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Applicability of Systems Science Approaches to the *Dietary Guidelines for Americans*

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Applicability of Systems Science Approaches to the *Dietary Guidelines for Americans*

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Authors

Lila Gutuskey
Rachel Neenan
Ross A. Hammond
Hilary Wagner

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U.S. Department of Agriculture
Food and Nutrition Service
1320 Braddock Place
Alexandria, VA 22314

Project Officer

Meghan Adler

Submitted by

Westat Insight
1310 North Courthouse Road
Suite 880
Arlington, VA 22201

Project Director

Hilary Wagner

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See appendix B for biographies of these workshop participants.

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Executive Summary

Every 5 years since 1980, the U.S. Department of Agriculture (USDA) and the U.S. Department of Health and Human Services (HHS) jointly issue the *Dietary Guidelines for Americans* (*Dietary Guidelines*), the cornerstone of Federal food and nutrition guidance. The *Dietary Guidelines* provide advice on what to eat and drink to meet nutrient needs, promote health, and prevent disease based on current nutrition science. The *Dietary Guidelines* document is a resource for health professionals, policymakers, and nutrition educators when providing nutrition guidance to the public or developing programs, policies, or communications. Federal programs are required to promote the *Dietary Guideline*s when carrying out any Federal food, nutrition, or health program.

In 2017, the National Academies of Science, Engineering, and Medicine (NASEM) published a report resulting from a congressional mandate to examine and suggest improvements to the process used to develop the *Dietary Guidelines* (NASEM, 2017). The report included a recommendation to the Secretaries of USDA and HHS to commission research and evaluate strategies to develop and implement systems approaches into the development of the *Dietary Guidelines*. After the release of the *Dietary Guidelines for Americans, 2020–2025*, Congress directed USDA to contract with NASEM to compare the process of developing the most recent *Dietary Guidelines* with the 2017 NASEM recommendations. That NASEM study, released in 2023, discussed the benefits of incorporating systems science approaches in the development of the *Dietary Guidelines* (NASEM, 2023). Report authors noted that systems science approaches are well suited to explore the dynamic, multifaceted systems and environments that affect the relationship between diet and health. They also suggested that applying systems science approaches to the *Dietary Guidelines* process could increase transparency in how the guidelines are developed and efficiency in how each *Dietary Guidelines* edition builds on the prior edition.

Systems science (sometimes called “complex systems science” or “complexity science”) refers to a set of methods designed to explore the relationships between various interconnected parts of complex systems. When relationships between parts of a system are clear and direct (e.g., a change in factor A results in an immediate, proportional change in factor B), standard analysis tools are typically adequate to help understand the factors at play. In complex systems, however, subtle relationships, ripple effects, time delays, moderating factors, or effects that occur only under certain conditions may be apparent. Systems science approaches are designed to account for, describe, and identify these types of complex relationships. Recognizing that many problems in population health have some or all of these characteristics, six studies (IOM [Institute of Medicine], 2012; IOM & National Research Council, 2015; NASEM, 2015; 2016; 2017; 2023) highlight the importance of systems science as a complement to standard analytical approaches, including two studies focused on the *Dietary Guidelines* and one focused on the food system (Institute of Medicine & National Research Council, 2015). A subsection of the *Healthy People 2030* report also focuses on systems science (Pronk et al., 2020).

In September 2022, the USDA Food and Nutrition Service’s Center for Nutrition Policy and Promotion (CNPP) contracted with Westat Insight to develop a comprehensive report with options to integrate systems science approaches into the *Dietary Guidelines* process. The main data source for the report was a workshop Westat Insight convened with thought leaders in systems science, nutrition, and public health. This report does not provide recommendations but serves as a summary of the discussions and ideas experts generated during that workshop.

In alignment with the NASEM report recommendations, experts focused on sharing and building out ideas for how systems science approaches could potentially be applied to the *Dietary Guidelines* process as it is currently structured and in the future as the field of systems science and its application to

nutrition research continues to grow. Broader questions, such as how other possible approaches might compare, were not a focus of this workshop. The workshop was not designed to comprehensively address the strategic or practical considerations needed to alter the *Dietary Guidelines* process. Though experts prioritized ideas in the course of group discussion, the workshop was not a formal process for consensus-building around a specific idea or set of ideas. Ideas not prioritized for further discussion may still be considered feasible or beneficial.

Workshop co-chairs encouraged experts to "think big," with a focus on how systems science could best contribute to the *Dietary Guidelines* process and purpose. During discussions to generate ideas, experts were instructed not to limit their contributions based on time or cost considerations. Recognizing that systems science research in the nutrition field is in its infancy, experts were also encouraged to think beyond what is possible with currently available data and research. They were to envision what systems science approaches could contribute to the *Dietary Guidelines* process or the field of nutrition science more broadly in the future as the systems science evidence base and supporting technologies continue to develop. Though the focus of the workshop was on *Dietary Guidelines* development, experts were not limited to development-related ideas alone, and they shared options related to *Dietary Guidelines* dissemination and implementation. Options identified in this report may interact with other relevant Federal efforts that share a similar mission to equitably prevent disease and promote health through nutrition.

Experts prioritized six action strategies during the 2-day workshop (figure ES-1). The six strategies vary in the entities responsible and partners required to carry out the strategy, the necessary timeline and costs, and the benefits to the *Dietary Guidelines* process. Strategies also vary in how directly they align with suggestions from 2017 and 2023 NASEM reports on ways systems science approaches could benefit the *Dietary Guidelines* process.

Figure ES-1. How Systems Science Research Could Contribute to Dietary Guidelines Development and Implementation Processes—Six Strategies Workshop Experts Identified

Experts prioritized six action strategies for how systems science can influence the *Dietary Guidelines* process:

1. Add scientific questions informed by ongoing systems science research (Step 1)
2. Use systems science methods to complement or augment existing methods used in scientific evidence review (Step 3)
3. Include systems science experts in *Dietary Guidelines* development (Steps 1–4)
4. Inform implementation efforts, which might also inform future iterations of *Dietary Guidelines* development (Step 5)
5. Consider the *Dietary Guidelines* process as a system that can be modeled for better understanding (Steps 1–5)
6. Generate systems science research that could inform future iterations of *Dietary Guidelines* development

An overview of each strategy follows:

- **Strategy 1. Add scientific questions informed by ongoing systems science research.** Systems science offers a different perspective that can complement standard analytic approaches. Systems science approaches can identify new questions to consider in step 1 (Identify scientific questions) of the *Dietary Guidelines* process. Experts discussed three example topics for new scientific questions:
  - Identifying which system structures have the most influence
  - Connecting the *Dietary Guidelines* to broader systems factors
  - Using new approaches to consider intrapersonal biological aspects of nutrition and diet
- **Strategy 2. Use systems science methods to complement or augment existing methods used in scientific evidence review.** Step 3 of the *Dietary Guidelines* process (Scientific evidence review) does not currently consider the types of evidence resulting from systems science research (e.g., models, maps, simulations). Broadening the types of scientific methodologies used in the scientific evidence review beyond systematic review, food pattern modeling, and data analysis would better enable the inclusion of systems science research. Models, for example, are well suited for capturing dynamics and heterogeneity across context and time. Systems science models provide insights into potential causal mechanisms, which can then be used to extrapolate findings from a randomized controlled trial in a limited population and timeframe to a broader range of population settings and timeframes.
- **Strategy 3. Include systems science experts in *Dietary Guidelines* development.** Systems science methods come with their own best practices, limitations, and considerations, which have been the subject of previous related reports by NASEM and HHS. One approach involves adding experts as members of the Dietary Guidelines Advisory Committee (Advisory Committee); as staff engaged in all steps of the *Dietary Guidelines* process; or as consultants engaged as needed to appropriately identify, assess, and consider evidence generated by systems science research. The relative costs are lower and the timeline is shorter for this strategy compared with the other five. Many of the action strategies described here would require this type of expertise.
- **Strategy 4. Inform implementation efforts, which might also inform future iterations of *Dietary Guidelines* development.** Overall, adherence to the *Dietary Guidelines* among the U.S. population is suboptimal. The primary audiences for the *Dietary Guidelines* are intermediaries who use the recommendations to inform programs, systems, policies, and environments that serve the U.S. population. Systems science models can support implementation efforts (step 5 of the *Dietary Guidelines* process) by informing the programs and interventions that use the *Dietary Guidelines*. Information generated through implementation research could inform future cycles of the *Dietary Guidelines*. Experts provided the following examples of how systems science models could support implementation of the *Dietary Guidelines*:
  - Modeling to customize programs and interventions for specific subpopulations
  - Modeling points of resistance to implementation of the *Dietary Guidelines*
  - Communicating the *Dietary Guidelines*
  - Simulation modeling to develop interactive decision tools for consumers
  - Modeling with simulated cohorts to identify implementation gaps
  - Simulation modeling of barriers to individual diet alignment with the *Dietary Guidelines*

- **Strategy 5. Consider the *Dietary Guidelines* process as a system that can be modeled for better understanding.** Activities and processes related to the *Dietary Guidelines* can be viewed as one large, interconnected system. This system could be described, explored, and potentially improved by creating a systems model. Through group model building, experts could identify the inputs, stakeholders, factors, and decision points involved in the development and implementation processes of the *Dietary Guidelines*. The model could help facilitate a common understanding of the processes, determine current gaps and leverage points, and visualize connections across involved actors and agencies.
- **Strategy 6. Generate systems science research that could inform future iterations of *Dietary Guidelines* development.** The use of systems methods to explore nutrition science is a growing but nascent field. As researchers continue to use systems methods to explore nutrition science and the evidence base expands, more information will be available to Advisory Committee members and Federal staff when they review evidence and develop recommendations. Workshop participants discussed several areas where additional systems science research would be particularly valuable:
  - Simulation modeling of the broader food systems in relation of the *Dietary Guidelines*
  - Economic modeling of a sustainable marketplace for food
  - Modeling to examine how practical or sustainable *Dietary Guidelines* recommendations are for Americans to follow

Chapter 1. Introduction

Every 5 years since 1980, the U.S. Department of Agriculture (USDA) and the U.S. Department of Health and Human Services (HHS) jointly issue the *Dietary Guidelines for Americans* (*Dietary Guidelines*), the cornerstone of Federal food and nutrition guidance. Within the USDA Food and Nutrition Service (FNS), the Center for Nutrition Policy and Promotion (CNPP) leads the development of the *Dietary Guidelines*. CNPP works closely with the HHS Office of the Assistant Secretary for Health's Office of Disease Prevention and Health Promotion (ODPHP) to meet this joint mandate.

The *Dietary Guidelines* provide advice on what to eat and drink to meet nutrient needs, promote health, and prevent disease based on current nutrition science. The *Dietary Guidelines* are a resource for health professionals, policymakers, and nutrition educators when providing nutrition guidance to the public or developing programs, policies, or communications. Federal agencies are required to promote the *Dietary Guidelines* when carrying out any Federal food, nutrition, or health program. The current *Dietary Guidelines, 2020–2025*, cover dietary patterns for each life stage from infancy to older adulthood and include guidance for individuals who are pregnant or lactating. Although the *Dietary Guidelines* guidance is not intended as clinical advice for treating chronic diseases, it often serves as a reference point for Federal, medical, voluntary, and patient care organizations as they develop clinical nutrition guidance.

In September 2022, FNS contracted with Westat Insight to develop a comprehensive report with key findings and options to integrate systems science approaches into the *Dietary Guidelines* process. The main data source for the report was a workshop Westat Insight convened with thought leaders in systems science, nutrition, and public health.

