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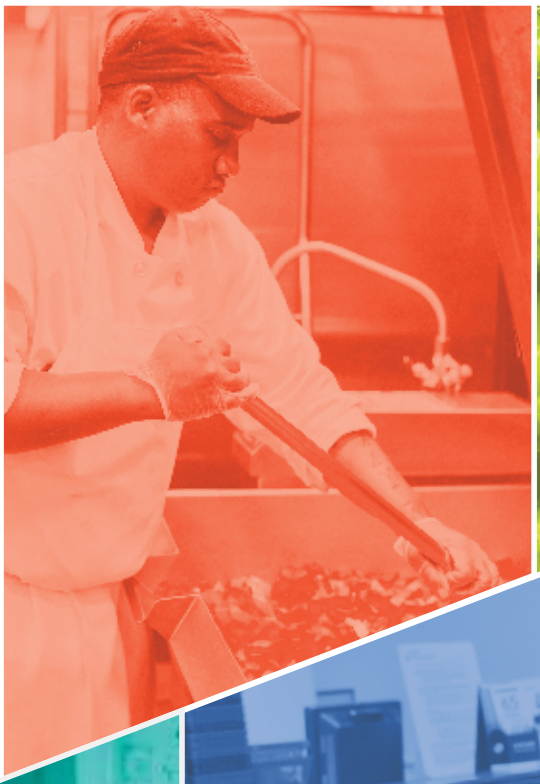

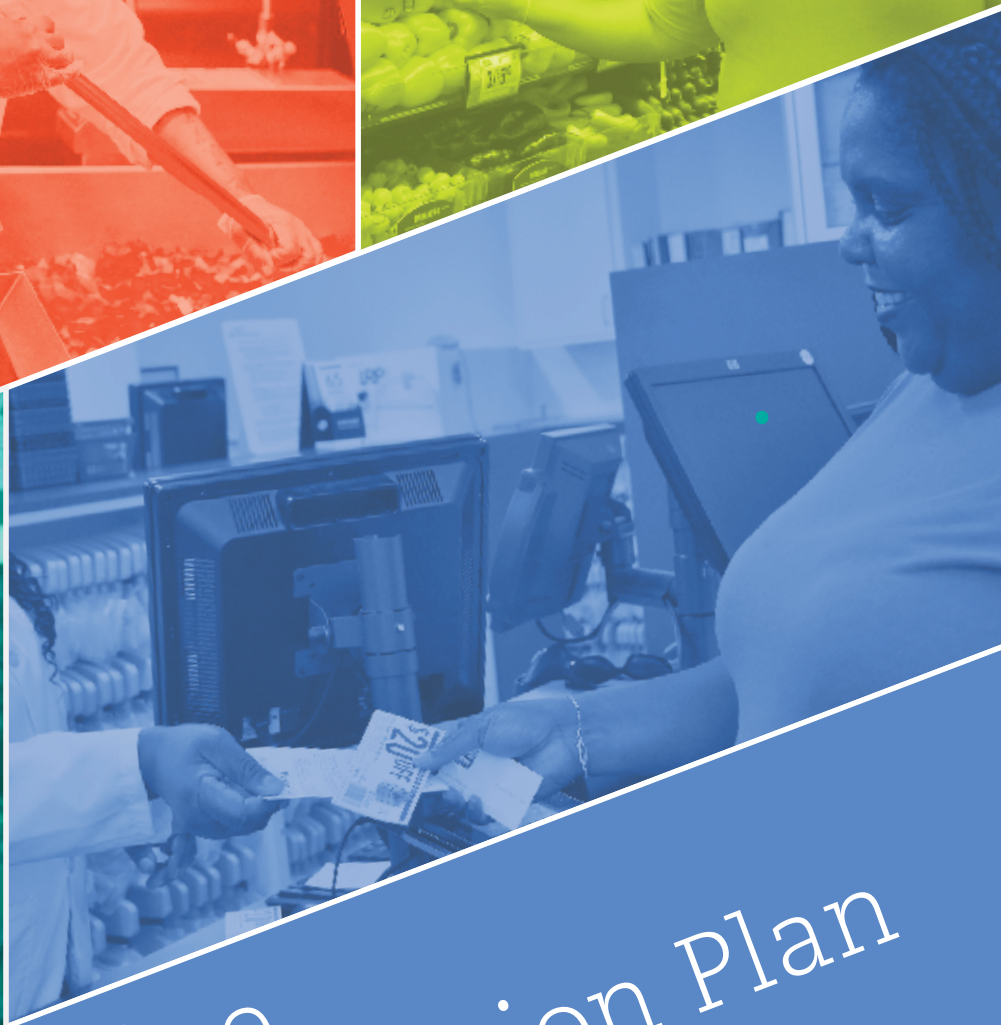

Food is Medicine Research Action Plan

CHLPI CENTER for HEALTH LAW and POLICY INNOVATION
HARVARD LAW SCHOOL

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This report has been informed by key informant interviews and virtual convenings with our Food is Medicine Advisors, beginning in June 2020 and continuing throughout 2021. Their expertise and generosity of time, insight, and examination shaped this work, and Food & Society at the Aspen Institute as well as the Research Action Plan authors are extremely grateful for them. The Advisory Board includes:

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The research included in this report was made possible through funding by the **Walmart Foundation**. The findings, conclusions, and recommendations presented in this report are those of Food & Society at the Aspen Institute and the Center for Health Law Policy Innovation alone, and do not necessarily reflect the opinions of the Walmart Foundation.

Executive Summary

Food is Medicine Research Action Plan

The United States faces an unabating chronic disease epidemic, leading to skyrocketing health care costs and devastating effects for individuals, communities, and the nation. The connection between chronic disease and nutrition is undeniable; nutrition not only plays a role in the onset of disease but also its prevention, management, and treatment. Efforts that involve a health care response to the need for better nutrition fall under the umbrella term "Food is Medicine." An emerging body of research demonstrates the enormous promise of Food is Medicine interventions across a range of health conditions in improving health and quality of life, while also curbing health care costs.

In order to build on these findings and strengthen the case for widespread integration into the health care system, health care providers, academic researchers, insurance providers, and policymakers alike want more purposeful research. The Food is Medicine Research Action Plan answers this call with a comprehensive set of recommendations for creating an evidence base that will advance health care integration, build a holistic understanding of effectiveness, and engage communities, providers, and researchers.

The Action Plan is written for:

- Researchers
- Funders
- Food is Medicine program implementers
- Advocates for increasing access to Food is Medicine interventions

In the Action Plan, Food is Medicine interventions include the following two components:

(1) the provision of food that supports health, such as medically tailored meals or groceries, or food assistance, such as vouchers for produce; and (2) a nexus to the health care system. Section III elaborates on this definition, as well as the existing interventions that it encompasses.

The result of an 18-month process of stakeholder engagement and guidance from experts in the field, the Research Action Plan contains:

- Key considerations for Food is Medicine research (Section IV)
- An overview of the published, peer-reviewed foundational research on the health outcomes associated with food insecurity, as well as the health outcomes associated with key federal food support programs (Section V)
- A discussion of the existing published, peer-reviewed research on Food is Medicine interventions, specifically medically tailored meals, medically tailored groceries, and produce prescriptions (Section VI)
- Concrete recommendations for future research (Section VII),with respect to
  - Ensuring that research is conceived, designed, executed, implemented, and disseminated using equity principles
  - Identifying key considerations for ensuring that research designs are robust and appropriate for yielding the most valuable and actionable information
  - Funding the most valuable research in the field
  - Identifying the most urgent questions that have yet to be explored

With the U.S. federal spending on health care nearing 25 percent of GDP, identifying how dietary interventions can meaningfully influence individual and population health is a national priority. This Action Plan is not meant to stand in for, replace, or undermine plans for broader systemic change in our health and food systems. It is instead intended to be complementary to such plans.

Existing and Forthcoming Research

The research on Food is Medicine builds upon a large and robust body of evidence that links food insecurity to poor health outcomes, both physical and mental. Research repeatedly demonstrates that food insecurity is associated with increased health care use and spending.

Food is Medicine interventions have grown exponentially in recent years. Section VI of the Action Plan provides the most comprehensive analysis to date of research on medically tailored meals, medically tailored groceries, and produce prescriptions. Section VI focuses exclusively on published, peer-reviewed research, because that is the research most often cited by those making key decisions about Food is Medicine program design, implementation, and funding. Peer-reviewed research is, however, only one part of a larger body of research that includes forthcoming studies, gray literature, and program evaluations.

Ongoing and forthcoming research indicates that the volume and rigor of research will continue to increase. These studies excitingly are beginning to fill some important gaps by focusing on health conditions and patient demographics that are underrepresented in the current literature. The greatest challenge—and starting point for this Action Plan—is how to propel rigorous, high-impact, translatable research that can quickly bring necessary reforms to our health care and food systems.

Key takeaways of current and forthcoming research include:

- Food is Medicine interventions—medically tailored meals, medically tailored groceries, and produce prescriptions—are not only replicable and scalable but also effective.
- All three interventions are associated with reduced food insecurity, improved dietary intake, and improved participant mental health.
- The medically tailored meals literature is the most well-developed, with rigorous study designs and results that pertain to clinical outcomes and health care utilization and spending. Medically tailored meals are associated with improvements in health outcomes for HIV/AIDs, type 2 diabetes, heart failure, and chronic liver disease, as well as reduced health care utilization and spending for people who are seriously ill.
- The medically tailored groceries literature is still emerging, but it represents significant innovation in connecting people with foods that support health. Programs are sometimes co-located in health care facilities or accessible at locations within the community, such as food pantries. Medically tailored groceries are associated with improvements in blood pressure and some type 2 diabetes-specific health outcomes.
- The produce prescription literature is also still emerging. It is the most voluminous and expansive, representing a wide range of program designs. The research demonstrates improvements in food security and dietary intake for a variety of participant populations, and is just starting to explore impacts on clinical health outcomes.

Recommendations for the Future of Research

The proliferation of Food is Medicine interventions and their increasing use within health care has been mostly ahead of the research, driven in large part by nonprofits and advocates who have developed creative programs to meet the nutrition-related needs of people living with chronic illness. But, particularly within the past five years, health care integration of Food is Medicine interventions is increasingly common. A new wave of interest and investment in exploring the full impact of these interventions offers opportunities to sustainably support and scale access to the most effective interventions.

Photo Credit: DC Greens

To inform the next decade of Food is Medicine research, the recommendations in this Action Plan:

- Offer concrete guidance on how to embed equity throughout the Food is Medicine research continuum;
- Identify key considerations to ensure that research designs are robust and appropriate for yielding the most valuable and actionable information;
- Identify the most urgent questions that have yet to be explored; and
- Describe how funders can support the most valuable research in the field.

Alignment with the core principles that inform these recommendations—equity, attention to research design and potential for translation, purposeful investment of resources, and contextualization of Food is Medicine within broader systems and institutions—should advance a future in which:

- Effective, appropriate Food is Medicine interventions are integrated into the US health care system, providing access to a wide range of proven interventions.
- All Food is Medicine research centers equity throughout the research continuum, in order to ensure that interventions truly empower individuals and communities and are effective across demographic groups.
- Everyone has the food that will allow them to live a healthy, dignified life.

ACTION PLAN RECOMMENDATIONS AT A GLANCE

EQUITY THROUGHOUT THE FOOD IS MEDICINE RESEARCH CONTINUUM

1. Understand the diverse experiences and broader context of the population that will receive or has already received the intervention.
2. At all stages of the research, plan to include the perspectives of potential study participants and the broader population that will receive or has already received the intervention.
3. In addition to including the perspectives of individuals with lived and/or local experience, researchers and funders should seek out perspectives and potential partnerships with community-based organizations that either provide similar services or support the study's target population in other ways.
4. Investigate the composition of the research team, including the team's perspectives and potential biases. Fully engage all team members in planning and decision-making.
5. Monitor study recruitment and retention.
6. All Food is Medicine researchers and funders should encourage academic research institutions to change policies that inhibit equity-centered research.
7. Research funders and researchers must ensure they adjust timelines and funding amounts to reflect the additional effort and investment of resources that may be required to do research that is truly equity-centered.
8. Whenever possible, qualitative research should be used to complement quantitative data.
9. Food is Medicine research design should reflect the reality of household composition and household equipment, with particular attention to the household member who buys and prepares most of the household's food.

THE FUTURE OF FOOD IS MEDICINE RESEARCH: CONSIDERATIONS IN RESEARCH DESIGN

10. Research should be appropriately powered to meaningfully evaluate the primary outcomes.
11. Researchers should prioritize rigorous study designs with a combination of qualitative and quantitative approaches, balancing the pursuit of rigor with the reality of Food is Medicine interventions.
12. Research should always report process and engagement metrics.
13. Researchers should carefully consider whether the intensity and duration of Food is Medicine intervention is likely to influence outcomes of interest.
14. Multi-sector stakeholders, including individuals in the target intervention demographic, should be convened to identify meaningful metrics across the Food is Medicine field. Metrics for specific health conditions should be developed in collaboration with primary care and specialist clinicians.

THE FUTURE OF FOOD IS MEDICINE RESEARCH: THE NEXT PHASE OF EXPLORATION

15. Research should evaluate components of multi-pathway interventions, such as food plus education versus only food, or food plus navigation assistance for broader social needs versus only food.

16. Leverage the insights of existing Food is Medicine research on health care cost and utilization to drive integration into health care.

17. Research must consistently explore the value and impact of Food is Medicine interventions beyond impact on health care cost and utilization.

18. Food is Medicine research should investigate the impact of interventions on health conditions where risk is associated with food insecurity and nutrition is key to the treatment or management of disease.

19. Research should explore the potential of Food is Medicine interventions to aid in prevention.

RESEARCH FUNDING: SUPPORTING THE NEXT PHASE OF INQUIRY IN THE FOOD IS MEDICINE FIELD

20. The National Institutes of Health should invest significantly more in Food is Medicine research.

21. A federal agency or federally appointed entity should be formally tasked with coordinating efforts across federal agencies to explore the impact of Food is Medicine interventions in many populations and geographies.

22. The Centers for Medicare and Medicaid Services (CMS), along with state Medicaid agencies, should capture data on Food is Medicine interventions from natural experiments generated by program policy changes. Evaluation of these impacts should be a priority for research funding.

23. Private funders should partner with each other and government agencies to enable more—and more ambitious—Food is Medicine research while ensuring that research aligns with equity principles.

FOOD IS MEDICINE INTERVENTIONS IN CONTEXT: BROADER RESEARCH THAT WILL SUPPORT TRANSFORMATIVE CHANGE

24. Research should explore the health impact of changes to food and nutrition support programs, especially recent developments in SNAP and WIC.

25. Research should examine the impact of income support programs on food insecurity, nutrition insecurity, and health.

26. Research should examine the impact of Food is Medicine interventions beyond the individual and household.

I. Introduction

Amid a deepening understanding of the fundamental relationship between diet and health, the US health care system serves as a critical vehicle for addressing individual nutrition to prevent, manage, and potentially reverse chronic diseases. Efforts that involve a health care response to these nutrition needs fall under the umbrella term **"Food is Medicine."**

The United States has arrived at a critical juncture for Food is Medicine, characterized in equal parts by scientific promise, a public health crisis, and the urgent need to advance equity throughout the food and health care systems.

In this Action Plan, "Food is Medicine interventions" are a spectrum of programs and services that respond to the critical link between nutrition and health. Food is Medicine interventions include:

- The provision of food that supports health, such as medically tailored meals or groceries, or food assistance, such as vouchers for produce, and
- A nexus to the health care system.

The United States faces an unabating chronic disease epidemic, leading to skyrocketing health care costs and devastating effects for individuals, communities, and the nation. An emerging body of research demonstrates the promise of Food is Medicine interventions across a range of health conditions. But health care providers, academic researchers, insurance providers, and policymakers alike want more purposeful research to build on early findings in order to facilitate widespread adoption of effective Food is Medicine interventions.[1]

The Food is Medicine Research Action Plan answers this call by laying out a comprehensive set of recommendations for creating an evidence base that will advance health care integration, build a holistic understanding of effectiveness, and engage communities, providers, and researchers.

"Health" defined: In this Action Plan, health is complete physical, mental, and social well-being, which includes adapting to evolving health needs and preventing or optimally managing disease.[2]

Experts have long known that food has a direct relationship to individual and population health. Beyond its role in meeting the body's basic energy requirements, food can protect against many types of chronic disease, aid in disease management, and support mental health.

While early nutrition research centered on the health impact of particular foods or nutrients, the focus has shifted toward overall dietary patterns that support health. A diet rich in fruits, vegetables, whole grains, and lean protein is associated with a lower risk of disease; conversely, a diet high in refined carbohydrates, added sugars, alcohol, and processed meats is associated with a higher risk of disease.[3] People living with particular primary and comorbid health conditions may also have specific dietary needs that must be met in order to manage their conditions and maximize the effectiveness of medications.

"Healthy dietary pattern" defined: In 2015, the US Dietary Guidelines Advisory Committee described a healthy dietary pattern as "higher in vegetables, fruits, whole grains, low- or non-fat dairy, seafood, legumes, and nuts; ... lower in red and processed meat; and low in sugar-sweetened foods and drinks and refined grains."[4] The 2020–2025 Dietary Guidelines for Americans build on this approach, identifying healthy dietary patterns for different life stages, but finding that the "core elements of a healthy dietary pattern are remarkably consistent across the lifespan and across health outcomes."[5]

An estimated 60 percent of the US adult population suffers from at least one chronic health condition, and those that are diet-related are the among the most prevalent: hypertension (27 percent of all adults), lipid disorders (22 percent of all adults), and type 2 diabetes (12 percent of all adults).[6] Diet-related health conditions cost the United States trillions of dollars each year in direct health care spending and lost economic productivity.[7] And these costs are rising.[8] Diet quality is now the leading risk factor for death in the United States, surpassing tobacco use.[9] Cardiovascular diseases, cancer, and diabetes—all of which count diet as a significant risk factor—account for over half of all adult deaths.[10]

"Foods that support health" defined: In this Action Plan, foods that support health are those that allow people to eat according to the dietary patterns that scientific consensus has identified as most likely to support physical, mental, and social well-being. These foods will evolve over time as research evolves and should cover a wide range of foods, making room for cultural norms as well as individual preferences.

1 in 10 Adults meets the US Dietary Guidelines recommendations for fruits and vegetables.

Unfortunately, the diets of most US residents do not align with the healthy dietary pattern identified in nutrition research as most likely to prevent chronic diet-related disease.[11] Only 1 in 10 adults meets the US Dietary Guidelines recommendations for fruits and vegetables.[12] The majority of young people ages 2 to 19 consume diets that researchers describe as "poor quality," with less than 1 percent attaining "ideal quality."[13] Technological advances in food processing, the rise of mass marketing and food retail, societal changes that make convenience and shelf-stability key factors in food purchasing, and federal subsidies for staple crops mean that ultra-processed foods are the most readily available and the least expensive, particularly in marginalized and under-resourced communities.[14] These foods, which are associated with increased caloric intake and weight gain, make up nearly 60 percent of the US diet and account for 90 percent of added sugar consumption.[15] Consumption of ultra-processed foods is also associated with increased risk for cardiovascular disease and early death.[16]

In addition to increasing health care costs, diet-related illnesses take a devastating toll on individual quality of life. Those living with these illnesses experience higher rates of physical disability, unemployment, stigma, depression, and anxiety.[17] These stresses are often compounded by onerous—and untenable—out-of-pocket expenses for medical care, also known as "financial toxicity."[18]

> *"Improvements in diet and nutrition offer us one of our greatest opportunities to have a profound and generational impact on human health. … The public health gains of such efforts would almost certainly dwarf any single medical innovation or intervention we could discover."*
>
> —Scott Gottlieb, Former Food and Drug Administration Comissioner, 2018

Table 1: Diet-Related Health Conditions

The range of diet-related health conditions varies widely, as does the precise role of diet in the prevention, progression, and management of different health conditions. With some health conditions, diet is associated with increased risk; while with others, diet may not affect onset but can curb symptoms or even aid in treatment. Strengthening the research that supports this list is an important part of the Food is Medicine movement.

Health condition	Diet as part of primary prevention	Diet aids in treatment/ management
Malnutrition[19]	✓	✓
Diabetes[20]		
Type 2 diabetes	✓	✓
Type 1 diabetes		✓
Gestational diabetes	✓	✓
Diet-related risk factors (type 2 diabetes): prediabetes (HbA1c of 5.7% to 6.4%), central obesity, high BMI		
Cardiovascular conditions, various[21]		
Atherosclerosis	✓	✓
Coronary heart disease (ischemic heart disease, coronary artery disease)	✓	✓
Peripheral artery disease		
Congestive heart failure	✓	✓
Stroke	✓	✓
Heart attack (myocardial infarction)	✓	✓
Hypertension (high blood pressure)	✓	✓
Diet-related risk factors: central obesity, high BMI, hyperlipidemia (high cholesterol)		
Cancer, various types[22]	[varies by type]	[varies by treatment]
Kidney/renal diseases[23]		
Chronic kidney disease	✓	✓
End-stage renal disease/kidney failure	✓	✓
Liver diseases[24]		
Nonalcoholic fatty liver disease (nonalcoholic steatohepatitis)	✓	✓
Alcoholic liver disease	✓	
HIV/AIDS[25]		✓
Arthritis[26]		
Osteoarthritis	✓	✓
Rheumatoid arthritis		[emerging]
Mental & neurological health, various conditions[27]	[varies by condition]	[varies by condition]
Pregnancy & early childhood development, various conditions[28]	[varies by condition]	[varies by condition]

The burden of diet-related disease reflects the country's deepest divisions and inequalities, disproportionately affecting low-income and majority Black, Latinx, and Indigenous communities.[29]

Addressing the epidemic of diet-related disease requires strengthening every individual's ability to consistently consume foods that support health. **Contrary to narratives that emphasize individual behavior and choice, this effort must focus on the structural forces beyond individual control that overwhelmingly shape food access, diet, and health.**

"Structural racism" defined: At the core of the racial and ethnic disparities that run throughout the food and health care systems is structural racism. Professor Zinzi D. Bailey and colleagues define structural racism as:

> Structural racism involves interconnected institutions, whose linkages are historically rooted and culturally reinforced. It refers to the totality of ways in which societies foster racial discrimination, through mutually reinforcing inequitable systems (in housing, education, employment, earnings, benefits, credit, media, health care, criminal justice, and so on) that in turn reinforce discriminatory beliefs, values, and distribution of resources, which together affect the risk of adverse health outcomes.[30]

Centuries of exclusionary policies have denied low-income and majority Black and brown communities access to foods that support health, along with affordable housing, outdoor spaces, quality medical care, stable employment, and well-resourced schools.[31] These interrelated policies continue to reverberate in society today, with disparities in rates of chronic disease the unjust result.[32] This reality increases the importance and urgency that Food is Medicine interventions effectively address the wants and needs of individuals and communities whom majority white institutions and policymakers have historically excluded from equitable treatment at interpersonal, institutional, and systemic levels.

When compared with other high-income countries, the United States spends nearly twice as much on health care yet has the highest rate of chronic diseases and the lowest life expectancy.[33] Efforts to reform the US health care system in the face of this grim reality have focused on three linked goals, known as the "triple aim"—improving the experience of health care among patients, improving the health of populations, and reducing the per capita cost of care.[34] This framework has recently been expanded to the "quadruple aim," with the inclusion of a critical fourth goal: improving the work life of health care providers.[35] The US health care system cannot achieve these aims without addressing diet, but unfortunately, it hasn't traditionally been set up to do so. Early research on Food is Medicine interventions demonstrates the potential for these interventions to have a meaningful impact in all four areas (see Section VI: Research on Food is Medicine Interventions).

Despite the longstanding recognition among the medical community that food and health are fundamentally linked, major public insurance programs have traditionally failed to cover food-based interventions. Food and nutrition have been the domain of public health, rather than the health care system.[36]

Health care entities have only recently begun to formally recognize the disproportionate impact that food insecurity and poor diet have on health outcomes, establishing programs that identify and respond to the need for more or different types of food. However, these programs face numerous challenges. At a foundational level, food does not neatly fit into the clinical context; the complexity of daily nutrition is difficult to address in a 15-minute consultation and requires different types of screening and referral. Often there is no billing mechanism for food resources. Even formal community referral systems face limitations as community-based nutrition programs may not have the resources to provide patients with the food they need. **Equipping the health care system to respond appropriately to nutritional needs requires significant collaboration, largely with partners outside of the clinical setting, and sufficient funding.** In addition, these programs face barriers related to data-sharing and confusion around application of health care fraud and abuse laws, which can create further challenges for operation and administration.[37]

Ultimately, lack of clarity around when food can be a health care benefit and, if it is not a health care benefit, how it can be utilized to support patients and their families means that formal reforms may be needed to meaningfully integrate Food is Medicine interventions into health care. Because support for health care reforms is driven by research on intervention efficacy, developing a robust body of evidence is critical. The compelling findings of research so far, the proliferation of interventions, and the momentum around Food is Medicine make deep investigation a worthwhile and urgent endeavor.

