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More Nutrition Precision, Better Decisions for the Health of Our Nation

Patrick J Stover[1] and Janet C King[2]

[1]Vice Chancellor and Dean for Agriculture and Life Sciences, Texas A&M AgriLife, College Station, TX, USA; and [2]Professor of Graduate School, University of California, Berkeley, CA, USA

ABSTRACT

Nutritional science is evolving to an enhanced emphasis on recent scientific and technological advancements supporting a transition to precision nutrition as a strategy for disease prevention and management across populations. The complexity of chronic disease, which afflicts 6 in 10 adult Americans, is highlighted in the diet–disease relation where it is apparent that there is no "one size fits all" approach to disease management. Precision nutrition is the study of how individuals respond differently to food and nutrients, and it leads to personalized or classified, evidence-based guidelines that represent the best approach for fighting chronic disease. Enhanced resources are imperative as we transition to a precision nutrition approach that will transform agriculture and nutritional science to support positive health outcomes. Both the USDA and the NIH recognize the need to prioritize research and funding on precision nutrition. Increased federal investment in this realm is critical as we look ahead; it will help lower health care costs, while supporting individual health and quality of life. *J Nutr* 2020;150:3058–3060.

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Leading dietary guidance in the USA is based on the premise that Americans are healthy. Yet, a 2017 RAND Corporation report revealed that 6 in 10 adult Americans had ≥1 chronic health condition, and 40% had >1 (1). Although chronic diseases are complex traits and multifactorial, we know diet is an underlying and modifiable risk factor associated with many chronic diseases. We also know the interaction goes both ways – disease modifies nutrient and food needs (2). Through greater investment in precision nutrition, diet can be a solution to disease prevention and management – food as medicine.

Both the USDA (3) and now the NIH (4) have articulated the need for a focus on precision nutrition – the study of how people respond differently to food and nutrients and how genetics, epigenetics, age, gender, and disease status affect these responses. As Rodgers and Collins recently noted when referring to the 2020–2030 Strategic Plan for NIH Nutrition Research, "Implementing the bold vision of the precision nutrition field as a research framework will guide nutrition science over the next 10 y into new territory, with exciting potential to untangle the complex internal and external factors that shape the role of diet in overall health" (5). Several higher education institutions strongly support these agencies prioritizing precision nutrition research and believe that investments in precision nutrition will shape the role nutrition plays in lowering health care costs, improving the overall health of the American public, and ensuring the sustainability of our food system for future generations.

The Evolution of Nutrition

Over the past 50 y, the field of nutrition accomplished great strides in addressing diseases of nutrient deficiency, which led to the establishment of dietary recommendations and food policies. However, given the burden of diet-related chronic disease and its impact on health care costs, economic productivity, and now population vulnerability to Coronavirus Disease 2019 (COVID-19), we are challenged to prevent and manage nutrition-related chronic diseases through diet.

The challenge is daunting – nutrient deficiencies manifest the same symptoms in most individuals, whereas chronic diseases are multifactorial complex traits determined by numerous environmental and individual endogenous biological factors that manifest over a lifetime. Also, nutrient needs vary as a function of our biological individuality and change throughout the life cycle. This variability results in responders and nonresponders to dietary interventions, which indicates that we need to develop new approaches to understanding the complex diet-disease relation. Population averages are of limited use when determining dietary needs for an individual when chronic disease endpoints are used. Recommendations based upon averages don't reflect the biological dynamics of dietary needs that vary among individuals and change over a lifetime. Both

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Address correspondence to PS (e-mail: Patrick.Stover@ag.tamu.edu).

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the USDA and NIH strategic plans acknowledge we must seek new approaches to meet the new expectations and let the science lead us.