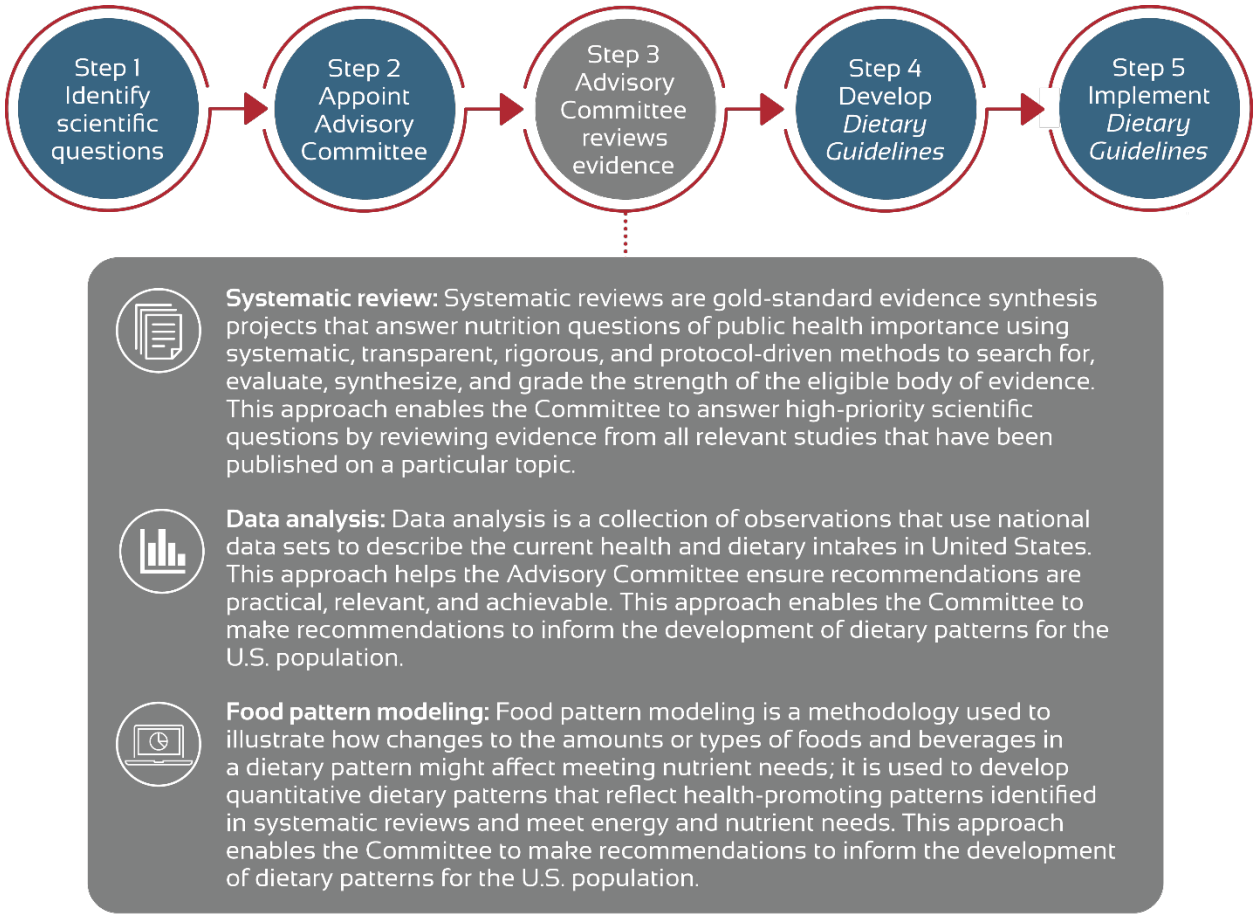
Dietary Guidelines Process

The *Dietary Guidelines* process includes five main steps (see figure 1). First, USDA and HHS propose scientific questions and topics for the public and an advisory committee to consider (step 1). Next, USDA and HHS convene an external Dietary Guidelines Advisory Committee (Advisory Committee) composed of experts nominated by the public (step 2). This Advisory Committee develops a scientific report based on its review and consideration of current nutrition science (step 3).

The Advisory Committee uses three complementary methods to review the scientific evidence: systematic reviews, food pattern modeling, and data analysis. Food pattern modeling and systematic review methodologies were introduced into the process with the 2005 and 2010 Advisory Committees, respectively (figure 1). USDA and HHS continue to improve and enhance these methods over time to ensure they are rigorous and state of the art (see figures 1 and 2).

The Advisory Committee's scientific report provides independent, science-based advice to inform USDA and HHS's development of the *Dietary Guidelines* (step 4). The final step (step 5) is the implementation of the new *Dietary Guidelines* by nutrition policymakers, programs, and health professionals.

Figure 1. Dietary Guidelines Process



Source: Adapted from *Dietary Guidelines for Americans*. (n.d.). *Work under way*. https://www.dietaryguidelines.gov/examine-evidence

Recommendations of National Academies of Sciences, Engineering, and Medicine Reports

The National Academies of Sciences, Engineering, and Medicine (NASEM) are private, nonprofit institutions that provide "independent, objective advice to inform policy with evidence, spark progress and innovation, and confront challenging issues for the benefit of society" (NASEM, n.d.). In 2017, an expert committee that NASEM convened published a report based on a congressional mandate to examine and suggest improvements to the process used to update the *Dietary Guidelines* (NASEM, 2017). The 2017 NASEM report noted that further growth in the use of systems science tools in nutrition science would increase the evidence base to facilitate deeper integration into the *Dietary Guidelines* process.

> "The secretaries of USDA and HHS should commission research and evaluate strategies to develop and implement systems approaches into the DGA. The selected strategies should then begin to be used to integrate systems mapping and modeling into the DGA process" (NASEM, 2017, p. 91).

After the release of the *Dietary Guidelines for Americans, 2020–2025*, Congress requested a study to compare the most recent *Dietary Guidelines* development process with the 2017 NASEM recommendations. In that report, released by NASEM in 2023, the authors discussed the benefits of incorporating systems science approaches in two areas (NASEM, 2023):

- **Apply systems science approaches to explore the relationship between diet and health.** Systems science methods are well suited to represent the complex, multifactorial systems and environmental factors that surround diet and health. These approaches can be used to clarify causal mechanisms, identify relationships, and support precision nutrition by developing recommendations for diverse subpopulations.
- **Apply systems science approaches to the *Dietary Guidelines* process.** The process used to develop and implement the *Dietary Guidelines* could be considered a system itself. Applying systems science methodologies to the *Dietary Guidelines* "system" could increase transparency of how the guidelines are developed and implemented. This approach could also help guide and prioritize future research, investments, and changes in *Dietary Guidelines* development and implementation efforts.

Systems Science Overview

Systems science (sometimes called "complex systems science" or "complexity science") refers to a set of methods designed to explore the relationships among various interconnected parts of complex systems. When relationships between parts of a system are clear and direct (e.g., a change in factor A results in an immediate, proportional change in factor B), standard analysis tools are typically adequate to help us understand the factors at play. In complex systems, however, subtle relationships, ripple effects, time delays, moderating factors, or effects that occur only under certain conditions may be apparent.

Systems science approaches are designed to account for, describe, and identify these complex relationships. Recognizing that many problems in population health have some or all of these characteristics, six studies (IOM [Institute of Medicine], 2012; IOM & National Research Council, 2015; NASEM, 2015; 2016; 2017; 2023) highlight the importance of systems science as a complement to standard analytical approaches. A subsection of the *Healthy People 2030* report also focuses on systems science (Pronk et al., 2020). Table 1 describes four common systems science methods.

Table 1. Systems Science Methods Commonly Used in Health Sciences

Method	Description
Network analysis	Network analysis is a set of techniques for describing and analyzing relationships ("ties") among individual elements of a system ("nodes"). In the context of nutrition, nodes could be people in a social network but could also be statistical relationships between energy and nutrient intake, for example. By examining the structure of a network, network analysis provides insight into how these relationships may affect outcomes or processes that play out across them. Network analysis is especially well suited when relational data can be collected or created from available evidence and when research questions are focused on how network structure relates to outcomes or dynamics.

Method	Description
Agent-based modeling	Agent-based modeling is an approach for simulating dynamics that occur when individual actors ("agents") in a system interact with one another, generating trajectories through time and population-level patterns. Agent-based modeling can help uncover mechanisms that may be driving patterns or statistical relationships observed empirically and can also be used as a "policy laboratory" for understanding the potential consequences (intended or unintended) of interventions. Agent-based modeling is especially well suited when the research questions involve extensive heterogeneity across individuals or contexts, or the dynamics are likely to involve significant adaptation through time.
System dynamics modeling	System dynamics modeling represents the overall structure of a system using a set of constructs representing accumulation ("stocks"), dynamics ("flows"), and feedback. In a system dynamics model, simulation is used to understand how the system structure shapes dynamics and opportunities for intervention. System dynamics modeling is particularly advantageous when the research goals involve capturing the broadest possible subset of the underlying system or when feedback cycles are well defined and central to the outcomes.
Group model building	In contrast to the three previously described techniques, group model building is a qualitative technique. Like system dynamics modeling, it aims to represent the structure of a system to gain insight, but it does so visually and is often participatory in nature. Group model building produces "system maps" that can help interested parties depict the many interacting elements of a system, build consensus about this structure, and identify potential places where change may be beneficial. Group model building is useful in its own right and is also often a valuable precursor or complement to one of the quantitative modeling techniques above.

Chapter 2. Project Approach

In September 2022, FNS contracted with Westat Insight to examine potential ways to integrate systems science approaches into the *Dietary Guidelines*. To meet this objective, Westat Insight convened a group of thought leaders in systems science, nutrition, and public health. The Westat Insight and FNS Center for Nutrition Policy and Promotion (CNPP) project teams recruited Dr. Ross Hammond, an expert in public health systems science approaches, to co-chair the workshop with Dr. Lila Gutuskey, a Westat Insight expert in engagement of interested parties and group facilitation.

Project Objectives

- Explore potential options to incorporate systems science into the process to develop the *Dietary Guidelines*.
- Determine the applicability and feasibility of the proposed options to improve *Dietary Guidelines* process.
- Identify the steps and resources needed for any feasible, applicable, and beneficial options.

Experts

The project team, including Dr. Ross Hammond, identified a group of experts diverse in race, geography, and expertise and submitted the list for CNPP review. Some experts had been members of past Advisory Committee and NASEM committees. CNPP sent invitations to 26 experts; 16 agreed to participate in the workshop. One expert could attend only the first day of the workshop, and one expert could attend only the second day of the workshop, resulting in a total of 15 attendees present each day. Appendix B includes biographies of experts who participated in the workshop, and appendix C lists documents the project team asked experts to review before attending the workshop.

Workshop

The workshop was held in Washington, DC, March 29–30, 2023. On Day 1, CNPP staff presented information on the *Dietary Guidelines* process, and contributors to the 2017 and 2023 NASEM reports shared an overview of the systems science-related recommendations in those reports. Experts then met in large and small groups to generate ideas on how systems science approaches could inform the *Dietary Guidelines* process and discussed how to categorize those ideas.

Day 2 of the workshop was divided into two main sessions. In the morning, experts discussed options for incorporating systems science into the three approaches the Advisory Committee uses in step 3 of the *Dietary Guidelines* process to review nutrition evidence: systematic review, data analysis, and food pattern modeling. In the afternoon, experts discussed options for incorporating systems science approaches across all five steps of the *Dietary Guidelines* process.