Photo Credit Courtesy Tufts Friedman School of Nutrition Science and Policy

Table 2: Food is Medicine Momentum: A Timeline of Select Significant Events in the Evolution of Food is Medicine Since 1929

The Concept of Food is Medicine is Not New

In the United States, institutional recognition within the medical field of the close link between nutrition and health goes back nearly 100 years. In 1929, the American Medical Association launched its Committee on Foods, which was shortly thereafter broadened to the Council on Foods and Nutrition.[38] In 1941, during World War II, President Franklin Delano Roosevelt convened his first White House Conference on the topic of Nutrition for Defense. The conference largely focused on "public health and medical aspects of nutrition" and concluded with a list of key findings, the first being that "great and sometimes startling advances in our knowledge of nutrition in recent years have made it clear that the food an individual eats fundamentally affects his health, strength, stamina, nervous condition, morale, and mental functioning."[39]

A Timeline of Significant Events in Food is Medicine, continued

1929–1980

1929: The American Medical Association launches its Committee on Foods.[40]

1941: President Franklin Delano Roosevelt convenes the White House Conference on Nutrition for Defense.[41]

1946: Congress passes the National School Lunch Act to "safeguard the health and well-being of the Nation's children and to encourage the domestic consumption of nutritious agricultural commodities and other food."[42]

1964: Congress passes the Food Stamp Act, permanently authorizing the Food Stamp Program (renamed the Supplemental Nutrition Assistance Program, or "SNAP," in 2008) to provide, among other things, "for improved levels of nutrition among low-income households."[43]

1966: Congress passes the Child Nutrition Act, which establishes the School Breakfast Program as well as other child nutrition programs, in "recognition of the demonstrated relationship between food and good nutrition and the capacity of children to develop and learn."[44]

Late 1960s: Dr. H. Jack Geiger and colleagues offer "prescriptions" for food to families with malnourished children out of a community health center in Mound Bayou, Mississippi.[45]

1969: President Richard Nixon convenes the White House Conference on Food, Nutrition, and Health.[46] The conference resulted in a report containing around 1,800 recommendations for ending hunger and malnutrition in the United States—1,650 of which were implemented within two years of the White House Conference.[47]

1971–1972: The 1971 White House Conference on Aging report finds that "one-half to one-third of the health problems of the elderly are related to nutrition" and recommends that nutrition services and counseling be "a required component of all health delivery systems."[48] The following year, Congress passes the Older Americans Act, establishing the Elderly Nutrition Program to provide grants to states for congregate and home-delivered meal programs.[49]

1971–1974: The Food Stamp Program undergoes significant legislative changes aimed at increasing participation, including the requirement that states expand the program to every political jurisdiction.[50]

1972–1975: The Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) evolves from a pilot to a permanent program, authorized by Congress to "provide supplemental nutritious food as an adjunct to good health care during such critical times of growth and development in order to prevent the occurrence of health problems."[51]

A Timeline of Significant Events in Food is Medicine, continued

1980–2018

1983: Section 1915(c) of the Social Security Act allows home- and community-based services waivers in the Medicaid program, the first vehicle that allowed Medicaid dollars to pay for home-delivered meals for certain enrollees (at a minimum, those who but for the provision of such services would need to be institutionalized).[52]

1985: The first medically tailored meal organizations are founded in order to respond to the HIV pandemic; the combination of access to registered dietitian nutritionists and home-delivered meals helped people living with HIV combat wasting and manage medications and side effects.[53]

1990: Congress passes the Ryan White CARE Act, establishing the Ryan White HIV/AIDS Program to fund treatment and comprehensive care services, including "nutrition services," for low-income people living with HIV.[54]

1994: A group of food and nutrition providers serving people living with HIV hold the first annual conference of the AIDS Nutrition Services Association (ANSA), later renamed the Association of Nutrition Services Agencies, to share best practices and nutrition science.[55]

Late 1990s–early 2000s: Most medically tailored meal organizations expand their missions to serve people living with all illnesses.[56]

2010: Congress passes the Patient Protection and Affordable Care Act (ACA), instituting health care reform across the country and sanctioning many innovative projects that have come to include Food is Medicine interventions.[57]

2010–2013: ANSA dissolves and is re-formed as the Food Is Medicine Coalition, a national coalition of nonprofits delivering medically tailored meals, nutrition counseling, and education to people across the country who are too sick to shop or cook for themselves.[58]

2014: The Agricultural Act of 2014 (the Farm Bill) establishes the Food Insecurity Nutrition Incentive Program (FINI) grant program, dedicating $100 million to support produce incentive programs for SNAP recipients, and permitting a "produce-prescription" design for these incentives.[59]

2016: The Centers for Medicare & Medicaid Services (CMS) launches the Accountable Health Communities model, authorized under the ACA, to test whether systematically identifying and addressing the health-related social needs of Medicare and Medicaid beneficiaries through screening, referral, and community navigation services will impact health care costs and reduce health care utilization.[60]

2016–2018: CMS approves requests from states, such as Massachusetts and North Carolina, to implement Medicaid Demonstration Waivers that allow states to use Medicaid funds to address health-related social needs through a variety programs, including nutrition interventions.[61]

A Timeline of Significant Events in Food is Medicine, continued

2018–2021

2018–2019: CMS broadens the scope of supplemental benefits covered under Medicare Advantage plans so that plans may cover nutrition services for certain groups.[62]

2018: The California state legislature appropriates $6 million for a three-year medically tailored meals pilot for Medi-Cal (the state's Medicaid program) recipients with congestive heart failure.[63]

2018: The Bipartisan Food is Medicine Working Group forms in the US House of Representatives.[64]

2018: The Agricultural Improvement Act of 2018 (the Farm Bill) renames FINI as the Gus Schumacher Nutrition Incentive Program (GusNIP) and expands funding to $250 million, with a maximum of 10 percent set aside to support produce prescription programs over five years (2019–2023).[65]

2019: Comprising produce prescription program operators, researchers, and advocates, the National Produce Prescription Coalition forms to "catalyze the vital role of food and nutrition in improving health and wellness by collectively leveraging the unique opportunities for Produce Prescriptions to achieve wellness through the healthcare system, and embedding & institutionalizing Produce Prescriptions within the healthcare payment model."[66]

2020: North Carolina authorizes $2.5 million in state funding to expand a pilot produce prescription program across the state.[67]

2020: New York includes medically tailored meals on a list of approved services that managed care plans can choose to provide to enrolled Medicaid members as covered benefits.[68]

2020: The House Appropriations Committee directs the National Institutes of Health (NIH) to research Food is Medicine, explicitly naming medically tailored meals and produce prescriptions.[69]

2020: The NIH includes evaluating "how we can improve the use of food as medicine" as one of four strategic goals in its 2020–2030 Strategic Plan for NIH Nutrition Research.[70]

2020: Legislation that would require the Massachusetts Medicaid program to mount and evaluate a pilot that connects Medicaid enrollees to a spectrum of food and nutrition interventions is introduced in the state legislature, and reintroduced in 2021.[71]

2020: The Medically Tailored Meals Pilot Demonstration Act is introduced in the US House of Representatives, proposing the creation and evaluation of a CMS medically tailored meals pilot program for Medicare enrollees following an inpatient hospital admission, but does not pass. The bill is reintroduced in 2021.[72]

2020–2021: The federal response to the Covid-19 pandemic includes an array of new assistance programs, enhancements and flexibilities for existing programs, and funding opportunities. These include an increase in SNAP's maximum benefit, SNAP emergency allotments, countless flexibilities in SNAP administration, school meal replacement through Pandemic-EBT, the Farmers to Families Food Box Program, GusNIP Covid Relief and Response grants ($75 million), extended Medicaid waivers allowing meal delivery, expanded unemployment benefits, stimulus checks, an expanded Child Tax Credit, and more. SNAP benefits also increased by 21 percent in 2021 after the U.S. Department of Agriculture conducted a review of the Thrifty Food Plan that the SNAP allotment is based on.[73]

A Timeline of Significant Events in Food is Medicine, continued

2020–2021: Congress attempts to appropriate funds for produce prescription pilot programs in both the Veterans Health Administration and Indian Health Service.[74]

2021: Virginia establishes a working group to plan for a three-year produce prescription pilot, and requests $2 million to operate the pilot.[75]

2021: California proposes including medically supportive food and nutrition interventions on a list of approved services that managed care plans can choose to provide to enrolled Medicaid members as covered benefits.[76]

Food is Medicine can equip the health care system to respond to nutrition needs while building the evidence base for broader reform.

This Food is Medicine Research Action Plan asserts a cohesive direction for future research that illuminates who will benefit from what types of nutrition interventions, in what ways, and under what circumstances—while maintaining equity as the guiding force for research prioritization and design. The Action Plan focuses on the health care system as the main vehicle for providing Food is Medicine interventions in the short term. However, the findings from the research proposed in this Action Plan will have important implications for broader structural reforms in the food system and beyond. Inquiry at the intersection of health care and food is a critical pursuit that can push nutrition research as a whole in practical, productive, and interdisciplinary directions. By changing and monitoring how Americans typically respond to food insecurity and nutrition needs as they relate to preventive, curative, and ameliorative health care, researchers will uncover important truths that can inform future health, food, labor, agriculture, transportation, and environmental policies.

Photo Credit: God's Love We Deliver (Jessica Frankl)

II. About the Food & Society Food is Medicine Initiative

In this section, we introduce the goals and target audience of the *Food is Medicine Research Action Plan* and describe how it was developed.

Mission

The Food is Medicine Initiative of Food & Society at the Aspen Institute catalyzes investment in high-impact Food is Medicine research that advances health care integration, builds a holistic understanding of effectiveness, and engages new communities, providers, and researchers.

Vision

Food & Society works toward a future in which:

- Everyone has the food that will allow them to live a healthy, dignified life according to their specific needs
- Effective, appropriate Food is Medicine interventions are integrated into the U.S. health care system nationwide, providing access to a wide range of proven interventions
- All Food is Medicine research applies an equity framework to ensure that interventions empower individuals and communities and are effective across demographic groups

About the Food is Medicine Research Action Plan

This Action Plan assesses and builds on Food is Medicine findings to date. We outline proposed recommendations that will assist the health care system in deploying effective nutrition interventions in both the near- and longer term, while providing a credible basis for redesigning policy and regulatory mechanisms to support that shift.

The Action Plan contains:

- An overview of the current research on the health impacts of food insecurity, key federal nutrition programs, and Food is Medicine interventions
- Concrete recommendations for future research in the field with respect to:
  - Ensuring that research is conceived, designed, executed, implemented, and disseminated using equity principles;
  - Identifying key considerations to ensure that research designs are robust and appropriate for yielding the most valuable and actionable information;
  - Identifying the most urgent questions that have yet to be explored;
  - Funding the most valuable research in the field; and
  - Understanding the research outside the scope of Food is Medicine that has major implications for nutrition and health, both within and beyond the health care system.

This Action Plan is written for:

Researchers

By identifying key evidence gaps, we hope to encourage existing experts in the field and new researchers to explore questions that will move Food is Medicine forward and help stakeholders across all sectors take steps to increase access to foods that support health. To encourage engagement and alignment with equity principles, we share methods for centering racial equity in research, along with trends in best practices for researchers to ensure that research is a positive and productive experience for participants, and that results are meaningful and translatable.

Funders

Comprehensive investigation in the Food is Medicine field requires robust investment from a range of funders, both public and private. The Action Plan identifies opportunities that are particularly suited to certain funders, and to collaborative funding. We encourage funders to review plans to support Food is Medicine research with a focus on equity.

Advocates

The Action Plan contains a clear-eyed assessment of Food is Medicine research and specific recommendations on how to build the evidence base. It argues that research can demonstrate the value of Food is Medicine from several perspectives, from impact on health care utilization and cost to impact on individual well-being and community resilience.

Program Implementers

Partners and funders ask Food is Medicine programs to demonstrate impact and value. We reflect on research objectives, design, outcomes, and processes in order to help program implementers use research and evaluation dollars wisely and invest in research that meaningfully adds to the field, while minimizing burdens on program participants and Food is Medicine program staff.

Process

The Food is Medicine Research Action Plan is the result of a two-year, highly collaborative process that launched just as the Covid-19 pandemic was taking hold. Though the onset of the pandemic altered timelines and plans for in-person meetings, the initiative still actively engaged experts in the field from all sectors, organizations, and institutions working in Food is Medicine. The initiative has also responded to the national call for racial justice and an end to systems of racism, exclusion, and oppression. Any research that features the food and health care systems, with their manifold, deeply embedded inequities, must reflect the current national dialogue and move the nation toward urgently needed reform. In carrying out its activities, the initiative has sought to remain flexible in order meet the moment and reflect, to the best of its members' abilities, the lessons that have emerged. We recognize that many important lessons have yet to be discovered.

To inform the Action Plan, the Food is Medicine Initiative:

- **Formed an Advisory Board:** The Advisory Board includes leading researchers, program providers, policy experts, and advocates across the spectrum of Food is Medicine interventions:
  - Clinical researchers, social scientists, and physicians who study food and health inequities
  - Representatives from food banks and providers of medically tailored meals, medically tailored groceries, and produce prescriptions
  - Representatives from relevant federal agencies, including the Centers for Medicare and Medicaid Services and the Centers for Disease Control and Prevention
  - Representatives from other key groups, such as health care organizations, health insurers, retail, and philanthropy
- **Defined "Food is Medicine":** As the term "Food is Medicine" does not have a technical, widely agreed-upon definition, it was important to establish a definition for the purposes of the initiative. The initiative worked closely with the Advisory Board to establish a definition both narrow enough to yield useful recommendations and broad enough to encompass a range of promising interventions.
- **Launched the initiative:** In June 2020, the leadership team hosted a two-day online meeting to introduce the initiative and explore key topics with some of the field's leading figures. The 55 attendees represented a range of fields and disciplines, including academic research, program evaluation, health care delivery, food and nutrition program delivery, health insurance, policy advocacy, federal policy, and retail. The initial gathering identified areas for further exploration and directly informed the structure and content of this report.
- **Gathered data and input:** Following the initial launch, the leadership team conducted a series of targeted workshops, listening sessions, and key informant interviews to gather information and to go more in-depth on some areas. Topics included research methodology, regional challenges, data, Covid-19, payer perspectives, and racial equity in research. A working group on racial equity in research collaborated on a journal article for academic publication, with the working title "Centering Racial and Ethnic Equity in Food is Medicine Research."

Key Insights that Informed the Food is Medicine Initiative and Action Plan

The Action Plan builds on the knowledge and activities of individuals, organizations, and institutions that have been developing and working in this field for many years. The following key insights gleaned from that work informed the initial outline and process for creating the Action Plan:

The existing evidence base demonstrates sufficient promise to warrant further research and implementation of proven interventions.

There is a lack of consensus and coordination about research in the field. This is due, in part, to disparate actors—from researchers and program providers to health care payers and policymakers—operating within a field that is cross-disciplinary by definition.

Food and nutrition interventions are rarely one size fits all. The field needs a nuanced portrait of what works, for whom, and why to ensure appropriate and effective scale. Large-scale investment in Food is Medicine research will yield results and insights to support coverage of Food is Medicine by health care payers as well as effective implementation by program providers.

Non-temporary funding for evidence-based Food is Medicine interventions is best achieved through the public and private health care system. Retrofitting and reforming the health care system to integrate these interventions will require buy-in from the health care sector and structural reforms to support program coverage and administration, as well as significant philanthropic and government investment in research and program innovation.

Though the impact of Food is Medicine interventions on health care costs can and will be further explored, the key metrics by which Food is Medicine interventions are evaluated must extend beyond cost.

Food is Medicine interventions should further build on and enhance—not replace—the current baseline support for food access across the United States.

In the absence of transformative changes to the social safety net in the United States, and given the economic and health impacts of the Covid-19 pandemic, Food & Society at the Aspen Institute anticipates that rates of food insecurity and chronic diet-related disease will persist in the coming years. Likewise, we anticipate that the country's rampant health disparities, many of which were exacerbated by the Covid-19 pandemic, will persist or even rise.

We expect to see a significant impact on health and well-being from better understanding how to leverage nutrition within the current and near-future health care system. A robust body of evidence on Food is Medicine interventions will also have enormous value for informing broader reform efforts in the food and health care systems. At the same time, the full scale of this benefit may not be observable for many years.

Where the health care and food systems intersect is the scope of this Action Plan. While the research shows a measurable clinical impact from increasing access to Food is Medicine interventions, we recognize that many potential clients/patients/beneficiaries cannot access a health care system that includes these types of initiatives. Employing a strategic approach to building the evidence base for health care integration from the outset can help ensure that Food is Medicine interventions do not exacerbate or compound inequities and access barriers within the health care system.

III. Food is Medicine Defined

In this section, we lay out the scope of Food is Medicine interventions explored in the Food is Medicine Research Action Plan and describe the main categories of interventions being deployed as of 2021.

The phrase "Food is Medicine" has been used in connection with a broad array of concepts, products, and services. The idea that food is central to health is a tenet of many cultures.[77] The phrase has also been used to market foods and dietary supplements.[78]

We adopt a more specific definition. The purpose of this Action Plan is to articulate how research can move society toward widespread and equitable access to evidence-based, culturally appropriate, and community-centered nutrition interventions in the context of health care. Accordingly, we use Food is Medicine to refer to the intersection of food and health care. And we use "Food is Medicine interventions" to refer to the specific activities that increase access to foods that support health in that context.

In this Action Plan, "Food is Medicine interventions" are a spectrum of programs and services that respond to the critical link between nutrition and health. Food is Medicine interventions include:

- **The provision of foods that support health, such as medically tailored meals or groceries, or food assistance, such as vouchers for produce**
- **A nexus to the health care system**

Currently, Food is Medicine interventions are accessed in one of two ways:

- Interventions are actively recommended by a health care provider who has identified the need for the intervention in a clinical setting. In this scenario, a provider screens or assesses a patient and immediately provides a referral or prescription for the intervention.
- Interventions are provided because the individual has been previously screened for, deemed at risk for, or diagnosed with a health condition that is related to or affected by diet. Although the screening or diagnosis may have taken place in a health care setting, the intervention is provided without the active involvement of a health care provider.

For example, someone who is food insecure and diagnosed with type 2 diabetes in 2019 might access a medically tailored food box at a food bank in 2021 without their provider's direct involvement or knowledge. In this scenario, identification of the health risk or health-related need that prompts eligibility for the intervention—confirmation of food insecurity and existence of a diet-related health condition—takes place in a community setting.

The clinical and community access points for Food is Medicine interventions reflect the movement's origins. For example, **medically tailored meals** were initially provided as a community response to a health issue (wasting among people living with HIV), but their provision was divorced from the health care system.[79] As management and treatment of HIV/AIDS evolved and experience demonstrated the critical importance of nutrition, health care providers became more involved.

Today, Registered Dietitian Nutritionists design medically tailored meals for individuals while clinicians assess their need and eligibility. The Ryan White CARE Act acknowledged the importance of medically tailored nutrition in the management of HIV by providing funding for these services in addition to medical and pharmaceutical interventions.[80] Providers of medically tailored meals quickly recognized that people living with HIV were not the only individuals who needed access to disease-specific nutrition; to date, however, there are not similar federal funding streams for those living with other illnesses.

Produce prescriptions also largely originated outside the health care system. Although Dr. Jack Geiger famously prescribed food for his malnourished patients living in the Mississippi Delta in the 1960s, the practice wasn't widespread.[81] In the 1980s and 1990s, a series of federal and state programs began to provide subsidies or vouchers for fruits and vegetables, especially locally grown fruits and vegetables.[82] While these programs often targeted groups with specific nutritional needs and access challenges (such as WIC participants or low-income seniors), they were also created to promote the purchase of local food and were divorced from health care.[83] With increasing recognition of the association between diet and chronic disease, the link between produce subsidies and health care was reemphasized, culminating in the 2018 Farm Bill, which set aside up to 10 percent of $250 million in nutrition incentive funding for programs that involve a health care entity and measure success, in part, based on health outcome metrics.[84]

Interventions Within this Action Plan's Definition and Scope

For the purposes of this Action Plan, we focus on three categories of interventions:

1. **medically tailored meals**
2. **medically tailored groceries**
3. **produce prescriptions**

National coalitions of intervention providers have established definitions of two of these categories—medically tailored meals and produce prescriptions—that have recently been adopted by many health care entities and government programs. However, interventions that are evaluated in the peer-reviewed literature and described as medically tailored meals and produce prescriptions do not always align with these definitions.

In describing each intervention category, therefore, we acknowledge any specific definitions established by national coalitions and the breadth of activities and services that appear in the peer-reviewed literature using the same terminology. Where, as in the case of medically tailored groceries, there is no national coalition that has defined the intervention, we describe the breadth of activities and services that appear in the peer-reviewed literature and refer to definitions of similar services adopted by state health care entities.

The goal of describing these interventions is not to limit the scope of Food is Medicine interventions, which are necessarily evolving in response to research and the complex realities of the health care and food systems, but to capture where the field is now so that future research can build on and further explore, rather than repeat, the existing literature.

Table 3: Overview of Food is Medicine Interventions

Food is Medicine interventions involve a range of key design and implementation decisions, each with the potential to impact health outcomes. In distinguishing the three intervention categories covered in this report, we largely focus on the preparation level of the food provided (complete meals, a range of perishable and nonperishable grocery items, or only produce) and the amount of food provided (complete or near-complete nutritional needs, partial nutritional needs, or supplemental nutritional needs). This categorization is not intended as a bright-line rule but rather as a helpful schema. Indeed, the line between medically tailored groceries and produce prescriptions is already quite blurry as produce prescriptions are sometimes expanded to offer a greater quantity of food or even to cover non-produce items.

	Medically tailored meals	Medically tailored groceries*	Produce prescriptions*
Preparation level and type of food	Ready-to-eat (reheated in an oven or microwave) meals and snacks	A range of perishable and nonperishable grocery items, including produce, that will require further preparation	Produce—fresh, frozen, or canned (no added salt, sugar, or fat)—which, depending on the items, may require further preparation
Amount of food	Complete or near-complete (over 50% of caloric needs met) nutrition	Partial or near-complete nutrition	Supplemental nutrition

**There is significant overlap between these two categories as some produce prescriptions cover significant amounts of produce (either via voucher or direct provision) or even non-produce, minimally processed items.*

Medically tailored meals defined: Fully prepared meals designed by a Registered Dietitian Nutritionist to address an individual's medical diagnosis, symptoms, allergies, and medication side effects.

The Food is Medicine Coalition definition: "Medically tailored meals are delivered to individuals living with severe illness through a referral from a medical professional or healthcare plan. Meal plans are tailored to the medical needs of the recipient by a Registered Dietitian Nutritionist (RDN), and are designed to improve health outcomes, lower cost of care, and increase patient satisfaction."[85]

Typically, the need for medically tailored meals is identified by a physician or other health care provider who refers the patient to a medically tailored meal organization and provides information about the patient's diagnoses and other relevant health information. Patients generally have complex and/or terminal illnesses and co-occurring conditions that make it difficult to shop or cook. Medically tailored meal interventions frequently include access to medical nutrition therapy or nutritional counseling from Registered Dietitian Nutritionists (RDNs) who are either employed by the meal provider or a health care organization in partnership with the meal provider.

Given the origins of medically tailored meals during the height of the HIV epidemic and the demographic of individuals with very complex health needs who generally receive them today, medically tailored meals are frequently a long-term critical support. Recently, health care insurers and providers have started offering medically tailored meals on a short-term basis, such as post-hospitalization outpatient support, and to address an acute clinical need, such as very high hemoglobin A1c (HbA1c) levels among people with diabetes.[86] They have also provided medically tailored meals to people experiencing high-risk pregnancies.[87] With these shorter-term uses, the duration of the intervention is set by the insurance plan, funder, or health care organization policy. Where duration isn't set by policy, the ongoing need for medically tailored meals is periodically recertified by the medical provider.

Table 4: Medically Tailored Meals in Practice

Use Case Provided by Alissa Wassung and Lisa Zullig, MS, RDN, CSG, CDN, of God's Love We Deliver, a member organization of the Food is Medicine Coalition

	Medically Tailored Meals: In General	Use Case: Medically Tailored Meals for People Living with Diabetes and Renal Failure
Clients/ participants	Medically tailored meal programs typically serve clients living with severe and/or chronic illness and activities of daily living limitations. Prevalent diagnoses include congestive heart failure, chronic kidney disease, uncontrolled diabetes, HIV/AIDs, and cancer. Most clients have two or more comorbidities.	Participants are patients at a dialysis center who have a diagnosis of type 2 diabetes and end-stage renal disease.
Referral/ identification	Clients are assessed for the need for medically tailored meals by a health care provider or health insurance plan. Those identified as eligible based on specific program criteria are then referred to the medically tailored meal provider, in many cases a community-based nonprofit organization.	Patients are identified and referred to services in one of two ways: (1) clinicians or staff overseeing the dialysis screen the patients for nutrition needs, or (2) the patient's treating physician, usually an endocrinologist or nephrologist, refers the patient.
Food selection and sourcing	Meal plans are tailored to the medical needs of the client by an RDN, reflecting appropriate dietary therapies based on evidence-based nutritional practice guidelines to address medical diagnoses, symptoms, allergies, and medication side effects. Medically tailored meal providers layer specialty diets, including but not limited to renal, diabetic, heart-healthy, and texture-modified (soft, minced, pureed) diets. Food is Medicine Coalition member organizations follow the Coalition's Medically Tailored Meal Nutrition Standards, which establish specific nutrient requirements for different health conditions.	Following a referral, the medically tailored meals organization conducts an intake with the patient that identifies relevant details about the client's home environment, such as the client's food preparation equipment, and identifies any mobility needs. An RDN then performs an in-depth nutrition assessment to identify nutrition-related problems, determine the level of care, create a treatment plan with the client that includes the planned intervention and frequency of evaluation, assign any dietary restrictions if needed, conduct counseling, and provide verbal and written education following evidence-based nutritional guidelines. The RDN selects an appropriate meal plan based on the patient's individual needs. For this patient population, the meal plan would provide an adequate amount of calories and protein, while controlling for the amount of sodium, potassium, phosphorus, fluid, and added sugars.

Table 4: Medically Tailored Meals in Practice, continued

	Medically Tailored Meals: In General	Use Case: Medically Tailored Meals for People Living with Diabetes and Renal Failure
Food preparation and other program components	For organizations that belong to the Food is Medicine Coalition, nutrition assessment and ongoing opportunities for nutrition counseling and medical nutrition therapy are offered along with the meal program. Organizations must prepare meals from scratch using fresh ingredients, without fillers or preservatives. Medically tailored meal providers must maintain passing grades on food-safety inspections from the local departments of health on a consistent basis. There must be a certified food handler on every food-related shift. Any individuals who work with food must receive food-safety training.	Meals are fully prepared in the organization's commercial-grade kitchen and flash frozen. Patients reheat meals throughout the week according to the instructions; meals can be reheated in a microwave or oven. Meals include a well-balanced entrée, salad, roll, and low-sugar dessert or fruit, as appropriate based on the nutrition assessment. Ongoing nutrition counseling is available to the client throughout. Patients can speak with an RDN on staff at the medically tailored meal organization to discuss how to navigate their meal schedule and medications throughout the day and about foods they are using to supplement their diet for any meals not provided by the program.
Food distribution and/or delivery	Medically tailored meals are available through home delivery or pick-up. Home delivery is an especially important feature for clients with mobility issues. All nutrition services, including assessment and counseling, are delivered either in person or via telehealth.	10-21 meals are delivered once per week to the patient's home in a refrigerated vehicle.
Duration	Medically tailored meals can be utilized for short or long durations. They are frequently part of a long-term health management plan for patients experiencing severe illnesses, like cancer or HIV. Patients with chronic illnesses will generally have an initial assessment and then a reassessment for need and eligibility every six months. Alternatively, medically tailored meals can be episodic, such as during a high-risk pregnancy and the post-partum period, or as part of a patient's recovery process, such as after surgery, during chemotherapy, or after an in-patient hospitalization. Ideally, the duration will match a patient's medical needs and allow for re-dosing as appropriate.	Patients with these diagnoses are usually referred to the program for one year, with an RDN assessment every six months to adjust dietary needs and to determine continued eligibility and need for the program. When meals are provided to a patient as part of a contract with an insurer or hospital, the contract determines the duration and number of meals; it can be shorter or longer than six months and include a varied number of meals per week.

Medically tailored groceries defined: Distributions of unprepared or lightly processed foods that recipients are meant to prepare for consumption at home; the contents are sufficient to prepare nutritionally complete meals or provide a significant portion of the ingredients for such meals, including produce, whole grains and legumes, and lean proteins.

Medically tailored groceries range from boxes of store-bought shelf products to a format similar to a meal kit, with ingredients portioned by meal and small allocations of items like spice blends and sauces.[88] Distribution sites include food pantries located on-site in health care settings, community food pantries, and other community sites. Some programs offer home delivery. Nutrition education and recipes are sometimes made available to recipients, and the food items are approved by an RDN as appropriate for certain medical diets and health conditions, such as a diabetes-appropriate food box. Generally, however, food is not tailored to individual cultural needs, food preferences, or preparation abilities. Recipients are screened for food insecurity or deemed eligible for the intervention due to participation in a means-tested program such as Medicaid or SNAP.

Note: WIC meets the definition of a medically tailored grocery intervention.

Table 5: Medically Tailored Groceries in Practice

Use Case Provided by Dr. Hilary Seligman of the University of California-San Francisco and Joy Goetz of the Atlanta Community Food Bank

	Medically Tailored Groceries/Food Boxes: In General	Use Case: Grady Hospital Food as Medicine Prescription Program in partnership with Atlanta Community Food Bank: a Food Pharmacy
Clients/participants	Medically tailored groceries or food boxes typically serve clients with diet-related health risks or conditions who are: • food insecure or have other documented challenges in accessing nutritious foods, • able to prepare food for themselves using raw ingredients, and • have minimal barriers to picking up food from a community location.	Participants are patients of primary care physicians within Grady Health System. They have been identified through a clinic visit as having (1) a positive screening for food insecurity and (2) uncontrolled diabetes (HbA1c over 9) and/or (3) stage 2 hypertension.
Referral/identification	Identification and referral of patients is done by a health care provider or health insurance plan. Alternatively—and, especially when programs are operated outside of the clinical setting—participants may be eligible because they have previously been diagnosed with a health condition. Staff at community-based organizations (for example, a food bank) will also sometimes provide screenings and assessments on-site.	A health care provider (physician or allied professional) identifies the patient as meeting eligibility criteria and provides the referral to the food pharmacy, which is on the Grady Hospital campus. Food pharmacy staff are also notified and proactively reach out to the patient. Patients can receive food on the day of enrollment.
Food selection and sourcing	Foods are pre-selected, often by an RDN or physician, as appropriate for meeting the dietary needs of the chronic disease being treated and/or prevented. Some programs offer some flexibility for clients to choose the foods they prefer. Sourcing of food depends on the program; community food pantry programs will often use existing sourcing and distribution networks.	Households of four or fewer receive 20 to 30 pounds of fresh produce and 4 pounds of whole grains and legumes (low-sodium canned or dried). Households of five or more receive 40 to 60 pounds of fresh produce and 8 pounds of whole grains and legumes (low-sodium canned or dried). The Atlanta Community Food Bank supplies the food for the food pharmacy.
Food preparation and other program components	Because the food items provided are largely raw ingredients and whole foods, recipients need to prepare the food themselves. Programs sometimes include educational components, such as nutrition information brochures, nutrition counseling, and cooking classes.	Participants use the ingredients to prepare food at home. Ingredients are augmented with cooking classes in the hospital's teaching kitchen and nutrition classes taught by Grady Health dietitians. Participation in at least one cooking class and two nutrition sessions are required to maintain program eligibility.

Table 5: Medically Tailored Groceries in Practice, continued

	Medically Tailored Groceries/Food Boxes: In General	Use Case: Grady Hospital Food as Medicine Prescription Program in partnership with Atlanta Community Food Bank: a Food Pharmacy
Food distribution and/or delivery	Participants pick up food on a regular basis at a set location, or home delivery is sometimes available. Food is often assembled in a pre-packaged box or bag.	The food pharmacy is located adjacent to the lobby of Grady Hospital. Participants can return for food every two weeks while they are enrolled in the program.
Duration	Medically tailored groceries are generally conceived as part of a long-term nutritional health management plan for patients experiencing food insecurity and diet-related chronic illnesses, like diabetes, pre-diabetes, and hypertension. The program's impact on participant health, with the exception of blood pressure, is often observed over months to years (not weeks). Programs strive for duration to match a patient's medical needs and allow for re-dosing as appropriate.	Participants enroll in the program for three months and can re-enroll every three months up to one year if they are participating. Participation is defined as: • picking up food every two weeks (at least four pick-ups), • attending nutrition classes or visits (at least twice), • attending cooking class (at least once), and • following up with the health care provider.

