15 April 2020

To: Board of Health, Health Officer, and Ravalli County Commissioners.
From: James R. Olsen

Subject: Successes with Integrated Response; Modeling;

I understand that at least one member of the Board of Health has been attending the Incident Management Team — thank you.

Integrated Response. Ravalli County has a statewide reputation for being the Best in Montana in responding to Domestic Abuse, Child Abuse, and Mental Health Crisis Intervention. I saw how it worked as I participated in each of these as a Board Member, Business Owner, and Advocate. This success *required* multiple agencies and businesses to create an integrated response – including non-profit organizations, the justice system, and institutions such as Marcus Daley Hospital.

Our county has another challenge, COVID-19 – and has the opportunity to provide the best response. While the Incident Management Team has done well to integrate the government operations, the best practice is to embrace – and be embraced by – every sector of the medical community, from Marcus Daley, to the Montana Nurses Association MDMH Local 35, to clinics up and down the valley.

Provincialism may cost lives. That means the Board of Health may need to exercise their authority under MCA 50-2-116 (2)(c)(i).

Modeling. My master's degree included several modeling courses. The basic principle passed to me by a professor was that "a model is not the system; it is a way for you to understand the system." Here the "system" is the interaction of an infectious agent with a human population; both have complexities and unknowns. The insight into how the system works is much more important than the predictions.[1]

For a model to give accurate projections it almost always must have:

1) An internal representation of the key process in the real system. The models used by the Weather Service, which always seem to use the biggest and fastest supercomputers available, is an example – good for about 5 to 10 days in advance.
2) An accurate data input. The weather models, for example, use weather station inputs from around the world and contain equations which emulate the physics of weather.[2]

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[1] Tufekci, "Don't Believe COVIT-19 Models, That's not what they're for."
[2] National Weather Service, "About Models."

Similarly, a Relocatable Over The Horizon Radar (ROTHR) has a model for the Ionosphere built into the software that was designed by the country's leading scientists — but it still needs real time "sounding" to measure its response to radio waves many times a day to be reliable.[3]

Another example is a simple predictive model written in GPSS[4] for the West House Mental Health Crisis Center to estimate the number of beds. The inputs were from the County Attorney's Office, visits to similar facilities, and the like.

The problem with COVID-19 predictive models is two-fold.

1) The models that include the mechanism for infections use inputs such as reproduction rate, incubation time, etc. But they have a very simplistic model of the other part of the system – the human population – assuming a uniform mix and no adaptive behaviors. This approach seems to be abandoned for COVID-19.
2) Models which curve fit data.[5] These models do not include representations of the system except in the most top-level estimates. The mathematics is common to many different domains and are no specific to medicine.[6]

The problem COVID-19 models is the extreme uncertainty of the data input.[7] As mentioned in previous inputs, deaths are easiest to count — even though there are errors in this. The equations and approach for some models are published. The model used frequently in the press recently, dubbed the Chris Murray Model, is a curve fitting model. Its primary driver is extrapolating the death rate.[8] The approach is:

"(i) identification and processing of COVID-19 data;
 (ii) statistical model estimation for population death rates as a
        function of time since the death rate exceeds a threshold in a location;
(iii) predicting time to exceed a given population death threshold in states early in the
        pandemic; and
(iv) modeling health service utilization as a function of deaths."[9]

The "statistical model estimation of …death rate" basically takes the curve of deaths over time from China, Italy, South Korea, and the U.S., applies it to reported deaths at a location (for

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[3] AN/TPS-71 ROTHR. I was the data processing and software manager for this system. Every medium to large military and air traffic control system involves numerous models – predictive for key components and processes before the system is built and embedded in the system.

[4] General Purpose Simulation System — a modeling language specifically for queuing systems, the most basic example being the length of a line at a supermarket checkout county.

[5] "Briefing, Pandemic trade-offs," *The Economist*, pages 13-14;

[6] This is a very common approach, for instance, in the literature for projecting highway traffic accident rates.

[7] Garg S, "Hospitalization Rates…"

[8] Murray, Christopher JL and IHME COVID-19 health service utilization forecasting team, "Forecasting COVID-19 impact on hospital bed-days, ICU-day…" page 4-5.

[9] Ibid, page 3. The problem of modeling a complex system with uncertain data is similar to the Climate Change models — and the projections. It has gotten so politicized that some take them as gospel and others totally debunk them, when, in the peer review article itself, the authors are often characterizing the limitations and potential uncertainty of the output — even while producing a work that helps understand the problem if one could accept the uncertainties inherent in that problem.

example the State of Montana), projects future deaths from that. Added to this is the effect of four stay-at-home strategies appears to be estimated by the authors, not from the data.

