Modeling & Forecasting COVID-19 in NM

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December 1, 2020

N S A
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 2020-11-30

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 2020-11-30

Week	Best Case (5th Percentile)	Middle Case (50th Percentile)	Worst Case (95th Percentile)^
2020-11-30		97,095*	
2020-12-07	109,471	114,774	121,285
2020-12-14	121,597	133,760	148,579
2020-12-21	132,170	152,415	177,952
2020-12-28	141,642	169,918	208,320
2021-01-04	150,022	186,091	238,204
2021-01-11	157,782	201,632	267,046

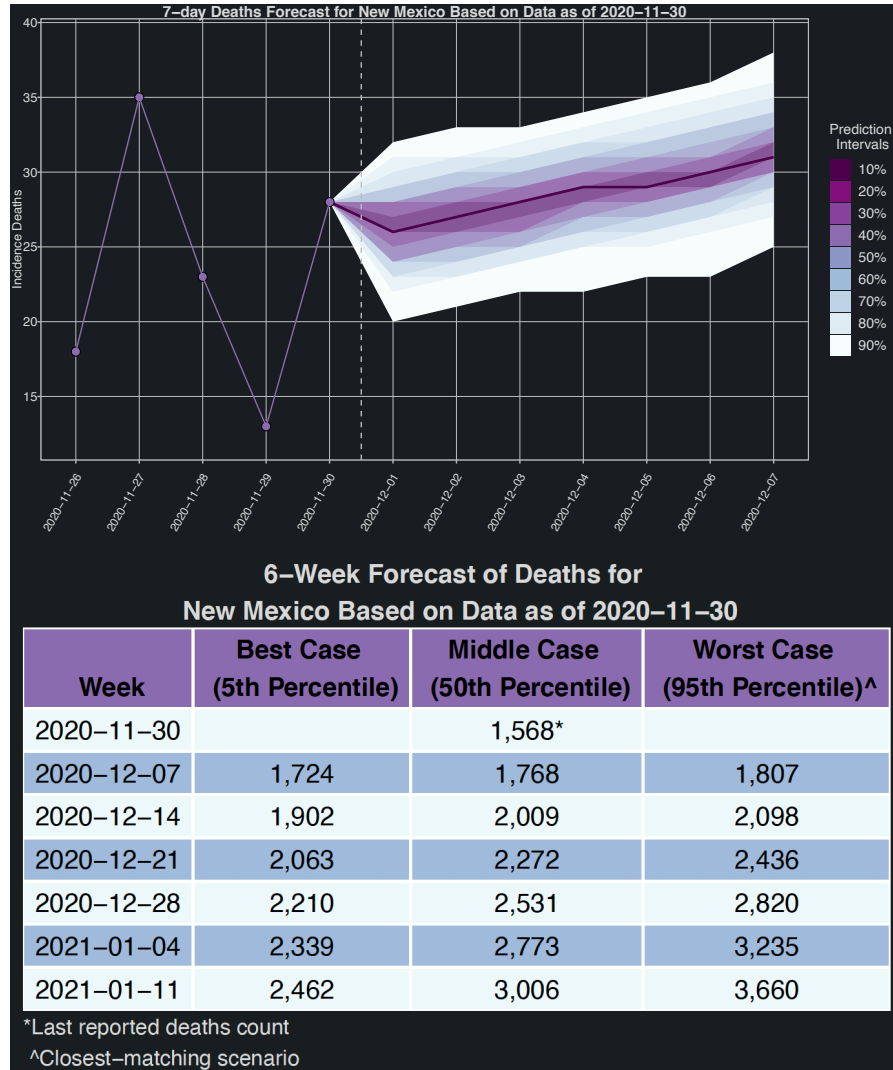*Last reported confirmed cases count
^Closest-matching scenario

6-Week Forecast of Daily Average of Confirmed Cases for New Mexico Based on Data as of 2020-11-30

Week	Best Case (5th Percentile)	Middle Case (50th Percentile)	Worst Case (95th Percentile)^
2020-11-30		1,850*	
2020-12-07	1,768	2,526	3,456
2020-12-14	1,732	2,712	3,899
2020-12-21	1,510	2,665	4,196
2020-12-28	1,353	2,500	4,338
2021-01-04	1,197	2,310	4,269
2021-01-11	1,109	2,220	4,120

*Last reported confirmed cases count
^Closest-matching scenario

So what?
The daily number of cases is expected to range between 1,768 and 3,899 in the next two weeks

Short- & Long-Term Forecast for NM: Deaths

7–day Deaths Forecast for New Mexico Based on Data as of 2020–11–30

6–Week Forecast of Deaths for New Mexico Based on Data as of 2020–11–30

Week	Best Case (5th Percentile)	Middle Case (50th Percentile)	Worst Case (95th Percentile)^
2020–11–30		1,568*	
2020–12–07	1,724	1,768	1,807
2020–12–14	1,902	2,009	2,098
2020–12–21	2,063	2,272	2,436
2020–12–28	2,210	2,531	2,820
2021–01–04	2,339	2,773	3,235
2021–01–11	2,462	3,006	3,660

*Last reported deaths count
^Closest–matching scenario

6–Week Forecast of Daily Average of Deaths for New Mexico Based on Data as of 2020–11–30

Week	Best Case (5th Percentile)	Middle Case (50th Percentile)	Worst Case (95th Percentile)^
2020–11–30		24*	
2020–12–07	22	29	34
2020–12–14	25	34	42
2020–12–21	23	38	48
2020–12–28	21	37	55
2021–01–04	18	35	59
2021–01–11	18	33	61

*Last reported confirmed deaths
^Closest–matching scenario

So what?
The daily number of deaths is expected to range between 22 and 42 in the next two weeks

Growth Rate for NM

Daily Growth Rate for the Past Six Weeks in New Mexico as of 2020-11-30
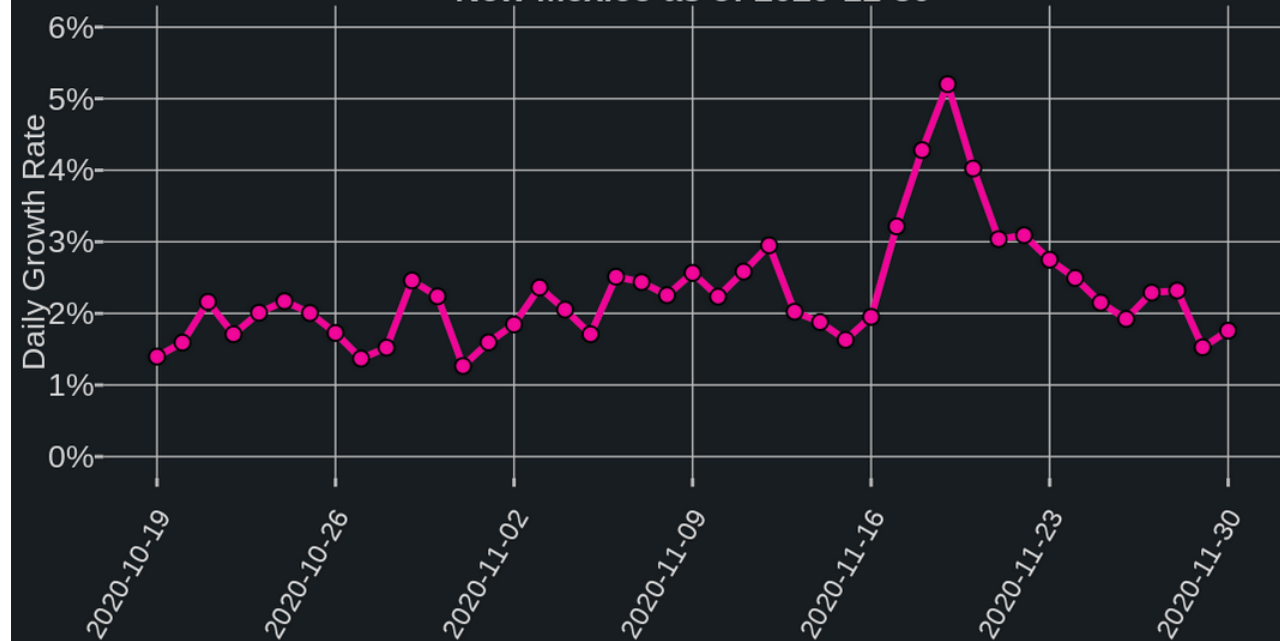
6-Week Forecast of the Average Weekly Growth Rate for New Mexico Based on Data as of 2020-11-30

Week	Best Case (5th Percentile)	Middle Case (50th Percentile)	Worst Case (95th Percentile)^
2020-11-30		2.1%*	
2020-12-07	1.7%	2.4%	3.2%
2020-12-14	1.5%	2.2%	2.9%
2020-12-21	1.2%	1.9%	2.6%
2020-12-28	0.99%	1.6%	2.3%
2021-01-04	0.82%	1.3%	1.9%
2021-01-11	0.72%	1.2%	1.6%

*Last weekly mean daily growth rate

^Closest-matching scenario

So what?

As of November 30th, the average growth rate in NM is at 2.1% (down from 3.7%)

Deaths have been increasing by an average of 1.6% per day (down from 1.8%)
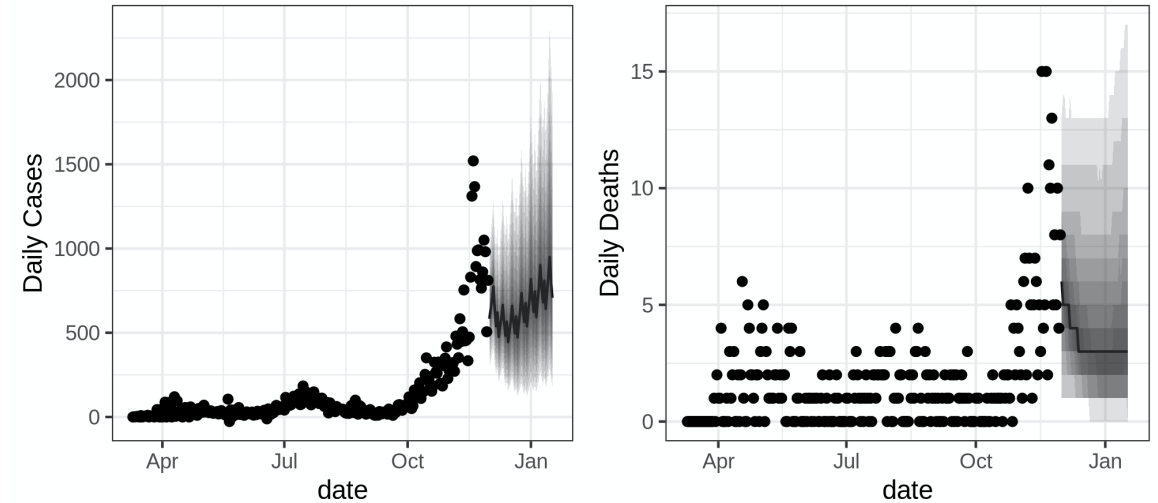
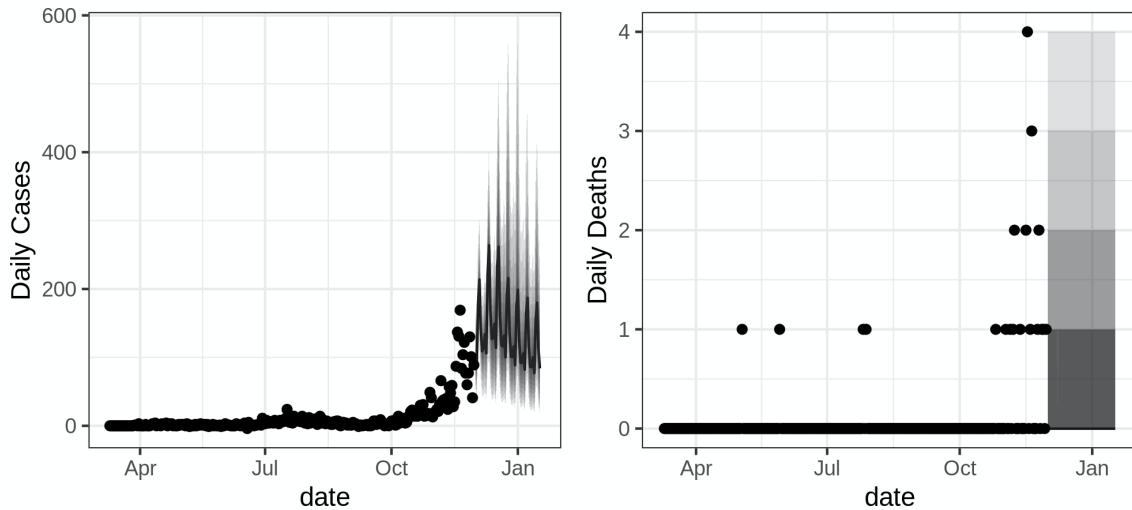# > Regional Forecasts, Growth Rates, & Hospitalizations

