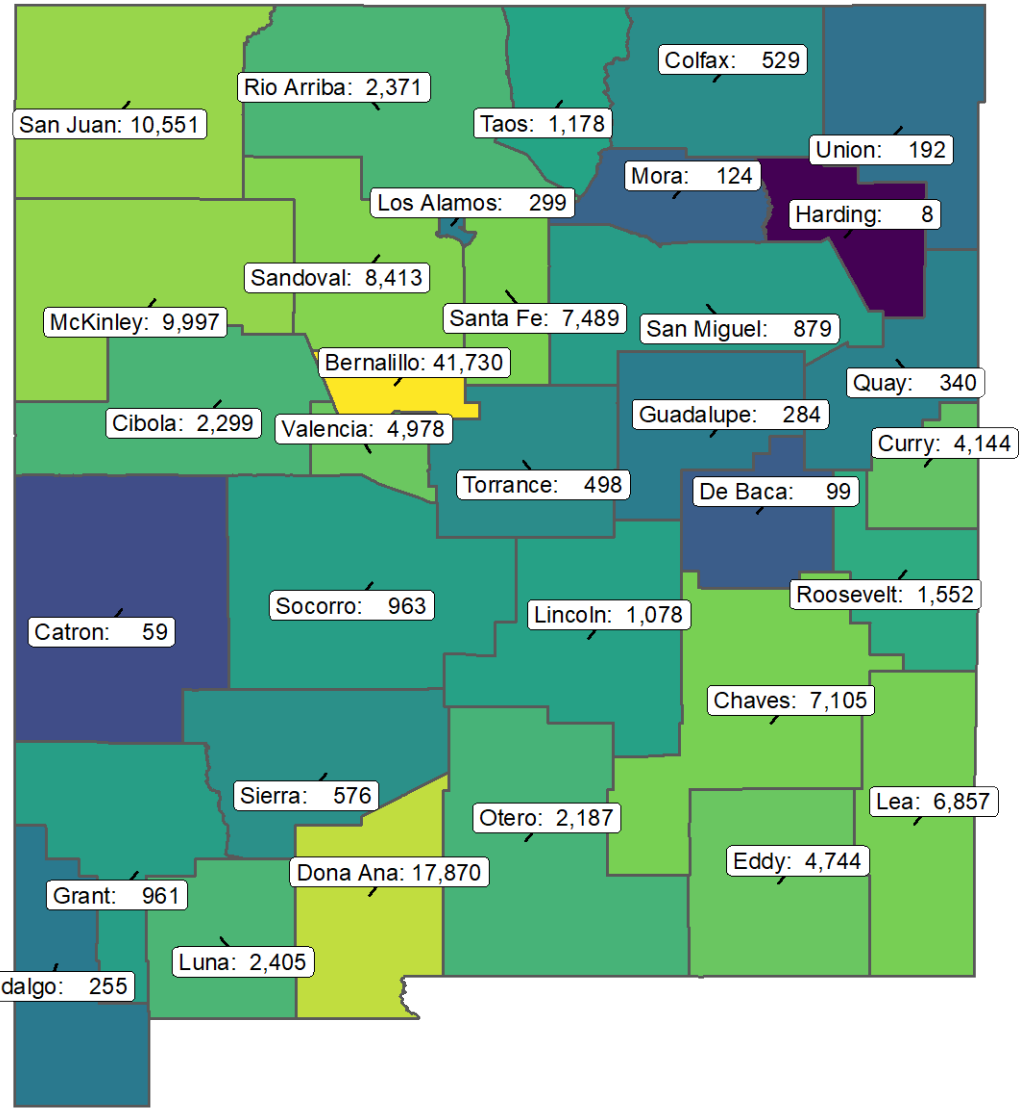


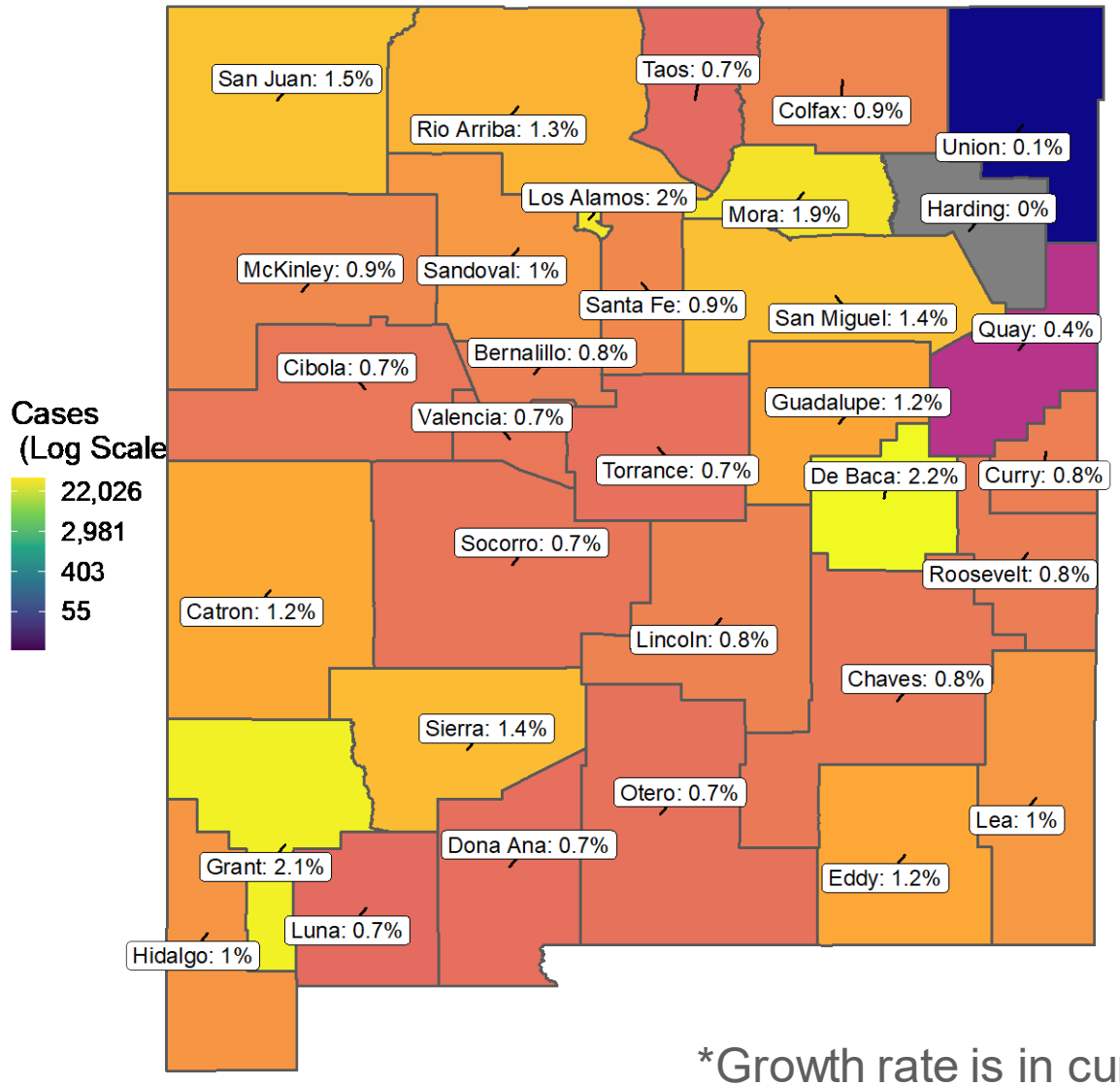




*Growth rate is in cumulative cases

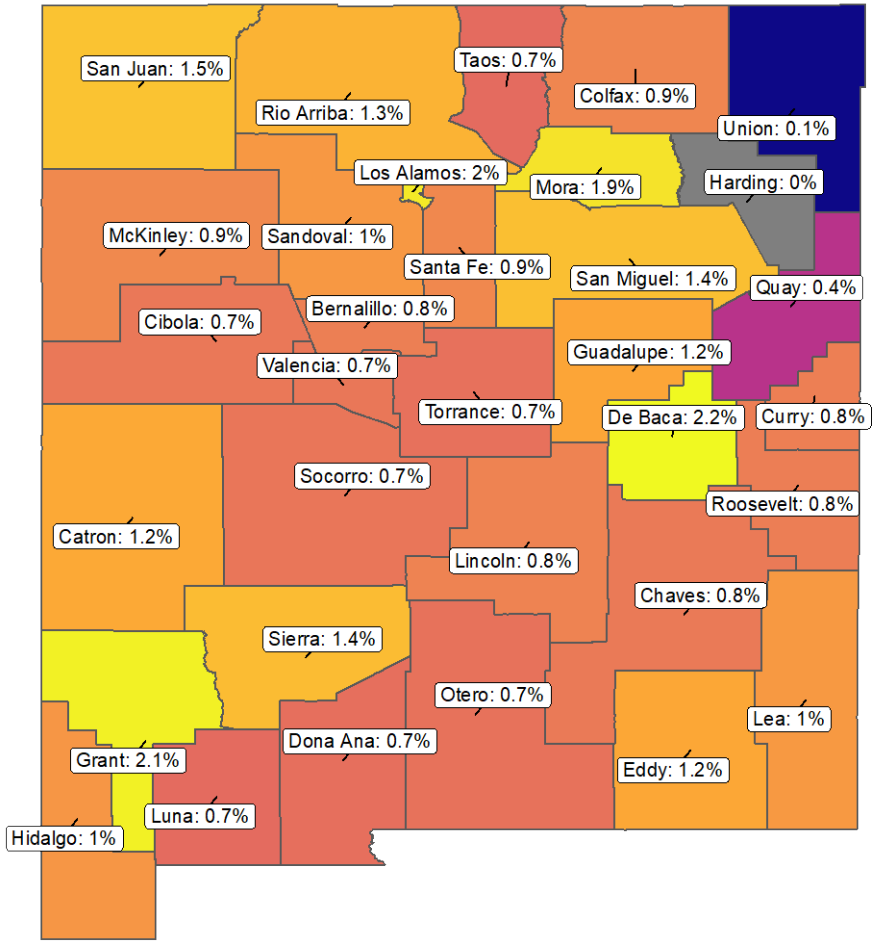
Cumulative Cases & Daily Growth Rate for NM: Jan 4





