

VIEWPOINT

Precision Nutrition—the Answer to “What to Eat to Stay Healthy”

Griffin P. Rodgers, MD
National Institutes of Health, Bethesda, Maryland.

Francis S. Collins, MD, PhD
National Institutes of Health, Bethesda, Maryland.

The long-recognized centrality and importance of nutrition for good health naturally lead to the practical question of what to eat to stay healthy.

Many studies have revealed profound differences among individuals in disease risk and biological responses to diet, making it challenging to fully answer this question. This necessitates moving beyond a one-size-fits-all dietary prescription for optimal health and disease prevention.

The modern view of food and medicine has led to a substantial shift in nutrition research and practice known as precision nutrition, which has great potential to offer multidimensional and dynamic nutrition recommendations. Like precision medicine, the field of precision nutrition aims to understand the health effects of the complex interplay among genetics, microbiome, antibiotic and probiotic use, metabolism, food environment, and physical activity, as well as economic, social, and other behavioral characteristics. Only with a firm grasp of the contributions and interrelationships among these factors will it be possible to develop targeted nutrition guidance for diverse individuals in a highly diverse world.

The National Institutes of Health (NIH) is leading efforts to advance the field of precision nutrition as the best strategy to catalyze nutrition science and related fields into meaningful, clinically relevant dietary solutions for both individuals and populations that share physiological, behavioral, or sociocultural features. The *2020-2030 Strategic Plan for NIH Nutrition Research* promotes rigorous science to answer fundamental questions

[T]he goal is to bring to fruition the promise of the science of precision nutrition and advance understanding of the vitality of food in health.

about human nutrition, including the following: the role of nutrition in promoting health and reducing the burden of disease throughout life and across generations; interactions of nutrition with other potentially modifiable exposures such as the microbiome; and how to use this holistic knowledge to develop and implement actionable recommendations.¹

Research to address and mitigate diet-related chronic diseases is especially important in light of the current coronavirus disease 2019 (COVID-19) pandemic, given the increased risks faced by people with these underlying diseases, which disproportionately affect vulnerable populations due to health and social disparities. Exploring how diet and nutritional status modify immune response could help explain some of the vari-

ability in COVID-19 morbidity and mortality, even in individuals without diet-related chronic disease.

Advancing the science of precision nutrition is needed to focus on the role of nutrition across the lifespan and address diet-related conditions through multifaceted interventions that go beyond choosing healthy foods. Poor nutrition is a key risk factor for a host of chronic diseases and conditions that are the leading causes of death and disability in the US—including cardiovascular disease and stroke, type 2 diabetes, obesity, cancers, and others—with associated health care costs estimated in the hundreds of billions of dollars annually.²

Recognizing the highly multidisciplinary nature of modern nutrition science, precision nutrition investigations will benefit from innovative technologies and interdisciplinary research alliances that should enable deciphering of the various roles (alone and together) of whole foods, individual nutrients, sociocultural influences on eating and lifestyle, societal infrastructure on the health of individuals and populations, and genome/microbiome variation between individuals.

Precision Nutrition as an NIH Research Strategy

As the lead federal agency for nutrition research and research training, NIH has funded many landmark clinical trials that have yielded some of the most important advances to date on nutrition and diet-disease relationships. The *2020-2030 Strategic Plan for NIH Nutrition Research* aims to be a catalyst for modernizing nutrition research and ensuring rigor and consistency across bio-

medical research studies that examine the role of diet in disease. As one example, a large cohort study designed to answer key questions about precision nutrition is being developed for potential support by the NIH Common Fund, with an initial investment of \$150 million over 6 years.

Funding for additional projects, most of

which are intended to be investigator-initiated, will depend somewhat on NIH annual appropriations, but will be guided by attention to 4 strategic goals that aim to address current challenges in nutrition science (Box). Integrated throughout the plan is consideration of 5 key cross-cutting areas needed to ensure the success of these efforts, such as addressing nutrition and health disparities across the US.

What to eat and the effects of food and nutrition. Strategic goal 1 calls for basic and methodological research in nutrition science through integrated connections with other fields of study such as bioinformatics, neurobiology, and genomics. Point-of-care devices such as wearable nutrient monitors and mobile technologies to measure diet, genome, and microbiome information will help assess relationships much more accurately among dietary

Corresponding Author: Francis S. Collins, MD, PhD, Office of the Director, National Institutes of Health, One Center Drive, Bldg 1, Room 126, Bethesda, MD 20892 (collinsf@od.nih.gov).

Box. 2020-2030 Strategic Plan for NIH Nutrition Research**Vision for the Future: Precision Nutrition for All****Strategic Goals for Answering Key Questions^a**

- 1: Spur discovery and innovation through foundational research
 - To answer the key question "What do we eat and how does it affect us?"
- 2: Investigate the role of dietary patterns and behaviors for optimal health
 - To answer the key question "What and when should we eat?"
- 3: Define the role of nutrition across the lifespan for healthy development and aging
 - To answer the key question "How does what we eat promote health across our lifespan?"
- 4: Reduce the burden of disease in clinical settings
 - To answer the key question "How can we improve the use of food as medicine?"