The factors to take the death rate and extrapolate hospital beds, ICUs, and ventilation are based in data from the countries listed, adjusted for age groups. The error function itself is a default assumption (Gaussian) by the authors, and may or may not, in fact, be correct.

The authors, by necessity, admit to a host of assumptions. So, while the news often reports the model output as if the public should take it as a certainty, the error estimate from the model is very large (the pink area being the error) for Montana:[10]
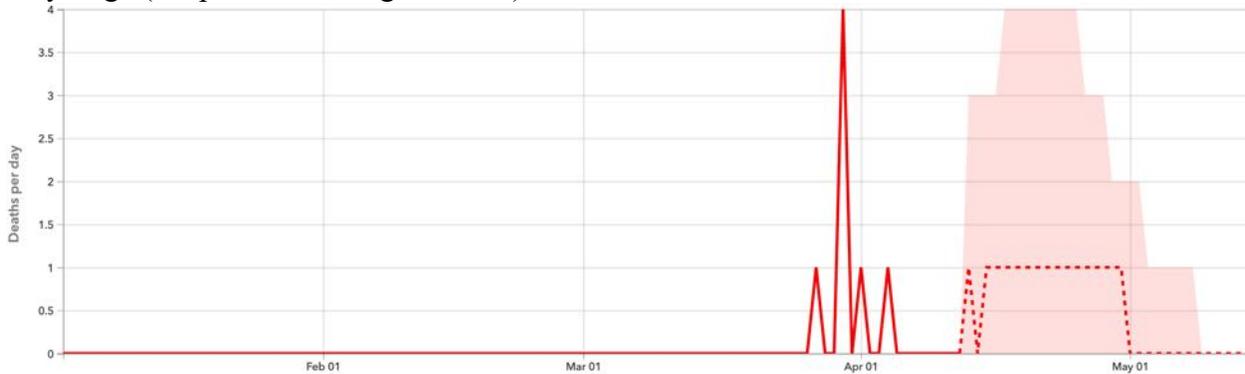
And, to this one must add the errors due to the uncertainties of the data and the model itself. This projection of deaths is extrapolated to hospital beds, ICUs, and ventilators. The data is so sparse for Montana that it should not even be published in my opinion (and apparently the authors of the model).

Even the larger data set from the United States has a large error range estimated by this model:
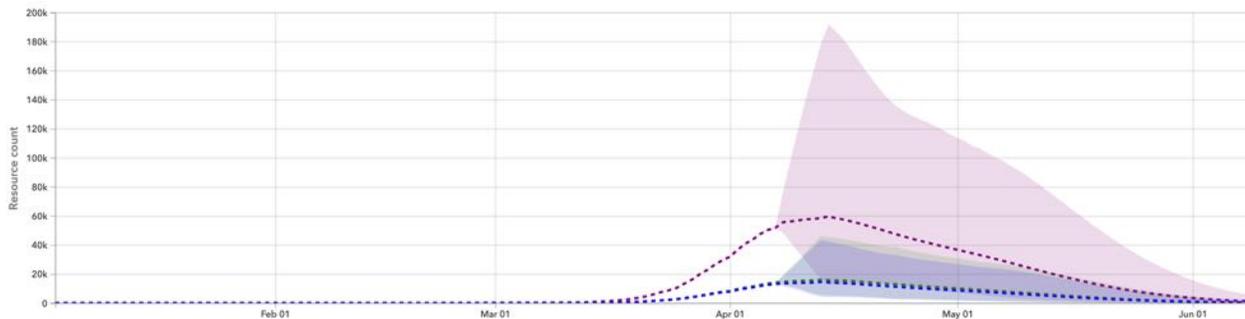
Looking Ahead for Ravalli County. So, what does this all mean? The model produces no useful projection values for Ravalli County, neither the timing nor medical capacity. What is useful is the shape of the curve and understanding what factors are important. It is just as useful to look at the timing and rates, adjusted by population and the nature and timing of population control — and assume when you get your first case or two of community acquired infections that the curve is on the way.

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[10] Covid-19 Data.

That is the approach I would take — look at locations that have gone before us and adjust for population, an estimate of the effectiveness of stay-at-home. This would seem to serve as well as the models I have seen so far — and, by making use think about it, help understand it better that simply taking a model output at face value.