Photo Credit: DC Greens

Produce prescriptions defined: Vouchers or restricted debit cards that can be redeemed for produce or direct distributions of produce that are made available to recipients based on a health condition or risk.

Produce is generally fresh but can also be canned or frozen if there is no added sugar, salt, or fat.[89] The redemption or pick-up site varies by program. An increasing number of commercial food retailers are serving as redemption sites in addition to farmers' markets, which are the traditional access points for these programs. The definition of "produce" can also vary by program: most programs support access only to fruits and vegetables, while others have included legumes, grains, and more, blurring the distinction between produce prescriptions and medically tailored groceries.

Produce prescriptions are sometimes paired with services provided by RDNs, such as nutrition education, nutrition resources, supermarket tours, cooking classes, and medical nutrition therapy.

Table 6: Produce Prescriptions in Practice

Use Case Provided By Andrea Talhami Of DC Greens In Washington, Dc

	Produce Prescriptions: In General	Use Case: DC Greens in partnership with Giant Food, a grocery chain operating in Washington, DC
Clients/participants	Produce prescription programs typically serve clients with a diet-related health risks or conditions who are: • food insecure or have other documented challenges in accessing nutritious foods, and • able to shop for food and prepare meals.	Participants are enrolled in a partner Medicaid managed care plan and have a diagnosis of hypertension, diabetes, or prediabetes. Medicaid enrollment is used as a proxy for food insecurity.
Referral/ identification	Identification and referral of participants is performed by the health care provider or health insurance plan. Alternatively—and, especially when programs are operated outside of the clinical setting—participants may be eligible because they have previously been diagnosed with a health condition. Community providers will also sometimes provide screenings and assessments on-site. The prescription comes in the form of a paper prescription that can be redeemed for produce or electronic benefit (such as a debit card) with restrictions on where it can be used and what items it can cover.	Health care providers at partner clinics in DC assess program eligibility and issue a prescription, prompting participants to receive the benefit on their Giant Food bonus card.
Food selection and sourcing	Eligible produce is generally fresh but can also be canned or frozen if there is no added sugar, salt, or fat. Some programs have expanded the benefit to include legumes, grains, and other items. Produce prescriptions grew, in part, out of farmers' market voucher programs and, as such, are often closely tied to farmers' markets and sometimes explicitly aim to also support local producers. The role of participant choice depends on the program. Generally, participants will use their benefit at eligible locations—which can include supermarkets, grocery stores, farmers' markets, and other locations—and select the items that they want. Produce is sometimes pre-selected and pre-packaged, presented in a box or bag.	Participants receive $80 per month on their Giant Food bonus card that can be spent on any fresh or frozen fruits and vegetables at participating Giant grocery stores.

Table 6: Produce Prescriptions in Practice, continued

	Produce Prescriptions: In General	Use Case: DC Greens in partnership with Giant Food, a grocery chain operating in Washington, DC
Food preparation and other services	Because the food items provided are largely raw ingredients and whole foods, participants need to prepare the food themselves. Programs sometimes include educational components, such as nutrition information brochures, nutrition counseling, and cooking classes.	Participants prepare the foods at home. There are no additional requirements to participate in the program, although a dietitian employed by the grocery store provides free consultations and participants have the opportunity to participate in nutrition and cooking classes.
Food distribution and/or delivery	Prescription vouchers have monetary value and can be used at participating farmers' markets or food retailers (corner stores, grocery stores, supermarkets, and pharmacies that sell produce) to purchase produce. Accessibility often depends on the hours of the participating site and/or retail store—for example, prescriptions are often easier to redeem at a nearby supermarket than a weekly farmers' market with limited hours. For programs where produce is pre-selected and pre-packaged, participants pick up produce on a weekly basis (sites often have limited hours or options). Some programs operate mobile markets (e.g., veggie vans).	Participants use their bonus card at checkout to pay for fresh and frozen fruits and vegetables at partner Giant grocery stores.
Duration	Produce-prescription programs are generally conceived as part of a long-term nutritional health management plan for patients who are food insecure and at risk of or experiencing diet-related chronic illnesses, like diabetes, pre-diabetes, and hypertension. The program's impact on participant health, with the exception of blood pressure, is often observed over months to years (not weeks). Programs strive for duration to match a patient's medical needs, generally at least six months, and allow for re-dosing as appropriate.	Participants enrolled in the program check in with their providers every three months to renew the benefit for up to one year.

Other Interventions Within the Scope of Food is Medicine

In addition to medically tailored meals, medically tailored groceries, and produce prescriptions, the following interventions are also within the Action Plan's Food is Medicine definition and scope:

- Education or health care services when combined with an intervention that provides food, such as medically tailored meals, medically tailored groceries, or produce prescriptions. These services include nutrition education, lifestyle or other behavior change programs, cooking classes, health care services like group visits for diabetes management, and more.
- The addition of food provision or food purchasing power to existing food support programs, when triggered by a health condition or health assessment. For example, a SNAP recipient might receive additional funds or subsidies for produce based on a nutritional assessment by a health care provider.

Interventions Outside of this Report's Definition and Scope

A number of Food is Medicine interventions clearly meet the Action Plan's definition. Identifying certain programs and services as out of scope is more difficult. If nutrition is foundational to health, shouldn't every attempt to improve dietary quality be considered Food is Medicine? Wouldn't universal eligibility for the National School Lunch Program and a boost to the SNAP allotment, for example, do more for the nation's baseline health than any program limited to people living with certain health conditions? The answer, quite possibly, is yes. What about the implementation of a comprehensive income-support program that increased overall purchasing power for food and other necessities among low-income people? Again, likely yes. For example, unemployment insurance provided during the outset of Covid-19 pandemic reduced rates of food insufficiency and food insecurity.[90] We may likewise see a significant impact on food insecurity and ability to obtain foods that support health from the temporary increase in the Child Tax Credit enacted as part of the American Rescue Plan Act, which is estimated to reduce child poverty by nearly 45 percent.[91]

The goal of this Action Plan is to help researchers, health system stakeholders, policymakers, and communities better understand how to leverage nutrition within *the current and near-future health care system* to improve health outcomes and eradicate health disparities. Given the US federal budget's expenditure on health care—25 percent of GDP—it should be a national priority to identify when dietary interventions delivered and paid for within the health care system can meaningfully influence individual and population health.[92] The intersection between the health care and food system is the scope of this Action Plan. This Action Plan is not meant to stand in for, replace, or undermine plans for broader systemic change in the health and food systems. It is instead intended to be complementary to such plans.

Given our goals, the following interventions are outside of the scope of this report:

- **Administration of micronutrients (such as vitamins or other supplements) or a specific food because it contains a concentrated amount of a micronutrient.** First, supplementation of micronutrients to address nutritional deficiencies identified in the clinical setting is generally accepted as part of health care—for example, someone with a documented deficiency of vitamin B12 will be able to receive a B12 prescription and generally have that supplement covered by insurance.[93] Second, prescribing a specific food to address health risks or health conditions, rather than a range of foods that reflect a healthy diet, is questionable—for example, carrots were once the only vegetable covered by WIC.[94] Furthermore, emphasizing specific foods as necessary for health can lead to significant environmental and social impacts from ramping up production of those foods to meet variable demand.[95]
- **Products administered in parenteral or enteral nutrition.** These are products for patients who need complete or supplemental nutrition administered under the supervision of a doctor—for example, those who are unable to swallow. These products meet the Food and Drug Administration's definition of "medical foods," or foods that are defined by law as "formulated to be consumed or administered enterally under the supervision of a physician and intended for the specific dietary management of a disease or condition for which distinctive nutritional requirements, based on scientific principles, are established by medical evaluation."[96] Interventions that use these products are generally already integrated into health care, covered in many instances by Medicaid, Medicare, and private insurance.
- **Existing federal nutrition and food support programs, with the exception of WIC.** Federal nutrition and food support programs, such as SNAP, are linchpins of food access in the United States and this Action Plan frequently references them. However, enrollment in these programs does not depend on connection with the health care system and, furthermore, food assistance is not typically tailored to health needs. Excluding these programs from the scope of this report is not intended to diminish their critical importance to health or present Food is Medicine interventions as superior. Indeed, the research on these programs (discussed in Part V: Foundational Research) provides a critical foundation for Food is Medicine research to build on. What's more, the disconnect between health care and the operation of these programs has rendered them easier to use, resulting in less administrative burden when it comes to enrollment and benefit redemption than has historically been the case with programs more closely tied to health care, like WIC.
- **Nutrition education initiatives, either for individuals or health care clinicians, that do not include the provision of food or enhanced support to purchase food.** For individuals, initiatives that emphasize nutrition education or counseling alone will likely disproportionately help those who have the discretionary resources to make recommended changes. Patients with more limited resources may not be able to implement those changes without some form of tangible aid. This Action Plan focuses on interventions that reduce these inequities through the provision of material assistance. With regard to nutrition education for health care providers, we recognize the critical role of health care providers who are trained and incentivized to advise patients on the role of diet as it relates to treatment for health conditions. Medical education and training contain significant gaps when it comes to nutrition and its use in disease treatment and management.[97] Medical schools are starting to take note, implementing a range of changes and programs.[98] These programs, however welcome, lie outside of the scope of this report.

Photo Credit: God's Love We Deliver (Rommel Demano)

While the definition of Food is Medicine in this report is limited in order to facilitate actionable and specific recommendations for future research, individuals and families should be put in touch with all appropriate and effective programs and services that afford them the opportunity for a nutritious and culturally appropriate diet.

As the health care system evolves to provide more upstream interventions and preventive services, and the pathways for change in health via Food is Medicine interventions are further explored, the scope of Food is Medicine will also evolve. In putting forward this Action Plan, Food & Society hopes to spur the creation and adoption of programs that redefine the boundaries of what is possible at the nexus of health care and food—to not only alter business as usual within the health care system but also to yield discoveries about the relationship between food and health that can inform and speed positive change beyond health care.

IV. Key Considerations for Food is Medicine Research

In this section, we introduce key considerations for research that pertains to food and nutrition, the health care system, and the intersection of these two critically important and complex fields. Many of these considerations are reflected in Section VII: Recommendations.

Food is Medicine research is challenged by the enormous complexity of its essential components: food and health. Future research needs to purposefully engage with and navigate the complexity at the intersection of these two components.

The provision of something so essential and meaningful as food coupled with a complex health care system that is often difficult to navigate—and, for some, difficult to trust—demands that research and interventions be subject to heightened level of scrutiny in order to avoid missteps or potential harms. This requires a commitment to centering equity in research conception, design, execution, interpretation dissemination, and translation.

Researchers must carefully consider the identity and perspectives of research participants as well as the intended intervention recipients—those who will hopefully benefit from the intervention beyond the research phase. Researchers must make decisions about research purpose and scope with a focus on equity. Practically, this means that researchers and funders should ask key questions that illuminate *whether* and *how* the information sought will be meaningful to the research participants, the field, and future policymaking. Examples of key questions that should be answered prior to research include:

- Who are the likely research participants, and who are the ultimate intended recipients of the proposed intervention? Are these two groups similar and, if not, how do these differences impact the significance of the research results? Have individuals from both of these groups been engaged early and authentically in the process of research conception and design? Is the proposed research and intervention desired by these groups? Does the research team reflect the demographics and circumstances of these groups and, if not, how will the team understand the full context in which the research is taking place?
- What foods does the intervention include? Are they appropriate and appealing for individuals from diverse backgrounds and cultures? Where personal choice is limited (e.g., in the case of fully prepared meals), how do participant perspectives, preferences, and food preparation abilities inform what is offered in the program?
- What level of engagement with health care does the research and intervention require? Are there barriers to this engagement for participants or for health care providers?
- Is the research appropriately powered to evaluate impact across different demographic groups?
- Is there a plan in place for flexibility in the research design to accommodate participant needs without compromising the integrity of the research?
- Is there a qualitative research component that can illuminate whether and why participants value and engage with the intervention?

In the existing Food is Medicine research, a number of peer-reviewed studies have found statistically significant improvements in food security, diet quality, and disease management.[99] **Studies have also looked at hospitalization and health care costs, finding significant reductions in inpatient admissions, emergency visits, and medical spending among those receiving Food is Medicine interventions.**[100] **Recipients also report feeling cared for by health care providers, less stressed, and more confident about understanding nutrition and eating healthy foods.**[101] In patient surveys administered at one health system, the vast majority of patients screened for food insecurity found the screening and subsequent referral to food resources valuable.[102] This research is explored in more depth in Section VI. Research on Food is Medicine Interventions.

These findings indicate that Food is Medicine interventions can effect change on many important fronts. They can transform an individual's ability to alter diet to aid in disease management. They can reduce the number of traumatic and expensive hospitalizations. And they can improve patient-provider relationships.

Exploring the broader context of Food is Medicine interventions at the outset of research should result in the creation of programs and interventions that are:

- **easy to access and to use by the people who will ultimately use them, and**
- **easy to recommend and track for health care entities**

For more on how to center equity in Food is Medicine research, see Recommendations 1–9.

Food and Health: What to Consider as Food is Medicine Interventions Are Designed, Tested, and Scaled

What drives food consumption and enables attainment of health is heavily influenced by numerous biologic, sociopolitical, and socioeconomic factors, complicating scientific analyses and understandings of causality. In conversations with advisors and other stakeholders, the following factors emerged as critical to keep in mind when designing interventions that can truly address longstanding health disparities through nutrition.

Food

- **Food is a biologic necessity.** Simply put, people cannot live without food. Many countries explicitly recognize an individual right to food.[103] The United States does not, but it has established numerous food-support programs over the past century.[104] In addition, specific nutritional needs and tastes change dramatically over the course of one's lifespan. The first 1,000 days in a child's life are a particularly critical period in which nutritional deficiencies put children at risk of serious lifelong health complications and in which food preferences are formed that may persist throughout adulthood.[105]
- **Food is an integral part of human culture.** In addition to nutritional value, food has significant social value and meaning.[106] The preparation, consumption, and sharing of food is a fundamental part of participation in any society. Food is used, for example, to mark special occasions and religious festivals, solidify relationships, convey social status, support different ideologies, and promote and demonstrate cultural conformity.[107] The experience of food is also often deeply personal and familial, evoking specific emotions, moods, and memories.[108] Some studies have suggested that food-evoked emotions are one of the strongest predictors of food choice.[109]
- **Food is political.** Legacies of racism and nativism influence ideas about what people should eat, demonizing or exoticizing certain foods and complicating cultural relationships with traditional ways of eating.[110] The US government has, at times, actively interfered with food sovereignty—the ability for people to have "healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and [the] right to define their own food and agriculture systems."[111] For example, the US Department of Agriculture has a long, well-documented history of discrimination against Black farmers that includes denying loans, delaying loan processing times, and excluding Black farmers from federal insurance and disaster relief programs.[112] This has led to significant land loss among Black farmers, who now make up less than 2 percent of all farmers.[113] The federal government's forced removal of Indigenous communities from their lands along with brutal assimilationist policies disrupted traditional food systems and caused widespread food insecurity.[114] In some cases, federal food-support programs have played a role in worsening dietary patterns among Indigenous communities by promoting consumption of ultra-processed foods in place of traditional foods.[115]
- **Caregivers are powerful nutrition gatekeepers.** Caregivers are often the primary people responsible for the diets of three important—and often nutritionally vulnerable—populations: children, people with disabilities, and older adults.[116] In the United States, caregiving responsibilities for these three groups disproportionately fall on women.[117] Child caregiving obligations also have spillover effects on the entire household, with parents and older siblings reducing their own food intake to shield young children from food insecurity.[118] Poor nutrition among older adults is associated with increased caretaking burdens.[119] Not only do older adults have limited capacity to cook and shop due to frailty, but they may also face unique challenges such as oral health problems, loss of muscle tone that impacts chewing and swallowing, and changes in taste and smell that make food less appealing.[120]

- **What someone consumes is rarely a straightforward choice.** In addition to cultural factors, diet is dictated by what foods are accessible, affordable, and acceptable. Agricultural policy influences what foods are produced in the United States, and by whom.[121] Trade policy influences what is imported. Over 100 years of explicitly racist zoning and housing policies have influenced the location of grocery stores and other food vendors, the existence and accessibility of the transportation systems, and the accumulation of wealth and economic opportunity that render food affordable.[122] Marketing and advertising also have an outsized influence on shaping food tastes and driving demand, particularly among children and adolescents.[123] Research has found that fast-food companies and makers of unhealthy foods explicitly target advertising to Black and Hispanic youth, increasing health disparities.[124] Beyond direct advertising and marketing, corporations and trade groups spend hundreds of millions of dollars each year to influence policy, including nutrition policies such as the Dietary Guidelines for Americans, the Farm Bill, and the Child Nutrition Reauthorization Act.[125]

While the terms "food deserts" (limited access to healthy foods) and "food swamps" (inundation with fast food and unhealthy food options) are often used to characterize a neighborhood's food environment, some activists and scholars are now using the term "food apartheid"—defined as "the structural, political, and experiential limits on the availability of nutritious, healthy, affordable, and culturally appropriate foods, and/or limited or uncertain access to food"—to more aptly describe the intentional, structural forces shape food access and acknowledge racial disparities.[126]

- **Messages about nutrition are often confusing and conflicting.** Even when people have the resources and desire to buy foods that support health, they are often confused about what to eat.[127] Nutrition research continuously evolves, sometimes contradicting previous findings (notable examples include low-fat diets, eggs, and soy protein). At the same time, the food industry intentionally sows confusion through industry-funded research and misleading marketing and advertising.[128] Research has found that exposure to conflicting nutrition information can result in "nutrition backlash," whereby people are less likely to trust nutrition science or follow healthy eating advice.[129] However, coordinated messaging is challenging as people receive nutrition information from a wide variety of sources, including health care providers, nutrition program providers (e.g., SNAP-Ed, WIC, and food pantry programs), friends, family, social media, news and magazine articles, television, salespeople, and food labels.[130] If well-equipped with nutrition knowledge and cultural competency, health care providers can be a driving force to help clarify messages and motivate healthy eating changes. Among the 54 percent of food consumers who receive nutrition advice from their provider about foods to eat and to avoid, 78 percent initiate some type of eating change.[131]

In the book *Pressure Cooker: Why Home Cooking Won't Solve Our Problems and What We Can Do About It*, Sarah Bowen, Joslyn Brenton, and Sinikka Elliot illustrate the pressures women navigate as they try to feed their families. Drawing on extensive interview and ethnographic data, the book captures the complex range of circumstances around food and nutrition that Food is Medicine interventions try to address. These include a lack of financial resources, lack of time, lack of transportation, lack of space and equipment to cook, and tensions and confusion around choosing the "right" foods, to name just a few. For example, in the book:

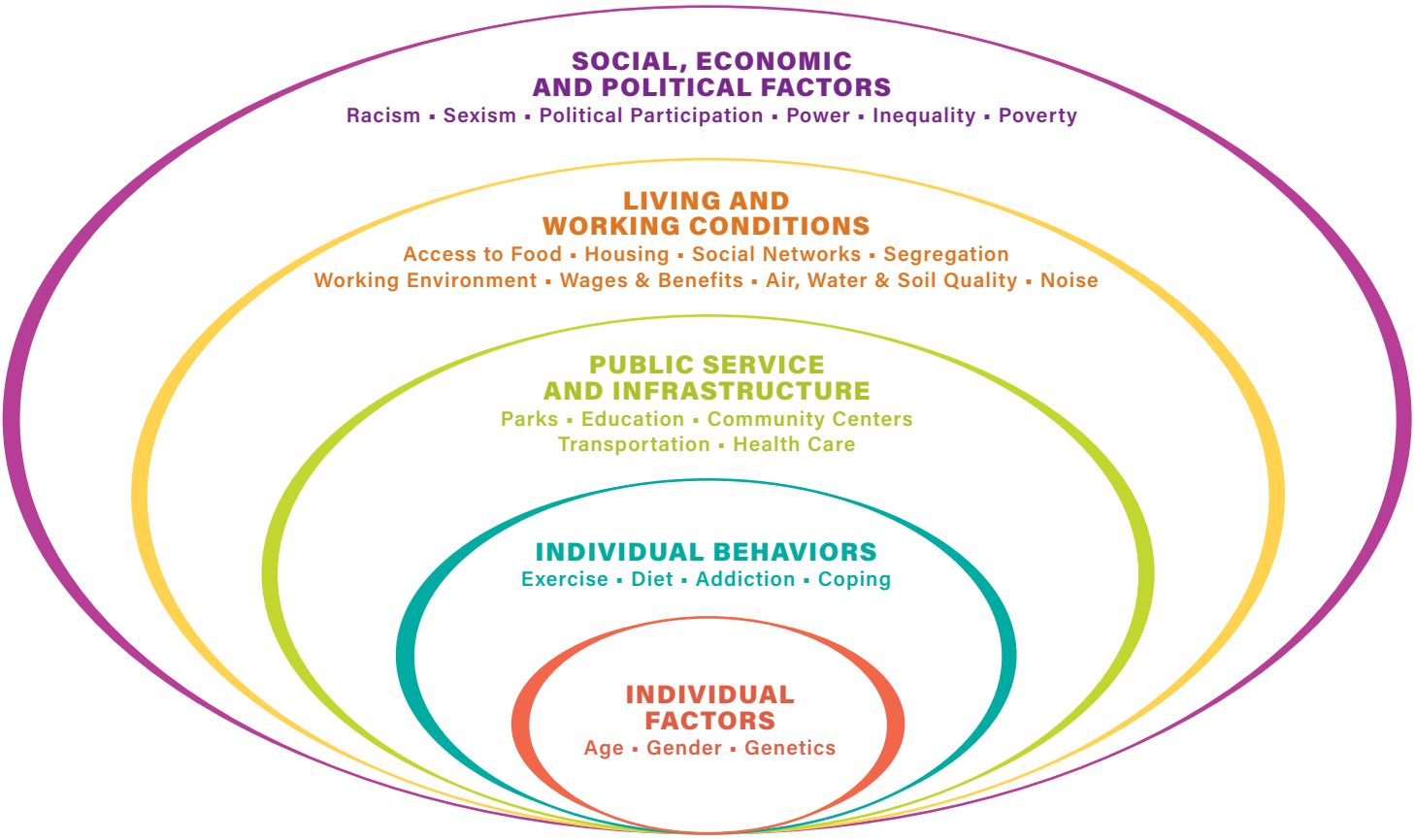
- Leanne, a mother of three, navigates a low-paying job in food service with unpredictable hours, a kitchen often infested with cockroaches, and lack of transportation that makes grocery shopping and traveling to food pantries difficult. Though she likes to cook and takes great pride in making family meals, the lack of resources and time presents a challenge. She sometimes skips meals or eats less to ensure her family has enough food.
- Patricia, a grandmother trying to support her adult daughter and two grandchildren, puts meals together in the small hotel room where the family lives, with only a microwave, a small bathroom sink, and a very small food budget.
- Rae Donahue and her husband both work 40-plus hours a week and don't always have time to cook meals from scratch for their young son. Rae wants her family to be healthy but struggles to make sense of dietary advice that does not resonate with her family's traditional foodways, or their identity as a Southern Black family.
- Rosario, who cooks traditional Mexican food for her family of three, negotiates mealtimes with children who sometimes reject the dinners she has made in favor of the "American" food their friends eat.

Health Care

- **Health is multidimensional.** There is now widespread recognition that social and environmental factors, not health clinical care, are primarily responsible for shaping individual and population health.[132] Dialogue on how to influence these broader factors is increasingly common among the World Health Organization, US federal health agencies, and health care providers and payers nationwide, creating new policy frameworks and investment paradigms.[133] A cornerstone of the literature around social determinants of health (the conditions in which people live,work, eat, and play) is that health disparities, or differences in health status among different groups of people, are complex and multifactorial; it is near-impossible to isolate any one factor and ignore their dynamic interrelations.[134] At the same time, this means that addressing one factor, such as food, could simultaneously improve a number of health outcomes.

Health is Multifactorial and Multidimensional

This diagram depicts a variation of the socio-ecological model of health, which emphasizes the social, political, and environmental contexts that shape individual health. While the factors enumerated in the outer layers have a direct impact on the inner layers, the inner layers are often closest and most apparent to the individual. Many times, the socio-ecological model is used to show that it can be difficult to create meaningful change at the individual level without acknowledging and engaging these broader contexts; it is important that health interventions explicitly work across all levels.[135]



Social Determinants of Health and Health-Related Social Needs: The health care system has traditionally been designed to (and is currently best equipped to) respond to downstream impacts of the social determinants of health. Access to nutritious food, for example, is a social determinant of health, influenced by one's food environment and financial and social resources. The health care system is deeply intertwined with, but does not explicitly control, these factors—and yet it can, and increasingly does, respond to the lack of access to nutritious food (a health-related social need) resulting from these circumstances.[136]

Social Determinants of Health vs. Health-Related Social Needs

Social determinants of health	The World Health Organization defines social determinants of health as "the conditions in which people are born, grow, live, work and age," which are "shaped by the distribution of money, power and resources."[137] These factors, including income, race, and education, are not positive or negative; however, they cannot be isolated from the dynamic and complex political realities in which they exist. Examples: income, as well as the policy choices, environmental factors, and social forces that make access to healthy living conditions and health care dependent on income and wealth.
Health-related social needs	Health-related social needs are social risk factors for poor health outcomes (e.g., food insecurity). With an individual's permission, the health care system may seek to address health-related social needs through referral to or the provision of appropriate services (e.g., food). Examples: food insecurity, housing instability, lack of transportation, and lack of income.

- **Food insecurity is closely linked with increased rates of chronic disease and higher health care costs.** Rates of food insecurity are higher among those with chronic diet-related illnesses. Using National Health and Nutrition Examination Survey (NHANES) data, one study consistently found statistically significant differences in the prevalence of food insecurity when comparing those with a diet-related health condition with their counterparts without that condition—diabetes (19.5 percent food insecurity prevalence among those living with diabetes vs. 11.5 percent food insecurity among those without that diagnosis), hypertension (14.1 percent vs. 11.1 percent), coronary heart disease (20.5 percent vs. 11.9 percent), congestive heart failure (18.4 percent vs. 12.1 percent), and obesity (14.3 percent vs. 11.1 percent).[138] Food insecurity is associated with higher health care utilization and significantly higher health care costs. Individuals who are food insecure have more hospitalizations and emergency department visits than their counterparts who are food secure, and they are more likely to be in the top 10 percent or even 2 percent of health care expenditures.[139]
- **Access to health care is a persistent challenge.** Even with significant policy changes over the past decade to expand health insurance coverage, 28.9 million non-elderly individuals were uninsured in 2019.[140] Those who are uninsured are disproportionately Black, Latinx, and Indigenous.[141] They are also disproportionately individuals without legal status.[142] Predicating access to Food is Medicine interventions on health insurance therefore poses a very real risk of excluding uninsured populations and further embedding health disparities.

Photo Credit: God's Love We Deliver (Jessica Frankl)

- **The US health care system is fragmented.** The increasing use of private companies to administer publicly funded insurance, often through managed care plans, is increasing disparities in the range of benefits provided by Medicare and Medicaid, especially when it comes to nutrition. For example, of the 62 million people enrolled in Medicare, about 60 percent are enrolled in traditional ("fee-for-service") Medicare and have no access to a benefit that provides food. Among the 40 percent of Medicare beneficiaries who are enrolled in a managed care or Medicare Advantage program, only 39 percent had access to a meal benefit, with access depending on whether their plan chose to cover the service.[143] Even if Food is Medicine interventions are implemented by one health care organization or insurer, there is no guarantee that individuals with the same needs will have the same access across individual states or nationwide.

- **The provision of health care is not a guarantee of equitable treatment and attitudes.** More than one in five patients report experiences of discriminatory treatment from medical professionals, with the majority of such discriminatory treatment relating to race or ethnicity.[144] Experiences of discrimination in the health care setting may mean that people of color are less likely to volunteer information about health-related social needs to their medical providers or trust their recommendations regarding Food is Medicine interventions.[145] For example, caregivers sometimes worry that disclosing food hardship will make them seem like unfit parents and could lead to a provider reporting them for child mistreatment.[146] Clinicians might preferentially screen some patients for food insecurity based on assumptions about who is food secure. They might refer some patients to interventions based on implicit assumptions, such as who is deserving of help, creating additional inequities. Linking Food is Medicine interventions to the health care system could mean that people of color receive them less often than white individuals with similar health profiles.

