Modeling & Forecasting COVID-19 in NM

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November 10, 2020

NNSA
National Nuclear Security Administration
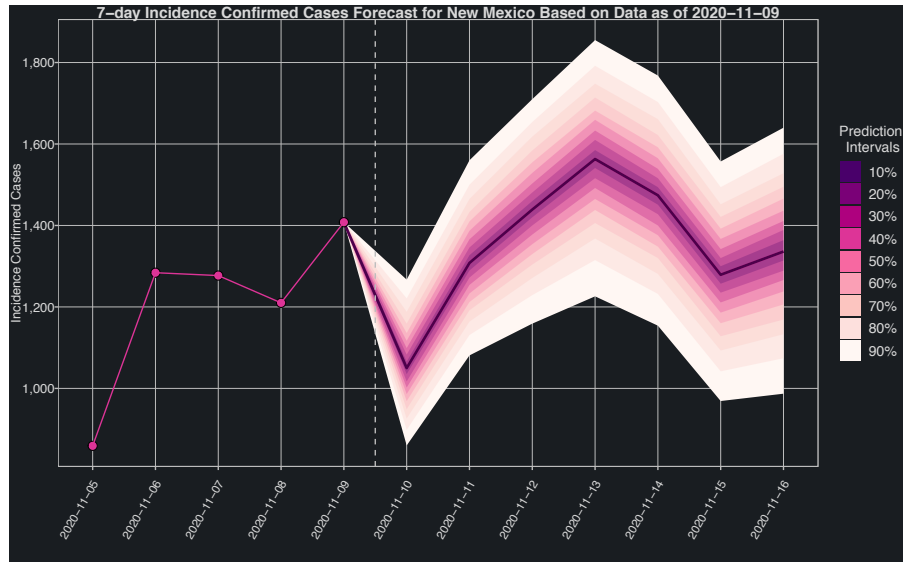
Short- & Long-Term Forecast for NM: Cases

7–day Incidence Confirmed Cases Forecast for New Mexico Based on Data as of 2020–11–09

Prediction Intervals

- 10%
- 20%
- 30%
- 40%
- 50%
- 60%
- 70%
- 80%
- 90%

6–Week Forecast of Confirmed Cases for New Mexico Based on Data as of 2020–11–09

Week	Best Case (5th Percentile)	Middle Case (50th Percentile)	Worst Case (95th Percentile)^
2020–11–09		56,289*	
2020–11–16	63,895	65,730	67,551
2020–11–23	71,411	76,812	81,543
2020–11–30	78,301	88,724	99,005
2020–12–07	84,611	100,354	120,686
2020–12–14	90,418	111,274	145,735
2020–12–21	95,420	121,849	172,151

*Last reported confirmed cases count
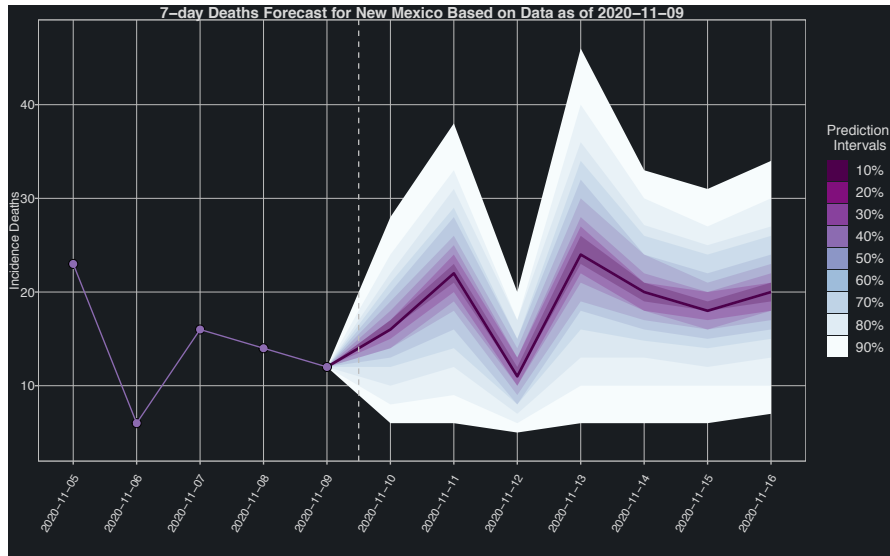^Closest–matching scenario

6–Week Forecast of Daily Average of Confirmed Cases for New Mexico Based on Data as of 2020–11–09

Week	Best Case (5th Percentile)	Middle Case (50th Percentile)	Worst Case (95th Percentile)^
2020–11–09		1,169*	
2020–11–16	1,087	1,349	1,609
2020–11–23	1,074	1,583	1,999
2020–11–30	984	1,702	2,495
2020–12–07	901	1,661	3,097
2020–12–14	830	1,560	3,578
2020–12–21	715	1,511	3,774

*Last reported confirmed cases count
^Closest–matching scenario

So what?
The daily number of cases are expected to range between 1,600 and 2,000 in the next two weeks for the worst case scenario

Short- & Long-Term Forecast for NM: Deaths

7–day Deaths Forecast for New Mexico Based on Data as of 2020–11–09

Prediction Intervals

10%	
20%	
30%	
40%	
50%	
60%	
70%	
80%	
90%	

6–Week Forecast of Deaths for New Mexico Based on Data as of 2020–11–09

Week	Best Case (5th Percentile)	Middle Case (50th Percentile)^	Worst Case (95th Percentile)
2020–11–09		1,130*	
2020–11–16	1,175	1,268	1,337
2020–11–23	1,226	1,454	1,654
2020–11–30	1,281	1,689	2,145
2020–12–07	1,340	1,973	2,867
2020–12–14	1,394	2,290	3,863
2020–12–21	1,447	2,627	5,105

*Last reported deaths count
^Closest–matching scenario

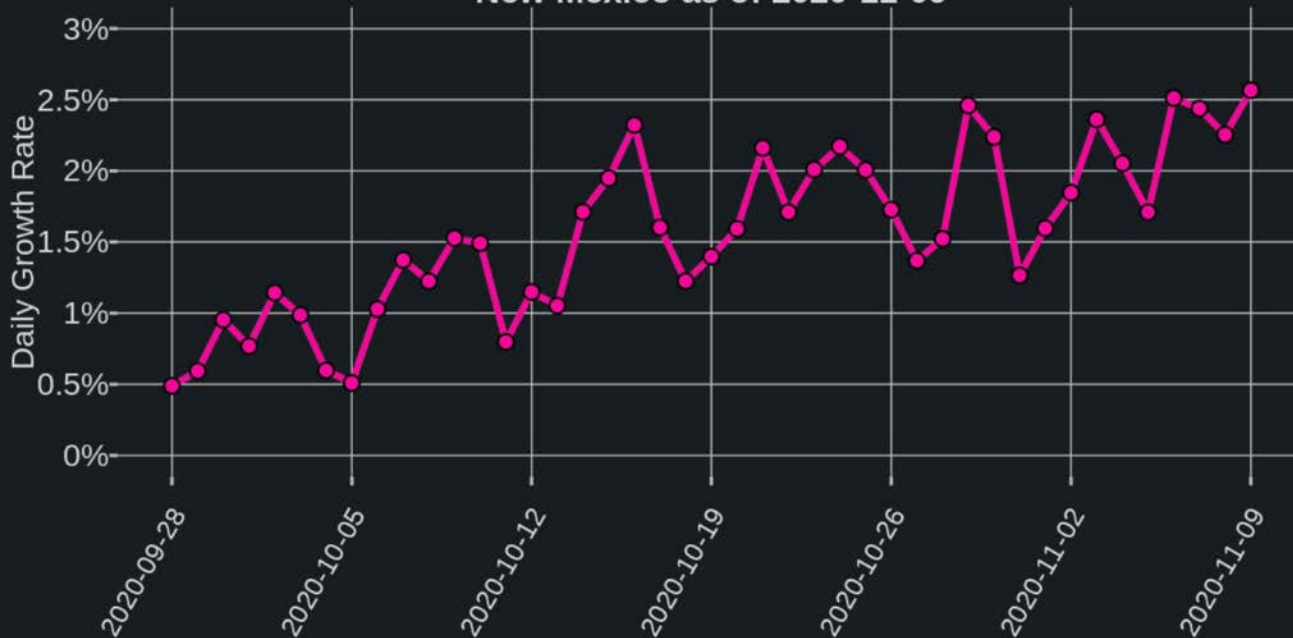### 6–Week Forecast of Daily Average of Deaths for New Mexico Based on Data as of 2020–11–09

Week	Best Case (5th Percentile)	Middle Case (50th Percentile)^	Worst Case (95th Percentile)
2020–11–09		13*	
2020–11–16	6	20	30
2020–11–23	7	27	45
2020–11–30	8	34	70
2020–12–07	8	41	103
2020–12–14	8	45	142
2020–12–21	8	48	177

*Last reported confirmed deaths
^Closest–matching scenario

So what?
The daily number of deaths are expected to range between 20 and 27 in the next two weeks for the middle case

Growth Rate for NM

Daily Growth Rate for the Past Six Weeks in New Mexico as of 2020-11-09

6-Week Forecast of the Average Weekly Growth Rate for New Mexico Based on Data as of 2020-11-09

Week	Best Case (5th Percentile)	Middle Case (50th Percentile)	Worst Case (95th Percentile)^
2020-11-09		2.3%*	
2020-11-16	1.8%	2.2%	2.6%
2020-11-23	1.6%	2.3%	2.7%
2020-11-30	1.3%	2.1%	2.8%
2020-12-07	1.1%	1.8%	2.9%
2020-12-14	0.95%	1.5%	2.7%
2020-12-21	0.77%	1.3%	2.4%

*Last weekly mean daily growth rate
^Closest-matching scenario

So what?
As of November 9th, the average growth rate in NM is at 2.3% (up from 1.7%)

> Regional Forecasts, Growth Rates, & Hospitalizations

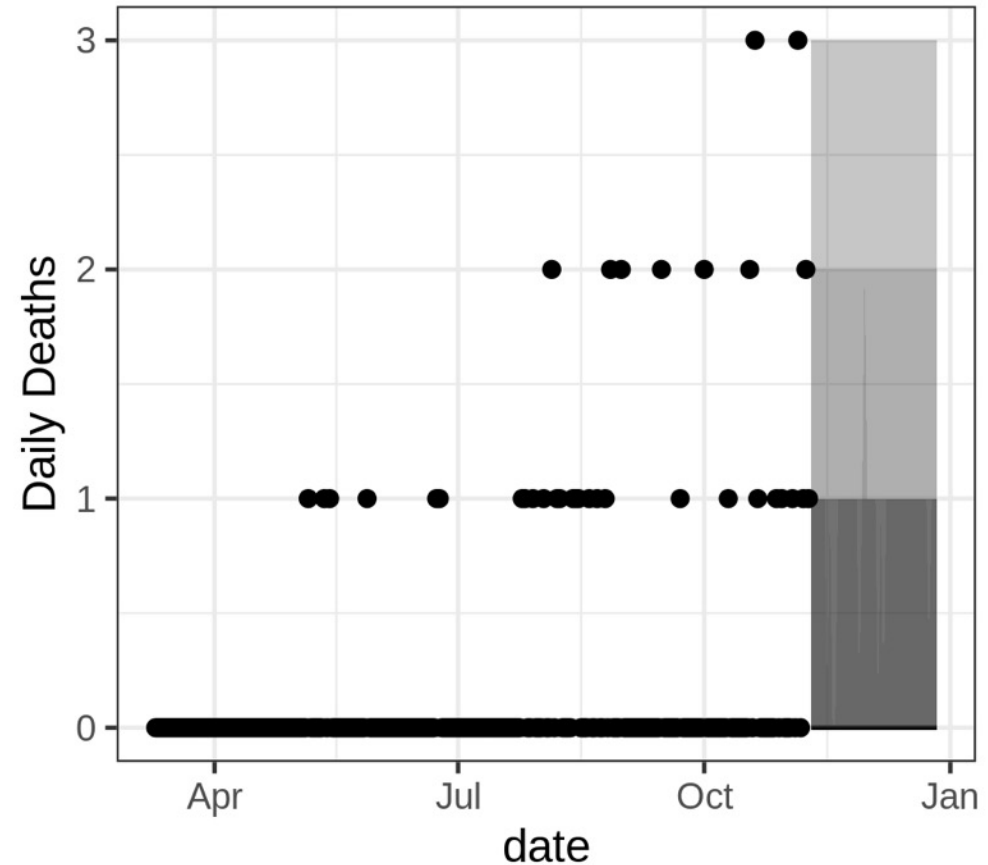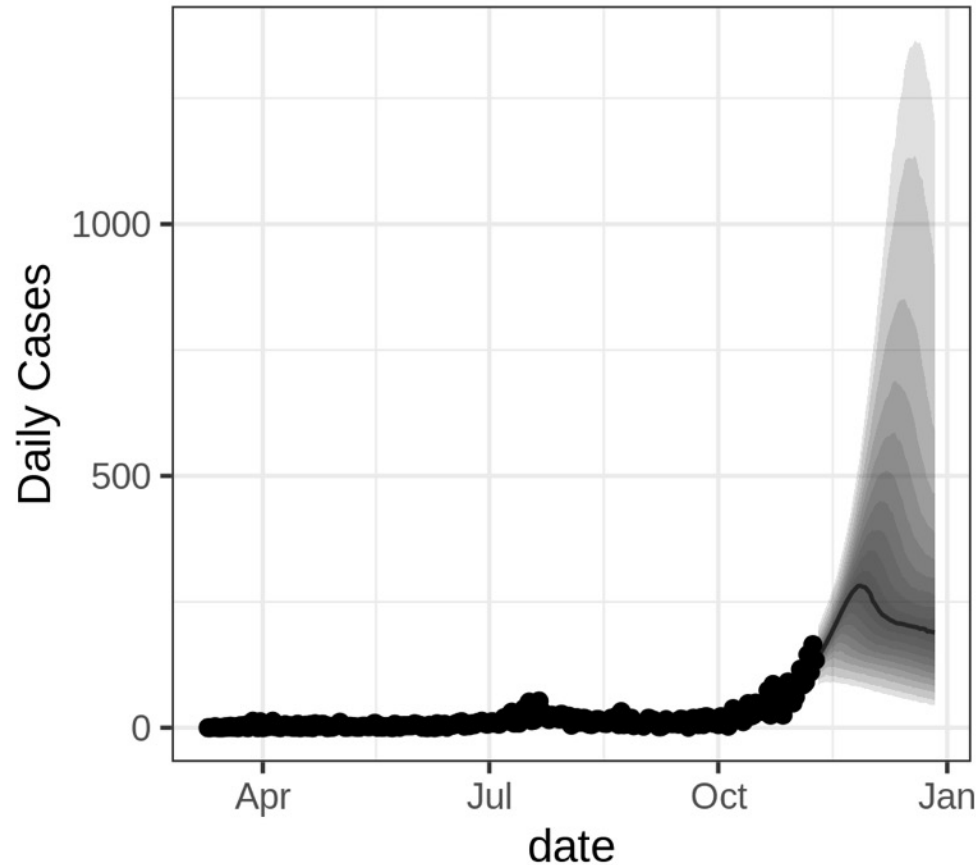# Central Region Forecasts

