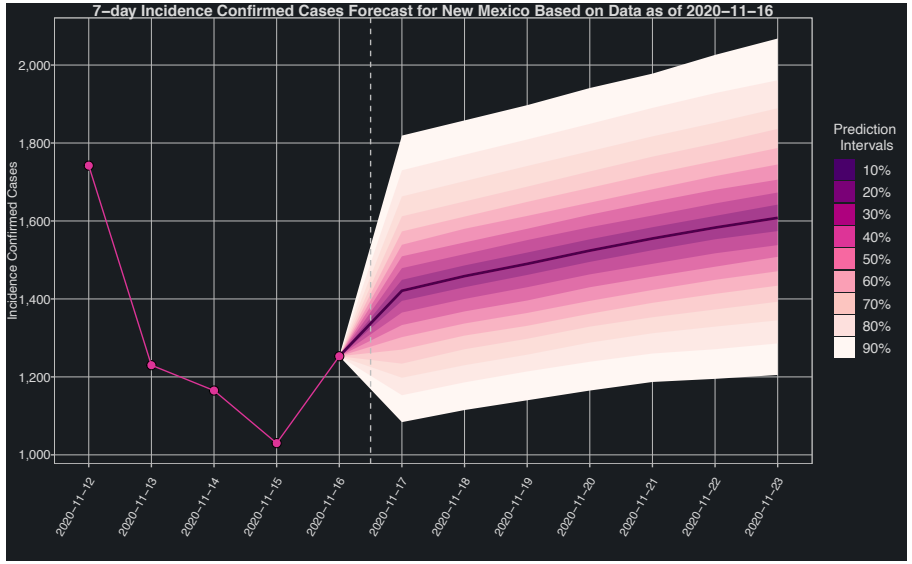
Modeling & Forecasting COVID-19 in NM

November 17, 2020

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 2020–11–16

Week	Best Case (5th Percentile)	Middle Case (50th Percentile)	Worst Case (95th Percentile)^
2020–11–16		65,454*	
2020–11–23	73,601	76,088	79,018
2020–11–30	82,056	87,756	94,354
2020–12–07	89,742	99,392	110,947
2020–12–14	96,636	110,370	128,659
2020–12–21	102,580	120,840	146,805
2020–12–28	107,717	130,956	165,048

*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 2020–11–16

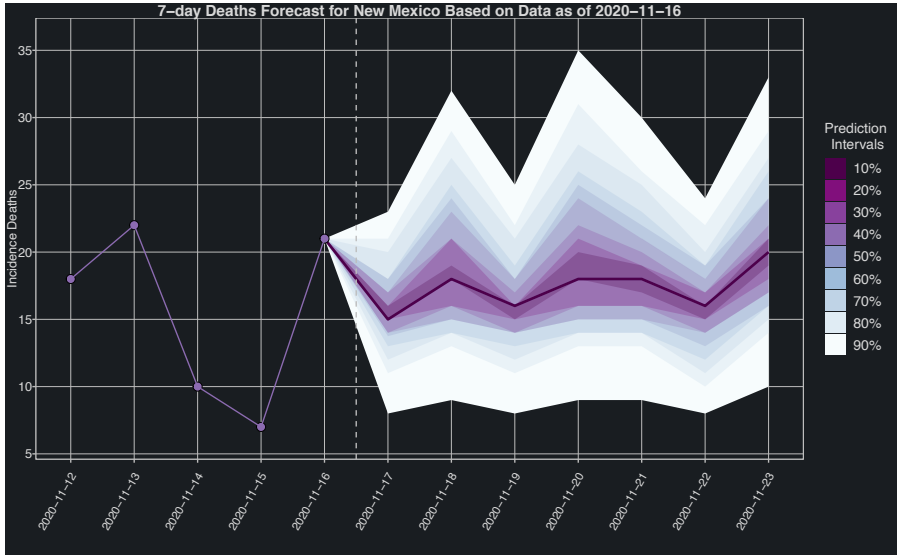
Week	Best Case (5th Percentile)	Middle Case (50th Percentile)	Worst Case (95th Percentile)^
2020–11–16		1,309*	
2020–11–23	1,164	1,519	1,938
2020–11–30	1,208	1,667	2,191
2020–12–07	1,098	1,662	2,370
2020–12–14	985	1,568	2,530
2020–12–21	849	1,496	2,592
2020–12–28	734	1,445	2,606

*Last reported confirmed cases count
^Closest–matching scenario

So what?

The daily number of cases are expected to range between 1,500 and 2,200 in the next two weeks for the middle/worst case scenarios

Short- & Long-Term Forecast for NM: Deaths



6–Week Forecast of Deaths for New Mexico Based on Data as of 2020–11–16

Week	Best Case (5th Percentile)	Middle Case (50th Percentile)	Worst Case (95th Percentile)^
2020–11–16		1,236*	
2020–11–23	1,301	1,360	1,425
2020–11–30	1,379	1,505	1,670
2020–12–07	1,462	1,668	1,976
2020–12–14	1,541	1,837	2,351
2020–12–21	1,613	2,006	2,769
2020–12–28	1,677	2,163	3,233

*Last reported deaths count
^Closest–matching scenario

6–Week Forecast of Daily Average of Deaths for New Mexico Based on Data as of 2020–11–16

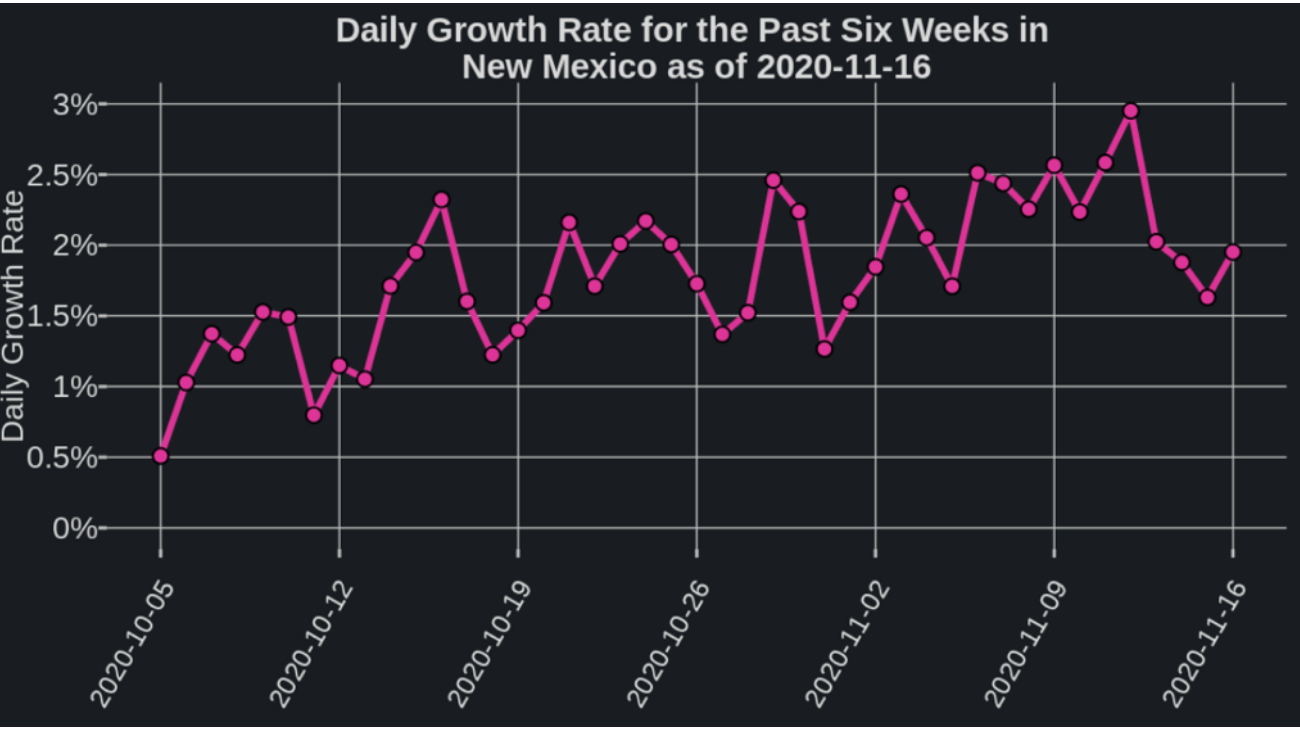
Week	Best Case (5th Percentile)	Middle Case (50th Percentile)	Worst Case (95th Percentile)^
2020–11–16		15*	
2020–11–23	9	18	27
2020–11–30	11	21	35
2020–12–07	12	23	44
2020–12–14	11	24	54
2020–12–21	10	24	60
2020–12–28	9	22	66

*Last reported confirmed deaths
^Closest–matching scenario

So what?

The daily number of deaths are expected to range between 18 and 21 in the next two weeks for the middle case

Growth Rate for NM



6-Week Forecast of the Average Weekly Growth Rate for New Mexico Based on Data as of 2020-11-16

Week	Best Case (5th Percentile)	Middle Case (50th Percentile)	Worst Case (95th Percentile)^
2020-11-16		2.2%*	
2020-11-23	1.7%	2.2%	2.7%
2020-11-30	1.6%	2.1%	2.6%
2020-12-07	1.3%	1.8%	2.3%
2020-12-14	1.1%	1.5%	2.1%
2020-12-21	0.86%	1.3%	1.9%
2020-12-28	0.70%	1.2%	1.7%

*Last weekly mean daily growth rate

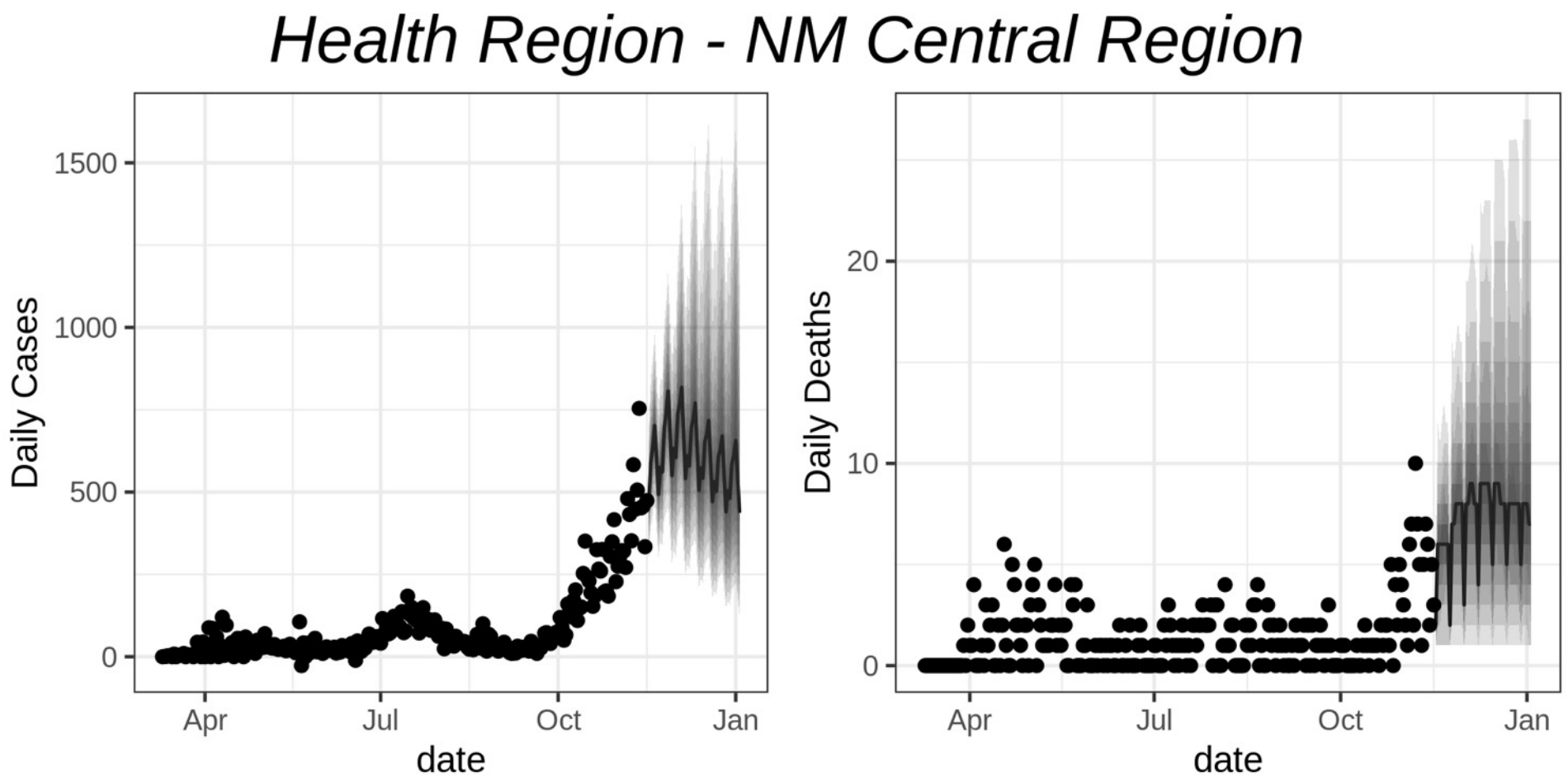
^Closest-matching scenario

So what?