Photo Credit: God's Love We Deliver (Jessica Frankl)

V. Foundational Research

Section V provides an overview of the published, peer-reviewed research on health outcomes associated with food insecurity and federally funded food support programs—namely, the Supplemental Nutrition Assistance Program (SNAP), the National School Lunch Program (NSLP), Older Americans Act Nutrition Services Program (OAANSP), and the Special Supplemental Nutrition Program for Women, Infants and Children (WIC). This research establishes an important foundation for Food is Medicine intervention research (Section VI). We also identify WIC as a 50-year old Food is Medicine program with valuable lessons for the field.

Though research on Food is Medicine interventions is still emerging, it continues to build on evidence that firmly establishes the connection between food insecurity and poor health outcomes, increased health care utilization, and increased health care costs. Likewise, evidence demonstrates the health impacts of providing food, most importantly through some of the country's key food support programs: the Supplemental Nutrition Assistance Program (SNAP), the National School Lunch Program (NSLP), Older Americans Act Nutrition Services Programs (OAANSP), and the Special Supplemental Nutrition Program for Women, Infants and Children (WIC). Although WIC, unlike the other food support programs, meets this initiative's definition of Food is Medicine—enrollment requires nutrition assessment by a health professional—we have included it in foundational research because the program has been in existence for nearly 50 years.

This section reviews the health outcomes associated with food insecurity—as well as the health outcomes associated with the provisions of food support via SNAP, NSLP, OAANSP, and WIC. We conducted a search with associated terms using Pubmed and also requested information about relevant research from the Action Plan's network of advisors and stakeholders. The studies we have included examine the association between food insecurity, SNAP, NSLP, OAANSP, and WIC and physical and/or behavioral health outcomes. They were conducted in the United States, written in English, and published in peer-reviewed journals within the last 25 years.

Food Insecurity and Health Outcomes

A large and robust body of evidence links food insecurity to poor health outcomes. Being food insecure increases risk for a number of serious health conditions, is associated with higher health care utilization and costs, and motivates a range of coping behaviors that lead to poor health outcomes.

Over 20 studies in our literature review examined the impact of food insecurity on health outcomes, finding that food insecurity is associated with:

- Worsened mental health outcomes including depression,[147] anxiety,[148] and stress[149]
- Worsened physical health outcomes including heart disease,[150] obesity,[151] diabetes,[152] hypertension,[153] and hyperlipidemia[154]
- Poor health and developmental risk in children[155]
- Health-damaging circumstances and behaviors including poor diet quality,[156] unhealthy weight control,[157] disordered eating,[158] poor diabetes self-management,[159] low medication adherence,[160] and missed clinical visits[161]
- Increased health care utilization and costs including inpatient hospitalizations,[162] emergency department visits,[163] and prescription medications.[164]

Food insecurity is associated with worsened health outcomes through a number of pathways. Research has identified poverty as a primary cause of food insecurity; the two terms, however, are not synonymous. For example, there are households with incomes below the federal poverty threshold who are not food insecure and those with incomes above the federal poverty threshold who are food insecure.[165] Research has also identified a number of other factors associated with increased food insecurity, from individual and household characteristics—including household makeup, race and ethnicity, education, mental and physical health conditions, disability, and substance use—to macroeconomic trends including low wages, high housing costs, high unemployment rates, and residential instability.[166] Indeed, all of these factors come into play when it comes to understanding the connection between food insecurity and health outcomes.

Food insecurity makes it harder to consume foods that support health, largely due to affordability and time constraints.[167] An unhealthy diet then leads to worsened health outcomes.[168] Episodes of food scarcity alternating with food availability can lead to undereating and binge eating, which can promote insulin resistance.[169] Faced with limited resources, individuals may not attend to their health needs in order to prioritize other pressing basic needs such as food, housing, and purchasing medications, causing health conditions to worsen over time.[170] In addition to tradeoffs between purchasing food or medications, food insecure individuals who take medications on an empty stomach can experience adverse side effects and reduced medication efficacy.[171]

Researchers have also found that lack of food overall and the lack of culturally acceptable food give rise to feelings of deprivation and alienation, which can contribute to mental health issues including increased stress, anxiety, and depression.[172] Stigma associated with accessing free meal sites and food resources also exacerbates poor mental health outcomes.[173]

Food and Nutrition Support Programs and Health Outcomes: Supplemental Nutrition Assistance Program (SNAP), National School Lunch Program (NSLP), and Older Americans Act Nutrition Services Programs (OAA Nutrition Programs)

While a lack of food is associated with poor health outcomes, the provision of food is associated with improved health outcomes. This section reviews the relevant research on the following federally funded food and nutrition support programs:

- **Supplemental Nutrition Assistance Program (SNAP):** SNAP is the country's largest and most flexible food support program, currently providing benefits to over 40 million individuals.[174] In 2020, the average individual benefit was $155 per month, while the average household benefit was $301 per month.[175] However, these amounts increased by 21 percent with USDA's updates to the Thrifty Food Plan.[176] SNAP benefits come with relatively few restrictions; they may be used to purchase any food items, with the exception of hot ready-to-eat foods and alcoholic beverages, at eligible retailers.[177]
- **National School Lunch Program (NSLP):** NSLP is the country's second largest food support program, providing meals to nearly 30 million school-age children.[178] NSLP accounts for roughly one-third of participants' daily caloric intake and, when combined with the School Breakfast Program, represents over half of participants' daily caloric intake.[179] NSLP meals must adhere to nutritional standards; these were significantly overhauled in 2010 with the passage of the Healthy, Hunger-Free Kids Act (HHFKA).[180]
- **Older Americans Act Nutrition Services Program (OAA Nutrition Programs):** The Nutrition Services Program, authorized under the Title III of the Older Americans Act, provides states and US territories with grants to support senior nutrition services programs—namely, congregate nutrition services programs and home-delivered nutrition services programs.[181] The congregate nutrition services program serves meals to older adults in congregate settings, such as senior centers or faith-based settings, providing opportunities for socialization with others and health promotion activities.[182] The home-delivered nutrition services program delivers meals to individuals who are homebound or otherwise have difficulty obtaining and preparing food for themselves.[183] Meals served using OAA funds must meet the current Dietary Guidelines for Americans.[184]

All three programs are associated with lower health care utilization and positive health outcomes—most notably, improvements in weight status, self-reported health status, and diet quality. However, these findings are not uniform across the peer-reviewed literature; some studies have found mixed results, such as higher rates of obesity among SNAP participants, particularly when participants are compared with eligible nonparticipants (those who meet the program's eligibility requirements but are not enrolled). Understanding these mixed results requires a closer look at the key demographic characteristics, including baseline health, of those who do enroll in these programs. For example, those who participate in SNAP are more likely to be sick, food insecure, and in much worse financial situations than eligible nonparticipants.[185] Researchers note the difficulty of isolating the role of program participation in relation to primary outcomes, especially among populations who face manifold—and, often, hard-to-measure—social, economic, and health challenges.[186]

Table 7: Food Support Programs and Health Outcomes

An overview of the research on health outcomes related to three federally funded food and nutrition support programs: SNAP, National School Lunch Program, and Older Americans Act Nutrition Programs. Health outcomes—positive, negative, and mixed—are noted, as well as key findings about how these programs support health.

SNAP

Description	Health Outcomes	Additional Findings and Notes
Enrollment: SNAP is the country's largest and most flexible food support program, currently providing benefits to over 40 million individuals.[187] **Eligibility criteria:** Eligibility factors include household income, household assets, immigration status, college enrollment status, and work status, but specific requirements vary by state.[188] **Foods available:** SNAP benefits come with relatively few restrictions; SNAP may be used to purchase food items, with the exception of hot ready-to-eat food and alcoholic beverages, at eligible retailers.[189]	Participation is associated with positive health outcomes: • Improved diet quality[190] • Improved weight status[191] • Improved self-reported health status, and fewer sick days[192] • Improved physical health, growth, and development among young children[193] • Improved medication adherence and reduced nursing home and hospital admissions among older adults[194] • Lower health care use and spending [by sub-group][195] Participation is also associated with mixed and poor health outcomes: • Higher rates of obesity[196] • Poorer dietary intake[197] • Higher cardiovascular disease mortality and diabetes mortality rates[198] • Higher rates of depression[199] • Unmet healthcare needs[200]	Potential pathways for positive health outcomes: • The provision of food leads to a reduction in food insecurity and frees up resources to address other basic needs.[201] • Increased purchasing power for groceries increases consumption of home-cooked meals, and decreases consumption of less nutritious fast food and restaurant meals.[202] Potential pathways for mixed and poor health outcomes: • Baseline health and other demographic characteristics of participants.[203] • SNAP benefit amounts are insufficient to purchase the relatively more expensive healthy food items associated with positive health outcomes.[204] • SNAP benefits run out, particularly at the end of the month, leading to periods of undereating.[205] • For those who cycle on and off of SNAP, changes in buying power can lead to worsened health outcomes.[206] • SNAP-enhanced purchasing power varies by neighborhood and food costs.[207] • Higher rates of depression may be due to feelings of stigma and dependency, reverse causation bias (whereby depression drives food insecurity and SNAP participation), or an unmeasured confounding variable.[208]

National School Lunch Program

Description

Enrollment: NSLP is the country's second largest food support program, providing meals to nearly 30 million school-age children.[209] NSLP accounts for one-third of participants' daily caloric intake and, when combined with the School Breakfast Program, represents over half of participants' daily caloric intake.[210]

Eligibility criteria: Any student attending a participating school can receive an NSLP lunch.[211] Students at or below 130% of the federal poverty level can receive a free lunch, students at 130-185% FPL can receive a reduced-price lunch, and students above 185% FPL can receive a low cost full price lunch.[212]

Foods available: NSLP lunches must meet federal nutrition standards and meal patterns; however, the specific foods served, and the methods of preparation vary by school district.[213]

Program Impact and Health Outcomes

NSLP participation (across all income categories) is associated with positive health outcomes:

- Improved weight status[214]
- Improved self-reported health[215]
- Healthy Hunger-Free Kids Act (HHFKA) nutrition standards, particularly, are associated with decreased overweight and obesity trends, as well as narrowed racial and ethnic disparities within those trends.[216]

Participation is also associated with mixed and poor health outcomes:

- Three studies found no association between NSLP participation and weight status or health outcomes.[217]
- Two studies found that participation was associated with worsened weight status.[218]

Additional Findings and Notes

Potential pathways for positive outcomes:

- Meals provided through NSLP are more nutritious than meals from home or elsewhere, due to updated HHFKA standards.[219]
- HHFKA standards have increased consumption of fruits, vegetables, and whole grains.[220]

Potential pathways for negative and mixed outcomes:

- Baseline health and other demographic characteristics of participants
- Negative weight associations were strongest for students who ate fewer lunches per week.[221]
- The difficulty of isolating the impact of NSLP given the significant role of other variables, such as income, food insecurity, and neighborhood food environment.[222]
- Changes in the composition of students who consume meals also make it difficult to isolate impact of NSLP from other factors that impact the health status of the NSLP participant groups.[223]

Older Americans Act Nutrition Programs

Description

Enrollment: In 2018, the congregate nutrition services programs provided over 70 million congregate meals to nearly 1.5 million participants, while the home-delivered nutrition services programs delivered 147 million meals to almost 900,000 participants.[224]

Eligibility criteria: The only federal eligibility requirement is that a participant must be at least 60 years old; otherwise, eligibility is determined by states and local entities.[225]

Foods available: Meals served using Older Americans Act (OAA) funds must meet the current Dietary Guidelines for Americans, and each meal must provide at-minimum one-third of the daily recommended Dietary Reference Intakes (as established by the Food and Nutrition Board of the National Academy of Sciences).[226]

Program Impact and Health Outcomes

Participation in congregate nutrition services programs is associated with positive health outcomes:

- Reduced hospital admissions overall, as well as ED visits that lead to hospital admission[227]
- Fewer home health episodes[228]
- Reduced nursing home admissions (effect was especially significant for low-income individuals)[229]

Participation in home-delivered nutrition services programs is associated with positive health outcomes:

- Improved ability for independent aging in place[230]
- Improved dietary intake[231]
- Decreased institutionalization[232]

Participation OAA Nutrition Programs is also associated mixed and poor health outcomes:

- One study found that participants were more likely to have a home health episode, admission to skilled nursing facility, higher average Medicare expenditures, and an emergency department visit lead to hospital admission.[233]

Additional Findings and Notes

Potential pathways for positive outcomes:

- Congregate meal sites allow for socialization with peers.[234]
- The provision of meals reduces the burdens of food shopping and cooking, allowing individuals to remain in their homes as they age.[235]
- The provision of meals supports the recovery process for individuals who have acute hospital episodes and leads to a reduction in food insecurity, freeing up resources to address other basic needs.[236]

Potential pathways for mixed outcomes:

- Baseline health and demographic characteristics of participants, including increased risk of physical disability, chronic disease, and financial strain[237]
- Some participants' nutritional intake may be limited to what they consume through OAA programs (one to two meals/day), which are not intended to/designed to meet participants' full nutritional needs.[238]

The First Large-Scale Food is Medicine Program: the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC)

The Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) is a well-established, federally funded Food is Medicine program that plays a critical role increasing access to foods that support health for low-income families.[239] As the first national nutrition support program with eligibility criteria tied to the health care system, the program's operation and evolution offers important lessons for current and future Food is Medicine interventions: namely, that a limited food package can limit program appeal, and that administrative complexity can be a barrier to participation. The program also demonstrates that Food is Medicine interventions can be brought to scale, reduce disparities, and improve key health outcomes.

WIC is the country's third-largest food and nutrition support program, serving about 7 million people (1.63 million parents, 1.71 million infants, and 3.52 million children under 5) each month through the provision of food (via packages, vouchers, or credits), nutrition education, and referrals to social and health care services.[240]

Participants are low-income (between 100 percent and 185 percent of the federal poverty threshold depending on the state) and must be deemed at "nutritional risk" by a health professional.[241]

WIC meets the Action Plan's definition of a Food is Medicine intervention, as it includes both the provision of food and a nexus to the health care system:

- **Provision of food:** The WIC food package provides targeted, supplemental nutrition for pregnant people and their young children in order to improve health outcomes. There are seven different WIC food packages, each designed to meet specific nutritional needs at different stages of pregnancy and early childhood development: pregnancy, postpartum, breastfeeding, fully formula-fed (infants), partially breastfeeding (infants), fully breastfeeding (infants), and early childhood (ages 2-5).[242] WIC provides checks, vouchers, or an electronic benefit card that can be used to purchase eligible foods each month at an authorized store or farmers market.[243]
- **Nexus to health care system:** In order meet the nutritional risk eligibility requirement, WIC applicants undergo an assessment by a health professional (e.g., a physician, nurse, or nutritionist). The assessment is generally performed, at no cost to the applicant, at a local WIC clinic, but can also be conducted by other health professionals, such as the applicant's physician.[244] The assessment includes the applicant's height and weight, as well as a blood test for anemia.[245] The clinical criteria for nutritional risk varies by state, but typically includes a medical-based condition (such as anemia, underweight, or history of poor pregnancy outcome) or a dietary-based condition (such as having a poor diet).[246] Information collected during the assessment is used to select the appropriate food package, design nutrition education, and make referrals to additional service providers.[247]

HEALTH OUTCOMES ASSOCIATED WITH THE WIC PROGRAM

WIC is widely recognized as one of the most effective nutrition programs in the United States.[248]

This report reviewed 11 studies that examine the impact of WIC participation on health outcomes.[249] **WIC participation is associated with:**

- **Decreased preeclampsia;**[250]
- **Increased length of gestation and birth weight;**[251]
- **Decreased preterm delivery and neonatal intensive care unit (NICU) stays;**[252]
- **Decreased infant mortality; and**[253]
- **Reduced racial disparities in maternal and birth outcomes (notably, preterm delivery, low birth weight, NICU admission, and infant mortality), particularly for Black pregnant people when compared with their white counterparts.**[254]

Overall, WIC improves health outcomes through the provision of certain foods deemed particularly important for pregnant people and young children, as well as through increased purchasing power for health care due to lower food expenses.[255] A recent USDA review of WIC found that the program particularly improves the diet of young children (ages 2-4) compared with eligible nonparticipants, and that WIC participants consume fewer calories from added sugars and saturated fats than non-participants.[256] In addition to food, WIC also provides nutrition education, breastfeeding promotion and support, and referrals to health care and social services.[257] However, the studies reviewed by this Action Plan do not isolate the effects of the provision of food from the provision of the additional services.

The evolution and administration of WIC offers important lessons for food is medicine interventions

1. In an intervention where the types of food provided are limited, participant choice and consideration of cultural preferences are important.

WIC was created in 1972 as a pilot program and later formalized as a national program in 1974.[258] Since WIC's inception, the WIC food package has undergone significant changes to better meet participants' needs. The food packages have evolved over time from a 1970s package that included infant formula, milk, cheese, eggs, cereal, and fruit juice to food packages that include a much wider variety of foods and are differentiated by the age and breastfeeding status of participants.[259] Even so, the National Academies of Science, Engineering, and Medicine (NASEM) noted as recently as 2017 that some foods in the WIC package were less preferred by people with different cultural backgrounds and that "expanding to allow more culturally suitable options merits consideration."[260] Fruit and vegetables, today one of the most popular and most redeemed foods in the WIC package, were introduced only in 1992—and then, only carrots were included, exclusively for breastfeeding parents.[261] A broader fruit and vegetable benefit for all participants, distributed as a voucher that allows participants to choose their own fruits and vegetables up to a specific dollar value, was not implemented until 2009.[262]

2. Administrative complexity in program enrollment and implementation is a barrier to program participation.

Prior to May of 2020, many participants in WIC found it challenging to meet the program's eligibility and enrollment requirements. Enrollment and, in some cases, receipt of benefits required in-person visits at the local WIC office. Lack of transportation and child care, wait times at the WIC office, and difficulty in scheduling appointments were all cited as barriers to participation.[263] The Covid-19 pandemic spurred major changes in WIC program administration as Congress gave USDA the authority to enact waivers for greater flexibility in the administration of WIC, most notably allowing states to issue benefits remotely rather than requiring participants to pick up their WIC EBT cards and/or paper vouchers, and allowing participants to enroll or re-enroll in WIC without in-person visits.[264] These and other waivers are still in effect, and advocates hope that many of these changes will be made permanent.

Redeeming WIC benefits also poses challenges. For example, stores are sometimes out of WIC-eligible foods and cashiers who aren't knowledgeable about how to handle WIC transactions can delay checkouts, increasing the stigma that WIC participants experience.[265]

Key takeaways from WIC for future Food is Medicine intervention design

Fifty years of evolution in the structure and operation of WIC reveal factors that are key to maximizing participation in future Food is Medicine programs:

- Revisions to the food package underscores the importance of providing a wide variety of foods to accommodate cultural and personal preferences: if people don't consume the food because they don't like it, the program won't achieve the desired impact.
- WIC demonstrates the complexity of limiting food choice in an intervention, especially as interventions scale and become integrated into government programs. Each small change to the WIC food package involves months and in some cases years of scientific inquiry, preparation of official reports, and synthesis of public comment. This limits the program's nimbleness in responding to the latest advances in nutrition science.
- WIC's comprehensive range of services and supports mean that a significant minority (41% of $4.8 billion in 2021) are expended on non-food program components for participants, including nutrition education and breastfeeding support.[266] Other multi-component Food is Medicine interventions must consider the cost of non-food components as they scale.
- Finally, persistent challenges to enrolling in WIC and redeeming benefits illustrate the value of establishing simple eligibility criteria and enrollment processes for Food is Medicine interventions, and of ensuring that interventions are easy to use.

From Foundational Research to Food is Medicine Interventions

The promise of Food is Medicine interventions relies on two key assumptions: first, that inconsistent access to food has a negative impact on health, and second, that programs and interventions that address access and even target the provision of food to specific health needs can both reduce negative health outcomes and promote positive health outcomes. This overview of the country's largest food support programs establishes that Food is Medicine research builds on a body of evidence that firmly supports the finding that food insecurity is associated with wide array of poor physical and mental health outcomes, as well as with increased health care utilization and spending. In addition, research on existing food support programs (SNAP, NSLP, OAA Nutrition Programs, and WIC) begins to demonstrate that the provision of food is generally associated with improved health outcomes.

VI. Research on Food is Medicine Interventions

This section examines the published, peer-reviewed research on medically tailored meals, medically tailored groceries, and produce prescriptions—the three primary categories of Food is Medicine interventions described in Section III: Food is Medicine Defined. It provides an overview of what has been tested and how, for what purposes, and in what populations, while summarizing what this research tells us about impact and effectiveness and identifying gaps that remain.

Over the past decade, research on Food is Medicine has transformed the field and laid the groundwork for conversations about widespread adoption. The research demonstrates that Food is Medicine interventions are not only replicable and scalable but also effective. All three interventions examined in this report have been shown to reduce food insecurity, improve dietary intake, and support mental health.[267] Across multiple studies, medically tailored meals are associated with reductions in health care utilization and spending as well as improvements in disease-specific clinical outcomes.[268] Medically tailored groceries and produce prescriptions have also been associated with improvements in blood pressure, HbA1c, and diabetes self-management, though results vary with intervention design and duration.[269] Researchers have also undertaken qualitative assessments across all interventions, yielding critical insights about program design and implementation, participant satisfaction and engagement, and health care provider perspectives.

As the research tables in this report demonstrate, the volume and rigor of research has increased each year. And this trend is set to continue with an impressive number of forthcoming studies and ongoing research that explore a vast range of health care, patient, and health condition-specific outcomes. The opportunities for investigation also continue to expand as exciting new programs and policy innovations are implemented across the country. The challenge now is how best to propel rigorous, high-impact, translatable research that can quickly bring necessary reforms to our health care and food systems.

The findings in this section are drawn exclusively from the published, peer-reviewed research. In addition to undergoing the rigors of the peer-review and publication process, this research is also what is most readily available to and requested by those making key decisions about Food is Medicine program design, implementation, and funding. It is important to note however, that this focus omits many important facets of the larger body of evidence on the efficacy and value of Food is Medicine, including forthcoming studies, gray literature, and program evaluations. In addition, the resources required to undertake research on the health impact of Food is Medicine interventions and seek publication in a peer-reviewed journal are not available to all program implementers. One goal of this Action Plan is to encourage deployment of additional resources to ensure that future research engages a wide range of perspectives and captures the full impact of Food is Medicine interventions.

At a Glance: Food is Medicine Peer-Reviewed Studies

	Medically Tailored Meals	Medically Tailored Groceries	Produce Prescriptions
Number of studies reviewed	10	12	27
Health condition(s) of study participants	Type 2 diabetes, HIV/AIDS, heart failure, chronic liver disease, and multiple health conditions including type 2 diabetes, cancer, end-stage renal disease, and congestive heart failure	Type 2 diabetes, prediabetes, cancer, hypertension, hyperlipidemia, and multiple health conditions including type 2 diabetes, cancer, HIV/AIDS, hypertension, and heart disease	Type 2 diabetes, prediabetes, obesity, cancer, hypertension, pregnancy, and multiple health conditions (not specified)
Study designs	RCT, pilot RCT, randomized cross-over trial, retrospective matched cohort, retrospective chart review, pre-post with comparison group, pre-post with no comparison group, qualitative evaluation	RCT, pilot RCT, nested cohort study, pre-post with no comparison group, retrospective chart review, mixed-methods evaluation, qualitative evaluation	Pilot RCT, non-randomized, parallel, controlled trial, non-controlled longitudinal intervention trial, pre-post with no comparison group, pre-post with comparison group, quasi-experimental prospective study with comparison group, longitudinal retrospective cohort study, mixed-methods evaluation, qualitative evaluation
Primary outcomes	Inpatient admissions, emergency department visits, admissions to a skilled nursing facility, rehospitalizations, health care costs, diet quality, food insecurity, BMI, frailty/disability, independence in activities of daily living, health-related quality of life, cost-related medication underuse, hypoglycemia, hemoglobin A1c, diabetes distress, diabetes self-efficacy, depressive symptoms, internalized HIV stigma, ART adherence, chronic liver disease-specific outcomes, and heart failure-specific outcomes	Food security, dietary intake, fruit and vegetable intake, hemoglobin A1c, diabetes self-management, diabetes self-efficacy, medication adherence, hypoglycemic episodes, BMI, physical activity, and depression scores	Food insecurity, dietary intake, preterm birth weights, infant weight, breastfeeding, blood pressure, hemoglobin A1c, BMI, exercise, and mood
Process and engagement measures assessed	Participant experience and satisfaction, participant feedback, adherence to intervention food, food consumed outside of intervention food, intervention food thrown away or shared, and cost of intervention	Participant experience and satisfaction, health care provider experience and satisfaction, program utilization, and cost of intervention	Participant experience and satisfaction, accessibility, health care provider experience, purchasing behaviors, nutrition knowledge, voucher redemption rates, and cost of intervention

In addition to studies that evaluate the impact of individual Food is Medicine interventions, we consulted a systematic review and meta-analysis by Bhat et al. examining interventions that largely fall under the "produce prescription" category as well as a scoping review by Veldheer et al. examining "healthcare organization-based interventions to improve access to fruits and vegetables for their patient populations."[270] The criteria for inclusion in these two reviews includes studies conducted outside the United States and programs where the emphasis was on education and very little food was provided. Nevertheless, a key observation made by both authors is critical to assessment of the broader Food is Medicine research base: it can be difficult to draw comparisons between studies, because intervention design varies and important process and participation metrics are inconsistently reported.

IMPORTANT CONCEPTS IN FOOD IS MEDICINE RESEARCH

Several key concepts are critical to understanding Food is Medicine research, both in contextualizing the current body of evidence related to efficacy and in identifying opportunities to purposefully build on this evidence in the future.

Baseline Health

It is critical to understand the baseline health of the target population. Generally, the worse the overall health of the participant, the faster researchers can expect to see changes in outcomes for health conditions that are highly sensitive to diet. For example, a diabetic participant who has a baseline HbA1c of 10.0 and cannot shop and cook for themselves due to a disability is more likely to see an improvement after six months of medically tailored meals than a diabetic patient who has a baseline HbA1c of 6.5 and can shop and cook for themselves. Similarly, if a participant has very few health care costs at baseline, then the program is less likely to reduce already low health care costs.

Intensity of Intervention

The intensity of the intervention refers to how much food is provided, often measured on a per-week basis. This key concept can also include what kind of food is provided, as well as how long food is provided (also referred to as duration). Programs that target all aspects of a healthy diet, such as medically tailored meals or medically tailored groceries, are more likely to improve health quickly than fruits and vegetables alone. And programs that last for an extended period of time—generally, six-plus months—are more likely to produce measurable health outcomes. Household size also matters in determining the intensity of the intervention, as food will be shared within a household.[271] For example, if a recipient of medically tailored meals is a parent with three children and the family is food-insecure, the recipient will likely share food with their children, thereby reducing the intensity of the invention for the intended recipient. However, if meals are scaled for household size and the children also receive meals, the parent is more likely to fully consume each meal.

Adherence

Study results must be interpreted within the context of program adherence, participation, and engagement. Very low adherence rates bias the results toward the null hypothesis of no program impact. For example, if participants are redeeming only half of their produce prescription vouchers at a farmers market because it is open only on Saturdays and not conveniently located, then they are receiving a substantially less intensive intervention than intended. In contrast, if the program is available at multiple access points with convenient hours and locations and participants redeem more vouchers, they will receive a more-intensive intervention that is more likely to achieve the intended outcome. Other issues that may have an impact on adherence include throwing or giving away intervention food—these issues, too, can be addressed through program design. While the medical literature often refers to adherence as "compliance," this suggests that the participant was not meeting program expectations when, in reality, the program may have been poorly designed, inconvenient, or unwelcoming for participants.

Outcome of Interest

The outcome being measured will also have a direct impact on the amount of time in which results can be expected. For example, HbA1c and blood pressure may be highly sensitive to changes in diet. A Food is Medicine intervention may have a significant impact on HbA1c or blood pressure within four to six months; however, the same program may not have a meaningful impact on BMI for one to two years.

Sample Size

Some of the existing Food is Medicine studies, particularly those focused on produce prescriptions, have small sample sizes. A small sample reduces a study's ability to observe the true impacts of an intervention. The larger the sample, the lower the statistical uncertainty and the more precise the study's findings. A power calculation allows a researcher to predict the minimum sample size required to be confident that a study will capture the impact of the intervention. If a study is underpowered, it may not be worth conducting and, further, conducting it may even be unethical. With smaller groups of study participants, qualitative research can yield critical insights into program design, implementation, and acceptability.

