COVID-19 MODELING
April 6, 2020
Overview

- **Goal**: Develop multiple forecasting perspectives
  - Oliver Wyman – Helen Leis
  - Columbia University – Professor Jeffrey Shaman, Ph.D.
  - Northeastern University – Professor Alessandro Vespignani, Ph.D.

- **Forecasting is imprecise:**
  - Focus on the near term: Forecasting is much less predictable the further out you model
  - Focus on ranges rather than specifics: Forecasts are represented as a range of possible outcomes (i.e., likely, best & worst)
  - Consistent refinement: Continually updating with new data and new assumptions
  - Appropriate Perspective: Ultimately forecasts are developed for planning purposes and are not representative of definitive outcomes

- **Ultimate Purpose of Forecasting: Medical Surge Planning**
  - Tracking the available staffed hospital beds
  - Tracking the available ICU beds
  - Tracking the available ventilators
  - Tracking the supply of PPE
Comparison of Growth by Country

COVID-19 Coronavirus Cases per Capita over Time by Country, updated 5-April-2020

Based on chart by Micah Siegel. 2020 Population are UN estimates. Growth is average from last 5 days. Assumes 5% US cases require ICU and 58,000 ICU beds available". Source Data: JHU CSSE [https://github.com/CSSEGISandData/COVID-19]

*For China, the early days are skipped and Day 1 corresponds to 16-Jan-2020. **American Hospital Capacity And Projected Need for COVID-19 Patient Care, “Health Affairs Blog, March 17, 2020. DOI: 10.1377/hblog20200317.457910
VT’s Growth Rate Compared to Northeast States

COVID-19 Coronavirus US Case Density over Time by State, updated 26-Mar-2020

Ave Daily Growth from Last 5 Days, Ranked

1. MO 52% 14. MT 31% 27. IL 25% 40. VA 23%
2. CT 48% 15. FL 31% 28. MD 25% 41. HI 21%
3. WV 45% 16. DE 30% 29. NY 25% 42. MN 20%
4. MA 40% 17. PR 29% 30. CA 24% 43. NM 20%
5. AL 40% 18. LA 29% 31. MS 24% 44. AR 19%
6. OK 39% 19. MI 29% 32. WV 23% 45. RI 19%
7. ID 38% 20. AK 28% 33. DC 23% 46. IA 19%
8. NJ 38% 21. KS 28% 34. SC 23% 47. OR 19%
9. PA 37% 22. GA 26% 35. SD 22% 48. WI 18%
10. AZ 36% 23. KY 26% 36. NH 22% 49. ND 16%
11. IN 34% 24. TX 26% 37. NV 22% 50. ME 15%
12. CO 33% 25. NC 25% 38. UT 22% 51. WA 13%
13. VT 32% 26. OH 25% 39. TN 21% 52. NE 10%

US Overall Daily Growth Rate: 26%
Green = Lower, Red = Higher than yesterday

Based on a chart by Micah Siegel. 2018 US Census population estimates. Assumes 5% of cases require ICU and 58,000 ICU beds available in US”. Source Data: JHU CSSE (https://github.com/CSSEGISandData/COVID-19)

“First significant day is defined as the day when the number of cases exceeds 1 case per 2,000,000 residents. **American Hospital Capacity And Projected Need for COVID-19 Patient Care, Health Affairs Blog, March 17, 2020. DOI: 10.1377/hblog20200317.457910
VT’s Growth Rate Compared to Northeast States

COVID-19 Coronavirus US Cases per Capita over Time by State, updated 5-April-2020

Based on a chart by Micah Sigel. 2018 US Census population estimates. Assumes 5% of cases require ICU and 58,000 ICU beds available in US**. Source Data: JHU CSSE [https://github.com/CSSEGISandData/COVID-19]

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Vermont’s Daily COVID-19 Confirmed Case Growth

Source: Vermont Department of Health

Days until confirmed cases double

- ~5.5 days +
- ~5.5 days
- ~3 days
- ~3 days
- ~3 days
- ~3 days
- ~3 days
- ~3 days
- ~5.5 days

# of existing cases
# of new cases
Vermont’s Daily Growth Rate Compared to Total Cases

Source: Vermont Department of Health

Note: This chart notes the stability of Vermont’s case growth rate as we approached and surpassed 100 confirmed cases.
Close Look at Forecasting vs. Actual Case Count

Actual Cases vs. Projections (March 8th to April 9th // 0-1,000 Cases)

- Actual Covid+ thru 4/1
- OW Mid March: Avg Best-Case
- OW Mid March: Avg Worst-Case
- OW Late March: Avg Best-Case
- OW Late March: Avg Worst-Case
- Columbia Late March
Close Look at Forecasting vs. Actual Case Count

Actual Cases vs. Projections (March 8th to April 9th // 0-1,000 Cases)

- Actual Covid+ current
- OW Mid March: Avg Best-Case
- OW Mid March: Avg Worst-Case
- OW Late March: Avg Best-Case
- OW Late March: Avg Worst-Case
- Columbia Late March
- 513
Days Until the Impact of Social Distancing is Seen

Actual Cases vs. Projections (March 8th to April 9th // 0-1,000 Cases)

1000
750
500
250
0

Closing Schools
Closing Bars & Restaurants
State of Emergency

10 to 14-day delay in effect

Stay Safe Stay Home – 14 days
March 24th – April 8th
Total Vermont Testing Over Time
Vermont’s Mobility Reductions

Key Points:

1. 50% Reduction in physical movement with mitigation policies in place
2. Dip on Feb 7 is the snowstorm; this means people are moving around LESS than they did during the big snowstorm → this is very good

Source: Dr. Vespignani, Northeastern University
Hospitalization Needs – Likely, Best & Worst
Note – Late March Trajectory

Modeling is for planning purposes only
Not representative of definitive outcomes.
ICU Needs – Likely, Best & Worst
Note – Late March Trajectory

COVID-19 Capacity Scenarios - ICU Needs

<table>
<thead>
<tr>
<th>Simulation</th>
<th>ICU Capacity Exceeded By</th>
</tr>
</thead>
<tbody>
<tr>
<td>Best Case</td>
<td>Never</td>
</tr>
<tr>
<td>Likely Case</td>
<td>4/14/2020</td>
</tr>
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<tr>
<td>Total</td>
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* April 2nd: 8 patients in ICU

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Ventilator Needs – Likely, Best & Worst
Note – Late March Trajectory

COVID-19 Capacity Scenarios - Ventilator Needs

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93 Ventilators Available

* April 2nd: 1 patient needing ventilation

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