Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Commentary

The public health response to COVID-19: balancing precaution and unintended consequences

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Since the beginning of the COVID-19 pandemic, public health decision-makers have been called on to identify responses that are appropriate in intensity, duration, and scope. In March 2020, epidemiological models of potential epidemic trajectories rapidly became a primary tool used to inform such decisions. Early models focused on estimating fundamental quantities and projecting the speed at which generic interventions should be deployed to subvert early spread [1]. Models were developed using available data in real time, with a primary aim to enhance understanding of transmission and clinical severity. However, foundational insights of transmission dynamics are not public health implementation specifics. Understanding the impact of a single intervention strategy compared with nothing on the SARS-CoV-2 reproductive rate, for example, is not the same as studying the impact of different strategies to mitigate transmission risks. Foundational insights generated from these models shaped a global pandemic response that has largely taken the form of large-scale government mandates—including shelter-in-place orders and closure of nonessential businesses, collective outdoor spaces, schools, and universities. The far-reaching nature of these measures reflected an immediate urgency to halt explosive infectious disease growth. As the pandemic has evolved, however, we have learned that this epidemic, like many before it, is characterized by tremendous heterogeneity at the level of countries, states, cities and counties, neighborhoods, congregate settings, and even households [2–4].

Translating fundamental insights from epidemiological models into effective public health practice implies transparency about the conditions on which insights are projected into estimates with the most common condition of COVID-19 models being of a homogenous population with relatively homogenous social networks. However, there are consequences to a top-down mandate of nonspecific responses onto a heterogeneous population. Nonspecific primary prevention approaches are known to increase disparities by further marginalizing those already at highest risk of severe outcomes—including people living in congregate settings and people of disadvantaged communities who may also have poorer existing access to care and higher rates of comorbidities that increase risk of poor COVID-19-related outcomes [5]. As an example, the closure of businesses has had a dramatic economic effect on populations already generally at the margins, with tens of millions of people filing for unemployment in the United States alone and countless more seeing their “gig economy” incomes fall dramatically. There have also been significant disruptions to the health system with currently unmeasured, but potentially substantial, increases in morbidity and mortality associated with diversion of resources away from prevention and treatment of cardiovascular disease, mental illness, acute illnesses, reproductive health, cancer, and other infectious diseases—to name a few [6]. Similarly, disruptions to the educational system at all levels may have downstream effects on the health and well-being of individuals, populations, and the economy [7].

Evaluating the implementation of more nuanced strategies will require us to look deeper for evidence as to how and why specific activities helped reduce epidemic spread, for whom, when, and under what conditions. The media has commonly portrayed that the primary factor differentiating “successful” and “unsuccessful” responses is the speed and intensity with which broad-scale policy change has been enacted. We hail leaders, for example, whose responses have been swift and strong while decrying those whose responses have been delayed or less stringent. But this reaction

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may selectively overlook specific cities, regions, and even countries where there have been disconnects between the level of stringency and incidence rates of COVID-19. For example, Arkansas has among the least stringent measures of any state and as of April 26th, has half the number of cases per capita as compared with its neighboring state, Mississippi. Sweden has received significant international press for its intentionally relaxed response and yet has fewer cases per capita than many countries—including Belgium, Switzerland, and France—that swiftly enforced shelter-in-place restrictions. The disconnect between epidemiological trajectories and intervention intensity can also be observed in countries across Asia and Africa. Focusing on high-level, broad policy decisions as singular causal determinants belies a complexity and heterogeneity of transmission dynamics to be considered if we are to move from "flattening the curve" to turning it downward. This complexity occurs on many levels, including individual-level determinants of health, community-level patterns of interaction based on local economies and population density, structural factors including health disparities and policy environments, environmental factors such as seasonality and air pollution, and of course factors related to the effectiveness and efficiency of public health interventions themselves.

Relative to earlier public health emergencies, our ability to gather additional layers of information, such as those generated with "big data", and analyze those data with computational tools of increasing complexity has grown tremendously. There are many types of models, including, but not limited to, those designed to estimate the local rate of spread, to forecast cases, to elucidate fundamental mechanisms such as the relative contribution of presymptomatic or subclinical transmission and the relative importance of each key element of the reproductive rate, and to compare the potential impact of various combination of strategies. All are useful to the response because they answer different questions. What are needed during the next phase of pandemic response are models validated against and adapted to as much real-world data as possible to help answer questions about which specific interventions to use, in which populations, at what time, and under what context. Ensuring that epidemiological data are routinely collected on the characteristics of COVID-19 testing, cases, and deaths is critical in guiding these analyses—data such as socioeconomic status, race and ethnicity, residence in a congregate living setting such as a homeless shelter, long-term care facility, or in detention of some form. We must also explicitly acknowledge where the limitations of the currently available data challenge the ability to examine the comparative effectiveness of different interventions.