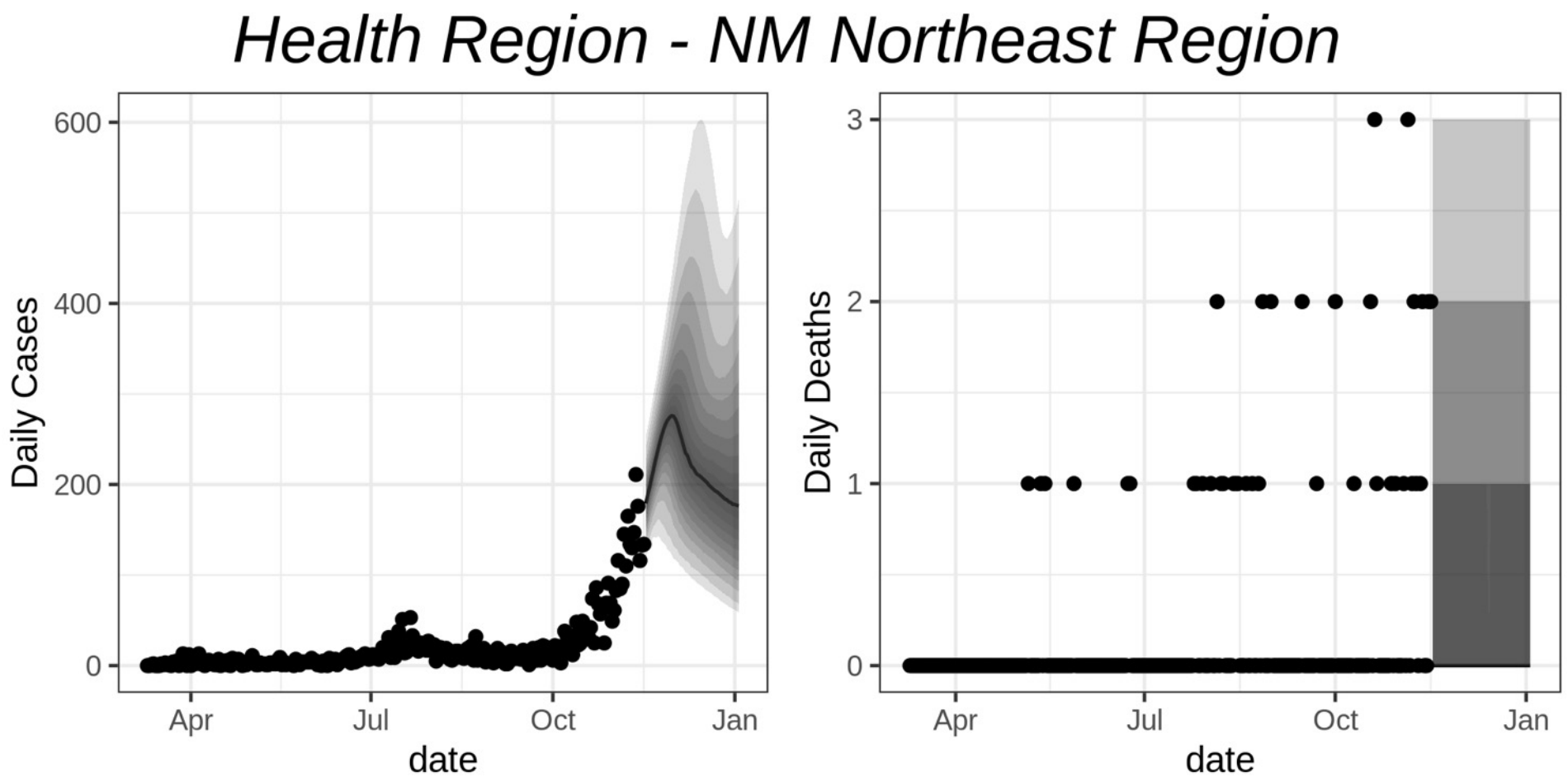
As of November 16th, the average growth rate in NM is at 2.2% (down from 2.3%)