^a Cross-cutting research areas are relevant to all strategic goals described in this plan: minority health and health disparities; health of women; rigor and reproducibility; data science, systems science, and artificial intelligence; and training the nutrition scientific workforce.

intake, genomics, and microbial influences on health and disease, thereby strengthening the evidence base for developing comprehensive dietary guidelines and strategies.³

What and when to eat? Strategic goal 2 recognizes the emergence of innovative methods to assess eating and nutritional status in real time. Controlled feeding studies embedded within cohort investigations will help overcome well-known limitations of self-reporting methods. In addition, artificial intelligence/machine learning methods could serve to advance knowledge through their ability to detect patterns in huge existing and forthcoming data sets toward understanding individual variation in health outcomes associated with dietary intake, dynamic eating behaviors, and innate physiological processes.

How does nutrition promote health across the lifespan? Strategic goal 3 addresses how nutritional needs and eating behaviors change over time. Evidence supporting the developmental origins of health and disease theory suggests that nutritional, environmental, and microbial exposures beginning periconceptually can have profound effects on health and disease outcomes later in life, potentially with intergenerational implications.⁴ Despite the importance of diet, key gaps remain. For example, the composition of human milk (including the poorly understood role of the microbiome) varies substantially among women and changes over time, and better understanding of these

variations and their effects are needed. In addition, comparatively little is known about how nutrition can be leveraged to improve age-related cognitive decline, frailty, mental health disorders, social isolation, and changes in eating behaviors.

How to improve use of food as medicine? Research on the field of precision nutrition will help increase understanding of the therapeutic relationships among food, medications, and a wide range of health conditions and diseases. Research within strategic goal 4 could have substantial clinical value toward development of standardized and core measures to evaluate clinical nutrition support practices and to determine their effects on health outcomes. Appreciating the contribution of interindividual variation will be essential for making accurate and effective treatment decisions.

Moving Ahead

Implementation of the *2020-2030 Strategic Plan for NIH Nutrition Research* has the potential to transform nutrition science. Precision nutrition represents a comprehensive, holistic approach to investigate the role of nutrition and health as the complex system it is. Its multidimensional focus on answering challenging questions about what, when, where, how, and why to eat is emblematic of the convergence of biomedical science as an interdisciplinary endeavor. Identification and applications of new technologies and diverse ways of thinking about nutrition science, including inviting diverse expertise and innovative research strategies, should help ensure equitable distribution of the fruits of nutrition science.

More specifically, the proposed NIH Common Fund initiative would generate a community resource for discovery and validation of novel algorithms related to the science of precision nutrition.⁵ The NIH obtained public input on challenges and opportunities related to precision nutrition research through a recent request for information notice.⁶ While efforts will build on these large, NIH-led projects and results from past efforts such as the Human Genome Project and Human Microbiome Project, the success of studies focusing on the field of precision nutrition will rely largely on momentum from investigator-initiated studies driving biomedical research and fostering multidisciplinary training of the next generation of researchers.

Implementing the bold vision of the precision nutrition field as a research framework will guide nutrition science over the next 10 years into new territory, with exciting potential to untangle the complex internal and external factors that shape the role of diet in overall health. Together with partners across the federal government and the wider community of researchers, the goal is to bring to fruition the promise of the science of precision nutrition and advance understanding of the vitality of food in health.

ARTICLE INFORMATION

Conflict of Interest Disclosures: None reported.

Published Online: August 7, 2020.
doi:10.1001/jama.2020.13601

Additional Contributions: NIH Nutrition Research Task Force cochairs include Griffin P. Rodgers, MD; Francis S. Collins, MD, PhD; Diana W. Bianchi, MD; Gary H. Gibbons, MD; Norman E. Sharpless, MD; Christopher J. Lynch, PhD, is executive director.

REFERENCES

1. US Department of Health & Human Services; National Institutes of Health. *2020-2030 Strategic Plan for NIH Nutrition Research*. Published May 2020. Accessed May 27, 2020. <https://www.niddk.nih.gov/about-niddk/strategic-plans-reports/strategic-plan-nih-nutrition-research>
2. Centers for Disease Control and Prevention (CDC). Health and Economic Costs of Chronic Diseases. Updated March 23, 2020. Accessed August 5, 2020. <https://www.cdc.gov/chronicdisease/about/costs/index.htm>
3. Shan Z, Rehm CD, Rogers G, et al. Trends in dietary carbohydrate, protein, and fat intake and diet quality among US adults, 1999-2016. *JAMA*. 2019;322(12):1178-1187. doi:10.1001/jama.2019.13771
4. Gillman MW. Developmental origins of health and disease. *N Engl J Med*. 2005;353(17):1848-1850. doi:10.1056/NEJMe058187
5. Common Fund Program Lifecycle. Accessed May 5, 2020. <https://commonfund.nih.gov/planningactivities/overview-planning>
6. Request for Information: Challenges and Opportunities in Precision Nutrition Research. Notice No. NOT-RM-20-017. Accessed May 12, 2020. <https://grants.nih.gov/grants/guide/notice-files/NOT-RM-20-017.html>