Health Region - NM Central Region
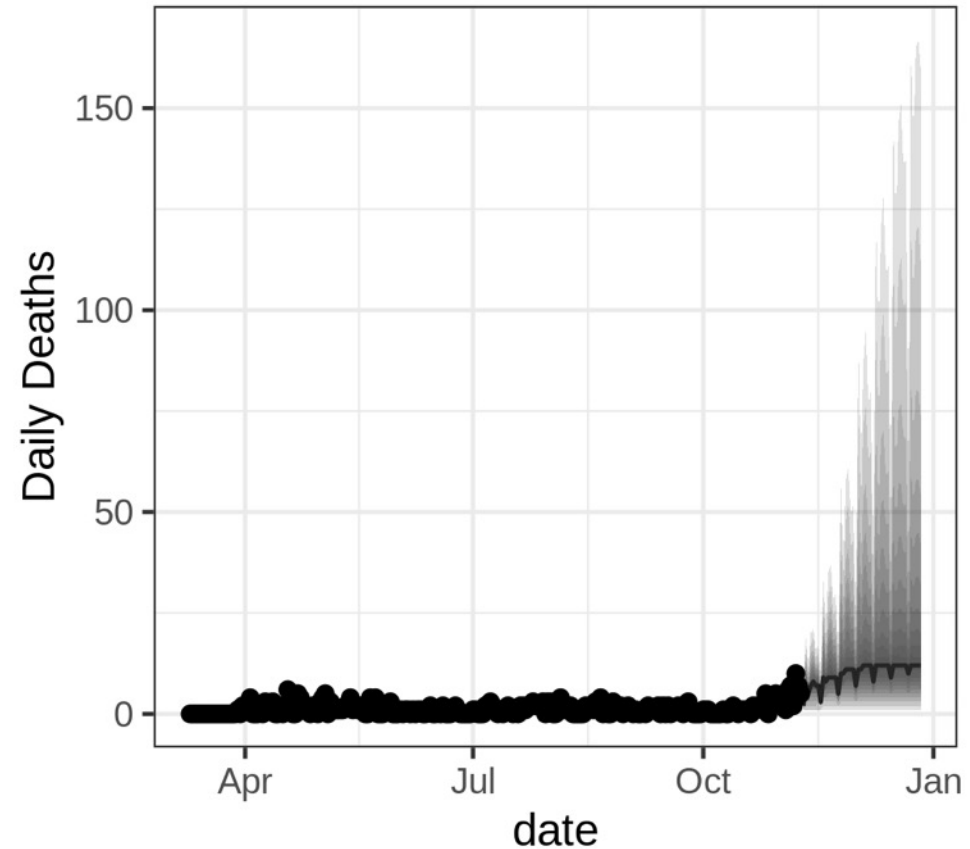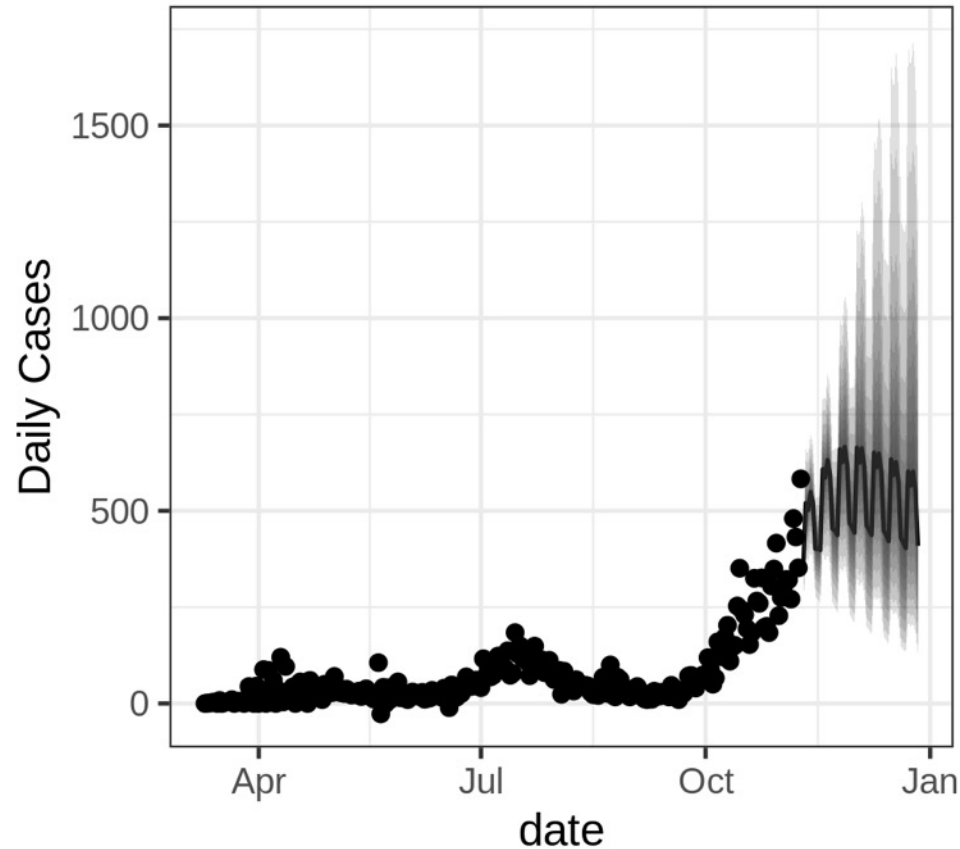
So what?

The daily number of cases is expected to range between 510 and 560 for the middle case scenario

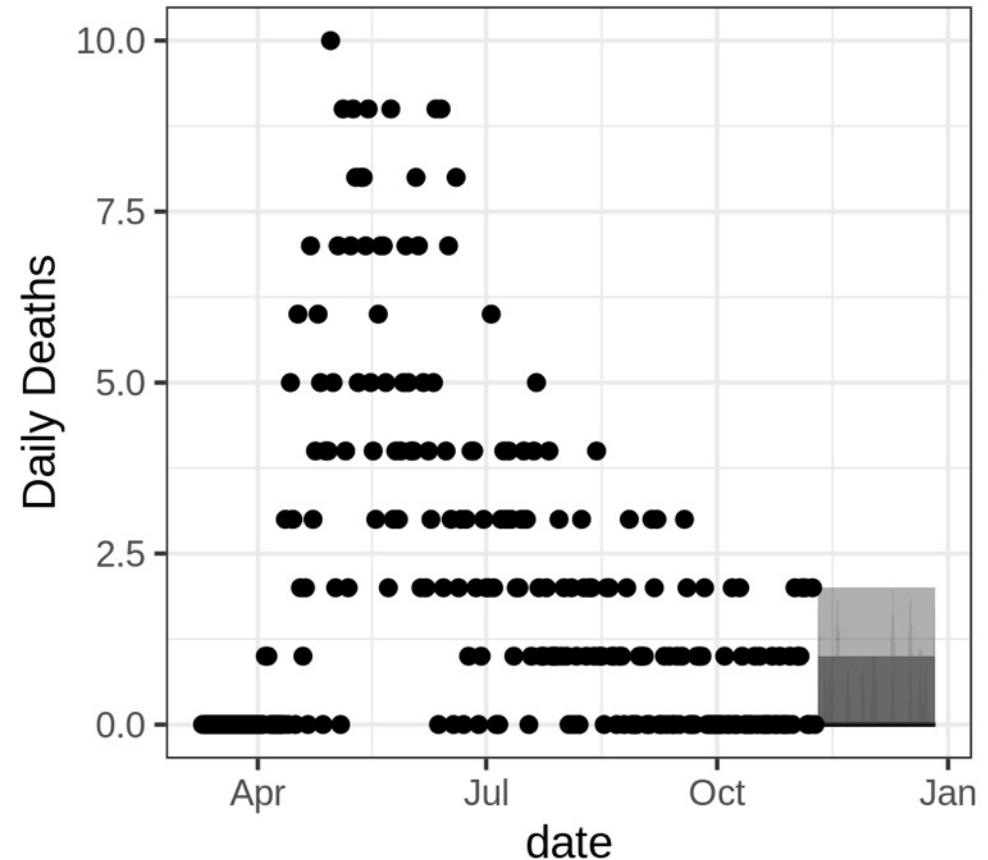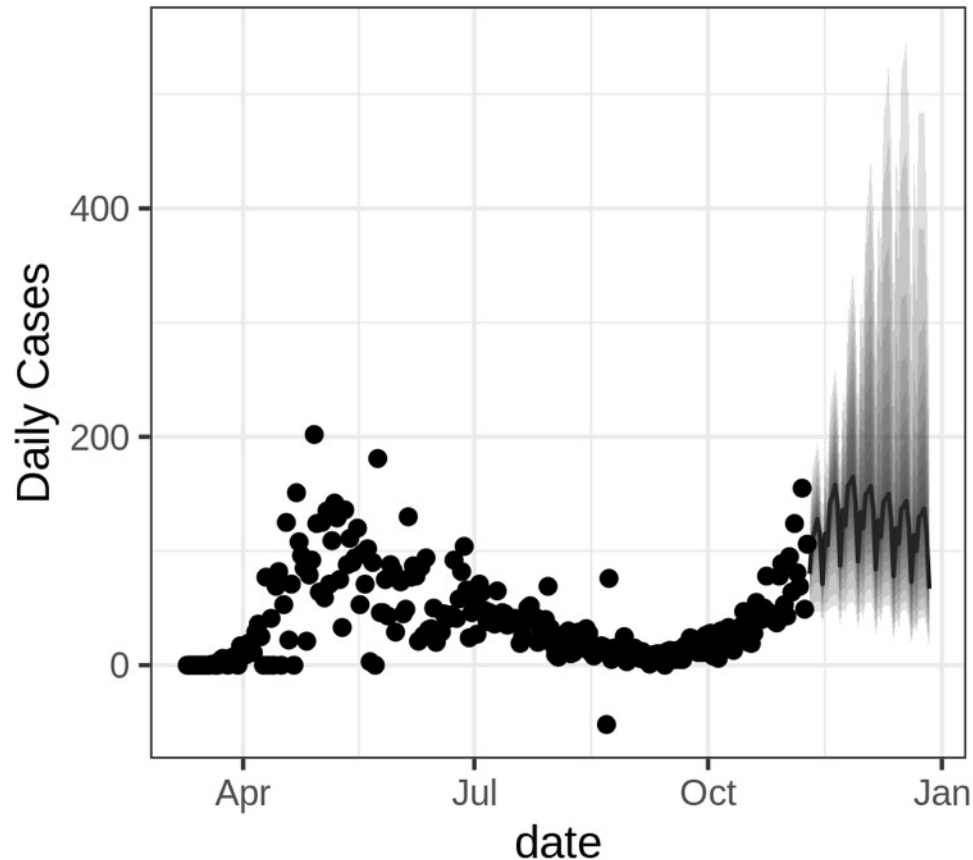# Northeast Region Forecasts

Health Region - NM Northeast Region

So what?

