Modeling & Forecasting COVID-19 in NM

Copyright Notice And Disclaimer

For Scientific and Technical Information Only
© Copyright Triad National Security, LLC. All Rights Reserved.

For All Information
Unless otherwise indicated, this information has been authored by an employee or employees of the Triad National Security, LLC., operator of the Los Alamos National Laboratory with the U.S. Department of Energy. The U.S. Government has rights to use, reproduce, and distribute this information. The public may copy and use this information without charge, provided that this Notice and any statement of authorship are reproduced on all copies.

While every effort has been made to produce valid data, by using this data, User acknowledges that neither the Government nor Triad makes any warranty, express or implied, of either the accuracy or completeness of this information or assumes any liability or responsibility for the use of this information. Additionally, this information is provided solely for research purposes and is not provided for purposes of offering medical advice. Accordingly, the U.S. Government and Triad are not to be liable to any user for any loss or damage, whether in contract, tort (including negligence), breach of statutory duty, or otherwise, even if foreseeable, arising under or in connection with use of or reliance on the content displayed on this site.
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.
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

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

Data Source: JHU https://github.com/CSSEGISandData/COVID-19

Cases (Log Scale)
1 20 403 8,103

7-day–average daily growth rate (%)
1.0 2.0 4.0 8.0 16.0
Daily Growth Rate for NM Nov 9

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

*arrows indicate more than 0.5% difference in growth rate from last week’s analysis*
So what?

• MOST New Mexicans live in a county with accelerating growth rates and high per-capita case counts.
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

<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>11/15</td>
<td>195</td>
<td>231</td>
<td>271</td>
</tr>
<tr>
<td>11/22</td>
<td>183</td>
<td>274</td>
<td>361</td>
</tr>
<tr>
<td>11/29</td>
<td>170</td>
<td>303</td>
<td>465</td>
</tr>
<tr>
<td>12/6</td>
<td>152</td>
<td>308</td>
<td>581</td>
</tr>
<tr>
<td>12/13</td>
<td>140</td>
<td>300</td>
<td>704</td>
</tr>
<tr>
<td>12/20</td>
<td>125</td>
<td>290</td>
<td>809</td>
</tr>
</tbody>
</table>

“Scaled” Scenario

So what?

We are over baseline ICU bed capacity for concurrent COVID-19 patients; predictions exceed 300 concurrent COVID-19 ICU beds 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?
"I₀ 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 I₀ 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
Mobility is decreased in some places, **but not all**

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

**Eddy**

**Lea**
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.

**Arizona__Apache**

**Texas__El Paso**
Diversity across the state

New Mexico_Bernalillo

New Mexico_McKinley

Cases

Date (Simulation - symptom onset)
A few other counties

New Mexico__Valencia

New Mexico__Curry

New Mexico__Santa Fe
A few other counties

New Mexico__Sandoval

New Mexico__Luna

New Mexico__Chaves
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?