> Regional Forecasts, Growth Rates, & Hospitalizations

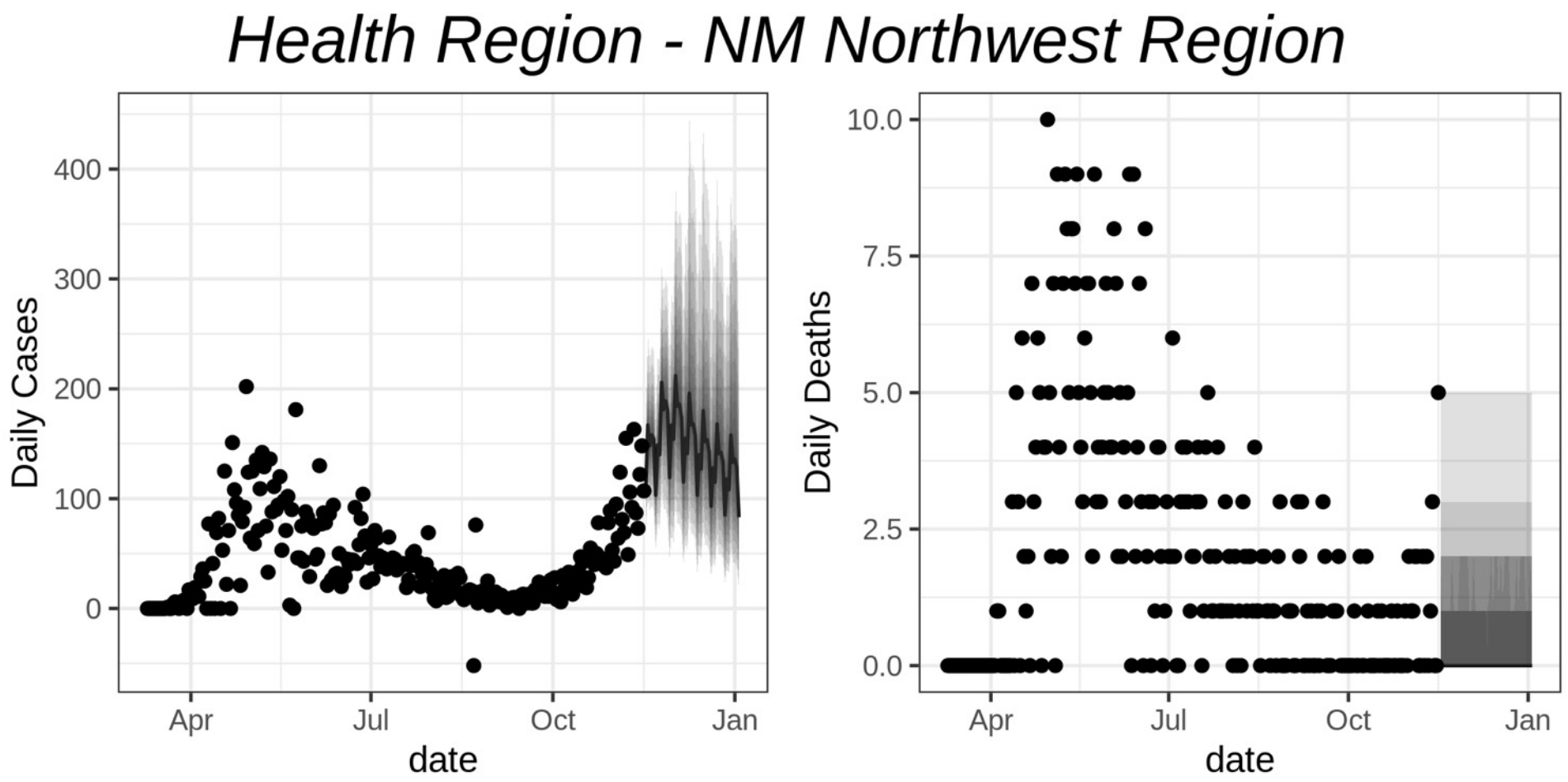
Central Region Forecasts



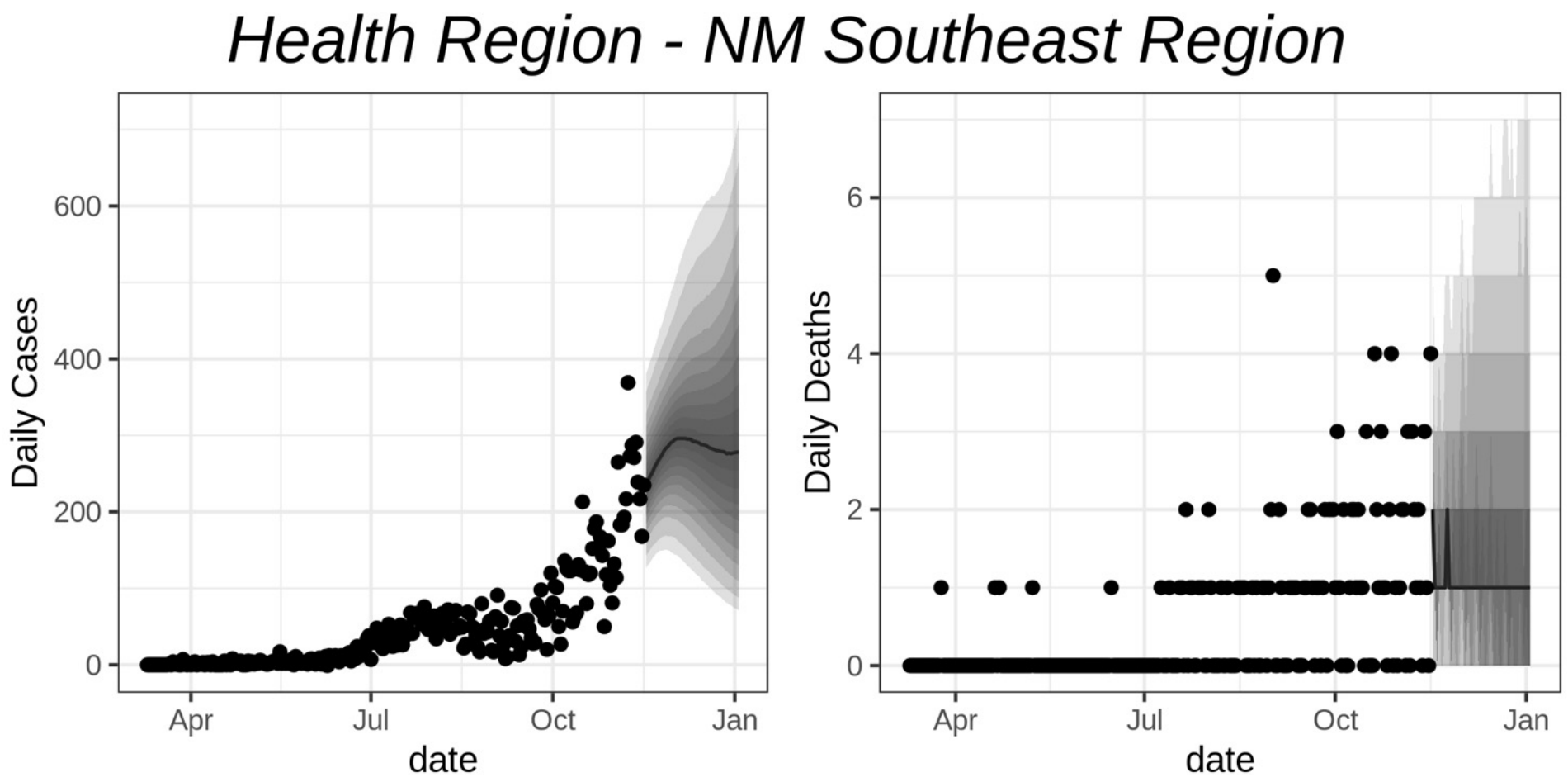
Northeast Region Forecasts



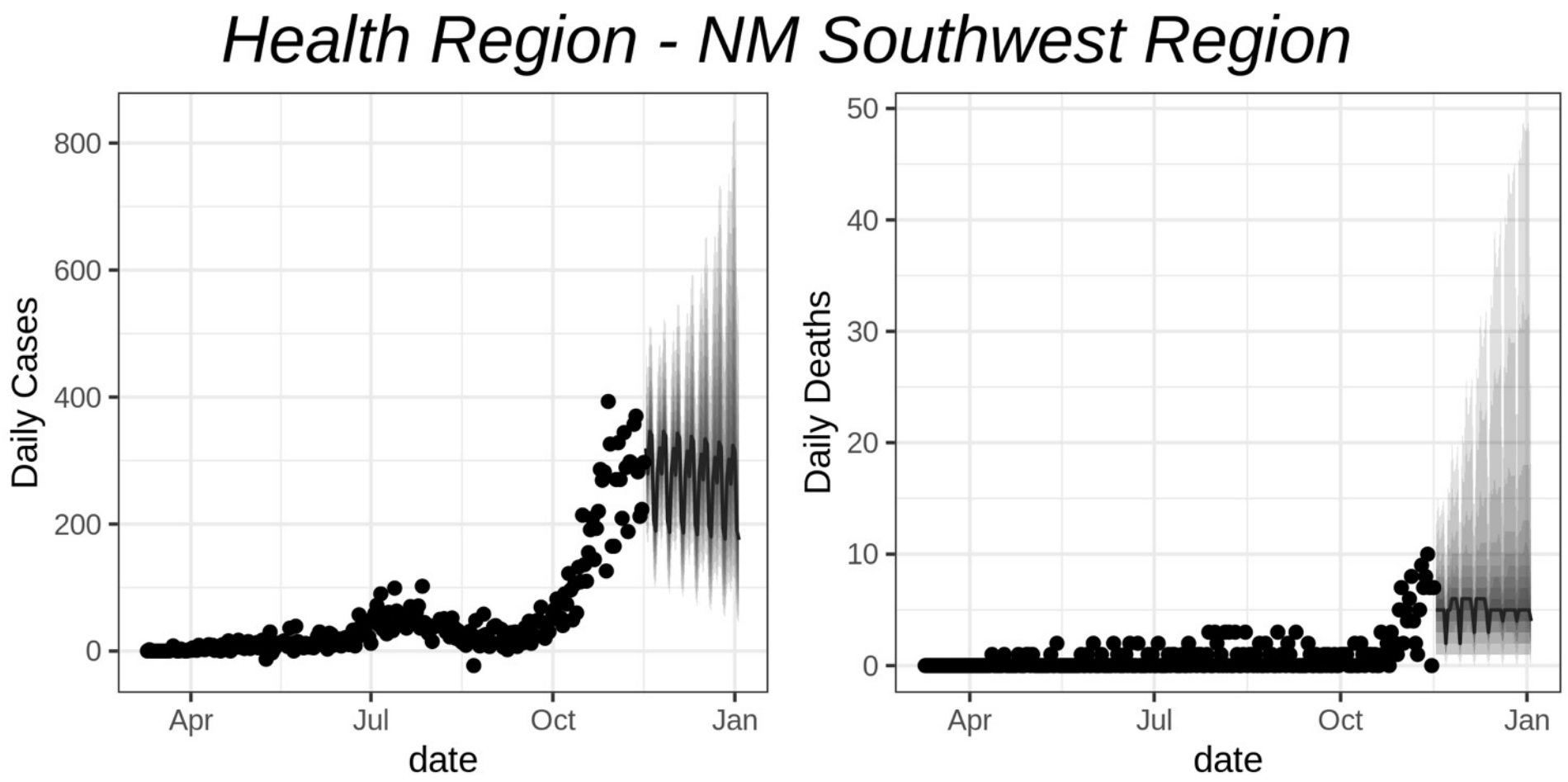
Northwest Region Forecasts



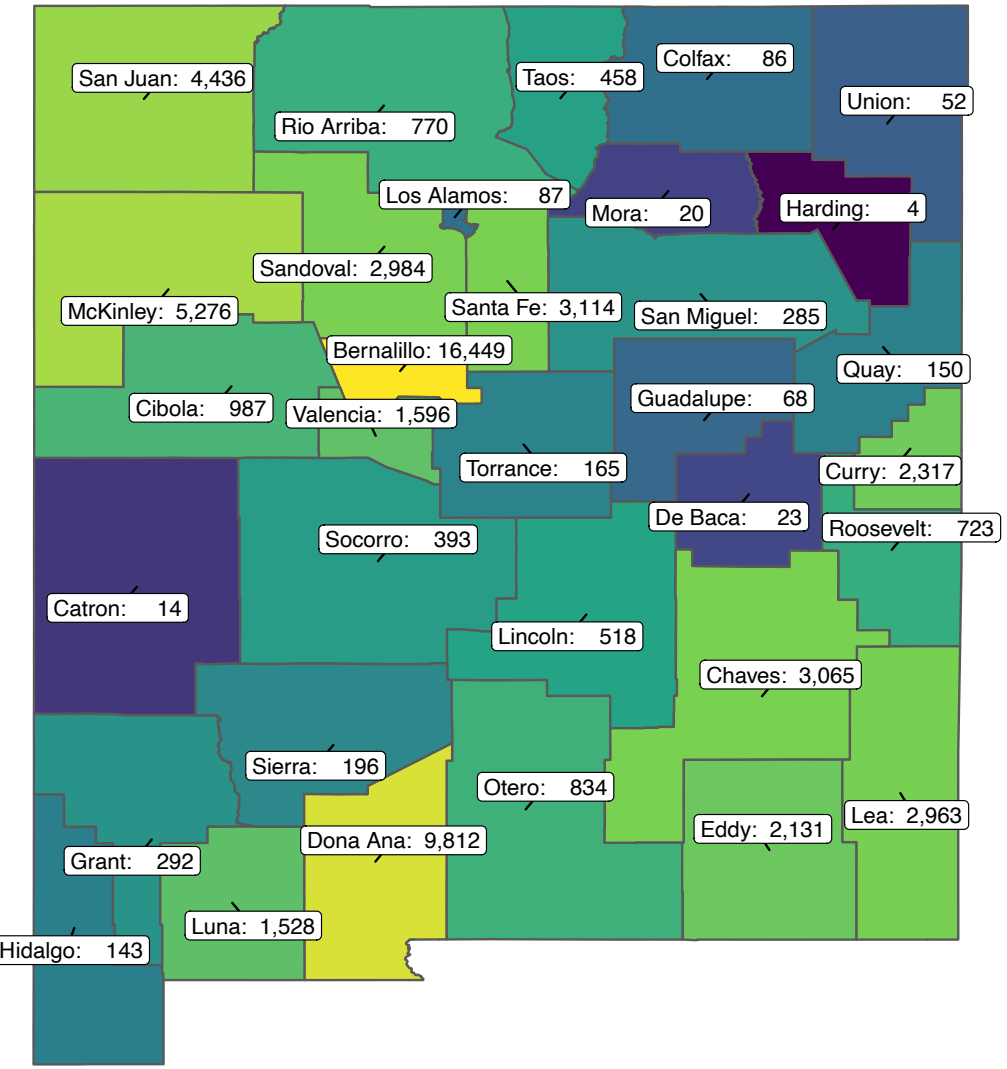
Southeast Region Forecasts

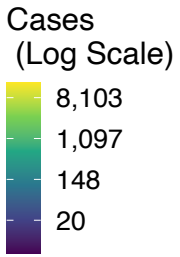


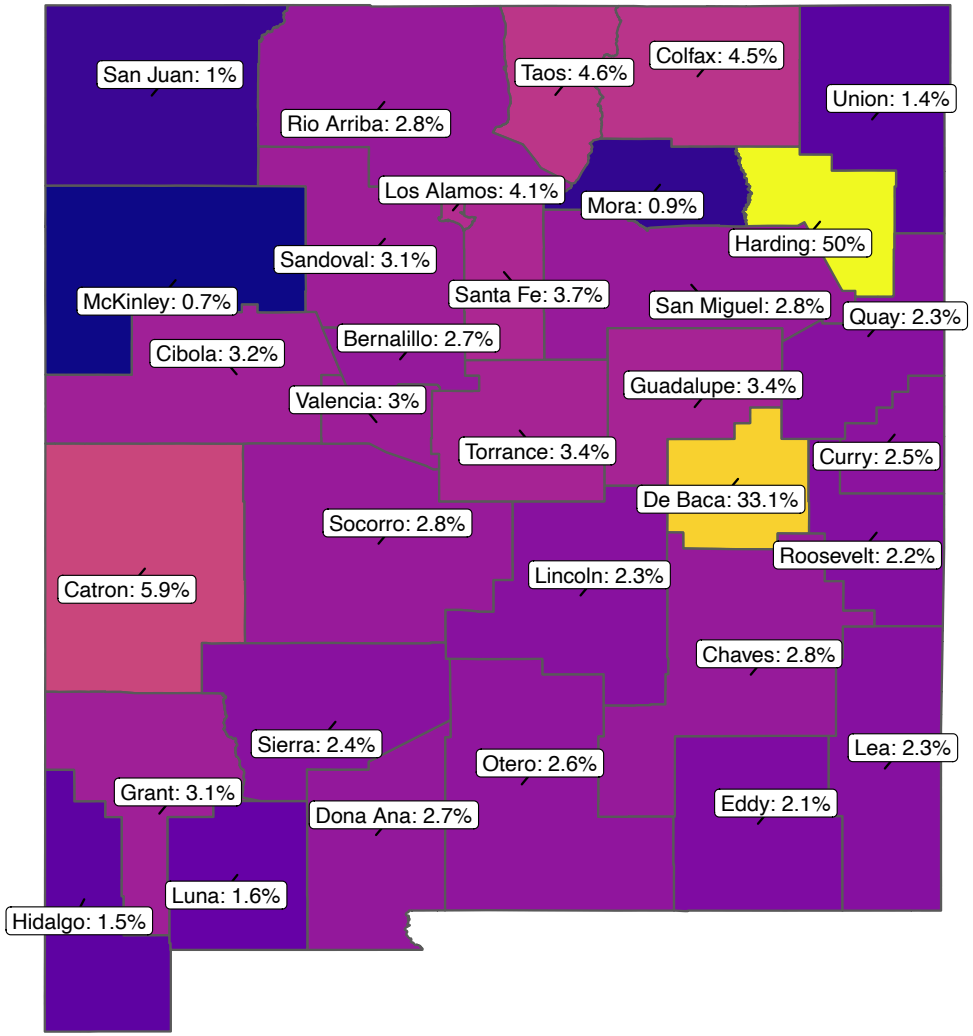
Southwest Region Forecasts

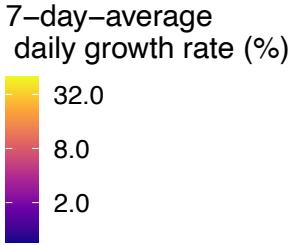


Cumulative Cases & Daily Growth Rate for NM: Nov 16

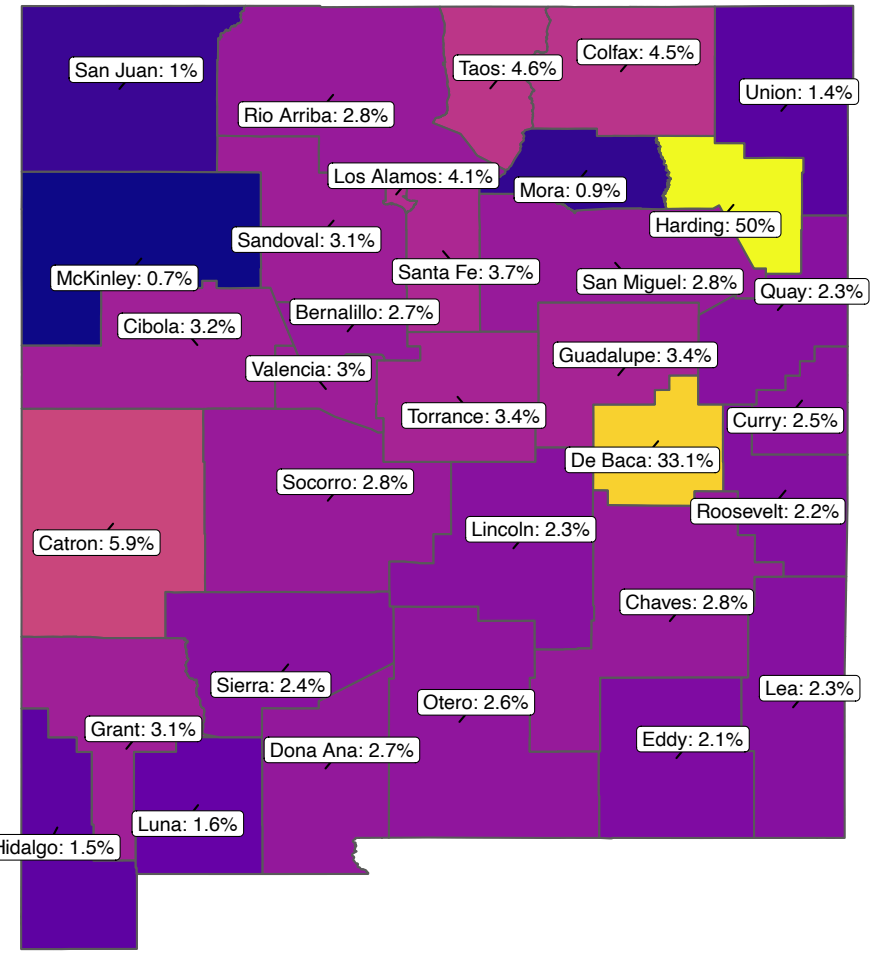








Daily Growth Rate for NM Nov 16



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

Socorro **2.8%** =
Los Alamos **4.1%** =
Mora **0.9%** ↓
Roosevelt **2.2%** ↓

Colfax 4.5% ↑
Quay 2.3% ↑
Hidalgo **1.5%** ↑
DeBaca **33.1%** ↑
Catron **5.9%** ↑
Union **1.4%** ↑

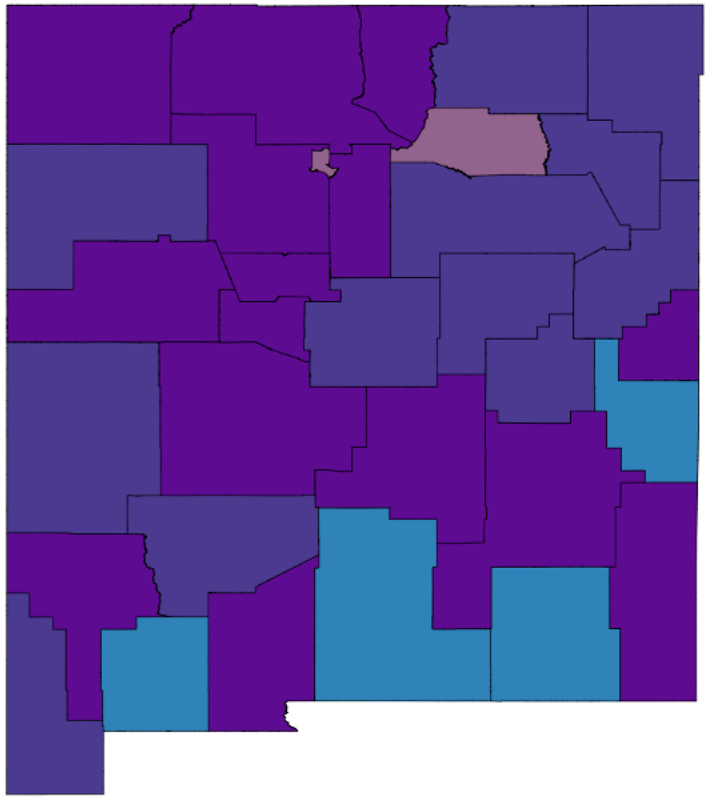
County	Daily Growth Rate	Change
San Juan	**1.0%**	=
Rio Arriba	**2.8%**	=
Sierra	**2.4%**	↓
McKinley	0.7%	=
Sandoval	**3.1%**	↑
Santa Fe	**3.7%**	↑/=
Cibola	**3.2%**	↑/=
Bernalillo	**2.7%**	↑
Valencia	**3.0%**	=
Torrance	**3.4%**	↑
Lincoln	**2.3%**	↑
San Miguel	**2.8%**	=
Chaves	**2.8%**	↑
Dona Ana	2.7%	=
Otero	**2.6%**	↓
Lea	**2.3%**	=
Eddy	**2.1%**	=
Curry	**2.5%**	=
Grant	**3.1%**	↑
Luna	**1.6%**	↓
Taos	**4.6%**	↑