Regression to the Mean

This is a well-documented phenomenon that can occur if a variable is extreme at baseline. Over time, the variable will move closer to the population mean, independent of any intervention. Regression to the mean is most likely to affect results in a pre/post pilot study without a control group. In this scenario, data may seem to report a significant effect when in fact there is none, or the effect is much smaller than the results suggest. Food is Medicine studies are particularly susceptible to regression to the mean, especially when the eligibility criteria target high-risk patients with high baseline measurements in biomarkers or health care utilization. For example, if a study enrolls participants who all have a very high HbA1c (i.e., greater than 10mg/dL), most HbA1c values will get better over time. This may have nothing to do with the intervention, but rather with the fact that values that are extremely abnormal, such as very high HbA1c, tend to move toward normal.

Selection Bias

This form of systematic error can arise when enrolling participants in a study—those who enroll or remain in a study may differ from those who do not enroll (or the control group) in meaningful ways other than access to the intervention or exposures under investigation. For example, while it may seem reasonable to compare SNAP participants with eligible nonparticipants, a number of factors—such as financial distress, poor baseline health, and household demographics—influence whether or not someone participates in SNAP in the first place, and those factors can then influence study outcomes. Sometimes these factors can be measured as confounders and accounted for within study design and analysis; however, ignoring these factors when selecting control groups can bias the results of the study, failing to capture the true effects of the intervention or exposure. The potential for selection bias also arises when those who do not complete the study differ from those who do in a meaningful way—for example, if those who did not complete a produce prescription study lived the farthest away from the distribution site, the study results could overstate the impact of the intervention in favor of those who lived closer, failing to capture its full impact. A well-run randomized control trial is one way to remove concerns of selection bias.

Medically Tailored Meals

Table 8: Medically Tailored Meals Peer-Reviewed Literature

Author	Study Design	Intervention	Key Findings
Tapper[272] **(2020)**	**Pilot RCT** n = 40 adults with cirrhosis and ascites (chronic liver disease)	MTM delivery program: 4 weeks of meals and 8 weeks of follow-up	MTM group vs. standard of care group: • Required fewer paracenteses • Quality of life improved more • Spent fewer days in the hospital
Berkowitz[273] **(2020)**	**Semi-structured interviews** n = 20 adults diagnosed with type 2 diabetes with HbA1c>8.0%	MTM delivery program 12 weeks of meals	Participants were generally satisfied with MTM. They emphasized the importance of receiving culturally appropriate food and reported improved quality of life, ability to manage diabetes, and stress reduction. Participants also suggested combining MTM and other programs with additional financial assistance, particularly with medications.
Berkowitz[274] **(2019)** **JAMA**	**Retrospective cohort study with near/far matching** n = 1020 adults Intervention: 499 existing MTM program clients	MTM delivery program: average of 12.4 months of meals	MTM group vs. matched cohort: • 49% fewer inpatient admissions • 72% fewer admissions to skilled nursing facilities • 16% reduction in health care costs
Berkowitz[275] **(2019)** **J. Gen. Int. Med.**	**Randomized cross-over trial** n = 42 adults diagnosed with type 2 diabetes with HbA1c>8.0%	MTM delivery program: 12 weeks "on-meals" (intervention) and 12 weeks "off-meals" (control)	"On-meals" group vs. "off-meals" group: • Increased Healthy Eating Index 2010 score by +31.4/100 • Reduced food insecurity from 62% to 42% • Reduced hypoglycemia from 64% to 47% • Fewer days when mental health interfered with quality of life
Henstenburg[276] **(2019)**	**Retrospective chart review** n = 103 adults, existing MTM program clients with complex health conditions who filled out the 2016 Client Satisfaction Survey	MTM delivery program: at least 6 months of meals	• Decreased hospitalizations (p=0.0077) • BMI was stable (median decrease of 0.04) and did not vary by diagnosis
Berkowitz[277] **(2018)**	**Retrospective matched cohort** n = 3077 adults, dually eligible for Medicaid and Medicare; members of a managed care plan Separate matched cohorts: MTM recipients: n =133, n = 1002 nonrecipients Non-Tailored Food: n = 624 recipients, n = 1318 nonrecipients	MTM delivery program and non-tailored food (NTF) delivery program: at least 6 months	MTM group vs. matched cohort: • 70% fewer ED visits • 72% fewer uses of emergency transportation • 52% fewer inpatient admissions • lower medical spending (–$570) • $220 in net health care cost savings NTF group vs. matched cohort: • 44% fewer ED visits • 38% fewer uses of emergency transportation • lower medical spending (–$156)
Hummel[278] **(2018)**	**RCT** n = 66 adults ≥ 55 years old with a history of systemic hypertension; discharged to home following hospital admission for acute decompensated heart failure.	MTM delivery program: 4 weeks of meals, with 12 weeks of follow-up	Intervention vs. control: • Similar Kansas City Cardiomyopathy Questionnaire summary scores • Increased Kansas City Cardiomyopathy Questionnaire clinical summary scores (p=0.053) • Fewer 30-day heart failure readmissions (p=0.06) and days re-hospitalized within that timeframe (p=0.055)

Table 8: Medically Tailored Meals Peer-Reviewed Literature, continued

Author	Study Design	Intervention	Key Findings
Palar[279] **(2017)**	Pre-post with no comparison n = 56 adults, existing Project Open Hand clients with HIV and/or type 2 diabetes and income under 300% FPL	MTM pickup program: 6 months of meals	Nutritional measures: • Decreased food insecurity (p<0.0001) • Decreased consumption of fatty foods (p=0.003) • Decreased consumption of sugary foods or drinks (p=0.006) • Fewer depressive symptoms (p=0.028) • Decreased binge drinking (p=0.008) • Decreased number of participants reporting giving up health care for food (p=0.029) or food for health care (p=0.007) • HIV group: increased ART adherence (p=0.046) • Type 2 diabetes group: decreased diabetes distress (p<0.001); increased perceived diabetes self-management scores (p=0.007); decreased BMI (p=0.035)
DiMaria-Ghalili[280] **(2015)**	Cross-sectional descriptive study n = 171 adults, MTM program clients who completed Client Satisfaction Survey Comparison: National Survey of Older Americans Act Participants (NSOAAP) respondents n = 191, 272 from the Northeast n = 622,410 from urban/suburban areas	MTM delivery program (duration not specified)	MTM recipients vs. National Survey of Older Americans Act Participants: • More likely to rate the program highly (p<0.01) • Reported healthier eating (p<0.01); improved health p<0.01); satisfaction with taste (p<0.01); and satisfaction with variety (p<0.01)
Gurvey[281] **(2013)**	Pre-post pilot with comparison group n = 698 adults, members of a Medicaid Managed Care Organization Intervention: = 65 existing MTM program clients Comparison: n = 633 matched nonrecipients	MTM delivery program: at least 6 months of meals	Intervention vs. comparison: • Lower mean monthly health care costs ($28k vs. $41k) • Lower mean monthly inpatient costs ($220k vs. 132k) • Lower HIV/AIDS mean monthly costs ($37k vs. $17k) • Fewer monthly ED visits (p=.0001) • Fewer monthly inpatient visits p=.0001) • Shorter monthly inpatient length of stay (p=.0008) • Lower percentage of individuals discharged to home (p=.0001)

Research Table Acronyms

AIDS	Acquired Immunodeficiency Syndrome
ART	Antiretroviral Therapy
BMI	Body Mass Index
BP	Blood Pressure
CDC	Centers for Disease Control and Prevention
CSA	Community Supported Agriculture
DSME	Diabetes Self-Management Education
ED	Emergency Department
FPL	Federal Poverty Level
FQHC	Federally Qualified Health Center
FV	Fruit and Vegetable
HbA1c	Hemoglobin A1c
HIV	Human Immunodeficiency Virus
MTM	Medically Tailored Meal
NSOAAP	National Survey of Older Americans Act Participants
NTF	Non Tailored Food
RCT	Randomized Control Trial
Rx	Prescription
SD	Standard Deviation
SES	Socioeconomic Status
SNAP	Supplemental Nutrition Assistance Program
WIC	Special Supplemental Nutrition Program for Women, Infants, and Children

Medically Tailored Meals Peer-Reviewed Literature: A Closer Look

Research on medically tailored meals has advanced rapidly, with increasing rigor and study size. This research is leading the way on demonstrating measurable decreases in health care utilization and spending, along with improvements in clinical outcomes across a range of health conditions. Forthcoming research will continue to probe these exciting results with even larger, longer studies, while also looking at new patient populations, such as those with cancer.

No. of studies:	10
No. with control or comparison group:	3
No. with sample over 100:	5
Duration range:	4 weeks to 6+ months
Intensity range:	50-100% of dietary intake

Health conditions: Type 2 diabetes, HIV/AIDS, heart failure, chronic liver disease, multiple health conditions (studies that measure outcomes for existing clients of medically tailored meal providers generally include participants with a range of health conditions, including type 2 diabetes, cancer, end-stage renal disease, and congestive heart failure)

Patient populations: Urban, suburban, dually eligible for Medicaid and Medicare, food insecure

Primary outcomes: Inpatient admissions, emergency department visits, admissions to a skilled nursing facility, rehospitalizations, health care costs (inpatient, outpatient, emergency department, pharmacy, emergency transportation), Healthy Eating Index scores, diet quality (18-item Multifactor Screener), food insecurity, BMI, frailty/disability, Katz Index of Independence in Activities of Daily Living, health-related quality of life, cost-related medication underuse/competing demands between food and medicine, hypoglycemia (self-reported), hemoglobin A1c (HbA1c), diabetes distress, diabetes self-efficacy, depressive symptoms, internalized HIV stigma, ART adherence, chronic liver disease-specific outcomes (paracenteses per person-week, measures of liver function, diuretic dose, quality of life symptom inventory), heart failure-specific outcomes (Kansas City Cardiomyopathy Questionnaire, cardiac biomarkers), qualitative insights and process metrics, including patient satisfaction, food preferences, and program adherence.

Strength of Research Design: The evidence base for medically tailored meals is the most robust among the three Food is Medicine interventions examined in this report. Of the 10 studies, two are randomized trials, five use comparison groups, and five have samples of over 100.

Intervention Design: Intervention design across studies is relatively consistent; most of the interventions were delivered by three medically tailored meal providers with standardized programs for different patient populations. The most notable variations were in program duration, ranging from four weeks to over six months, and intensity (the amount of food provided), ranging from 50-100 percent of a patient's dietary intake. Meals were generally home delivered, but one intervention (Palar 2017) required that participants pick up meals. Meals were sometimes complemented with nutrition counseling.

Across the spectrum of Food is Medicine interventions, medically tailored meals are the most intensive for service providers—requiring the preparation and, often, home delivery of food—and therefore the most expensive. They are also the most direct: by minimizing some of the most challenging factors that program participants face in food and nutrition interventions—such as affordability, time, knowledge, skills in food preparation, and the need for transportation—medically tailored meals can lead to greater impact and stronger causal inferences. However, for the intervention to be effective, participants must consume the meals. Factors such as nutrition education, cultural acceptability, palatability, and household dynamics are therefore critical to program design.[282]

Program Participants: Historically, medically tailored meals have been provided to populations with highly complex health profiles. All studies feature the same core inclusion criterion: a diagnosis of one or more serious, nutrition-related or nutrition-sensitive medical condition. Half of the studies also use income or food security as an inclusion criterion, further compounding the clinical, nutritional, and social risk factors of study participants. Six studies focus on participants with specific medical conditions—type 2 diabetes (three), HIV (one), acute decompensated heart failure (one), and chronic liver disease (one), while four include participants across a range of health conditions, often diabetes, CVD, kidney disease, and HIV. All studies include participants living in urban and suburban settings.

Generally, participants were extremely sick and many struggled to shop and cook for themselves. They already faced significant health risks and had high baseline health care costs. Therefore, it is difficult to extrapolate outcomes to the general population or even to those with high health care usage and costs who are not at serious nutritional risk.[283]

Key Metrics and Outcomes: By far, the medically tailored meals literature includes the most studies (six) that measure health care utilization and cost outcomes, such as emergency department visits, hospitalizations and rehospitalizations, nursing home admissions, average length of stay, total costs, and cost savings. The medically tailored meals literature also features the most health condition-specific outcomes, such as diabetes distress and self-management, HIV stigma, antiretroviral therapy adherence, and quality of life scores for heart failure and chronic liver disease. Likewise, disease-specific studies tend to include relevant biometric measures, such as HbA1c and cardiac and serological biomarkers. A handful of studies (three) provide qualitative data on participant satisfaction, experience, and suggestions for improvement.

Research on Medically Tailored Meals in the Pipeline: There are a number of ongoing and planned research studies strategically designed to build on the existing evidence base, targeting gaps and continuing to deploy rigorous methodologies. Forthcoming research will explore the impacts of medically tailored meals on patients with lung cancer, colorectal cancer, HIV, congestive heart failure, hypertension, type 2 diabetes, and pregnancy. A number of studies will also measure mental health and quality of life outcomes, including depression, anxiety, general well-being, and functionality. Sample sizes range from 60 to 1000. This pipeline research also includes at least five studies funded by the NIH.

Medically Tailored Meals and Equity Considerations: Medically tailored meals remove a number of logistical and financial barriers to food access. The provision of meals also serves as a point of social contact and support. While meal choice is often limited, many of the meal providers participating in these studies strive to use recipes that reflect the food traditions of their client populations. It is important that studies note when and how client preferences and tastes are incorporated into intervention design as this can play a key role in overall adherence.

To date, research on medically tailored meals has evaluated health outcomes and health care utilization for the principal program participant. In practice, however, a number of medically tailored meal providers do not serve just the individual patient—they provide meals to the entire household. These interventions may rely, in part, on the providers meeting the nutritional needs of everyone in the household, allowing the principal program participant to consume most or all of the food that was intended for them. Research is in progress that will evaluate the importance of providing meals to the full household as well as the range of benefits experienced by other household members.

Another key practice of many of the meal providers participating in these studies is access to as-needed nutrition counseling. Participants can work with Registered Dietitians Nutritionists (RDNs) to help them stay with a diet that may be unfamiliar, understand why medically tailored meals are important for their health, schedule consumption of meals around taking medication, and make appropriate choices about what to eat outside of the meals if the intervention doesn't provide full daily nutrition or once the intervention ends. Research has yet to explore the full range of these benefits or the impact of different program components.

Key Unanswered Questions: Research has yet to evaluate optimal intervention intensity (the amount of food provided) or duration for different health conditions and levels of acuity. Research also must identify which participants can transition to medically tailored groceries or produce prescriptions and maintain health outcomes, on what timeline, and under what circumstances. This information is especially important for medically tailored meals as the most resource-intensive Food is Medicine intervention. Similarly, research must investigate what happens to meal recipients' diet and health once the intervention ends.

Table 9: Medically Tailored Meals: Condition-Specific Study Results

This table provides a snapshot of the key outcomes that have been measured for different health conditions, noting if a medically tailored meal intervention was associated with a statistically significant increase (⬆) or decrease (⬇) or no impact (–).

Health Condition	Outcome	Result
Multiple health conditions	Emergency department visits	⬇
	Inpatient admissions	⬇
	Overall health care costs	⬇
	Admission to skilled nursing facility	⬇
	Self-reported healthier eating	⬆
	Self-reported health status	⬆
Type 2 diabetes	Healthy Eating Index Score	⬆
	Dietary quality (18-item Multifactor Screener)	⬆
	Food security	⬆
	Hypoglycemia	⬇
	Depression (Patient Health Questionnaire)	⬇
	Binge drinking	⬇
	Hospitalizations and ED visits	–
	Self-reported diabetes management and awareness	⬆
	Diabetes distress	⬇
	HbA1c	–
	BMI	⬇
	Tradeoffs between health care and food	⬇
HIV/AIDS	Food security	⬆
	Dietary quality (18-item Multifactor Screener)	⬆
	Depression (Patient Health Questionnaire)	⬇
	Binge drinking	⬇
	BMI	–
	HIV Stigma Scale	–
	Hospitalizations and ED visits	–
	Self-reported ART adherence	⬆
	Tradeoffs between health care and food	⬇
Heart failure	Kansas City Cardiomyopathy Questionnaire Score	⬆
	Kansas City Cardiomyopathy Questionnaire Clinical Score	–
	Cardiac and serological biomarkers	–
Chronic liver disease	Paracenteses	⬇
	Ascites-specific quality of life metrics	⬆
	Days in the hospital	⬇

Medically Tailored Groceries

Table 10: Medically Tailored Groceries Peer-Reviewed Literature

Author	Study Design	Intervention	Key Findings
Sastre[284] **(2021)**	**Retrospective chart review** n = 542 admitted patients identified as food insecure	Vouchers for medically tailored food for food insecure patients at discharge: one-time. Study period of 12 months	38% of patients redeemed vouchers. Among patients who redeemed vouchers, the average number of hospital readmissions 7% lower than those who did not redeem vouchers
Cheyne[285] **(2020)**	**Pre-post pilot with no comparison group** n = 192 adults with clinical history of prediabetes	Diabetes-appropriate food packages and text-based education: monthly, six-month assessment of a 12-month intervention	Improved food security, dietary intake, physical activity, health status, and depression scores ($p < .001$ for each) BMI did not change significantly.
Paolantonio[286] **(2020)**	**Nested cohort study** n = 33 food insecure cancer patients (SNAP participants were not eligible)	Unrestricted* supplemental Food Voucher for Food Insecure Cancer Patients: monthly for 6 months *$230/month debit card with only restrictions on cigarettes, alcohol, and cash back	On average, patients spent 77% of unrestricted voucher funds on items categorized as "healthy," with the largest portion spent on animal protein (22%), fruits (15%), and vegetables (13%). 70% of patients reported eating most or all of the food themselves.
Hickey[287] **(2020)**	**Mixed-methods evaluation** n = 504 patients with self-reported/clinic reported food insecurity	Pediatric clinic-based food pantry: three-day supply of food (no limit or frequency reported), 22-month study period	No significant relationship between accessing the pantry and preventative service completion for up-to-date immunization status, completed lead screening, or completed developmental screening at 27 months of age
Aiyer[288] **(2019)**	**Pre-post mixed-methods evaluation** n = 172 food insecure adults	Produce distributions: 30 pounds of fresh produce and four "Food Rx-friendly" nonperishable food items every two weeks for 9 months	Food insecurity decreased from 100% at baseline to 10.2% at visit 3 and 5.9% by visit 12 Perceived helpfulness of provided foods in improving dietary behaviors: fruits = 94.4%, vegetables = 90.6%, lean proteins = 85.2%, whole grains = 82.1%, low-fat dairy = 73.4%
Feinberg[289] **(2019)**	**Pre-post pilot with no comparison group** n= 112 patients with type 2 diabetes HbA1c ≥ 8.0%)	Food farmacy program for adults with type 2 diabetes: monthly for 12 months	HbA1c decreased from 9.6% to 7.5% Health care spending for participants insured by Geisinger (n=37) dropped by 80%. Operational cost of ~$2,400 per patient a year
Greenthal[290] **(2019)**	**Semi-structured interviews** n= 30 patients, 89 providers	Hospital-based food pantry: Up to two times a month	Patients: alleviated some concerns about stigma and inspired greater confidence in food quality. Providers: supported hospital-based food pantry and made frequent referrals; expressed a desire for additional training related to food insecurity.

Table 10: Medically Tailored Groceries Peer-Reviewed Literature, continued

Author	Study Design	Intervention	Key Findings
Ferrer[291] **(2019)**	**Pilot RCT** n=58 adults with type 2 diabetes (HbA1c >9%)	Medically tailored grocery pickup for adults with type 2 diabetes: two times a month for six months	HbA1c decreased by 3.1% in the intervention group vs 1.7% in the control group (p = 0.012). Starting the Conversation Diet scores improved in the intervention group (p< .001). BMI was unchanged in both groups.
Seligman[292] **(2018)**	**RCT** n = 568 food pantry clients with HbA1c ≥7.5	Diabetes-appropriate food package program at food banks: 11 food packages over six-month period	No significant difference between intervention and control groups in HbA1c.Within the intervention group, HbA1c decreased significantly among those who fully engaged vs. partially engaged (p=0.02). Statistically significant improvements in the intervention compared with the control group: food security (p=0.03), food stability (p=0.01), fruit and vegetable intake (p=0.04), and tradeoffs between food and diabetes supplies (p=0.03)
Wetherill[293] **(2018)**	**Pre-post pilot with no comparison group** n = 43 patients at a health clinic with hypertension, diabetes, and/or hyperlipidemia	Pilot clinic-based food pharmacy to support chronic disease self-management: monthly food packages over seven-month study period	Significant improvement in daily dietary fiber intake. Slight increase in daily fruit and vegetable intake. Mean food security did not change. Among participants who had high blood pressure at enrollment (n = 17), diastolic blood pressure significantly improved.
Gany[294] **(2016)**	**Nested cohort study** n = 351 patients at five cancer clinics	Hospital-based food pantry for low-income cancer patients: weekly food packages over four-month period	The median number of return visits after initial visit was 2 and the mean was 3.25 (SD=3.07). Younger patients used the pantry less, immigrant patients used the pantry more, and prostate cancer and Stage IV cancer patients used the pantry more.
Seligman[295] **(2015)**	**Pre-post pilot with no comparison group** n= 687 food pantry clients with self-reported diabetes diagnosis and/or HbA1c ≥6.5%	Diabetes-appropriate food package program at food banks: monthly food packages over six-month period	Mean HbA1c decreased from 8.11% at baseline to 7.96% at follow-up (p<0.001) Diabetes self-efficacy and medication adherence increased. Fruit and vegetable intake increased. 88% of participants reported that they preferred the diabetes food box to regular food pantry options.

Medically Tailored Groceries Peer-Reviewed Literature: A Closer Look

Medically tailored groceries—sometimes called healthy food boxes, healthy food packages, food pharmacies, or hospital/clinical food pantries—blend key components from medically tailored meals and produce prescriptions. As medically tailored grocery programs are also often co-located within health care facilities, they represent the most fertile ground for exploring health care provider perspectives and engagement with food support programs. Medically tailored groceries are associated not only with decreases in food security but also improvements in health condition-specific outcomes. Forthcoming research will continue to explore a variety of different program designs—such as the type of food provided, the amount of food provided, duration, and home delivery—among different patient and geographic populations.

No. of studies:	12
No. with control or comparison group:	3
No. of studies with sample over 100:	5
Duration range:	6 to 12 months
Intensity range:	up to 25% of dietary intake (many studies do not specify)

Health conditions: type 2 diabetes, prediabetes, cancer, hypertension, hyperlipidemia, multiple health conditions; studies that measure outcomes for existing hospital and health center patients generally include participants with a range of health conditions, including type 2 diabetes, cancer, HIV/AIDS, hypertension, and heart disease

Patient populations: urban, suburban, rural, food insecure, uninsured, Medicaid enrollee, households with children

Primary outcomes: food security, dietary intake (various), fruit and vegetable intake, hemoglobin A1c (HbA1c), diabetes self-management, diabetes self-efficacy, medication adherence, hypoglycemic episodes, BMI, physical activity, depression scores, patient experience and satisfaction, health care provider experience and satisfaction, and program utilization

Strength of Research Design: The evidence base for medically tailored groceries is still emerging. Over half are pilot studies, exploring program implementation and laying the groundwork for larger, more rigorous investigations. As compared with the medically tailored meals literature, fewer studies use control groups or randomization. The medically tailored groceries literature includes two randomized control trials, one of them a pilot trial, six pre/post evaluations without comparison groups, and one retrospective chart review. In addition, a qualitative study assesses program feedback from both patients and clinical health care providers.

Intervention Design: Medically tailored groceries differ from medically tailored meals on a number of accounts. The literature features grocery interventions delivered in one of two settings: community-based food pantries or clinic-based food pantries. Grocery items are generally unprepared, whole, or minimally processed foods. In some interventions, grocery items were presented as a "package" or "food bag," limiting client choice, while others allowed participants to choose what they wanted from a variety of pre-selected items. Participants generally pick up grocery items on a weekly or bi-weekly basis and interventions run from six to 12 months. As the food is not prepared and the intervention is generally not delivered to the participant's home, medically tailored groceries are less time- and resource-intensive for providers than medically tailored meals, meaning that they are usually less expensive per program participant than a medically-tailored meals intervention.

In studies of medically tailored groceries, there was much greater variation in key program elements than in studies of medically tailored meals. There was a wide range of diversity in populations, intensity, duration, nutritional composition, type of distribution, and educational components, making it harder to define each intervention and compare its impact across different populations, settings, and outcomes.

Program Participants: Within the existing medically tailored groceries literature, over half of the studies focus on specific health conditions: prediabetes and diabetes (five) and cancer (one).

Food insecurity is generally a key inclusion criterion—three studies enrolled participants who were existing food pantry clients, while five studies enrolled participants who had been screened for food insecurity by a health care professional.

Participants in medically tailored grocery programs were generally able to shop and cook for themselves, distinguishing this group from participants in medically tailored meal studies.

Key Metrics and Outcomes: Nearly all studies measure dietary intake using a variety of tools, and many measure food security. Diabetes interventions measure a variety of diabetes-related outcomes, including HbA1c. Other clinical outcome measures include BMI and diastolic blood pressure.

Research on Medically Tailored Groceries in the Pipeline: Forthcoming research will continue to explore the impact of medically tailored groceries on patients with diabetes (again, measuring HbA1c) and households with children. Research will also explore new territory, including the impact of home delivery and the impact of medically tailored groceries on people living with HIV and rural populations.

Medically Tailored Groceries and Equity Considerations: The delivery model of the interventions in these studies required participants to accommodate certain pick-up times and, further, have the time, equipment, and knowledge to prepare meals. While food pantry models appear to offer participants some choice—especially about whether or not they wish to take items—studies on food box and food package interventions did not mention whether participant tastes and preferences played a role in which foods were provided, or if participants were able to choose whether or not to take items. A number of programs included education components, ranging from an educational booklet with recipes to classes and nutrition counseling.

Key Unanswered Questions: It is critical that medically tailored groceries research discuss key intervention design decisions, notably intensity (what percentage of dietary intake an intervention is designed to provide), scaling for household size (whether households with more people receive more food), and whether the program addressed participant tastes, preferences, and convenience considerations (location, transportation, physical ability, and the like). These critical design features are not only important for comparing and contrasting different interventions and study results. They are also worthy of independent investigation—for example, how much food provided for how long yields optimal results for different health conditions? Or, does allowing for participant choice increase program satisfaction and/or adherence?

Research also needs to investigate what happens when participants bring food home—do they have the time, knowledge, skills, and tools to prepare meals? Who helps them and shares food with them? How are foods used to support the needs of others in their community? Which foods are participants able to easily incorporate into their cooking? What resources do groceries free up and how does this translate into other gains, for instance extra disposable income?

Finally, as with medically tailored meals, research needs to understand what happens to participants when the intervention ends and whether health outcomes can be sustained.

Table 11: Medically Tailored Groceries: Condition-Specific Study Results

This table provides a snapshot of the key outcomes that have been measured for different health conditions, noting if a medically tailored meal intervention was associated with a statistically significant increase (⬆) or decrease (⬇) or no impact (–).