The daily number of cases is expected to range between 200 and 270 for the middle case scenario

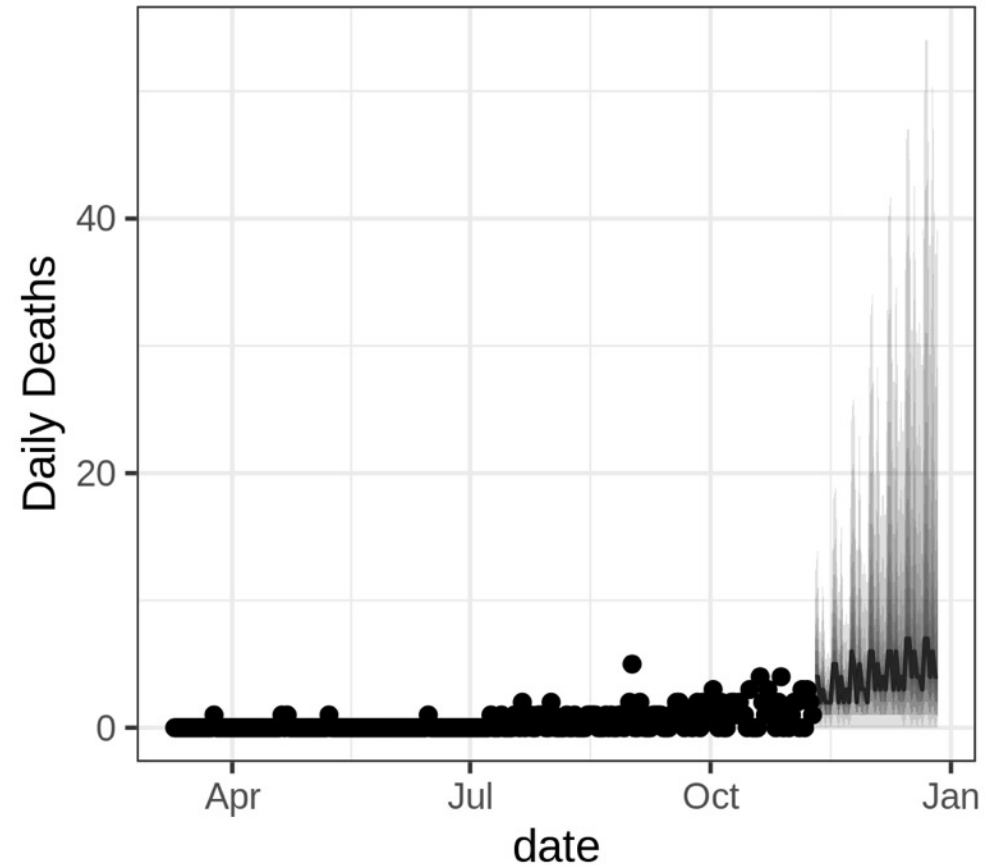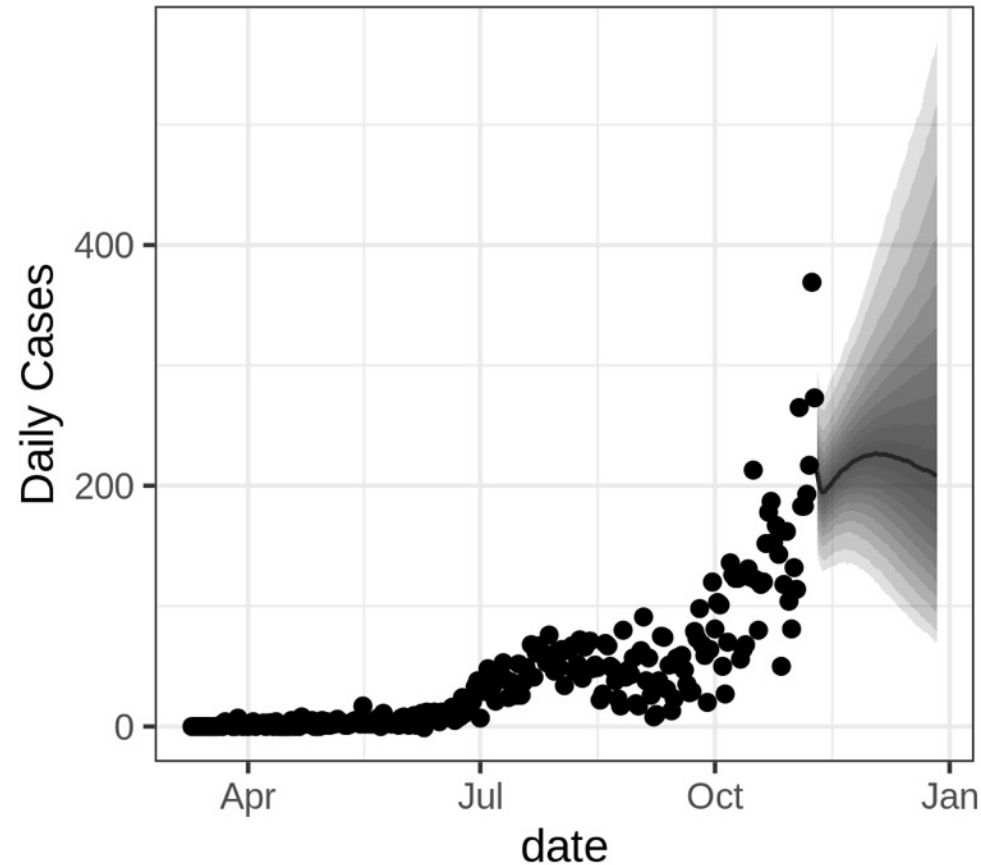# Northwest Region Forecasts

Health Region - NM Northwest Region

So what?
The daily number of cases is expected to range between 120 and 140 for the middle case scenario

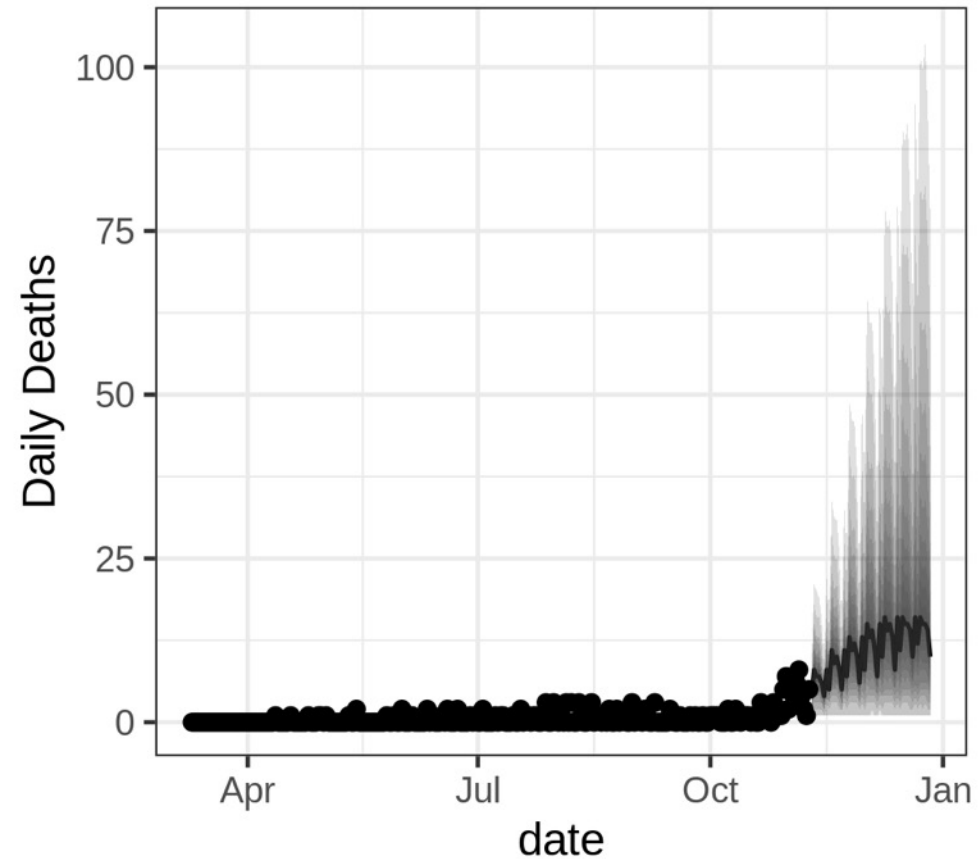# Southeast Region Forecasts
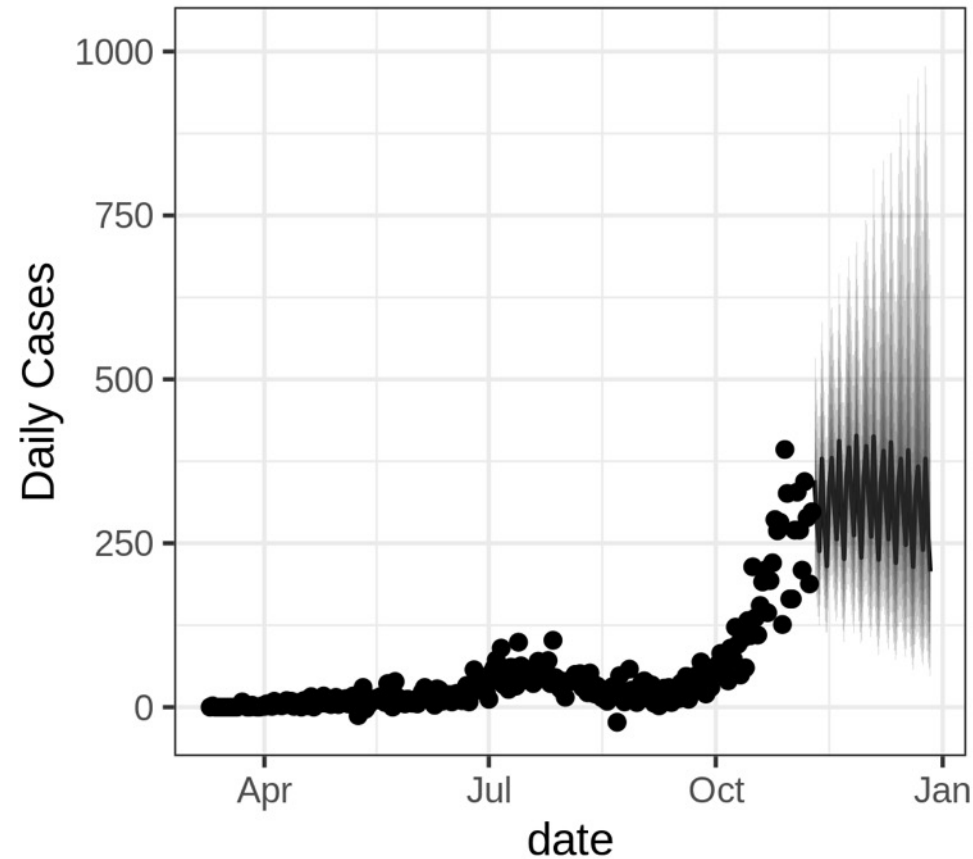

Health Region - NM Southeast Region

So what?

The daily number of cases is expected to range between 210 and 225 for the middle case scenario
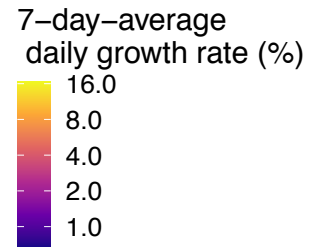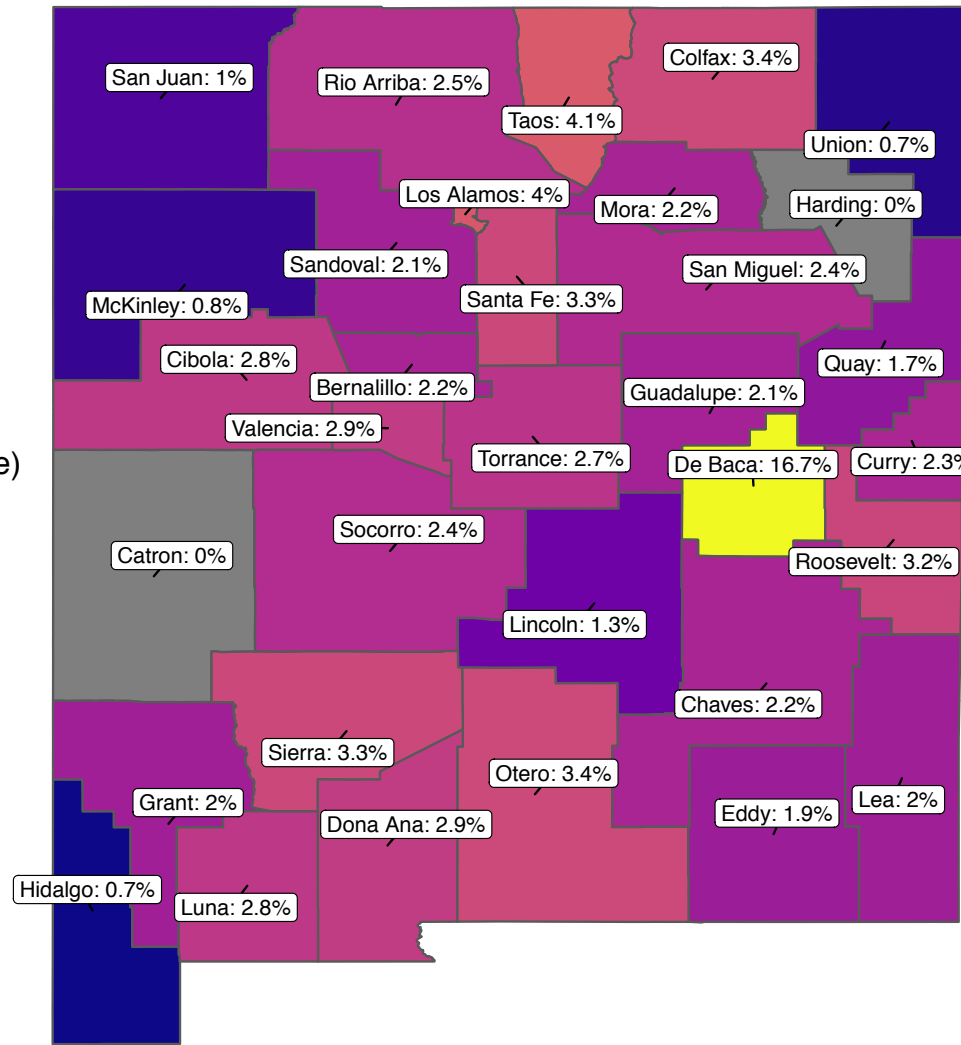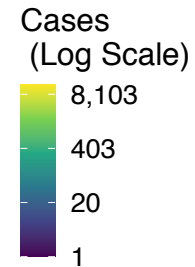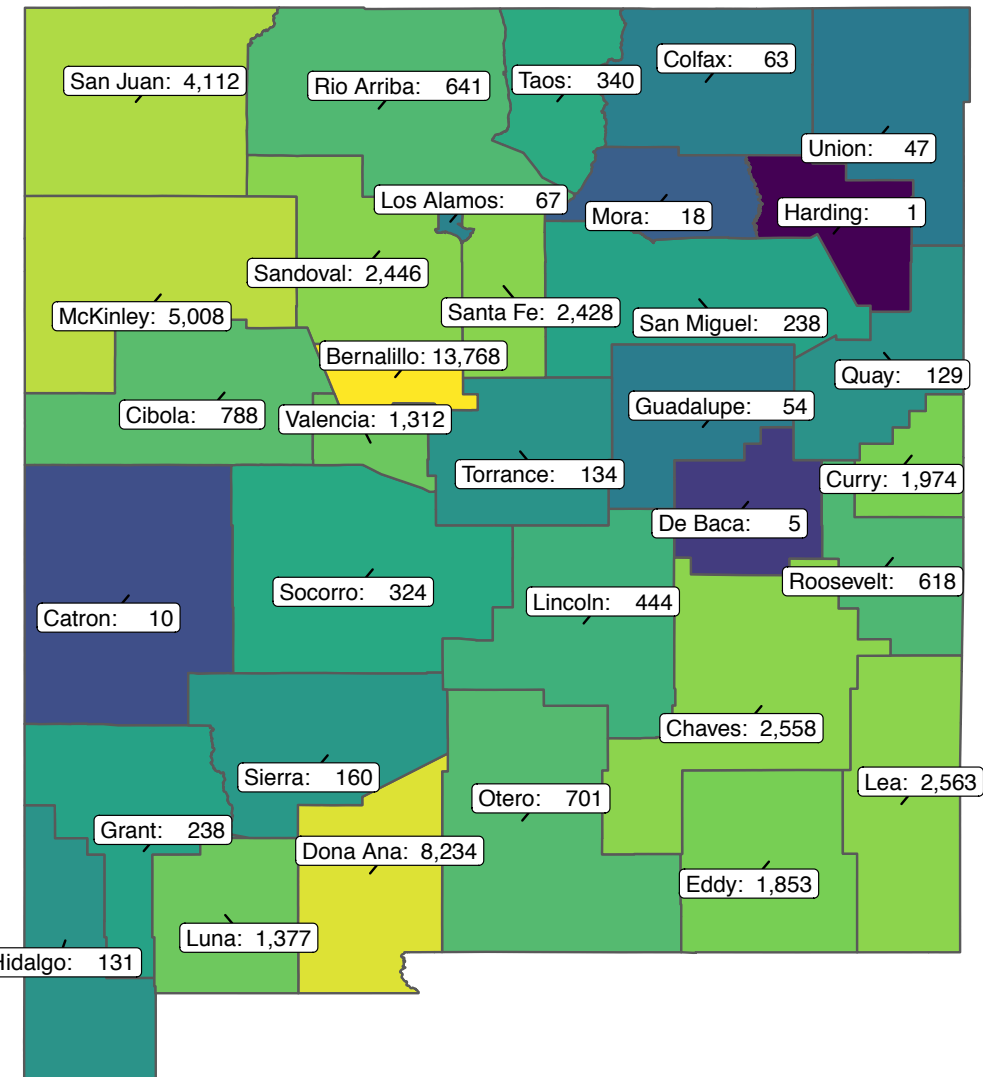
Southwest Region Forecasts
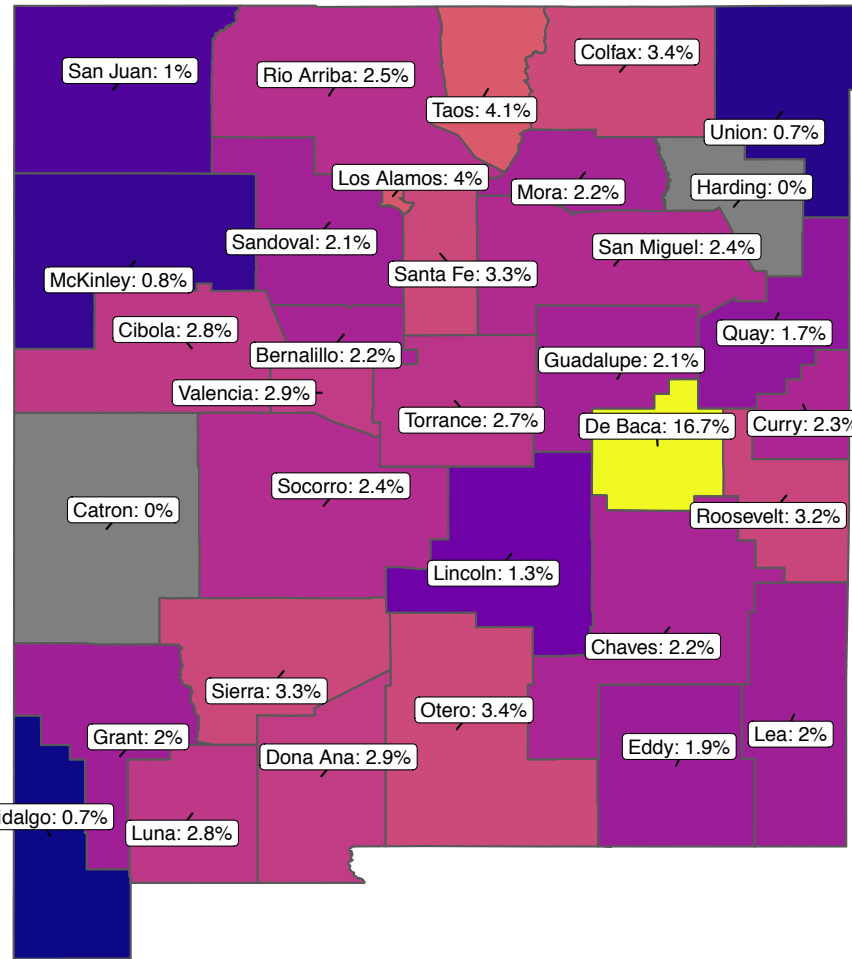