*Growth rate is in cumulative cases

Daily Growth Rate for NM Jan 4



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

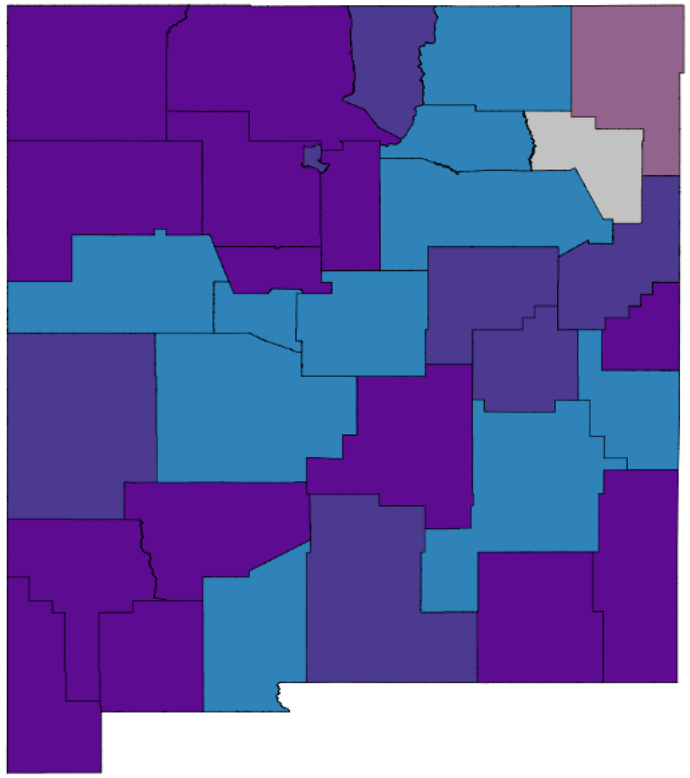
Socorro 0.7% =
Quay 0.4% =
Mora **1.9%** =
Union 0.1% =
Hidalgo **1.0%** =
Colfax 0.9% ↓
Roosevelt 0.8% **=**

DeBaca **2.2%** ↑
Los Alamos **2.0%** ↑
Catron* **1.2%** ↑

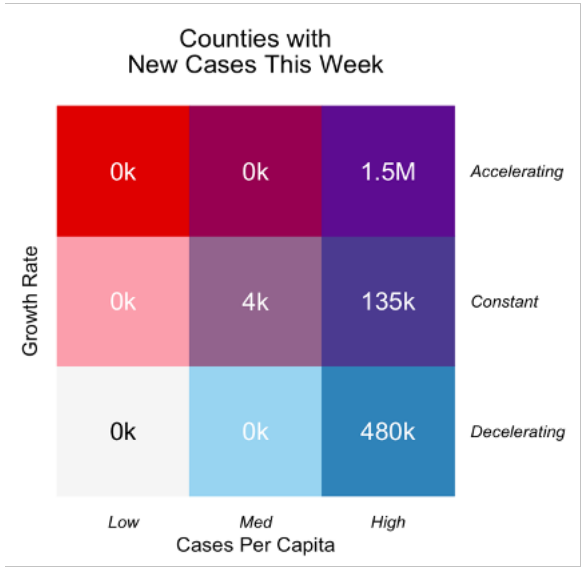
County	Daily Growth Rate	Change
San Juan	**1.5%**	=
Rio Arriba	**1.3%**	=
Sierra	**1.4%**	↑
McKinley	0.9%	=
Sandoval	**1.0%**	=
Santa Fe	0.9%	=
Cibola	0.7%	↓
Bernalillo	0.8%	=
Valencia	0.7%	=
Torrance	0.7%	↓
Lincoln	0.8%	=
San Miguel	**1.4%**	↓
Chaves	0.8%	↓
Dona Ana	0.7%	=
Otero	0.7%	=
Lea	**1.0%**	=
Eddy	**1.2%**	=
Curry	0.8%	=
Grant	**2.1%**	↑
Luna	0.7%	=
Taos	**0.7%**	=

Weekly Growth Rate for NM: Another View (Jan 4)

COVID-19 across New Mexico
A 7-day moving window comparison
January 4, 2020



Impacted New Mexicans



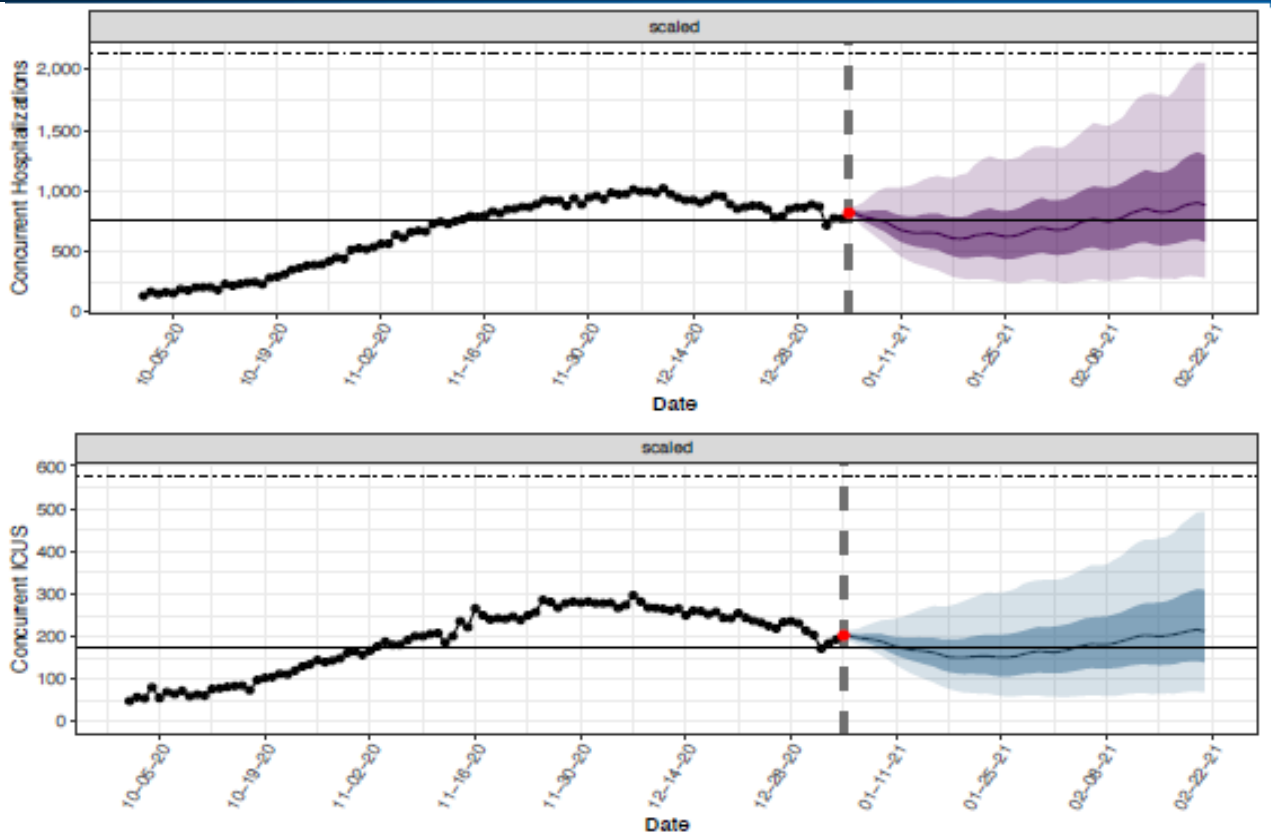
Number of New Mexicans living in regions with particular combinations of per capita case counts and 7-day growth rates

So what?

- Most people in New Mexico are living in a county that is accelerating
- Counties with >500 weekly cases per 100k: Lea, Eddy, McKinley, San Juan, Sierra, Hidalgo, DeBaca

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

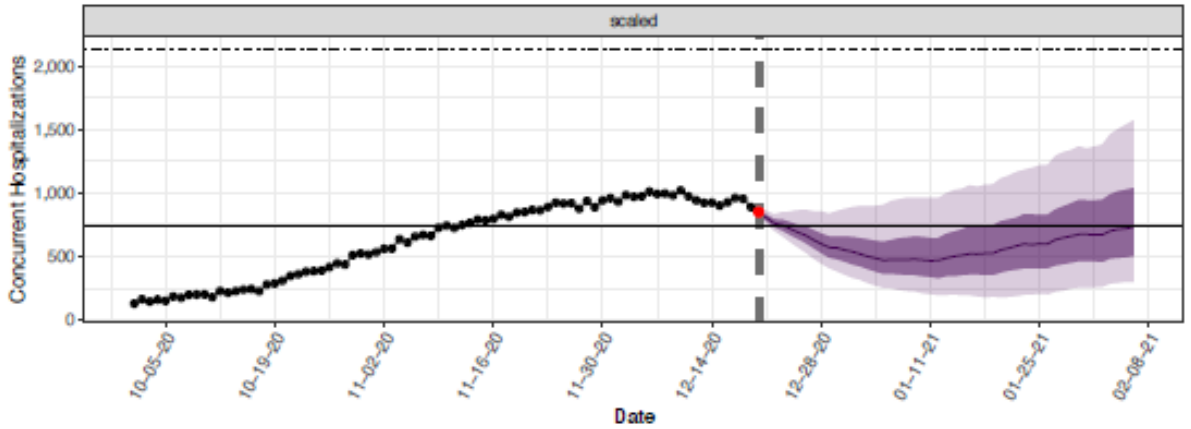
Week	Qu. 5% (best case)	Qu. 50% (median)	Qu. 95% (worst case)
1/11	134	177	242
1/18	78	152	271
1/25	62	151	303
2/1	60	163	333
2/8	61	181	368
2/15	67	200	430

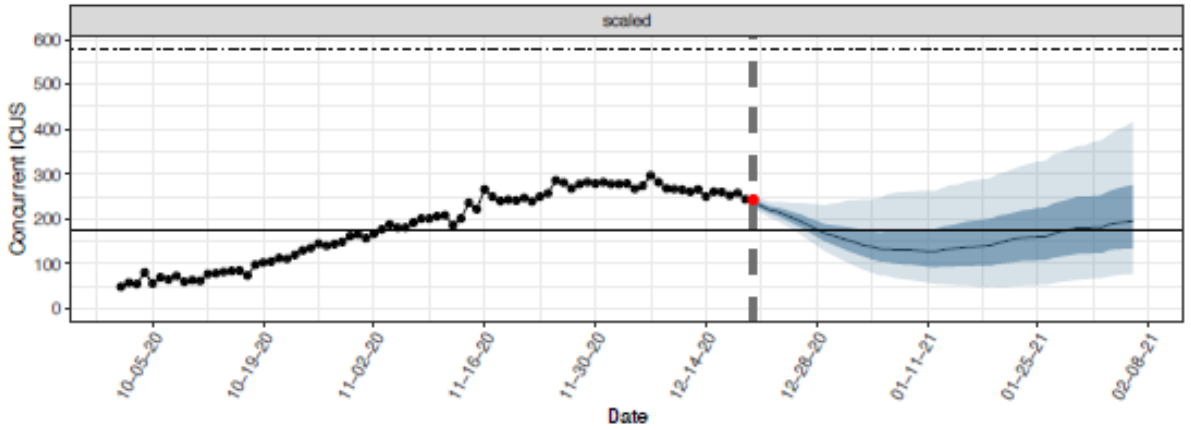
"Scaled" Scenario

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 followed by another increase

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)
1/11	326	499	786
1/18	212	456	833
1/25	185	471	953
2/1	187	511	1021
2/8	196	563	1167
2/15	207	622	1357

