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Letter to the Editor

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Integrating Data Variability Into Contemporary COVID-19 Decision Support

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In April of 2020, the National Center for Disaster Preparedness (NCDP) at Columbia University's Earth Institute partnered with Commonwealth Edison (ComEd) to examine the coronavirus disease 2019 (COVID-19) pandemic and support relevant decision-making to facilitate workforce safety and continuity of utility operations in an environment where initial data were scant and variable. Central to this effort was the development of a SEIR (Susceptible, Exposed, Infectious, Removed) model by ComEd. The model was based on the work of Gayane Poghotanyan, and the system of equations was based on the work of Gabriel Goh. Nearly a dozen inputs were monitored (see below) and updated bi-weekly.[1,2] The model projected absenteeism for the ComEd workforce based on projections from the larger data and trends from 5 counties where the majority of ComEd's workforce resides. Running the model required input parameters collected from an ongoing literature review by NCDP.[3] More than 80 studies from peer reviewed, prepeer reviewed, and nonpeer reviewed sources were analyzed as they were published between January and August 2020. The lack of definitive information about epidemiological parameters, is evidenced by the abundance of conflicting information even from credible sources. This results from an inconsistency in data collection and reporting as well as the impact of different contexts and interventions on virus transmissibility.

At the time of this analysis, R_0 was the most suitable for variability analysis among COVID-19 SEIR model parameters. R_0 is the basic reproduction number of an infectious disease in a population, representing the average number of secondary cases in a population susceptible to the disease.[4] Figure 1 below shows reported R_0 over the course of 8 mo, demonstrating substantial variability in studies from early 2020. R_0 variability began high and then decreased, eventually vacillating around 2.0 in mid-2020, presumably as social interventions took hold and as more data became available. The observed R_0 started to slowly increase during the summer months, with the highest observed value around 3.5 in late summer. This may have been due to lifting of intervention measures in some areas.

In addition to R_0 data, other variables suffered from greater paucity making similar analysis challenging. These included variables on: *Virus:* effective reproduction rate, asymptomatic rate; *Days to recovery:* mild and severe; *Hospitalization:* rate, days from onset of illness to hospitalization, days hospitalized; *Fatality:* fatality rate, incidence fatality rate, days from onset of illness to death.

A key inconsistency in these reported parameters is that various studies focused on different statistical representations: some studies focused on a mean value, while others provided ranges. For these parameters, we did not undertake an in-depth review due to their variability, difficulty in tracking, and lack of overall observations.

Due to the gradual and variable emergence of information during disasters, precise data is a luxury in decision-making. Instead, we must rely on a dynamic approach, which integrates new information as it becomes available. Often, this requires a combined subjective and objective decision-making framework that shifts toward objectivity as data variability converges and becomes more precise. This includes allowing a degree of imprecision in parameters that are continually updated as new information about the disease is discovered. Additionally, the balance between promptness of model updates and precision in model parameters is an ongoing process as we learn more about how COVID-19 spreads and impacts on various populations and the efficacy of different intervention efforts.

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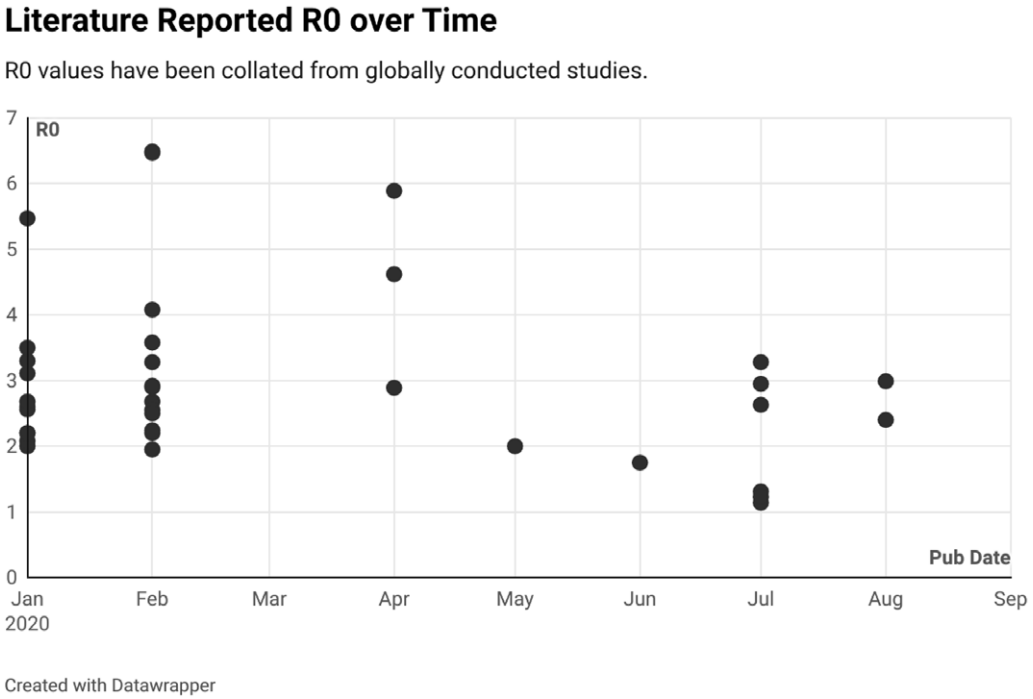

Figure 1. R_0 reported in the literature.

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