Health Region - NM Southwest Region

So what?

The daily number of cases are expected to range between 300 and 325 for the middle case scenario

Cumulative Cases & Daily Growth Rate for NM: Nov 9

Daily Growth Rate for NM Nov 9

7–day–average
daily growth rate (%)
16.0
8.0
4.0
2.0
1.0

Union 0.7% =
Socorro **2.4%** =
Hidalgo 0.7% =
DeBaca **16.7%** =
Catron 0.0% ↓

Los Alamos 4.0% ↑
Mora 2.2% ↑
Colfax **3.4%** ↑
Roosevelt **3.2%** ↑
Quay **1.7%** ↑

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

Los Alamos National Laboratory

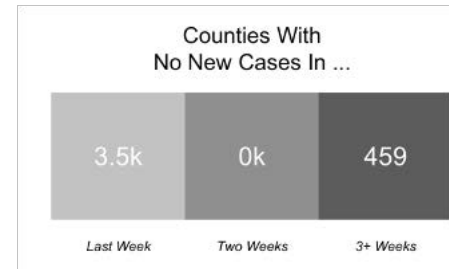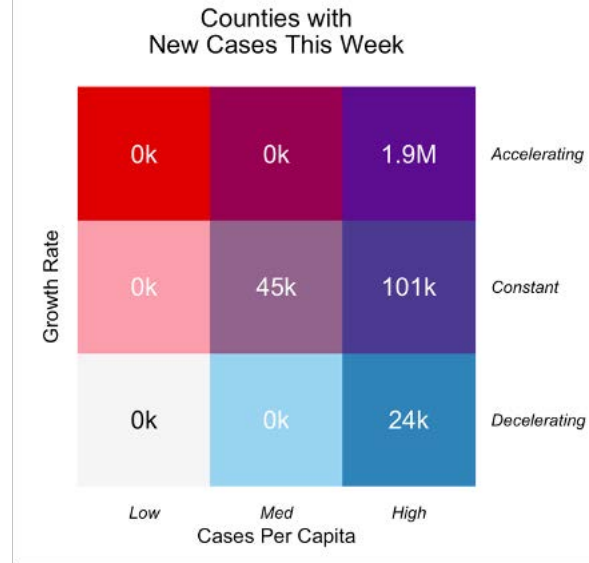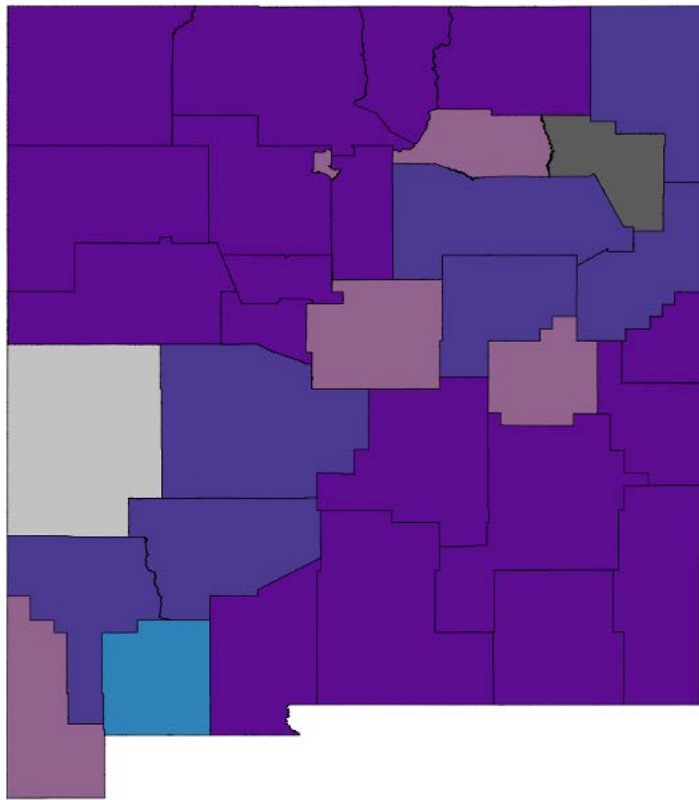| County	Daily Growth Rate	Change
San Juan	1.0%	↑
Rio Arriba	2.5%	↑
Sierra	**3.3%**	↓
McKinley	0.8%	=
Sandoval	2.1%	↑
Santa Fe	3.3%	↑
Cibola	**2.8%**	↑
Bernalillo	2.2%	=
Valencia	2.9%	=
Torrance	2.7%	↑
Lincoln	1.3%	=
San Miguel	2.4%	↑
Chaves	2.2%	↑
Dona Ana	2.9%	=
Otero	3.4%	↑
Lea	2.0%	↑
Eddy	1.9%	=
Curry	2.3%	↑
Grant	2.0%	↑
Luna	2.8%	↓
Taos	**4.1%**	↑

Growth Rate for NM: Another View (Nov 9)

COVID-19 across New Mexico
A 7-day moving window comparison
November 9, 2020

Impacted New Mexicans

Counties with New Cases This Week

Growth Rate

0k	0k	1.9M	Accelerating
0k	45k	101k	Constant
0k	0k	24k	Decelerating
Low	Med	High	

Cases Per Capita

Counties With No New Cases In ...

|		
3.5k	0k	459
Last Week	Two Weeks	3+ Weeks

So what?

- **MOST New Mexicans live in a county with <u>accelerating growth rates and high per-capita case counts</u>**

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
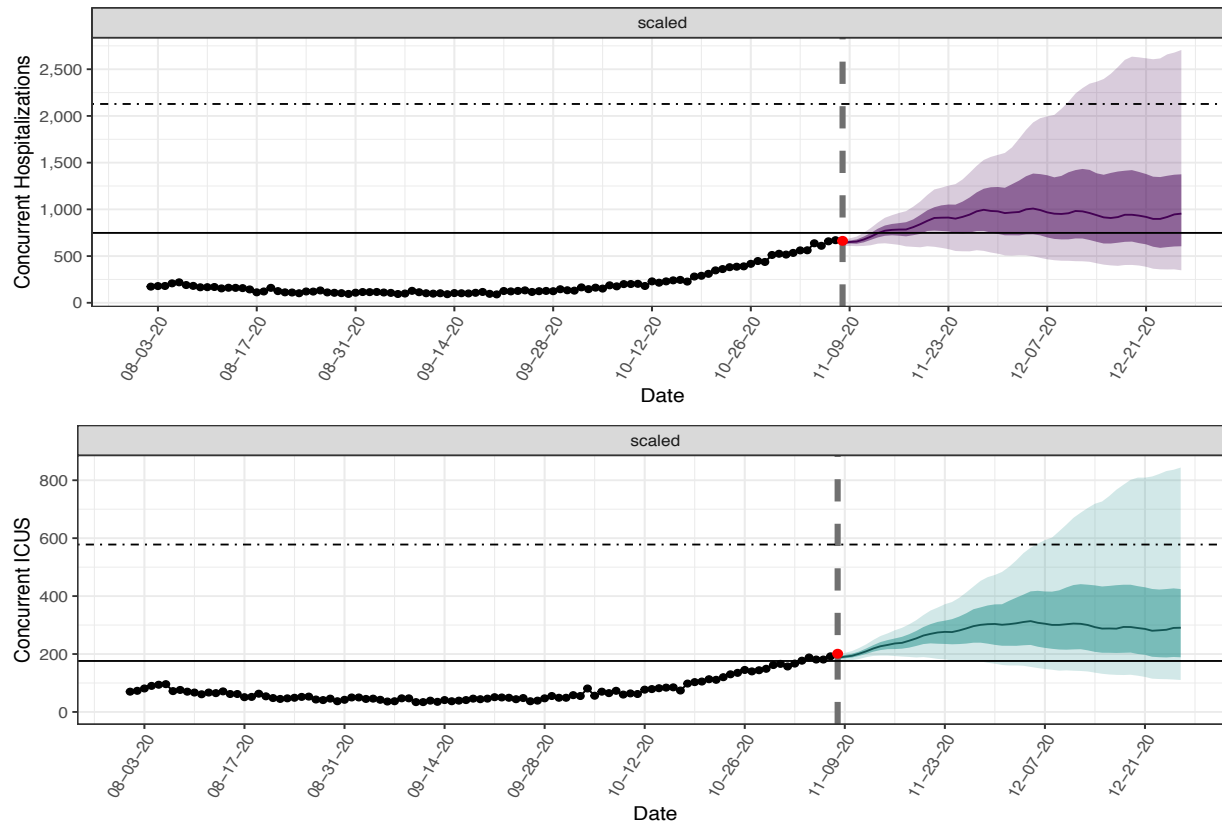
Concurrent COVID-19 ICUs beds

Week	Qu. 5% (best case)	Qu. 50% (median)	Qu. 95% (worst case)
11/15	195	231	271
11/22	183	274	361
11/29	170	303	465
12/6	152	308	581
12/13	140	300	704
12/20	125	290	809

"Scaled" Scenario

t?