Weekly Growth Rate for NM: Another View (Nov 16)

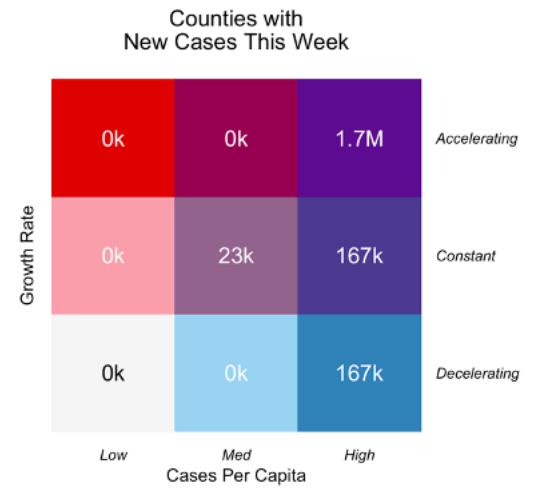
COVID-19 across New Mexico

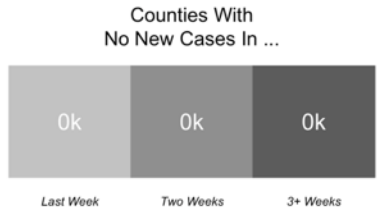
A 7-day moving window comparison

November 16, 2020



Impacted New Mexicans





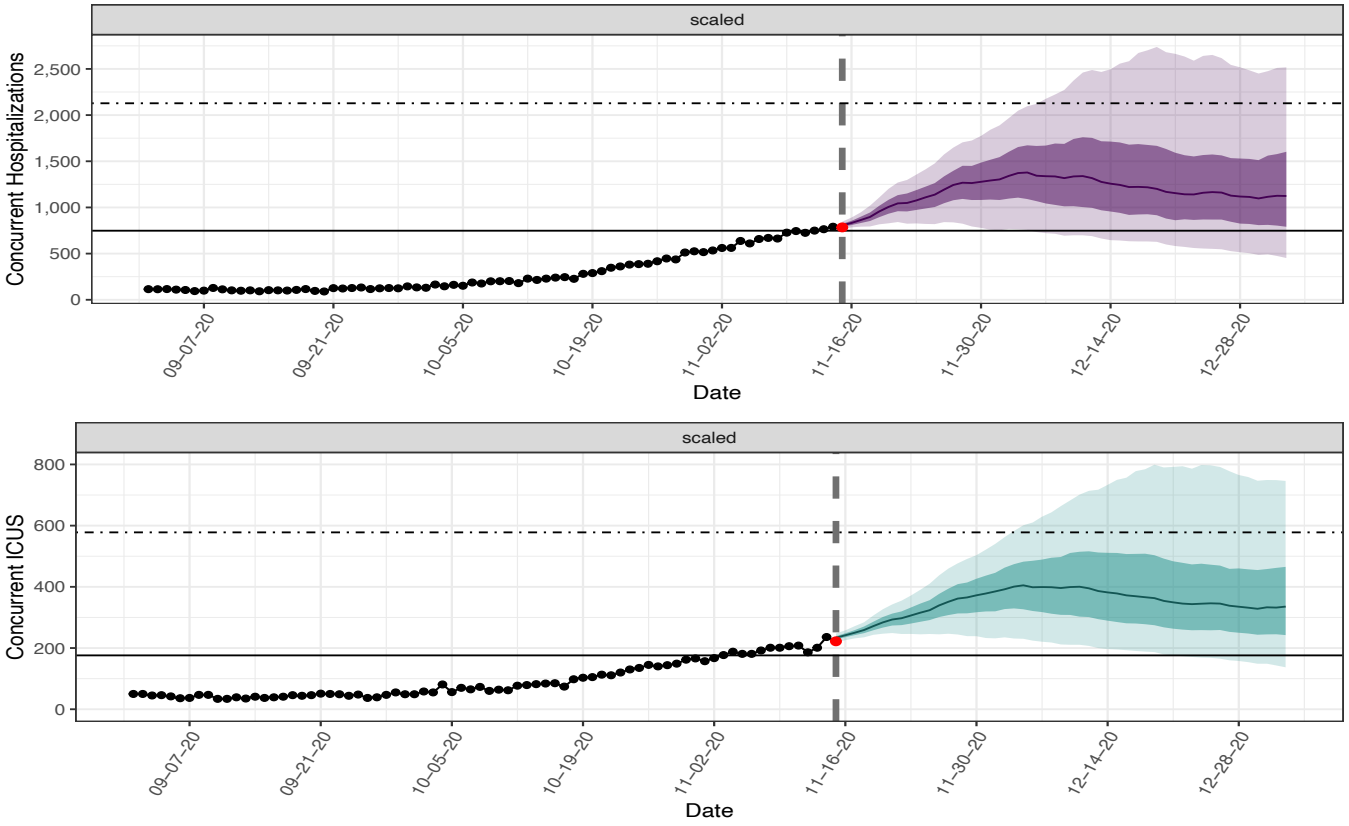
So what?

- MOST New Mexicans continue to live in a county with accelerating growth rates and high per-capita case counts
- Luna, Otero, Eddy, and Roosevelt are decelerating but still high per-capita case counts

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

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

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

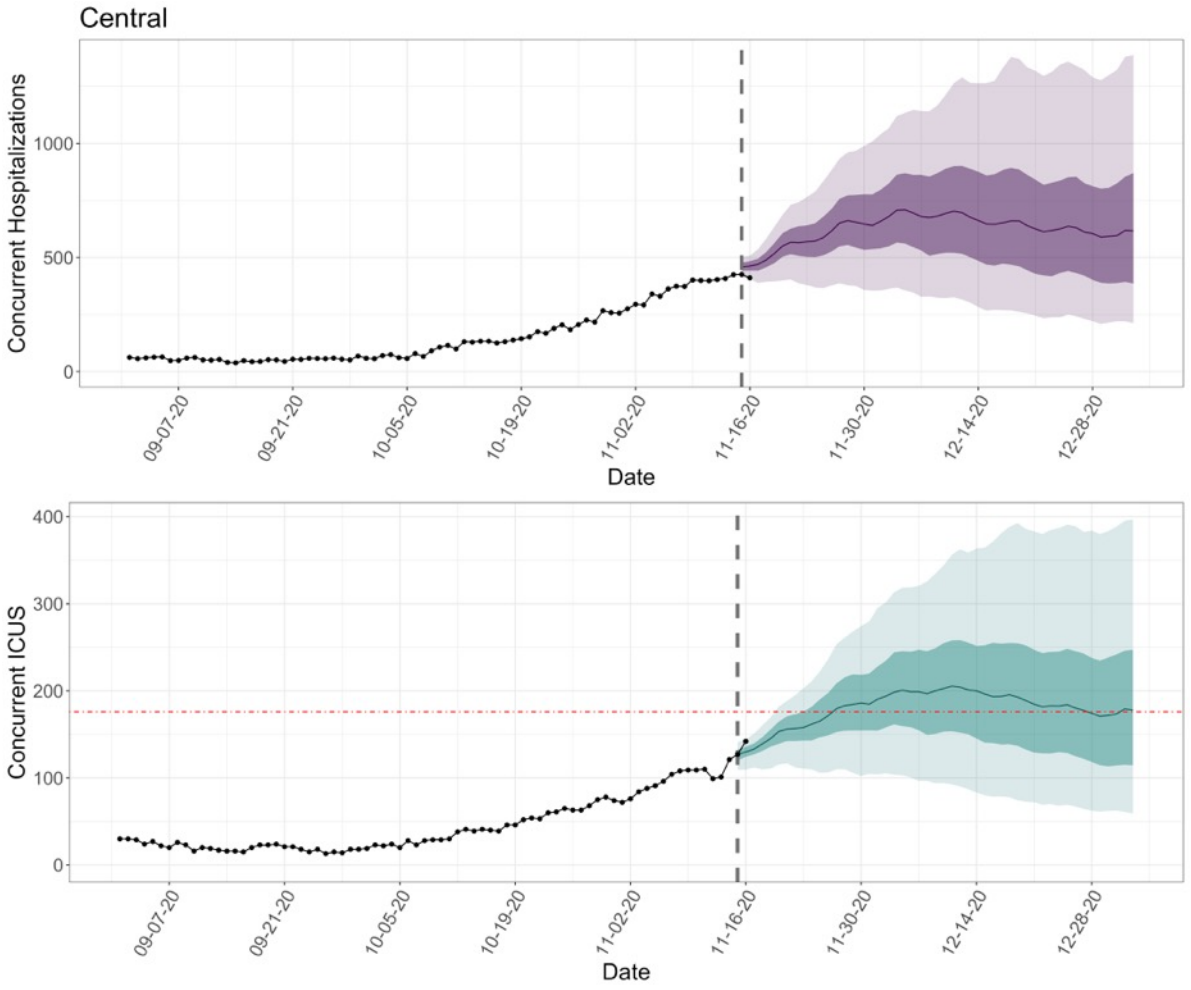
Week	Qu. 5% (best case)	Qu. 50% (median)	Qu. 95% (worst case)
11/15	246	297	355
11/22	239	365	491
11/29	224	399	610
12/6	200	386	717
12/13	179	354	790
12/20	160	338	778

"Scaled" Scenario

So what?

We are over baseline ICU bed capacity for concurrent COVID-19 patients; predictions reach nearly 400 concurrent COVID-19 ICU beds needed by end of November

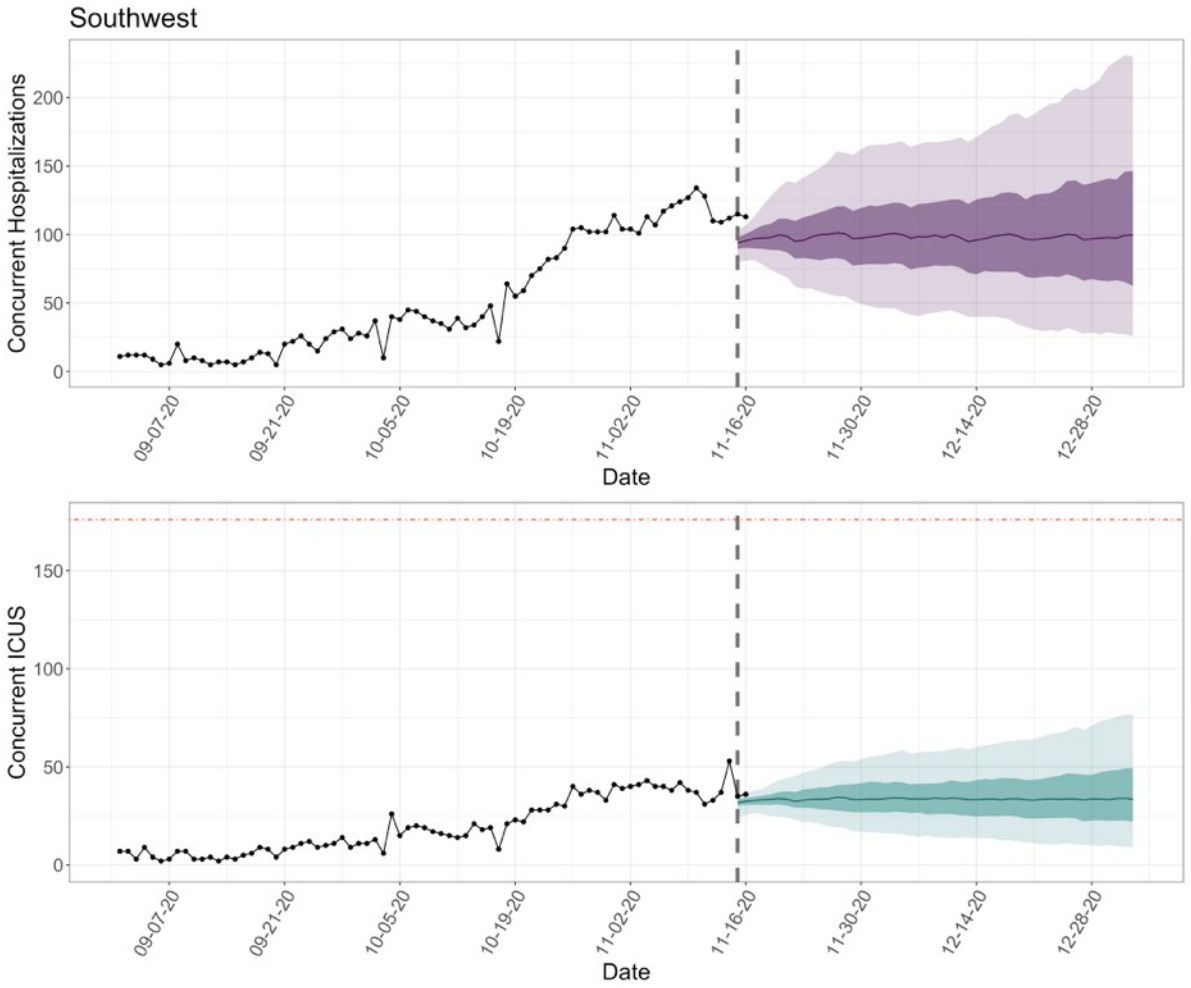
Regional Hospitalization Forecasts: Central