Each session involved *idea generation* and *idea buildout*. First, experts took turns sharing ideas and briefly describing them during *idea generation*. Note takers documented the ideas and displayed them on dry-erase sheets throughout the room. The experts reviewed all listed ideas and voted for those they considered most

Focus of Idea Buildout

- Who would carry out the strategy (e.g., systems science researchers, the Dietary Guidelines Advisory Committee, CNPP/ODPHP staff, other Federal agencies)?
- What are the benefits, challenges, and resources needed to carry out the strategy?
- What are the relative time and cost needs across strategies?

promising and useful for incorporating systems science into the *Dietary Guidelines*. The experts were instructed to cast three votes; they could cast all their votes on a single idea or spread them across several ideas. After tallying the votes, the group discussed the top two or three ideas from each session in depth during *idea buildou*t, with a focus on how each idea intersects with the *Dietary Guidelines* and practical considerations for implementation (see text box).

The workshop co-chairs encouraged experts to "think big," with a focus on how systems science could best contribute to the *Dietary Guidelines* process and purpose in its entirety. During idea generation discussions, experts were instructed not to limit their contributions based on time or cost considerations. They were also encouraged to think beyond what was possible with currently available data and research to envision what systems science approaches could contribute to the *Dietary Guidelines* process, or the field of nutrition science more broadly, in the future. Experts were not limited to development-related ideas alone and also shared options related to *Dietary Guidelines* dissemination and implementation.

Review and Analysis

The project team reviewed the ideas experts generated during the workshop to identify common themes, with a focus on ideas that received the most votes and discussion time. The study team grouped related ideas into six broad categories of action strategies based on the intersection of the ideas with the *Dietary Guidelines* process. Chapter 3 describes these six strategies and related examples. Chapter 4 discusses information and context related to the application of these strategies and their relevance to the *Dietary Guidelines* development and implementation processes. Appendix A presents ideas generated during the workshop that received fewer votes or less discussion time or did not have a clear overlap with the six action strategies that were prioritized.

Workshop co-chair and systems science expert Dr. Hammond supported the project team in reviewing and categorizing ideas generated during the workshop and coauthored this report. To ensure the report accurately reflects workshop discussions, nine workshop attendees provided feedback on an early draft of the report. Four attendees reviewed the full draft report, and five reviewed only the draft executive summary.

Limitations

Consistent with the NASEM report recommendations, the project team asked experts to focus on identifying and building out potential ways systems science could be applied to the *Dietary Guidelines*. Broader questions were outside the scope of the workshop, such as how the benefits of incorporating systems science approaches might compare with the benefits of incorporating other new methodologies.

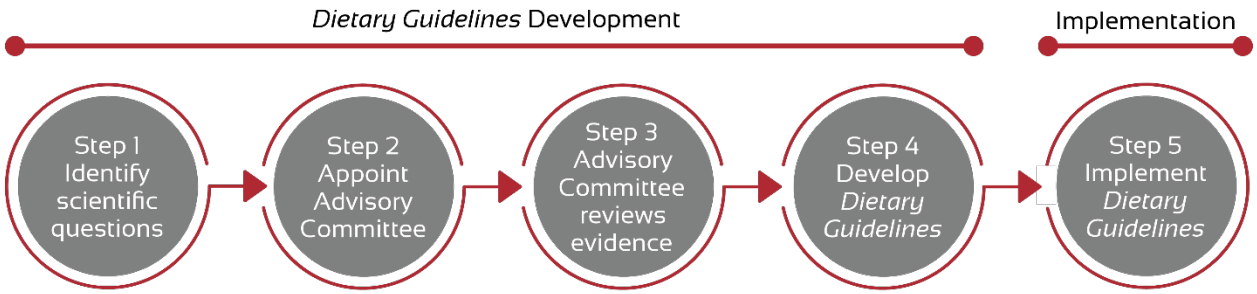
This report is based solely on expert opinions documented through workshop proceedings. Not all voices and opinions were present at the workshop. For example, one invited expert declined to attend the workshop because they were not convinced it was appropriate to apply a systems modeling approach to the *Dietary Guidelines*, arguing that understanding what factors influence eating behaviors will not necessarily change recommendations on what to eat for optimal health.

This report is not meant to provide recommendations to any group or organization, and the workshop was not designed to build formal consensus on a specific idea or set of ideas. Ideas that workshop members did not prioritize appear in appendix A.

Chapter 3. Action Strategies

Over the course of the 2-day workshop, experts prioritized six action strategies (figure 2) and identified specific approaches related to each. This chapter describes the six action strategies and approaches generated during workshop discussions. Appendix A includes additional ideas generated during the workshop that were not prioritized by experts and are not otherwise discussed in this report.

Figure 2. How Systems Science Research Could Contribute to Dietary Guidelines Development and Implementation Processes—Six Strategies Workshop Experts Identified



Experts prioritized six action strategies for how systems science can influence the *Dietary Guidelines* process:

1. Add scientific questions informed by ongoing systems science research (Step 1)
2. Use systems science methods to complement or augment existing methods used in scientific evidence review (Step 3)
3. Include systems science experts in *Dietary Guidelines* development (Steps 1–4)
4. Inform implementation efforts, which might also inform future iterations of *Dietary Guidelines* development (Step 5)
5. Consider the *Dietary Guidelines* process as a system that can be modeled for better understanding (Steps 1–5)
6. Generate systems science research that could inform future iterations of *Dietary Guidelines* development

1. Add scientific questions informed by ongoing systems science research

Systems science offers a different perspective that can complement standard analytic approaches. Systems science approaches can identify new questions to consider in step 1 (Identify scientific questions) of the *Dietary Guidelines* process.

Experts discussed the following three examples:

- **Identify which system structures have the most influence.** Mechanistic models of dynamics can help identify system structures that have the most potential to influence dietary patterns, which can help identify and prioritize related evidence gaps. Identifying the most influential system structures could help focus data collection and evidence gathering on priority elements likely to provide the most insight. In other words, systems models could help identify data and questions that could be addressed using conventional analysis techniques already part of the *Dietary Guidelines* process.

- **Connect *Dietary Guidelines* to broader systems factors.** Upstream food system factors and downstream implementation factors influence people's dietary patterns and could be connected to *Dietary Guidelines*, as has been proposed in several previous NASEM reports (IOM, 2012; IOM & National Research Council, 2015). It may be useful for the Advisory Committee to consider different questions, such as those arising from systems perspectives and modeling that can be answered using either the current evidence review methods (*Dietary Guidelines* step 3) or through systems science approaches (see strategy 2).
- **Use new approaches to consider intrapersonal biological aspects of nutrition and diet.** Using systems science models in this way would generate novel questions about how diet quality influences future behaviors (e.g., how preferences or habits form or endure) (Hawkes et al., 2015). These questions could be answered using conventional evidence-review techniques (*Dietary Guidelines* step 3) or novel systems modeling (see strategy 2). Agent-based modeling would be especially well suited for this purpose.

2. Use systems science methods to complement or augment existing methods used in scientific evidence review

- Experts recognized that systems science evidence could benefit the development of the *Dietary Guidelines*. Simulation modeling of diets consumed by the U.S. population, including subpopulations, is being integrated for the first time in the current cycle of the *Dietary Guidelines* (i.e., 2025–2030) as part of food pattern modeling to evaluate the proposed patterns and improve representation of diverse dietary practices across the population. More broadly, the current inclusion criteria in the *Dietary Guidelines* scientific evidence review process (*Dietary Guidelines* step 3) do not readily accommodate the type of evidence (e.g., models, maps, simulations) resulting from systems science research. Broadening the types of evidence included in the scientific evidence review beyond randomized controlled trials and observational studies would better facilitate the inclusion of systems science research. Models, for example, are well suited for capturing dynamics and heterogeneity across context and time. Systems science models provide insights into potential causal mechanisms, which can then be used to extrapolate findings from a randomized controlled trial in a limited population and timeframe to a broader range of population settings and timeframes. Broadening the inclusion criteria would require systems science expertise to evaluate the quality of evidence (see strategy 3) but would enable the development process to benefit from relevant ongoing systems science research (see strategy 5).

Workshop participants also discussed several ways *Dietary Guidelines*-specific systems science modeling could complement the current step 3 methods:

- **Modeling to address data limitations.** Systems science models could be used to answer questions where data gaps prohibit standard food pattern modeling, or insufficient evidence is available to conduct systematic reviews. Current food pattern modeling methods could be applied to simulated data generated through systems science methods; for example, to help understand emerging topics such as the impact of low-carbohydrate diets or ultraprocessed foods. This approach is most aligned with the work being done in the current cycle of the *Dietary Guidelines.*

- **Modeling to project effects on subpopulations.** Dietary intake data sets examined during the development process for the *Dietary Guidelines* may have limited representation from subpopulations and vulnerable groups because of small sample sizes. Experts noted that because they can capture extensive heterogeneity rather than average effect, systems science methodologies could be used to model variability in dietary intakes, including for underrepresented populations. This information could be used to adjust the USDA dietary patterns in the *Dietary Guidelines*.
- **Modeling to consider longer time horizons.** Systems science methods could be used to explore how the body responds to changes in dietary intake over time, including dynamics and life course analyses. As described by experts during the workshop, these analyses could involve examining how contextual factors affect food choices, and how the relative importance of these contextual factors changes as a person ages (Reedy et al., 2017). Systems science techniques, such as agent-based and system dynamics modeling, could represent metabolic mechanisms and how diet changes influence—and are influenced by—metabolism over time. Experts noted that some systems science models have already examined dietary dynamics over time in relation to preference formation and early exposure to foods, and more work could be done in the future to advance an understanding of these factors. This information could feed into the food pattern modeling process currently used in step 3 of the *Dietary Guidelines* process. This approach would complement the current evidence-based approaches because it would involve examining how diet quality influences future behavior rather than examining dietary quality as the outcome.
- **Systems modeling to understand intrapersonal biological aspects of nutrition and health.** Experts noted that the relationship between diet and health is incredibly complex and multifactorial, with important heterogeneity across individuals, timepoints, and contexts. Systems science has already shown potential in understanding life course perspectives (including preference formation), simulating how effects may differ across populations, and capturing the importance of context on choices (Hawkes et al., 2015). Further advancement in this research opens the door to the potential recommendation of dietary patterns more customized to a diverse population (Reedy et al., 2017).

3. Include systems science experts in *Dietary Guidelines* development

To appropriately identify, assess, and consider evidence generated by systems science, it will be important to engage systems science experts in the *Dietary Guidelines* process. Systems science methods come with their own best practices, limitations, and considerations, which have been the subject of previous related reports (Hammond, 2015; IOM, 2012, appendix B; Pronk et al., 2020). Many of the action strategies described in this report would also require this type of expertise. Systems science experts could be added as members of the Advisory Committee (step 2), staff engaged in all steps of the *Dietary Guidelines* process, or consultants engaged as needed.

4. Inform implementation efforts, which might also inform future iterations of *Dietary Guidelines* development

Noting that overall rates of *Dietary Guidelines* adherence among the U.S. population have remained suboptimal, experts engaged in an extensive discussion of how systems science could inform efforts to improve healthy eating. The primary audiences for the *Dietary Guidelines* are intermediaries who use the recommendations to inform programs, systems, policies, and environments that serve the U.S. population. During the workshop, experts expressed particular enthusiasm for the use of systems

science models to support implementation through these intermediaries by informing the programs and interventions that use the *Dietary Guidelines*. Ideas included in this category could inform *Dietary Guidelines* implementation efforts (step 5).