Health Condition	Outcome	Result
Multiple health conditions	Fruit intake, adults	–/⬆
	Vegetable intake, adults	–/⬆
	Fruit intake, children	⬆
	Vegetable intake, children	–
	Daily dietary fiber intake	⬆
	Food security	–
	Diastolic blood pressure	⬇
	Hospital readmissions	⬇
	Self-reported health status	⬆
Type 2 diabetes	Healthy food intake (Starting the Conversation Diet score)	⬆
	Healthy food intake (FRESH Foods Survey)	⬆
	Food security	⬆
	Food stability	⬆
	Fruit intake, adults	⬆
	Vegetable intake, adults	⬆
	Sugar intake	–
	Self-reported hypoglycemic episodes	–
	Self-reported diabetes management and awareness	–/⬆
	Diabetes distress	–/⬇
	Tradeoffs between food and healthcare	⬇
	Medication adherence	–
	Health status (CDC's Behavioral Risk Factor Surveillance System)	⬆
	HbA1c	–/⬇
	Diastolic and systolic blood pressure	⬇
	BMI	–
	Physical activity	⬆
	Depression	⬇

Produce Prescriptions

Table 12: Produce Prescriptions Peer-Reviewed Literature

Author	Study Design	Intervention	Key Findings
Veldheer[296] **(2021)**	**Pre-post with no comparison group** n = 97 adults with type 2 diabetes, HbA1c ≥ 7.0%, and BMI ≥ 25 kg/m²	Produce prescription program with DSME: $28–$140/month in vouchers for seven months	• HbA1c decreased by 1.3% ($p < 0.001$). Reductions were associated with higher voucher redemption rates (p=0.032) and a change in diabetes medications ($p = 0.003$). • Changes in BP and BMI were not statistically significant. • Average redemption rate using intent-to-treat was 53%. Redemption was significantly, positively associated higher dollar amounts ($p < 0.001$).
Slagel[297] **(2021)**	**Non-randomized, parallel, controlled trial** n = 36 food insecure adults with a diet-related health condition.	Produce prescription voucher program with expanded nutrition education: seven-month intervention (voucher amount not specified)	• Increased frequency of consuming vegetables, healthful food purchasing practices, and the ability to afford more bills (e.g., utilities) ($p < 0.05$) • Changes in food security, clinical biomarker, and biometric measures were not significant.
Bryce[298] **(2021)**	**Pilot RCT** n = 128 adults with , HbA1C > 8.0%.	Produce prescription debit card program at FQHC farmers market: up to $80 for four months	• As compared with control, no statistically significant differences in any outcome metrics (HbA1c, BMI, or BP), but a small effect size for HbA1c • Pre/post within intervention group, HbA1C decreased significantly (p=0.006), with a small to medium effect size.
Ridberg[299] **(2021)**	**Pre-post with comparison group** n = 592 pregnant adults enrolled in WIC	For pregnant WIC recipients: $40 FV vouchers (distributed with WIC vouchers) over 14-month study period	• Food security increased ($p = <0.001$), intervention vs. comparison. • Average intake frequency of whole fruit, salad, total fruit, and combined FV here higher for intervention group vs. comparison. • Compared with births in historical control group (n=2299), odds of preterm delivery were 37% lower in intervention group ($p = 0.18$).
Burrington[300] **(2020)**	**Prospective convenience sample, pre/post-tests** n = 10 families with low SES with one or more children at risk for chronic disease	Produce prescription pilot with online ordering and nutrition education in rural setting: weekly credit ($15-$25, depending on family size) for five months	• Redemption of online produce credit was 94% and class attendance was 80%. • The program increased confidence with cooking, tasting new foods, and cooking/following new fruit and vegetable-based recipes. Average fruit and vegetable intake rose for children to 5+ servings/day. Confidence, culinary skills, and food literacy increased slightly.
York[301] **(2020)**	**Pre-post pilot** n = 21 Latinx adults with self-reported diagnosis of type 2 diabetes	Organic vegetable distributions: weekly pickup of vegetables for 12 weeks	• No statistically significant change in HbA1c • Reduced systolic ($p = 0.03$) and diastolic ($p = 0.01$) blood pressure
Orsega-Smith[302] **(2019)**	**Pre-post qualitative evaluation** n = 41 food insecure adults with one of the following: Medicaid enrollee, overweight, or have 2+ children	Clinic-based mobile market produce distribution: 15-25 lbs/month of produce for one year	• Adult fruit and vegetable intake significantly increased. • Child fruit consumption also significantly increased, but there was no difference in child vegetable consumption. • Fruit and vegetable purchase avoidance based on cost decreased (65.0% to 51.2%).
Berkowitz[303] **(2019)**	**Pre-post qualitative evaluation** n = 41 adults; health center patient; food insecure, and one of the following: Medicaid enrollee, overweight, or have 2+ children	Clinic-based mobile market produce distribution: 15-25 lbs/month of produce for one year	• Adult FV intake significantly increased. • Child fruit consumption also significantly increased, but there was no difference in child vegetable consumption. • FV purchase avoidance because of costs decreased (65.0% to 51.2%).
Saxe-Custack[304] **(2019)**	**Non-controlled longitudinal intervention trial** n = 114 caregiver–child pairs	Produce prescription voucher program at two pediatric clinics: $15 vouchers (no limit reported) for six months	• Increased child-reported mean daily intake of whole fruit ($p = 0.03$) • Increase in total fruit intake (including fruit juice) and vegetable intake was not significant.

Table 12: Produce Prescriptions Peer-Reviewed Literature, continued

Author	Study Design	Intervention	Key Findings
Emmert-Aronson[305] (2019)	**Longitudinal, repeated-measures single arm design** n = 49 FQHC patients with behaviorally- mediated clinical concerns and/or food insecurity	Vegetable voucher (part of a Behavioral Pharmacy program): $10/week for 16 weeks	• Increased consumption of fruits and vegetables • Changes in diastolic blood pressure and acute care utilization were not significant. • Acute care utilization decreased by 77%.
Ridberg[306] (2019)	**Pre-post with no comparison group** n = 578 low SES households with children 2-18 yrs who were clinically obese or overweight	Farmers market produce prescription program: $0.50 to $1.00/person per day for 4 to 6 months	• 72% of households increased their summative food security score. • In adjusted regression models, participants had higher change scores with five or six clinical visits, compared with one or two visits and education level of caretaker.
Ridberg[307] (2019)	**Retrospective cohort study** n = 883 children; overweight or obese	Farmers market produce prescription program: $0.50-$1.00 per household member a day in vouchers that could be redeemed up to six times	• Increase from first to last visit in the percentage of federal dietary guidelines being met was 93% to 100% for fruits, 64% to 70% for vegetables, and 78% to 86% for combined fruits and vegetables. • Dose propensity of 0.32 cups for each additional visit • Average voucher redemption was 59%.
Marcinkevage[308] (2019)	**Mixed-methods process and outcome evaluation** n =144 adults; SNAP enrollment	SNAP-based nutrition incentive prescription for supermarkets: $10 voucher each week for up to six months	• Overall redemption rate was 54.4%. • 88.9% of participants reported that the program was easy to use; 86.8% reported increased ability to afford balanced meals. • 88.2% reported eating more fruits and vegetables; 71.5% reported managing their health conditions better; and 81.2% reported improvement in meeting nutrition, diet-related, or meal plan goals.
Schlosser[309] (2019)	**Qualitative interviews** n = 23 food insecure adults with hypertension diagnosis	Farmers market produce prescription program for hypertension: $40 a month for three months	• Transportation issues shaped shopping and eating patterns and limited participant ability to access farmers markets. • Limited and unstable income shaped participant shopping and eating behavior before, during, and after participation. • Consider structural constraints in program design.
Joshi[310] (2019)	**Mixed-methods process evaluation**	Farmers market produce prescription program for hypertension: $40 a month for three months	• Implementation: seven diverse providers screened 266 patients over three months; 224 were enrolled. Over $14,500 of vouchers were redeemed. • Identify and involve multiple key decisionmakers; use nonclincal staff; and develop a routine communication plan to address implementation issues.
Izumi[311] (2018)	**Mixed-methods evaluation** n = 9 FQHC patients who completed survey	Discount community-supported agriculture (CSA) program for FQHC patients: weekly pick up for 23 weeks	• 78% of respondents indicated that the CSA program improved their health or health behaviors. • Proportion of members who thought they ate as many vegetables as they thought they should rose from 17% to 67%. • Focus group (n=15) participants said program improved diet quality and provided instrumental, informational and emotional support.
Trapl[312] (2018)	**Pre-post with no comparison group** n = 137 food insecure adults with hypertension diagnosis	Farmers market produce prescription program for hypertension: $40 a month for three months	• Daily fruit consumption increased ($p < 0.001$). • Daily vegetable consumption increased ($p < 0.001$). • Farmers market visits and voucher redemption were not associated with fruit and vegetable consumption. • 86% voucher redemption
Bryce[313] (2017)	**Pre-post with no comparison group** n = 65 adults; type 2 diabetes diagnosis or HbA1c > 6.5	Produce prescription program for diabetes: $10 a week for up to four weeks	• Average HbA1C decreased from 9.54% to 8.83% ($p = 0.001$). • Weight and BP did not change ($p > 0.05$).
Cavanagh[314] (2017)	**Retrospective pre/post with control using medical records** n = 54 adults; low SES, hypertensive, obese and/or diabetic	Mobile market produce prescription program: weekly $7 fruit and vegetable vouchers for at least five weeks	• Mean BMI decreased by 0.74 kg/m2, versus 0.35 kg/m2 in control ($p=0.02$).

Author	Study Design	Intervention	Key Findings
Trapl[315] **(2017)**	**Mixed-methods evaluation** n = 40 pregnant adults; <24 weeks gestation adults residing within high poverty area	Farmers market produce prescription program for pregnant adults: four $10 vouchers for 16 weeks.	• 56% of participants redeemed ≥1 voucher. Redemption didn't vary significantly by model of care or by perceived barriers to fruit and vegetable intake. • Living closer to a farmers market increased redemption (88.1%). • Providers (n = 10) indicated that the program created opportunities to talk about diet.
Omar[316] **(2017)**	**Pre-post with no comparison group** n = 27 adults with BMI >25	Farmers market debit card produce prescription program: up to $40 on a rechargeable debit card over 12 weeks and $20 boxed food delivery for completing program	• 78% of participants reported an increase in their daily intake for fresh fruits and vegetables, with an average increase of 2 cups/day. • Biometrics (n = 16): 5 had weight loss and 5 had improvements in blood pressure.
George[317] **(2016)**	**Pre-post with qualitative evaluation** n = four low SES families; patients at weight loss clinic; children overweight and/or obese	Farmers market produce prescription with medical student mentor: four $50 vouchers for eight weeks	• On average, families spent $40.68 of vouchers and reported one weekly produce item going unused. • Transportation and unpredictable work schedules were major barriers for both families and mentors. • Integrating medical student nutritional mentoring into the program was feasible and conferred benefits to families, students, and vendors.
Chrisinger[318] **(2016)**	**Pre-post with no comparison group** n = 353 families	Farmers market produce prescription program: $10 voucher for 16 weeks	• Significant increase in children's fruit and vegetable consumption reported by parents. • Rx redemption rates were low (36%), likely due to logistical factors.
Goddu[319] **(2015)**	**Implementation evaluation**	Multi-site produce prescription program: $5 coupon off $20 purchase at Walgreens and $10 voucher for local farmers markets	• Value and convenience of the prescription are strong determinants of use. • A small and diverse coordinating team is key.
Watt[320] **(2015)**	**Quasi-experimental prospective study with comparison group** n = 61 pregnant (first trimester) low SES, Hispanic adults	Farmers market produce prescription program for Hispanic, pregnant, low-income adults: weekly vouchers (amount not reported) for six months	Intervention vs. comparison: • More likely to breastfeed (p = 0.07) • Infants more likely to pass the ages and stages developmental screen (p =0 .06) • More likely to have significant improvements in diet, exercise, and depression (p ≤ .05) • No association with infant weights • Significant variation in redemption rates
Friedman[321] **(2014)**	**Mixed-methods, community-based participatory research** n = 44 adults; diagnosed with type 2 diabetes; enrolled in diabetes education program n = 13 providers	Farmers market produce prescription program for diabetes: $1 coupons for farmers market (no limit reported) for 22 weeks	• 80% of the prescriptions were spent on the same day the patients received them. Patients enjoyed social aspects of the market. • Provider communication about diet decreased over time.
Freedman[322] **(2013)**	**Mixed-methods evaluation** n = 41 low SES adults diagnosed with type 2 diabetes	FQHC-based farmers market produce prescription program for diabetes: $25 vouchers at baseline, $25 at midpoint, and $40 at follow-up over 22 week periods	• Increased daily fruit and vegetable consumption (p=0.07)

Produce Prescriptions Peer-Reviewed Literature: A Closer Look

The research on produce prescriptions represents the vast range of what is possible with these programs. Indeed, as produce prescription programs have become a national movement, with millions of dollars in dedicated federal funding each year through the GusNIP Produce Prescription Grant Program and a rapidly proliferating number of programs in different settings across the country. In recent years, both the Veterans Administration and Indian Health Service have explored establishing produce prescription pilots. The research on these interventions demonstrates improvements in food security and dietary intake, while starting to explore critical questions around primary and secondary prevention. The volume and scope of forthcoming research is exciting—in particular, studies will start to aggregate evaluations and results from all federally funded programs, representing unprecedented scale.

No. of studies:	27
No. with control or comparison group:	5
No. with sample over 100:	8
Duration range:	four weeks to two years
Intensity range:	$1 one-time coupon to $140/month (not consistently reported)

Health conditions: type 2 diabetes, prediabetes, obesity, cancer, hypertension, pregnancy, multiple health conditions (studies that measure outcomes for existing hospital and health center patients generally include participants with a range of health conditions)

Patient populations: urban, suburban, rural, food insecure, uninsured, Medicaid enrollee, households with children, women

Primary outcomes: food insecurity, dietary intake (various), preterm birth weights, infant weight, breastfeeding, blood pressure, hemoglobin A1c, BMI, exercise, mood, purchasing behavior, nutrition knowledge, participant experience and satisfaction, health care provider experience, implementation metrics including voucher redemption rates

Strength of research design: The research on produce prescriptions, sometimes referred to as "vouchers" or "referrals," is the most voluminous. But it is also diffuse. The literature includes two randomized control trials and one pilot randomized control trial. Over half of studies are pre-post evaluations, but only three include comparison groups. Sample size ranges from four to 883. Only a handful of studies (five) evaluate anthropometric measures and biomarkers; instead, most evaluate dietary metrics and process metrics, such as participation and satisfaction.

More so than the literature on medically tailored meals or groceries, the produce prescription literature includes qualitative studies that highlight participant and health care provider perspectives and contain key insights for program implementation and replication. The produce prescription literature includes the only study that explicitly uses community-based participatory research approaches, whereby participants and community members are actively involved in program design, metrics, and evaluation.

Intervention design: The monetary value of prescriptions varied widely, from a one-time $1 coupon to a $140/month voucher, as did the duration of the program, from four weeks to two years. It can be hard to accurately evaluate the intensity of an intervention, as prescriptions were infrequently scaled for household size and redemption rates were often low (or unreported). Nearly half of the interventions in the literature provided vouchers that could be redeemed only at farmers markets, which generally operate on a weekly, seasonal basis. However, programs are increasingly making it possible to redeem prescriptions at other food retail and distribution sites, including large retailers, pharmacies, local grocery stores, and via community-supported agriculture (CSA) programs. Many of the produce prescription programs featured in the literature also included an educational component, such as nutritional counseling, cooking classes, and health-education classes.

Like the research on medically tailored groceries, the research on produce prescriptions demonstrates significant differences in intervention design—namely, prescription amount, program duration, and program convenience—making it hard to draw meaningful conclusions about effectiveness. Low participation and/or redemption rates also diluted the strength of results.

Program participants: Just over half of the interventions featured in the literature enrolled participants who had or were at risk for type 2 diabetes and/or cardiovascular disease. Other interventions focused on child nutrition (seven), pregnancy (three), and existing patients with a range of health conditions at federally qualified health centers (three). Most interventions explicitly included food insecurity as a criterion for eligibility.

Key metrics and outcomes: Only four studies measured biometric outcomes: height and weight (four), HbA1c (three), and blood pressure (three). However, produce prescription interventions that are of very short duration or low intensity (e.g., $10 a month in fruits and vegetables) may not be well suited for observing biometric changes.

Research on produce prescriptions in the pipeline: Created under the Gus Schumacher Nutrition Incentive Program (GusNIP), the Nutrition Incentive Program Training, Technical Assistance, Evaluation and Information Center (NTAE) supports evaluation of GusNIP produce prescription awardees. There are currently 25-30 unique organizations with programs under way. In addition to conducting individual analyses, NTAE will pool evaluation results from these programs. Other pipeline research will investigate a range of biometric indicators, program costs and utilization, health care costs and utilization, and qualitative and quantitative assessments of participant and provider experience. Study participants include those with a range of health conditions, including diabetes and pregnancy. Anticipated sample sizes are significantly larger than the existing literature, with one study looking at a sample of over 7,000 produce prescription participants.

Produce prescriptions and equity considerations: Among the three intervention types examined in this report, produce prescriptions generally provide the least amount of food and have the lowest cash value. The relatively low cost of the intervention and its ease of delivery for providers—especially when delivered via a debit card or the provision of a voucher rather than food itself—makes produce prescriptions easier to scale to more people and broader patient populations. Produce prescription interventions feature the greatest amount of participant choice within a food category: participants can choose any fruit or vegetable available at the redemption site.

Redemption mechanisms are also rapidly evolving, making produce prescriptions more accessible and easier to use for people with transportation challenges and work- or child care-related time constraints. In addition to physical vouchers and debit cards, one program trialed an online ordering platform (Burrington 2020), while another provided the option for delivery (Omar 2016).

Key unanswered questions: Published in response to the scoping review by Veldheer et al., recent commentary by Hager and Mozaffarian provides a comprehensive overview of key questions for future produce prescriptions research.[323] Hager and Mozaffarian call on researchers to investigate which patient populations are most likely to benefit, minimum effective duration and intensity of interventions, cost effectiveness, the role of nutrition education, and the potential benefit of food items beyond fruits and vegetables. While highlighting the need for more studies that assess biometric outcomes, they caution that not all health conditions are well suited for produce prescriptions and they encourage researchers to focus on conditions, such as poorly controlled diabetes or hypertension, that are most sensitive to short-term dietary changes. Likewise, while highlighting the need for more rigorous methodologies, they note that double-blind control trials may not always be appropriate and recommend alternatives, such as quasi-experimental studies with carefully matched controls.

Additionally, research must investigate questions such as how to best operationalize produce prescription programs—for example, the use of vouchers versus electronic benefit cards and what tech infrastructure is needed. Research should also understand the household effects of produce prescriptions and, importantly, what happens when the program ends.

Table 13: Produce Prescriptions: Condition-Specific Study Results

This table provides a snapshot of the key outcomes that have been measured for different health conditions, noting if a medically tailored meal intervention was associated with a statistically significant increase (⬆) or decrease (⬇) or no impact (–).

Health Condition	Outcome	Result
Diet-related disease risk, usually as indicated by food security status or BMI	Healthy Eating Index scores	⬆
	Fruit intake, adults	⬆
	Vegetable intake, adults	⬆
	Fruit intake, children	⬆
	Vegetable intake, children	–/⬆
	BMI	–/⬇
	Food security	⬆
	Diastolic blood pressure	⬇
	HbA1c	–
Hypertension	Fruit consumption	⬆
	Vegetable consumption	⬆
	Fast food consumption	⬇
	Diastolic blood pressure	–
	Systolic blood pressure	⬇
	BMI	⬇
Type 2 diabetes	HbA1c	–/⬇
	BMI	–
	Diastolic blood pressure	–
	Systolic blood pressure	–
	Fruit and vegetable consumption	–
Pregnancy and infant health	Food security	⬆
	Dietary intake (measurement)	⬆
	Preterm births	–
	Birth weight	–
	Systolic blood pressure	–
	Blood glucose	–
	Breastfeeding	–
	Developmental screening	–
	Exercise	⬆
	Depression	⬇
Multiple health conditions	Exercise	⬆
	Depression	⬇
	Acute care utilization	⬇

Conclusion

The 49 studies reviewed in this section demonstrate that Food is Medicine interventions are associated with improved dietary intake, improved health status, improved disease-specific health outcomes and biomarkers, decreased depression, decreased tradeoffs between food and medication, decreased health care utilization and spending, and more. However, the strength of the research varies and, ultimately, many studies have small samples, low retention rates, and no control or comparison groups. There is also significant variation across intervention categories—while the 10 medically tailored meals studies feature the most rigorous research design, the 27 produce prescription studies include only three randomized control trials. The literature on medically tailored groceries falls somewhere between: while there are only 12 studies, half include a control or comparison group. Moreover, drawing conclusions within each category or across all categories is nearly impossible given significant variation in program design (intensity, duration, delivery, etc.) and participant demographics (health condition, food security status, economic status, etc.).

This section outlines what the research can tell us about a variety of Food is Medicine programs and interventions. Importantly, it also underscores what remains unknown. Section VII of the Research Action Plan builds on this foundation and includes specific recommendations to advance Food is Medicine research. It focuses on the research questions that need to be asked and the types of studies that need to be conducted to help create a more complete picture of Food is Medicine interventions. Addressing these questions and studies can further illustrate how Food is Medicine programs can be most effective across a range of demographics and types of participants.

VII. Recommendations

The current body of research on Food is Medicine interventions has shifted the national dialogue around nutrition and health. From Congress to state legislatures, from the US Department of Agriculture (USDA) to state Medicaid programs, the government is promoting, testing, and expanding Food is Medicine interventions, compelled by the future that Food is Medicine research points to—a healthier nation and a more effective and cost-efficient health care system.

The proliferation of Food is Medicine interventions and their increasing use within health care has been conducted mostly ahead of the research, driven in large part by nonprofits and advocates on the ground who developed creative programs to meet the nutrition-related needs of people living with chronic illness. But, particularly within the past five years, health care integration of Food is Medicine interventions is increasingly common. As a result, a new wave of interest and investment in exploring their full impact offers opportunities to sustainably support and scale access to the most effective interventions.

To inform the next decade of Food is Medicine research, the recommendations in this Action Plan:

- Offer concrete guidance on how to embed equity throughout the Food is Medicine research continuum
- Identify key considerations for ensuring that research designs are robust and appropriate for yielding the most valuable and actionable information
- Identify the most urgent questions that have yet to be explored
- Describe how funders can support the most valuable research in the field
- Discuss research outside the scope of Food is Medicine that has major implications for nutrition and health, both within and beyond the health care system.

The core principles that inform these recommendations are equity, attention to research design and potential for translation, purposeful investment of resources, and contextualization of Food is Medicine within our broader systems and institutions. Alignment with these principles will advance a future in which:

- Everyone has the food that will allow them to live a healthy, dignified life according to their specific needs.
- Effective, appropriate Food is Medicine interventions are integrated into the US health care system nationwide, providing access to a wide range of proven interventions.
- All Food is Medicine research centers equity through the research continuum, so that interventions empower individuals and communities and are effective across demographic groups.

Equity Throughout the Food is Medicine Research Continuum

The incidence of diet-related chronic disease in the United States compels us to urgently identify the most effective Food is Medicine interventions. **We must know what interventions work, for whom, and for how long.** We must understand interventions in context, both of the individual and the household receiving the intervention, as well as the broader ecosystem of communities, programs, and policies that dictate nutrition access across the lifespan.

Using equity principles to guide all phases of the Food is Medicine research process is critical to the strategic deployment of limited financial and human resources.

If equity is not a central principle that guides the concept and execution of research, research risks irrelevance at best—and, at worst, can do real harm, by further embedding the systemic racism and inequitable access that has long run throughout both the food and health systems.

Centering equity in Food is Medicine research means that we can come to a deeper understanding of the many factors—political, historical, cultural, personal—that influence everyone's relationship to food and its impact on health, and then act on that new understanding.

> *"Because every research project is unique, there is no one-size-fits-all approach to incorporating a racial and ethnic equity perspective in research. However, all researchers can apply [equity principles] to their work … to create greater equity."*
>
> —Jenita Parekh, Kristine Andrews, Shantai Peckoo, authors of *A Guide to Incorporating a Racial and Ethnic Equity Perspective Throughout the Research Process*. Oct. 2019, ChildTrends.

The authors of the Food is Medicine Research Action Plan recognize that all research is subject to practical constraints of funding, time, purpose, and capacity. Some of the recommendations in this Action Plan—for example, purposeful consideration of the composition and potential biases of the research team—can be implemented immediately for almost all research in this field. The implementation of others will require new resources, collaborative efforts, and transformation of entrenched institutional practices with impact far beyond the Food is Medicine field. It won't always be practical to apply every recommendation to every research endeavor. But in many cases, protocols and plans can shift in meaningful ways to ensure greater alignment with equity principles.

In the two-year course of the Action Plan's stakeholder engagement process, the recommendations below emerged as key to ensuring that Food is Medicine research advances health equity: a fair and just opportunity for everyone to be as healthy as possible, with the aim of "reducing and ultimately eliminating disparities in health and its determinants that adversely affect excluded or marginalized groups."[324]

Researchers, funders, program implementers, and advocates should ask at the outset of new research and then throughout the research process: "How can I maximize alignment with equity principles for this study at this moment with these constraints?"

01. Seek to understand the diverse experiences and broader context of the population that will receive or has already received the intervention.

- This applies to both the potential study participants and the broader population that will receive the services if the intervention is shown to be effective. Purposeful exploration of the intended participant's context can influence intervention design, composition of the research team, research timeline, selection of outcomes to evaluate, and more. It is the responsibility of the research team to make clear-eyed assessments of their research concept and design and to clearly articulate the trade-offs involved in specific choices along the research continuum.

Food is Medicine research should be conducted with full acknowledgment of the diverse values, cultures, and histories that make the provision of food much more than a simple pathway toward better physical health. Every intervention won't be able to meet the needs of every study participant—but by fully exploring context prior to finalizing design, researchers can identify and address cultural blind spots, find weaknesses in the intervention design that would interfere with study completion, and maximize the study's impact by making the results more translatable.

Where the research intervention will be deployed within a particular group, but would ideally reach a broader population, consider:

Factors to explore for study participants and broader target population	
Languages spoken	Will the intervention be easy to access and participate in regardless of primary language?
Cultural competency of individuals interacting with program participants	Will program staff or health care providers be equipped to appropriately interact with and understand the needs of program participants?
Diversity of foods available	Will the foods that are available within the intervention be acceptable to individuals with different cultural backgrounds and across different geographies and seasons? Is there sufficient flexibility in the foods offered to adapt to cultural preference? Does the intervention allow for participant choice in food or prioritize participant autonomy in some other way?Are foods offered to study participants of similar quality to those available for purchase at a retail vendor?
Program eligibility barriers	Does the intervention rely on having health insurance or access to health care? Does referral to the intervention depend on recurring interactions with a health care provider? Does eligibility for the intervention rely on legal status in the United States?
Circumstantial and relational barriers	Does success of the intervention depend on having access to transportation or child care? Does it depend on having time, knowledge, and equipment to prepare food? Does it depend on having stable housing? Does it rely on the engagement and labor of a caregiver or caregivers (often women)? Will the presence of other family members in the household (e.g. grandchildren who are periodically present) impact the use of the intervention? Do researchers or program implementers make assumptions about participants' cognitive or physical abilities, and have they received training on sensitive assessment? Does the intervention require time commitments that are unrealistic for the participant population?
Associated stigma	Does the intervention require participants to disclose or otherwise reveal sensitive information to others in their community? Is the intervention provided in a manner that publicly identifies the participant as a recipient?
Unintended outcomes	Could the intervention unintentionally disrupt a participant's access to other resources and needed services?
Post-intervention impacts	What happens when the intervention ends? Will participants be able to access foods that were provided as part of the intervention?

02. At all stages of the research, plan to include the perspectives of potential study participants and the broader population that will receive or has already received the intervention.

- Establish fair compensation policies for research advisors or co-investigators with lived or local experience. If study participants will be asked to contribute stories, photos, or other media during the dissemination of research results, establish policies to compensate participants for these additional contributions.

Ethical storybanking: Operation Food Search, in St. Louis, Missouri, uses an "ethical storybanking" practice when capturing anecdotes from participants in their Fresh RX: Nourishing Healthy Starts study. In this study, pregnant people who are food insecure receive meal kits, with whole-food ingredients portioned by the meal, to cook at home. To acknowledge the value of video and written testimonials from program participants, which will be used when discussing the research and disseminating results, the organization compensates participants for the time they spend creating them, and also compensates participants when the videos or written testimonials are used.

- Allow for flexibility in research timeline and planned activities so that the research plan can be adjusted in accordance with feedback and input from these individuals. Research should demonstrate commitment to community feedback, either by using designs that permit flexibility (see Recommendation 11) or by involving community stakeholders in discussions on interim results and dissemination plans.
- When planning interventions, integrate long-term skills and capacity building efforts as possible and appropriate. This requires taking steps to establish partnerships and agreements to collaborate before the intervention design and evaluation is finalized.

Building the capacity of research participants: As part of the Fresh RX: Nourishing Healthy Starts study, Operation Food Search, in St. Louis, Missouri, worked with their pilot participants—pregnant people enrolled in Medicaid who were experiencing food insecurity—to refine survey instruments and other materials that would be used in the study's next phase. Operation Food Search created a participant advisory council, providing compensation for participants shared expertise, and modified the pilot methodology based off direct participant feedback. Over the course of those interactions, the pilot participants built relationships with one another that outlasted the study and included sharing parenting advice and baby supplies. Operation Food Search also purposefully included a focus on building the advocacy skills of study participants, creating the "Momvocates" program to encourage participants to share their perspective and engage in state and national advocacy work to increase access to Food is Medicine interventions.

03. In addition to including the perspectives of individuals with lived and/or local experience, researchers and funders should seek out perspectives and potential partnerships with community-based organizations that either provide similar services or support the study's target population in other ways.

- Because so many Food is Medicine interventions or similar services are provided by community-based organizations (CBOs), partnering with these entities to conduct research can leverage local expertise and help to illuminate opportunities or barriers to scaling access to Food is Medicine interventions. CBOs that are led by, and focused on the needs of, the study's target population are likely to have important insights about community values and preferences, along with established community rapport and trust. They are another important Food is Medicine research partner.
- Engagement with CBOs also requires compensation to organizations for their time, expertise, and the value of their connection and credibility within the community.

04. Investigate the composition of the research team, including the team's perspectives and potential biases. Fully engage all team members in planning and decision-making.