Concurrent COVID-19 ICUs beds: Central

Week	Qu. 5% (best case)	Qu. 50% (median)	Qu. 95% (worst case)
11/22	112	157	195
11/29	106	184	268
12/6	101	199	319
12/13	87	201	359
12/20	73	189	386
12/27	64	178	382

Regional Hospitalization Forecasts: Southwest



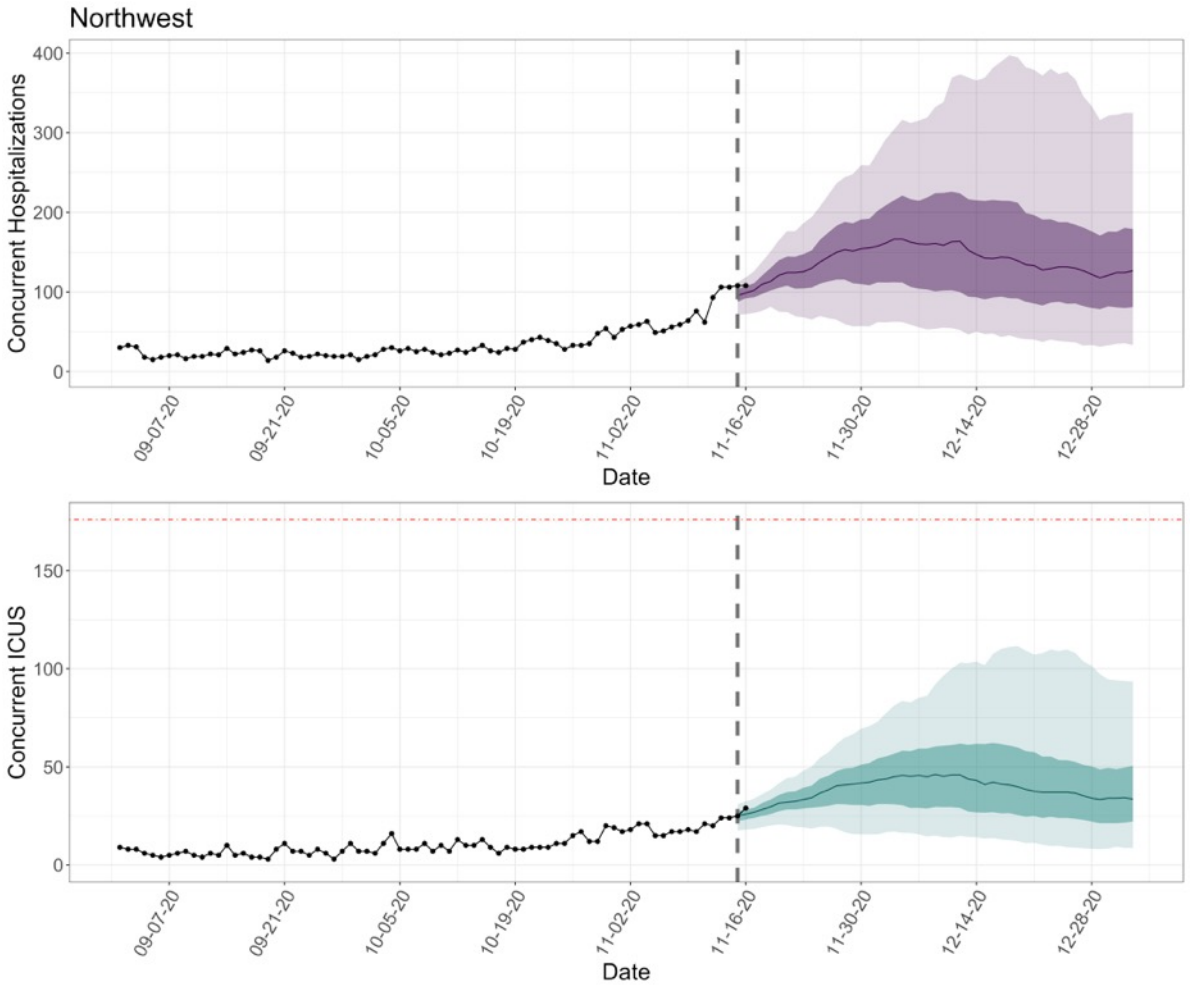
Concurrent COVID-19 ICUs beds: Southwest

Week	Qu. 5% (best case)	Qu. 50% (median)	Qu. 95% (worst case)
11/22	23	32	45
11/29	17	33	53
12/6	15	34	57
12/13	14	33	59
12/20	12	33	64
12/27	10	33	69

So what?

- Southwest region has the most uncertainty in predicted hospitalizations; this depends on if the epidemic will slow down in the next week or two and the ongoing hospitalization rate

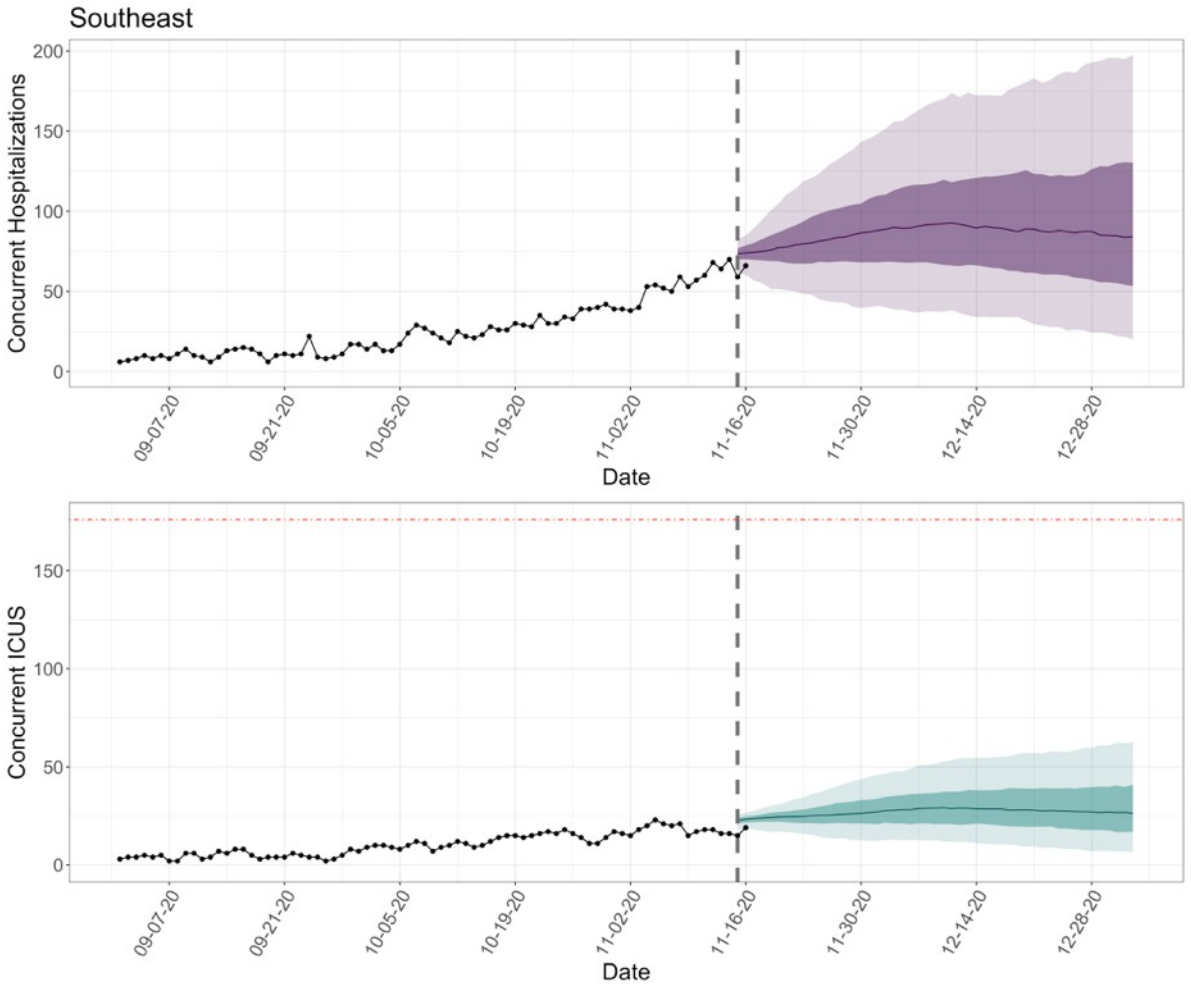
Regional Hospitalization Forecasts: Northwest



Concurrent COVID-19 ICUs beds: Northwest

Week	Qu. 5% (best case)	Qu. 50% (median)	Qu. 95% (worst case)
11/22	19	32	45
11/29	16	41	67
12/6	16	45	83
12/13	14	44	103
12/20	11	38	109
12/27	9	35	104

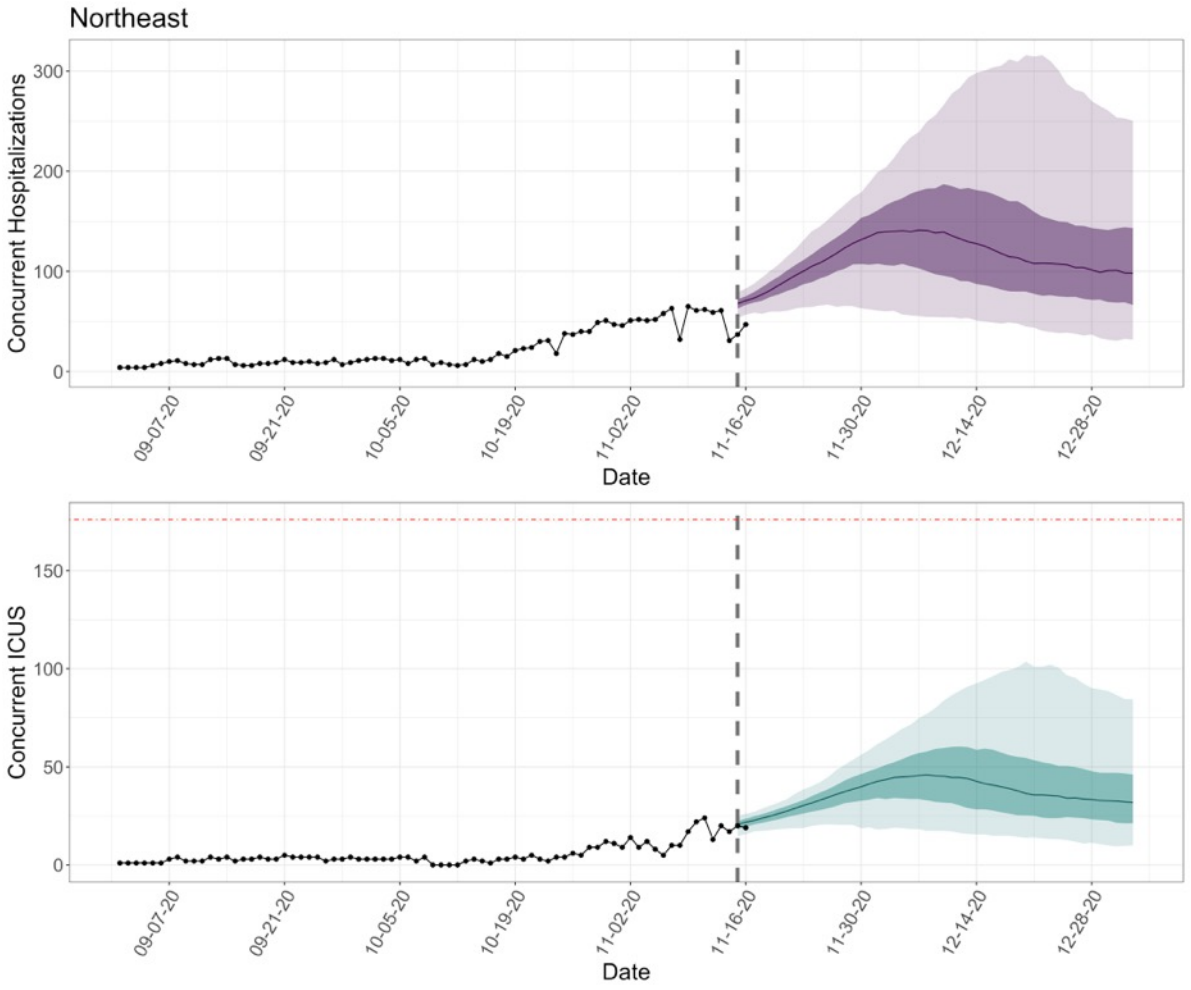
Regional Hospitalization Forecasts: Southeast



Concurrent COVID-19 ICUs beds: Southeast

Week	Qu. 5% (best case)	Qu. 50% (median)	Qu. 95% (worst case)
11/22	16	25	34
11/29	13	26	43
12/6	13	28	49
12/13	12	29	54
12/20	9	28	57
12/27	7	27	60