The "Nature versus Nurture" debate that began over 2000 y ago has recently settled mostly in a draw with the understanding that these interrelated factors of genetics and environment don't function independently (6). Nutrition and infections are strong environmental factors that challenge survival and are excellent examples of the significant interplay between the environment and genetics. Throughout history, humans have metabolically adapted to meet their nutrition needs based upon the available food supply. Our ancestry and environment affect the many complex systems within our body, leading to tremendous population diversity. This diversity is encoded in our genomes, including historical references to how our immune system responds to a pathogen and how we metabolize available food. Individuals are adapted to their ancestral environments, but not to new environments – including changes in the food system and novel pathogens. COVID-19, with its array of symptoms affecting individuals to various degrees, highlights the fact that there is no "one size fits all" to disease impact, nor to its prevention and treatment. Infectious diseases, such as COVID-19, have complex phenotypes with a wide range of biological responses, and likewise for diet-related diseases (7). New measures, tools, and tactics are needed to go deep within the phenotypes to better understand the etiology of disease and complex interactions among food components and our physiological and pathophysiological responses to environment.

The Potential of Precision Nutrition

A variety of diets can lead to positive health outcomes, but exactly which diet(s) is best for an individual and how this changes throughout the life cycle is revealed through assessments that may include many of the -omics (i.e., nutrigenomics, transcriptomics, metabolomics, metagenomics, etc.) (8). Individual responses to nutrition and their impact throughout the lifespan are modified by a variety of factors such as ancestral heritage, environment, age, nutrition status, stress, sleep, gut bacteria, disease state, among other factors. Importantly, the behavioral component of nutrition and exposure factors adds additional elements of complexity to the diet-disease relation. Guidelines and advice based on the best science won't improve the health of the population unless they are accepted and adopted in free-living people. Hence, for precision nutrition to be effective, biological individuality must be assessed in the context of dietary behavioral factors in nutrition studies. "Real-world" experiments that capture both the biological and behavioral dimensions of the diet-disease relation cannot be studied in isolation as they have the potential to mutually reinforce each other.

One of the primary goals of precision nutrition is to provide tailored dietary advice with an anticipated individualized response (7). While a growing body of evidence supports the need for precision medicine for optimal individual health and the management of chronic disease, significant effects in "personalized," "individualized," or "precision" nutritional interventions are less frequent as clinical evidence supporting such interventions is unavailable (8). Successful implementation of precision nutrition first requires a significant investment of resources and funds, which both the USDA and NIH have indicated are priorities.

The payoff of the investment in precision nutrition will be measured in terms of savings from rising health care costs seemingly unhindered by population-based recommendations, as well as improved quality of life and decreased morbidity. The development and refinement of point-of-care and other diagnostic tools and the creation and deployment of studies used to assist in providing more tailored interventions, though costly at the outset, may be more cost-effective in the long-run in terms of public health and health economics than generalized guidelines based upon an assumed "average" healthy population. Precision nutrition offers the opportunity to achieve intervention outcomes through better – and more precise – clinical and public health decision-making.

Enhanced Resources Will Move Us Forward

Focused funding and prioritization of precision nutrition will allow us to execute studies in real-time in a real-world environment that consider the complexity of diet interventions and measure the efficacy of these interventions in meaningful ways. Clinicians and researchers will begin to better understand what motivates or enables individuals to make healthy lifestyle changes, including real-time feedback on their health status. Within the context of research, regular monitoring using meaningful and accurate measures in the real-world could enhance our ability to predict biological as well as behavioral response patterns, and to identify subgroups in the diet-disease relation (9). As accessibility of the technologies grows and data are shared to understand population subgroups who behave similarly in the diet-disease relation, our impact on the most at-risk minority populations and communities that suffer the brunt of the chronic disease burden will grow exponentially.

Personalized dietary guidance based on individualized factors will require support from the highest levels of USDA and NIH. The conclusion of the recently published Personalized Responses to Dietary Composition Trial (PREDICT) I study (9), which enrolled over 1100 twins and unrelated, healthy adults in the USA and UK and found an individual's gut microbiota was predictive of their cardiometabolic indicators and personalized responses to food, further challenges the logic of standardized, population-based dietary recommendations and suggests, instead, population-wide precision nutrition as a strategy for disease prevention. Precision nutrition will transform nutrition science to support positive health outcomes in a way we have never been able to do before. Investments in the future of nutrition science, particularly around precision nutrition, are critical to the long-term health of our nation, allowing us to reduce health care costs, improve individual health, and support a responsive food system. Now, more than ever, we must advance the field of nutrition science with better research and set higher expectations for what our field can deliver for the health of Americans.

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