"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 during the first 3 weeks of January

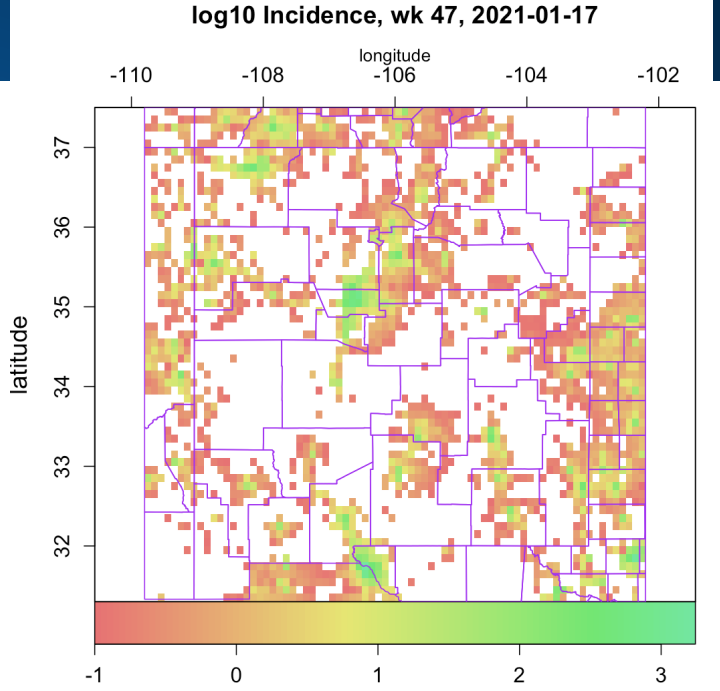
05 Jan 2021: EpiGrid modeling

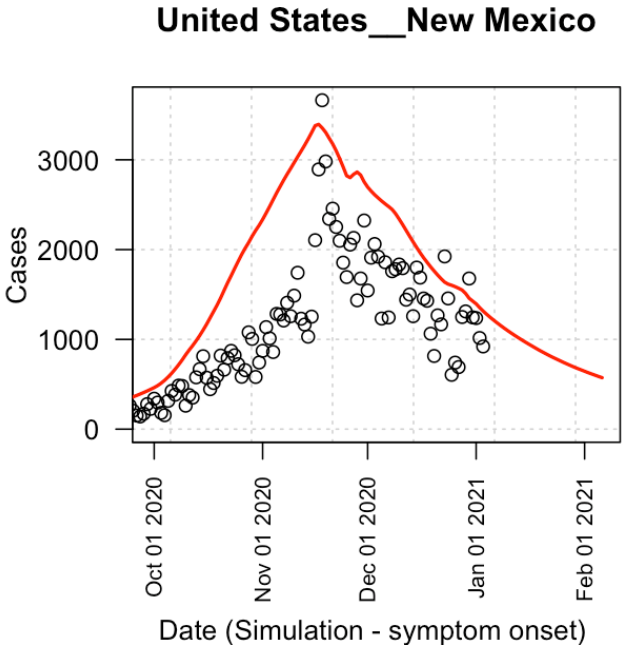
- Assumes all counties remain “red”. (More precisely we assume that transmission parameters stay as they are.)

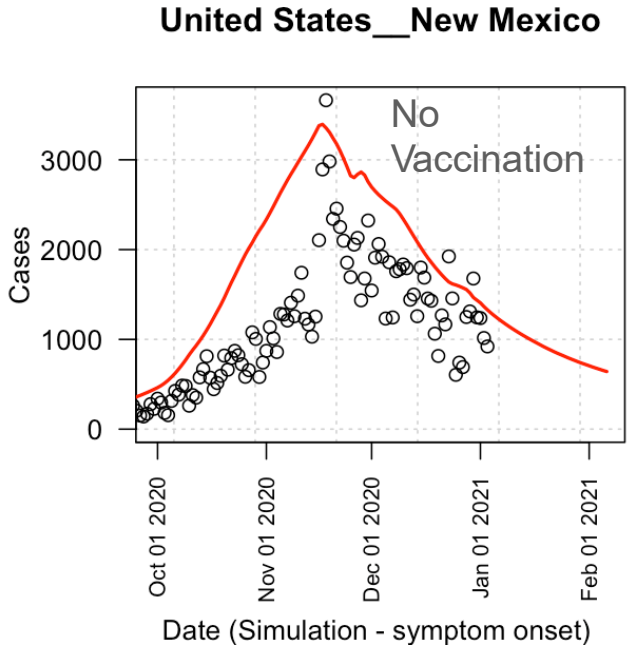
- Quarantine mostly modeled at 50% Dec. 8th-22nd and 45% afterwards (quarantine times slower later).

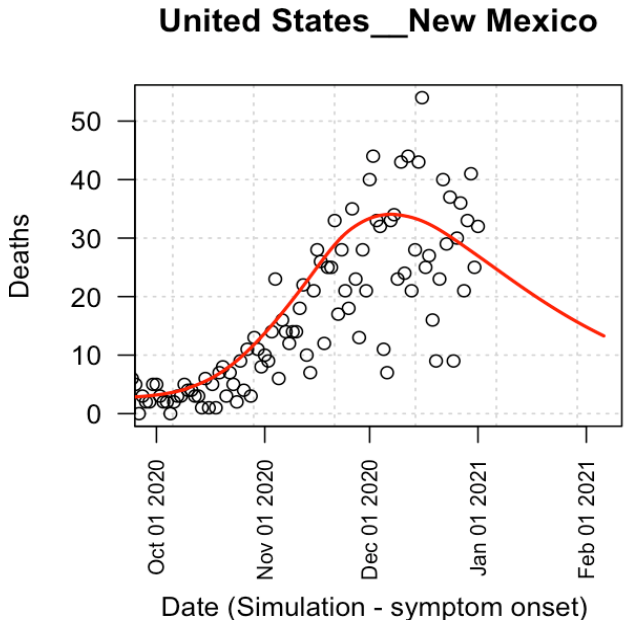
- Small increases in transmission are parameterized for Thanksgiving. A few days around Dec. 25th, and New Year’s Day are similarly increased.

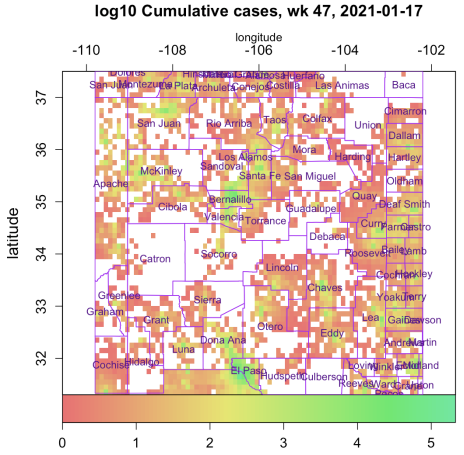
- Vaccination starts Dec. 15th with 2500 people per day and 90% vaccine effectiveness. Initial effects are now at the threshold of detectability, see below.





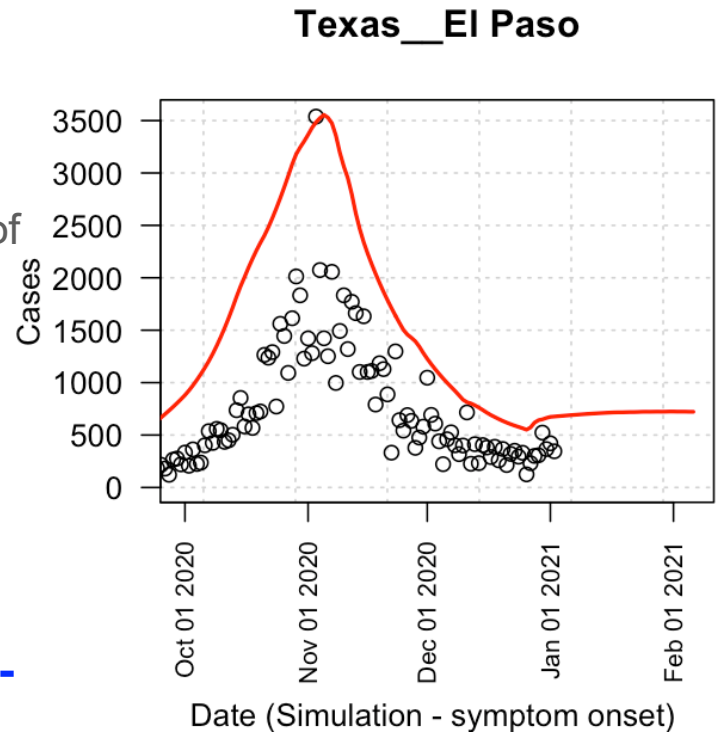






05 January 2021 Model (EpiGrid) – more details and information

- **Daily reported cases in El Paso are no longer declining.**
- **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 ranges from 0.5 to 0.45 for NM over the last three weeks.
- **Baseline results do *not* reflect B.1.1.7 (N501Y/"London"/UK) variant of SARS-CoV-2**
  - Potential for a 50% increase in contagion/force of infection.
  - Caveats apply, non-flat age distribution of cases, higher viral titers, no increased pathology.

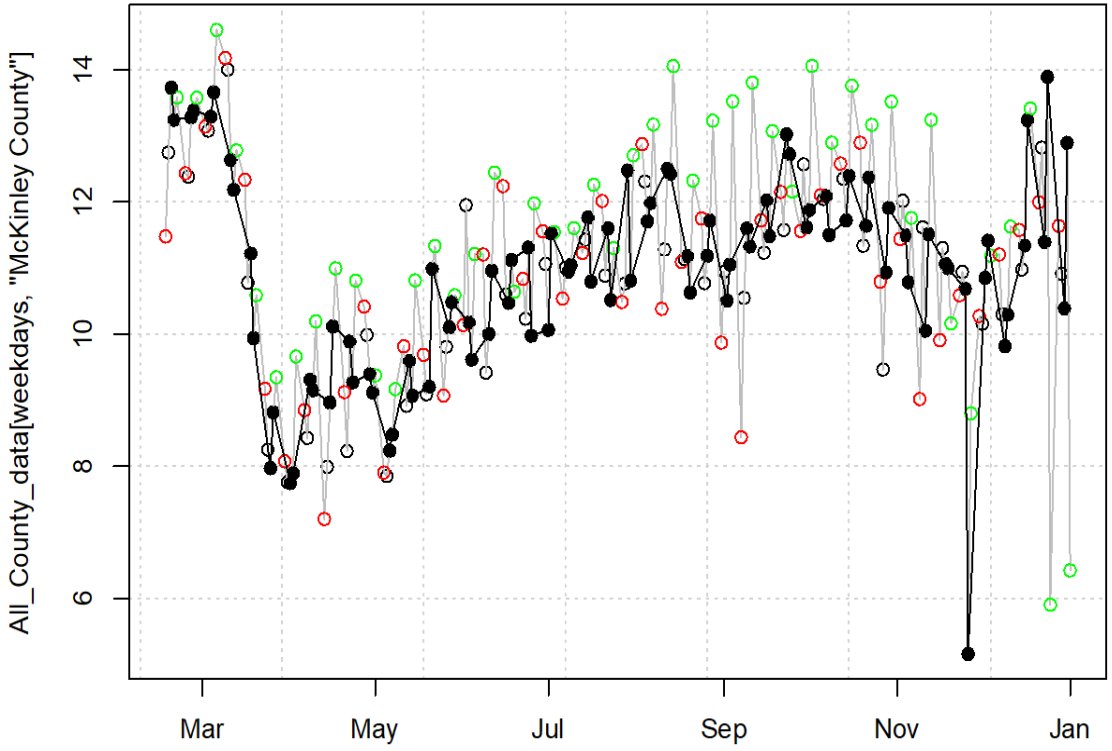


T-80 Mobility – northern counties (Data only).

