22 Dec 2020: EpiGrid modeling

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

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

- Small increases in transmission are parameterized for Thanksgiving, and assumed for Christmas and New Year’s.
22 December 2020 Model (EpiGrid) – more details and information

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

- Transmission is based on mobility with modifications due to PHO’s.
  - Modeling of public reaction and public health orders (PHO) is similar to previous models.
  - Geographical heterogeneity of mobility accounts for the majority of variations in the force of infection from county-to-county.

- Death rates now include more of the inhomogeneity by-county
  - Counties with higher-risk populations have higher death rates.

- Isolation and quarantine rates are assumed to be stable.
  - Swab to results times: Assuming 1-3 days
  - Base isolation rate is 0.42 for NM.
  - Quarantine slowly recovering, some counties at 0.50 (i.e. 50%).
T-80 Mobility – northern counties (Data only).

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

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

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

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

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

- Weekends NOT shown
- Monday
- Wednesday/Thursday
- Friday (usually higher)
Fundamental Considerations for Vaccination Objectives. Effects Modeled.

1. **EpiGrid reflects vaccination going forward.**
   - Analysis greatly aided by access to by-time and by-location data (county, or finer resolution).

2. **Reduce the death rate.** Time frame ~4 weeks to initial effects with Pfizer
   - Early administration to high-risk populations and individuals at elevated risk of mortality (immediately after 1a).
   - Along with SNFs and residential living facilities, and people living with pre-existing conditions, some Pueblo and the Navajo Nation residents share some of these same underlying risks of congregation and mortality.
   - People living with ESRD, DMII, COPD, etc.
   - Over-65 years, see recent TX directives for vaccination after group 1a.
   - At risk populations are driving hospital load, and mortality.
   - High risk-for-mortality populations are widely distributed and preferential administration is unlikely to inhibit other objectives.

3. **Lower the rate of spread. Connectivity-based, and geographically-based.** Time frame ~3 weeks to see initial effects with Pfizer.
   - The existence of geographical hot-spots (N.B. Top 10 Zip Code list) allows targeting of other demographic contributors to risk of transmission.
   - Employment description is correlated with daily contact rate and associated demographic risk factors (i.e. income, etc.).
   - Targeting job that are high-transmission will automatically select for the most significant risk during stemming from high-contact work.
   - "Front-line" vs. “essential”

4. **Achieve vaccine-mediated herd immunity.** Time frame determined by integrated vaccine production and administration.
   - Because vaccine-mediated herd immunity can go well beyond the extinction threshold, this creates an opportunity for the elimination of COVID.
   - Recent events in the UK (N501Y & assoc. mutations) point out the extraordinary utility of elimination as distinct from epidemic control.
Situational Awareness:
Some counties may not be slowing down as fast as others

- Grant, Guadalupe, Quay, Rio Arriba, San Miguel, San Juan appear to not have decreasing daily case counts

- DeBaca, Colfax, Los Alamos, Socorro, Roosevelt, and Valencia may also be failing to see decreasing daily incidence.
Hospital bed concurrent usage by COVID-19 patients

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

• New Mexico’s epidemic spread is improving very slowly. Probably unstable to any significant perturbation.
• The New Mexico epidemic is geographically dispersed for the foreseeable future.
• Nationwide geographical dispersion requires that state-to-state travel plays an important role.
• Bernalillo’s role driving ICU need/requirements might be less dominant in the near future.
• NM Test positivity remains well above 7%. >~10% recently.
• El Paso’s daily incidence continues to decline.
• Vaccination will not alter these results the first week of January.
• Targeting vaccine to high-mortality areas and populations will have the largest immediate effect on this model.
• Changes in care continue to lower the hospital load.
• Discussion:
  – Vaccinating high risk-of-mortality populations will lower the mortality rate and lower hospital loading.
  – Schools are highly mitigated, elementary school provides little evidence for in-school spread.
  – School staff as a boost to case investigation and tracing?
  – Indoor, un-masked activities are inherently risky (meals). How to mitigate? Airflow in addition to distance? For re-opening…
  – Qualitatively higher testing rates (i.e. 10x) can substantially offset local epidemics (i.e. South Korea) by facilitating tracing and quarantine.
So what?
The daily number of cases are expected to range between 371 and 1,415 in the next two weeks.