Experts also noted that information generated through implementation research could then be available to review in step 3 of future *Dietary Guidelines* development cycles. Similar to strategy 6, the scope of topics explored during evidence review would need to be expanded beyond diet and chronic disease risk to include this kind of evidence. This became a major focus of discussion during the second day of the workshop. Experts provided the following examples of how systems science models could support *Dietary Guidelines* implementation:

- **Simulation modeling of barriers to individual diet alignment with the *Dietary Guidelines*.** Experts discussed how network mapping and computational modeling could be used to understand the underlying dynamics that influence individual choices and behaviors. Identifying factors that facilitate or prevent adoption of the recommendations could provide valuable information for *Dietary Guidelines* development and implementation efforts. Research questions that simulation models could help address include the following:
  - What are the physical and social contexts for dietary behaviors? Why, when, and how do people eat what they eat?
  - Why is alignment of Americans' diet with the *Dietary Guidelines* lower than optimal? What are the most significant individual/environmental factors that shape dietary patterns less aligned with recommendations?
  - What are the key barriers U.S. population segments face in eating in alignment with the *Dietary Guidelines*?
  - What marginal changes would help increase the first 10 percent of alignment?
  - What is the optimal alignment to the *Dietary Guidelines* (i.e., tipping point) to drive changes in systems to influence population-level dietary patterns?
  - How much investment and in what types of supports (e.g., nutrition education, food labeling) would contribute the most to positive changes in food choices?
  - How does nutrition misinformation or disinformation spread and affect implementation efforts?
- **Modeling to customize programs and interventions for specific subpopulations.** Modeling scenarios could help professionals better customize programs and interventions for specific subpopulations. Examples of subpopulations mentioned include groups served through Federal nutrition assistance programs, such as women participating in the Special Supplemental Nutrition Program for Women, Infants, and Children. Models could include contextual factors of food consumption, such as the time and place where people eat and food availability by geographic region. An initial focus could be determining the level of precision and personalization that would be helpful, without being restrictive or impractical for the population.
- **Modeling points of resistance.** Identify important areas of possible policy resistance, or organizational resistance, to the implementation of the *Dietary Guidelines*.
- ***Dietary Guidelines* communication.** Support professionals in customizing communication to their priority populations (e.g., older adults living in rural areas, parents of young children living in urban areas).

- **Simulation modeling/systems dynamic models to develop an interactive decision tool.** Professionals could use the envisioned interactive decision support tool to work with individuals to input their current dietary intake, preferences, and personalized desired outcomes (e.g., prevent diabetes). Simulations could be precomputed for all possible recommendations and permutations to identify the most effective dietary changes any particular individual could make to improve their health (these would potentially differ based on their starting point, circumstances, context, etc.).
- **Models with simulated cohorts to identify implementation gaps.** Experts discussed how the use of "simulated cohorts" in systems science models could help pinpoint which implementation gaps would have the largest impact on downstream outcomes and should therefore be prioritized. This recommendation includes more than how to communicate the guidelines but also how to augment effective and pragmatic implementation.

5. Consider the *Dietary Guidelines* process as a system that can be modeled for better understanding

The activities and processes surrounding the *Dietary Guidelines* can be viewed as one large, interconnected system. This system could be described, explored, and potentially improved by creating a systems model. Specifically, experts recommended conducting a group model-building exercise to identify the various inputs, stakeholders, factors, and decision points that relate to the development and implementation of the *Dietary Guidelines*. Creating a model could help facilitate a common understanding of the *Dietary Guidelines* processes, determine current gaps and leverage points, and visualize connections across involved actors and agencies.

6. Generate systems science research that could inform future iterations of *Dietary Guidelines* development

The use of systems methods to explore nutrition science is a growing but nascent field. As research continues and the evidence base expands, more information could become available to the Advisory Committee members and Federal staff when they review evidence and develop recommendations. Workshop participants discussed several areas where additional systems science research would be particularly valuable to invest in:

- **Simulation modeling of the broader food system in relation to the *Dietary Guidelines*.** The *Dietary Guidelines* focuses on individual-level consumption but has implications for the broader food system—as related to feasibility and downstream consequences. Systems science simulation models could help facilitate rigorous connections between the *Dietary Guidelines* and the broader food system. Researchers could use simulation models to consider which aspects of the food system would most strongly shape better nutrition for the population. Models could generate a decision support tool that includes broader food system implications of dietary guidance and food system constraints that affect diet, facilitating the inclusion of preferences and priorities. This idea is aligned with recommendations from a 2015 NASEM report on the food system, which advised systems science be used for this specific purpose (Institute of Medicine & National Research Council, 2015). The analytical framework from the 2015 report represents the idea of unavoidable and multidimensional tradeoffs between the food system and other health, economic, social, and environmental outcomes.

- **Economic modeling of a sustainable marketplace for food.** Relatedly, experts discussed systems science-driven modeling that would facilitate a greater understanding of which approaches to improve nutrition would be economically sustainable in the marketplace. Researchers could use economic modeling to identify how the food system and people's food choices interact. For example, would unintended consequences occur if people adhered to the *Dietary Guidelines*? What aspects of the food system would need to be addressed to ensure people could adhere to the *Dietary Guidelines*? Why is the U.S. food supply inconsistent with dietary guidance? (Miller et al., 2015). The 2015 NASEM report on the food system identified several such tradeoffs that would need to be addressed to make the *Dietary Guidelines* recommendations more achievable for more people (Institute of Medicine & National Research Council, 2015). Economic modeling, including agent-based or system dynamics models with cost components, could create a business case for how accessible and affordable foods can also sustain businesses throughout the food system, engaging and creating buy-in for parties not historically involved in public health and nutrition.
- **Modeling to examine how practical or sustainable *Dietary Guidelines* recommendations are for Americans to follow.** Experts noted the evidence review process could explore how practical the *Dietary Guidelines* recommendations are for the population. Outcomes and adherence levels from past *Dietary Guidelines* could be modeled and factored into the development for future recommendations, or projected outcomes based on proposed *Dietary Guidelines* could be modeled. This evidence could then be considered by the Advisory Committee as part of the evidence review (*Dietary Guidelines* step 3). This approach could also examine patterns of adherence to previous *Dietary Guidelines* and clarify reasons for variance in adherence and uptake of the *Dietary Guidelines* across subpopulations or audiences of various interested parties.

Research on these topics could be included in the *Dietary Guidelines* process only if the current scope of topics is expanded beyond exploring the relationship between individual dietary factors and chronic disease. (Note: Similar ideas that focus specifically on expanding research to inform the *implementation* of the *Dietary Guidelines* are described in strategy 4.)

Chapter 4. Discussion

Experts were asked to consider possible strategies without the constraints of time, cost, or what was possible with currently available data and research. Once action strategies were developed, experts discussed what it would take to operationalize each of them. To help inform the conversation, CNPP and ODPHP staff who participated in the workshop contributed information about current processes and responsibilities across Federal organizations. This chapter presents additional details to inform decision making on carrying out strategies.

1. Add scientific questions informed by ongoing systems science research

Action Strategies

- *Identify which system structures have the most influence*
- *Connect Dietary Guidelines to broader systems factors*
- *Use a new approach to consider intrapersonal biological aspects of nutrition and diet*

Responsible party and necessary partners: CNPP and ODPHP staff would be responsible for adding scientific questions in the first step of the *Dietary Guidelines* process; systems science experts would be partners in developing questions.

Timeline and first steps: First, CNPP and ODPHP staff would determine if new scientific questions informed by systems science research are a high priority for each future *Dietary Guidelines* cycle (e.g., 2030–2035, 2035−2040). If scientific questions informed by ongoing systems science research are deemed a priority, CNPP and ODPHP staff could partner with systems science experts to identify possible questions and verify whether sufficient evidence is available to answer proposed questions.

Benefits: Systems science methods offer a complementary perspective to standard analytic approaches. This strategy is responsive to the 2017 NASEM report and aligns with the 2023 NASEM report, which stated that systems science approaches are well suited to clarify causal mechanisms, identify relationships, and support precision nutrition by developing recommendations for diverse subpopulations.

Challenges: If CNPP and ODPHP staff add new systems science-focused questions, other questions may need to be deprioritized. Because sufficient evidence must be available to answer questions, the types of questions that can be asked in the next one or two cycles of the *Dietary Guidelines* could be limited as the necessary systems science evidence is generated. If the evidence is available but does not fit within the current scope of evidence review, additional Federal resources (e.g., staff time) may be necessary to expand the evidence review to answer the new questions.

2. Use systems science methods to complement or augment existing methods used in scientific evidence review

Action Strategies

- *Modeling to address data limitations*
  - *Project effects on subpopulations*
  - *Consider longer time horizons*
  - *Understand intrapersonal biological aspects of nutrition and health*
- *Systems map of publicly available data sources*

Responsible party and necessary partners: CNPP and ODPHP staff would be responsible for expanding the scientific evidence compiled and reviewed in step 3 of the *Dietary Guidelines* process; systems science researchers would be responsible for developing the evidence base aligned with topics relevant to the *Dietary Guidelines* process.

Timeline and first steps: Diet simulations within food pattern modeling are being initiated in the current *Dietary Guidelines* cycle (i.e., 2025–2030). CNPP and ODPHP staff can use learnings from this cycle to determine if simulation modeling should continue in future cycles and identify any changes, refinements, or additions to apply.

Current Approaches to Scientific Evidence Review

- Data analysis
- Nutrition evidence systematic review
- Food pattern modeling

It will likely take at least one or two additional cycles of *Dietary Guidelines* for researchers to establish evidence through systems science aligned with topics relevant to the process. Once established, CNPP and ODPHP staff, in collaboration with any systems science experts engaged as Advisory Committee members, contractors, or Federal staff, would need to determine if the new information fits within the current scientific evidence review or there would be value in including a new type of evidence review.

Benefits: Systems science approaches can provide different kinds of information that can complement conventional data. For example, available data sources could be used to help identify new relationships and prioritize future research. Diet simulation modeling could help evaluate the proposed dietary patterns and improve representation of diverse dietary practices across the population, including smaller population segments than the *Dietary Guidelines* process has been able to explore in the past.

Challenges: As systems science capacity within the *Dietary Guidelines* process (strategy 3) and the evidence base using systems science (strategy 6) evolve, the value of this strategy will increase. Many existing guidelines or recommendations generated through systems modeling elsewhere in the health sciences use a "comparative modeling" approach to build consensus, which requires sufficient resources and investment (Centers for Disease Control and Prevention, 2023; CISNET [Cancer Intervention and Surveillance Modeling Network], n.d.)

3. Include systems science experts in *Dietary Guidelines* development

Action Strategy

Include experts as—

- *Members of the Dietary Guidelines Advisory Committee*
- *CNPP and ODPHP staff, either as new hires or through professional development*
- *Consultants to CNPP and ODPHP staff*

Responsible party and necessary partners: CNPP and ODPHP staff would be responsible for choosing how to engage systems science experts in the development of *Dietary Guidelines*; systems science experts and funding sources would be necessary partners.

Timeline and first steps: A first step for CNPP and ODPHP is to identify how to include a systems science expert or experts within the development process. If the decision was made to train existing staff, hire a new staff member(s), or contract an expert consultant(s), the next likely step would be to determine the associated expense and secure the necessary funds. Depending on how CNPP and ODPHP chose to include systems science experts and the process to secure any necessary funding, this strategy could be implemented in the next *Dietary Guidelines* development cycle (i.e., 2030–2035).

Benefits: This strategy would be relatively low cost compared with other strategies. As systems science evidence relevant to the *Dietary Guidelines* process becomes available, it will be important for an expert(s) to assess whether research is evidence-based and rigorous enough for inclusion. An expert(s) could be included in the process in various ways, providing some flexibility on how to operationalize this strategy.

