



Editorial

Promise of personalized medicine



The goal of personalized medicine is arguably as old as medicine itself,¹ and the promise of using simultaneously broad (all genes and all exposures), precise (single molecules or cells), and unbiased (not dependent on prior knowledge) data sets to tailor clinical care is the compelling objective of systems biology as applied to medicine. In this issue, Virkud et al² present a useful and informative overview of the “big data” domains, including genomics, epigenomics, transcriptomics, and proteomics along with the microbiome and exposome and their integrated effects on the metabolome, which are the grist for the systems biology mill. They remind us that these data sets, fully elucidated and understood through the lens of the central dogma of molecular biology, constitute a flow of information from what is encoded in our genes through the expression of their products and the subsequent interaction of them with both the legion of microbiota within us and the myriad environmental exposures without.

Although the acquisition of these richer data sets may sometimes be simply conflated as personalized medicine (arguably such approaches can be applied with simpler data sets as well, and there is no guarantee that the generation of larger data sets will necessarily be applied in a personalized fashion), the authors make the case well that, in allergy practice, the data sets we routinely generate (eg, skin testing and specific IgE testing) leave much to be desired. They also point out that multiomics data acquisition is approaching, in terms of both cost and time to delivery, the point at which it can be potentially useful in the clinic. One example is the improvements to immune deficiency diagnosis afforded by whole exome sequencing. As we accumulate richer data along the information continuum from genetic polymorphisms to dysbiosis and exposures, the stage would appear to be increasingly set for application in clinical allergy as well.

Along with this promise, however, are some potential pitfalls that we, the practicing allergists, will need not only people such as Dr Virkud and her colleagues to help us avoid but also our entire research, clinical, and education communities. As the authors discuss in the review, the expansiveness of these data sets presents new challenges and requires new approaches in data analysis. Not only is the opportunity for statistical false-positive results increased but also, although the data generation itself may be unbiased in unprecedented ways, its interpretation must be as rigorously protected from the same tendencies toward pareidolia and other forms of bias as that of any other

data set. Furthermore, what is not discussed as much in the review article is that the complexity and the requisite analytical sophistication push this literature well beyond the statistical training level of the average practicing physician and patient. This is happening just as the scientific enterprise faces concerns about research reproducibility, poor-quality science journalism, low science literacy in the general population, and increasing trends of predatory publishing and other sources of “junk science” all contributing to the news feeds of our own and our patients.

If we are to successfully translate the promise of systems biology in medicine to our patients, we must engender the trust of our patients and promote a culture that understands and values scientific evidence. To do so, I advocate the following: (1) in research, we must embrace the tenets of reproducible research³; (2) in practice, we must strive to practice evidence-based medicine, an integration of best research evidence with clinical expertise and transparency about the limits of current evidence^{4,5}; and (3) in society, we must support education and science literacy—a most defensible form of patient advocacy⁶ even in this overly politicized time. Unless we succeed in the competition of ideas within a larger society, the promise of personalized medicine will be severely constrained.

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