**Short- & Long-Term Forecast for NM: Cases**
The daily number of deaths are expected to range between 8 and 37 in the next two weeks.
So what?

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

Deaths have been increasing by an average of 1.4\% per day over the past week (\textit{down} from 1.7\%).
Regional Forecasts, Growth Rates, & Hospitalizations
Central Region Forecasts

New Mexico - Bernalillo

Health Region - NM Central Region

So what?
The average number of daily cases for the Central Region is expected to be around 300 next week.
Northeast Region Forecasts

New Mexico - Santa Fe

New Mexico - Rio Arriba

Health Region - NM Northeast Region

So what?
The average number of daily cases for the Northeast Region is expected to be around 90 next week.
Northwest Region Forecasts

So what?
The average number of daily cases for the Northwest Region is expected to be around 170 next week.
Southeast Region Forecasts

So what?
The average number of daily cases for the Southeast Region is expected to be around 90 next week
Southwest Region Forecasts

So what?
The average number of daily cases for the Southwest Region is expected to be around 90 next week.
Cumulative Cases & Daily Growth Rate for NM: Dec 21

Cases (Log Scale)
- 22,026
- 1,097
- 55

7-day-average daily growth rate (%)
- 2.0
- 1.0
- 0.5

Growth rate is in cumulative cases

Data Source: JHU https://github.com/CSSEGISandData/COVID-19 Cumulative Cases: 2020-12-20

County COVID-19 Weekly Growth Rate
Growth rate is in cumulative cases

Los Alamos National Laboratory
Daily Growth Rate for NM Dec 21

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

7-day-average daily growth rate (%)

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

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

Data Source: JHU https://github.com/CSSEGISandData/COVID-19 County COVID-19 Weekly Growth Rate
So what?

- Most people in New Mexico are living in a county that is decelerating but still high per capita case counts.
- 8 counties are accelerating: Rio Arriba, Taos, Colfax, Eddy, Guadalupe, Roosevelt, Dona Ana, Grant.
- Counties with >500 weekly cases per 100k: Colfax, Eddy, Guadalupe, Lea, McKinley, Rio Arriba, Roosevelt, San Juan, Union, Valencia.
Concurrent Hosp & ICU Beds Based on Forecasts – Average Stay of 8 Hosp, 15 Days for ICU/vent & 25% ICU rate

**So what?**

We are over baseline ICU bed capacity for concurrent COVID-19 patients; our model is tracking with the median this week. Model is predicting a gradual decline over the next 3 weeks (129 concurrent COVID-19 ICU beds by January 10)
Concurrent Hosp & ICU Beds Based on Forecasts – Average Stay of 8 Hosp, 15 Days for ICU/vent & 25% ICU rate

So what?

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

Concurrent COVID-19 ICUs beds: Central

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

So what?

ICU bed usage is expected to **gradually decline** in the Central region; tracking with median.
Regional Hospitalization Forecasts: Southwest

Concurrent COVID-19 ICUs beds: Southwest

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

So what?

ICU bed usage is expected to decrease slowly in the Southwest region. Estimates are tracking...
Regional Hospitalization Forecasts: Northwest

Concurrent COVID-19 ICUs beds: Northwest

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

So what?

ICU bed usage is expected to slowly decrease or remain steady in the Northwest region;
Regional Hospitalization Forecasts: Southeast

Concurrent COVID-19 ICUs beds: Southeast

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

So what?

ICU bed usage is expected to **slowly decrease** in the Southeast region; tracking with median.
Regional Hospitalization Forecasts: Northeast

Concurrent COVID-19 ICUs beds: Northeast

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

So what?
ICU bed usage is expected to **slowly decrease** in the Northeast region; tracking between best and median cases.
> Non-Congregational Shelter Forecast
Non-Congregate Shelter Forecast

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

• We calculate a ratio between the mean number of daily new cases over the previous two weeks to current occupied rooms
  – We apply this ratio to the forecast of COVID-19 cases from the LANL COFFEE model to estimate the number of rooms needed

• We use the spread in the case forecast to report a subsequent spread in the shelter forecast

• We calculate the number of new rooms need by applying the ratio of occupied rooms:new cases to the number of cases forecasted in each county
Non-Congregate Shelter Forecast: Santa Fe

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

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

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

- Observations
- 50th Percentile forecast
- 5th-95th Percentile forecast
Non-Congregate Shelter Forecast: Bernalillo

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

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

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

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