Central Region Forecasts

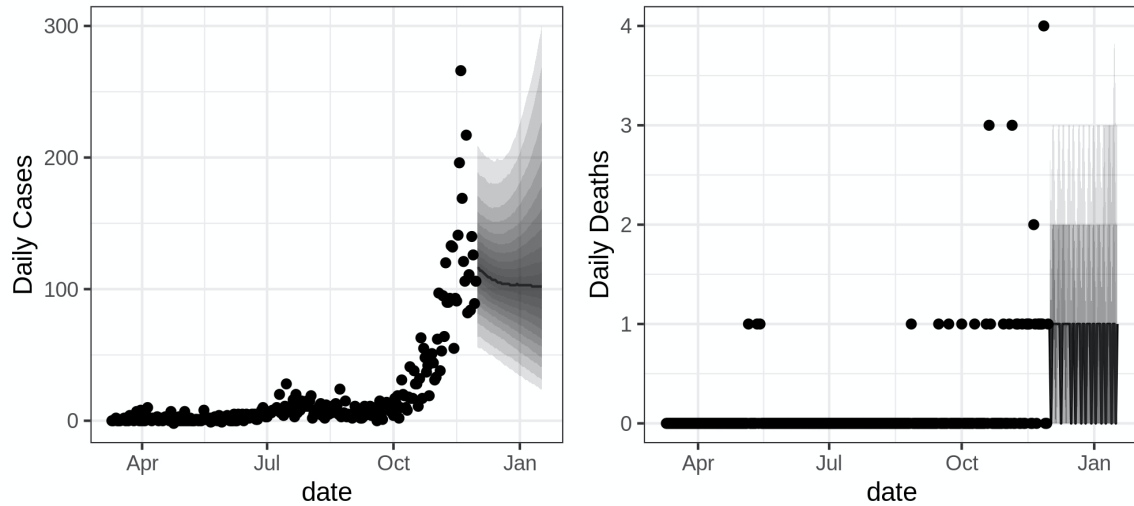New Mexico - Bernalillo
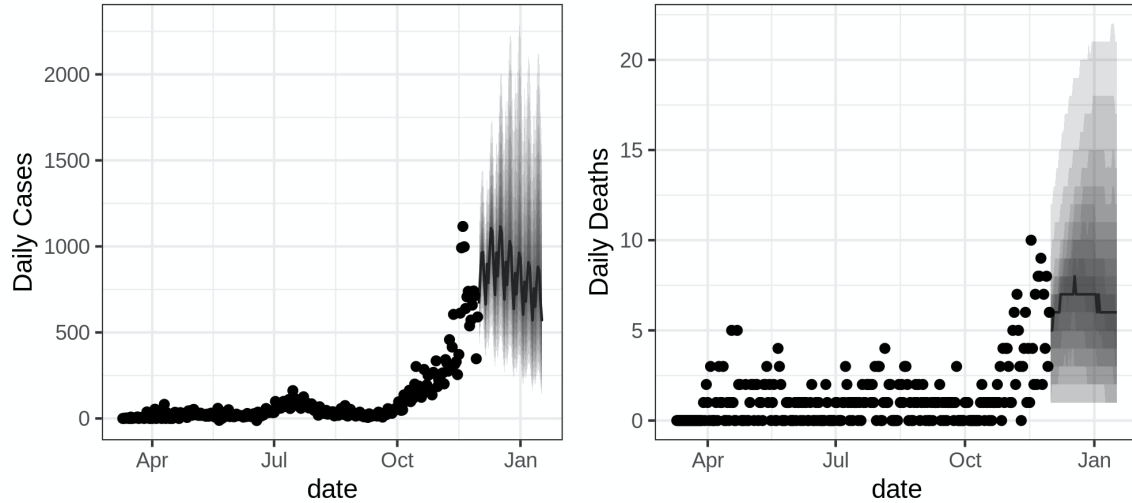
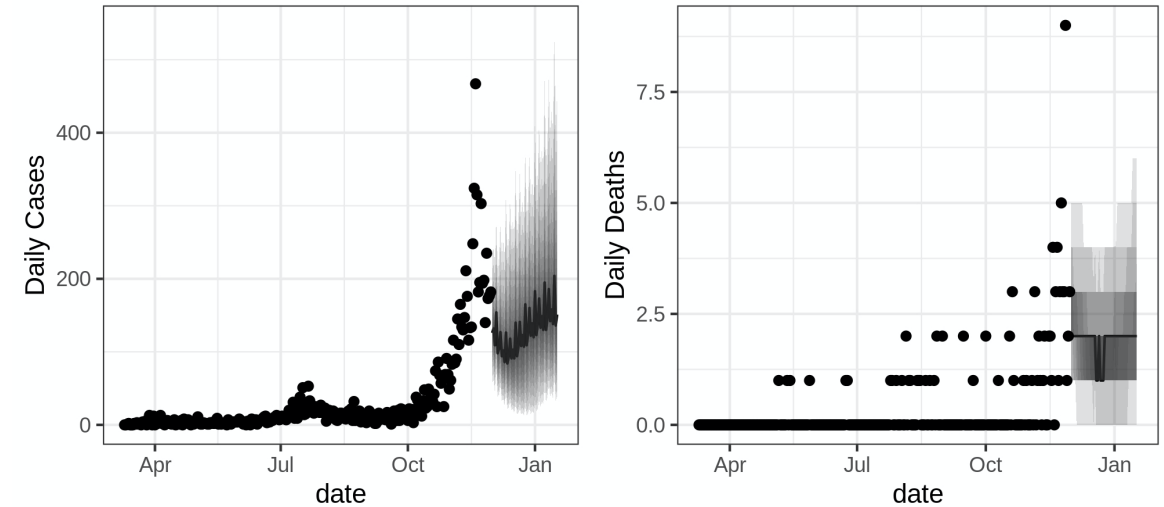Health Region - NM Central Region

New Mexico - Valencia

So what?
The average number of cases for the Central Region is expected to be around 600 next week
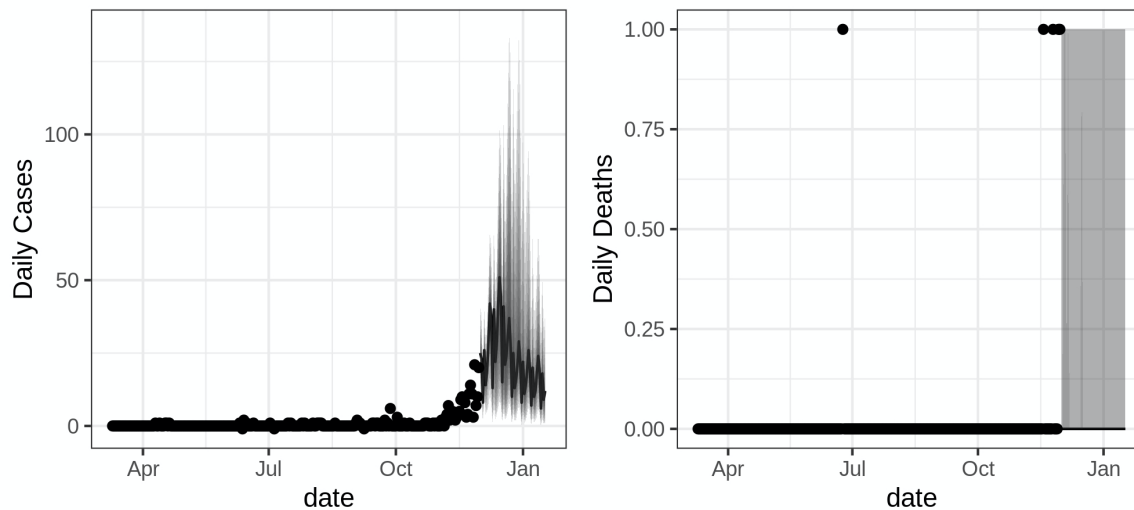
Northeast Region Forecasts

New Mexico - Santa Fe
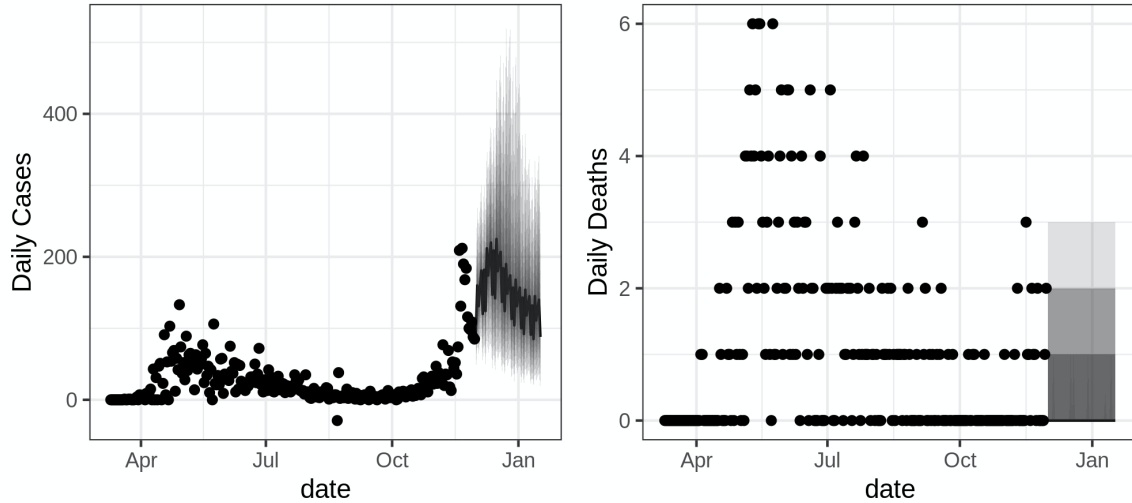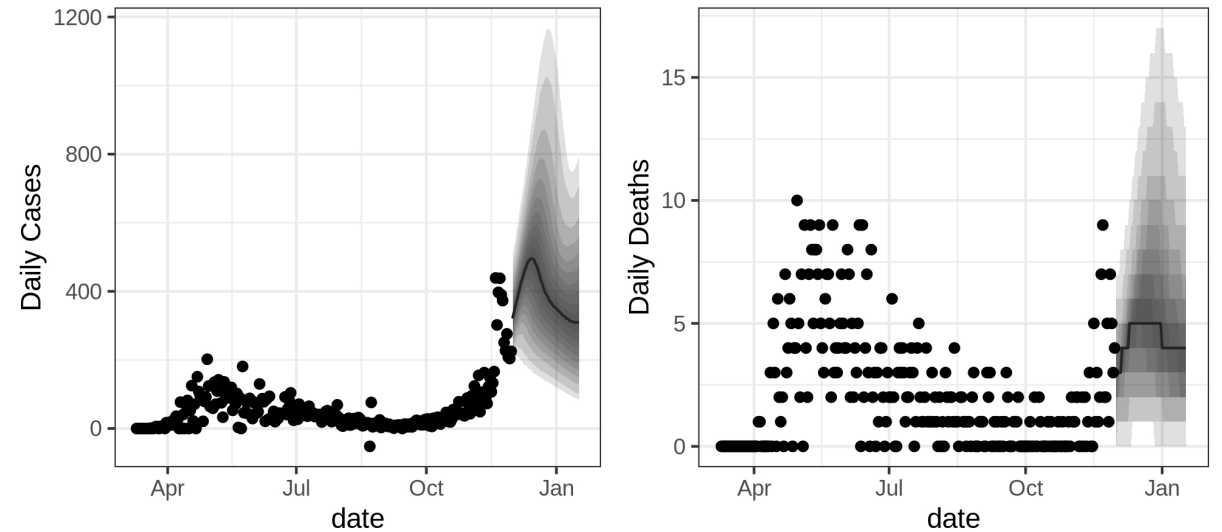
Health Region - NM Northeast Region

New Mexico - Colfax

So what?
The average number of cases for the Northeast Region is expected to be around 100 next week
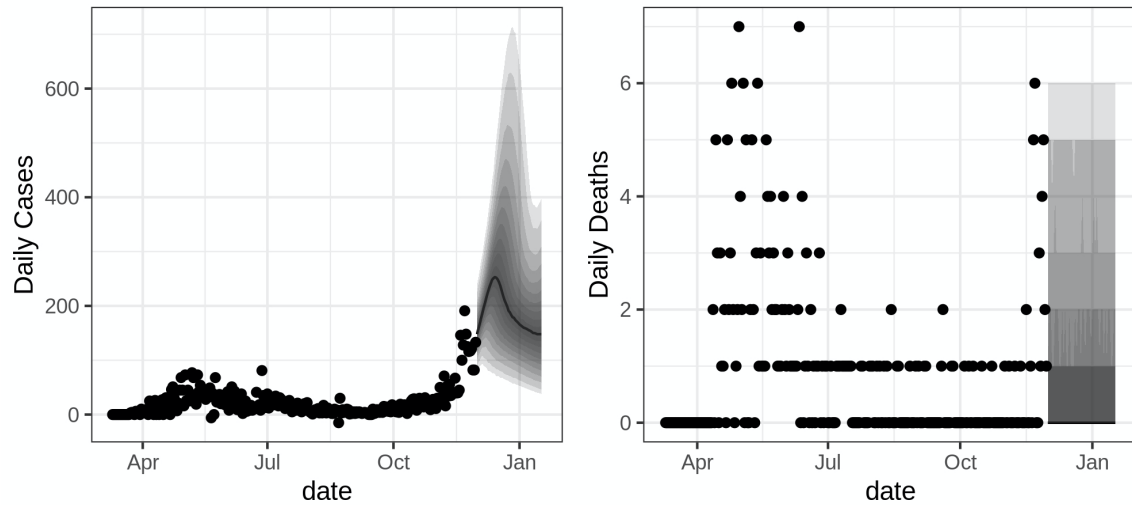
Northwest Region Forecasts

New Mexico - McKinley
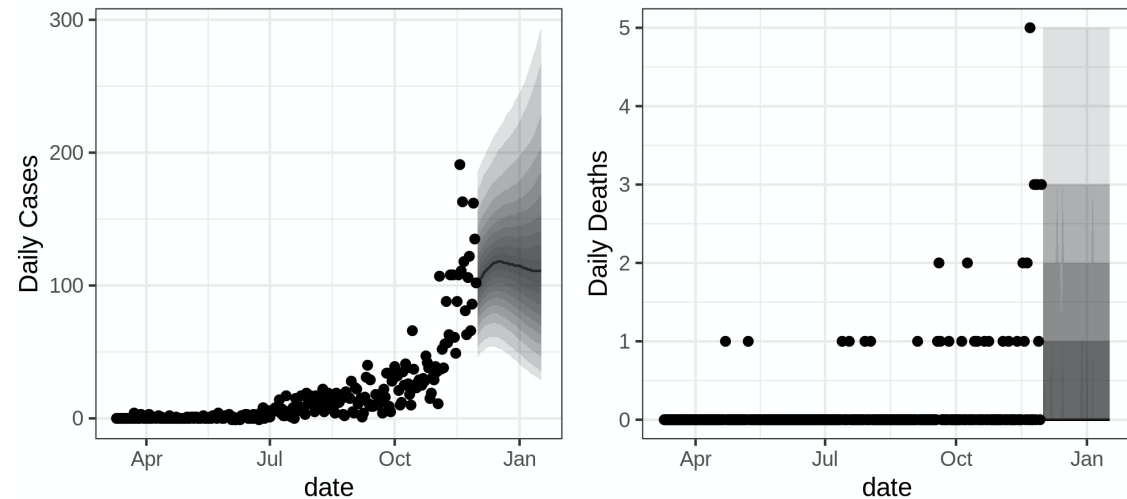
New Mexico - San Juan
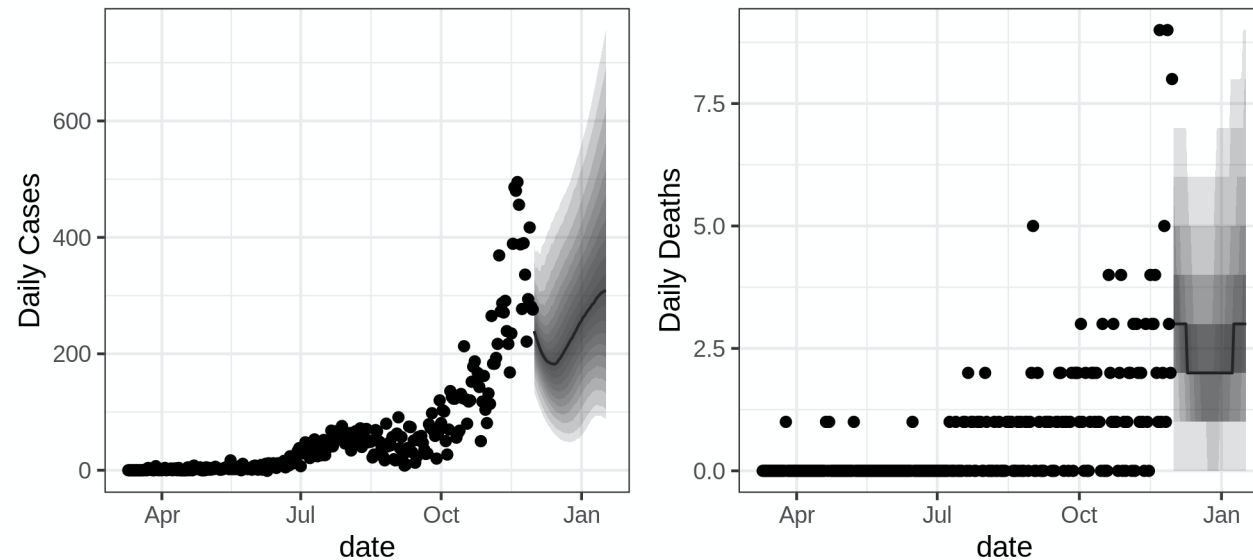
Health Region - NM Northwest Region