Ravalli County is lagging the "hot spots" in Montana so far. The peak for the County could be delayed to the point where it occurs after the Stay-at-Home directive is lifted.

The bottom line is that the day is coming when we have to figure out how to have economic activity while COVID-19 present in our population.

Testing. The evidence continues to pile up for a strategy of high levels of testing. Right now the criteria is CDC Category I and II — which means the patient has significant symptoms.

This still appears to be the case in spite of concerns about false-negatives, which are based primarily on uncertainty. The false negative rate in one study of patients who were symptomatic was around 3% which estimates the rate raising as days pass from the onset of symptoms.[11]
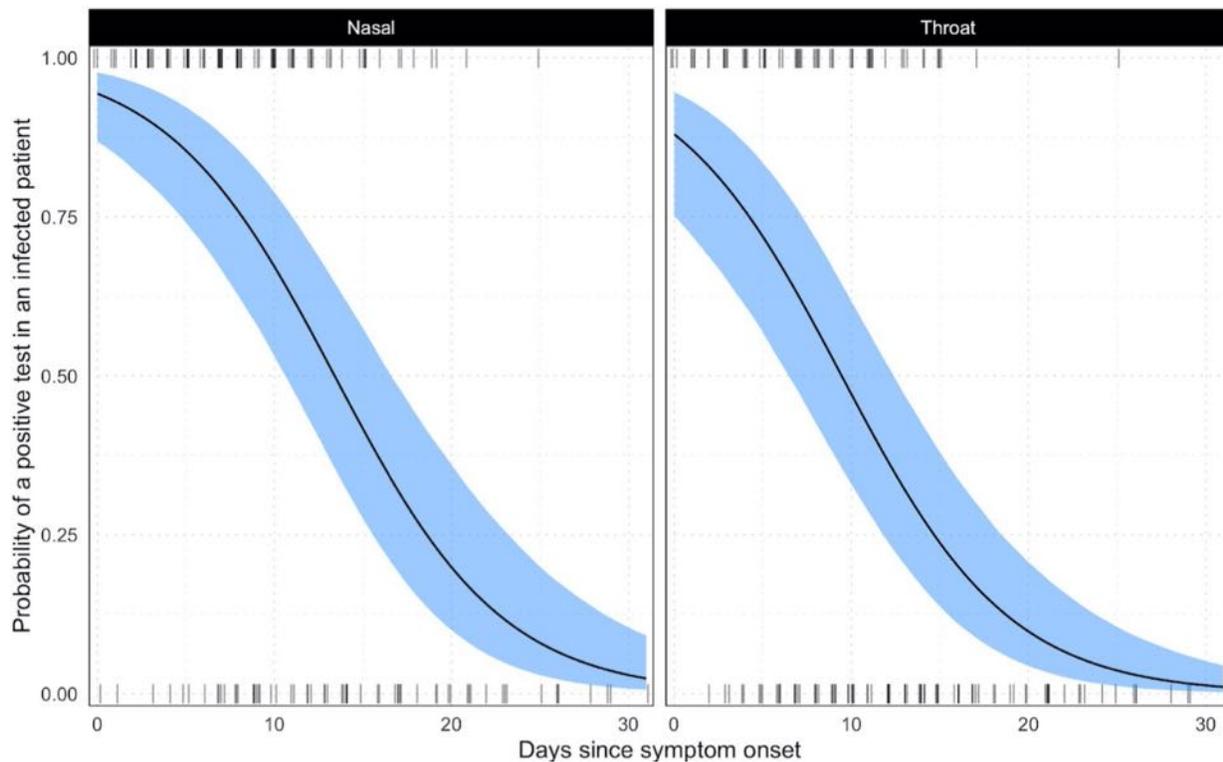
However, there is concern that the rates may be much higher — especially considering asymptomatic people and the uncertainty due to the lack of definitive data.[12]

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[11] Wikramaratna, "Estimating false-negative detection rate…"
[12] West, "COVID-19 Testing: The Threat of False-Negative Results."

On the other hand, as noted in prior submissions, the overall data shows that countries that do massive testing have much better outcome in reducing death rates per population.

Antibody tests — which are available for purchase — seem to be waiting in the United States for FDA approval which loosened and then tightened its standards. If this gets sorted out, antibody tests will improve the knowledge of the presence of COVID-19 in our population.