- Draft internal position statements for each member of the research team.[325] These can reveal or highlight gaps in relevant experience and knowledge.
- Purposefully create a research team made up of people with diverse professional and personal backgrounds. Take every opportunity to ask for and put into practice the perspectives of all research team members.
- Establish protocols in communication and operation that ensure all members of the team are fully engaged in planning and decision-making.

05. Monitor study recruitment and retention.

- Discuss the expected demographic breakdown of the study participants prior to recruitment based on catchment area. Monitor study recruitment to ensure that the diversity of enrolled participants meets or exceeds expectations.
- Researchers should thoughtfully consider how they are collecting race and ethnicity data to ensure that data collected is comparable to federal data. They should be explicit about why they are collecting and reporting race and ethnicity data.
- Offer implicit bias and/or cultural competency trainings to all clinicians and other personnel who will participate in study recruitment.
- Plan to support all study participants in study completion. This could mean providing access to resources that support retention where need is demonstrated, such as vouchers for transportation.

Measures necessary to support study retention should be built into preliminary budget plans and then documented and reported; the need for nutrition support does not exist in a vacuum and can inform translation of research interventions to real-world programs.

06. All Food is Medicine researchers and funders should encourage academic research institutions to change policies that inhibit equity-centered research.

- Equity-centered research in the Food is Medicine field might require the following:
  - Taking time to build trust with marginalized communities despite pressures to publish frequently
  - Building the research budget to account for participant and community partner compensation as well as study-retention supports like transportation vouchers or childcare
  - Using novel design approaches that allow the study to adapt to changing circumstances and the needs of participants
  - Working in interdisciplinary research teams in which both researchers and nonacademic program partners or study participants are equal coauthors of research, even though the university recognizes first-author publications as a primary criterion for advancement.
- Our Food is Medicine advisors identified the following examples of practices that would increase the ability of Food is Medicine researchers to align research practices with equity principles:
  - Review tenure and advancement criteria with a focus on revising criteria that unintentionally discourage researchers from aligning their work with equity principles
  - Establish criteria for equity-centered research and recognizing engagement in this research in tenure and professional advancement decisions
  - Supplement external research awards to enable and encourage research in partnership with marginalized communities
  - Explicitly recognize research that includes marginalized communities and communities of color as a positive criterion for advancement.

07. Research funders and researchers must ensure they adjust timelines and funding amounts to reflect the additional effort and investment of resources that may be required to do research that is truly equity-centered.

- The practices and expectations of entities that fund research, from government entities like the National Institutes of Health to philanthropic institutions, have enormous influence over what research is done and how. Funders can transform baseline practices in the field by encouraging research clearly focused on equity principles. But imposing new funding conditions must come with a practical understanding of the new activities and capacities that meeting those conditions will require on the part of researchers. Exploring the social context of study participants, engaging advisors and members of the research team who have lived experience, and ensuring that the intervention is optimally designed for participant engagement are all critical—but take time and can increase costs. Building trust with members of a particular community may require a different set of activities or a broader concept of the core research team than funders are accustomed to supporting. Timelines and funding amounts should be commensurate with funder expectations, reflecting the range of efforts and activities that equity-centered research comprises.

08. Whenever possible, qualitative research should be used to complement quantitative data.

- Qualitative research methods are essential for advancing Food is Medicine research as they capture the impact that cultural relevancy and socioeconomic factors have on participation in and adoption of Food is Medicine interventions.
- Although more data on how participants engage with and use Food is Medicine interventions has emerged in recent years, this area is still a significant and important gap in the literature.
- Researchers need to know more, for example, about whether and how—and for how long—participants change their household purchasing habits as a result of receiving a Food is Medicine intervention, and how they feel about the quality and quantity of the food provided. Interviewing and observing potential participants where appropriate allows researchers to identify where people's experiences with food and health, and their interactions with the health care system, are embedded within a nexus of inequality.
- Qualitative research on participant experience can help experts better understand differences in perspectives, motivations, and intervention engagements across different groups. It can yield information critical for refining interventions to best meet the needs of study participants as the program scales.

09. Food is Medicine research design should reflect the reality of household composition and household equipment, with particular attention to the household member who buys and prepares most of the household's food.

- Food provided to a household is likely to be shared among household members, potentially diluting the observable impact of a Food is Medicine intervention that is scaled for an individual. This is especially true if the person receiving the food is an adult or teenager in a household with young children.[326] Even when Food is Medicine interventions aim to improve the health outcomes of a particular member of the household, they should ideally be scaled to household size.
- Household composition and food needs may change over time. For example, grandchildren may live with grandparents over the summer or during school breaks. An adolescent might become the primary shopper for the household when the parent takes a second job. Researchers should consider and plan for changes in how food interventions might be sourced, used, or shared during these periods.
- Food is Medicine research that explores impacts on children must focus, at least in part, on the preferences, capacities, and circumstances of adult caregivers, especially female caregivers. Women in the United States shoulder a disproportionate responsibility for feeding children and other family members.
- Food is Medicine research that evaluates interventions for older adults must recognize the particular challenges unique to nutrition in this population, such as oral health problems, loss of muscle tone that impacts chewing and swallowing, changes in taste and smell that make food less appealing, and isolation. But they should also recognize the preferences, capacities, and circumstances of the individuals who are caring for them.[327]

- The success of Food is Medicine interventions generally relies on participants having access to some equipment for food storage and preparation. Frozen meals must be stored and reheated. Whole-food ingredients must be processed and cooked. Study participants' access to storage and equipment should be considered in research design and implementation.
- The provision of food or additional support to buy food, whether targeted at one person or purposefully deployed at the household level, has the potential to change eating patterns and affect the experiences, capacities, tastes, and preferences of the entire household beyond the duration of the intervention. Researchers should consider how to capture these intergenerational and longer-term impacts of Food is Medicine interventions.

The Future of Food is Medicine Research: Considerations for Research Design

Future Food is Medicine research should be designed to advance the field and to set the stage to translate research results into the real world. The proliferation of innovation and widespread enthusiasm for Food is Medicine interventions has opened a window of opportunity for important policy reforms—reforms that will address a variety of hard-to-navigate legal and regulatory barriers, support the infrastructure needed to scale access to services, and sustainably fund effective interventions within our health care system.

Across the country, health insurers are increasingly incorporating Food is Medicine interventions into benefits; hospitals and community health centers are formalizing partnerships with community-based organizations to respond to patients' nutrition needs; and the federal government is (for now) spending millions of dollars on the USDA's GusNIP Produce Prescription program. But seizing this window of opportunity relies on knowing what has worked already, what will work in new studies, and how to effectively translate research findings into information that program implementers and advocates can use in real time to refine programs and inform the decisions of policymakers.

Over the course of developing the Action Plan, advisors identified several elements of research design as critical to strengthening the rigor and relevance of Food is Medicine research.

10. Research should be appropriately powered to meaningfully evaluate the primary outcomes.

- Researchers should always conduct a power calculation prior to committing to a quantative study, in order to know if it will detect the primary outcomes and, where possible, secondary outcomes. As the Poverty Action Lab at the Massachusetts Institute of Technology points out, ensuring that research is appropriately powered also "reduces the likelihood that results will be misinterpreted or used to support contradictory arguments."[328] **If a study is underpowered, it may be extractive;** that is, consider the implications of asking participants to contribute their time and experiences without giving them a significant chance of contributing to a meaningful conclusion. Where a potential study might be underpowered to detect a primary outcome using quantitative methods, consider whether information that is critical to refining program design might be gleaned via qualitative methods.

- Whether a study is appropriately powered is one factor policymakers pay attention to when making decisions about nutrition and health care reform. While pilot studies are critical to testing whether a particular intervention can be delivered as planned, their primary purpose is to optimize intervention design prior to testing in a larger, more rigorously designed study. In the Food is Medicine field, however, small pilots are sometimes expected to yield insights into whether the intervention will have the desired impact on health outcomes, utilization, or costs. Research often stalls at the conclusion of the pilot because results are inconclusive. Decision-makers are loath to take steps to integrate interventions into health care unless they know they can rely on replication of results in a larger population. Whenever possible, research should be appropriately powered to report results for groups with different demographics (racial and ethnicity categories, rural vs. non-rural residence, etc.), acknowledging that additional resources might be required to recruit a different demographic or deliver the intervention to more participants.

11. Researchers should prioritize rigorous study designs with a combination of qualitative and quantitative approaches, balancing the pursuit of rigor with the reality of Food is Medicine interventions.

- In health care, randomized control trials (RCTs) are often cited as the ideal research design for influencing changes in health care policy and practice. There are now several Food is Medicine RCTs in the literature and many more under way. But RCTs in the Food is Medicine arena are not always practical, ethical, or best suited to test the efficacy of nutrition support—especially for groups that may already be food insecure or vulnerable to resource deprivation and whose circumstances might vary significantly due to fluctuations in income, employment, access to public benefits, or housing instability.
- Using an adaptive design can address some of the major drawbacks of RCTs in the Food is Medicine field. Adaptive design allows for planning to be flexible without compromising the integrity of the results.[329] Changes can be made over the course of the study based on accumulating data, including refining the sample size, abandoning treatments or doses, changing the allocation ratio of patients to trial arms, identifying patients most likely to benefit from enrollment and focusing recruitment efforts on them, and stopping the trial at an early stage for success or lack of efficacy.[330]
- Other rigorous study designs include those that can accurately assess whether (1) a change has occurred, (2) the change that occurred is a result of the intervention and not another cause, and (3) whether the degree of change is significant from the perspective of important stakeholders.[331] The study design should reflect a strategy to generate data that can support causal inference.

Alternatives to the Standard Randomized Control Trial
Stepped wedge cluster RCT: An initial period when no participants receive an intervention is followed, at intervals ("steps"), by clusters of individuals randomized to receive the intervention; eventually, all study participants receive the intervention.[332]
Interrupted time series: Data are collected at multiple and equally spaced time points before and after an intervention, with the goal of identifying data differences before and after an intervention.[333]
Regression discontinuity: A strong research design that approximates random assignment, this compares individuals with values just above and just below a specific cut-off point to estimate a treatment effect—for example, where receipt of a Food is Medicine intervention is based on an HbA1c over 8.0 percent, researchers will compare groups with HbA1c levels just above and just below that number to estimate the effect of the intervention.[334]
Difference-in-difference: Frequently used to estimate the effect of distinct changes in government policy, this design depends on having at least two groups where neither is initially exposed to the treatment. In the second period, one of the groups is exposed to the treatment but not the other. Change in the outcome of interest in measured for each group, and then compared.[335]

- Researchers can also seek to evaluate natural experiments. These occur when an event not under the control of a researcher divides a population into exposed and unexposed groups, using the naturally occurring variation in exposure to identify the impact of the event on an outcome of interest.[336] For example, the implementation of Medicaid 1115 waivers in Massachusetts and North Carolina have made Food is Medicine interventions available as a Medicaid benefit to some residents within those states. But individuals with similar health profiles in neighboring states don't have such access. Researchers could evaluate the health care utilization of individuals with access and those without, using the difference in state policy to draw conclusions about the impact of the waiver on the health of Medicaid beneficiaries.
- **Researchers can use qualitative methods to capture in-depth information about how participants are valuing, accessing, and using programs.** This information is critical to process and impact evaluation. It helps researchers understand the perspectives and preferences of people who participate in these programs and refine interventions as programs are brought to scale, without sacrificing equitable access.

12. Research should always report process and engagement metrics.

- Many studies in the current Food is Medicine literature fail to report on the process or engagement of study participants with respect to the intervention. We frequently can't tell, for example, how many participants completed a study or how many redeemed a produce prescription voucher. We generally don't know how many of the provided meals study participants actually consumed. Process and engagement metrics are critical for translating research results into policy and practice. A study that reports mixed health outcomes based on data from a small fraction of participants likely tells us much more about the inaccessibility of the intervention design than it does about the impact of the intervention on health outcomes.
- Research should always report on:
  - **Intensity**
    e.g., meals per week, with or without snacks, value of voucher, frequency of voucher
  - **Duration**
  - **Access mechanism**
    e.g., referral source, physical instrument or debit card, operating hours, and locations of sites where benefits are redeemed
  - **Home delivery** (yes/no)
  - **Client choice in foods provided or able to be accessed** (yes/no)
  - **Scaled for household** (yes/no)
  - **Capacities required to participate**
    e.g., does the intervention require knowing how to prepare food and having the tools to do so?
  - **Adherence and participation levels**

13. Researchers should carefully consider whether the intensity and duration of Food is Medicine intervention is likely to influence outcomes of interest.

- The hypotheses, design, and outcome measurements in Food is Medicine interventions must ask: which health outcomes can we reasonably expect a food-focused intervention to change, and by how much? A $10 per week coupon for fruits and vegetables that is made available for three months is unlikely to have a significant effect on an individual's BMI, for example. Investigating changes in household food purchasing patterns, changes in health care provider/patient dynamics, self-reported health status, or disease management capacity might be better outcomes to explore.

Should Common Metrics Be Used to Assess the Efficacy of Food is Medicine?

THE CALL FOR COMMON METRICS

In the interest of translating research results into policy and day-to-day practice as quickly as possible, many have called for establishing common metrics, or standardized evaluation measures, in Food is Medicine research. To motivate policy change and adoption of Food is Medicine interventions in the health care industry, researchers and policymakers want to amass a large body of evidence on certain data points—for instance, the impact of Food is Medicine interventions on health care costs or hospital readmissions. If all Food is Medicine research on medically tailored meals demonstrates a significant positive impact on, for example, 30-day hospital readmissions, the case for Medicare and Medicaid coverage of these meals becomes much stronger.

Food is Medicine program implementers are also increasingly being asked to demonstrate the health impact of their program interventions as they compete for scarce philanthropic resources. Many of these organizations are accustomed to conducting internal program evaluations but haven't yet worked with health care partners to obtain and analyze health outcome and utilization data. Obtaining and analyzing health data is time-consuming and can be expensive for community-based providers; some have called for common metrics in order to better understand what they can or should evaluate as they explore their program's impact on health.

Some Food is Medicine research funders have also supported the concept of common metrics. They may know, for example, that they are able to fund only a part of the research necessary to effect policy change and scale access to critical nutrition interventions. They hope that research supported by other funders will report on similar outcomes, building the case for broader change.

POTENTIAL DRAWBACKS OF COMMON METRICS

The idea of using common metrics in Food is Medicine research concerned many of our advisors. Common metrics might not work well for many studies, given the great variation in Food is Medicine interventions themselves and in the health care purposes for which they are deployed. Outcomes of interest for someone living with diabetes, for example, might be very different for someone undergoing cancer treatment. The same could be true for someone who cannot shop or cook for themselves versus someone who shops and prepares food for a family of five.

THE CONCERN ABOUT COMMON METRICS IS ESSENTIALLY THREEFOLD:

1. Identifying common metrics for Food is Medicine research will concentrate funding, publication opportunities, and other resources on research that use common metrics at the expense of research that explores other important or novel measures.
2. Using common metrics will result in reporting on outcomes for which studies are underpowered or where the intervention wouldn't be expected to have much or any on impact, diluting the strength of the Food is Medicine research.
3. Common metrics will increase the burden on program implementers and study participants involved in underpowered or poorly designed studies by compelling them to collect or give health information, investing significant time and resources for little ultimate gain.

Most of our Food is Medicine advisors agree on the need to explore evaluation metrics that can effectively measure the effect of particular interventions on different health conditions. To reconcile the interest in and concern about common metrics, more deliberate discussions are necessary.

14. Multi-sector stakeholders, including individuals in the target intervention demographic, should be convened to identify meaningful metrics across the Food is Medicine field. Metrics for specific health conditions should be developed in collaboration with primary care and specialist clinicians.

- An inclusive list of metrics, along with validated tools for assessment, would help guide researchers, program implementers, and funders toward understanding what can realistically be evaluated in Food is Medicine research. A series of multi-sector expert meetings could identify:
  - Metrics that are appropriate given the intensity of the intervention. For instance, outcomes that could reasonably change with the amount of food or frequency of food provided
  - Metrics that are suitable for the duration of the intervention. For instance, an intervention of four weeks versus six months
  - Metrics that are condition-specific
  - Metrics that are valuable to participants and participant households
  - Metrics that can capture impact beyond the participant's household
  - Metrics that can measure impact following an intervention

The Future of Food is Medicine Research: The Next Phase of Exploration

Future Food is Medicine research should prioritize addressing urgent gaps in the literature and conducting more research that will lead to policy change and intervention take-up. It must consistently explore outcomes beyond utilization and cost, and investigate the impact of Food is Medicine interventions on a wider array of health conditions.

The current body of Food is Medicine research has spurred important changes in our health care system and started to fundamentally shift the way we think about nutrition and health care. The task ahead is to leverage these findings in future explorations to improve lives, reduce health disparities, prevent or better manage disease, and curb rising health care costs. In order to realize the promise of Food is Medicine research to date, resource and efforts must be focused on addressing critical but still unanswered questions about what works, for whom, and how.

Research that has significant implications for health care integration in the short term should be a priority. At the same time, we must not lose sight of the need for large longitudinal studies that can illuminate opportunities for disease prevention and intergenerational or broader community impact.

The recommendations in this section identify areas of priority focus in the immediate next phase of Food is Medicine research; they should not be interpreted to limit the scope of promising areas of inquiry in a field that is dynamic, with so many important issues that have yet to be explored.

15. Research should evaluate components of multi-pathway interventions, such as food plus education versus only food, or food plus navigation assistance for broader social needs versus only food.

- Commonly accepted definitions and standards for Food is Medicine interventions are emerging, but peer-reviewed research has not yet evaluated the impact of each component of a Food is Medicine intervention. Consider the research on medically tailored meals: in addition to meals designed by a Registered Dietitian, medically tailored meal interventions evaluated in the literature generally include an individual nutrition assessment and also access to medical nutrition therapy and nutrition counseling support as needed throughout the intervention period. In the research on medically tailored groceries, the diabetes-appropriate food boxes distributed by food banks included nutrition education materials in addition to food. Pipeline research will begin to tease out the impact of these individual intervention components on health impacts. More such research is needed.

The complexity of an intervention has important implications for scaling programs: when components like nutrition education and navigation of social needs are included, they are now usually funded by philanthropy and grants. Scaling a multi-component intervention will require finding sustainable long-term support for all components. In addition, the complexity of an intervention could be a barrier to participation. The more components an individual must participate in to receive an intervention's health benefit, the higher the risk that the intervention will be inaccessible to those who need it most.

16. Leverage the insights of existing Food is Medicine research on health care cost and utilization to drive integration into health care.

- There's no escaping the reality that opportunities to influence health care costs are catalysts for change in health care policy. Interest in lowering health care costs, or at least curbing their growth, influences enthusiasm for and real-world uptake of Food is Medicine interventions. In some instances, innovations in health care policy are required by statute or regulation to be cost-neutral or cost-saving before they can be tested or incorporated into public health insurance programs, as is the case with Medicaid 1115 waiver demonstrations and services evaluated as part of CMMI Innovation Models. Even where cost neutrality and cost savings aren't required by law as a condition of integrating Food is Medicine interventions into health care, health care organizations and insurers still frequently prioritize cost as they make decisions about which new services and benefits to offer. Many openly acknowledge that addressing health-related social needs is both a moral imperative and conceptually good for business. But before moving Food is Medicine interventions out of small programs supported by philanthropic partnerships into the standard benefits package, C-suite leadership generally looks for a predictable return on investment. From a practical standpoint, research that can demonstrate the capacity of a Food is Medicine intervention to reduce health care costs will speed integration into health care.
- The advisors who contributed to this Action Plan at once recognized this reality and strongly asserted that Food is Medicine interventions will not, and should not be expected to, always be cost-neutral or cost-saving. The vast majority of health care services are in fact neither. In the Medicare program, for example, coverage of health care services is based on, among other factors, a determination that the service is "reasonable and necessary."[337] The phrase "reasonable and necessary" is defined in the Medicare Program Integrity Manual—and that definition does not include consideration of cost.[338] Rather, it focuses on services that are safe and effective, nonexperimental, and appropriate for Medicare patients.[339] Focusing resources relating to nutrition interventions on research where the primary outcome of interest is cost or utilization of high-cost services would be myopic, ignoring other important factors that influence whether an intervention ultimately becomes a covered health care benefit.
- At the same time, researchers can leverage the fact that cost and utilization will continue to be a significant motivator for policymakers and health care companies. Where cost and utilization of high-cost services are the primary outcomes assessed in research, research can maximize opportunities to influence health care coverage policy by focusing, in part, on robustly designed studies that meet the following (exemplary, not exhaustive) criteria:

Priority interventions for evaluating impact on cost and utilization	Factors contributing to prioritization
▪ Evaluation of medically tailored meals in populations with highly complex health needs and multiple comorbidities ▪ Priorities for building on the current data include identifying the optimal length of duration and eligibility criteria.	▪ Medically tailored meals generally provide 50% or more of an individual's nutrition. ▪ Meals are usually delivered to the home, eliminating transportation barriers to accessing the meals. ▪ Baseline health among the target population is generally poor, increasing the potential for significant gains from the intervention.
▪ Evaluation of interventions that provide a significant portion of daily and fully prepared nutrition for a period of time after hospitalization, for conditions where inpatient costs are high and readmissions are likely (for example, heart failure)	▪ Post-hospitalization, individuals who are not well enough to prepare meals can become malnourished, which increases both their risk for readmission and probable length of stay if they are readmitted. ▪ With a solid evidence base, integrating temporary post-hospitalization support into health care is one of the most feasible policy changes, from both a political and practical perspective.
▪ Evaluation of interventions that provide a significant portion of daily nutrition, scaled to household, where one or more recipients live with a disease that is highly sensitive to diet and costly to manage (for example diabetes, congestive heart failure, or kidney disease)	▪ Interventions that provide a higher quantity of food are more likely to significantly impact both food insecurity and diet quality, increasing the speed of clinical changes that could impact costs. ▪ Interventions scaled to household size in multigenerational households increase the likelihood that the targeted recipient of the nutrition support will consume the food.
▪ Longitudinal evaluations that match nutrition support to acuity of need: for example, providing medically tailored meals to someone with multiple comorbidities and a produce prescription to someone with prediabetes. Interventions that provide significant nutrition support to individuals who are more health-compromised are likely to impact cost. Where less food is provided or the population has less acute needs, the longer study period may be needed to observe cost and utilization outcomes in the population, in addition to clinical or other outcomes of interest.	▪ Data on the impact of longer-term interventions are a prominent gap in the literature. Studies that include a range of interventions longer than one year are likely to capture changes in health care costs and utilization and, as a bonus, to yield information about prevention or other important benefits that can inform shifts in policy both within and outside of the health care arena.
▪ Evaluation of interventions that provide a significant portion of nutrition support to individuals with high-risk pregnancies.	▪ As research on the WIC program has shown and other research is under way to confirm, nutrition support during pregnancy is associated with a reduction in preterm births, with significant implications for health care costs: preterm births incur 23 times the cost of full-term births in the Medicaid program.[340] Interventions that are associated with longer gestation are likely to demonstrate an impact on health care costs, in addition to yielding important health benefits for the parent and child.

17. Research must consistently explore the value and impact of Food is Medicine interventions beyond impact on health care cost and utilization.

- The objective of controlling health care costs is only one part of the triple aim of health care reform. Food is Medicine interventions have shown significant impact in the other two areas: improving clinical outcomes and patient experience. Stakeholders across the Food is Medicine field—researchers, funders, program implementers, and advocates—should prioritize further exploration of the impact of interventions on metrics that make a meaningful difference in health, but don't necessarily manifest as cost savings. Instead, Food is Medicine interventions might be cost-effective at producing desirable health outcomes, even if they cost more to provide than the care individuals currently receive or than an alternate treatment or service.[341] Interventions that may not be cost-saving or cost-effective can nevertheless produce important and desirable health outcomes, and thereby become part of the standard of care. Finally, the equity principles explored in Recommendations 1-9 must also be applied in exploring the value and impact of Food is Medicine interventions, influencing the questions research seeks to answer as well as the process by which it attempts to do so.

Exploring the Impact of Food is Medicine—Health Outcomes and More

A host of health-related outcomes have enormous value to individuals and communities, as well as health care entities. These outcomes include biomarkers such as HbA1c or blood pressure as well as outcomes related to quality of life, health-promoting behaviors, medication adherence, health condition-specific management, and financial security. For example:

- Do Food is Medicine interventions allow an individual to live independently at home, instead of in an acute care facility?
- Do they make a course of cancer treatment easier to withstand and therefore complete?
- Do they ease pressure on household finances, so that people are able to pay utility bills or repair a vehicle?
- Do they support a family's long-term diet shift by allowing children to have repeated exposure to different fruits and vegetables without fear of deprivation if children initially reject certain foods?
- Do they support a healthy pregnancy and delivery of a healthy infant?
- Do they make diet-related chronic disease easier to manage, decreasing stress and feelings of depression and increasing the number of an individual's "Healthy Days at Home" per month?[342]
- Do they reduce the need to take certain medications?

Food is Medicine research has already explored some of these factors, with compelling findings. Pipeline research will yield additional insights. Future research must continue, and expand, these inquiries.

For the health care system, incorporating Food is Medicine interventions as a benefit or service might increase plan retention or improve provider-patient relationships. It might help improve quality ratings, which can attract additional patients and members, increase opportunities to win competitive contracts, and result in enhanced payments from government programs.

Multiple stakeholders, including people who would receive Food is Medicine interventions, clinicians, and community-based organizations, should participate in identifying appropriate and important metrics for Food is Medicine researchers to explore beyond health care cost and utilization.

The following is a non-exhaustive list of outcomes to consider when evaluating Food is Medicine interventions, and that research can continue to explore:

Food is Medicine Intervention Metrics Beyond Health Care Utilization and Cost
▪ Condition-specific bioclinical outcomes, for example HbA1c in the case of type 2 diabetes
▪ Individual and household stress
▪ Caregiver stress
▪ Self-efficacy
▪ Self-reported health
▪ Healthy Days at Home
▪ Intergenerational impact of interventions
▪ Long-term impacts of shorter-term interventions
▪ Impact on substance use
▪ Impact on provider-patient relationship
▪ Depression
▪ Reduction in health disparities
▪ Impact on household finances and necessary financial trade-offs
▪ Disease self-management
▪ Impact on employment
▪ Impact on the use of government programs and supports, with respect to both food programs and beyond
▪ Impact on medication use
▪ Social connectedness
▪ Impact on gendered division of food labor
▪ Broader impact of intervention on community, for example employment, the ability to find and buy local products, support for local agriculture, and the reduction in need to access charitable food sources

18. Food is Medicine research should investigate the impact of interventions on health conditions where risk is associated with food insecurity and nutrition is key to the treatment or management of disease.

- Research into the impact of Food is Medicine interventions on specific diet-related health conditions is emerging and more is underway, especially for conditions where diet is widely recognized as having a significant impact on disease management: diabetes, heart disease, cardiovascular disease, HIV, cancer, and kidney disease. However, research should explore the impact of Food is Medicine interventions on additional health conditions. Table 1 notes health conditions where food insecurity is associated with increased risk of diagnosis, and conditions where nutrition is important to disease management, including minimizing treatment side effects, and outcomes. Research should also explore the impact of interventions for the many individuals living with more than one diet-related health condition.

19. Research should explore the potential of Food is Medicine interventions to aid in prevention.

- Food is Medicine interventions have already demonstrated utility in tertiary prevention—that is, improving quality of life and reducing symptoms for people who are living with disease. Researchers are also interested in understanding the role of these interventions in primary and secondary prevention. With respect to secondary prevention, could a Food is Medicine intervention prevent a disease from getting worse? In the case of type 2 diabetes, could access to a Food is Medicine intervention as needed—either consistently or episodically during periods of food insecurity or elevated HbA1c levels—prevent amputations or vision loss years later? With respect to primary prevention, could the use of Food is Medicine interventions prevent the onset of disease all together? These are critical questions, but exploration requires longer study time lines and a larger investment of resources. See Recommendations 20 and 21 for discussion of the roles of the NIH and private funders in supporting longitudinal research on prevention.

Research Funding: Supporting the Next Phase of Inquiry in Food is Medicine

Over the next decade, purposeful research on Food is Medicine interventions should be a significant focus of government and private funders.

The fundamental relationship between nutrition and health warrants urgent attention from scientists and policymakers, especially as rates of chronic disease continue to climb and the factors that contribute to that increase are better understood. **Even amid competing demands for finite research funds, Food is Medicine interventions stand out because of the promise they hold to prevent, manage, and treat chronic disease, and because their success in doing so has enormous implications for policymaking and reform within and beyond the health care system.** Consider the impact of avoiding hospitalizations, maximizing the ability for parents and grandparents to live independently, or preventing diseases that are preventable. Consider the policies that could support the translation of these discoveries into not only health care but also agriculture and the environment, transportation, and social services. The pending questions in the Food is Medicine field are critically important. Government and private funders must invest in seeking answers.