So what?
The average number of cases for the Northwest Region is expected to be around 450 next week

Southeast Region Forecasts

New Mexico - Chaves

New Mexico - Lea

Health Region - NM Southeast Region

So what?
The average number of cases for the Southeast Region is expected to be around 200 next week
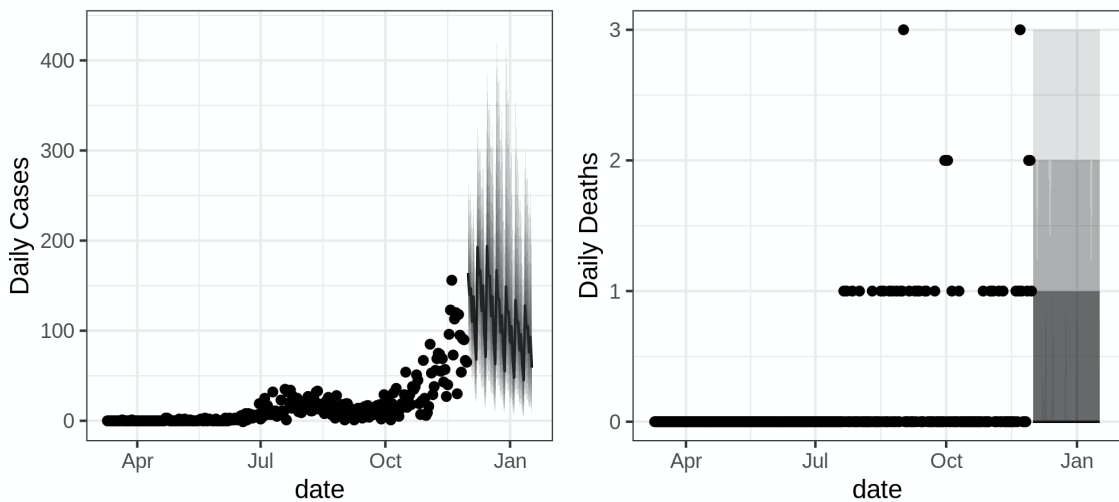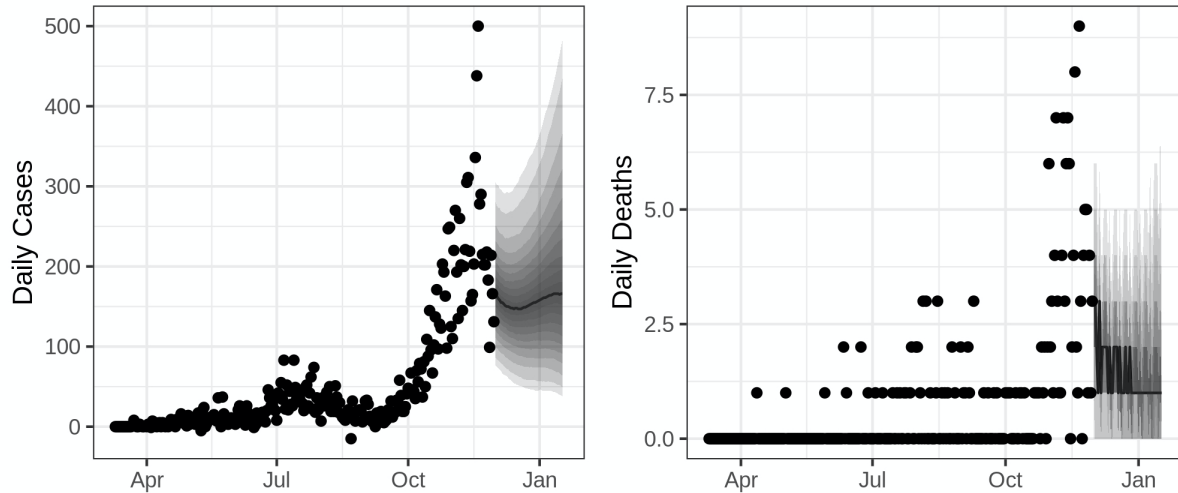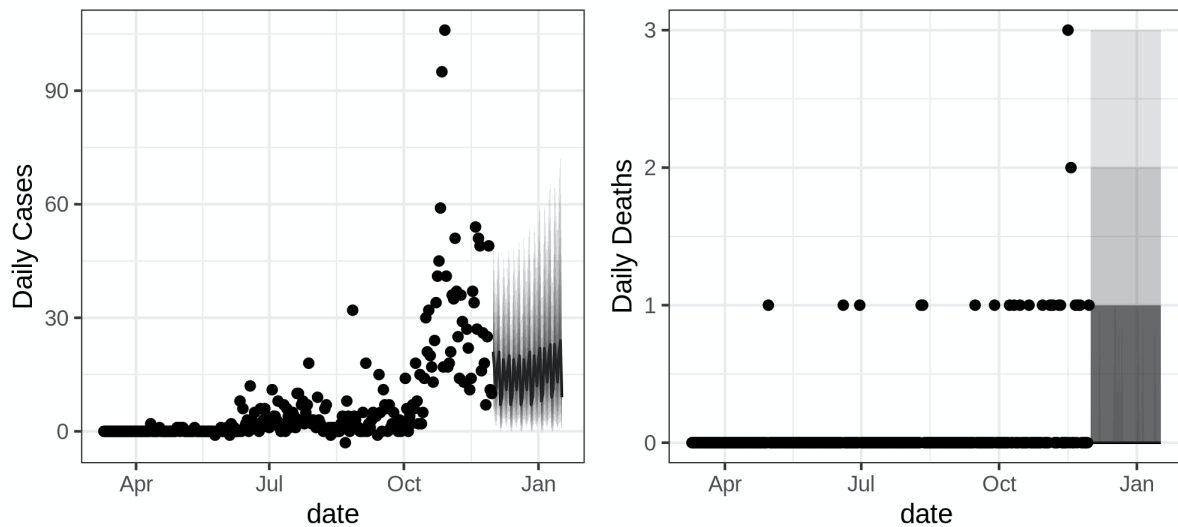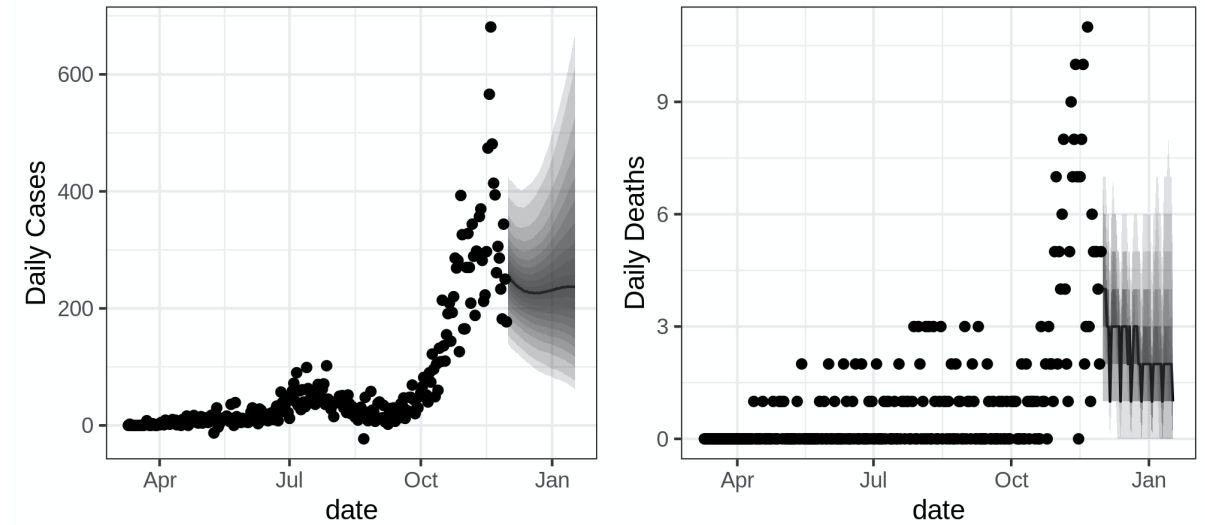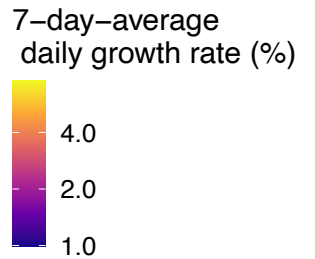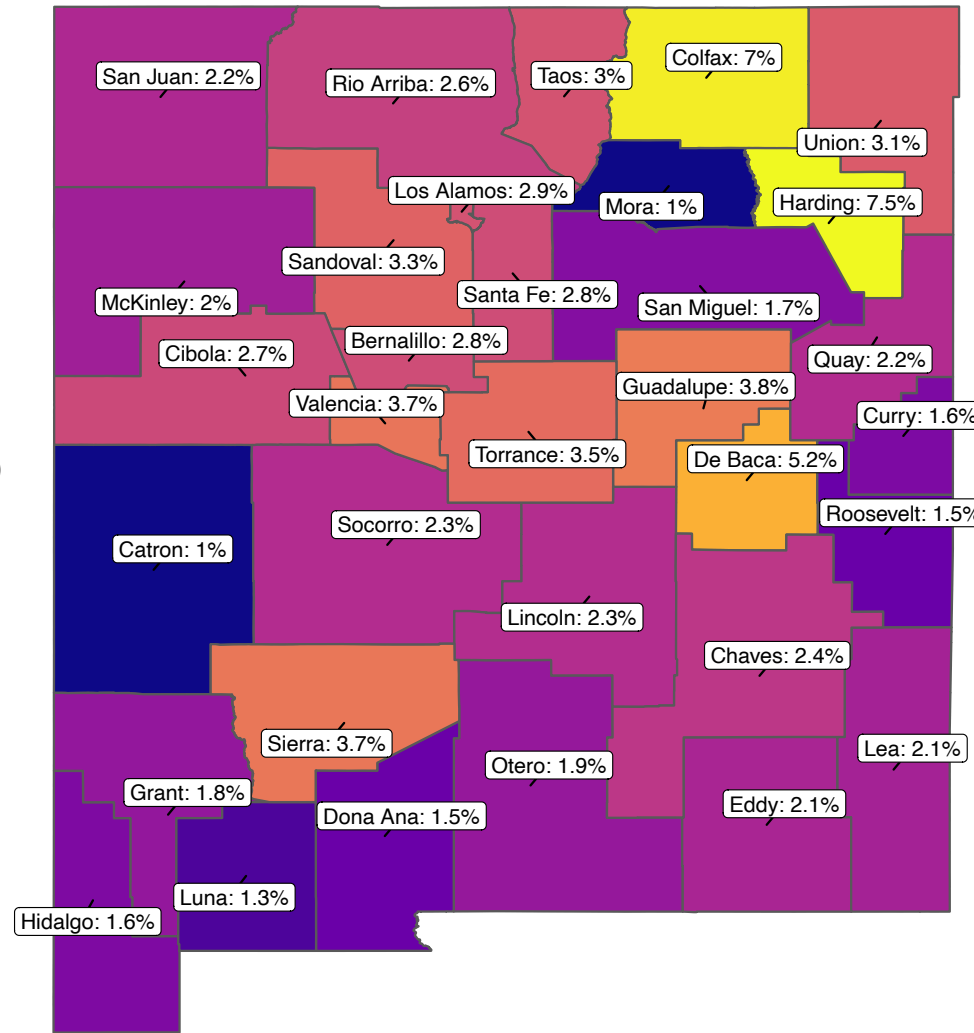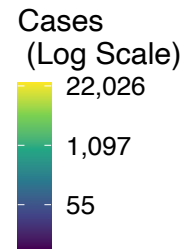
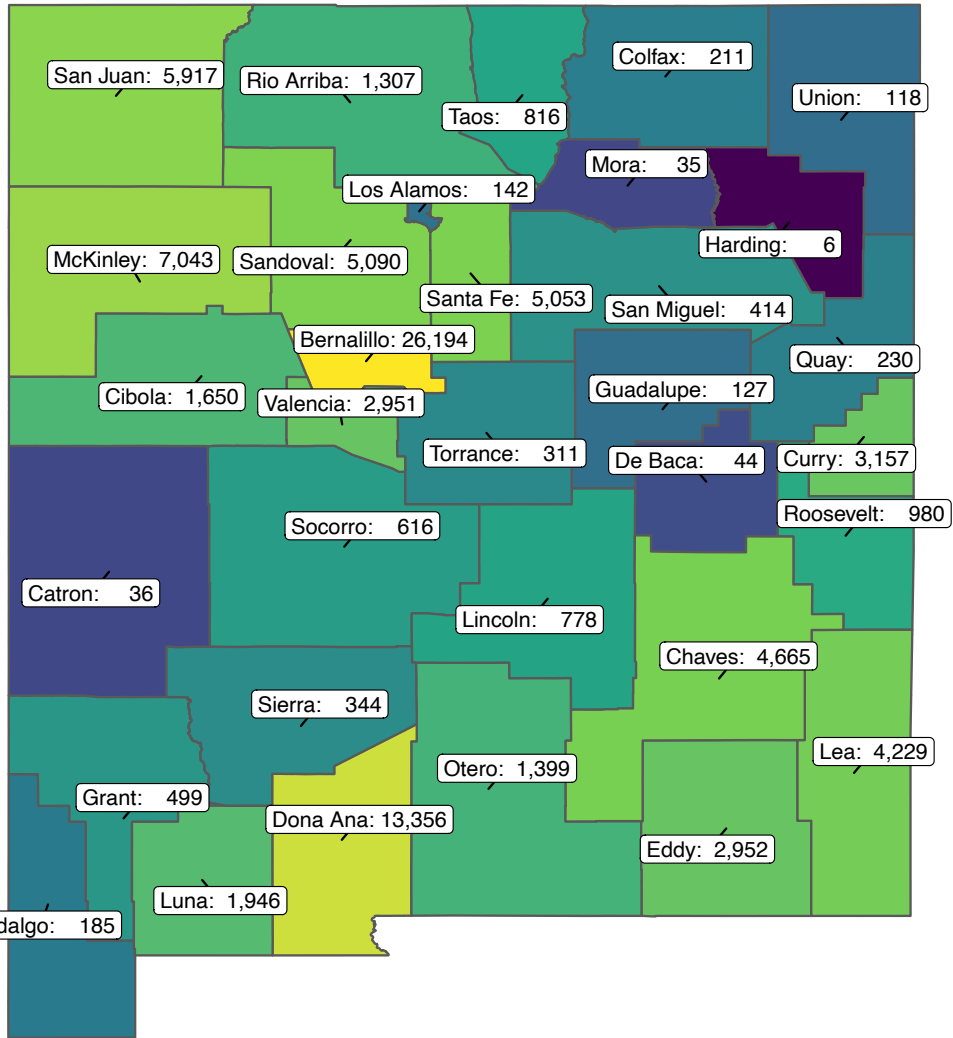# Southwest Region Forecasts

