

Precision medicine is 'personalized, problematic, and promising'

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The rapidly emerging field of precision medicine is a "disruptive innovation" that offers the possibility of remarkably fine-tuned remedies to improve patient health while minimizing the risk of harmful side effects, says J. Larry Jameson, MD, PhD, dean of the Perelman School of Medicine and executive vice president of the University of Pennsylvania for the Health System, in this week's issue of the *New England Journal of Medicine*. Writing with oncologist Dan L. Longo, MD, a professor of Medicine at Harvard Medical School, in a "Sounding Board" piece, Jameson surveys the terrain of the new field.

Precision medicine, they write, raises the potential of a "daunting explosion of information and the associated clinical guidelines." Moreover it creates a set of conditions where the interests of patients, physicians, health systems, [insurance companies](#), government agencies, and the [pharmaceutical industry](#) may not fully coincide, setting the stage for an absence of consensus on appropriate care choices.

The authors define [precision medicine](#) as "treatments targeted to the needs of individual patients on the basis of genetic, biomarker, phenotypic, or psychosocial characteristics that distinguish a given patient from other patients with similar clinical presentations." Buttressing this definition "is the goal of ... minimizing unnecessary side effects."

Noting that "many physicians contend that they have always practiced individualized and personalized medicine," the authors distinguish this

new field by the rapid pace of advances in diagnostic and [treatment options](#) powered by the convergence of technological breakthroughs. These include DNA sequencing (to identify genetic precursors to diseases for early treatment), cell sorting (isolating different cell types for study and treatment), epigenetics (externally turning genes "on" or "off"), proteomics (analyzing and identifying protein structure and function), and metabolomics (measuring and analyzing sugars and fats to improve diagnosis and treatment). In addition, sophisticated imaging such as computed tomography and ultrasonography can lead to highly accurate diagnoses, sparing patients from invasive testing or exploratory surgery.

Jameson and Longo point out that electronic health records also are an important factor in personalized medicine, and will grow in importance. Capitalizing on rich databases of clinical information, algorithms have been developed to identify patients at risk for certain diseases and to recommend drug selection and administration.

Such advances, however, must be weighed against the risk of information overload. For example, medicine has a history of dividing practitioners and researchers into "lumpers," who group related conditions together, and "splitters," who apply more exact definitions and thereby define more discrete entities. The authors say that advances in genetics and biomarkers will shift this balance in favor of the splitters. While this raises the prospect of more precise diagnosis and treatment, it complicates these processes, as well. In particular, primary care providers may have the most challenging role in precision medicine. Referrals to specialists will likely increase as a result.

Another complicating factor is that while patients, physicians, and [health systems](#) all seek better disease diagnosis and treatment, the latter two must balance individual patient needs and desires with appropriate utilization and sound fiscal management. Furthermore, insurance

companies and government programs such as Medicare and Medicaid are increasingly concerned that new tests and drugs will increase expenditures which may not be offset by more selective use and fewer side effects. Lastly, the pharmaceutical industry seeks new drug opportunities, but new drugs often replace profitable existing therapies. These divergent perspectives must be addressed, the authors say, through constructive and open dialogue in order to capture the full potential of precision medicine.

Gaps that remain in precision medicine include identifying new biomarkers to assist with disease detection and to help guide treatment, such as with concussions, and the need for enhancing imaging tests to detect conditions such as Alzheimer's disease. The authors write that the "financial incentives to create new diagnostic tests are not as strong as those to create new drugs, despite the fact that diagnostics and therapeutics are inextricably linked."

Cancer detection and treatment represents a major opportunity for precision medicine. In addition to medications that target altered genetic pathways, such as the leukemia drug imatinib, there is growing success with targeted immunotherapies, such as using a person's own engineered T cells to attack cancer cells.

Another rich opportunity is using technology to assist with acute interventions in individual patients. This area already includes automated defibrillators to detect and correct cardiac arrhythmias. Analogous opportunities exist for epilepsy and hypoglycemia, as well as for developing sensors and biomarkers to predict premature labor and other birth-associated abnormalities. Mobile technology, already assisting with some health and medication monitoring, could in the future detect conditions ranging from mood swings to pathologic skin lesions.

The authors conclude that the extent to which current and future

advances in precision medicine "are constructive or disruptive depends on our ability to harness vast amounts of new knowledge and treatment options within the framework of everyday clinical practice." Necessary steps include increased incorporation of information management into medical school curricula, more informatics support for physicians, increased access to specialists, and greater receptivity by regulatory agencies and payers to advances in precision medicine. The authors conclude: "When the term precision medicine disappears from our lexicon, we will know that a revised disease classification with more targeted treatment options has become the norm."

Provided by University of Pennsylvania School of Medicine

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