Regional Hospitalization Forecasts: Northeast



Concurrent COVID-19 ICUs beds: Northeast

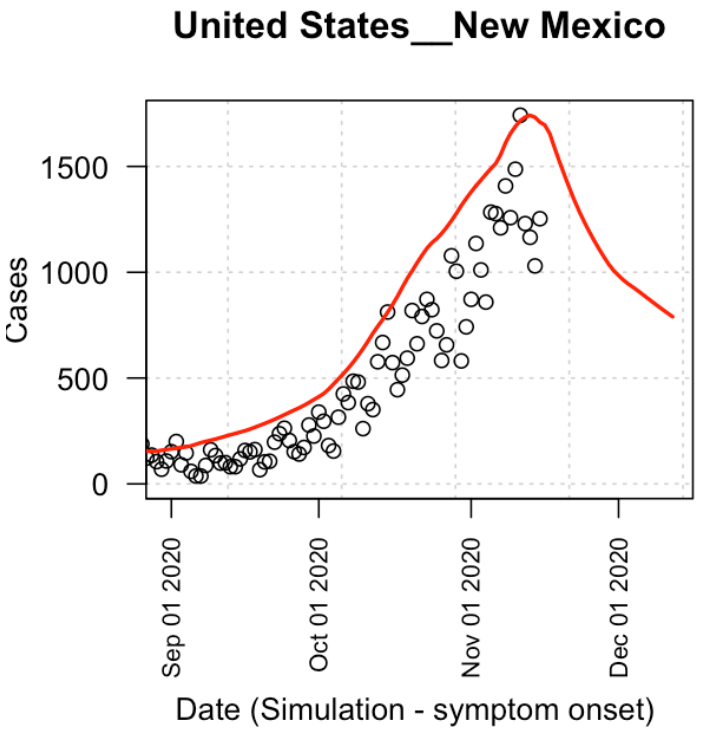
Week	Qu. 5% (best case)	Qu. 50% (median)	Qu. 95% (worst case)
11/22	19	29	36
11/29	20	39	54
12/6	18	45	71
12/13	16	44	91
12/20	14	36	104
12/27	11	34	92

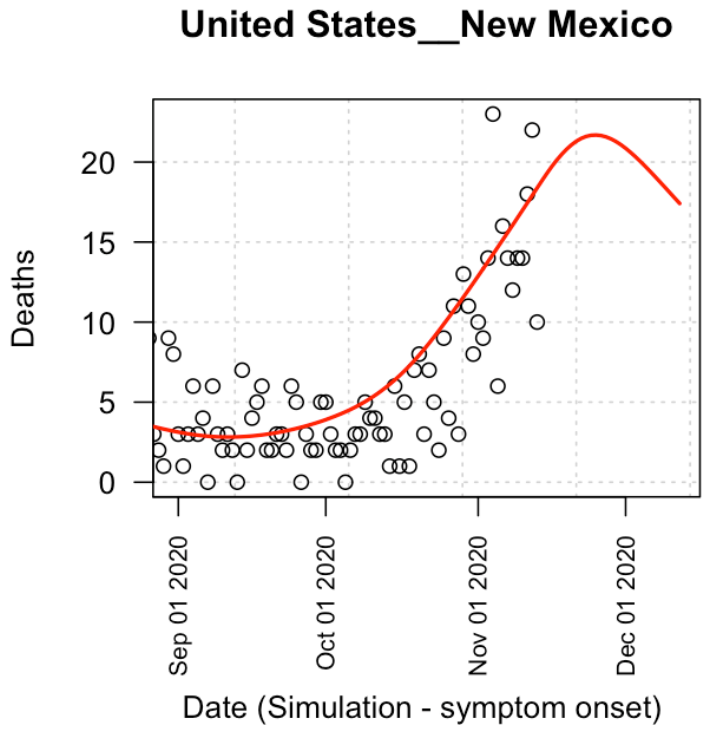
17 Nov 2020: EpiGrid modeling

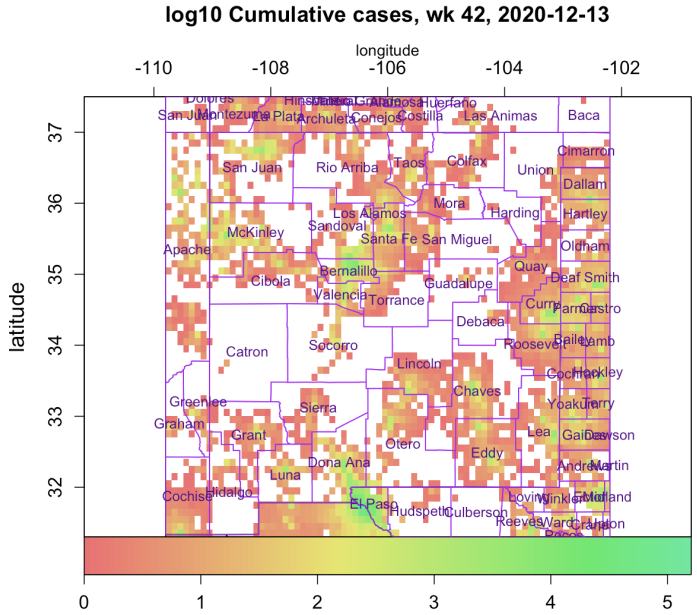
- Modifications due to Thanksgiving are not yet being modeled.

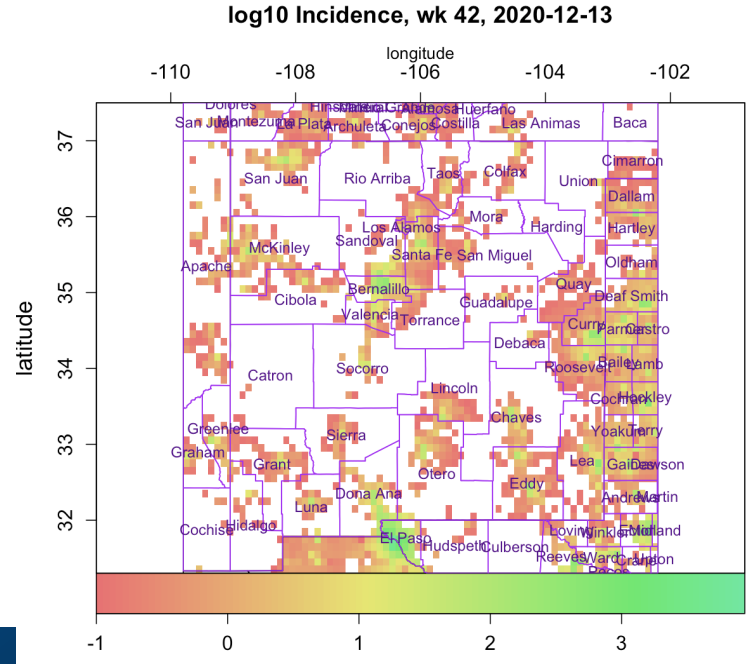
- Decreases in transmission due to the Nov. 16th PHO are being modeled based on the response to the March PHO.

- Quarantine increases in this model.





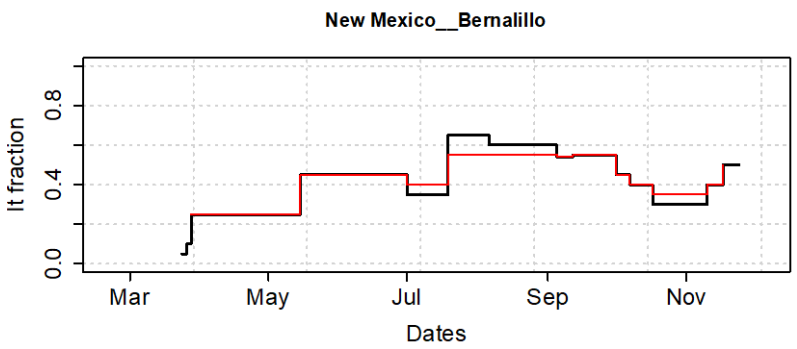




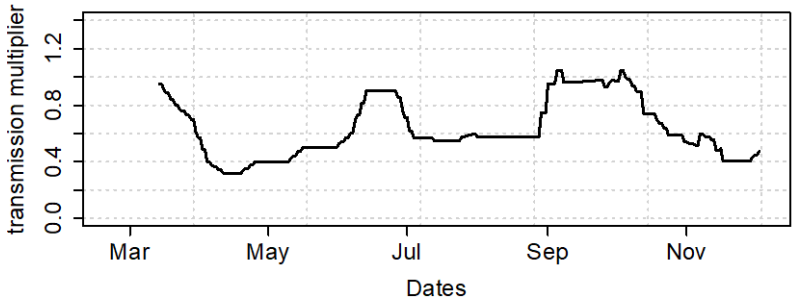
This week's model

- **The stay-at-home order in El Paso *was* having an effect; future unknown.**
  - A Nov. 13th court ruling ended the stay-at-home order. Some reduced transmission is still postulated for El Paso. This is a significant source of uncertainty relevant to Dona Ana county.
- **Modest transmission increases in some counties model "unexplained" (i.e. behavioral) transmission increases in those counties.**
  - Counties with transmission increases in Sept. or later are: Bernalillo, Dona Ana (5%), Luna, Santa Fe, Sierra, Socorro, Valencia.
  - Rio Arriba and Taos also have transmission increases, possibly due to the modeling of Colorado not reflecting recent changes.
- **Modeling of public reaction and public health orders (PHO).**
  - Aug. 29th PHO; 30% transmission increase (Chaves, Eddy, Lincoln, Quay are less); ends Nov. 16th. (significant increase over previous est.)
  - Oct 16th PHO; ~3 % transmission reduction; ends Nov. 16th
  - Oct. 23rd PHO; 5 – 10% transmission reduction; ends Nov. 16th
  - When incidence go up, people's protective behavior improves: 10/100,000/day -> 5% transmission drop; 50/100,000/day -> 10% decrease
  - Nov. 16th PHO; Response to the stay-at-home order is based on reaction to March PHO. Mobility decrease is assumed to be 90% of decrease in March/April.
- **Isolation and quarantine rates are assumed to be improving.**
  - Swab to results times: Estimates vary from 1-3 days to ~60 hours (http://www.tricore.org/covid_19_data_center)
  - Time to quarantine contacts down to 47 hrs (Nov. 6th)
  - Base isolation rate *was* recently 0.35, now for NM week starting Nov. 15th it is 0.5.

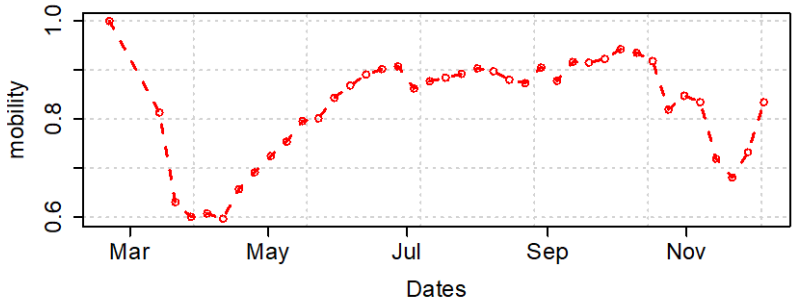
Quarantine and transmission control the epidemic: example Bernalillo



"I_t fraction" is the fraction of contagious people early in their disease progression who are quarantining. *Large is desirable.* Quarantine generally goes up with time, but decreases when (i) case counts are high and (ii) time from positivity to contact quarantine are long (NM State data). The Black curve shows Bernalillo. The red curve is the state-wide default.



Smaller transmission multipliers result in less transmission. *Small is desirable.* The transmission multiplier depends primarily on in-county mobility and varies due to other factors driven by, esp. public health orders (i.e. behavior). *A low transmission multiplier is less effective in the absence of a large/good I_t fraction.*



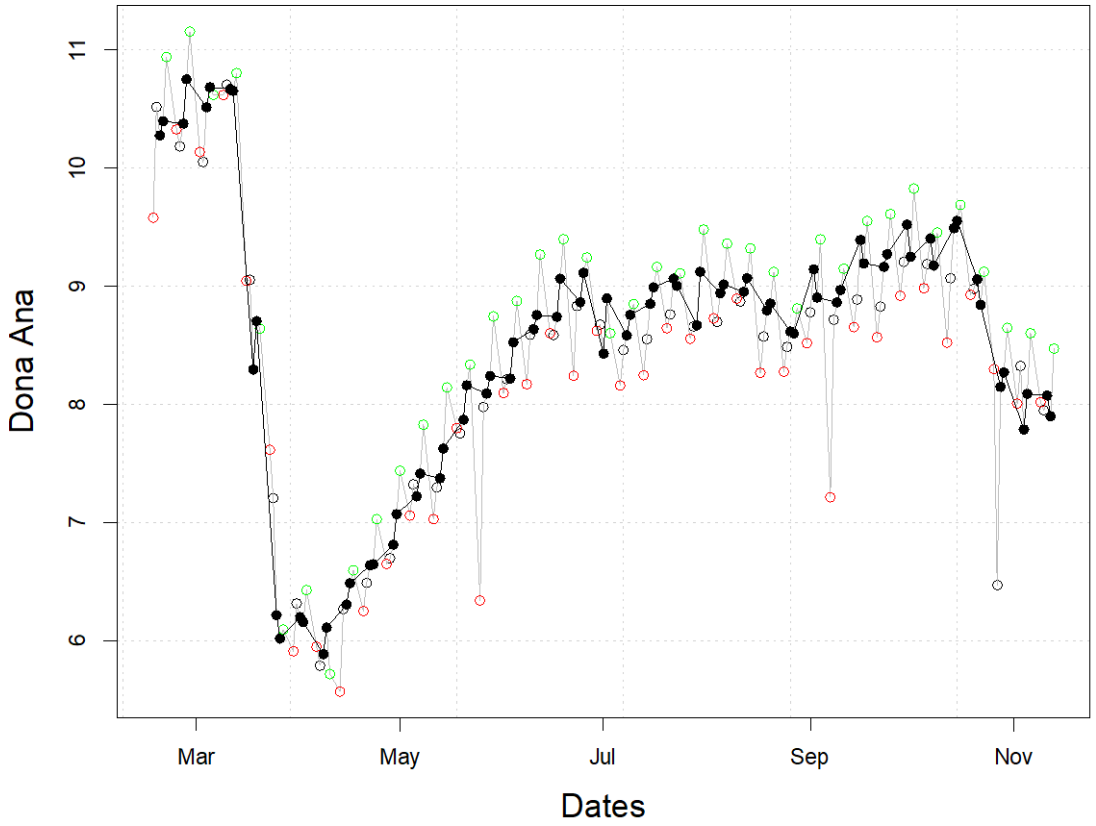
The red curve shows weekly averaged mobility for Bernalillo county, which is the primary model driver for the transmission multiplier above. The last 3 points are expected behavior, not measured.