So what?
The average number of cases for the Southwest Region is expected to be around 230 next week

Cumulative Cases & Daily Growth Rate for NM: Nov 30

Daily Growth Rate for NM Nov 30

Map labels:
San Juan: 2.2%, Rio Arriba: 2.6%, Taos: 3%, Colfax: 7%, Union: 3.1%, Los Alamos: 2.9%, Mora: 1%, Harding: 7.5%, Sandoval: 3.3%, Santa Fe: 2.8%, San Miguel: 1.7%, McKinley: 2%, Bernalillo: 2.8%, Quay: 2.2%, Cibola: 2.7%, Valencia: 3.7%, Guadalupe: 3.8%, Curry: 1.6%, Torrance: 3.5%, De Baca: 5.2%, Roosevelt: 1.5%, Catron: 1%, Socorro: 2.3%, Lincoln: 2.3%, Chaves: 2.4%, Sierra: 3.7%, Otero: 1.9%, Lea: 2.1%, Grant: 1.8%, Dona Ana: 1.5%, Eddy: 2.1%, Luna: 1.3%, Hidalgo: 1.6%

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

Socorro **2.3%** ↓
Los Alamos **2.9%** ↓
Mora **1.0%** ↓
Roosevelt **1.5%** ↓
Hidalgo **1.6%** =
DeBaca **5.2%** ↓
Colfax **7.0%** =
Quay **2.2%** ↓
Catron **1.0%** ↓
Union **3.1%** ↓

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

County	Daily Growth Rate	Change
San Juan	2.2%	↑
Rio Arriba	2.6%	↓
Sierra	3.7%	↑
McKinley	2.0%	=
Sandoval	3.3%	↓
Santa Fe	2.8%	↓
Cibola	2.7%	↓
Bernalillo	2.8%	↓
Valencia	3.7%	↓
Torrance	3.5%	↓
Lincoln	2.3%	↓
San Miguel	1.7%	↓
Chaves	2.4%	↓
Dona Ana	1.5%	↓
Otero	1.9%	↓
Lea	2.1%	↓
Eddy	2.1%	↓
Curry	1.6%	↓
Grant	1.8%	↓
Luna	1.3%	↓
Taos	3.0%	↓

COVID-19 across New Mexico
A 7-day moving window comparison
November 30, 2020

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

Impacted New Mexicans

Counties with New Cases This Week

Growth Rate	Low	Med	High	
Accelerating	0k	0k	12k	Accelerating
Constant	0k	0k	160k	Constant
Decelerating	0k	8.1k	1.9M	Decelerating

Cases Per Capita

Counties With No New Cases In ...

Last Week	Two Weeks	3+ Weeks
0k	0k	0k

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

So what?

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

- **All counties reported at least one case last week and only two counties had medium per capita case counts**

Concurrent COVID-19 ICUs beds

Week	Qu. 5% (best case)	Qu. 50% (median)	Qu. 95% (worst case)
12/6	213	268	342
12/13	189	307	450
12/20	173	323	508
12/27	153	317	573
1/3	132	294	624
1/10	110	276	602

"Scaled" Scenario

...at?

...current COVID-19 patients; our model is
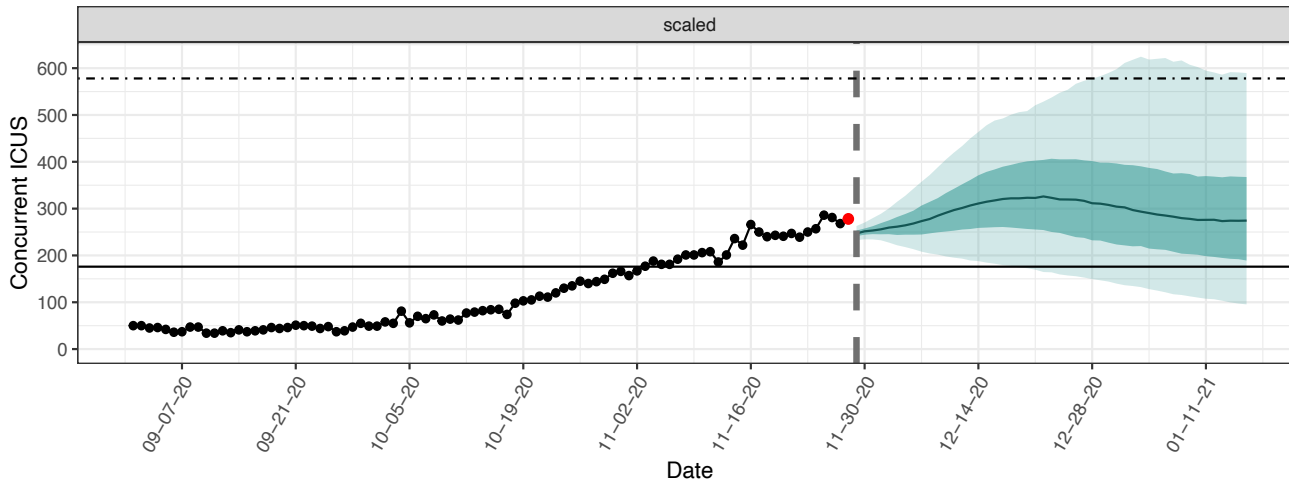...Predict between **323—508 concurrent COVID-**

Concurrent Hosp & ICU Beds Based on Forecasts – Average Stay of 8 Hosp, 15 Days for ICU/vent & 25% ICU rate
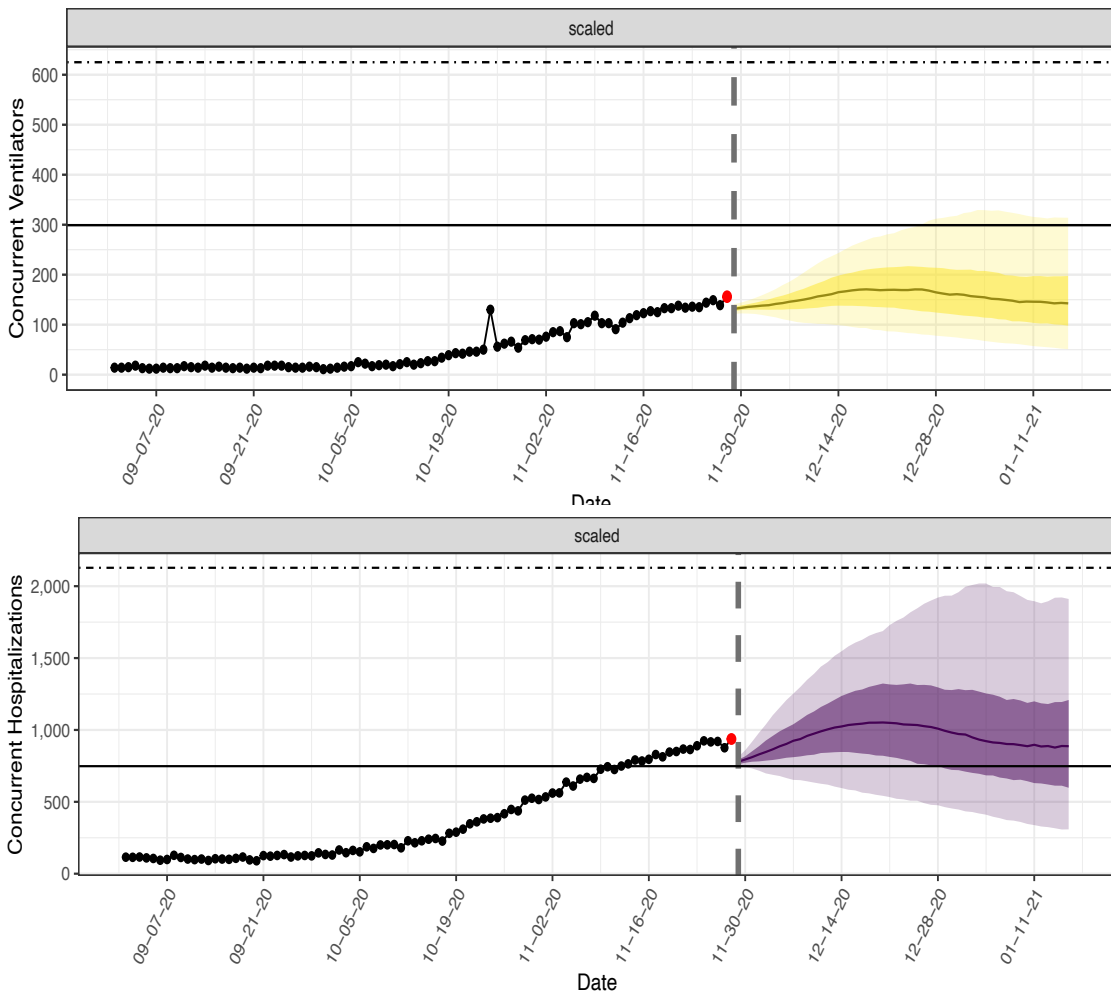
Concurrent COVID-19 non-ICU beds

Week	Qu. 5% (best case)	Qu. 50% (median)	Qu. 95% (worst case)
12/6	452	635	866
12/13	417	710	1066
12/20	369	729	1179
12/27	326	704	1327
1/3	286	639	1395
1/10	236	611	1302

"Scaled" Scenario

So what?

cking with worst case scenario this week; non-ICU beds
ween 729—1179 beds by December 20

Regional Hospitalization Forecasts: Central
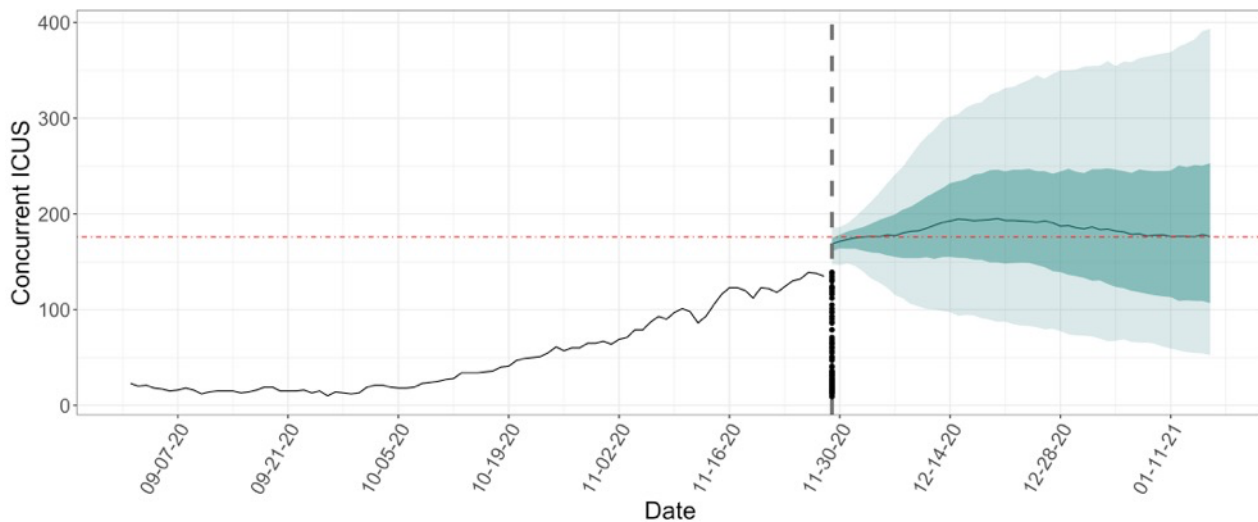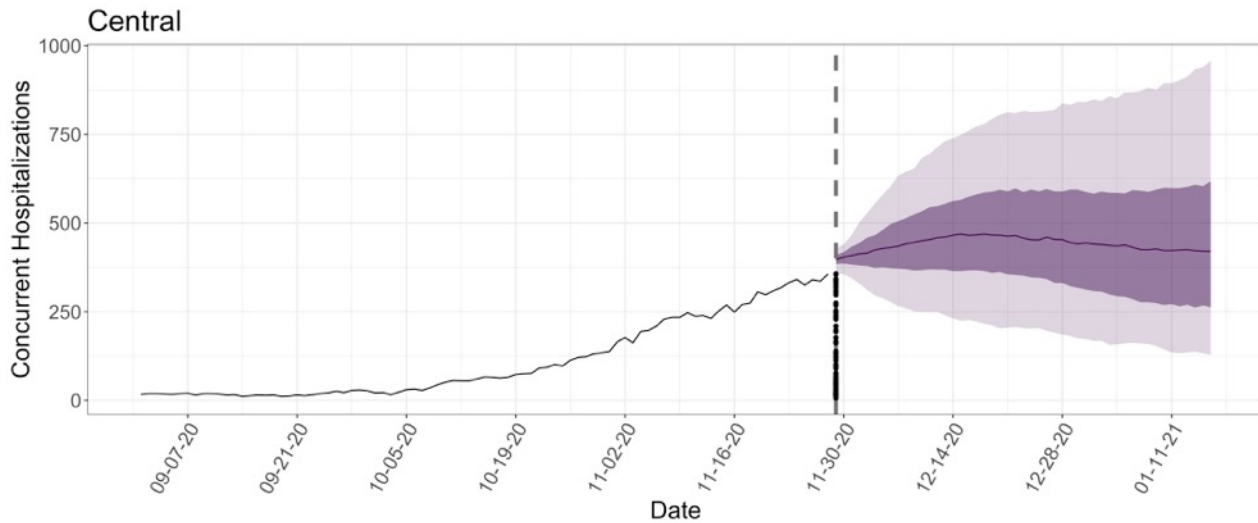
Concurrent COVID-19 ICUs beds: Central

Week	Qu. 5% (best case)	Qu. 50% (median)	Qu. 95% (worst case)
12/6	123	178	232
12/13	99	191	298
12/20	87	195	327
12/27	80	191	346
1/3	67	184	360
1/10	61	178	368

So what?