oncurrent COVID-19 patients; predictions needed by end of November
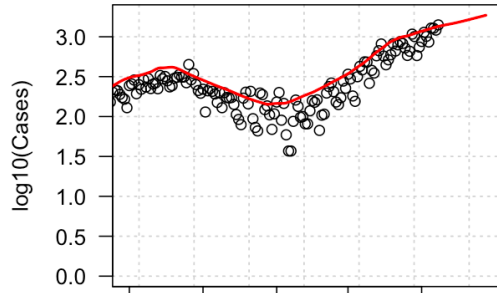
10 Nov 2020: EpiGrid modeling
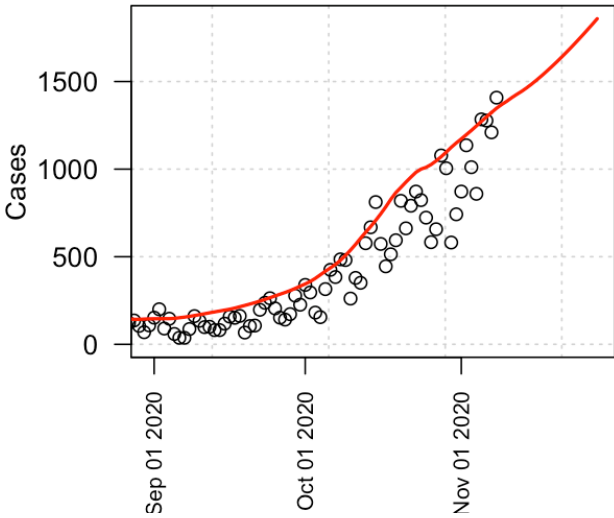
- The echo from the snowstorm's drop in mobility has ended.
- Thanksgiving is not yet being modeled.
- While incidence continues to rise, the growth rate of incidence slowing. This is obvious on a semi-logarithmic plot.
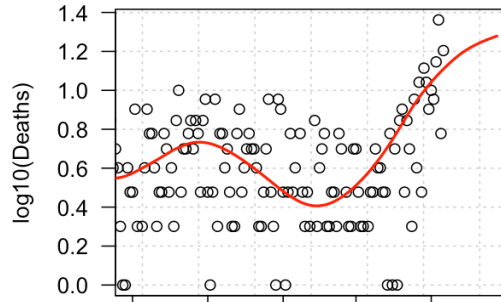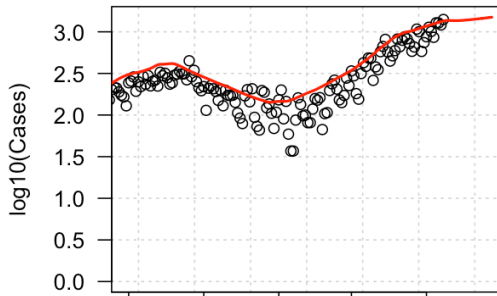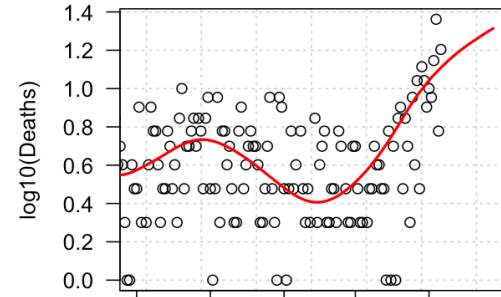- Above: baseline model (semi-log); Below: 10% improvement in the force of infection (semi-log)
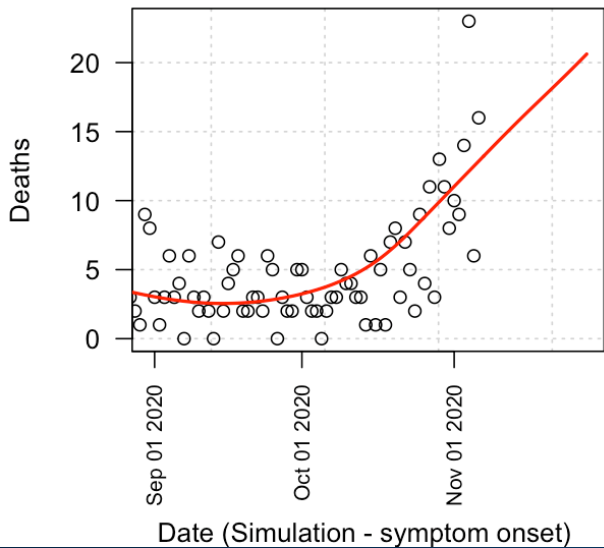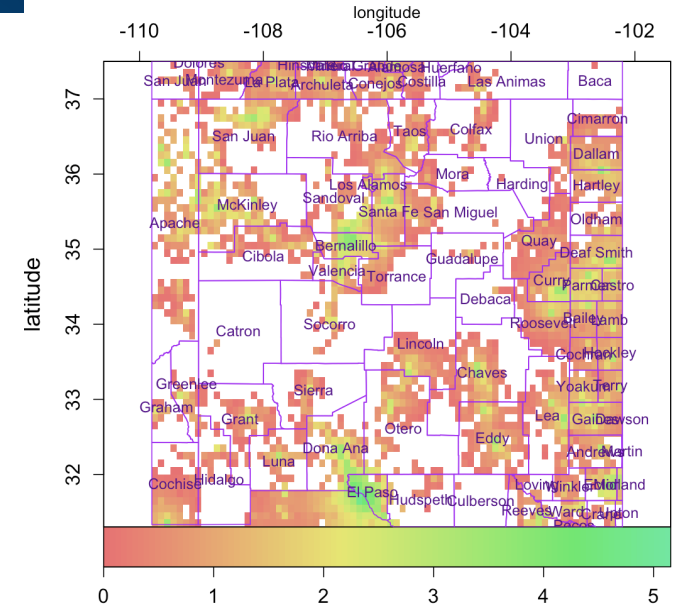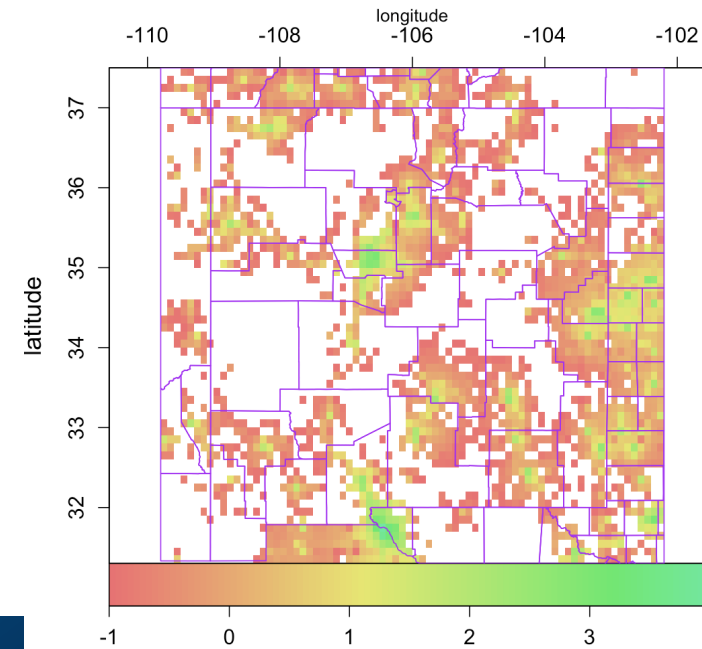
This week's model is similar to last week

- **The stay-at-home order in El Paso is taking longer than anticipated to have an effect.**
 - Some business were not adhering to the public health order. https://www.elpasotimes.com/story/news/2020/10/30/el-paso-shutdown-order-businesses-stay-open-amid-covid/6088514002/
  - Since the Nov. 6th court ruling, fewer businesses are open. Sheriffs and Police are reported to be enforcing the order.

- **Small model changes reduce the "unexplained" (i.e. behavioral) transmission increases in all counties, aside from Santa Fe.**
  - Counties with behavioral transmission increase in Sept. or later are: Bernalillo, Dona Ana, Luna, Santa Fe, Sierra and Socorro.
  - Counties with a subsequent (incomplete) reduction: Bernalillo, Dona Ana, Luna, Sierra, Socorro.

- **Modeling of public reaction and public health orders (PHO).**
  - Aug. 29th PHO; 15% transmission increase
  - Oct 16th PHO; 3 – 7% transmission reduction
  - Oct. 23rd PHO; 5 – 10% transmission reduction
  - When incidence go up, people's protective behavior improves: 10/100,000/day -> 5% transmission drop; 50/100,000/day -> 10% decrease

- **Isolation and quarantine rates are still assumed to be low.**
  - Quarantine effectiveness in the model is assumed to be mainly due to rapid responses and school contact tracing.
 - How much does school contact tracing vary between counties?

# Quarantine and transmission control the epidemic: example Bernalillo

New Mexico__Bernalillo
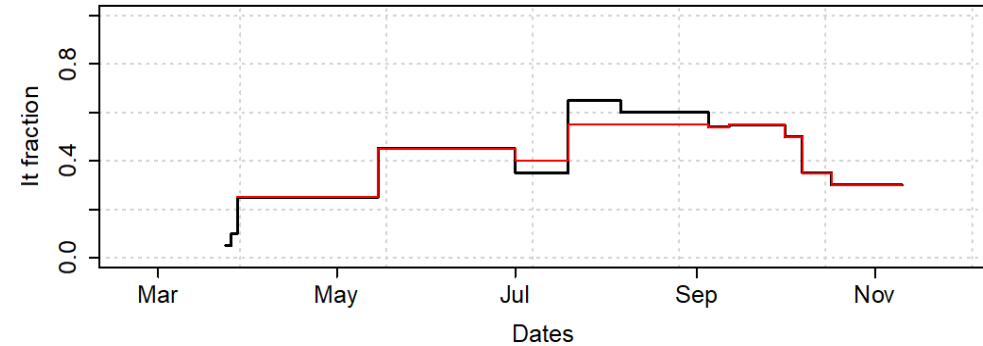
"I_t fraction" is the fraction of contagious people early in their disease progression who are quarantining. *Large is desirable.* Quarantine generally goes up with time, but decreases when (i) case counts are high and (ii) time from positivity to contact quarantine are long (NM State data). The Black curve shows Bernalillo. The red curve is the state-wide default.
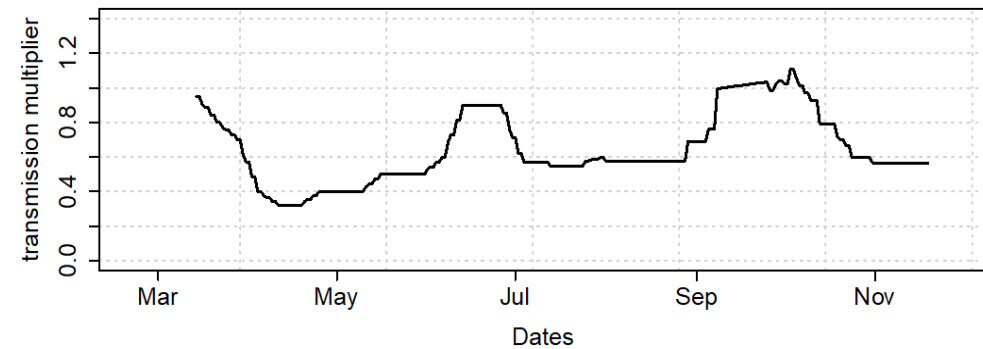
Smaller transmission multipliers result in less transmission. *Small is desirable.* The transmission multiplier depends primarily on in-county mobility and varies due to other factors driven by, esp. public health orders (i.e. behavior). *A low transmission multiplier is less effective in the absence of a large/good I_t fraction.*
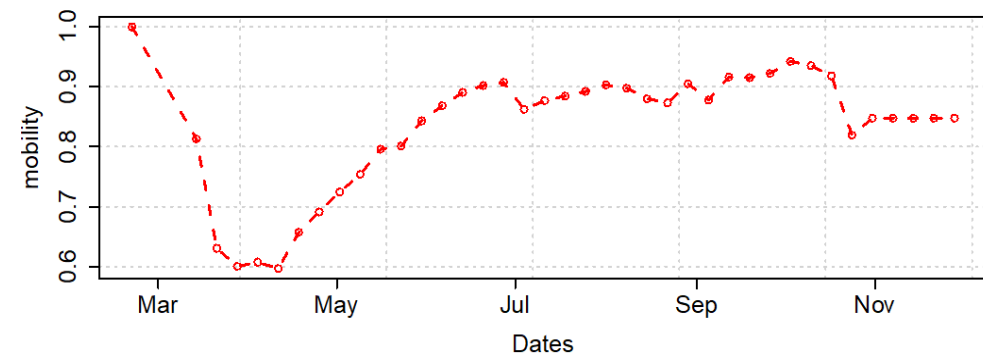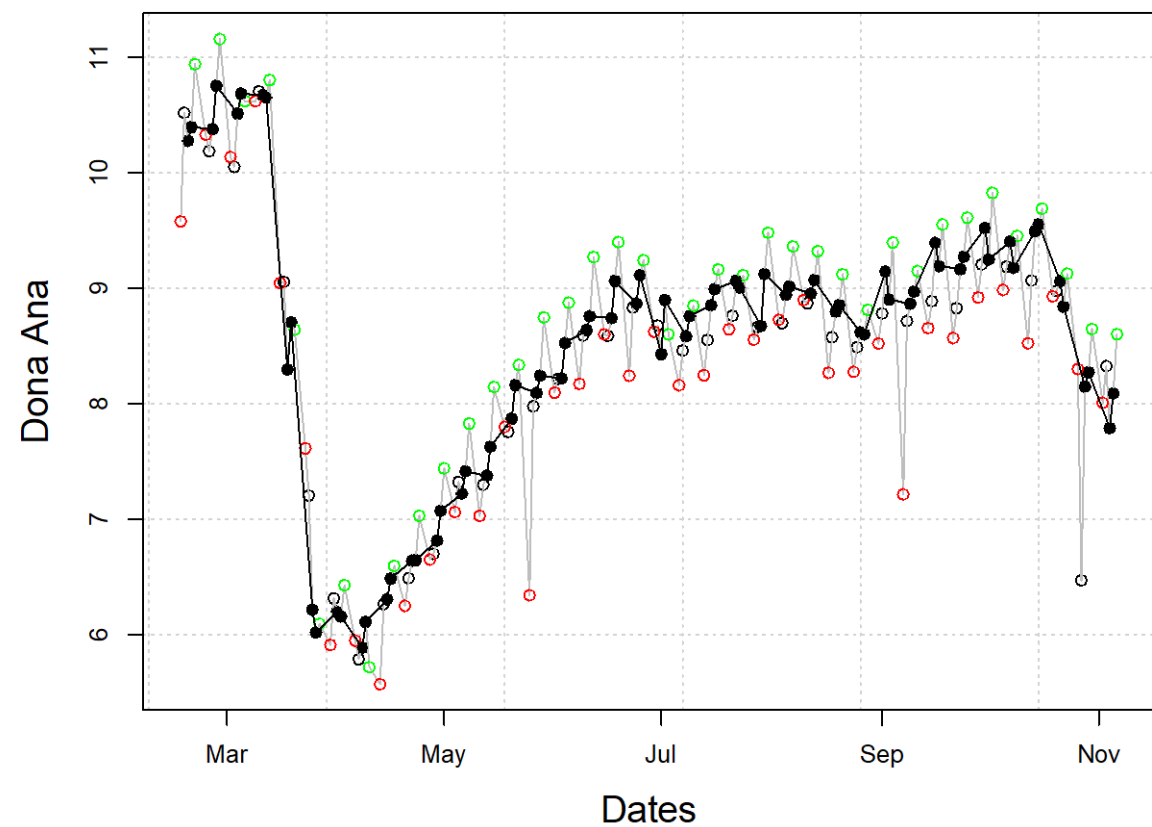

The red curve shows weekly averaged mobility for Bernalillo county, which is the primary model driver for the transmission multiplier above.