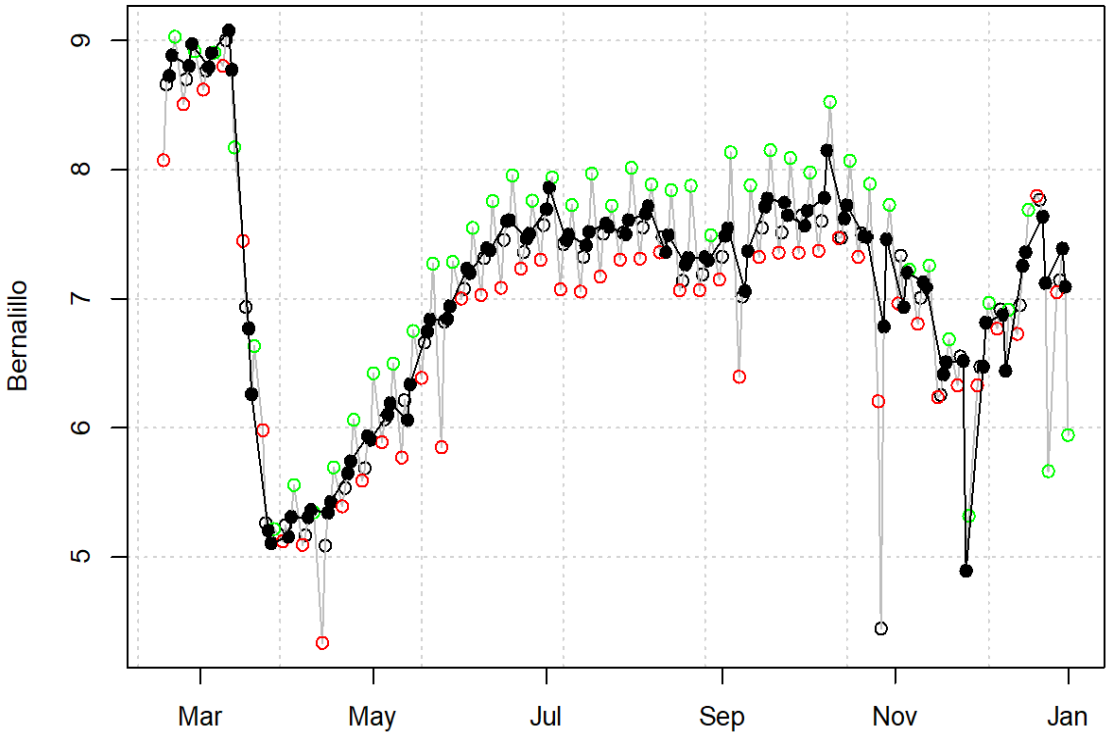
All counties had high mobility shortly before Dec. 25th with several counties having their peak mobility since May 2020. Los Alamos, Rio Ariba and Taos peaked between Dec 25th and New Year's. Mobility was low on Dec. 25th and Jan 1st (Fridays).

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

McKinley



Bernalillo

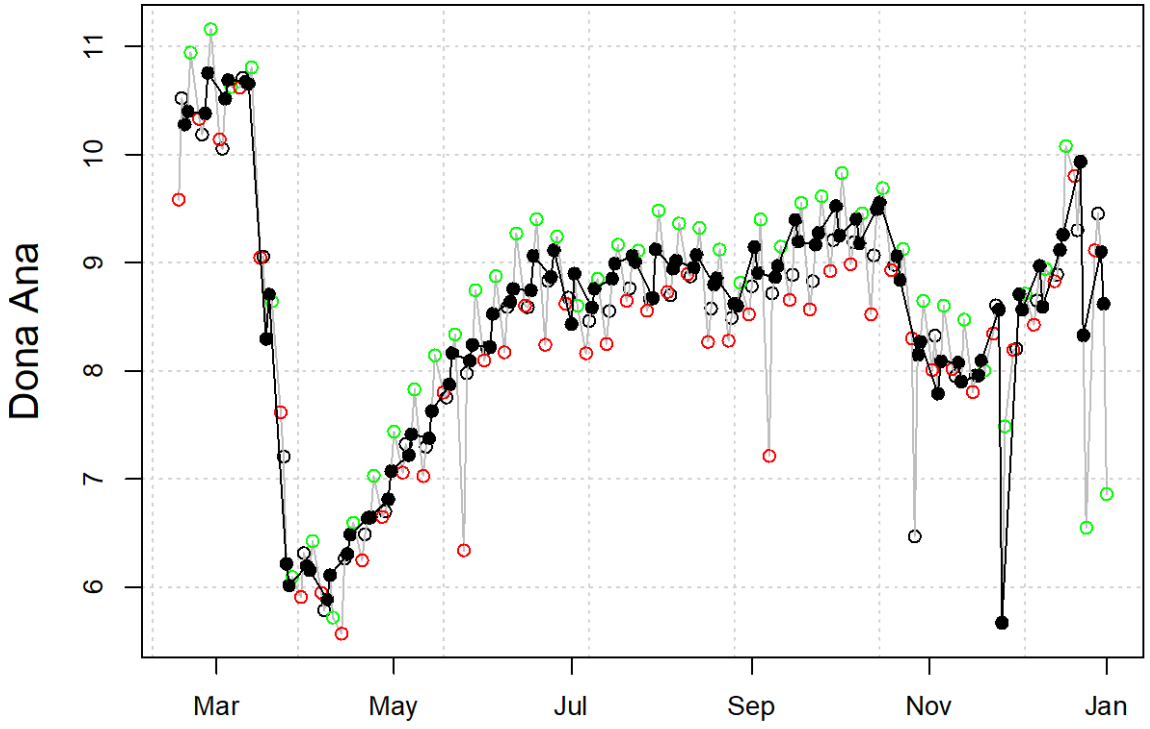


T-80 Mobility – southern counties (and Curry) (Data only)

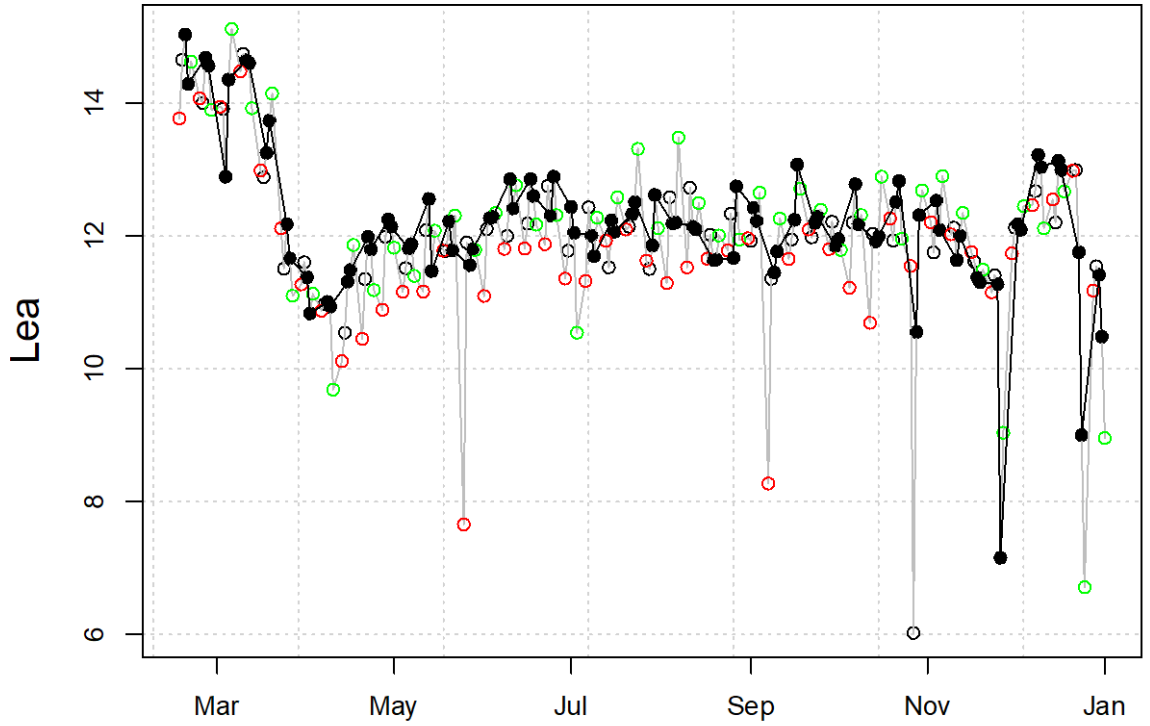
- Most counties had increased mobility shortly before the 25th. Chaves, Dona Ana, Otero, Lea, Lincoln, Socorro were at or near peak mobility since May. Dec. 25th and Jan 1st (Fridays) had low mobility.

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

Dona Ana



Lea



Fundamental Considerations for Vaccination Objectives. Effects Modeled.

0. EpiGrid reflects vaccination going forward.

- Analysis greatly aided by access to by-time and by-location data (county, or finer resolution). Currently using 2-2.5k/day vaccinations.
- *6 months to complete 2.1M vaccine series requires ~11k/day people being vaccinated, or ~22k inoculations/day over the long-haul.*
- *Current ~2k/day?*

1. 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).
  - At-risk and often congregated populations in multi-generation housing, etc.
  - People living with ESRD, DMII, COPD, etc.
  - 65-and-over years of age, *see recent TX directives for vaccination* after group 1a (older populations).
- *These populations are driving hospital load, and mortality.*
- High risk-for-mortality populations are *widely distributed* and preferential administration is unlikely to inhibit other objectives.