ICU bed usage is expected to _increase_ in the Central region until December 27

Regional Hospitalization Forecasts: Southwest
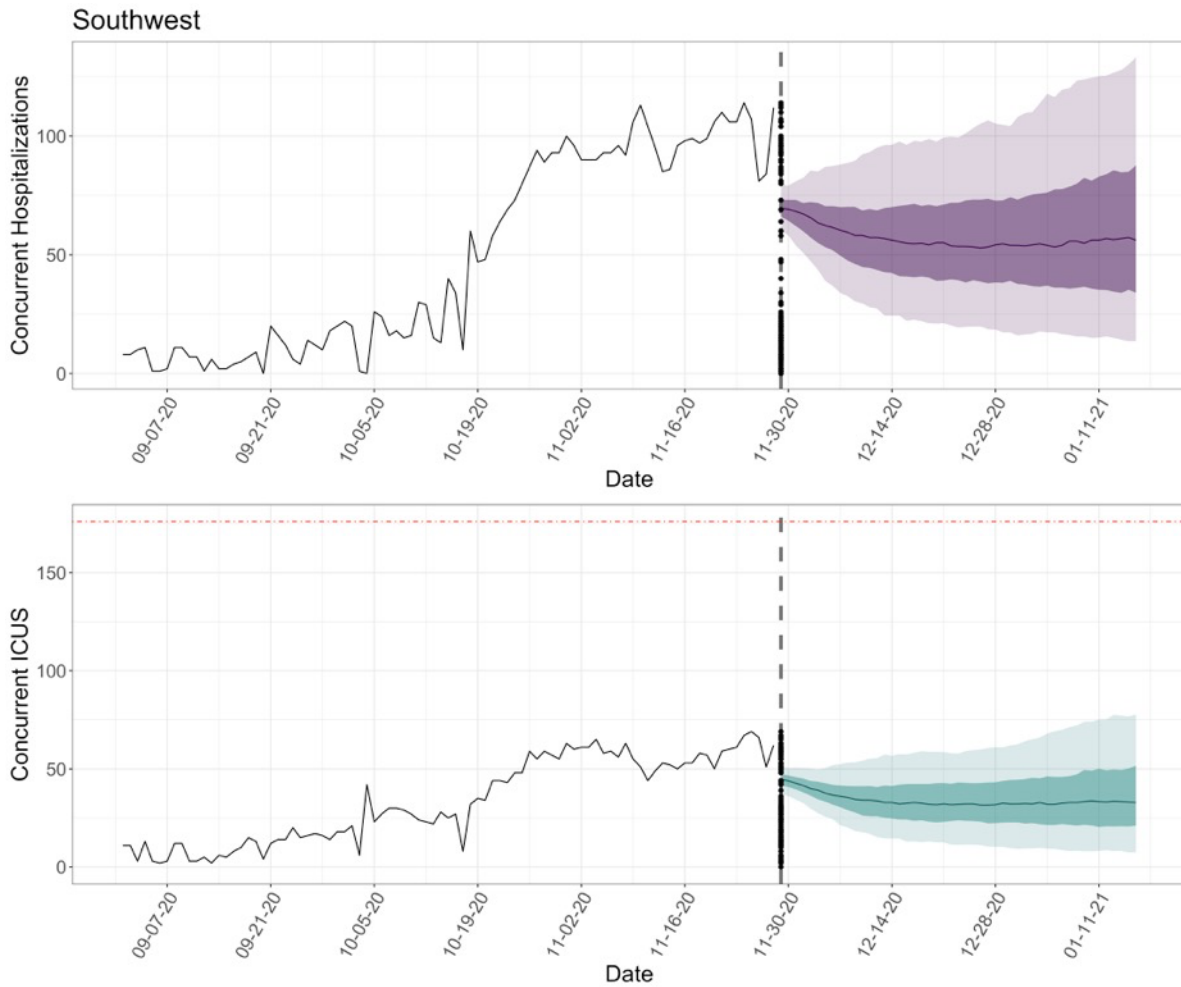
Southwest

Concurrent COVID-19 ICUs beds: Southwest

Week	Qu. 5% (best case)	Qu. 50% (median)	Qu. 95% (worst case)
12/6	24	37	52
12/13	15	33	57
12/20	13	32	59
12/27	10	32	61
1/3	10	33	66
1/10	8	34	74

So what?
ICU bed usage is expected to _decrease_ slowly in the Southwest region. Estimates are noisy

Regional Hospitalization Forecasts: Northwest

Northwest

Concurrent COVID-19 ICUs beds: Northwest

Week	Qu. 5% (best case)	Qu. 50% (median)	Qu. 95% (worst case)
12/6	32	55	81
12/13	29	70	120
12/20	24	81	161
12/27	22	78	188
1/3	20	68	200
1/10	15	63	173

So what?

ICU bed usage is expected to <u>increase</u> in the Northwest region until December 27
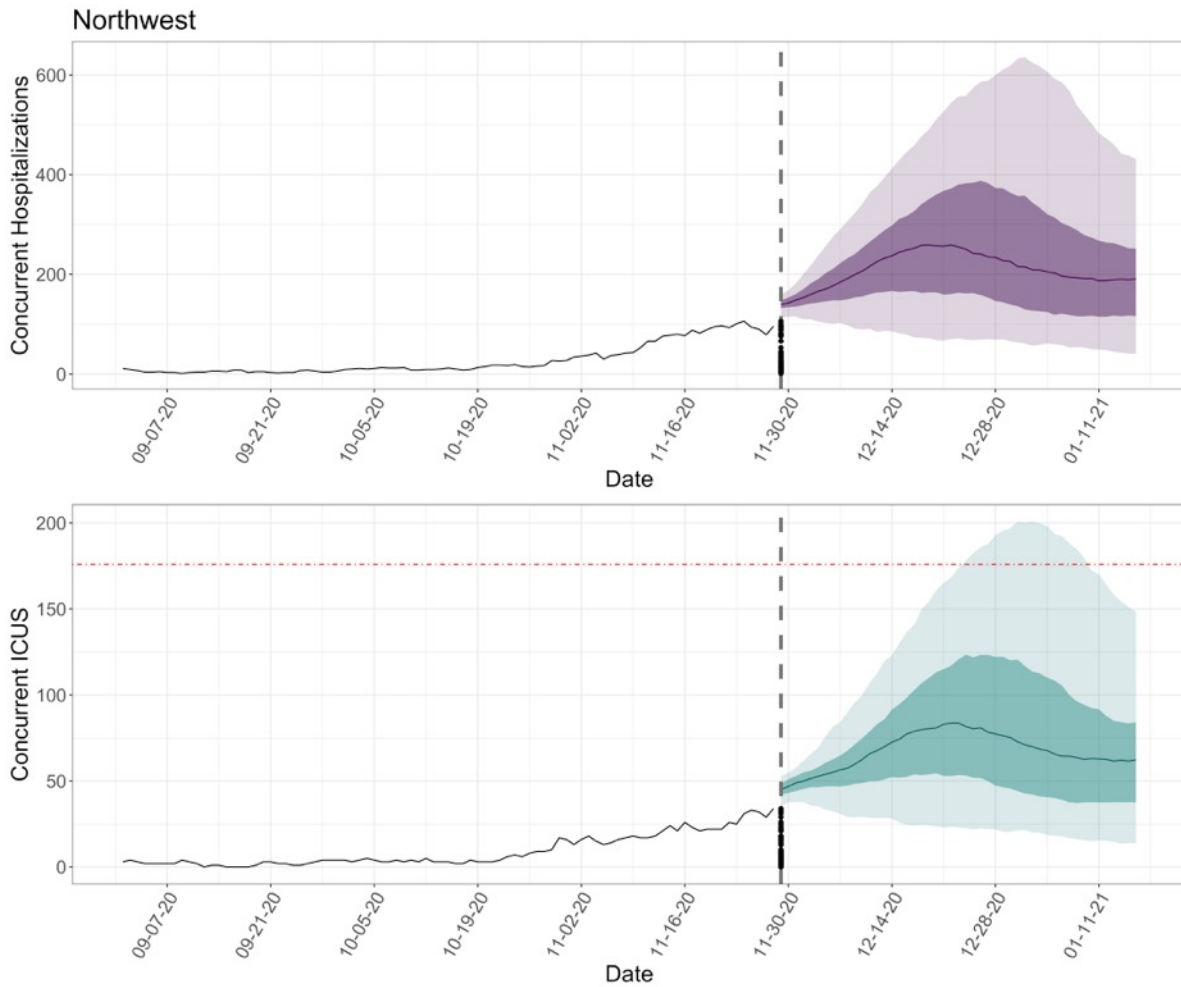
Regional Hospitalization Forecasts: Southeast
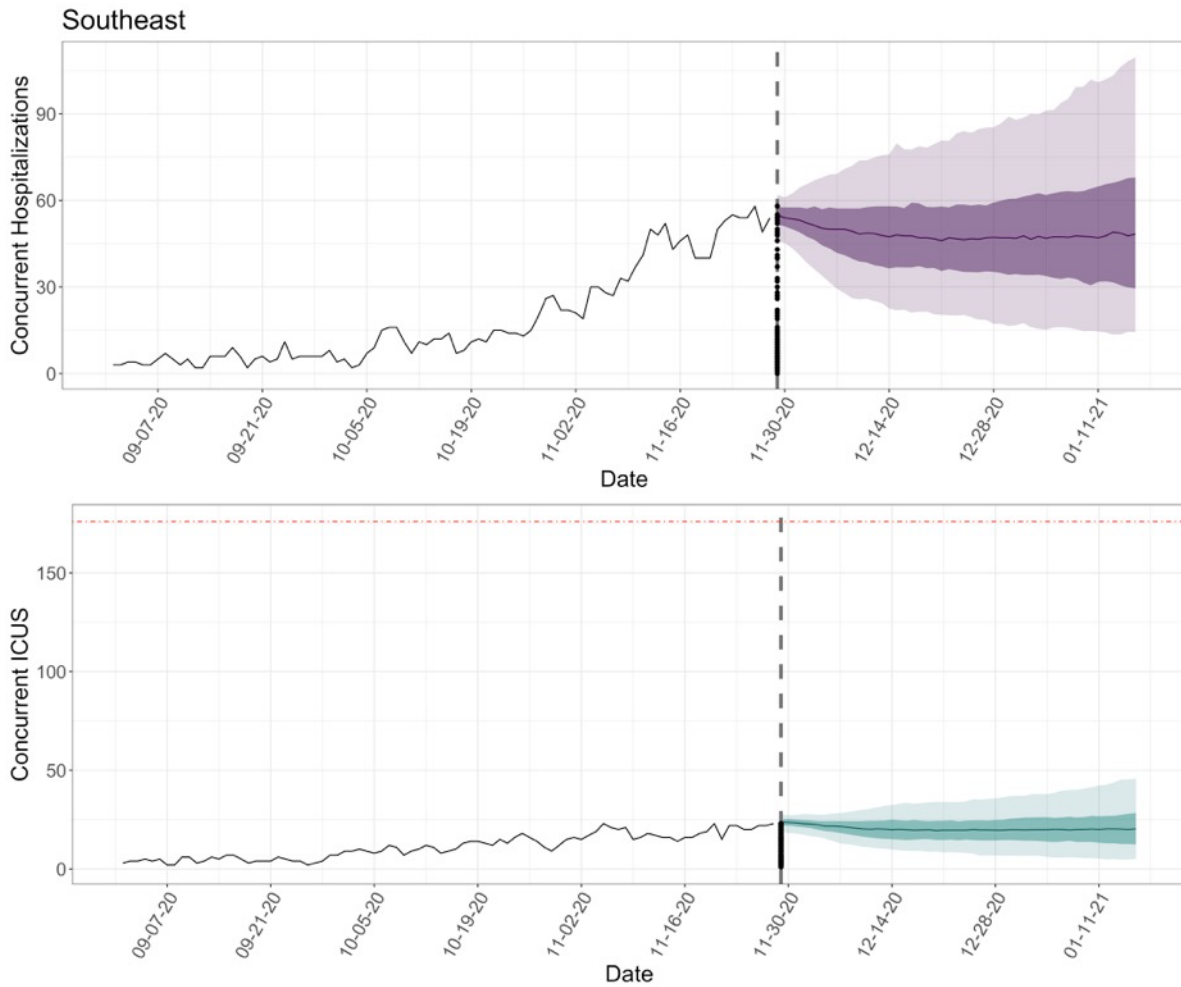
Southeast

Concurrent COVID-19 ICUs beds: Southeast

Week	Qu. 5% (best case)	Qu. 50% (median)	Qu. 95% (worst case)
12/6	14	22	28
12/13	10	20	32
12/20	9	19	34
12/27	7	20	35
1/3	7	20	38
1/10	5	20	41

So what?