Mobility is decreased in some places
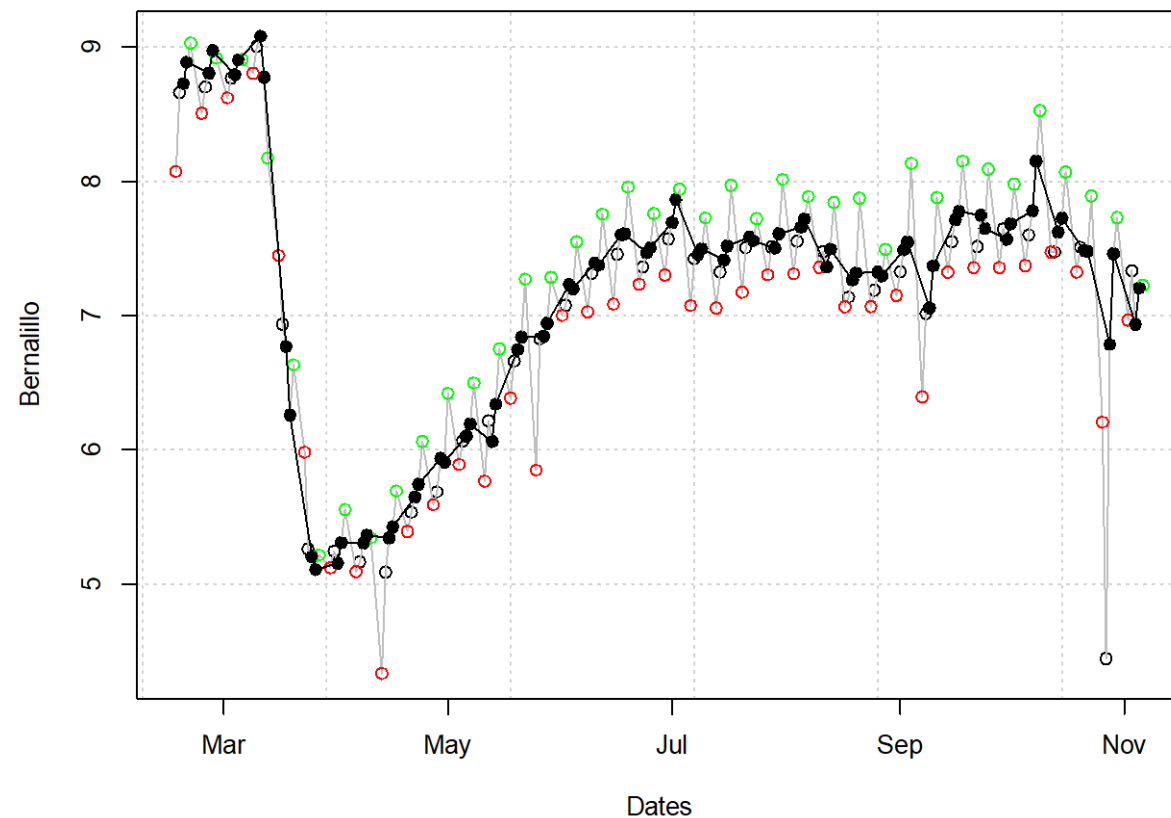
A large drop in mobility in Dona Ana County.

- A modest drop in mobility in Bernalillo.
  - Weekends NOT shown
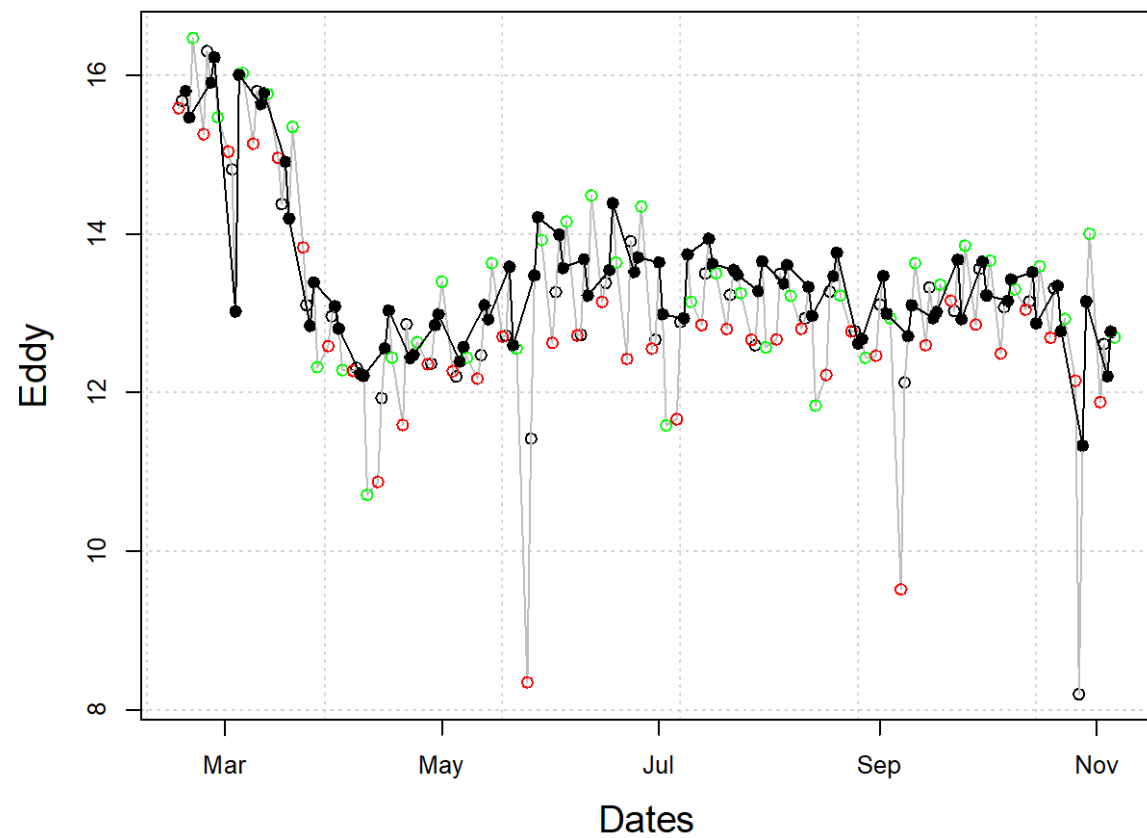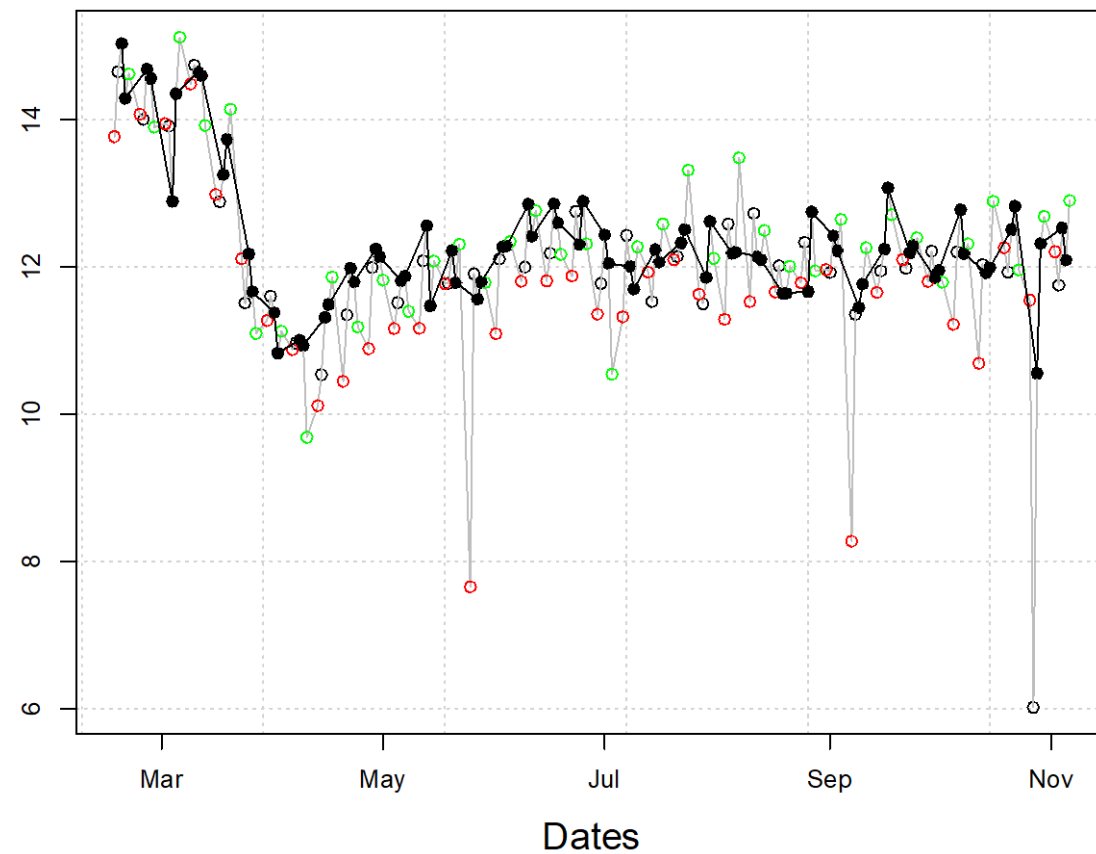 - Monday
  - Wednesday/Thursday
  - Friday