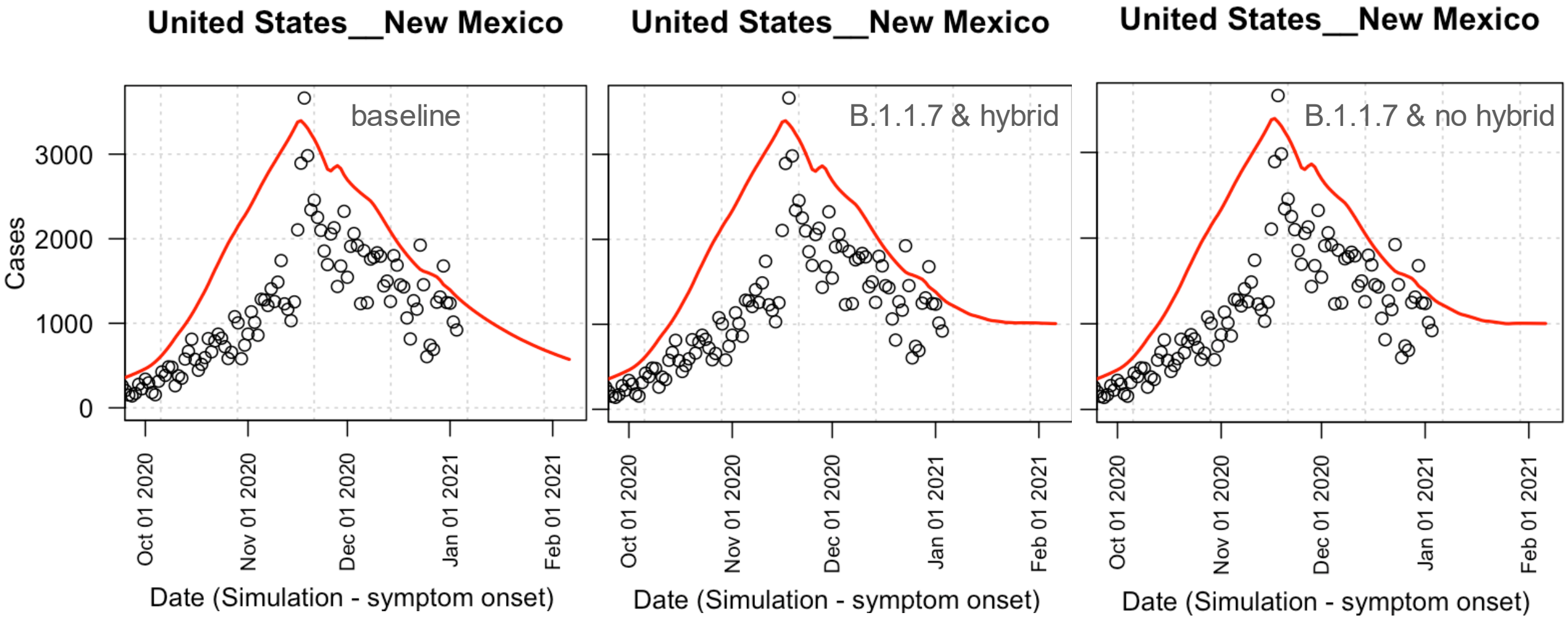
2. Lower the rate of spread. Connectivity-based, and geographically-based. Time frame ~3 weeks to see initial effects with Pfizer.

- Initial (threshold-discernable) effects on epidemic growth rate are present in NM's EpiGrid *model.* Confirmation with data will take time.
- 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". Essential workers may in some cases be low-risk.

3. 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 B.1.1.7 (N501Y & assoc. mutations) point out the extraordinary utility of elimination *as distinct from* epidemic "control".
- The presence of B.1.1.7 in the US may create a race between strain replacement and vaccination to avoid undesirably outcomes.

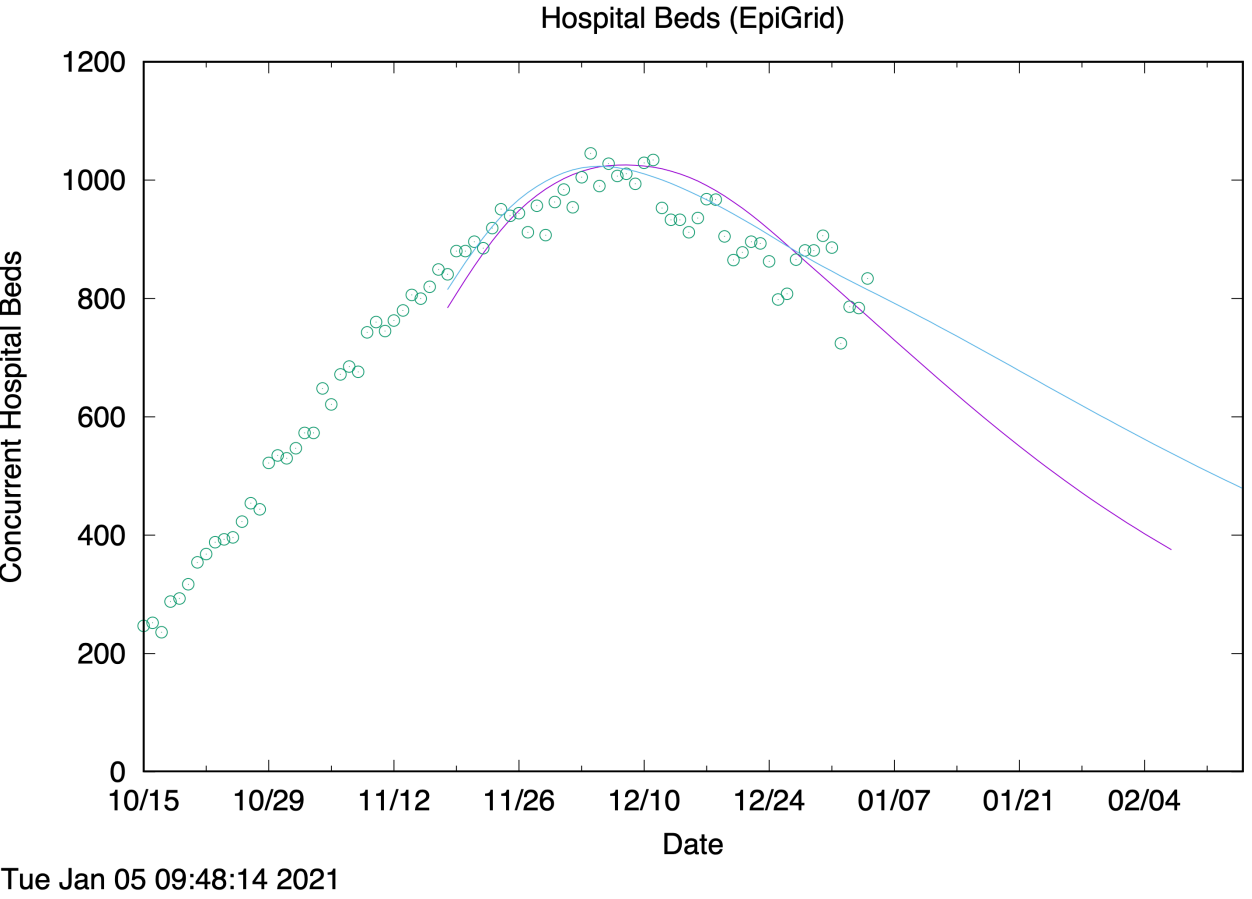
Virus variant B.1.1.7 likely more important than hybrid schools, State-wide view.

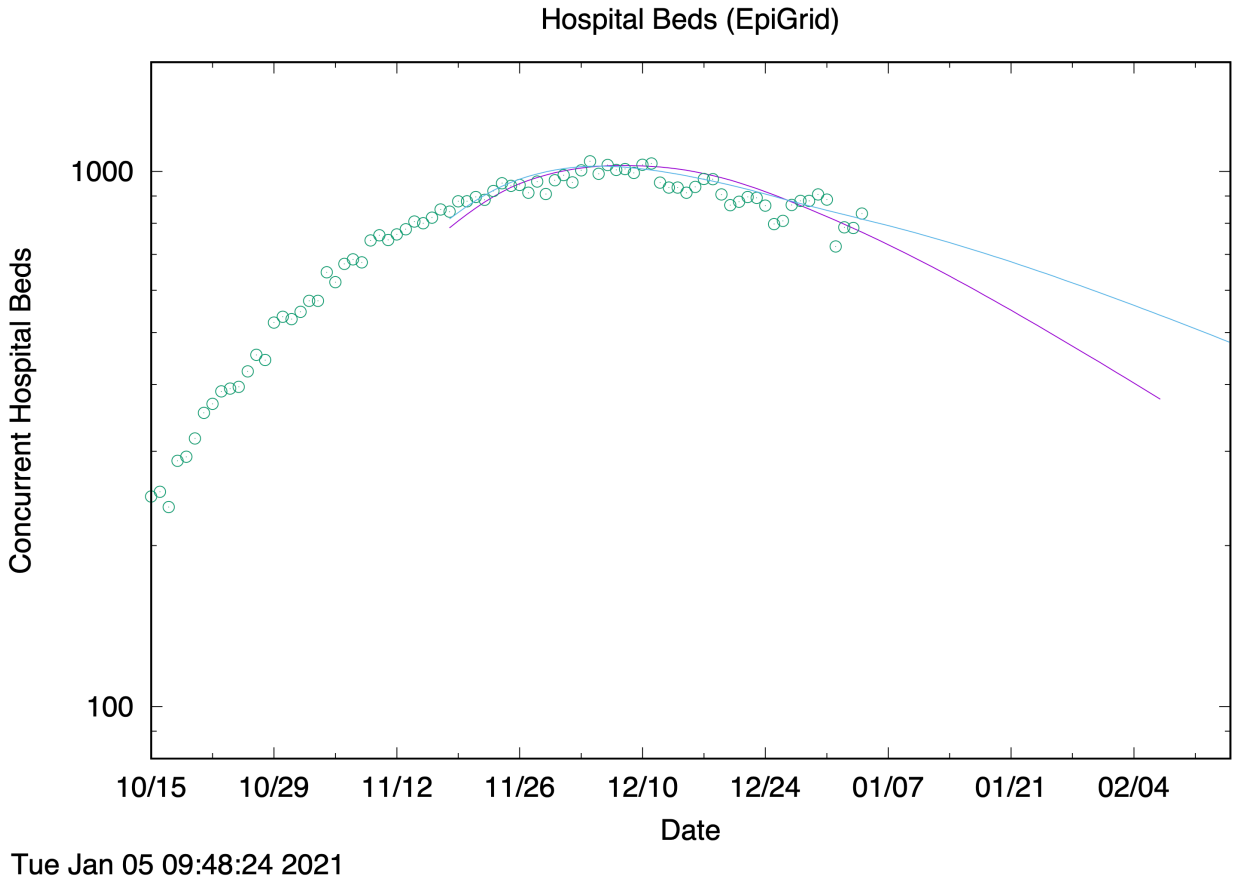


- Modeled as new variant replacement starting 5 January 2021, and requiring 10 weeks to complete (left two panels).
- Vaccination continuing at 2.5k/day vaccinations.

Hospital bed concurrent usage by COVID-19 patients

- Left panel: Linear vs. time shows hospital utilization and capacity. Current (lower) model and three week ago (upper, cyan).
- Right panel: Log vs. time, same data and models.
- November 16th PHO and Thanksgiving are now parameterized, Christmas and New Year's have similar parameterizations.
- Parameterized a hospital model going forward for the lower curve.