Ventilators for COVID-19. There is growing antidotal evidence that protocols for using a ventilator for other diseases may be less effective or harmful for COVID-19 patients in terms of the settings, pressure, and the position of the patient's body.[13]

Comorbidity. Various reports state that 1 to 15% of the deaths from COVID-19 are people who have no other health problems. New York's data reported as:[14]

Leading comorbidities among COVID-19 deaths in New York

As of midnight on April 6, **86.2%** of the state's 5,489 COVID-19 deaths involved at least one comorbidity.
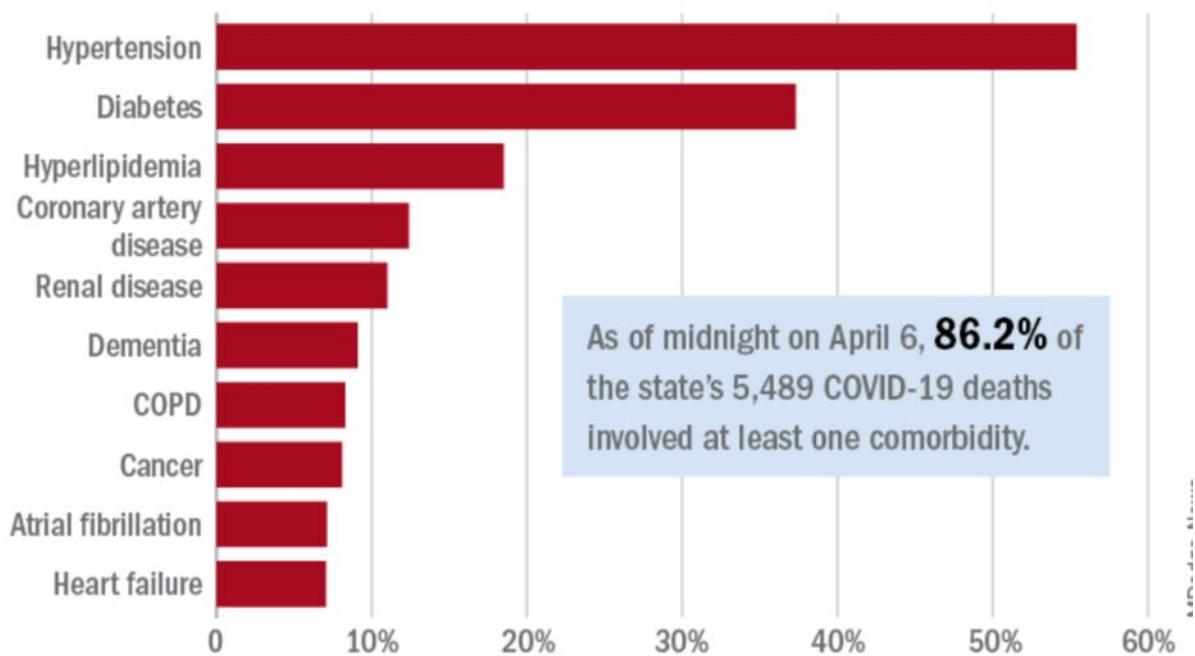
Note: Data reported on a daily basis by hospitals, nursing homes, and other health care facilities.
Source: New York State Department of Health

The disease does not just cause respiratory failure but can also inflame the heart muscle – raising the estimated death rate of people with cardiovascular issue to a 10% mortality rate.[15]

The medical profession does not yet seem to have a proven set of treatments and protocols for this combination — COVID-19 combined with other illnesses – suggesting COVID-19 patients

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[13] Gallegos, Alicia. "Does COVID-19 Require Different Ventilator Protocols?"
[14] Franki, "Comorbidities the rule in New York's COVID-19 deaths."
[15] Lewis, "How does cardiovascular disease increase the risk of severe illness and death from COVID-19?"

who have other issues should be treated with the knowledge brought by specialists in heart disease, renal disease etc. in combined with specific COVID-19 knowledge.

TO REPEAT SOMETHING IMPORTANT TO ME: Right to assemble.

The Governor's stay-at-home directive does not allow for assembly for religious or political purposes, even if all other elements of the directive are followed. The Board of Health hereby issues a stay for any enforcement of the directive for any religious or political gathering, provided that:

      Other elements of the directive are implemented.

      Additional protection of public health, hereby adopted by the board are implemented:

- The area of the assembly, if indoors, is sanitized.
- The participants remain 6 feet apart and wear masks.

The Chair of the Board will request and emergency opinion from the Attorney General under MCA 2-15-501 (7).

Best Regards,

James R. Olsen

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