It is also important to consider the health effects of the COVID-19 response in a broader sense, and begin to consider short-, medium-, and long-term implications. These implications will include impacts on other health conditions, including other infectious diseases and chronic diseases. For example, prolonged reductions in access to routine health care may increase adverse outcomes from cardiovascular events such as myocardial infarctions and strokes; cause longer-term morbidity and mortality through suboptimal management of hypertension, blood sugar, hypercholesterolemia; interrupt prevention of other infectious diseases through vaccination, testing, and pre-exposure prophylaxis, outreach services; weaken management of acute and chronic mental health needs; limit cancer screening and prevention services; and challenge the delivery of family planning services including contraception [8,9]. The trade-offs and opportunity costs of broad government mandates in response to the COVID-19 pandemic—including effects on socioeconomically marginalized communities—must be urgently considered by models designed to answer these broader questions. By focusing attention primarily on COVID-19 cases and deaths and pitting those against models of economic harm, we risk undervaluing the larger-scale and longer-term health of individuals, communities, and populations.

As we enter the next phase of pandemic mitigation, the response will need to better align with what the data are telling us there is differential risk in the acquisition, onward transmission, and consequences of COVID-19—and its mitigation strategies—across people, places, and time. It is tempting to look at countries, states, and cities that enacted immediate, broad-scale measures and now have smaller numbers of COVID-19 cases as "success stories"—but these same disruptions to routine health care systems in those settings may end up generating more deaths due to other conditions than would otherwise have been caused by COVID-19. The COVID-19 pandemic is, and will continue to be, characterized by settings and populations of higher and lower disease burden. As we develop mathematical models to guide programs and implementation strategies for the next phase of pandemic response, it will be increasingly important to a) account for implementation-relevant heterogeneity in the epidemiology of cases and morbidity and mortality as well as in the response and b) holistically consider not only the breadth of potential health outcomes resulting from COVID-19 and the corresponding response, but also the heterogeneity of epidemic burden, health systems culture and infrastructure, and existing health disparities at the local, state/provincial, and national levels.

In summary, our success as a society in combating COVID-19 will rapidly be judged by how effectively we can move from a "one-size-fits-all" approach to a locally responsive, nuanced public health strategy that accounts for both an increased breadth of health consequences and the striking epidemiologic heterogeneity that has characterized the pandemic from its beginning. To date, the COVID-19 response has appropriately been guided by the "precautionary principle" in epidemiology which suggests that we must intervene swiftly and aggressively when faced with a new public health risk of uncertain proportions [10]. As data to inform a more strategic approach emerge, however, we must begin to move from a precautionary position to one that also considers the proportionality and specificity of the public health response, with the overall goal of maximizing population health. The health and lives of our most vulnerable communities—which stand to lose the most from a long-term strategy of indiscriminate shutdown—hang in the balance.

References

[1] Hollingsworth TD. Controlling infectious disease outbreaks: Lessons from mathematical modelling. J Public Health Policy 2009;30(3):328–41.

[2] Trauer JM, Laurie KL, McDonnell J, Kelso A, Markey PG. Differential effects of pandemic (H1N1) 2009 on remote and indigenous groups, Northern Territory, Australia, 2009. Emerg Infect Dis 2011;17(9):1615–23.

[3] Dudas G, Carvalho LM, Bedford T, Tatem AJ, Baele G, Faria NR, et al. Virus genomes reveal factors that spread and sustained the Ebola epidemic. Nature 2017;544(7650):309–15.

[4] Baral S, Rao A, Sullivan P, Phaswana-Mafuya N, Diouf D, Millett G, et al. The disconnect between individual-level and population-level HIV prevention benefits of antiretroviral treatment. Lancet HIV 2019;6(9):e632–8.

[5] Charlton BG. A critique of Geoffrey Rose's 'population strategy' for preventive medicine. J R Soc Med 1995;88(11):607–10.

[6] Krumholz HM. Where Have All the Heart Attacks Gone? New York City, NY: New York Times; 2020. https://www.nytimes.com/2020/04/06/well/live/coronavirus-doctors-hospitals-emergency-care-heart-attack-stroke.html. [Accessed 12 May 2020].

[7] Poverty and Child Health in the United States. Pediatrics 2016;137(4). https://pediatrics.aappublications.org/content/137/4/e20160339.

[8] Carter P, Anderson M, Mossialos E. Health system, public health, and economic implications of managing COVID-19 from a cardiovascular perspective. Eur Heart J 2020;0:1–2. https://doi.org/10.1093/eurheartj/ehaa342.

[9] Tran NT, Tappis H, Spilotros N, Krause S, Knaster S. Not a luxury: a call to maintain sexual and reproductive health in humanitarian and fragile settings during the COVID-19 pandemic. Lancet Glob Health 2020. https://doi.org/10.1016/S2214-109X(20)30190-X.

[10] Stefánsson HO. On the limits of the precautionary principle. Risk Anal 2019;39(6):1204–22.