

Optimized Capacity and Mitigation OCM analysis, early warning indicator of hospital capacity overloads from COVID-19

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Abstract: OCM provides daily, early warning indications for COVID-19 cases. Shown is the maximum new cases an area can have today, without exceeding hospital capacity in the future as well as the effectiveness of mitigation efforts, and the month in which the risk to hospital capacity will subside. Actual and infection rate scenarios, are available to encourage public participation in mitigation policies. OCM applies to US counties, states and national levels. A medical expert survey enables updates as the virus evolves or conditions change.

1. Introduction:

OCM monitors and forecasts the risk to hospitals and when the risks will subside from future waves of the COVID-19 pandemic in the USA by state and county. The interactive dashboard powered by Esri, uses actual and five scenario infection rates, to explain the importance of public participation in mitigation policies.

Forecasted are the maximum new cases an area can safely handle today without overwhelming hospitals 14 days in the future. Public policy leaders are made aware of the month hospital risks will subside and the mitigation effectiveness in their area and in neighboring areas. Actual infection rates are compared to five real-world infection rate scenarios such as, Stay-At-Home and New York State past rates. Included is a survey to engage medical experts for input on key variables and recommendations.

2. Methodology:

To enable wide application for any area, the input variables have been kept to a minimum; population, total cases (current, 7 and 14 days past), and hospital open bed capacity/overwhelm percent. OCM scales from county to state and national levels, with a phase two ability of city and zip code analysis. Ensuring continued accuracy, OCM uses key variables from medical and epidemiology experts that can be regularly updated as more is learned of virus behavior or as virus behavior changes over time.

OCM performs continuous daily analytics based on the correlation between new daily cases and the hospital open bed capacity. Established is a maximum new case limit for each area based on this correlation, new case trend¹, asymptomatic monthly cases² and the areas density impact on cases³. Holding the daily new case count below the maximum new case limit through mitigation efforts, prevents hospital capacity from becoming overwhelmed in the future.

Daily new cases compared to the maximum case limit, indicates the risk of overwhelming hospital capacity as a percentage. Infection rates below the high-standard infection rate, indicates the effectiveness of mitigating the infection spread as a performance percent. The total past cases⁴ are compared to the required accumulated infections⁵ to substantially limit further contagion, to indicate the accumulated infection percent.

The number of months remaining is based on the required accumulated infection at the present time reduced by the go-forward monthly cases⁶. This is done at the state level. Line chart indicates the inversion point of the combined asymptomatic and density case counts, when crossing the count of accumulated infections⁷.

Infection rate scenarios are based on real-world monthly infection rates and effect both the new cases and the open hospital capacity, producing a comparative view on all indicators.

Stay At Home; .0015 per month
Standard Rate; .003 per month
High Standard; .004 per month
Outbreak; .008 per month
New York State; .012 per month
New York City; .015 per month

¹ New Case Trend; Based on comparison of the new case comparisons, currently, 7 and 14 day in the past, and infection rate. Indicates 14 days Green if infection rate is below .003 per month. Indicate 7 days Green and Red if trend down and infection rate above .003 per month. Indicates 0 days Red if trend is up and infection rate above .003 per month.

² Asymptomatic Monthly Cases; New monthly cases increased or reduced by the open hospital capacity, multiplied by the asymptomatic percent.

³ Density Impact on Cases; Cases that did not occur due to density based on the mitigation that occurred, below the high standard infection rate, during the peak infection rate for the area April to June.

⁴ Total Past Cases; Combined past cases and asymptomatic past case (past case multiplied by the asymptomatic percent).

⁵ Required Accumulated Infections; Percent of population requiring care reduced by the percent of population needed to significantly limit contagion.

⁶ Go-Forward Monthly Cases; Combination of new monthly cases increased or reduced by the open hospital capacity, the asymptomatic monthly cases, and density impact cases.

⁷ Accumulated Infections; Total past cases as a percent of the required accumulated infections.

Medical Expert Variables

- 1) Accumulated Infections; 70% (Range 50% to 70%)
- 2) Population that can self-care; 93% (Range 75 to 96.4%)
- 3) Percent of asymptomatic infections per reported infection; 45% (Range 25% to 80%)
- 4) Low population-density impact on limiting new cases; 40% (Range 20% to 50%)
- 5) Medicine effect in next 30 days, increasing hospital capacity; 2% (Range 0% to 100%)

3. Medical Expert Survey Questions and References:

- 1) Total accumulated infections within population required to limit contagion? (Range 50% to 70%)
4/30/2020 <https://hub.jhu.edu/2020/04/30/herd-immunity-covid-19-coronavirus/>
- 2) Percent of population that can self-care if infected? (Range 75 to 96.4%)
4/17/2020 <https://www.cdc.gov/mmwr/volumes/69/wr/mm6915e3.htm>
- 3) Percent of asymptomatic infections per reported infection? (Range 25% to 80%)
5/28/2020 <https://www.healthline.com/health-news/50-percent-of-people-with-covid19-not-aware-have-virus>
- 4) Approximate low population-density impact on limiting new cases? (Range 20% to 50%)
OCM calculates density based on the peak infection rate for the area April - June.
4/4/2020 <https://www.cebm.net/covid-19/covid-19-what-proportion-are-asymptomatic/>
- 5) Medicine effect in next 30 days, increasing hospital capacity? Current 2% (Range 0% to 100%)

4. Hospital Capacity Overload Risk Use of Risk Cold/Hot Map:

COVID-19 Risk to Population: Risk of Hospital Capacity Overload in Next 14 Days (Recommendations For Each County and Surrounding Counties. New Cases Includes Asymptomatic Cases)			
Blue Too Slow, 0% to 65%	Yellow Well Managed, 65% to 98%	Orange Caution, 98% to 100%	Hospital Overload in 14 Days
Area Limits: New Cases well below Max Cases	Area Limits: New Cases below Max Cases	Area Limits: New Cases approaching Max Capacity	Area Limits: New Cases above Max Capacity
Indications Included in Risk: Low – New Case/Infection Rate Trend High – Open Hospital Capacity High – Past Density Advantage	Indications Included in Risk: Mid – New Case/Infection Rate Trend Good – Open Hospital Capacity Good – Past Density Advantage	Indications Included in Risk: High – New Case/Infection Rate Trend Available – Open Hospital Capacity Low – Past Density Advantage	Indications Included in Risk: High – New Case/Infection Rate Trend Poor – Open Hospital Capacity Low – Past Density Advantage
Recommendations: Increase Opening Economy Encourage Public Participation in Mitigation Policies and More Activity	Recommendations: Cautiously Continue Opening Economy Evaluate Risk Using Mitigation Perf: Low – Public Message More Mitigation High – Consider Limiting Gatherings	Recommendations: Consider Limiting Gatherings Evaluate Risk Using Mitigation Perf: Low – Public Message More Mitigation High – Limiting Gatherings Consider Past Accumulated Infections Low – Risk of Spread is Higher High – Risk of Spread is Lower	Recommendations: Increase Stay-At-Home Policies Evaluate Risk Using Mitigation Perf: Low – Public Message More Mitigation High – Consider Limiting Gatherings Consider Past Accumulated Infections Low – Risk of Spread is Higher High – Risk of Spread is Lower Consider Activating Contingency Plans to Increase Hospital Capacity