Dona Ana

Bernalillo

Mobility is decreased in some places, but not all

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

# ICU concurrent usage: prior prediction (left), vs. most recent (right)

- Linear vs. time disguises modest improvement in the NM epidemic. Two different plots of exactly the same model and data.
- Linear plot makes potential ICU requirement apparent.
- Semi-logarithm plot reveals the growth rate or decline rate, rather than the pure ICU load.
- Improvement in Dona Ana county. Current mobility drops are not yet reflected in case counts. They are reflected in the model.
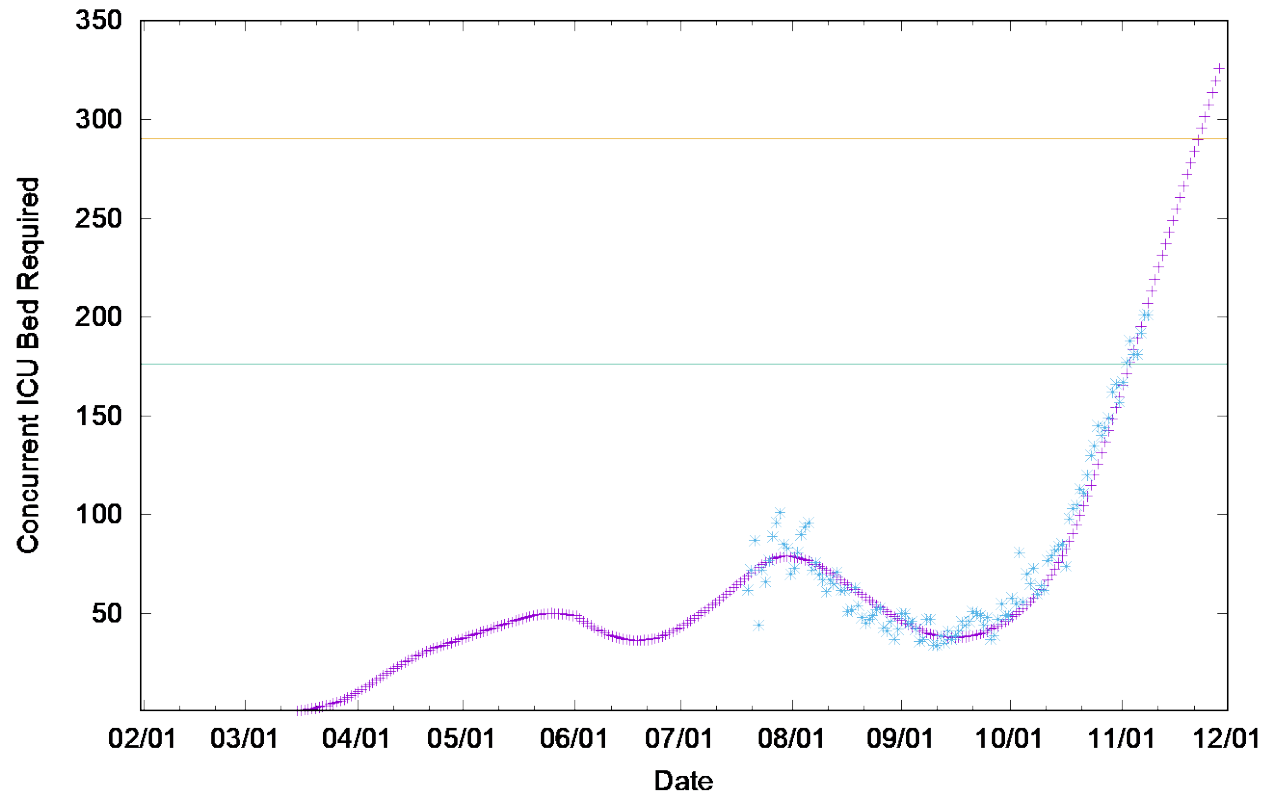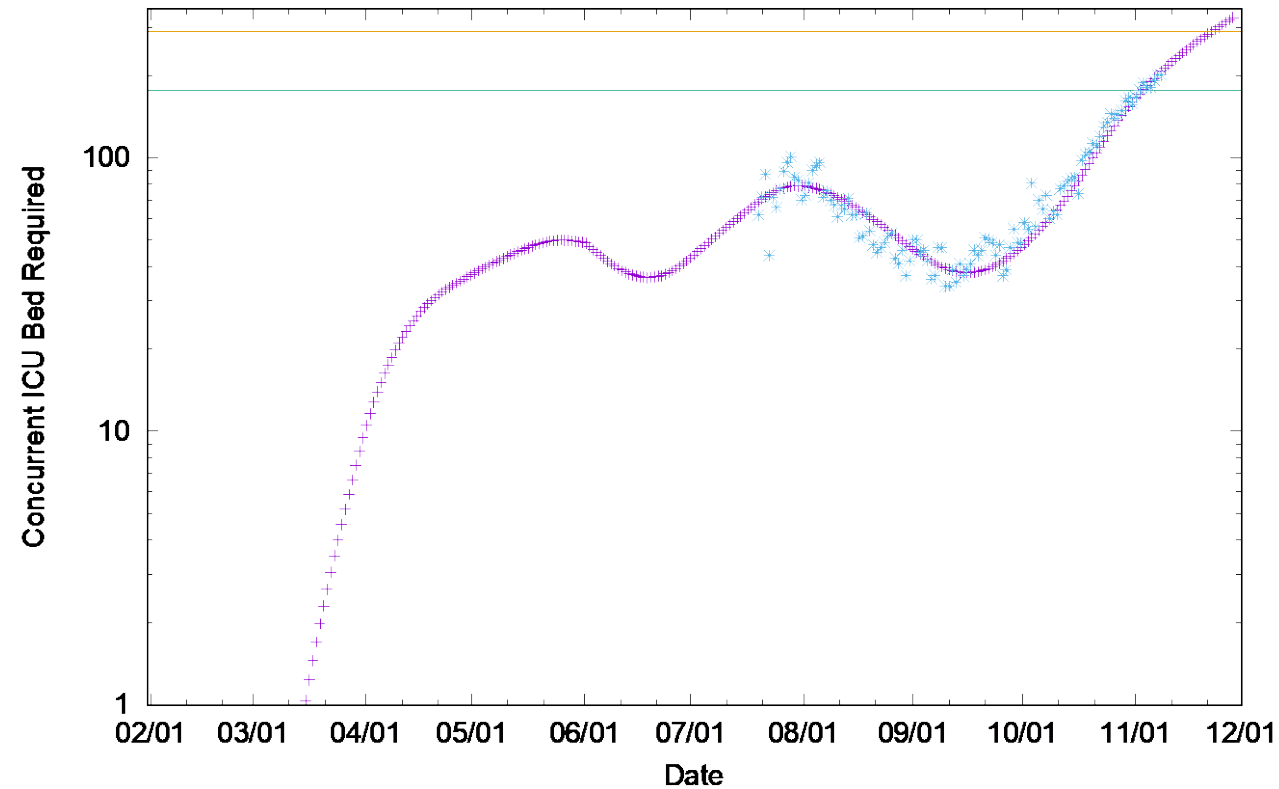
Positivity rates are quite high in some counties

- **Positivity over the past week** (from Covid ActNow https://www.covidactnow.org/us/new_mexico-nm?s=1170284)

    – Dona Ana ~16%

    – Luna ~ 16%

    – Lea ~ 12%

    – Curry ~ 14%

    – Eddy ~ 12%

    – Roosevelt ~12%

    – Chaves ~ 11%

- **The list of counties with test positivity rates > 10% is shorter than last week.**

- **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.

- Transmission in Bernalillo, Dona Ana, Luna, Sierra and Socorro is not currently increased as much as in earlier weeks, post-Labor Day.

- Rio Arriba and Taos have recent increases in cases. Rio Arriba has a history of unusually high case counts.

- San Juan, McKinley, Cibola and Valencia are all of concern (small numerical increases, in some cases possibly coming under control).

- Southeastern New Mexico still has high case counts due to high mobility; Eddy continues to have higher transmission relative to mobility than other non-urban counties in the state (as was true all summer).

- Neither Halloween nor Thanksgiving are currently modeled, and absent additional testing, tracing, and quarantine, these capabilities are unlikely to compensate the expected increases in transmission.
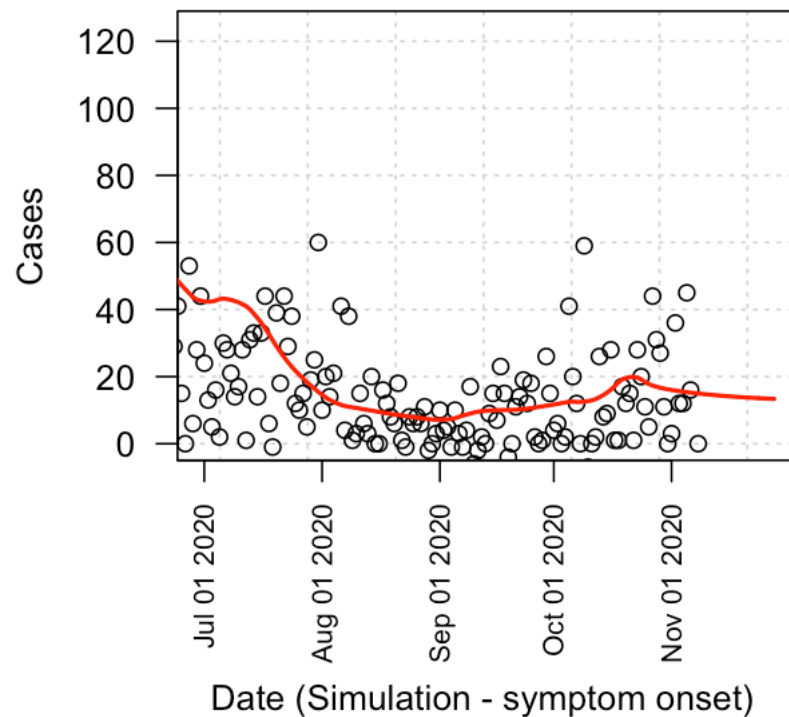
- Pueblos and Navajo Nation are having cases.
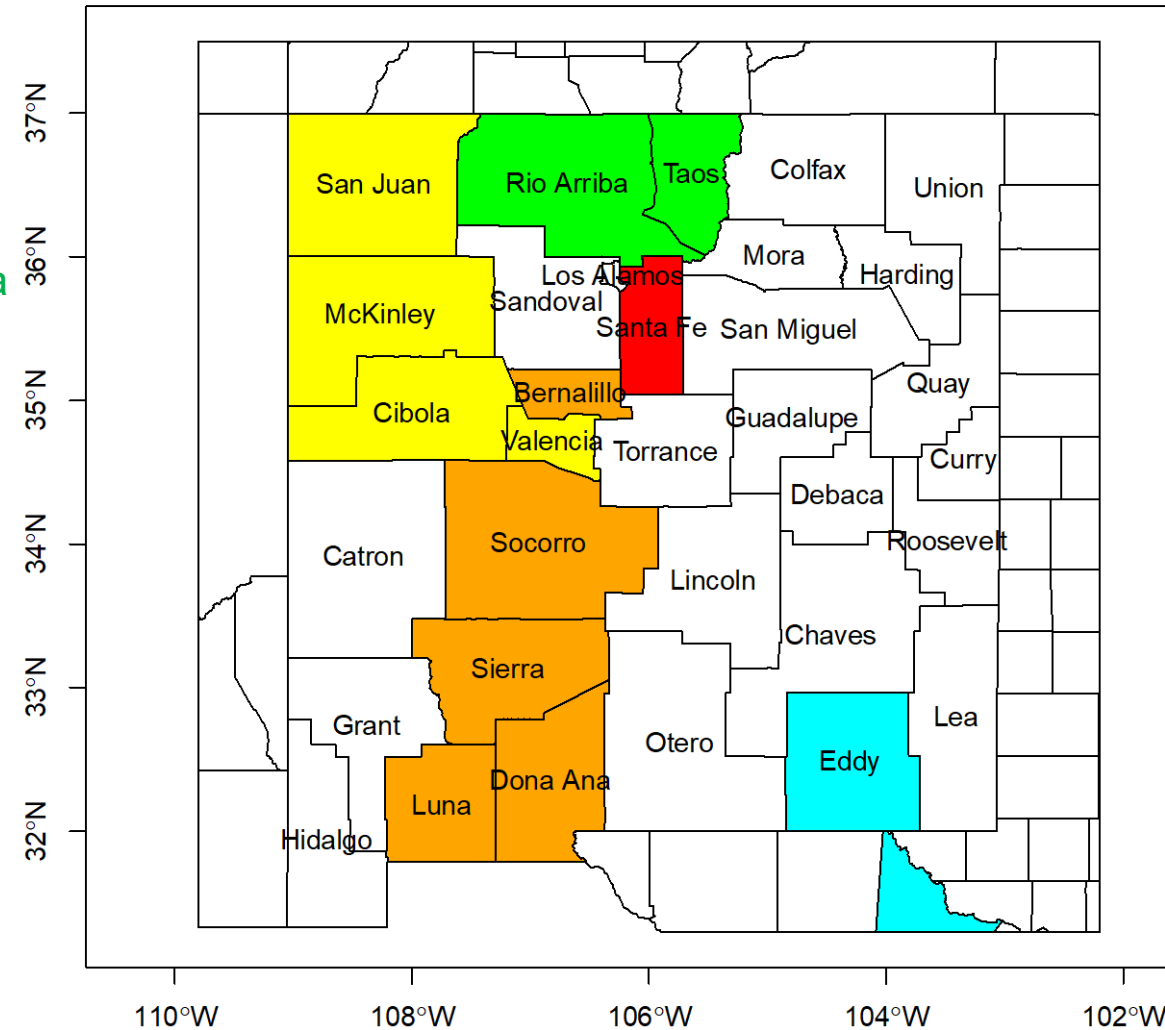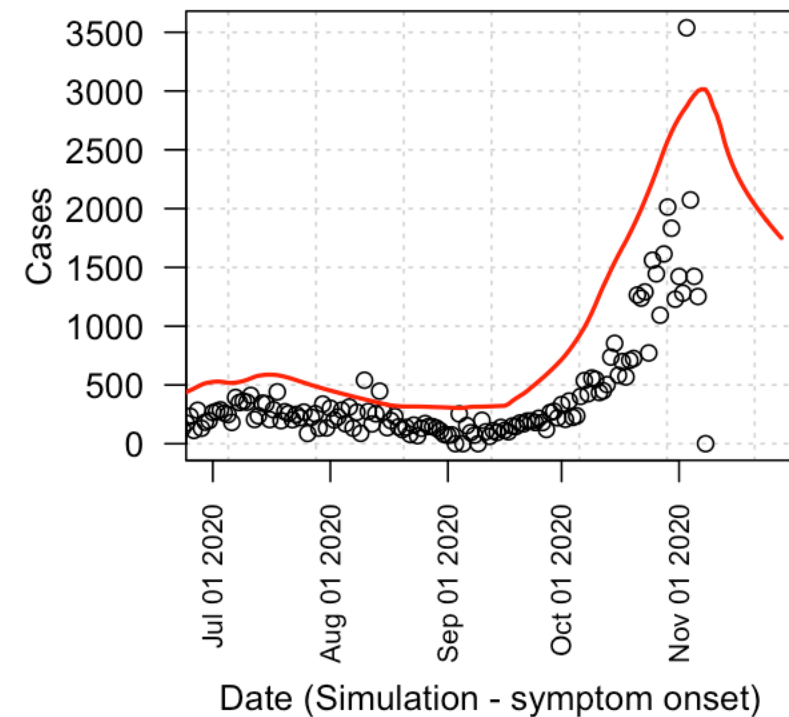
Border counties of importance
(Zero cases for the last time point is an artifact.)