Challenges: If CNPP or ODPHP staff took on the role as the systems science expert(s), there would likely be expenses to either provide professional development to existing staff or recruit and hire new staff. Hiring a consultants would also have related expenses that would need to be allocated. More than one expert may need to be engaged to provide expertise across multiple system science methods, such as the four identified in the introduction.

4. Inform implementation efforts, which might also inform future iterations of *Dietary Guidelines* development

Action Strategies

- *Modeling to customize programs and interventions for specific subpopulations*
- *Modeling points of resistance*
- *Dietary Guidelines communication*
- *Simulation modeling/systems dynamic models to develop an interactive decision tool*
- *Models with simulated cohorts to identify implementation gaps*
- *Simulation modeling of barriers to individual adherence to the Dietary Guidelines*

Responsible party and necessary partners: Systems science researchers would be primarily responsible for generating research, while responsibility for applying findings to the implementation of *Dietary Guidelines* is diffused across Federal programs, policymakers, and health professionals. Researchers would need to partner with one or more of these implementation groups and focus on relevant topics for that group. For example, researchers could partner with CNPP to explore how best to disseminate MyPlate to the public or partner with the Supplemental Nutrition Assistance Program (SNAP) to investigate how to increase SNAP purchases of foods that adhere to the *Dietary Guidelines*. Funding partners may also be needed to provide the necessary resources to undertake the research.

Timeline and first steps: The timeframe and level of resources involved would depend on the complexity and scale of the research question(s). Workshop participants suggested that a discrete subset of questions in this category could be feasibly modeled relatively quickly (1–2 years) and for a lower cost. Other larger, more complex research questions would involve a longer time period (3–7 years) at a higher cost. A first step for this approach might include a Federal funding agency releasing a call for proposals related to systems science and *Dietary Guidelines* adherence.

Benefits: Knowledge gained through systems science research about the barriers and facilitators to implementation efforts can be used to increase alignment with the *Dietary Guidelines* and improve population health. Implementation of the *Dietary Guidelines* is a complex effort involving many interested parties and potential ways to transmit information; systems science approaches are well suited to explore various facets of implementation efforts and identify key leverage points. Experts also noted this approach could facilitate a better understanding of health equity factors; exploring why alignment with the *Dietary Guidelines* is unequal across subpopulations could help inform interventions that benefit underrepresented groups. This research can also provide valuable contextual information to feed into the *Dietary Guidelines* development process by elucidating different practicalities or constraints across subpopulations.

Challenges: Because implementation occurs across various groups and scales and no single group or agency is responsible for this task, identifying key partners and securing funding for an appropriate starting point could present many challenges.

5. Consider the *Dietary Guidelines* process as a system that can be modeled for better understanding

Action Strategy

- *Conduct a group model-building exercise of the Dietary Guidelines development and implementation processes*

Responsible party and necessary partners: Conducting group model building on the *Dietary Guidelines* process would require a small group of systems science modelers and an expert facilitator, all familiar with the group model-building methodology. The expert facilitator would also serve as a translator to explain and clarify systems science concepts and methodology to participants. This expert facilitator would work with a group of participants knowledgeable about the *Dietary Guidelines* process. The size of the group would depend on the specific scope of the project, who is doing the mapping, and the way they like to work. Participants would include CNPP and ODPHP staff who lead the development process and should also include representatives from other agencies or groups that would be represented in the maps, including those who implement the *Dietary Guidelines*. Group model-building sessions work best

when group size and dynamics ensure all attendees can participate fully, which often constrains total group size.

Timeline and first steps: The timeline for this project would take approximately 1–2 years. A first step could involve CNPP requesting funding to hire or contract with the experts needed to facilitate the exercise and build the model.

Benefits: Carrying out this strategy would be relatively low-cost compared with other strategies. Completing a group model-building exercise could facilitate a common understanding of *the Dietary Guidelines* process. The finished model could help provide justification for investments in revising, modifying, and prioritizing activities within the *Dietary Guidelines* process; for this reason, it may be a natural first step to incorporate systems science approaches into the *Dietary Guidelines*. It could also help prioritize questions for multiple *Dietary Guidelines* cycles rather than working one cycle at a time. This approach is highly responsive to the NASEM report, which suggested the use of systems mapping to identify relevant connections across stakeholders (NASEM, 2017). Sharing model results with the public could also help increase transparency and improve trust in the *Dietary Guidelines* process and recommendations.

Challenges: Although CNPP and ODPHP lead *Dietary Guidelines* development, other agencies are involved in the process and clear the final document. Implementation is diffused across programs, agencies, and individual professionals and external organizations. Gathering staff knowledgeable about the various ways the *Dietary Guidelines* are implemented could be difficult because no one entity or agency leads this effort. The model-building exercise could also involve challenging interagency dynamics; competing perspectives may be apparent over the roles and responsibilities surrounding the *Dietary Guidelines*. Tension may develop between building an accurate map of how the process *currently works* versus an idealized but less useful map of how the process *should work*.

6. Generate systems science research that could inform future iterations of *Dietary Guidelines* development

Action Strategies

- *Simulation modeling of the broader food system and its relation to Dietary Guidelines*
- *Economic modeling of a sustainable marketplace for food*
- *Modeling to examine how practical or sustainable Dietary Guidelines recommendations are for Americans to follow*

Responsible party and necessary partners: Systems science researchers would be the primary developers of these new, complex models. To reach a preponderance of evidence and ensure models are trustworthy and accurate, this strategy would ideally involve funding multiple small groups of researchers. Groups would develop models on the same topic simultaneously but separately and then compare results. Because these topics go beyond the current scope of the *Dietary Guidelines* development, it would need to be a high-level government effort, including Federal agencies and partners beyond CNPP and ODPHP. Additional funding would be required.

Timeline and first steps: The development of systems science models can vary considerably in timeline and cost; some take only a few years and have moderate cost, while other, more ambitious modeling efforts can take 5–7 years and involve significant resources (e.g., HHS and the National Institutes of General Medical Sciences Models of Infectious Disease Agent Study; MIDAS [Models of Infectious

Disease Agent Study], 2023), HHS and the National Cancer Institute Cancer Intervention and Surveillance Modeling Network (CISNET, n.d.), HHS and the National Institutes of Health Environmental Influences on Child Health Outcomes Program (NIH [National Institutes of Health], 2023). Experts also noted potential value in a process for updating and continually refining these models over time. A first step for this approach might include a Federal funding agency releasing a call for proposals related to economic or simulation modeling of the food system (also consistent with the 2017 NASEM report).

Benefits: Generating systems science research in areas beyond the current scope of individual diet and disease risk could provide helpful context for those reviewing evidence and developing the *Dietary Guidelines*. Modeling economic sustainability and the food system could provide a more realistic view of the U.S. food landscape. Assumptions about the economy and the food system would be made explicit in these models, which could help inform coordinated decision making. Researchers could also help identify co-benefits, where improving *Dietary Guidelines* alignment could be beneficial in other domains (e.g., economic outcomes), providing justification for policy or program changes. Research in the field of nutrition science has acknowledged that an individual's diet is heavily affected by the systems and structures surrounding them (Economos & Hammond, 2017; Gillmand & Hammond, 2016; Hawkes et al., 2015; Swinburn et al., 2019). Focusing on individual factors and behaviors alone fails to consider the complete picture. These approaches can inform how to change the food system rather than individual behavior.

Challenges: Creating a feasible initial scope and engaging the appropriate coalition of partners could prove challenging. Some of the topics involved could also be politicized because they would involve modeling stakeholders external to the Federal government (e.g., food manufacturers). Experts cautioned that it will be important to guard against developing a poorly conceived model with inaccurate inputs. Identifying sufficient resources through funding partners may be a challenge.

Report Conclusion

To examine potential ways to integrate systems science approaches into the *Dietary Guidelines*, a group of experts in systems science, nutrition, and public health generated, discussed, and prioritized ideas for potential action strategies during the 2-day workshop. Across the six action strategies prioritized, key responsible parties and partners include CNPP and ODPHP staff, Federal agencies that fund nutrition research, and the field of systems science experts. Some strategies could more readily be incorporated into upcoming cycles of the *Dietary Guidelines* process, while other strategies will require researchers to produce additional systems science evidence. Despite each strategy having challenges (e.g., necessary resources), the workshop revealed broad consensus that all six strategies would add considerable value to the *Dietary Guidelines* process and impact, with particular enthusiasm regarding the role systems science could have in *Dietary Guidelines* implementation.

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Appendix A. Additional Expert Ideas

This appendix includes all ideas recorded during the workshop that are not described in the body of the report. Because of workshop time constraints, not all ideas could be built out with discussion about their potential benefits, challenges, and requirements for implementation. Experts voted on which ideas to build out and discuss in depth. The ideas listed below received fewer votes, had less discussion time, and had less overlap with the prioritized action strategies compared with those included in the main body of the report.

- As data are analyzed during the *Dietary Guidelines* process, interesting patterns and trends may emerge without clear causes being apparent. Systems modeling could be used to explore patterns and to generate and test hypotheses regarding causal explanations.
- Data analysis involves a level of uncertainty and potential for error. Systems science approaches could be used to elevate sensitivity analyses to a level with more confidence by simulating counterfactuals. When evidence on an emerging topic is nascent, but recommendations are needed urgently, systems science modeling and projections could help provide insights.
- Some experts suggested using network mapping to inform the selection of the Dietary Guidelines Advisory Committee (Advisory Committee) members to potentially help improve transparency of the selection process. Discussion was divided on this suggestion. One expert expressed that putting together a model to generate individual names of committee members might be an inefficient use of resources. Other experts noted that mapping the development process for the *Dietary Guidelines* as a whole (action strategy 4) would also help identify the areas of expertise or types of interested parties who should be represented to have a comprehensive Advisory Committee.
- Consult systems science models to target aspects of systematic review process. Consider whether each review can adequately identify the elements, structures, feedback loops, and goals related to the topics of interest. Then, create a systems map at the end of the process to demonstrate where further research is needed.
- Use systems science models to simulate counterfactuals for topics such as product reformulation. The counterfactuals produced by systems models could feed into food pattern modeling. Simulating alternative scenarios could facilitate an exploration of potential unintended consequences of the *Dietary Guidelines* recommendations or other related policies (e.g., the effects of tax policies or nutrition labeling laws on manufacturers).
- Model the relationship of the *Dietary Guidelines* implementation with other social movements that relate to dietary intake (e.g., animal rights movement, sustainability movement, organic movement). Determine which movements have overlapping goals or alignment issues.
- Apply systems science-informed frameworks used in other parts of the Federal Government to have a synergistic impact (e.g., Thriving Together Framework for Healthy People 2030). Researchers could model operating frameworks, profit margins, interactions and messaging, and nutrition education efforts across government agencies to explore how to elicit a greater impact on the population. Systems science methods could also be used to evaluate the impact of government-wide initiatives.

- Systems science might not have a place in the *Dietary Guidelines development* process; it might instead be more valuable for *implementation* efforts. Some experts suggested a rebalance in investments in *Dietary Guidelines* activities to prioritize implementation and use systems science to aid these efforts rather than focusing on refining the development process. This strategy could include a discretionary advisory committee focused on implementation. Experts suggested conducting these implementation-focused activities by applying a lens of environmental sustainability and health equity.

Appendix B. Workshop Participant Biographies

Jamy Ard, M.D.