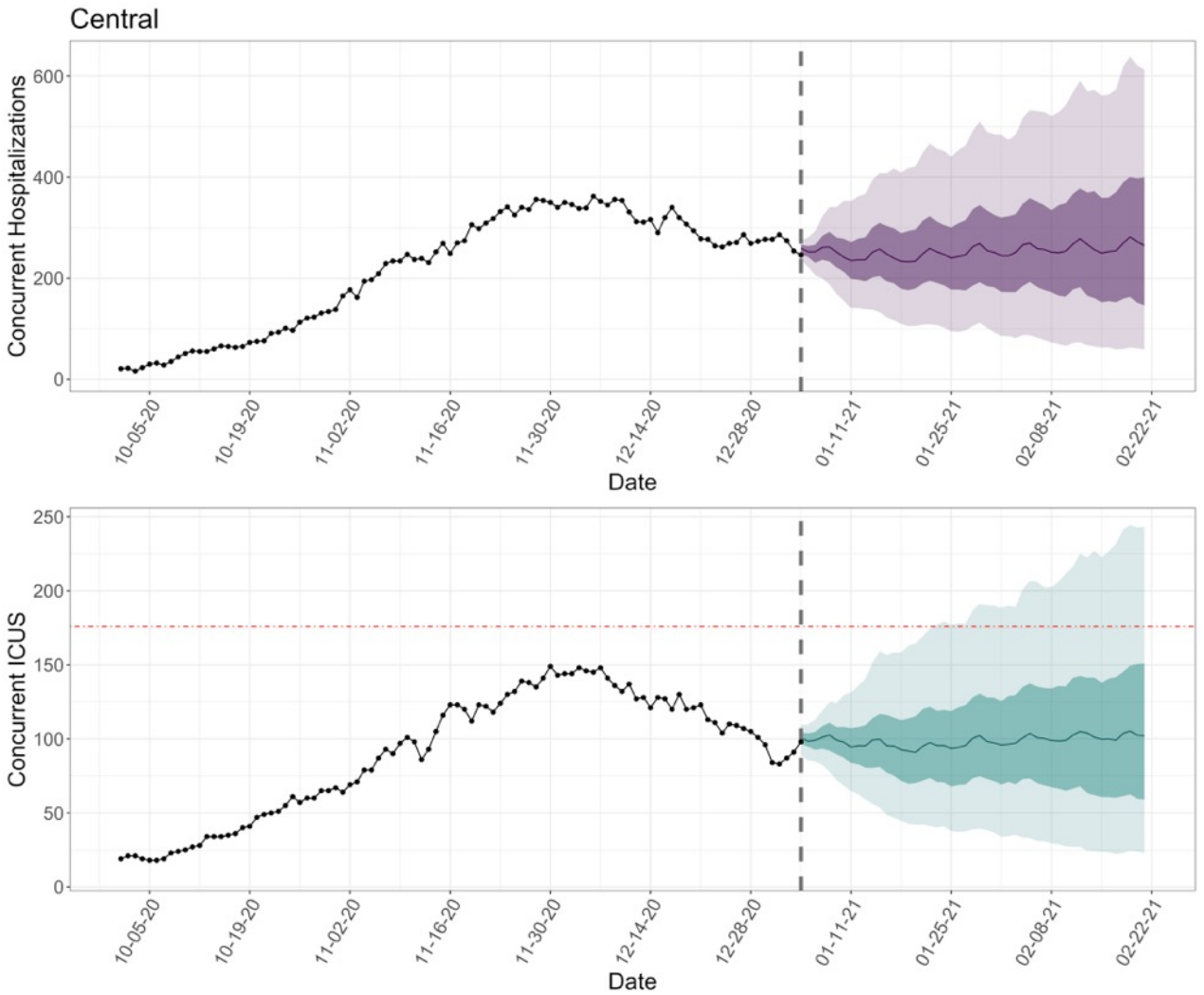


Conclusions and Discussion

- **New Mexico's epidemic spread is improving *very* slowly.**
- **Strain B.1.1.7 (N501Y/"London"/"UK"/…) represents a significant source of potentially dangerous uncertainty through strain replacement. *Monitoring capable of detecting B.1.1.7 spread in New Mexico should be a priority.***
- **El Paso's daily incidence has risen over the last week.**
- **Nationwide geographical dispersion likely a significant source of cross-state seeding of local transmission.**
- **Bernalillo's demand for ICU beds is now a less important factor than in December.**
- **NM Test positivity remains well above 7%. It was >~10% recently.**
- **The effects of vaccination are at the threshold of detectability in New Mexico's Epigrid *model*. Confirmation with data is likely to take weeks.**
- **Targeting vaccine to high-mortality areas and populations will have the largest immediate effect on this model.**
- **The level of hospital loading is consistently lower relative to recent incidence than compared with events in July.**
- **Discussion:**
  - Vaccinating high risk-of-mortality populations will lower the mortality rate *and* further lower hospital loading.
  - Schools are highly mitigated, elementary school provides little evidence for in-school spread with the current viral strain. SARS-CoV-2 strain B.1.1.7 represents a potential risk to in-person schooling plans. Improved PPE might be required, etc.
  - There is an urgent need for situational awareness regarding B.1.1.7. The level of contagion may be 1.5x that of the current "Milan" strain that dominates in the US and NM. *The situation is uncertain, and caveats apply. E.g. Non-flat age distribution of B.1.1.7 in the UK (Ferguson).*
  - Indoor, un-masked activities are inherently risky (meals). How to mitigate? Airflow in addition to distance?
  - 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 strain-level information that is likely to become important in the near future, and is compatible with high testing rates.

> Additional Slides

Regional Hospitalization Forecasts: Central



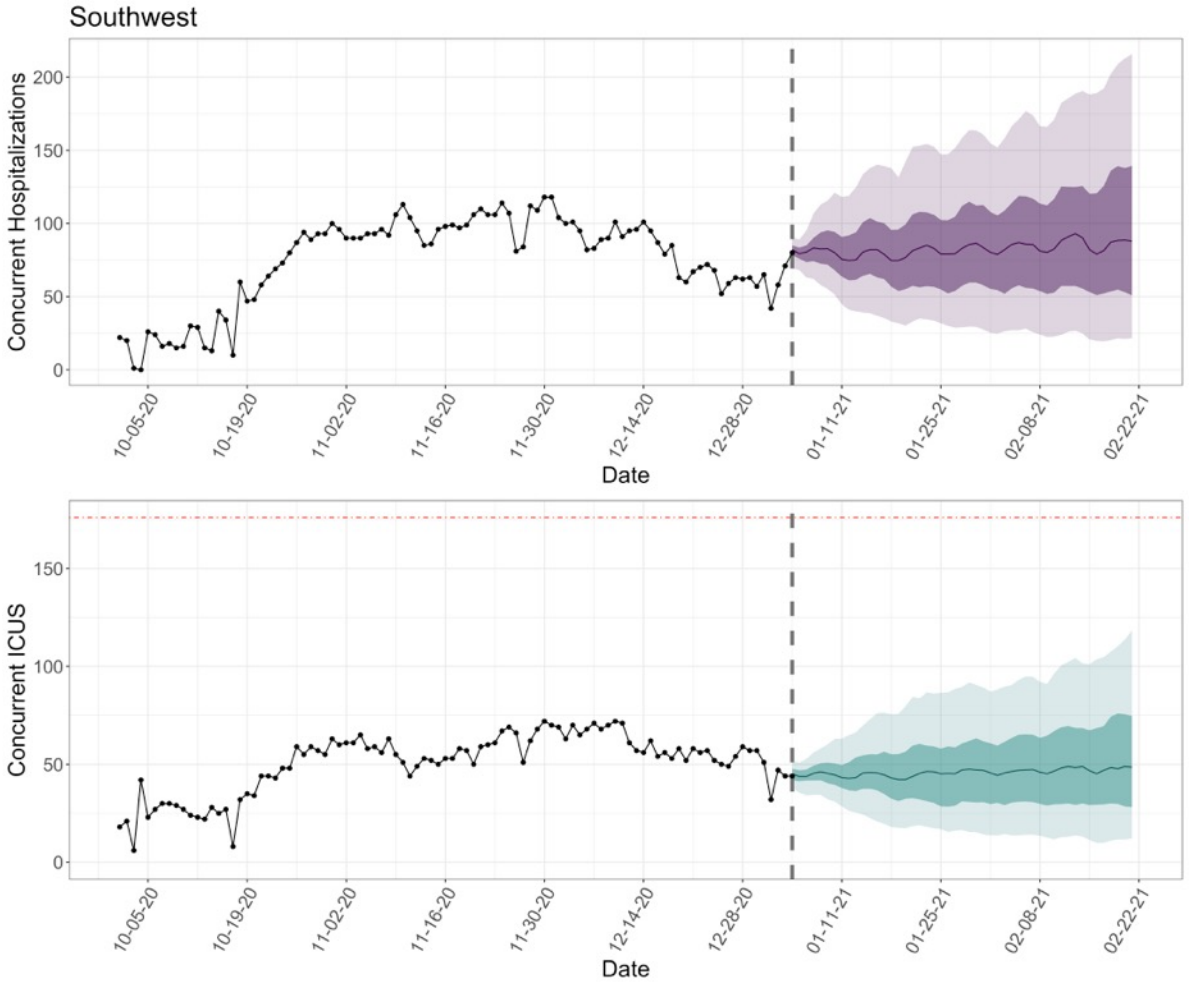
Concurrent COVID-19 ICUs beds: Central

Week	Qu. 5% (best case)	Qu. 50% (median)	Qu. 95% (worst case)
1/11	65	94	131
1/18	45	93	158
1/25	38	94	177
2/1	34	96	189
2/8	29	99	202
2/15	24	100	223

So what?

ICU bed usage is expected to remain steady; tracking with median.