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

Regional Hospitalization Forecasts: Northeast
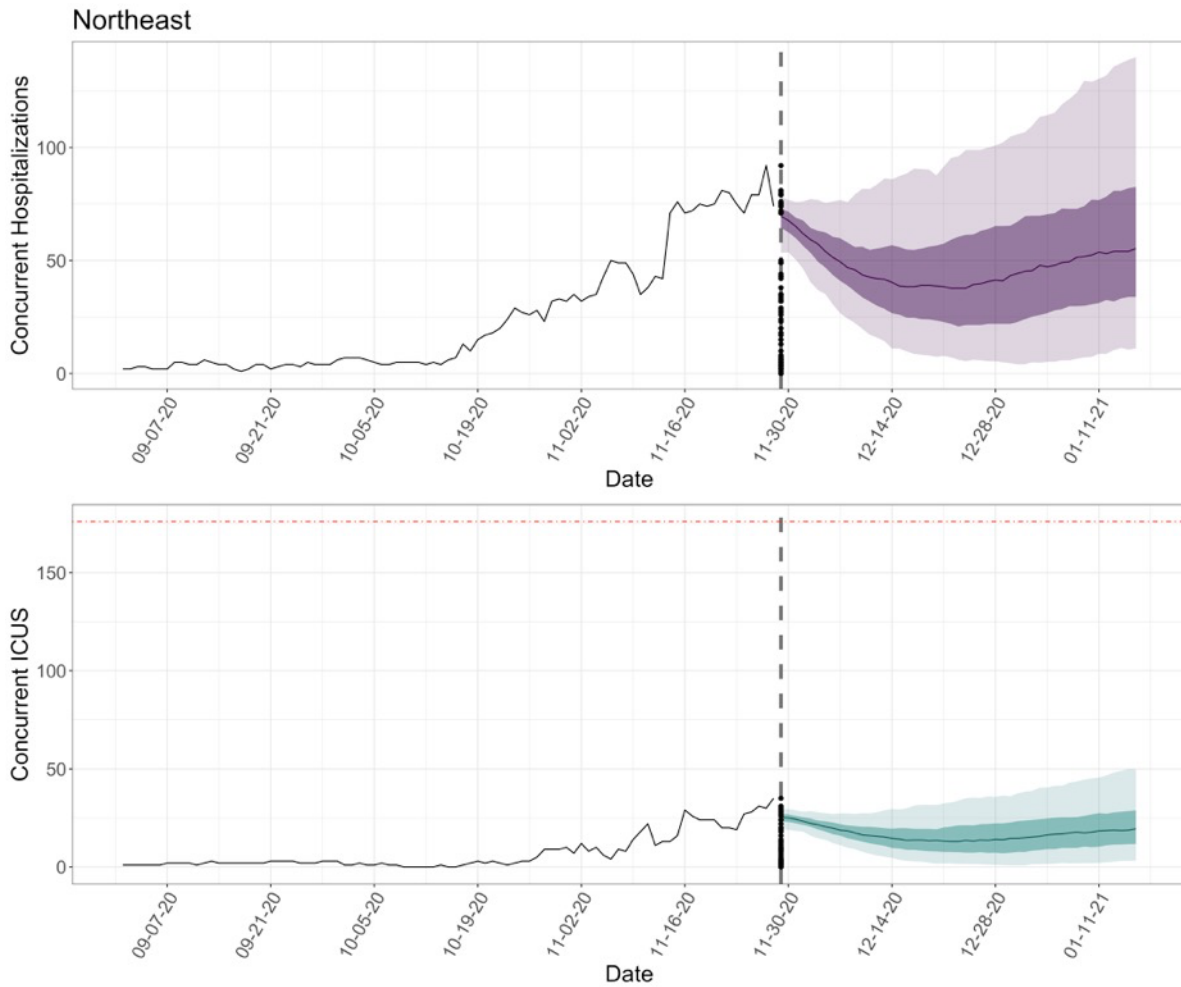
Northeast

Concurrent COVID-19 ICUs beds: Northeast

Week	Qu. 5% (best case)	Qu. 50% (median)	Qu. 95% (worst case)
12/6	12	20	27
12/13	5	15	29
12/20	2	14	32
12/27	1	14	36
1/3	1	16	40
1/10	2	18	45

So what?

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

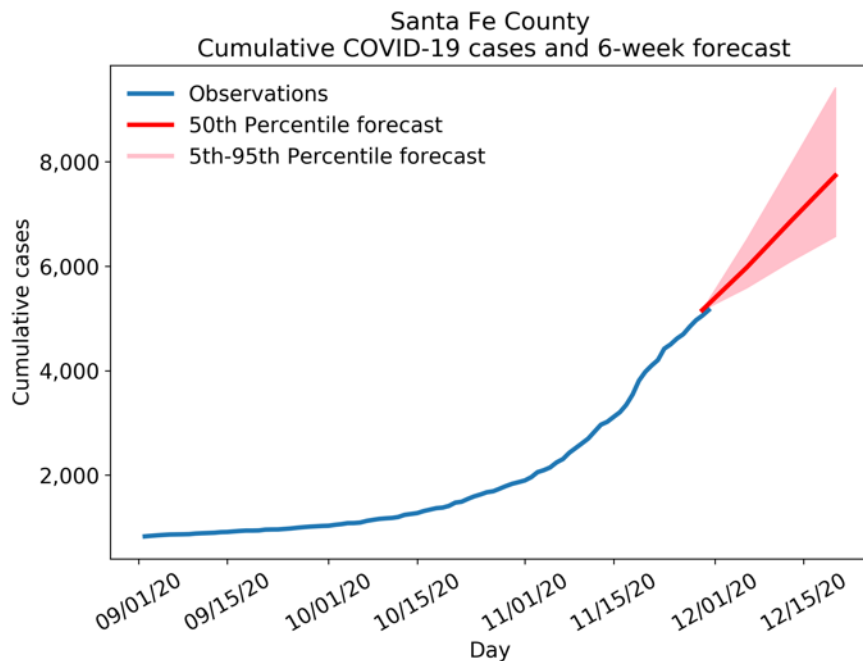> **Non-Congregational Shelter Forecast**

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**

Non-Congregate Shelter Forecast: Santa Fe

Number of cases as of 11/29/20: **5,159**
Number of shelter rooms available: **52**
Total number of patients/medical workers (including specialty): **35**
Number of patients: **35**
Number of medical workers: **0**
2-week avg. new cases per day: **140**

	12/6/20	12/13/20	12/20/20
Total cases	5,973 (5,589-6,508)	6,864 (6,100-7,953)	7,734 (6,572-9,414)
# of rooms needed	29 (15-48)	32 (18-52)	31 (17-52)
Deficit (-) or surplus of rooms	23	20	21

Santa Fe County
Cumulative COVID-19 cases and 6-week forecast

- Observations
- 50th Percentile forecast
- 5th-95th Percentile forecast

The forecast depicts the Santa Fe shelters will not be at capacity.

Non-Congregate Shelter Forecast: Bernalillo

Number of cases as of 11/29/20: **26,784**
Number of shelter rooms available: **191**
Total number of patients/medical workers (including specialty): **56**
Number of patients: **53**
Number of medical workers: **3**
2-week avg. new cases per day: **712**

	12/6/20	12/13/20	12/20/20
Total cases	31,234 (29,429-33,627)	36,636 (32,821-41,528)	42,018 (35,864-50,058)
# of rooms needed	50 (30-77)	60 (38-89)	61 (34-96)
Deficit (-) or surplus of rooms	141	131	130

Bernalillo County
Cumulative COVID-19 cases and 6-week forecast
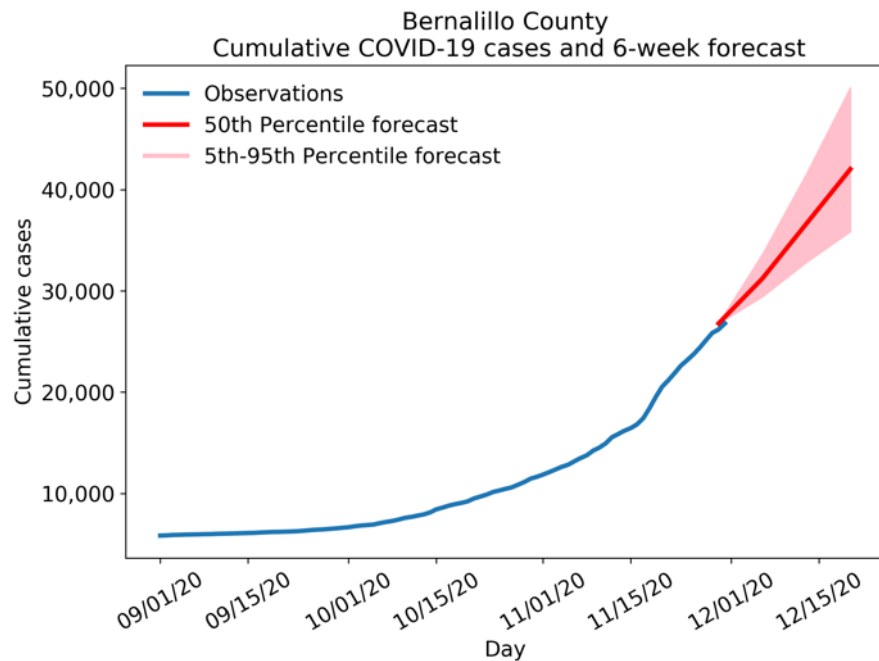
1-week average of new cases per day last week was 580 cases/day. This week it's 712 cases/day.

There was a large decrease in the number of patients/medical workers using shelters from last week to this week.

Non-Congregate Shelter Forecast: McKinley

Number of cases as of 11/29/20: **7,128**
Number of shelter rooms available: **160**
Total number of patients/medical workers (including specialty): **34**
Number of patients: **32**
Number of medical workers: **2**
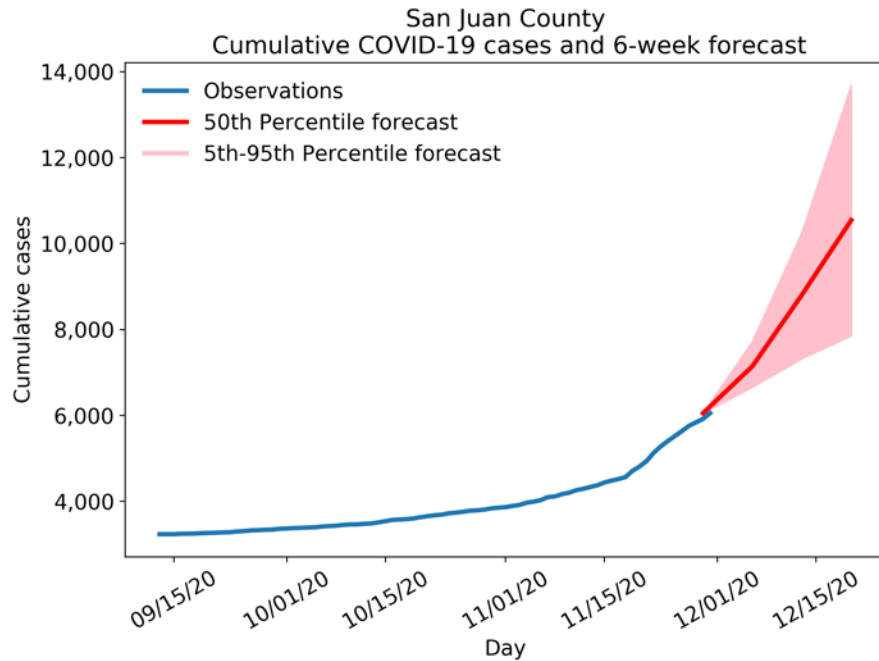2-week avg. new cases per day: **129**

	12/6/20	12/13/20	12/20/20
Total cases	8,087 (7,635-8,688)	9,469 (8,362-10,867)	10,971 (8,962-13,547)
# of rooms needed	36 (19-59)	52 (27-82)	57 (23-101)
Deficit (-) or surplus of rooms	124	108	103
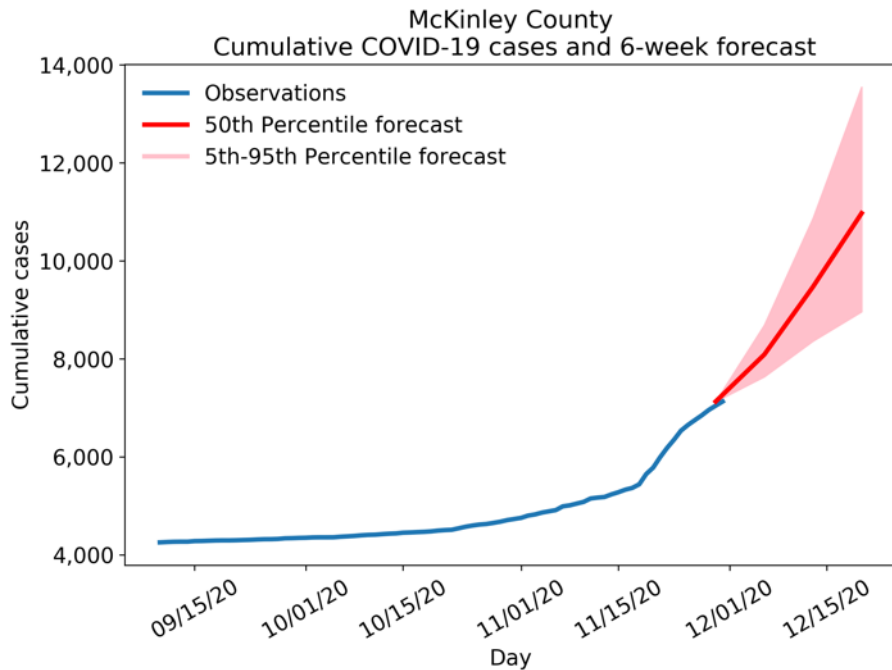
2-week average new cases per day increased from 83 cases/day last week to 129 cases/day.

McKinley County
Cumulative COVID-19 cases and 6-week forecast

Non-Congregate Shelter Forecast: San Juan

Number of cases as of 11/29/20: **6,050**
Number of shelter rooms available: **25**
Total number of patients/medical workers (including specialty): **14**
Number of patients: **14**
Number of medical workers: **0**
2-week avg. new cases per day: **112**

	12/6/20	12/13/20	12/20/20
Total cases	7,142 (6,653-7,724)	8,800 (7,319-10,264)	10,541 (7,848-13,686)
# of rooms needed	19 (11-30)	29 (12-45)	31 (9-61)
Deficit (-) or surplus of rooms (SJ)	6	-4	-6

San Juan County
Cumulative COVID-19 cases and 6-week forecast

2-week average new cases per day increased from 72 cases/day last week to 112 cases/day.

The number of forecasted cases and the number of shelter rooms needed increased.

In two weeks, the San Juan shelter rooms could be fully occupied.

01 Dec 2020: EpiGrid modeling

- Assumes all counties are in the "Red" category under the new county-by-county system.

- Still adapting to delayed reporting. *Illustrative* model satisfies (i) above cumulative cases at all dates, (ii) rough match just below peak number of cases. Situation is better than this with confidence, true peak was likely <3k/day.

- Quarantine modeled at 40%.

- ICU model requires substantial operational or treatment changes since October, possibly September.