Mobility is decreased in many counties compared to late September (Data only)

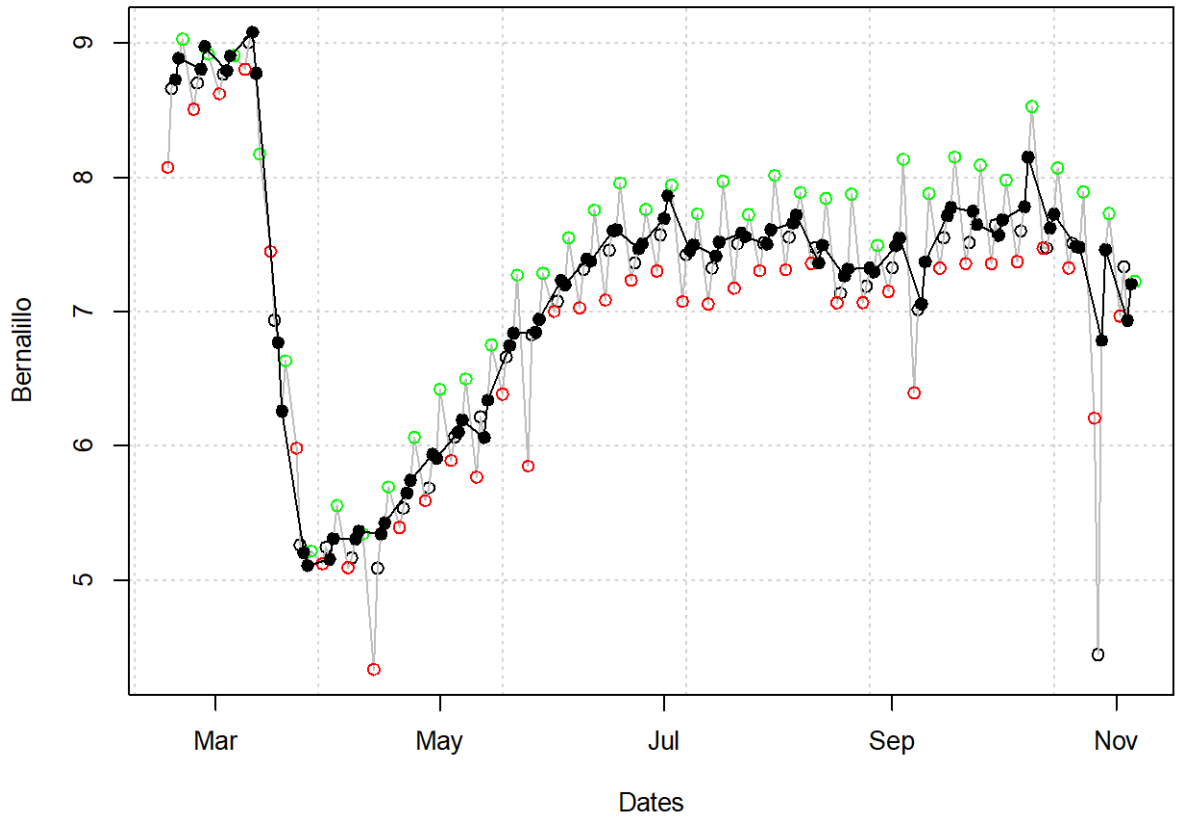
Decreased in all counties with large populations; Bernalillo, Dona Ana, San Juan, Santa Fe, and Sandoval,

- Weekends NOT shown
- Monday
- Wednesday/Thursday
- Friday

Dona Ana

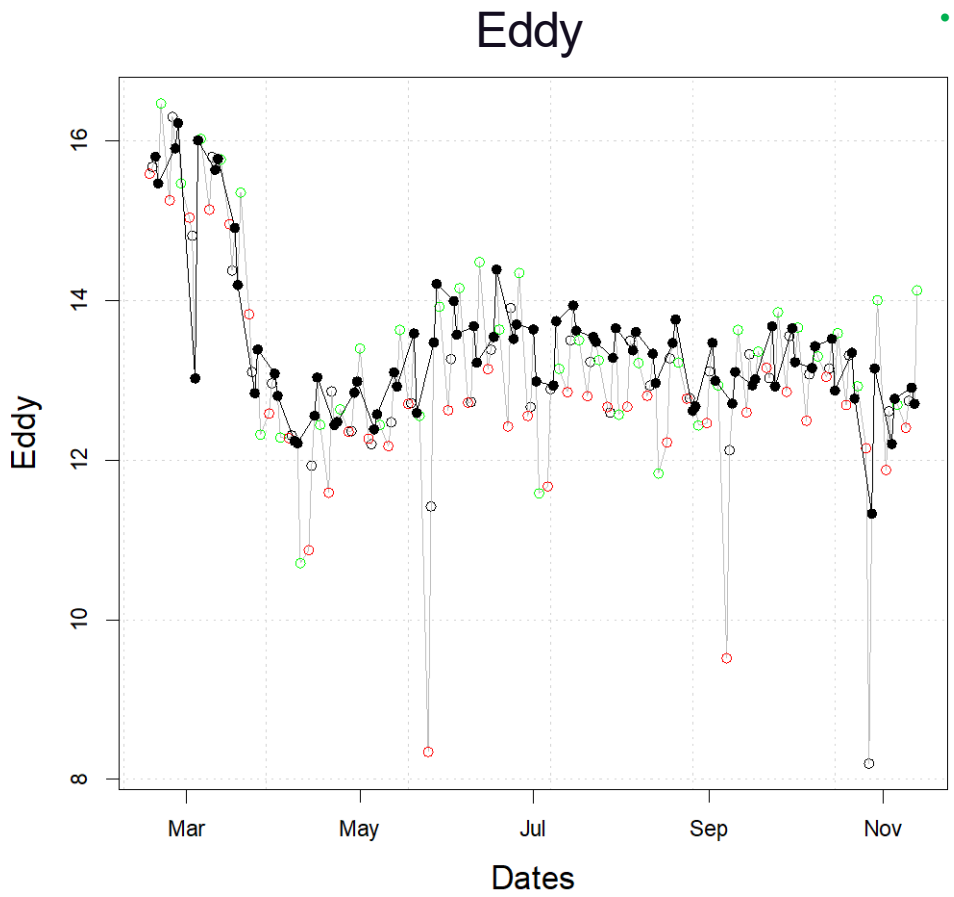


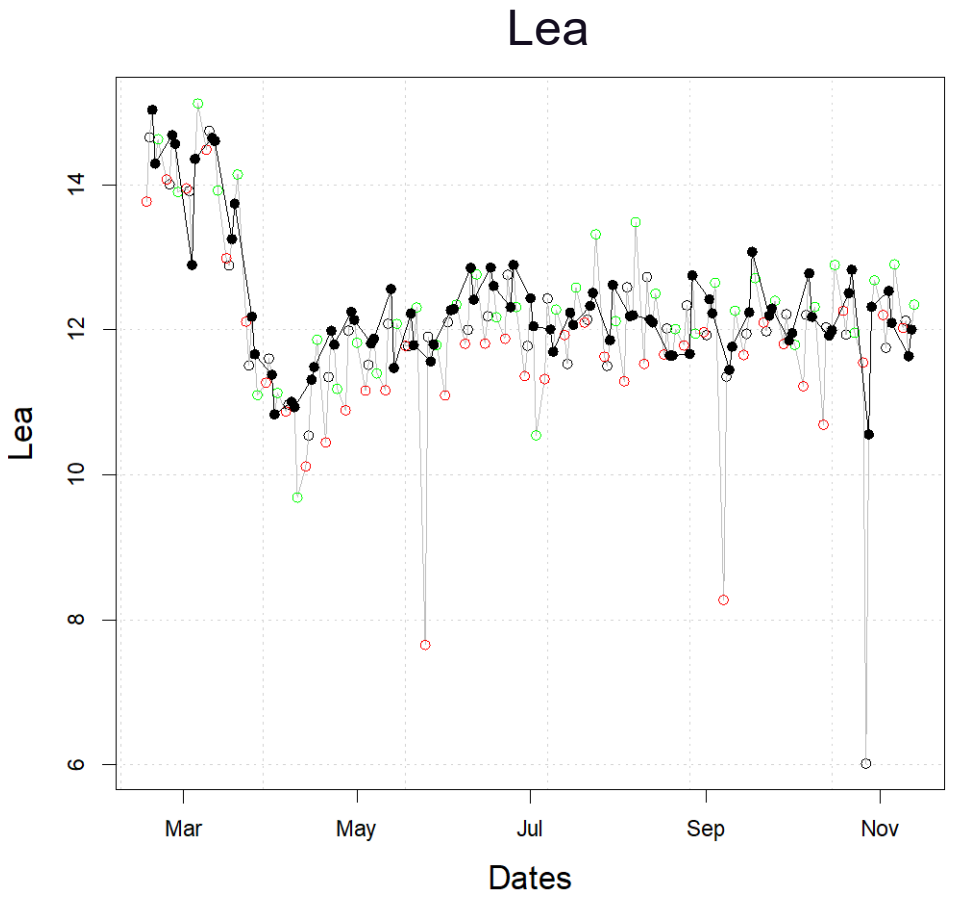
Bernalillo



Little or no decrease in southeastern counties. (Data only).

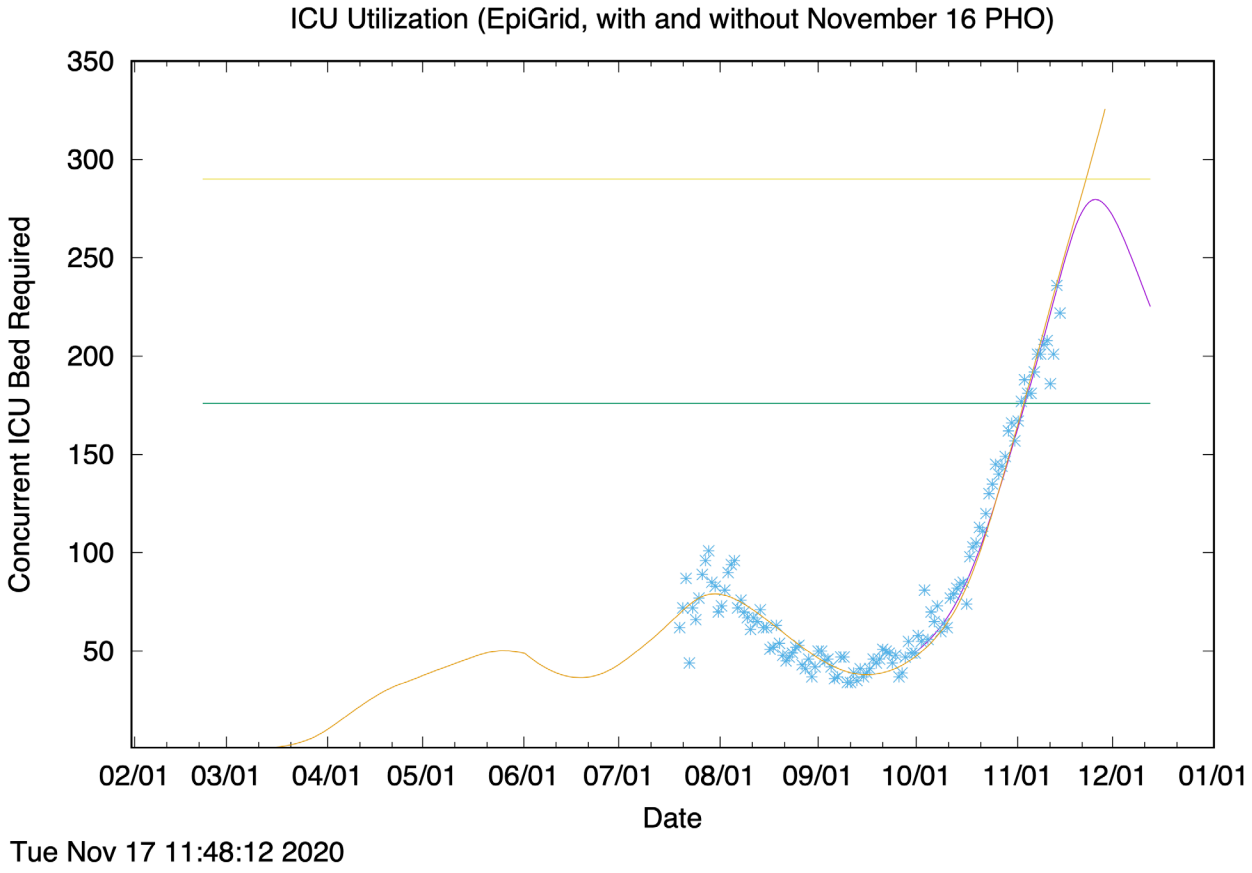
- Weekends NOT shown
- Monday
- Wednesday/Thursday
- Friday