Regional Hospitalization Forecasts: Southwest



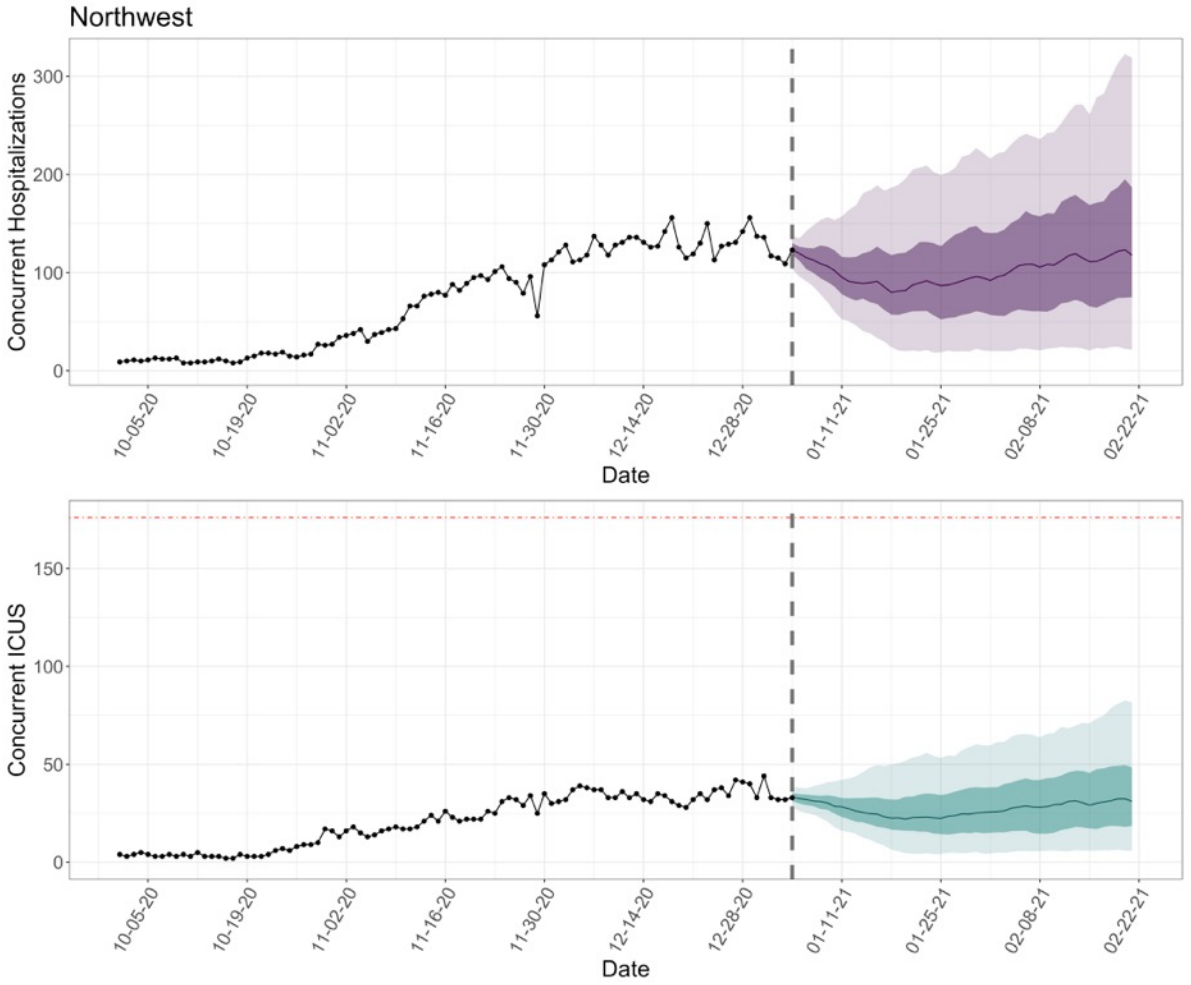
Concurrent COVID-19 ICUs beds: Southwest

Week	Qu. 5% (best case)	Qu. 50% (median)	Qu. 95% (worst case)
1/11	29	43	63
1/18	18	43	76
1/25	17	45	87
2/1	14	46	87
2/8	13	46	92
2/15	11	47	101

So what?

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

Regional Hospitalization Forecasts: Northwest



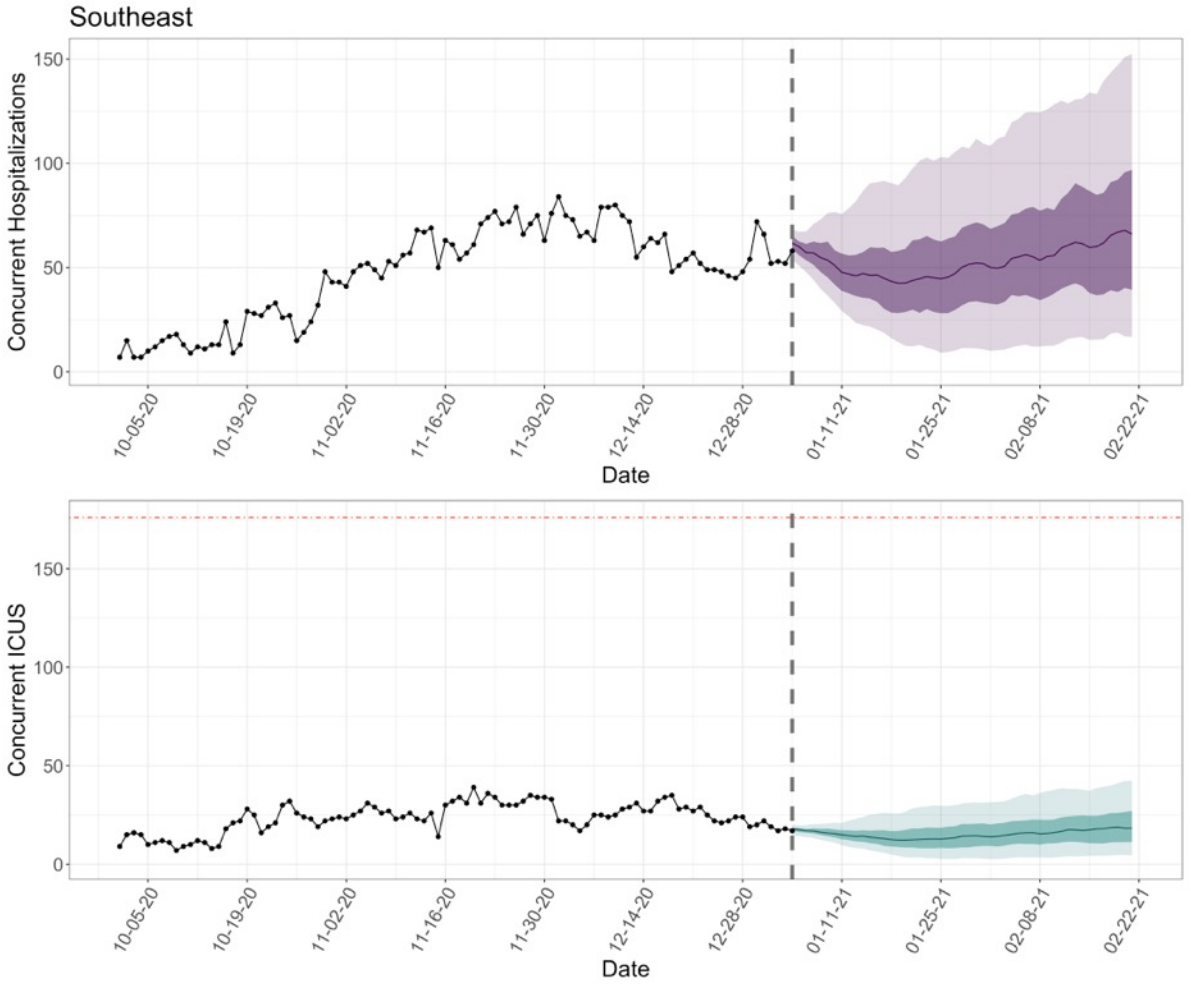
Concurrent COVID-19 ICUs beds: Northwest

Week	Qu. 5% (best case)	Qu. 50% (median)	Qu. 95% (worst case)
1/11	16	28	42
1/18	7	23	50
1/25	4	22	53
2/1	4	26	60
2/8	6	28	64
2/15	6	29	71

So what?

ICU bed usage is expected to slowly decrease in the Northwest region

Regional Hospitalization Forecasts: Southeast



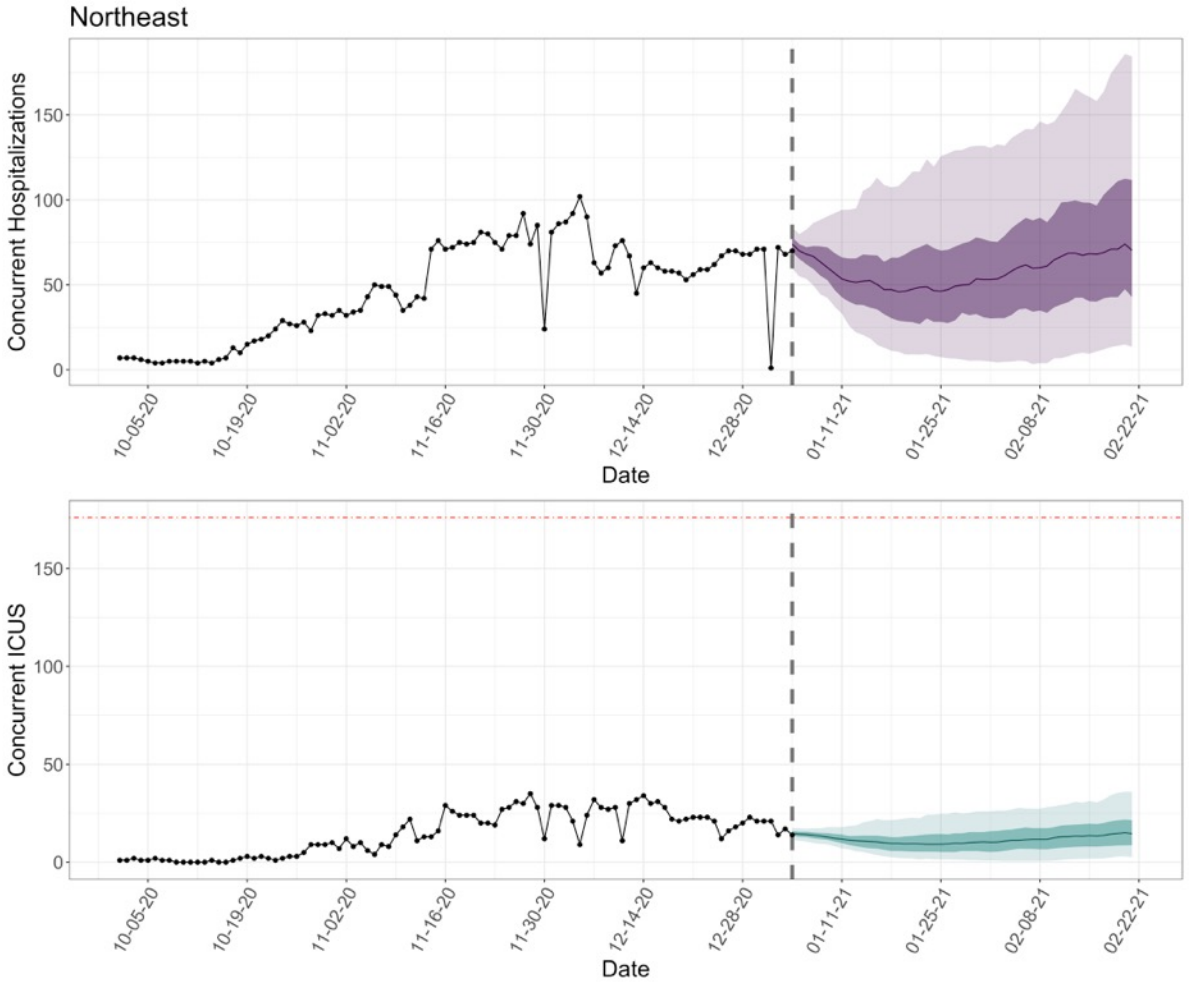
Concurrent COVID-19 ICUs beds: Southeast

Week	Qu. 5% (best case)	Qu. 50% (median)	Qu. 95% (worst case)
1/11	10	15	21
1/18	5	13	26
1/25	3	13	30
2/1	3	14	31
2/8	3	15	36
2/15	4	17	37

So what?