Jamy Ard, M.D., is a professor in the Department of Epidemiology and Prevention and the Department of Medicine at Wake Forest School of Medicine and interim associate dean for research. He is also co-director of the Atrium Health Wake Forest Baptist Weight Management Center, directing medical weight management programs. Dr. Ard's research interests include clinical management of obesity and strategies to improve cardiometabolic risk using lifestyle modification. With more than 25 years of experience in clinical nutrition and obesity, he has served on several expert panels and guideline development committees: the 2013 American Heart Association; the American College of Cardiology; The Obesity Society Guideline Panel on the Identification, Evaluation, and Treatment of Overweight and Obesity in Adults; and the U.S. Department of Agriculture's (USDA) 2020 *Dietary Guidelines* Advisory Committee.

Shari Barkin, M.D., M.S.H.S .

Shari Barkin, M.D., M.S.H.S., is an international expert in the field of behavioral interventions and community-engaged pragmatic randomized controlled trial research. She conducted the first intervention trial with the Pediatric Research in Office Settings Network, including 5,000 families in office-based violence prevention. She completed the longest pediatric obesity prevention pragmatic randomized controlled trial for underserved preschool-aged children. In 2008, she founded the Nashville Collaborative, an academic community partnership to develop and test two-generation obesity prevention and treatment strategies. Her research addresses health disparities in the prevention of obesity with a family-based approach. She examines the interaction of genetics, behavior, and environment at sensitive periods of childhood development. Over the past 20 years, Dr. Barkin's studies have demonstrated that behavior change appears to be nonlinear and works differently for different subgroups. She developed one of the only community behavioral interventions for Latinx preschool-aged overweight/obese children that effectively reduced BMI, a program now implemented in recreation centers nationally. Her success resulted from the novel integration of the science of social networks as an integral part of her behavior change interventions. Her findings challenge conventional wisdom regarding obesity prevention in underserved populations, paving the way for new directions to address this thorny issue that disproportionately affects underrepresented minority populations.

Christina Economos, Ph.D.

Christina Economos, Ph.D., is the dean ad interim at the Friedman School, the New Balance chair in childhood nutrition, and a professor of Public Health and Community Medicine at Tufts University School of Medicine. At the Friedman School, she co-founded and served as director of ChildObesity180, a nationally renowned research initiative focused on evidence-based interventions, multisector partnerships, and networks of interested parties to address the complex drivers of child health and promote equity. She has served as the dean for Research Strategy and as chair of the Nutrition Interventions, Communications, and Behavior Change Division at Friedman. Dr. Economos currently serves as the principal investigator on many large-scale, community-based interventions that examine childhood nutrition and physical activity with the goal of improving the health of all America's children. Her biobehavioral research studies are interdisciplinary and include theory-based obesity prevention interventions, cutting-edge systems science, and partnerships with diverse populations in urban and rural communities in schools, out-of-school environments, childcare centers, and restaurants. She has co-created and co-directed a university-wide institute to address global obesity as part of Tufts University's research and scholarship strategic plan. The Tufts Institute for Global Obesity Research is a community of over 50 faculty across 8 schools. She also serves as vice chair of the Roundtable on Obesity Solutions at the National Academies of Science, Engineering, and Medicine in Washington, DC, a multisector group tackling obesity. Dr. Economos received a bachelor of science from Boston University, a master of science in applied physiology and nutrition from Columbia University, and a doctorate in nutritional biochemistry from Tufts University. She has authored more than 200 scientific publications.

Naomi K. Fukagawa, M.D., Ph.D.

Naomi K. Fukagawa, M.D., Ph.D., is director of the USDA Beltsville Human Nutrition Research Center and professor of medicine emerita at the University of Vermont (UVM). She is a board-certified pediatrician with expertise in nutritional biochemistry and metabolism, including protein and energy metabolism, oxidants and antioxidants, and the role of diet in aging and chronic diseases. Dr. Fukagawa was president of the American Society for Clinical Nutrition and the American Society for Nutrition and served as vice chair of the 2010 Advisory Committee of the USDA and U.S. Department of Health and Human Services (HHS). She served as an associate editor of the *American Journal of Clinical Nutrition* and editor-in-chief of *Nutrition Reviews*. She received her M.D. from Northwestern University and her Ph.D. from the Massachusetts Institute of Technology (MIT). Her clinical training included residency at the Children's Hospital of Philadelphia, University of Pennsylvania; chief residency at UVM; and nutrition/gerontology fellowships at the Children's Hospital and Beth Israel Hospital, Harvard Medical School. She was assistant professor at Harvard Medical School and MIT, serving as director of the Nutrition Support Service at the Boston Children's Hospital. She was also assistant professor at Rockefeller University and served as the associate director of the Clinical Research Centers at MIT, Rockefeller University, and UVM. She continues research, ranging from cells and animals to in vivo studies, in human volunteers with a focus on whether and how diet can mitigate the adverse effects of environmental stressors while maintaining adequate food production in an environmentally friendly and sustainable manner.

Matthew W. Gillman, M.D., S.M., joined the National Institutes of Health (NIH) in 2016 as the inaugural director of the Environmental Influences on Child Health Outcomes Program. Dr. Gillman came to NIH from Harvard Medical School, where he was a professor of population medicine and director of the Obesity Prevention Program, and Harvard School of Public Health, where he was a professor of nutrition. With a background in the fields of internal medicine, pediatrics, and epidemiology, he has led cohort studies and randomized controlled trials and published widely in the prevention of chronic disease across the life course. Dr. Gillman won mentoring awards at Harvard Medical School and Harvard School of Public Health and has served in several national and international leadership positions, including on the United States Preventive Services Task Force and for the International Society for Developmental Origins of Health and Disease, from which he won the David Barker Medal in 2017. His clinical experience includes primary care for children and adults and preventive cardiology among children.

Matthew W. Gillman, M.D., S.M.

Lila Gutuskey, M.Ed., Ph.D., (workshop co-chair) is senior researcher at Westat Insight with more than 10 years of experience in research design and evaluation-focused training and technical assistance. Her work focuses on integrating and training on equitable evaluation and empowerment approaches to public health programming and evaluation and convening funders, implementers, and communities to develop policy and practice guidance. Dr. Gutuskey has supported projects for USDA's Food and Nutrition Service (FNS), HHS, the U.S. Department of Education, and the Centers for Medicare & Medicaid Services. She earned her doctoral degree from Wayne State University in Detroit, Michigan.

Lila Gutuskey, M.Ed., Ph.D.

Kevin Hall received his Ph.D. in physics from McGill University and is now a tenured senior investigator at the National Institute of Diabetes & Digestive & Kidney Diseases (NIDDK) of NIH in Bethesda, Maryland. His main research interests are the regulation of food intake, macronutrient metabolism, energy balance, and body weight. Dr. Hall develops mathematical models and computer simulations to better understand human nutrition and metabolism; the models are used to help design, predict, and interpret the results of clinical research studies conducted by his laboratory. Dr. Hall has twice received both the NIH Director's Award and the NIDDK Director's Award, and he is the recipient of the E.V. McCollum Award from the American Society for Nutrition, the Lilly Scientific Achievement Award from The Obesity Society, and the Guyton Award for Excellence in Integrative Physiology from the American Physiological Society.

Kevin Hall, Ph.D.

Ross Hammond, Ph.D.

Ross Hammond, Ph.D., (workshop co-chair) is the Betty Bofinger Brown Professor in Public Health at Washington University in St. Louis. He is also Director of the Center on Social Dynamics & Policy and a Senior Fellow in Economic Studies at The Brookings Institution and an external professor at the Santa Fe Institute. His research for the past two decades has focused on applying complex systems science to challenging policy problems, including work on obesity prevention, health disparities, pandemic containment, tobacco control, implementation science, and the food system. Dr. Hammond has authored numerous articles in journals such as *Lancet*, *Science*, the *Journal of the American Medical Association*, *Nature Medicine*, *Proceedings of the National Academy of Sciences*, and the *American Journal of Public Health*. His work has been featured in *The Atlantic*, *New Scientist*, and *Salon* and covered by NPR, *The Wall Street Journal*, the *Financial Times*, and major news outlets. Professor Hammond is an advisory Special Government Employee at the Food and Drug Administration (FDA) and serves on the Food and Nutrition Board of the National Academies of Science. Dr. Hammond previously served on the HHS Advisory Council on Minority Health and Health Disparities at NIH, on several National Academy of Sciences consensus panels, and on the recent *Lancet* Commission on Obesity. He has been a member of several NIH-funded scientific networks focused on computational system science modeling.

Kamal Henderson, M.D., M.Sc., Ph.D.

Kamal Henderson, M.D., M.Sc., Ph.D., is an adult cardiologist and clinical researcher working to understand the cardiovascular health equity gap that exists for vulnerable patient populations and to implement health system strategies to address this gap. His research focuses on the application of both systems science methodologies and implementation science to design and implement pragmatic sustainable healthcare interventions to prevent cardiovascular disease among high-risk and structurally disadvantaged populations. As a trained general preventive medicine and public health physician, he has knowledge and core skills in health systems management, clinical prevention, epidemiology, and public health program development and implementation. Dr. Henderson is currently an assistant professor at the University of Colorado School of Medicine and provides clinical care for our nation's veterans at the Rocky Mountain Regional Veteran Affairs Medical Center.

Matt Kasman, Ph.D.

Matt Kasman, Ph.D., is the assistant research director at the Brookings Institution Center on Social Dynamics and Policy. He has a background in computer science, software engineering, and policy analysis. He has applied complex systems science approaches to understand the impact of policies and practices across a wide range of topics in public health and is a pioneer in using these methodologies in the field of educational policy. His current research interests include childhood obesity prevention efforts, food systems, nutrition, physical activity, financial literacy, school choice, college enrollment, teacher labor markets, educational equity, tobacco regulatory policy, and adaptive decision making.

Shiriki Kumanyika, Ph.D., M.P.H., is an emeritus professor of epidemiology at the Perelman School of Medicine, University of Pennsylvania, and a research professor in the Department of Community Health and Prevention at Drexel University's Dornsife School of Public Health. She obtained a master's of science in social work from Columbia University, a Ph.D. in human nutrition from Cornell University, and a master's in public health from Johns Hopkins. Dr. Kumanyika's research has focused on diet and chronic disease issues, including sodium intake, obesity, and diet-related health disparities. She has applied her interdisciplinary background and research experience in numerous advisory roles in the United States and abroad and currently chairs the National Academies' Food and Nutrition Board. Dr. Kumanyika served on the 1995 and 2000 Advisory Committees.

Shiriki Kumanyika, Ph.D., M.P.H.

Brent Langellier, Ph.D., M.A., is an associate professor at Drexel University's Dornsife School of Public Health. His research seeks to understand and address drivers of health disparities, particularly those experienced by Latinos and other racial/ethnic minorities, immigrants, and individuals who live in poverty. Much of his research has focused on food behaviors, diet-related chronic disease, and participation in public programs. Currently, much of his research uses complex systems methods (e.g., agent-based simulation models, group model building) to generate insights into the drivers of health disparities and to identify policy levers to address disparities. He is the principal investigator of a Research Project Grant study funded by the National Institute of Minority Health and Health Disparities. The study uses complex systems methods in collaboration with community partners to describe the systems that lead to diet disparities across neighborhoods in Philadelphia and to identify combinations of public policies to address these disparities. He is also a principal investigator on a Robert Wood Johnson Foundation grant that uses retail scanner data and household survey data to assess how food purchasing healthfulness varies among participants in the Supplemental Nutrition Assistance Program based on local food and housing costs.

Brent Langellier, Ph.D., M.A.