- Preliminary estimate of the effect of Thanksgiving. A "bounce" is possible, but possibly *not* large in NM.
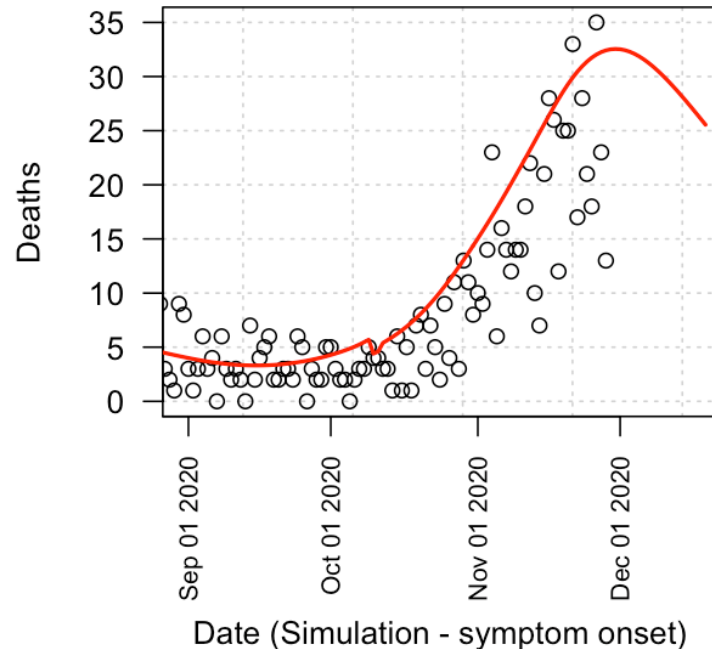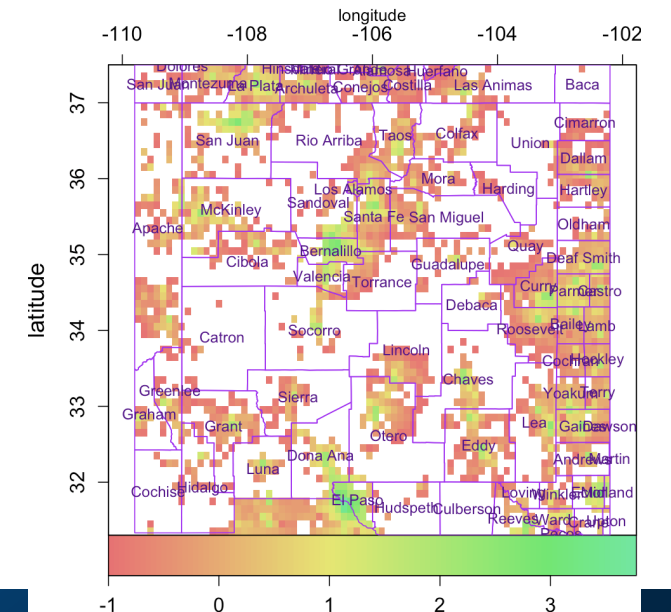

log10 Cumulative cases, wk 43, 2020-12-20
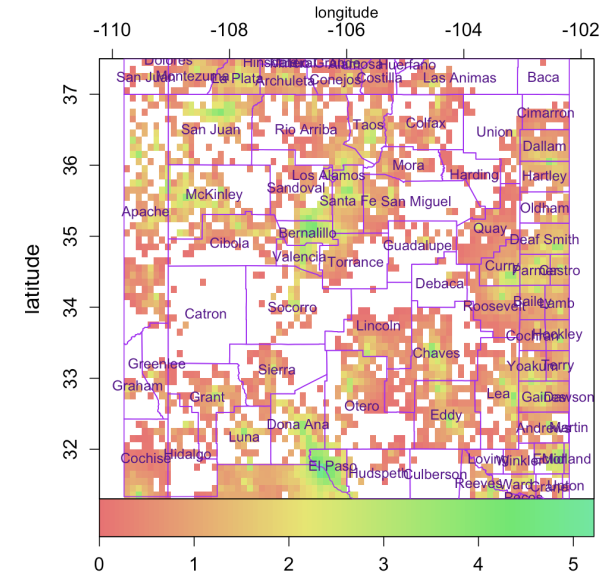

United States__New Mexico
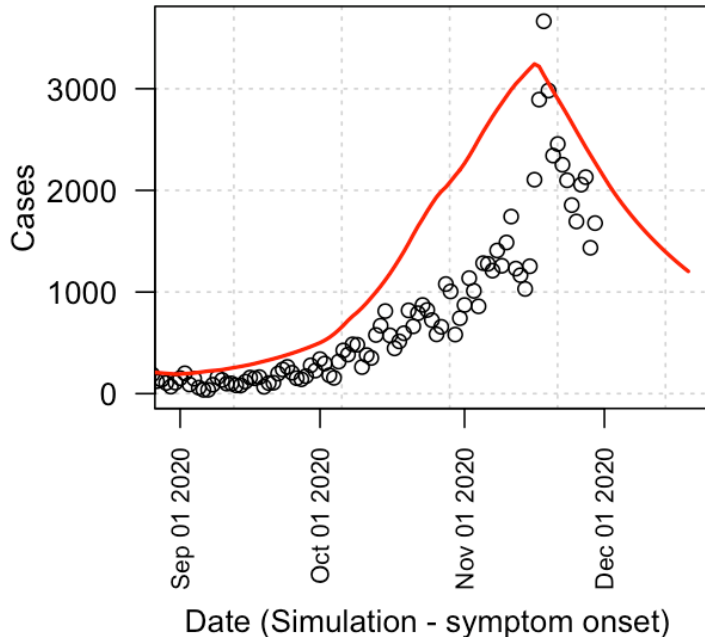
United States__New Mexico

log10 Incidence, wk 43, 2020-12-20

01 December 2020 Model (EpiGrid)

- **Reported cases in El Paso are decreasing, but positivity is > 20%.**
  - The decrease is modeled, *but assume a large number of unreported cases.*
- **Modest transmission increases in some counties model "non-mobility" (i.e. other 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 goes 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 *no longer based on reaction to March PHO.* Roughly 60%-90% of the March response observed in this analysis on a heterogeneous county-by-county basis.
- **Isolation and quarantine rates are assumed to be stable.**
  - Swab to results times: Assuming 1-3 days
  - Time to quarantine contacts down to 25 hrs (Nov. 19th)
  - Base isolation rate is 0.4 for NM.

Texas__El Paso

Date (Simulation - symptom onset)
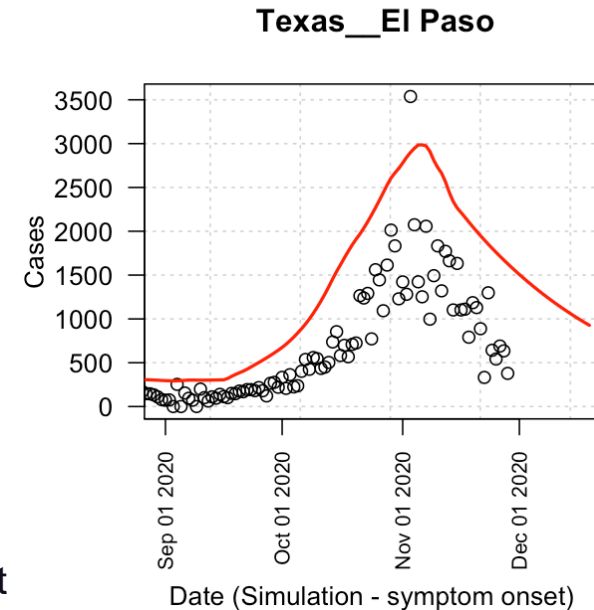
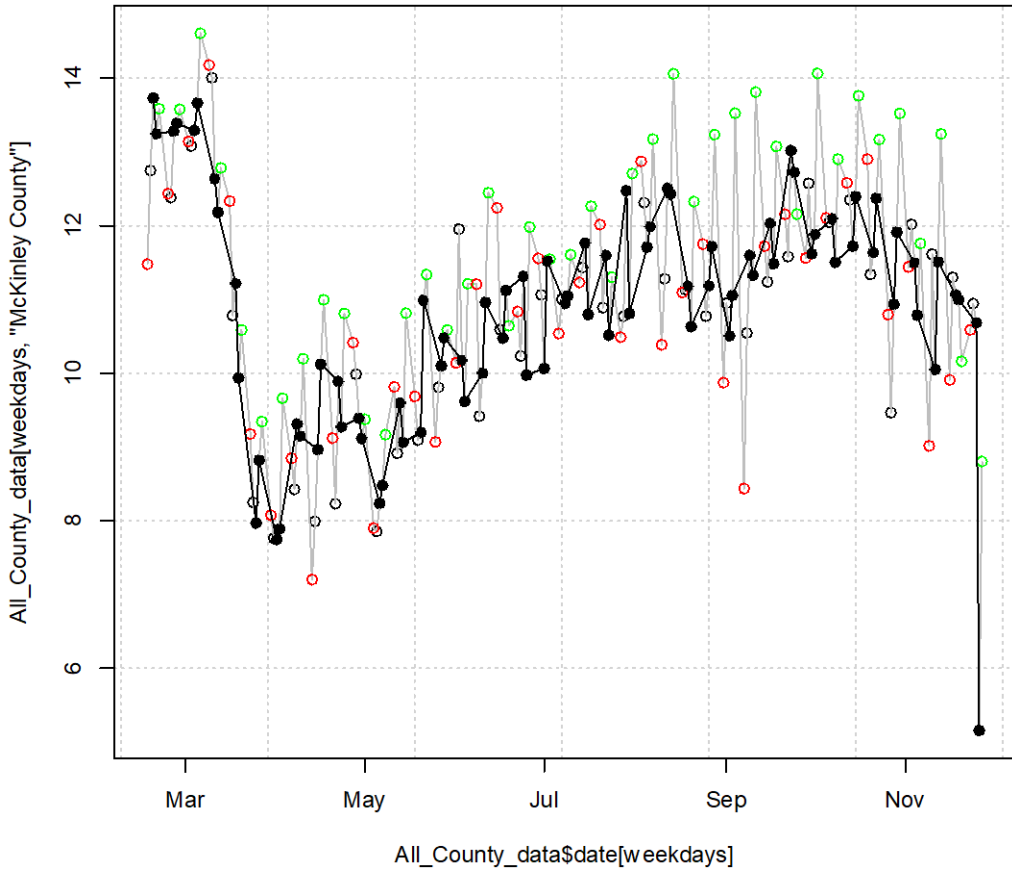# Mobility – northern counties (Data only). Sharp decrease on Thanksgiving.

McKinley and San Juan very slight decrease pre-Thanksgiving.

Taos and Los Alamos noisy but similar to McKinley and San Juan
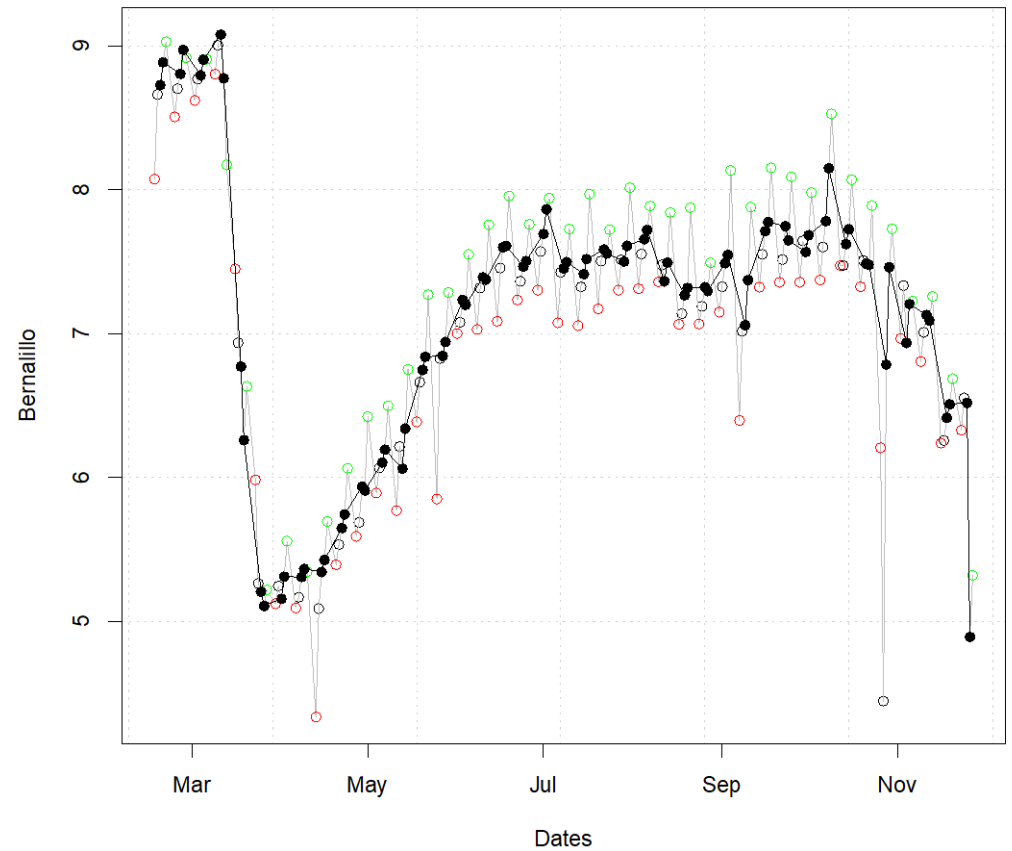
Bernalillo, Sandoval, Rio Arriba, Santa Fe still dropping, but Wednesday pre-Thanksgiving was high.

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

McKinley

Bernalillo

Mobility – southern counties (Data only)

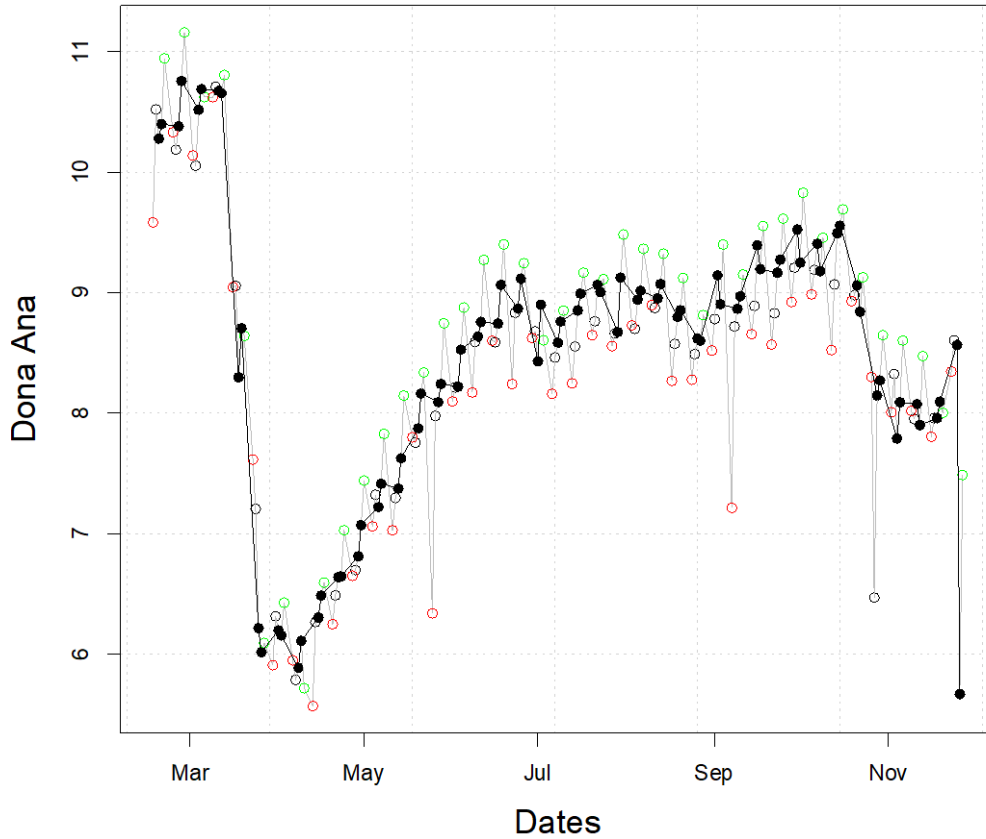Dona Ana not decreasing shows Wednesday peak and Thanksgiving drop

