Modeling & Forecasting COVID-19 in NM

January 19, 2021

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Short- & Long-Term Forecast for NM: Cases

The daily number of cases are expected to range between 500 and 1,400 in the next two weeks with an average of 900 cases.
The daily number of deaths are expected to range between 15 and 40 in the next two weeks with an average of 25 cases.
So what?
As of November 18th, the average growth rate in NM is at 0.64% (down from 0.92%)
> Growth Rates, & Hospitalizations
Cumulative Cases & Daily Growth Rate for NM: Jan 18

<table>
<thead>
<tr>
<th>County</th>
<th>Cases</th>
<th>7-day-average daily growth rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>San Juan</td>
<td>12,147</td>
<td>0.8%</td>
</tr>
<tr>
<td>Rio Arriba</td>
<td>2,907</td>
<td>1.3%</td>
</tr>
<tr>
<td>Taos</td>
<td>1,342</td>
<td>0.9%</td>
</tr>
<tr>
<td>Colfax</td>
<td>632</td>
<td>0.8%</td>
</tr>
<tr>
<td>Union</td>
<td>207</td>
<td>0.5%</td>
</tr>
<tr>
<td>Mora</td>
<td>141</td>
<td>1%</td>
</tr>
<tr>
<td>Harding</td>
<td>8</td>
<td>0%</td>
</tr>
<tr>
<td>Cibola</td>
<td>2,491</td>
<td>0.5%</td>
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<tr>
<td>Valencia</td>
<td>5,481</td>
<td>0.6%</td>
</tr>
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Data Source: JHU https://github.com/CSSEGISandData/COVID-19

Cumulative Cases: 2021-01-17

7-day-average daily growth rate (%)

*Growth rate is in cumulative cases*
Daily Growth Rate for NM Jan 18

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

County | Daily Growth Rate | Change
--- | --- | ---
San Juan | 0.8% | ↓
Rio Arriba | 1.3% | ↓
Sierra | 0.8% | =
McKinley | 0.6% | =
Sandoval | 0.8% | =
Santa Fe | 0.8% | =
Cibola | 0.5% | =
Bernalillo | 0.6% | =
Valencia | 0.6% | =
Torrance | 0.8% | =
Lincoln | 1.4% | =
San Miguel | 1.1% | =
Chaves | 0.6% | =
Dona Ana | 0.7% | =
Otero | 1.3% | =
Lea | 0.4% | ↓
Eddy | 0.9% | =
Curry | 0.6% | =
Grant | 1.2% | ↓
Luna | 0.8% | =
Taos | 0.9% | =

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

- Most people in New Mexico are living in a county that is decelerating.
- Counties with >500 weekly cases per 100k: Rio Arriba, Eddy.
- Luna and Lincoln are accelerating.

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

- Low: <10 cases/100k per week
- Med: 10-99 cases/100k per week
- High: >100 cases/100k per week
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>1/24</td>
<td>120</td>
<td>157</td>
<td>213</td>
</tr>
<tr>
<td>1/31</td>
<td>78</td>
<td>145</td>
<td>251</td>
</tr>
<tr>
<td>2/7</td>
<td>66</td>
<td>144</td>
<td>264</td>
</tr>
<tr>
<td>2/14</td>
<td>62</td>
<td>148</td>
<td>280</td>
</tr>
<tr>
<td>2/21</td>
<td>57</td>
<td>153</td>
<td>311</td>
</tr>
<tr>
<td>2/28</td>
<td>51</td>
<td>164</td>
<td>336</td>
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“Scaled” Scenario

So what?
We are at ICU bed capacity for concurrent COVID-19 patients; our model is tracking with the median this week. Model is predicting a gradual decrease over the next 3 weeks.
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 remain steady during the next 3 weeks
Regional Forecasts & Hospitalizations
So what?
The average number of cases for the Central Region is expected to be around 250 next week.
The average number of cases for the Northeast Region is expected to be around 130 next week.
Northwest Region Forecasts

So what?
The average number of cases for the Northwest Region is expected to be around 150 next week.
Southeast Region Forecasts

So what?
The average number of cases for the Southeast Region is expected to be around 150 next week.
The average number of cases for the Southwest Region is expected to be around 200 next week.
Regional Hospitalization Forecasts: Central

Concurrent COVID-19 ICUs beds: Central

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<td>52</td>
<td>78</td>
<td>104</td>
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<tr>
<td>1/31</td>
<td>34</td>
<td>68</td>
<td>118</td>
</tr>
<tr>
<td>2/7</td>
<td>24</td>
<td>67</td>
<td>125</td>
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<td>23</td>
<td>74</td>
<td>162</td>
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<td>2/28</td>
<td>20</td>
<td>79</td>
<td>179</td>
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So what?

ICU bed usage is expected to gradually decrease; tracking with median.
So what?

ICU bed usage is expected to remain steady in the Southwest region.
Regional Hospitalization Forecasts: Northwest

Concurrent COVID-19 ICUs beds: Northwest

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So what?

ICU bed usage is expected to **gradually decrease** 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>1/24</td>
<td>7</td>
<td>11</td>
<td>18</td>
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<tr>
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<td>10</td>
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</tr>
<tr>
<td>2/28</td>
<td>1</td>
<td>10</td>
<td>26</td>
</tr>
</tbody>
</table>

So what?

ICU bed usage is expected to gradually decrease in the Southeast region.
Regional Hospitalization Forecasts: Northeast

Concurrent COVID-19 ICUs beds: Northeast

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</tr>
</tbody>
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So what?