Douglas Luke, Ph.D., is the Irving Louis Horowitz professor in social policy at the Brown School at Washington University in St. Louis. He is the director of the Center for Public Health Systems Science, which has been active and funded for over the past 20 years. His research focuses on evaluation and implementation of evidence-based public health policies, with an emphasis on tobacco control. He has worked extensively with the Office on Smoking and Health at the Centers for Disease Control and Prevention (CDC) and has helped produce a wide variety of evidence-based translational products for community and State tobacco control, including the *Best Practices User Guides* and *the Point-of-Sale Report to the Nation*. Dr. Luke is also a leading methodologist with expertise in systems science, network analysis, agent-based modeling, and multilevel and longitudinal modeling. He published the first comprehensive reviews of network methods and systems science methods in public health. More recently, he was a member of the panel that produced the recent Institute of Medicine Report, *Assessing the Use of Agent-Based Models for Tobacco Regulation*, which provided FDA and other public health scientists with guidance on how best to use agent-based computational models to inform tobacco control regulation and policy. He received his Ph.D. in community and clinical psychology from the University of Illinois, Urbana-Champaign.

Douglas Luke, Ph.D.

Cynthia Ogden, Ph.D.

Cynthia Ogden, Ph.D., is an epidemiologist and analysis branch chief in the National Health and Nutrition Examination Survey (NHANES) Division at the National Center for Health Statistics, CDC. Dr. Ogden is an internationally recognized expert in nutritional and obesity epidemiology. She was a member of the team that developed the 2000 CDC pediatric growth charts used to define obesity in U.S. children and led the development of the recently released CDC extended BMI-for-age growth charts. She has published more than 175 papers, government documents, and book chapters on topics in nutrition, diet, obesity, growth, and physical activity. She also is an associate editor for *Obesity*, the journal of The Obesity Society. Dr. Ogden joined CDC as an Epidemic Intelligence Service officer after a postdoctoral year in the Nutrition Division at the New York State Department of Health. She has worked on nutrition-related projects for the Food and Agriculture Organization of the United Nations and currently is an adjunct professor at the George Washington University Milken Institute School of Public Health, advising students and teaching courses on nutritional and obesity epidemiology. She earned her Ph.D. and master's degrees from Cornell University, where her research focused on socioeconomic contributions to malnutrition among young children in Kigali, Rwanda.

Emily Oken, M.D., M.P.H.

Emily Oken, M.D., M.P.H., is a professor in the Department of Population Medicine at Harvard Medical School and the Harvard Pilgrim Health Care Institute and in the Department of Nutrition at the Harvard T.H. Chan School of Public Health. She directs the Division of Chronic Disease Research Across the Lifecourse within the department of Population Medicine. Her research focuses on the influence of nutrition and other modifiable factors during pregnancy and early childhood on long-term maternal and child health, especially cardiometabolic health, cognitive development, asthma, and atopy. She has also led studies examining predictors and sequelae of maternal overweight, weight gain, and related conditions such as gestational diabetes mellitus in the peripartum period. Her work on the toxicant risks and nutrient benefits of prenatal fish consumption has influenced national guidelines for fish consumption during pregnancy, helping to shift the previous focus of risk-only or benefit-only studies to a broader emphasis on the overall health effects of fish consumption for mother and baby. In support of this work, she has led longitudinal studies commencing in the peripartum period and following mothers and children throughout childhood. Dr. Oken is principal investigator of Project Viva, a groundbreaking U.S. prebirth cohort study that has followed pregnant women and their children since 1999. She is also principal investigator and a co-leader of the team assessing cardiometabolic, respiratory, and neurocognitive outcome measures on children enrolled 1996–97 in the Promotion of Breastfeeding Intervention Trial, a cluster-randomized trial of breastfeeding promotion in the Republic of Belarus. She has been inducted into the American Society for Clinical Investigation. Dr. Oken's commitment to research mentorship and promoting diversity has been recognized with local and national awards.

Nico Pronk, Ph.D., M.A., FACSM, FAWHP

Nico Pronk, Ph.D., M.A., FACSM, FAWHP, is president of the HealthPartners Institute and Chief Science Officer at HealthPartners, Inc., and he holds academic appointments as Affiliate Full Professor of Health Policy and Management at the University of Minnesota, School of Public Health in Minneapolis, Minnesota and as Visiting Scientist of Social and Behavioral Sciences at the Harvard T.H. Chan School of Public Health. Dr. Pronk's work is focused on connecting evidence of effectiveness with practical applications of programs and practices, policies, and systems that measurably improve population health and well-being. His work applies to the workplace, the health system setting, and the community and involves development of new models to improve health and well-being at the research, practice, and policy levels. Dr. Pronk was confirmed by the White House to serve as co-chair of the U.S. Secretary of Health and Human Services' Advisory Committee on National Health Promotion and Disease Prevention Objectives for the year 2030 (aka "Healthy People 2030"). He is a current member of the Food and Nutrition Board and chair for the Roundtable on Obesity Solutions at the National Academies of Sciences, Engineering, and Medicine. He serves on the board of directors for the Health Enhancement Research Organization and is the founder and past president of the International Association for Worksite Health Promotion. He is widely published in both the scientific and practice literatures and is an international speaker on population health and well-being. Dr. Pronk received his doctorate degree in exercise physiology at Texas A&M University and completed his postdoctoral studies in behavioral medicine at the University of Pittsburgh Medical Center at the Western Psychiatric Institute and Clinic.

Jill Reedy, Ph.D., M.P.H., RDN

Jill Reedy, Ph.D., M.P.H., RDN, is chief of the Risk Factor Assessment Branch (RFAB) of the Epidemiology and Genomics Research Program (EGRP) in the National Cancer Institute's (NCI) Division of Cancer Control and Population Sciences (DCCPS). Previously, she was a program director in RFAB from 2015 to 2019. As branch chief, Dr. Reedy oversees EGRP's research portfolio and initiatives that focus on diet, physical activity, and sleep assessment; methods, tools, technologies and resources for risk factor assessment; and obesity policy research. Her scientific interests include different methodological approaches in dietary pattern analysis, dietary surveillance, obesity policy, new technologies for dietary assessment, and measures of the food environment. Dr. Reedy partners with colleagues at NCI, USDA, the National Collaborative on Childhood Obesity Research (NCCOR), the World Cancer Research Fund (WCRF), and the American Institute for Cancer Research (ACIR), to develop resources for researchers including the Dietary Assessment Primer; the NCCOR Measures Registry Resource Suite; the NCCOR Catalogue of Surveillance Systems; the WCRF/AICR Score; and the Healthy Eating Index. Prior to joining EGRP, Dr. Reedy was a program director and nutritionist in DCCPS's Applied Research Program (now the Healthcare Delivery Research Program). She first joined NCI as a cancer prevention fellow. Dr. Reedy is a registered dietitian nutritionist and previously worked as a regional manager at the Dairy Council of California, a consultant with the California Nutrition Network, and a pediatric dietitian.

Other Workshop Speakers and Facilitators

Meghan Adler, M.S., RDN, FAND

Meghan Adler, M.S., RDN, FAND, is a nutritionist with USDA's Center for Nutrition Policy and Promotion (CNPP). She supported the development and implementation of the *Dietary Guidelines for Americans, 2020–2025*, leading a variety of projects focused on the development, translation, and dissemination of resources professionals can adapt for diverse communities. She serves as the USDA/HHS Food Pattern Modeling Interest Group coordinator, supports the food pattern modeling work of the 2025 Advisory Committee and is the project lead for the applicability of systems science approaches to the *Dietary Guidelines*. Prior to joining FNS, she worked for over a decade with USDA's Agricultural Research Service on food composition, dietary recall enhancement, and data dissemination of What We Eat in America, NHANES. She is a registered dietitian and received her degrees from the University of Delaware, where she supported the Healthy Aging in Neighborhoods of Diversity across the Life Span study in collaboration with the National Institute on Aging.

Janet de Jesus, M.S., RD

Janet de Jesus, M.S., RD, is a nutrition advisor in the HHS Office of Disease Prevention and Health Promotion. She is the HHS lead of the *Dietary Guidelines for Americans, 2020–2025*, and participates in other cross-cutting nutrition activities across the Federal Government. Previously, she was a public health advisor at the National Heart, Lung, and Blood Institute (NHLBI) for 18 years. At NHLBI, she supported the development of clinical practice guidelines for the prevention and treatment of cardiovascular risk factors in adults and pediatrics. She participated in the development of community programs to improve heart health in high-risk communities and nutrition education materials for cardiovascular health. Her community development portfolio includes materials for healthcare providers, consumer materials on cardiovascular risk reduction, and community health worker curriculum for multicultural communities. She completed her master's in nutrition at Florida State University in Tallahassee.

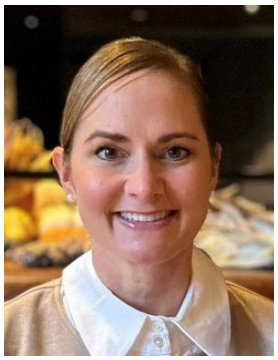
Stacy Gleason, M.P.H.

Stacy Gleason, M.P.H., is the director of food and nutrition research at Westat Insight. She has more than 20 years of experience in research, evaluation, and provision of technical assistance for Federal agencies, State agencies, and foundations. Ms. Gleason leads a talented team of researchers, designs and directs mixed-method evaluations, facilitates advisory and expert group meetings, and translates research findings into policy and practice recommendations. She has deep knowledge of Federal nutrition assistance programs and the populations they serve and has supported dozens of USDA FNS studies over the past two decades. She holds an M.P.H. in epidemiology from the University of Washington School of Public Health.

Julie Obbagy, Ph.D., RD, is the branch chief for Nutrition Evidence Systematic Review Branch, within USDA FNS CNPP. She has over 14 years of experience with CNPP's Nutrition Evidence Systematic Review (NESR) team, conducting systematic reviews on diet- and health-related topics. Dr. Obbagy has played a key role in developing NESR's rigorous methodology for reviewing food- and nutrition-related research, supporting numerous projects, including the 2010, 2015, 2020, and 2025 Advisory Committees and the integration of the birth to 24 months population into the *Dietary Guidelines for Americans*. Dr. Obbagy received bachelor's degrees in biology and American history from Brown University. She earned a doctorate in nutritional sciences from the Pennsylvania State University. Dr. Obbagy is a registered dietitian, completing her dietetic internship at NIH.

Julie Obbagy, Ph.D., RD

Eve E. Stoody, Ph.D., is the director of the Nutrition Guidance and Analysis Division of USDA CNPP. Two of her primary responsibilities are to support the development of the *Dietary Guidelines for Americans* and the reevaluation of the Thrifty Food Plan. Dr. Stoody served as the USDA staff lead in the development of the *Dietary Guidelines for Americans, 2020–2025*, and oversaw the development of the Thrifty Food Plan, 2021. She also supported the development of the 2010 and 2015 editions of the *Dietary Guidelines for Americans*. Prior to her current role, Dr. Stoody was a lead nutritionist within CNPP and an analyst for USDA's Nutrition Evidence Systematic Review team. She served as a project manager for the Pregnancy and Birth to 24 Months Systematic Review Project and the Dietary Patterns Systematic Review Project. She was also a fellow at HHS's Office of Disease Prevention and Health Promotion. She received her bachelor of science in biology with a minor in nutrition from Texas Christian University and her doctorate in nutrition from Texas Woman's University.



Eve E. Stoody, Ph.D.