Lincoln small decrease.
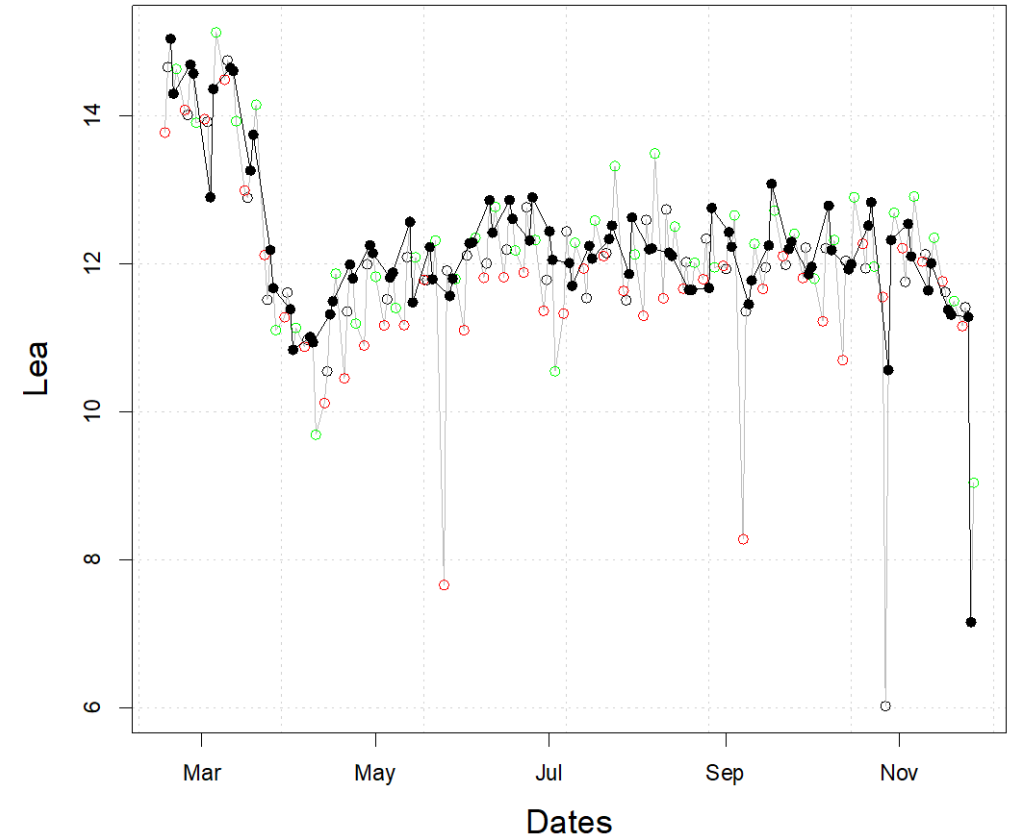
Lea and Luna close to April minimum and Eddy reached April minimum.

Chaves, Curry, Roosevelt, decreasing slowly.

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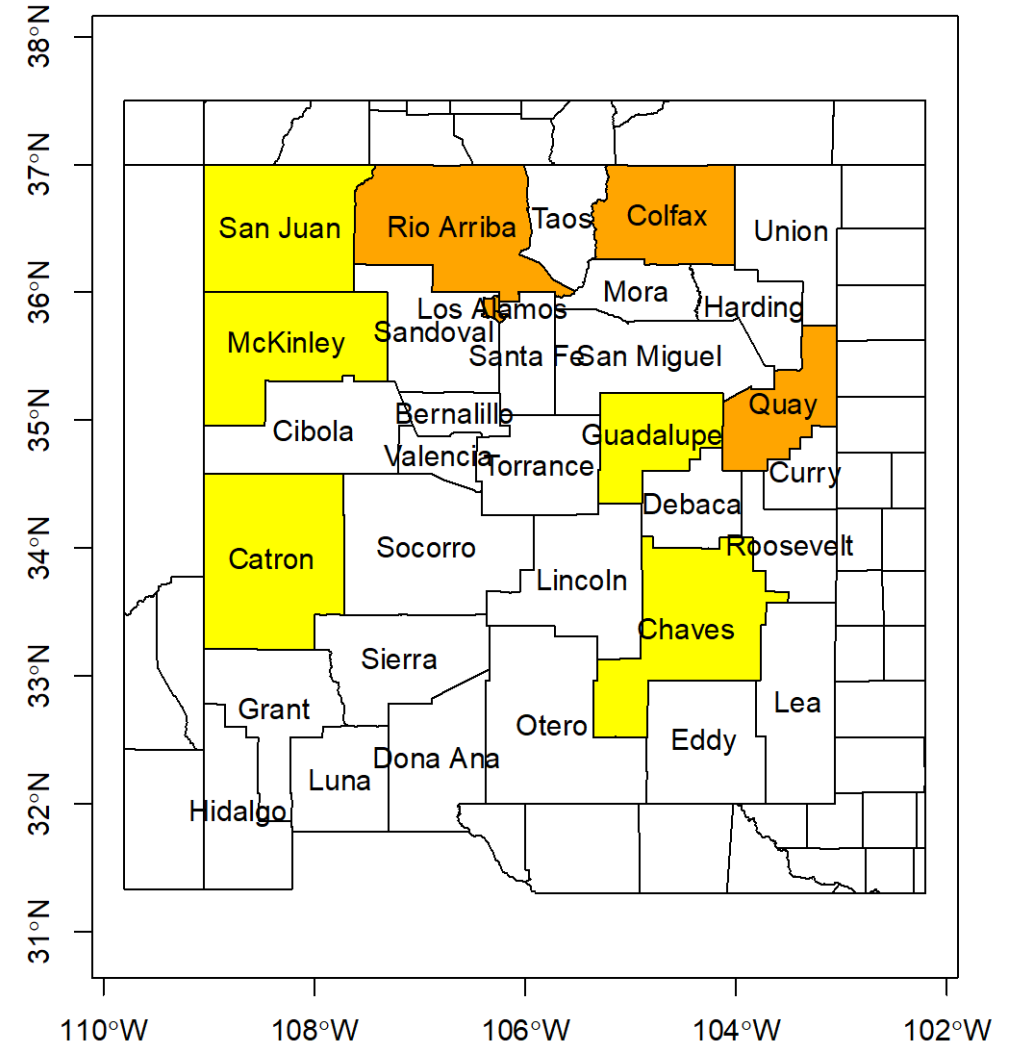- Wednesday/Thursday
- Friday (usually higher)

Dona Ana

Lea

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

- Colfax, Los Alamos, Quay, and Rio Arriba are not clearly slowing down yet.

- Catron, Chaves, Guadalupe, McKinley, and San Juan are unclear.

# ICU and General bed concurrent usage by COVID-19 patients

- Left panel: Linear vs. time shows ICU utilization and capacity. Yellow (10 Nov), lowest curve (17 Nov), Red (24 Nov), top/Orange (notional 01 Dec)
- Right panel: Linear vs. time shows hospital bed utilization. lower (24 Nov), upper peak (notional 01 Dec)
- November 16th PHO has averted most serious violation of ICU capacity limits.
- Notional models (upper curves) strongly imply that the model on page 1 under-estimates delayed reporting.
- This is most easily resolved by lowering the modeled peak to be below several days or a week's worth of incidence data. Likely well below 3k/day cases.
- This also implies that earlier public health orders were incrementally more effective than modeled with EpiGrid in the past.

ICU Utilization (EpiGrid, multiple models)
Notional: How Early Did Under-reporting Begin?
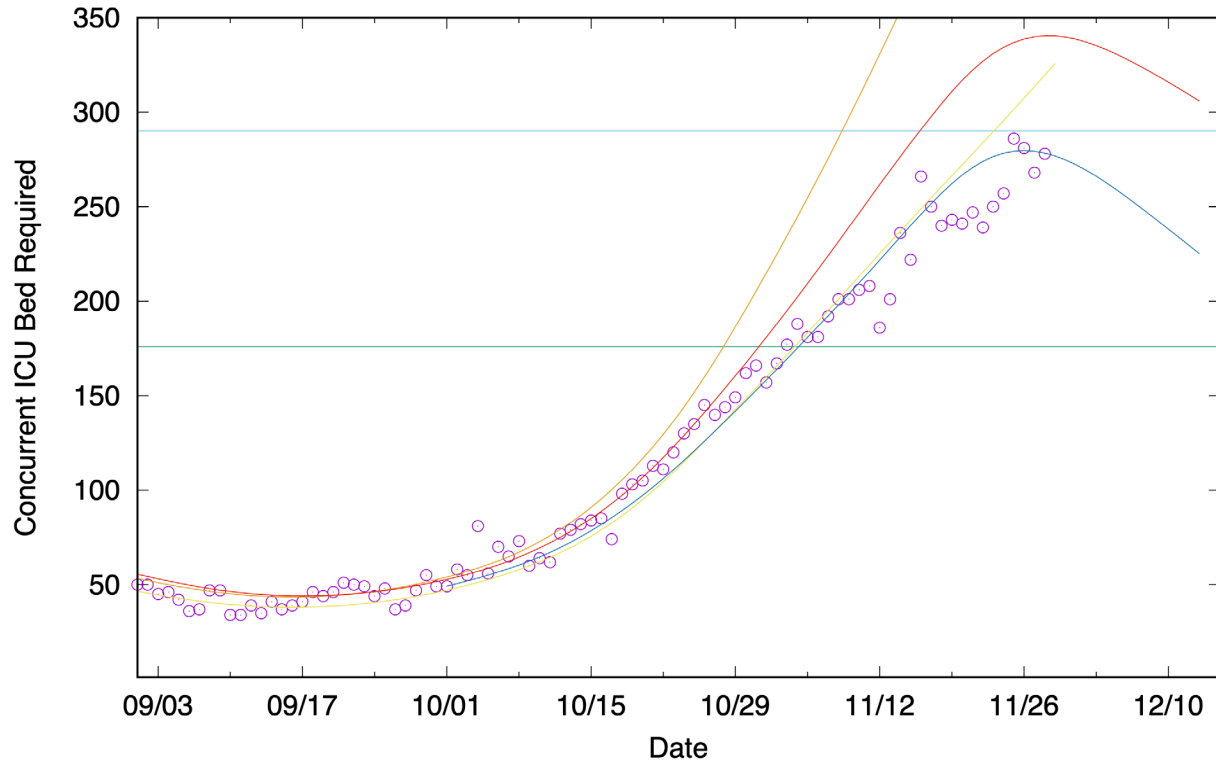
General Hospital Beds (EpiGrid, 11/25 vs. 12/01)
Notional: How Early Did Under-reporting Begin?

Tue Dec 01 11:13:31 2020
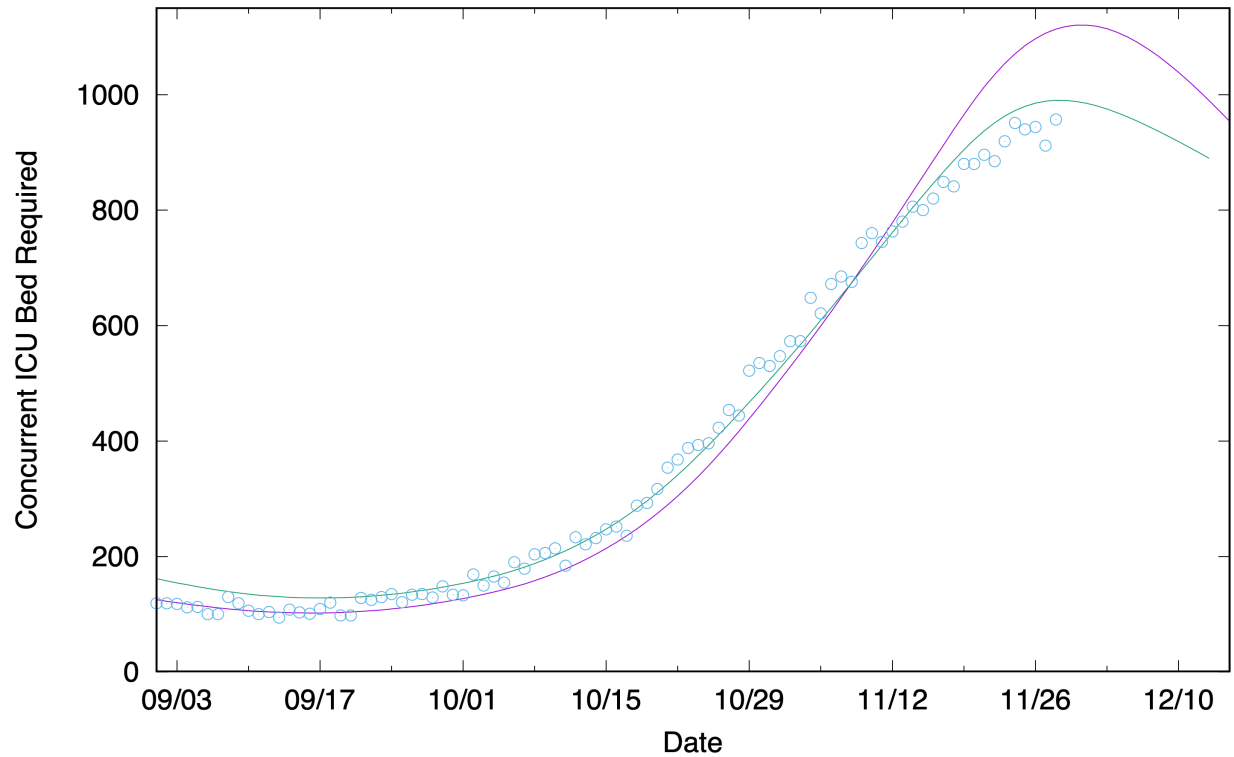
Tue Dec 01 10:58:59 2020

Conclusions and Discussion

- **Excepting a Thanksgiving Day Holiday bump due to contacts, New Mexico is likely slowly coming under control.**
- **The New Mexico epidemic continues to be geographically dispersed.**
- **Nationwide geographical dispersion requires that state-to-state travel plays an important role. Hotel occupancy changes may limit the effect of this source of new cases.**
- *Bernalillo still plays a substantial role driving ICU need/requirements.*
- **NM Test positivity remains well above 7%.**
- **El Paso's daily incidence continues to decline. Testing positivity suggests a substantial undercount of cases even in the context of falling incidence.**
- **Discussion:**
  - For re-opening: Low-risk activities first. Higher risk later.
  - Schools are highly mitigated, and elementary school provides little evidence for in-school spread?
  - School staff as a method to increase case investigation and tracing? Guam is using cell phone apps.
  - Indoor, un-masked activities are inherently risky. How to mitigate? Airflow in addition to distance? For re-opening…
  - 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?