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CHEST

# Decision-making About Risk in the Era of the Novel Coronavirus Disease

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The coronavirus disease 2019 (COVID-19) pandemic illustrates the importance of combining public health and clinical data, along with research on biological, social, and psychological mechanisms, to save lives. That is, the pandemic is the result of these types of diverse causal factors, and combating it requires a multifactorial approach. In this issue of *CHEST*, Jehi et al[1] present a mathematical model that integrates descriptive data about patients (eg, social factors, COVID-19 exposure, comorbidities, medications) with clinical data about outcomes of COVID-19 tests. The resulting nomogram and risk calculator provide a free step-by-step decision tool to individualize risk predictions for patients, outputting the likelihood of a positive diagnostic test result for COVID-19. This remarkable achievement would not have been possible without modern computing power, advances in decision sciences, and the crucial alignment of research-based data collection with extensive clinical data.

The model by Jehi et al is not perfect (no model is), and it is constrained by the limitations that the authors discuss. However, as countries face shortages of supplies, tests, and hospital beds during the COVID-19 crisis, models such as this one can be used to deploy scarce resources more effectively. As the authors emphasize, the availability of this kind of tool should in no way be interpreted as accepting or rationalizing inadequate testing capacity. Having the tool available should not diminish the responsibility to do what is right clinically for individual patients; in fact, it can help extend resources equitably to more patients. A basic ethical responsibility is to provide life-saving care to each patient, although reality falls short of this ideal.

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This ethical responsibility is heightened by the fact that health disparities are not distributed randomly in society but, rather, fall disproportionately on social groups that have experienced discrimination. Indeed, the worked example presented by Jehi et al in Figure 2 of their article starkly illustrates how risk jumps, simply by changing race from white to black in the model—holding all other variables constant—from 13.79% to 23.95%. A significant racial disparity was observed in both the Ohio and Florida samples, despite the differences between these states. Therefore, although allocation of scarce resources can be touted as a rational and unbiased economic decision in principle, it rarely turns out to be that way in practice. Research that incorporates social, behavioral, economic, and biological factors is required to understand and ameliorate these discrepancies in health outcomes.

In addition to social disparities and potential mechanisms underlying health inequities, the results of the model by Jehi et al also offer hints about potential mechanisms and mediators that are speculative at this point but that have some footing in plausible biological mechanisms. For example, some of the medications that are related to reduced risk might provide therapeutic insights, although, again, they might instead merely show that real-world observational data reflect nonrandom associations (eg, more affluent people with better health care to begin with are more likely to be vaccinated for pneumonia). Nevertheless, it is important to study and report these results as a step toward eventual causal testing of potential treatments.

Providing decision tools (a nomogram and calculator) is an often-overlooked but essential step in encouraging uptake of modeling results and other research in clinical practice. Rigorous psychological research has shown that these concepts are counterintuitive, and even experts (eg, well-trained physicians who have been educated about Bayes' theorem) are highly likely to not just be confused but systematically wrong about posterior probabilities (eg,

as discussed by Sox et al[2]). For example, suppose that the base rate of a disease is 10% and a diagnostic test has 80% sensitivity and specificity (ie, an 80% chance of a "positive" result if the patient has the disease; an 80% chance of a "negative" result if the patient does not have the disease). If a patient has a positive test result, how likely is it that he or she has the disease? Is it closer to 30% or to 70%? This question was asked of 82 physicians, all of whom were affiliated with a university teaching hospital. Two answers were provided to lessen the computational burden and to allow estimates to count as correct if they were in the correct ballpark. Note, too, that 30% vs 70% is likely to be a clinically significant difference. Only 31% of physicians selected the correct answer of 30%, well below chance.[3]

Some authors such as Klein et al[4] have argued that providing nomograms and calculators does not necessarily help people understand risk. However, when combined with conceptual or gist understanding and a format for distinguishing overlapping classes (ie, the classes of positive cases, negative cases, those with disease, and those without the disease), posttest judgments of medical students and physicians can be improved.[5,6] Decision support can take a variety of forms,[7] but health-care providers are unlikely to adopt this support without intuitive insight into why the designated decisions should be taken, which leads back to the inevitable issue of understanding the mechanisms behind health outcomes.

Leaders at every level must consider how they can support integrative endeavors exemplified by Jehi et al's[1] work by maintaining patient privacy but removing bureaucratic barriers and creating a culture of urgency about supporting research. In parallel, it is essential to bring public opinion along, a process that will take years and for that reason must begin now. Leaders must mount a concerted effort to explain the rationale for this research in saving lives and, more broadly, the essential role of science in public health.[8]

## References


1. Jehi L, Ji X, Milinovich A, et al. Individualizing risk prediction for positive Coronavirus Disease 2019 testing: results from 11,672 patients. *Chest*. 2020;158(4):1364-1375.
2. Sox HC, Higgins MC, Owens DK. *Medical Decision-making*. 2nd ed. West Sussex, UK: Wiley-Blackwell; 2013.
3. Reyna VF. How people make decisions that involve risk: a dual-process approach. *Current Dir Psychol Sci*. 2004;13(2):60-66.
4. Klein WMP, Ferrer RA, Kaufman AR. How (or do) people "think" about cancer risk, and why that matters. *JAMA Oncol*. 2020;6(7):983-984.
5. Brush JE Jr, Lee M, Sherbino J, Taylor-Fishwick JC, Norman G. Effect of teaching Bayesian methods using learning by concept vs learning by example on medical students' ability to estimate probability of a diagnosis: a randomized clinical trial. *JAMA Network Open*. 2019;2(12):e1918023.
6. Lloyd FJ, Reyna VF. A web exercise in evidence-based medicine using cognitive theory. *J General Intern Med*. 2001;16(2):94-99.
7. Delaney BC, Kostopoulou O. Decision support for diagnosis should become routine in 21st century primary care. *Br J General Pract*. 2017;67(664):494-495.
8. Reyna VF. A scientific theory of gist communication and misinformation resistance, with implications for health, education, and policy [published online ahead of print April 20, 2020]. *Proc Natl Acad Sci U S A*. https://doi.org/10.1073/pnas.1912441117