ICU bed usage is expected to slowly decrease 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)
1/11	7	12	18
1/18	3	10	22
1/25	1	9	25
2/1	1	10	26
2/8	1	12	27
2/15	2	14	31

So what?

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

> Non-Congregational Shelter Forecast

Non-Congregate Shelter Forecast

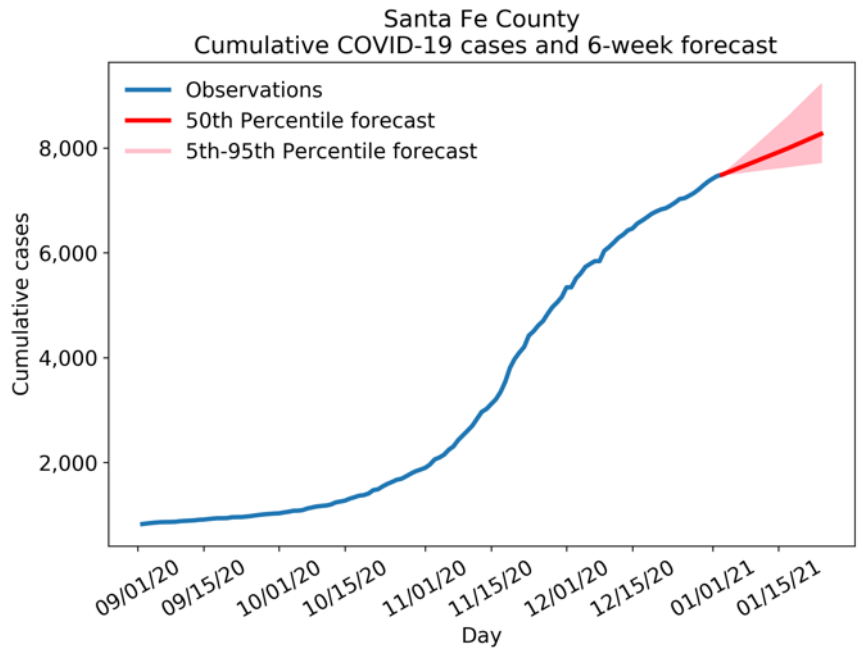
- **Our goal is to inform the capacity of Santa Fe and Albuquerque shelters for forecasting the potential that Santa Fe becomes full and guests need to reroute to Albuquerque**
  - We also examine McKinley and San Juan Counties, which historically have had high shelter use
- **We calculate a ratio between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

So what?

Shelter use right now is trending between median and worst case scenario predictions

Non-Congregate Shelter Forecast: Santa Fe

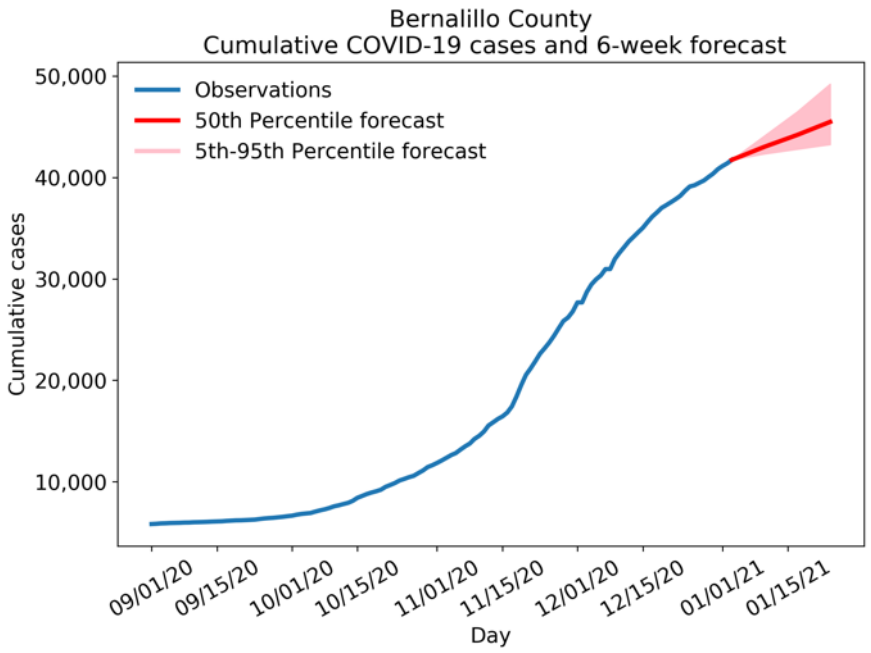
Number of cases as of 1/3/21: **7,489**
Number of shelter rooms available: **52**
Total number of patients/medical workers (including specialty): **36**
Number of patients: **35**
Number of medical workers: **1**
2-week avg. new cases per day: **50**



	1/10/21	1/17/21	1/24/21
Total cases	7,739 (7,570-8,035)	7,992 (7,647-8,598)	8,266 (7,726-9,215)
# of rooms needed	26 (8-56)	26 (8-58)	28 (8-63)
Deficit (-) or surplus of rooms	26	26	24

Non-Congregate Shelter Forecast: Bernalillo

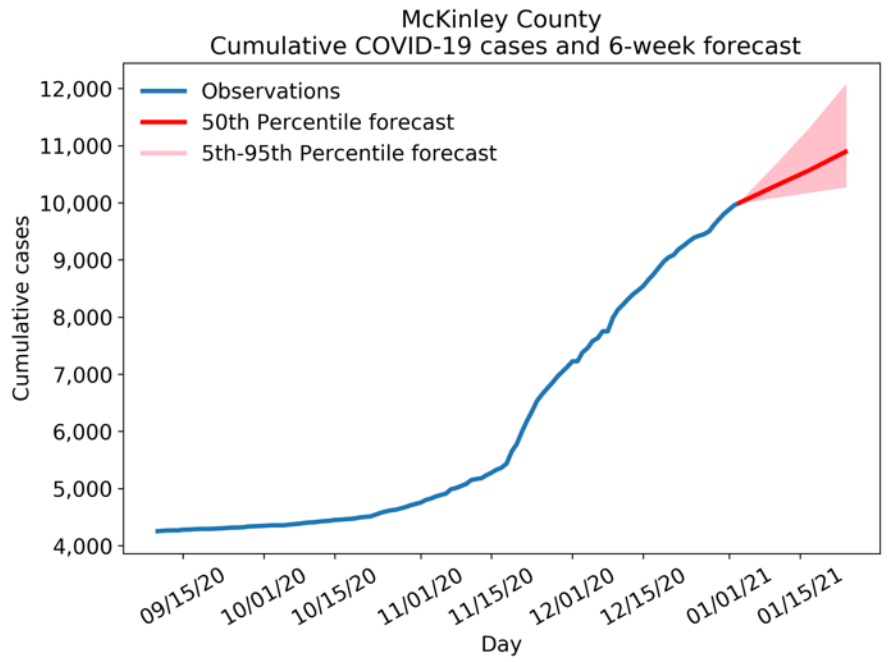
Number of cases as of 1/3/21: **41,730**
Number of shelter rooms available: **213**
Total number of patients/medical workers (including specialty): **43**
Number of patients: **40**
Number of medical workers: **3**
2-week avg. new cases per day: **318**



	1/10/21	1/17/21	1/24/21
Total cases	43,023 (42,329-44,101)	44,192 (42,791-46,474)	45,474 (43,249-49,195)
# of rooms needed	25 (12-23)	23 (9-46)	25 (9-52)
Deficit (-) or surplus of rooms	188	190	188

Non-Congregate Shelter Forecast: McKinley

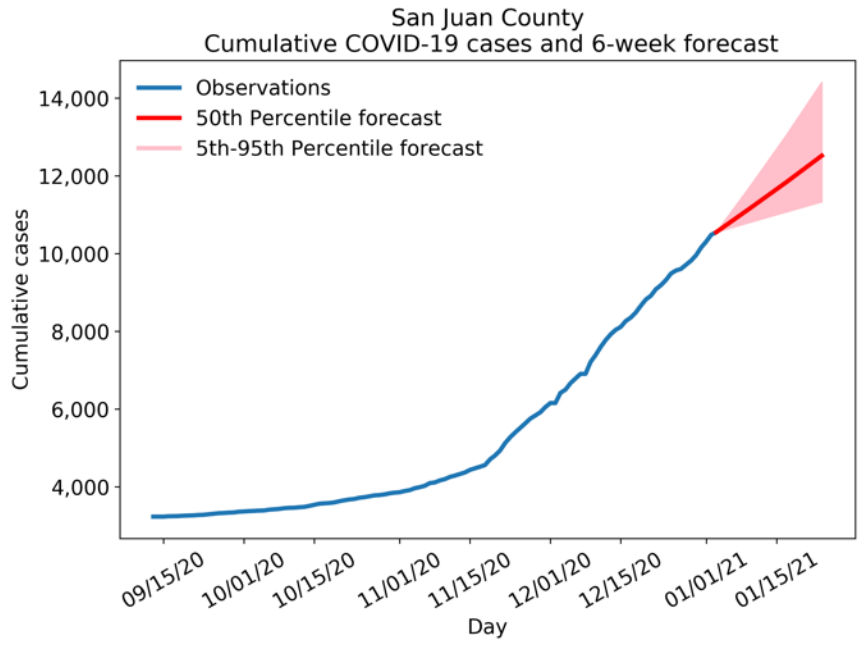
Number of cases as of 1/3/21: **9,997**
Number of shelter rooms available: **160**
Total number of patients/medical workers (including specialty): **51**
Number of patients: **46**
Number of medical workers: **5**
2-week avg. new cases per day: **68**



	1/10/21	1/17/21	1/24/21
Total cases	10,289 (10,099-10,639)	10,575 (10,191-11,309)	10,892 (10,286-12,055)
# of rooms needed	31 (11-69)	31 (10-72)	34 (10-80)
Deficit (-) or surplus of rooms	129	129	126

Non-Congregate Shelter Forecast: San Juan

Number of cases as of 1/3/21: **10,551**
Number of shelter rooms available: **25**
Total number of patients/medical workers (including specialty): **15**
Number of patients: **15**
Number of medical workers: **0**
2-week avg. new cases per day: **124**



	1/10/21	1/17/21	1/24/21
Total cases	11,190 (10,818-11,781)	11,841 (11,076-13,059)	12,518 (11,335-14,411)
# of rooms needed	11 (5-21)	11 (5-22)	12 (4-23)
Deficit (-) or surplus of rooms (SJ)	14	14	13