ICU bed usage is expected to remain steady in the Northeast region.
19 Jan 2021: EpiGrid modeling

- Assumes all counties remain “red”. (More precisely we assume that transmission parameters stay as they are.)

- Transmission increases due to Christmas and New Year’s are significantly increased over Thanksgiving (>~4x) and reflect a transient 3-4 day reporting delay.
19 January 2021 Model (EpiGrid) – more details and information

• Daily reported cases in El Paso are approximately constant.
• Vaccination starts Dec. 15th with 2700 people per day changing to 3200 people per day on Jan 4th and 90% vaccine effectiveness. This results in 98,800 people vaccinated (1 or 2 doses) on Jan 18th. The CDC reports ~99,000.
• 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 rates mostly modeled at 50% Dec. 8th-22nd and 45% afterwards (quarantine times slower later).
• Baseline results do not reflect B.1.1.7 (N501Y/”Kent”) variant of SARS-CoV-2
  • Potential for a 50% increase in contagion/force of infection.
  • No clear epidemiological evidence for widespread B.1.1.7 in New Mexico at this time.
  • Caveats apply, non-flat age distribution of cases, higher viral titers, no increased pathology.
T-80 Mobility – northern counties (Data only).

- Bernalillo, Rio Arriba, Sandoval, and San Juan which had relatively low mobility compared to summer last week all have increasing mobility.
- McKinley, Los Alamos, Santa Fe, Taos, and Valencia have fairly stable mobility which is still slightly higher than the first set on average.

• Weekends not shown
  • Monday
  • Wednesday/Thursday
  • Friday (usually higher)
  • Sat/Sun
T-80 Mobility – southern counties (and Curry) (Data only)

- Luna, Roosevelt lower than summer - with Roosevelt possibly decreasing.
- Curry barely lower than summer
- Chaves, Dona Ana, Eddy, Grant, Lea, Socorro, Lincoln similar to summer, with Eddy increasing a lot (shown).

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

0. Vaccination is included.

1. **Reduce the death rate.** Time frame ~4 weeks to initial effects with Pfizer. Minimal evidence – based on epidemiological data – of a reduction in CFR or IFR.
   - Early administration to high-risk populations and individuals at elevated risk of mortality (immediately after 1a).
   - At-risk and often congregated populations in multi-generation housing, etc.
   - People living with ESRD, DMII, COPD, etc.
   - 65-and-over years of age, see recent TX directives for vaccination after group 1a (older populations).
   - These populations are driving hospital load, and mortality.
   - High risk-for-mortality populations are widely distributed and preferential administration is unlikely to inhibit other objectives.

2. **Lower the rate of spread.** Connectivity-based, and geographically-based.
   - Initial (threshold-discernable) effects on epidemic growth rate are present in NM’s EpiGrid model. Quantification remains to be done.

3. **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 B.1.1.7 (N501Y & assoc. mutations) point out the extraordinary utility of elimination as distinct from epidemic “control”.
   - The presence of B.1.1.7 in the US may create a race between strain replacement and vaccination to avoid undesirably outcomes.
Situational Awareness:

- Cibola, Luna and Rio Arriba have increased transmission compared to what is expected from mobility.
- Dona Ana, and Sierra have slightly increased transmission compared to what is expected from mobility.
Hospital bed concurrent usage by COVID-19 patients

- Left panel: Linear vs. time (y-scale=1:1200) shows hospital beds. Models: 19Jan21 (middle), 12Jan21 (lower), 15Dec20 (upper).
- Right panel: Log vs. time, same data and models (y-scale = 400:1600).
- Christmas and New Year’s are 4-5x Thanksgiving modulation of the force of infection/level of contagion.
- Some slowing in the decline may soon be evident (relative to 15 December 2020).
Conclusions and Discussion

- New Mexico’s epidemic spread is appears to be slowing declining and at a high level of incidence.
- Variant B.1.1.7 (N501Y/“Kent”) represents a source of potentially dangerous uncertainty through strain replacement. Monitoring capable of detecting B.1.1.7 spread in New Mexico should be a priority.
- El Paso’s recent daily incidence is level.
- Nationwide geographical dispersion likely a significant source of cross-state seeding of local transmission.
- Bernalillo’s role driving ICU need/requirements is less important compared to statewide resources than in the past.
- The effects of vaccination are detectable in New Mexico’s Epigrid model. Quantification not yet available.
- Targeting vaccine to high-mortality areas and populations will have a large effect on this model.
- Hospital loading appears predictable for ~1 month with error bars comparable to daily variation in incidence.

Discussion:
- Vaccinating high risk-of-mortality populations will lower the mortality rate and further lower demand for beds from COVID-19 patients.
- Schools are highly mitigated, elementary school provides little evidence for in-school spread with the current viral strain. SARS-CoV-2 strain B.1.1.7 represents a potential risk to in-person schooling plans. Improved PPE might be required, etc.
- B.1.1.7 is not yet the dominant epidemiological variant in New Mexico.
- There is an urgent need for a capability to detect B.1.1.7. The level of contagion may be 1.5x that of the current “Milan” strain that dominates in the US and NM.
- Qualitatively higher testing rates (i.e. 10x) can substantially offset local epidemics (i.e. South Korea) by facilitating tracing and quarantine. Sequencing can provide diagnostics, and provides variant-level information that is likely to become important in the near future, and is compatible with high testing rates.