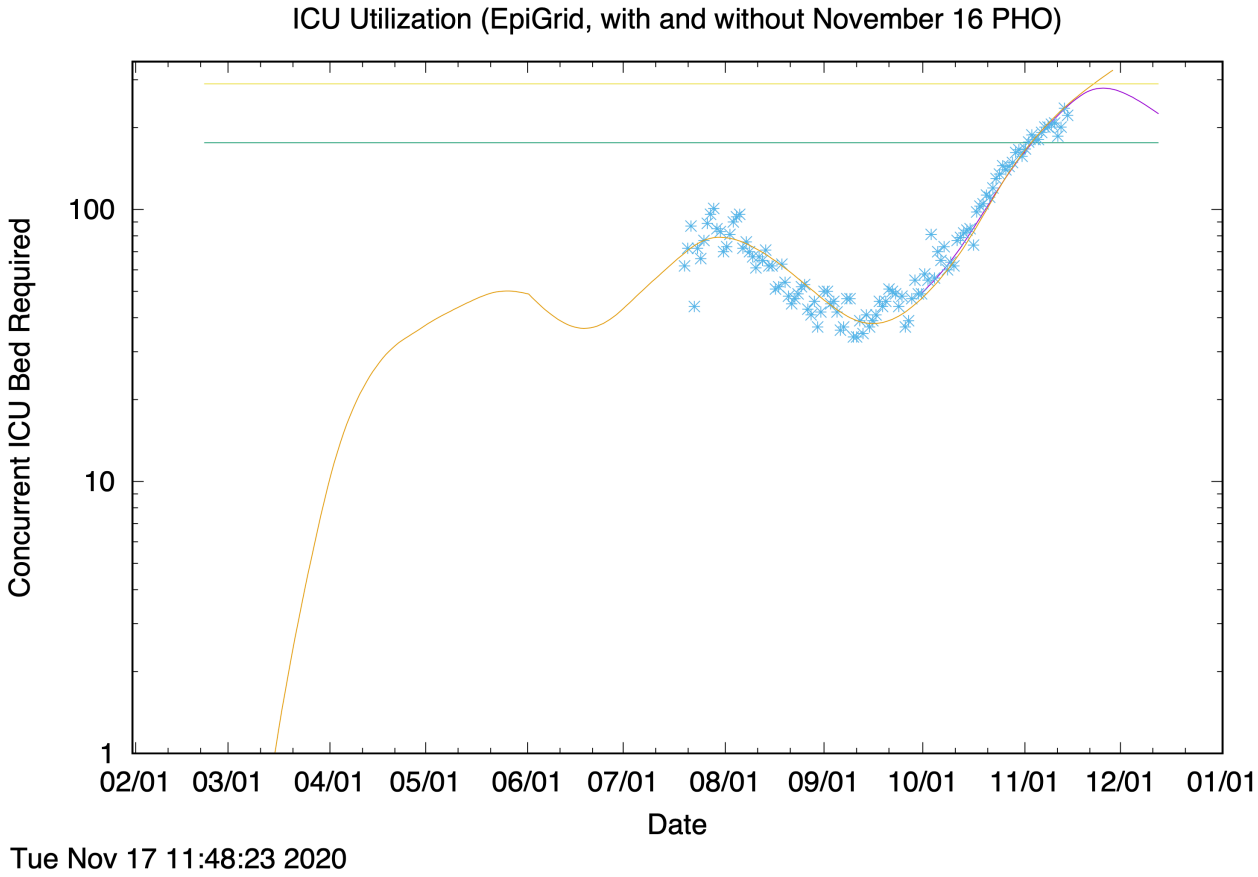




ICU concurrent usage: (left) linear y-axis, (right) log10 y-axis.

- Linear vs. time shows easy comparison with ICU capacity.
- Semi-logarithm plot reveals the growth rate or decline rate, rather than the pure ICU load.
- November 16th PHO may avert serious violation of ICU capacity limits.





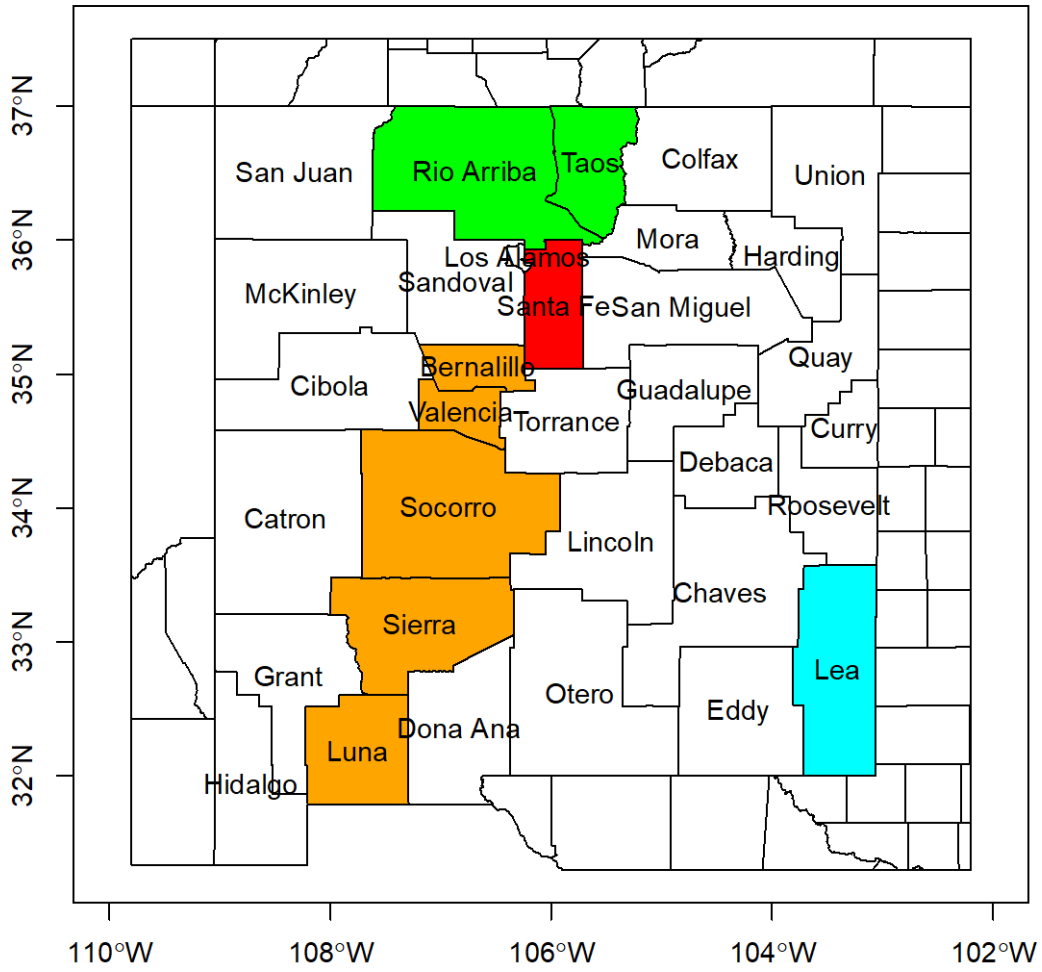
Positivity rates last week were still quite high in some counties

- **Positivity over the past week** (from Covid ActNow https://www.covidactnow.org/us/new_mexico-nm?s=1170284)
  - Curry ~ 21%
  - Lea ~ 20%
  - DeBaca ~20% (very rough estimate, small-number statistics?)
  - Eddy ~ 18%
  - Dona Ana ~16%
  - Chaves ~ 14%
  - Roosevelt ~13%
  - Luna ~12%
  - Valencia ~12%
  - Torrance ~11%

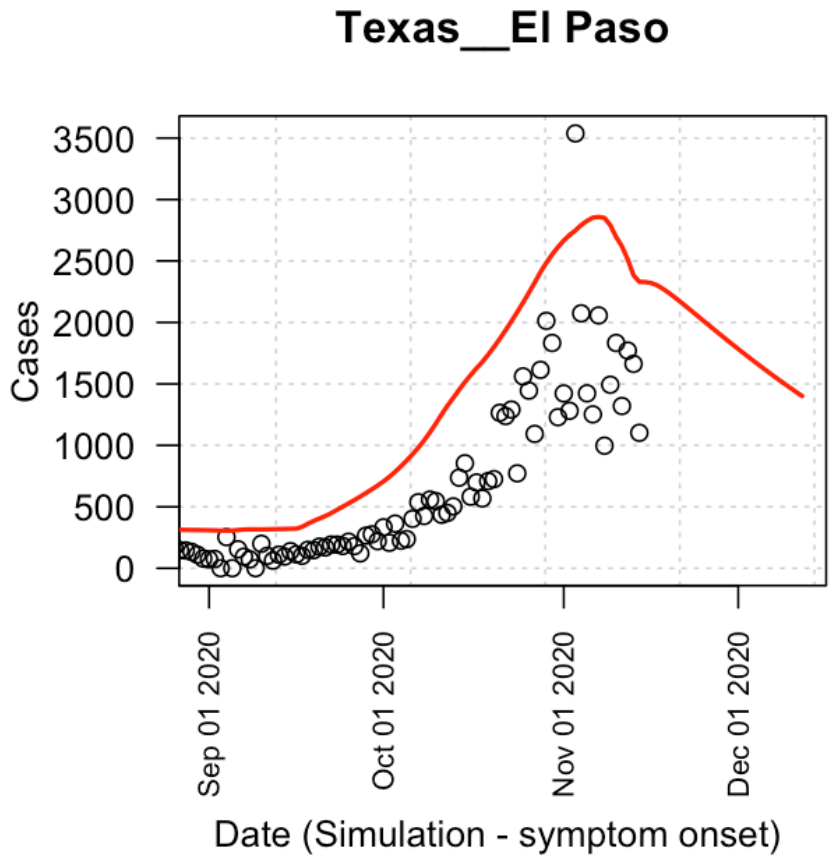
- **Under-reporting/diagnosis of cases is very likely higher than expected in high-test positivity counties. (This creates the possibility of model bias toward modeling less severe epidemics than exist in those counties. With a 2 week delay, hospitalization and death data allow this problem to be corrected.)**

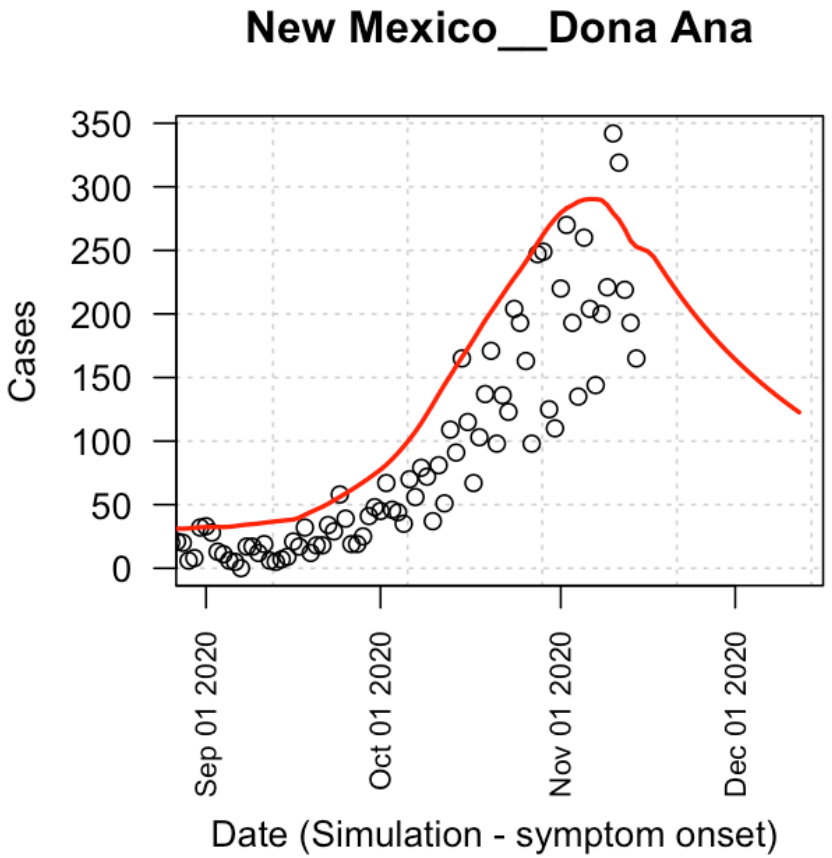
Situational Awareness: Heterogeneity, mostly urban vs. rural

- Significant (unexplained) increases in transmission which started after Labor Day is continuing unabated in Santa Fe.
- Bernalillo, Luna, Sierra, Socorro and Valencia are modeled with increased transmission.
- Rio Arriba and Taos are also modeled with increased transmission. (Colorado mitigation model needs updating.)
- *Mobility decrease to March PHO varied by county.* In the Spring this didn't matter because counties that didn't decrease mobility also had few cases. This time some of the counties with only small predicted mobility decreases have cases: *notably Lea*.
- Thanksgiving is not modeled differently from other weekends.
- Pueblos and Navajo Nation are having cases.



El Paso and Dona Ana: Public Health Order in El Paso was lowering incidence.





Conclusions and Discussion

- **The New Mexico epidemic is geographically dispersed.**
- **Nation-wide geographical dispersion implies that state-to-state travel plays an important role. Hotel occupancy changes may limit the effect of this source of new cases.**
- ***Bernalillo still appears to play a substantial role driving ICU need/requirements.***
- **A significant number of non-urban and frontier counties now support local epidemics.**
- **High test positivity rates show modest improvements in the last week.**
- **Serious ICU capacity-exceedance possibly avoided by the latest PHO.**
- **Abolition of El Paso's shelter-in-place order creates substantial uncertainty for Southern New Mexico. El Paso's order has just begun to roll-over the daily incidence curve.**
- **Discussion:**
  - For re-opening: low-risk activities first. High risk later?
  - Schools are highly mitigated, and 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. How to mitigate? Airflow in addition to distance? For re-opening…
  - Quarantine *support* along the lines of New Rochelle, NY in March to assist with optimal compliance?
  - Changes in terminology? "Pre-existing conditions" are present for what fraction of the middle-aged population?
  - Qualitatively higher testing rates (i.e. 10x) can substantially offset local epidemics (i.e. South Korea) by facilitating tracing. This will take time to plan and execute, but candidate technologies exist. Bar-coded sequencing with high-through put sequencing of viral clinical samples. Multiple 10k/day approaching 100k/day?