Appendix C. Workshop Preparation Guide

Thank you for participating in the upcoming *Workshop on the Applicability of Systems Science Approaches to the Dietary Guidelines for Americans*, hosted by the U.S. Department of Agriculture's (USDA) Center for Nutrition Policy and Promotion (CNPP). This workshop will explore potential options to incorporate systems science in the development of future editions of the *Dietary Guidelines for Americans* (DGA).

This guide describes the impetus for the workshop and provides links to reading materials. We encourage participants to read these materials prior to March 29, 2023, to facilitate a common understanding of the DGA, the process to develop the guidelines, and previous recommendations to incorporate systems science into the process. Gaining this understanding ahead of time will help ensure we have ample time for discussion and ideation.

Project Impetus

DGA is the central source for sound, evidence-based, food-based nutrition guidance from the Federal Government. DGA is published as a technical resource for health professionals, policymakers, and nutrition educators working with the public to help promote health and prevent disease. Every 5 years since 1980, the USDA and the U.S. Department of Health and Human Services (HHS) have jointly issued the DGA. Within USDA, CNPP leads development of the DGA in collaboration with HHS colleagues from the Office of Disease Prevention and Health Promotion. The current DGA (2020–2025) provides guidance by life stage from infancy to older adulthood.

Each new edition of the DGA follows a scientifically rigorous five-step process. USDA and HHS facilitate steps one to four with multiple rounds of internal and external stakeholder input and with the expertise of an independent scientific advisory committee (step 3). Step 5 occurs after the release of the DGA, carried out across the Federal Government and at the State and local levels. Figure C.1 depicts the DGA process:

Figure C.1. The Process for Developing the Dietary Guidelines for Americans

While an overall understanding of the DGA process is necessary to carry out workshop objectives, systems science may have the greatest applicability to the evidence review in step 3. During step 3, the *Dietary Guidelines* Advisory Committee reviews the scientific evidence gathered through three approaches to answer the scientific questions developed in step 1 and refined and prioritized by the Advisory Committee (shown in figure C.2).

Figure C.2. Approaches Dietary Guidelines Advisory Committee Uses to Examine Evidence

Nutrition Evidence for Systematic Review: A gold-standard evidence synthesis project that answers a nutrition question of public health importance using systematic, transparent, rigorous, and protocol-driven methods to search for, evaluate, synthesize, and grade the strength of the eligible body of evidence

Data analysis: A collection of analyses that uses national data sets to describe the current health and dietary intakes of Americans. These data help make the *Dietary Guidelines* practical, relevant, and achievable

Food pattern modeling: Analyses that illustrate how changes to the amounts or types of foods and beverages in a dietary pattern might affect meeting nutrient needs across the U.S. population

Source: Adapted from Dietary Guidelines for Americans. (n.d.). Work under way. https://www.dietaryguidelines.gov/learn-about-process#step-3-advisory-committee-reviews-scientific-evidence

Based on a 2017 congressionally mandated study to assess the DGA development process, the National Academies of Sciences, Engineering, and Medicine (NASEM) recommended the secretaries of USDA and HHS commission research and evaluate strategies to develop and implement systems approaches in the DGA. The selected strategies should begin to integrate systems mapping and modeling in the DGA process.

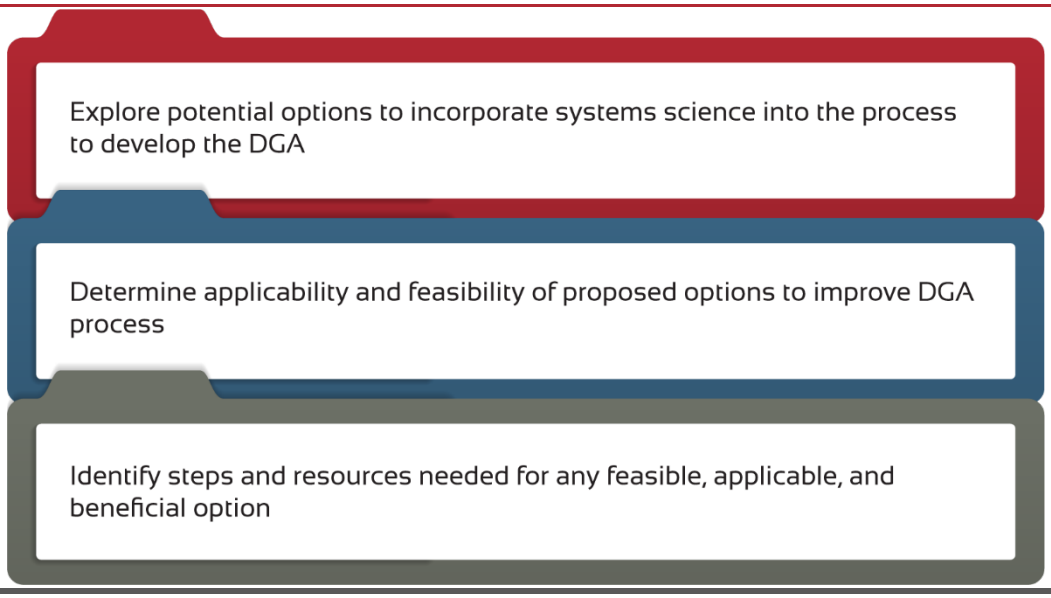
After the release of the *Dietary Guidelines for Americans, 2020–2025*, Congress requested a study to compare the process to develop the DGA with previous NASEM recommendations. In that report, *Evaluating the Process to Develop the Dietary Guidelines for Americans, 2020–2025: Final Report*, NASEM further discussed incorporating systems science approaches in the development of the DGA. Work to develop the 2025–2030 edition is already underway; the aim of the workshop is to develop options for next steps to inform future editions.

Systems approaches have been used for decades but only to a limited degree in the field of nutrition. Given the importance of DGA in setting policy, guiding practitioners, and educating and influencing consumers across the Nation, CNPP plans to consider the applicability of systems science approaches carefully and fully. This workshop will focus on three systems science approaches: system dynamics, network analysis, and agent-based modeling (described in detail in the resources linked in section C).

Workshop Goals

Figure C.3 identifies the workshop goals.

Figure C.3. Workshop Goals



Background Reading and Viewing

The workshop will gather experts on systems science and the DGA process. Short presentations will showcase both topics. However, as mentioned earlier, please review the resources in table 1, and read or view those outside your own expertise (and authorship!). A listing of optional reading follows table B.1.

Table B.1. Required Reading and Viewing Prior to Workshop

Topic	Required Reading and Viewing	Relevance and Notable Sections
DGA	U.S. Department of Agriculture & U.S. Department of Health and Human Services. (2020, December). *Dietary Guidelines for Americans, 2020–2025* (9th ed.). https://www.dietaryguidelines.gov/sites/default/files/2021-03/Dietary_Guidelines_for_Americans-2020-2025.pdf	Understanding scope of recommendations in *Dietary Guidelines for Americans, 2020–2025* provides foundational knowledge for evaluating incorporation of National Academies of Sciences, Engineering, and Medicine (NASEM) or other systems science recommendations in DGA process
DGA	U.S. Department of Agriculture & U.S. Department of Health and Human Services. (n.d.). *Learn about the process*. https://www.dietaryguidelines.gov/learn-about-process	Web page explains each step of 2025–2030 DGA process, with toggling facilitated between steps. Step 3 provides overview of process occurring now, when Dietary Guidelines Advisory Committee reviews scientific evidence
DGA	Office of Disease Prevention and Health Promotion. (2023). *2025 Dietary Guidelines Advisory Committee: Meeting 1 (day 1)* [Video]. VideoCast. U.S. Department of Health and Human Services. https://videocast.nih.gov/watch=48948	Recording of first day of 2025 Advisory Committee's first meeting, February 9, 2023. View following presentations (6–8): ▪ 6: Nutrition Evidence Systematic Review ▪ 7: Food Pattern Modeling ▪ 8: Data Analysis

Topic	Required Reading and Viewing	Relevance and Notable Sections
DGA	U. S. Department of Agriculture & U.S. Department of Health and Human Services. (n.d.). *USDA-HHS development of the Dietary Guidelines.* https://www.dietaryguidelines.gov/usda-hhs-development-dietary-guidelines	Web page provides in-depth information about how USDA HHS developed DGA (step 4) for current edition (2020–2025); explains process used for writing, review, and release
DGA/ Systems Science	National Academies of Sciences, Engineering, and Medicine. (2017). *Redesigning the process for establishing the Dietary Guidelines for Americans*. National Academies Press. https://doi.org/10.17226/24883	Original report; NASEM recommends convening this workshop. Please read following sections: ▪ Recommendation 7, p. 15 ▪ Adopting State-of-the-Art Processes and Methods to Maximize Scientific Rigor, pp. 49–50 ▪ Food Pattern Modeling, pp. 84–86 ▪ Advancing Methods Used, pp. 90–96
The DGA/ Systems Science	National Academies of Sciences, Engineering, and Medicine. (2023). *Evaluating the process to develop the Dietary Guidelines for Americans, 2020–2025: Final report*. National Academies Press. https://doi.org/10.17226/26653	Report compares process to develop DGA 2020–2025 to recommendations in previously published report *Redesigning the Process for Establishing the Dietary Guidelines for Americans*. Please read following section focused on systems science: ▪ Chapter 2, pp. 41–49, Supporting the Rigor and Integrity of the *Dietary Guidelines* by Addressing the Complexities Through Systems Science
Systems Science	National Academies of Sciences, Engineering, and Medicine. (2015). *A framework for assessing effects of the food system*. National Academies Press. https://doi.org/10.17226/18846	Report is relevant to broader impact lens for DGAs. Please read following section: ▪ Chapter 6, p. 233, The U.S. Food and Agriculture System as a Complex Adaptive System
Systems Science: Agent-Based Modeling and Policy	Hammond, R. A. (2015). Considerations and best practices in agent-based modeling to inform policy. *Assessment of agent-based models to inform tobacco policy regulation*. Institute of Medicine, National Academy of Sciences Press. Considerations and Best Practices in Agent-Based Modeling to Inform Policy - Assessing the Use of Agent-Based Models for Tobacco Regulation - NCBI Bookshelf (nih.gov)	Article provides useful primer on best practices and challenges for using agent-based modeling to inform policy
Systems Science models of diet	Langellier, B. A., Lobban, K., Bilal, U., Montes, F., Meisel, J., Cardoso, L. O., & Hammond, R. A. (2019). Complex systems approaches to diet: A systematic review. *American Journal of Preventive Medicine 57*(2), 273–281. Complex Systems Approaches to Diet: A Systematic Review - PMC (nih.gov)	Article provides recent systematic review of applications of systems science to diet to date

Topic	Required Reading and Viewing	Relevance and Notable Sections
Systems Science and Dietary Patterns Research	Reedy, J., Krebs-Smith, S., Hammond, R. A., & Hennessy, E. (2017). Advancing the science of dietary patterns research: Developing a framework and leveraging a complex systems approach. *Journal of the Academy of Nutrition and Dietetics 117*(7), 1019–1022.	Article describes how complex systems modeling might inform dietary patterns research

Optional Reading on Systems Science

Hammond, R. A. (2009). Complex systems modeling for obesity research. *Preventing Chronic Disease 6*(3). https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2722404/

Hammond, R. A., Osgood, N., & Wolfson, M. (2017). Using complex systems simulation modeling to understand health inequality. In G. A. Kaplan and S. Galea (Eds.), *Growing inequality: Bridging complex systems, population health, and health disparities*. Westphalia Press.

Institute of Medicine. (2012). *Accelerating progress in obesity prevention: Solving the weight of the nation*. The National Academies Press. https://doi.org/10.17226/13275 [Suggest reading appendix B]

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