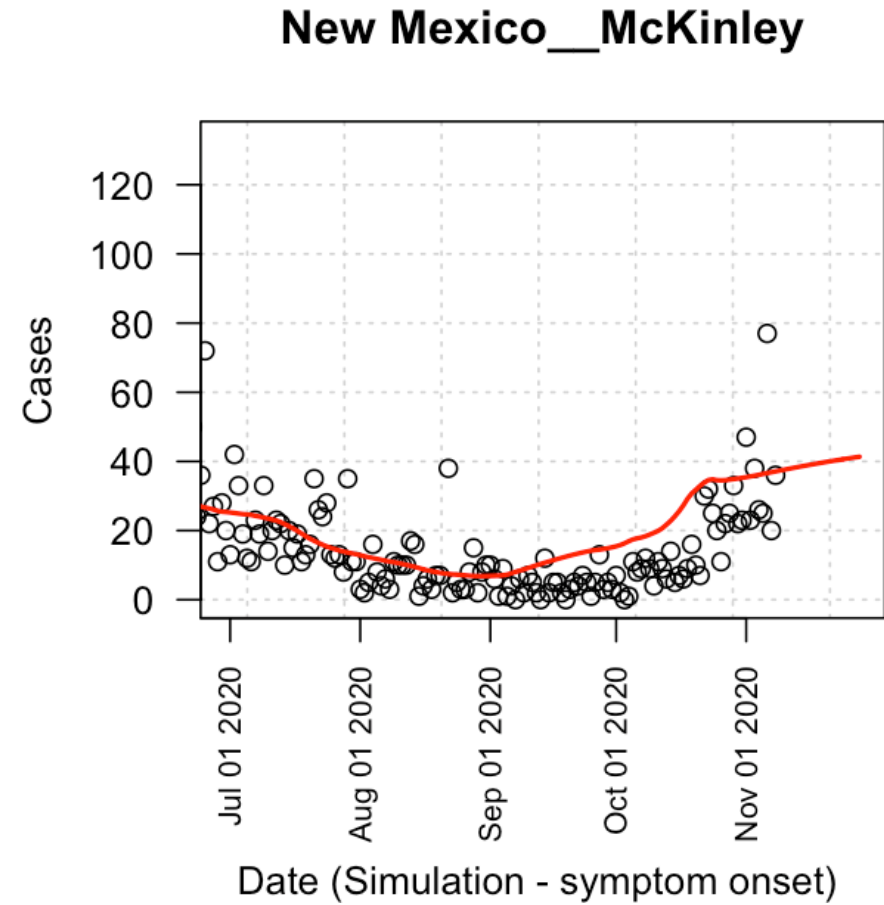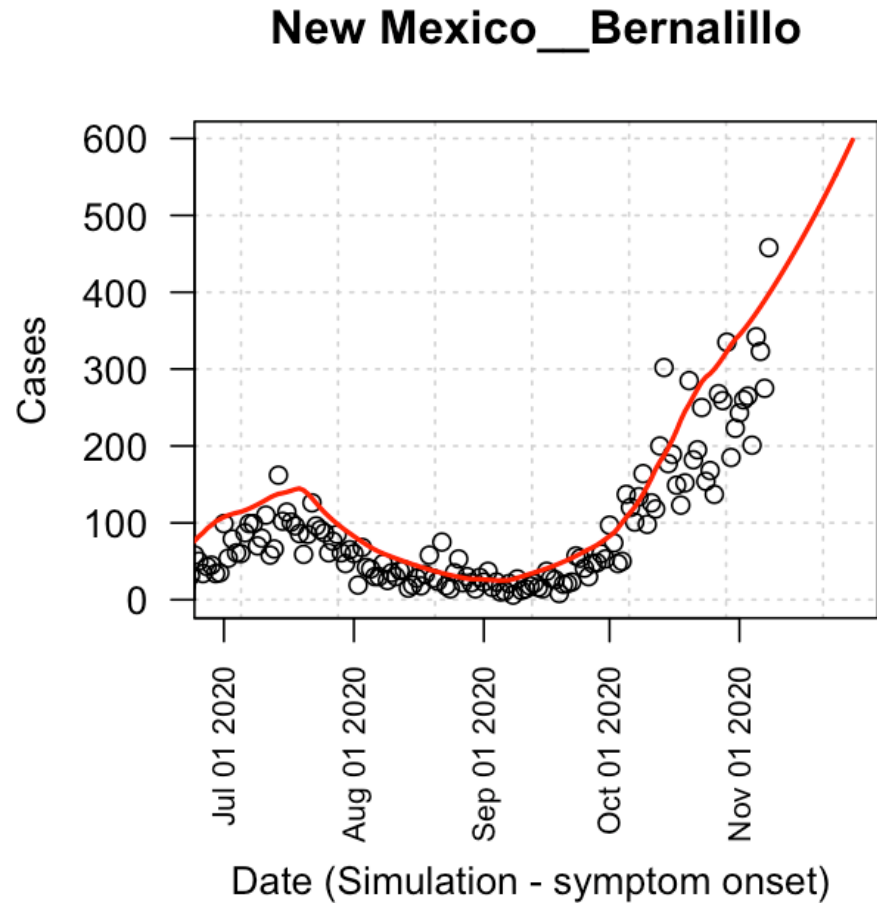Falling incidence is anticipated in El Paso based on PHO enforcement

Diversity across the state

A few other counties
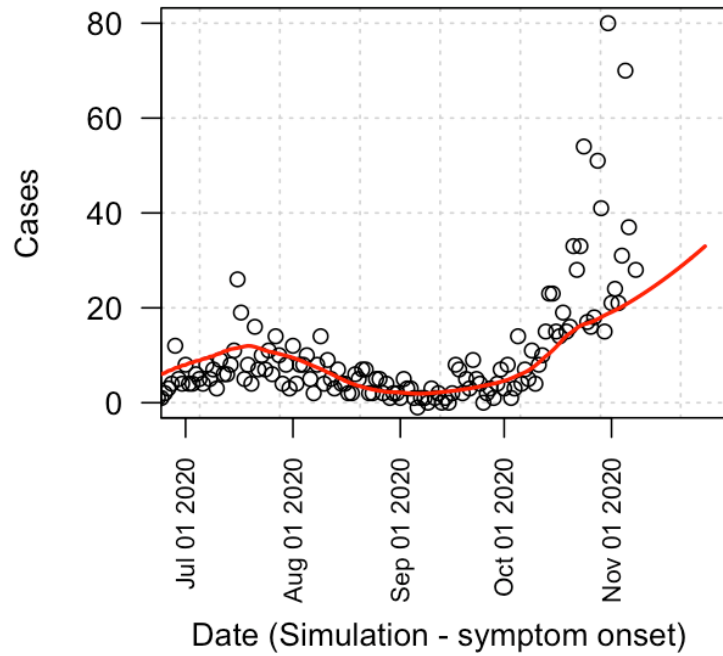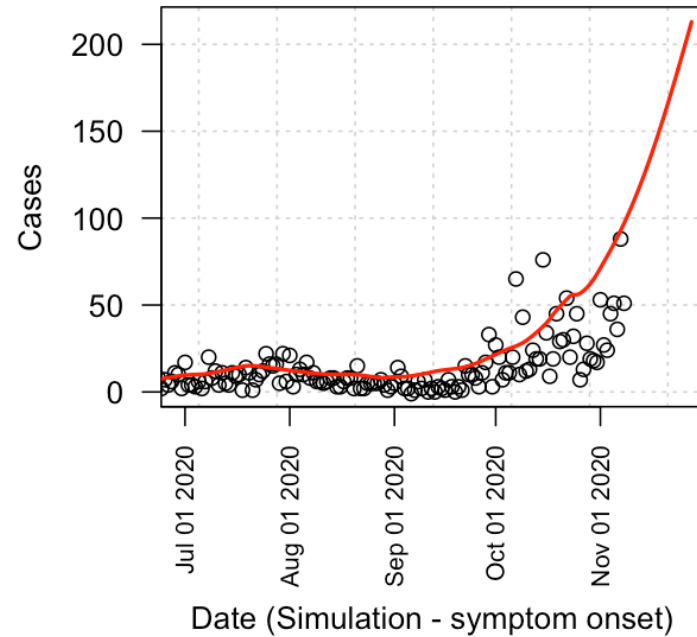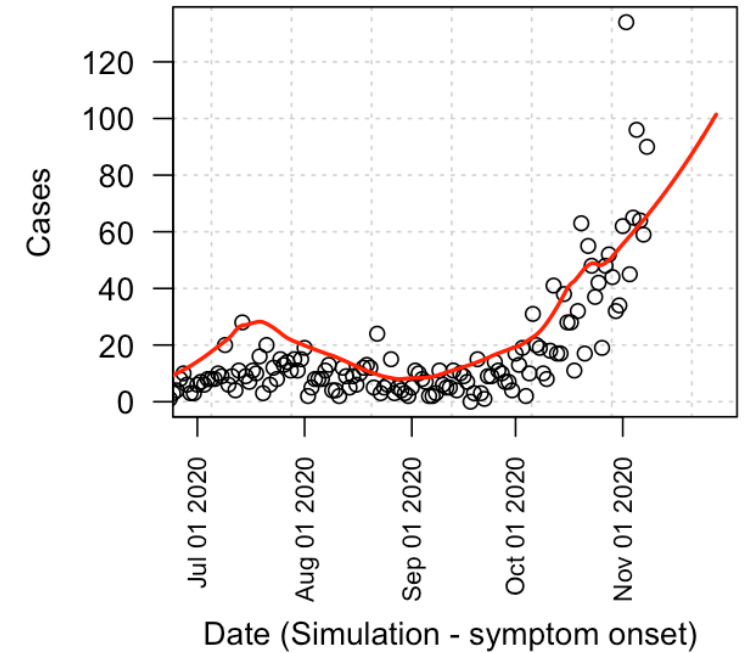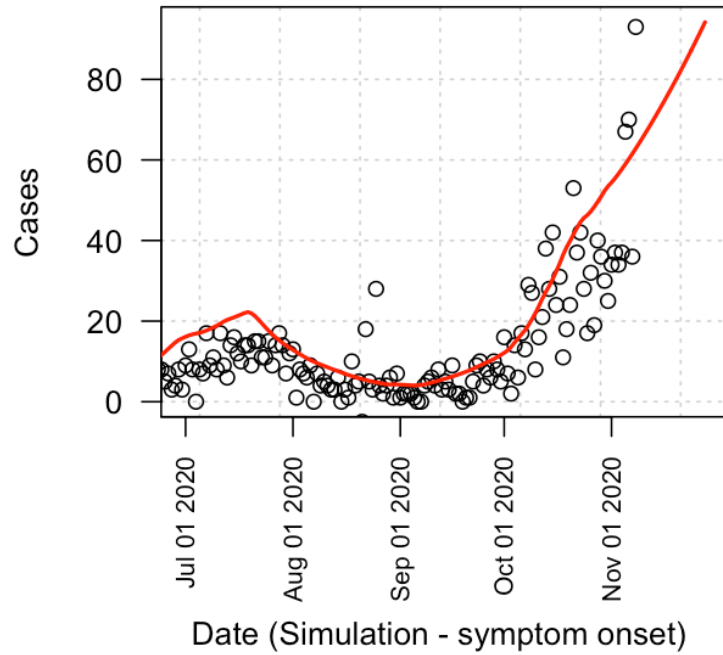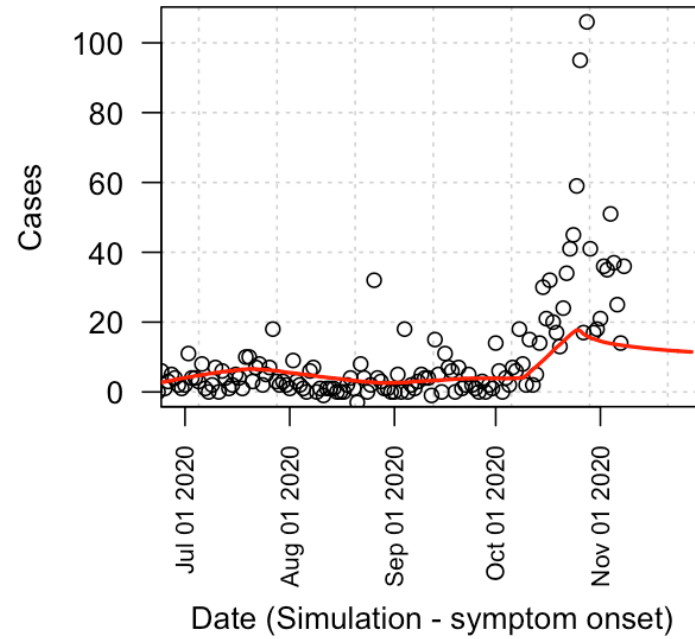
A few other counties
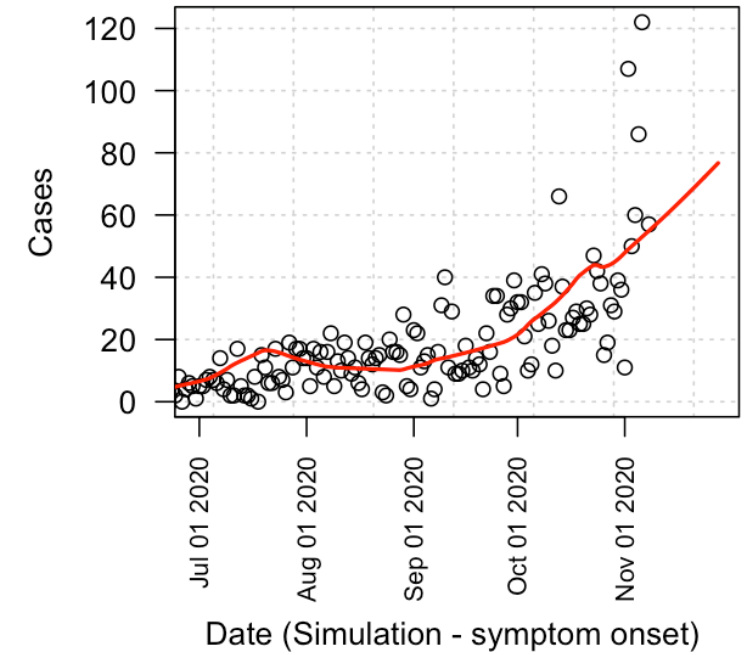
Conclusions and Discussion

- **The New Mexico epidemic is geographically dispersed.**
- **Nation-wide geographical dispersion implies that state-to-state travel plays an important role.**
- **Large population centers dominate the immediate consequence by virtue of their large population. *This is likely to change as the cumulative number of cases in other counties grows.***
- **A significant number of non-urban and frontier counties now support local epidemics.**
- **High test positivity rates show modest improvements in the last week.**
- **Discussion:**
  - Improvement in testing, tracing, quarantine, all due to over-load because of high disease incidence, are necessary.
  - Quarantine *support* along the lines of New Rochelle, NY in March to assist with optimal compliance?
  - Changes in terminology? "Pre-existing conditions" exist for what fraction of the middle-aged population?
  - Increased enforcement probably needed. N.B. New York City. Current infection control improvements will likely be offset by Thanksgiving before good control is achieved.
  - Continued, phased roll-back of high- and moderate-risk activities? Especially indoor activities.
  - Qualitatively higher testing rates (i.e. 10x) can substantially offset local epidemics (i.e. South Korea). 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?