20. The National Institutes of Health should invest significantly more in Food is Medicine research.

- Several recent actions of the National Institutes of Health indicate that the agency recognizes the importance and potential of Food is Medicine research. The agency issued a Request for Information in September 2021 that solicited input on how innovative and multidisciplinary research can address hunger, food insecurity, and nutrition insecurity—a charge that Food is Medicine research can certainly fulfill.[343] The amount of funding for Food is Medicine research within the agency has also increased, with a number of awards for studies on Food is Medicine interventions made between 2019 and 2021. This research is expected to yield significant insights about medically tailored meals, medically tailored groceries, and produce prescriptions over the next few years. These investments should continue and expand to include studies with longer duration that aim to assess prevention.
- **The NIH is best positioned to invest in large longitudinal studies of Food is Medicine interventions that can illuminate their utility in primary, secondary, and tertiary prevention.** Investigation of Food is Medicine Interventions aligns with the agency's 2020-2030 Strategic Plan for NIH Nutrition Research.[344]

21. A federal agency or federally appointed entity should be formally tasked with coordinating efforts across federal agencies to explore the impact of Food is Medicine interventions in many populations and geographies.

- In addition to the significant recent investment in Food is Medicine research by the NIH, the USDA has spent millions of dollars to evaluate the impact of Food is Medicine interventions. Additional expenditures have been proposed within the Department of Veterans Affairs and Indian Health Service.[345] To maximize the value of federal investment, one agency or federally appointed entity should be formally tasked with coordinating research on Food is Medicine interventions funded by all federal agencies and departments, ensuring that results are disseminated widely and that future research will build on the existing evidence base without duplication.

22. The Centers for Medicare and Medicaid Services (CMS), along with state Medicaid agencies, should seek to capture data on Food is Medicine interventions from natural experiments generated by program policy changes. Evaluation of these impacts should be a priority for research funding.

- Research on Food is Medicine interventions to date has spurred changes to public insurance programs that, in very limited circumstances, allow these interventions to be offered as benefits to Medicare and Medicaid beneficiaries. These opportunities are far from program-wide. The capacity to provide Food is Medicine interventions to Medicare or Medicaid beneficiaries depends on the following: in the case of Medicare, enrollment in Medicare Advantage and the individual insurer's coverage decisions; in the case of Medicaid, decisions by state program personnel and/or the managed care plans operating within a particular state. Although the vast majority of Medicare and Medicaid beneficiaries have no access through these programs to medically tailored meals, medically tailored groceries, or produce prescriptions, the recently expanded regulatory flexibilities within these programs mean an increasing amount of public health insurance dollars are expended on these interventions.
- Where Food is Medicine interventions are being offered as benefits, CMS is generally not collecting data on how these interventions do or do not affect beneficiaries' use of other program services. In situations where evaluation is required—for example, in the Medicaid 1115 demonstration initiatives in Massachusetts and North Carolina—the evaluation of the multi-component health care demonstration may not be targeted enough to capture the specific impact of Food is Medicine interventions. Variation in Medicare and Medicaid access to Food is Medicine interventions across localities and/or managed care plans represents an opportunity for CMS to collect and analyze data on provision of these services, and also for researchers to conduct research on these natural experiments.

Some of the top opportunities to better understand the impact of Food is Medicine interventions within Medicare and Medicaid include:

- Including Food is Medicine interventions as supplemental benefits within the Medicare Advantage program.
- Including Food is Medicine interventions within Medicare-Medicaid dual-eligible programs.
- Use of Food is Medicine interventions within Medicaid waiver programs in California, Massachusetts, and North Carolina. Though evaluation of the individual states' multi-component waiver programs is required, there is an opportunity for research to look more specifically at the impact of food within each state. In addition, inclusion of Food is Medicine interventions within these waiver programs could be compared between states.
- Integration of Food is Medicine interventions into Medicaid managed care through state program decisions or incentives, such as including them on a list of approved services that may be used "in lieu of" other health care services covered by the state.

23. Private funders should partner with each other and government agencies to enable more—and more ambitious—Food is Medicine research while also focusing on equity principles.

- There is almost no end to meaningful research questions that are yet to be fully explored in the Food is Medicine field. This Action Plan has identified many important gaps in the research. One is deeper inquiry into the qualitative experience of participants in Food is Medicine interventions. Another is examining a longer intervention duration and post-intervention short- and long-term impact. The Action Plan has also emphasized the fundamental importance of continuing to embed equity throughout Food is Medicine research, both through immediate implementation of best practices that can be operationalized within existing time and resource constraints and through advocacy for broader institutional and systems change that will normalize equity-centered research practices in the future.

Both public and private funders have important roles to play in ensuring that investments in Food is Medicine research advance equity and assist in answering the field's most urgent questions.

- Active collaboration and aggregation of resources can support larger studies, multi-site studies, and longer studies. Pooling resources can also increase the number of robust qualitative study components, recruitment of additional populations to participate in a study, and any supports that might be necessary to include that population, such translating recruitment materials into different languages. Wider collaborations can result in adding Food is Medicine-related inquiries to a study that will evaluate a broader intervention, efforts to meaningfully engage with the study population over the course of the research, interdisciplinary studies that assess the impact of Food is Medicine interventions beyond the individual and household, and much more.

Food is Medicine in Context: Broader Research That Will Support Transformative Change

To understand the full value and impact of Food is Medicine interventions within their broader context, research should further explore the impact of foundational nutrition support programs on health, illuminate the impact of income support programs on food insecurity and health, and seek to understand the impact of Food is Medicine interventions beyond the individual and household.

24. Research should explore the health impact of changes to food and nutrition support programs, especially recent developments in SNAP and WIC.

- Food is Medicine research relies on a body of foundational evidence that demonstrates the link between food insecurity and negative health outcomes, and between nutrition support programs and the reduction of food insecurity and positive health outcomes. Recent policy developments in SNAP and WIC, in particular, have increased these programs' purchasing power, and merit special research attention.
- First, re-evaluation of the Thrifty Food Plan, which is used to calculate SNAP benefits, prompted a significant increase in monthly household SNAP benefits beginning in October 2021.[346] This increase could, even without involvement from the health care system, meaningfully enhance the ability of SNAP participants to buy foods that support health. Previous USDA research indicates that a temporary increase to SNAP for some households with children was effective in significantly reducing child food insecurity and improving children's dietary quality, especially fruit and vegetable consumption.[347] Research should explore the effect of newly increased SNAP benefits on food and nutrition insecurity, dietary quality, and health.
- Second, during the Covid-19 pandemic Congress authorized an increase in the value of the WIC program's Cash Value Benefit that can be used by participants to buy fruits and vegetables, bumping it from $9 a month for children and $11 a month for adults to $35 a month per participant through September 2021.[348] Congress then acted to maintain an increased Cash Value Benefit (with slightly different benefit levels) through December 2021 and advocacy is underway to further extend the benefit or make it permanent.[349] This change to the Cash Value Benefit significantly increased WIC participants' fruit and vegetable purchasing power. The same USDA research that assessed the impact on child food insecurity and dietary quality of a temporary increase to SNAP also assessed the impact of a temporary increase to WIC, with an even greater observed increase in consumption of fruits and vegetables.[350] Research should seek to understand the health impacts of access to this enhanced benefit.

25. Research should examine the impact of income support programs on food insecurity, nutrition insecurity, and health.

- The pandemic spurred a host of relief efforts specific to increasing food purchasing power. It also prompted the creation of additional forms of unrestricted financial relief that could be used to meet any household need, including food. Two such programs, the Child Tax Credit and Pandemic Unemployment Insurance, have been shown to reduce household food insufficiency.[351] While both programs have ended, research on the impact of both programs on food insecurity, nutrition insecurity, and health is critical. While this Action Plan focuses on the potential of

Food is Medicine interventions to improve health outcomes, the authors and advisors explicitly recognize in Section III: Food is Medicine Defined that addressing poverty as a driver of both food insecurity and poor health outcomes is another promising path to similar ends. Relieving poverty can ensure that people have the ability to buy and consume foods that support health, according to their preferences.

- Beyond pandemic-related income-support programs, guaranteed-income experiments are proliferating across the country, motivated in part by early results of the Stockton Economic Empowerment Demonstration (SEED). This initiative provided 125 households in the majority low-income city of Stockton, California, with $500 per month for two years. Participants could spend the money in any way they chose, and purchases were tracked.[352] The first analysis of the data found that participants were healthier than the control group, with "less depression and anxiety and enhanced wellbeing."[353] And though dietary quality of participants in the study was not assessed, approximately one-third of the stipends were spent on food every month—the highest amount of any spending category.[354] Future analysis will examine hospitalizations among participants along with additional health data. This initiative demonstrates that guaranteed income programs have the potential to achieve some of the same goals as Food is Medicine interventions. Guaranteed income initiatives are planned for Los Angeles, Chicago, Denver, and more.

Research on guaranteed income initiatives impact should focus, at least in part, on changes in nutrition and health among participants.

26. Research should seek to understand the impact of Food is Medicine interventions beyond the individual and household.

- This Action Plan recognizes that Food is Medicine interventions, especially as they are scaled, have important implications for policymaking beyond health care and will certainly have impacts that reverberate beyond the individual and household. The sourcing of the food included in these interventions, and decisions about the range of retailers where benefits can be redeemed, can either support local businesses and communities or undermine them—for example, failing to ensure that local grocers can become benefit redemption sites. Establishing criteria for sustainability practices to which growers or vendors must adhere might affect the environment or the labor conditions of those who grow, pack, and deliver the food. When retailers, vendors, and community-based organizations are local, the provision of Food is Medicine interventions might increase opportunities for employment in the community. Finally, the provision of Food is Medicine interventions at scale could free resources for other needs across a social network or community, ultimately leading to desirable outcomes such as increased housing stability at a community level. Interdisciplinary research should strive to capture these impacts, building the case for funding and policy reform that will achieve positive outcomes on multiple fronts.

Food is Medicine Research: Meeting the Moment to Realize a Healthier Future

In the United States, we are just beginning to both understand and act on the potential for nutrition to prevent, manage, and treat disease. The current body of Food is Medicine research makes a strong case for robust investment in further exploration. With the enormous momentum for the concept of Food as Medicine that has built over decades and rapidly accelerated in the past five years, the country has arrived at an inflection point. We now have a significant opportunity to achieve two important objectives:

- First, to ensure that our current and near future health care system is able to address the nutrition-related needs of all people seeking care.
- Second, to better align our broader systems with the goal of supporting an individual's ability obtain the foods that support health.

To realize these goals, we must enable high-impact research whose results have the potential to translate into meaningful health policy change. We must invest in longitudinal studies that demonstrate the potential of these interventions to prevent and effectively manage chronic diet-related disease. We must study Food is Medicine interventions in their broader context, with an understanding that close attention to context is more urgent today than it has ever been, and that our health care system is deeply interconnected with our food system, our social policies, and our environment. And above all, we must ensure that equity is consciously and explicitly driving the research agenda and is embedded throughout the research process.

Efforts to research Food is Medicine interventions and reform our health care system may accordingly converge with, and complement, other initiatives to advance individual and community well-being, food sovereignty, racial justice, and environmental sustainability—and we hope they do. Our health care system cannot come close to fixing all of the structural issues that the country must address. However, it is undeniable that the US health care system—by its size, its complexity, and the share of the country's resources it consumes—bears a responsibility to do much, much better by its people than it currently does. Understanding the capacity of Food is Medicine interventions to improve health and quality of life brings us closer to that goal.

The current research has revealed a promising path toward materially improving individual and population health. The next steps are: strategic investment of resources, close attention to the process by which research is conducted, and awareness of the historical context and current injustice in which our health care and food systems exist.

By implementing the recommendations in the Food is Medicine Research Action Plan, we can build on the innovative research to date, powerfully shift the day-to-day operations of our health care system, and better understand how to reform and collaborate across institutions, programs, and policies within that system and beyond.

Endnotes

1 National Institutes of Health (NIH). Request for Information: Opportunities to End Hunger, Food, and Nutrition Insecurity. September. 10, 2021. Accessed November 1, 2021. https://grants.nih.gov/grants/guide/notice-files/NOT-OD-21-183.html; NIH. *2020-2030 Strategic Plan for NIH Nutrition Research. Accessed November 1, 2021.* https://dpcpsi.nih.gov/sites/default/files/2020NutritionStrategicPlan_508.pdf; Mozaffarian D, Mande J, Micha R. Food is Medicine – the Promise and Challenges of Integrating Food and Nutrition into Health Care. *JAMA Intern Med.* 2019;179(6):793-795. https://jamanetwork.com/journals/jamainternalmedicine/article-abstract/2730764; Downer S, Berkowitz SA, Harlan TS, Olstad DL, Mozaffarian D. Food is Medicine: Actions to Integrate Food and Nutrition into Health Care, *BMJ.* 2020; 369:m2482. Accessed January 12, 2022. https://www.bmj.com/content/369/bmj.m2482.

2 World Health Organization. Constitution. Accessed January 12, 2022. Who.int. https://www.who.int/about/governance/constitution; Fallon CK, Karlawish J. Is the WHO Definition of Health Aging Well? Frameworks for "Health" After Three Score and Ten. *American Journal of Public Health.* 109, no. 8. August 1, 2019: pp. 1104-1106. https://doi.org/10.2105/AJPH.2019.305177. Accessed January 1, 2022.

3 U.S. Department of Agriculture (USDA) and U.S. Department of Health and Human Services (HHS). Dietary Guidelines for Americans, 2020-2025. 9th Edition. December 2020. Accessed January 1, 2022. https://www.dietaryguidelines.gov/sites/default/files/2020-12/Dietary_Guidelines_for_Americans_2020-2025.pdf; Chiuve SE, Fung TT, Rimm EB et al. Alternative Dietary Indices Both Strongly Predict Risk of Chronic Disease. *J Nutr.* 142(6): 1009-1018. June 2012. Accessed January 1, 2022. https://doi.org/10.3945/jn.111.157222; World Cancer Research Fund/American Institute for Cancer Research. *Diet, Nutrition, Physical Activity and Cancer: a Global Perspective. Continuous Update Project Expert Report 2018.* Accessed Jan 1, 2022. https://www.wcrf.org/dietandcancer/resources-and-toolkits/.

4 Dietary Guidelines Advisory Committee. *Scientific Report of the 2015 Dietary Guidelines Advisory Committee: Advisory Report to the Secretary of Health and Human Services and the Secretary of Agriculture. U.S. Department of Agriculture.* Agricultural Research Service. 2015. Washington, DC. Accessed January 1, 2022. https://health.gov/sites/default/files/2019-09/Scientific-Report-of-the-2015-Dietary-Guidelines-Advisory-Committee.pdf.

5 USDA and HHS. *Dietary Guidelines for Americans, 2020-2025. 9th Edition*. December 2020. Accessed January 1, 2022. https://www.dietaryguidelines.gov/sites/default/files/2020-12/Dietary_Guidelines_for_Americans_2020-2025.pdf

6 Buttorff C, Ruder T, Bauman M. Multiple Chronic Conditions in the United States. Santa Monica, CA: RAND Corporation. 2017. Accessed January 1, 2022. https://www.rand.org/pubs/tools/TL221.html; Waters H, Graf M, The Costs of Chronic Disease in the U.S. Milken Institute. 2018. Accessed January 1, 2022. https://milkeninstitute.org/sites/default/files/reports-pdf/ChronicDiseases-HighRes-FINAL.pdf; Government Accountability Office. *Chronic Health Conditions: Federal Strategy Needed to Coordinate Diet-Related Efforts. GAO-21-593.* August 2021. Accessed January 10, 2022. https://www.gao.gov/assets/gao-21-593.pdf.

7 Waters H, Graf M, The Costs of Chronic Disease in the U.S. Milken Institute. 2018. Accessed January 1, 2022. https://milkeninstitute.org/sites/default/files/reports-pdf/ChronicDiseases-HighRes-FINAL.pdf

8 Government Accountability Office. *Chronic Health Conditions: Federal Strategy Needed to Coordinate Diet-Related Efforts. GAO-21-593.* August 2021. Accessed January 10, 2022. https://www.gao.gov/assets/gao-21-593.pdf.

9 The US Burden of Disease Collaborators. The state of US health, 1990-2016: Burden of diseases, injuries, and risk factors among US states. *JAMA*. 2018;319(14):1444–1472. Accessed January 12, 2022. doi:10.1001/jama.2018.0158; Ahmad FB, Anderson RN. The leading causes of death in the US for 2020. *JAMA*. 2021;325(18):1829–1830. Accessed January 12, 2022. doi:10.1001/jama.2021.5469.

10 Government Accountability Office. *Chronic Health Conditions: Federal Strategy Needed to Coordinate Diet-Related Efforts. GAO-21-593.* August 2021. Accessed January 10, 2022. https://www.gao.gov/assets/gao-21-593.pdf.

11 Schulze MB, Martinez-Gonzalez MA, Fung TT, Lichtenstein AH, Forouhi NG, Food based dietary patterns and chronic disease prevention, *BMJ*. 2018; 361:k2396. Accessed January 12, 2022. https://doi.org/10.1136/bmj.k2396.

12 Lee-Kwan SH, Moore LV, Blanck HM, Harris DM, Galuska D. Disparities in state-specific adult fruit and vegetable consumption. *MMWR Morb Mortal Wkly Rep.* CDC; 2017. 66:1241–1247. Accessed January 12, 2022. http://dx.doi.org/10.15585/mmwr.mm6645a1.

13 Liu J, Rehm CD, Onopa J, Mozaffarian D. Trends in diet quality among youth in the United States, 1999-2016. *JAMA*. 2020;323(12):1161–1174. Accessed January 12, 2022. doi:10.1001/jama.2020.0878.

14 Connor J, Schiek W. *Food Processing: An Industrial Powerhouse in Transition. 2nd ed.* NYC: John Wiley and Sons; 1997; Bleiweiss-Sande R, Sacheck JM, Chui K, Goldberg JP, Bailey C, Evans EW. Processed food consumption is associated with diet quality, but not weight status, in a sample of low-income and ethnically diverse elementary school children. *Appetite*. 2020 August: 151(104696). https://doi.org/10.1016/j.appet.2020.104696.

15 Martínez Steele E, Baraldi LG, Louzada MLDC, Moubarac JC, Mozaffarian D, Monteiro CA. Ultra-processed foods and added sugars in the US diet: evidence from a nationally representative cross-sectional study. *BMJ Open* 2016; 6:e009892. Accessed January 12, 2022. doi: 10.1136/bmjopen-2015-009892; Hall KD, Ayuketah A, Brychta R, Cai H, Cassimatis T, Chen KY, et al. Ultra Processed Diets Cause Excess Calorie Intake and Weight Gain: An Inpatient Randomized Controlled Trial of Ad Libitum Food Intake. *Cell Metab*. 2019 Jul 2;30(1):67-77.e3. doi: 10.1016/j.cmet.2019.05.008.

16 Rico-Campa A, Martinez-Gonzalez MA, Alvarez-Alvarez I, de deus Mendonca R, de la Fuente-Arriillaga C, Gomez-Donoso C et al. Association between consumption of ultra-processed foods and all cause mortality: SUN prospective cohort study. *BMJ.* 2019; 365:l1949. Accessed January 1, 2022. doi: https://doi.org/10.1136/bmj.l1949; Srour B, Fezeu LK, Kesse-Guyot E, Alles B, Mejean C, Andrianasolo RM, et al. Ultra-processed food intake and risk of cardiovascular disease: prospective cohort study (NutriNet-Santé). *BMJ.* 2019; 365 :l1451. Accessed January 12, 2022. doi: https://doi.org/10.1136/bmj.l1451.

17 Hare DL, Toukhsati SR, Johansson P, Jaarsma T. Depression and cardiovascular disease: a clinical review. *Eur Heart J*. 2014 Jun 1;35(21):1365-72. Accessed January 10, 2022. doi: 10.1093/eurheartj/eht462; Negata JM, Palar K, Goodling HC, Garber AK, Bibbins-Domingo K, Weiser SD. Food Insecurity and Chronic Disease in US Young Adults: Findings from the National Longitudinal Study of Adolescent to Adult Health. *J Gen Intern Med.* 2019; 34(12): 2756-2762. https://doi.org/10.1007/s11606-019-05317-8. Silverman J, Krieger J, Kiefer M, Herbert P, Robinson J, Nelson K. The Relationship Between Food Insecurity and Depression, Diabetes Distress and Medication Adherence Among Low-Income Patients with Poorly-Controlled Diabetes. *J Gen Intern Med*. 2015; 30(10): 1476-80). https://doi.org/10.1007/s11606-015-3351-1.

18 Khera R, Valero-Elizondo J, Nasir K. Financial toxicity in atherosclerotic cardiovascular disease in the United States: Current state and future directions. *J Am Heart Assoc.* 2020; 9:e017793. Accessed January 10, 2022. doi: 10.1161/JAHA; Khera R, Valero-Elizondo J, Okunrintemi V, Saxena A, Das SR, de Lemos JA et al. Association of out-of-pocket annual health expenditures with financial hardship in low-income adults with atherosclerotic cardiovascular disease in the United States. *JAMA Cardiol.* 2018;3(8):729-738. Accessed January 1, 2022. DOI: 10.1001/jamacardio.2018.1813; Caraballo C, Valero-Elizondo J, Khera R, Mahajan S, Grandhi GR, Virani SS et al. Burden and consequences of financial hardship from medical bills among nonelderly adults with diabetes mellitus in the United States. *Circulation: Cardiovascular Quality and Outcomes*. 2020; 13:e006139. Accessed January 10, 2022. https://doi.org/10.1161/CIRCOUTCOMES.119.006139; Valero-Elizondo J, Khera R, Saxena A, Grandhi GR, Virani SS, Butler J, Samad Z et al. Financial hardship from medical bills among nonelderly U.S. adults with atherosclerotic cardiovascular disease. *J Am Coll Cardiol*. 2019; 73 (6) 727–732. Accessed January 1, 2022. DOI: 10.1016/j.jacc.2018.12.004.

19 Malnutrition is an umbrella term that encompasses a range of nutrient and diet-related health conditions, from undernutrition to nutritional excess; however, diet is critical for all forms of malnutrition. Saunders J, Smith T. Malnutrition: causes and consequences. *Clin Med (Lond).* 2010;10(6):624-627. Accessed January 1, 2022. doi:10.7861/clinmedicine.10-6-624.

20 Evert A, Dennison M, Gardner CD, Garvey T, Lau KHK, MacLeod J, Nutrition Therapy for Adults with Diabetes or Prediabetes: A Consensus Report. *Diabetes Care* 1 May 2019; 42 (5): 731–754. Accessed January 10, 2022. https://doi.org/10.2337/dci19-0014; Forouhi NG, Misra A, Mohan V, Taylor R, Yancy W. Dietary and nutritional approaches for prevention and management of type 2 diabetes. *BMJ.* 2018; 361 :k2234. Accessed January 1, 2022. doi:10.1136/bmj.k2234.

21 Eckel RH, Jakicic JM, Ard JD, de Jesus JM, Miller NH, Hubbard VS et al. 2013 AHA/ACC Guideline on Lifestyle Management to Reduce Cardiovascular Risk. *Circulation*. 2014;129:S76–S99. Accessed January 1, 2022. https://doi.org/10.1161/01.cir.0000437740.48606.d1

22 Related to increased risk: While there is evidence linking BMI, excess fat, and other adiposity measures to the incidence of these cancers, research on the role of specific diets and nutrients is still emerging. See Key TJ, Bradbury KE, Perez-Cornago A, Sinha R, Tsilidis KK, Tsugane S. Diet, Nutrition, and Cancer Risk: What do We Know and What is the Way Forward? *BMJ.* 2020;368:m511. Accessed January 1, 2022. doi: https://doi.org/10.1136/bmj.m511; Lauby-Secretan B, Scoccianti C, Loomis D, Grosse Y, Bianchini F, Straif K. Body Fatness and Cancer – Viewpoint of the IARC Working Group, *N Engl J Med.* 2016; 375:794-798. Accessed January 1, 2022. DOI: 10.1056/NEJMsr1606602; World Cancer Research Fund/American Institute for Cancer Research. *Diet, Nutrition, Physical Activity and Cancer: a Global Perspective. Continuous Update Project Expert Report 2018*. Accessed Jan 1, 2022. https://www.wcrf.org/dietandcancer/resources-and-toolkits/; Related to treatment and management: The role of diet depends on the type of cancer; however, the National Cancer Institute recommends that all people with cancer pay attention to diet, whether to increase the effectiveness of treatment or counteract side effects. Research is still emerging on which diets are most effective for treatment of which cancers. See National Cancer Institute, *Eating Hints: Before, During, and After Cancer Treatment. 2018. Accessed January 1, 2022.* https://www.cancer.gov/publications/patient-education/eatinghints.pdf.

23 Kramer H. Diet and Chronic Kidney Disease. *Advances in Nutrition.* 2019 10(S4):S367-S379. Accessed January 1, 2022. https://doi.org/10.1093/advances/nmz011.

24 Chalasani N, Younossi Z, Lavine JE, Charlton M, Cusi K, Rinella M, et al. The diagnosis and management of nonalcoholic fatty liver disease: Practice guidance from the American Association for the Study of Liver Diseases. *Hepatology*. 2018 Jan;67(1):328-357. Accessed January 1, 2022. doi: 10.1002/hep.29367; George ES, Forsyth A, ItsiopoulosC , Nicoll AJ, Ryan M, Sood S et al. Practical Dietary Recommendations for the Prevention and Management of Nonalcoholic Fatty Liver Disease in Adults. *Advances in Nutrition.* 2018 Jan 9(1):30–40. Accessed January 1, 2022. https://doi.org/10.1093/advances/nmx007/; Kharbanda KK, Ronis MJJ, Shearn CT, Petersen DR, Zakhari S, Warner DR et al. Role of Nutrition in Alcoholic Liver Disease: Summary of the Symposium at the ESBRA 2017 Congress. *Biomolecules*. 2018 Mar 26;8(2):16. Accessed January 1, 2022. doi: 10.3390/biom8020016.

25 Tang AM, Quick T, Chung M, Wanke CA. Nutrition assessment, counseling, and support interventions to improve health-related outcomes in people living with HIV/AIDS: a systematic review of the literature. *J Acquir Immune Defic Syndr*. 2015;68 Suppl 3(0 3):S340-S349. Accessed January 1, 2022. doi:10.1097/QAI.0000000000000521.

26 Thomas S, Browne H, Mobasheri A, Rayman MP. What is the evidence for a role for diet and nutrition in osteoarthritis? *Rheumatology (Oxford)*. 2018 May 1;57(suppl_4):iv61-iv74. Accessed January 10, 2022. doi: 10.1093/rheumatology/key011; Forsyth C, Kouvari M, D'Cunha NM, Georgousopoulou EN, Panagiotakos DB, Mellor DD, Kellett J, Naumovski N. The effects of the Mediterranean diet on rheumatoid arthritis prevention and treatment: a systematic review of human prospective studies. *Rheumatol Int*. 2018 May;38(5):737-747. Accessed January 1, 2022. doi: 10.1007/s00296-017-3912-1.

27 Sarris J, Logan A, Akbaraly TN, Amminger GP, Balanza-Martinez V, Freeman M. Nutritional Medicine as Mainstream in Psychiatry, *Lancet Psychiatry*. 2015 Mar 2(3):P271-274. Accessed January 1, 2022. https://doi.org/10.1016/S2215-0366(14)00051-0; Adan RAH, van der Beek EM, Buitelaar JK, Cryan JF, Hebebrand J, Higgs S, Schellekens H, Dickson SL. Nutritional psychiatry: Towards improving mental health by what you eat. *Eur Neuropsychopharmacol*. 2019 Dec;29(12):1321-1332. Accessed January 10, 2022. doi: 10.1016/j.euroneuro.2019.10.011; Beyer JL, Payne ME. Nutrition and Bipolar Depression. *Psychiatr Clin North Am*. 2016 Mar;39(1):75-86. Accessed January 1, 2022. doi: 10.1016/j.psc.2015.10.003; Aucoin M, LaChance L, Cooley K, Kidd S. Diet and Psychosis: A Scoping Review. *Neuropsychobiology*. 2020;79(1):20-42. Accessed January 10, 2022. doi: 10.1159/000493399; Solfrizzi V, Custodero C, Lozupone M, Imbimbo BP, Valiani V, Agosti P et al. Relationships of Dietary Patterns, Foods, and Micro- and Macronutrients with Alzheimer's Disease and Late-Life Cognitive Disorders: A Systematic Review. *J Alzheimers Dis*. 2017;59(3):815-849. Accessed January 1, 2022. doi: 10.3233/JAD-170248; Klein P, Tyrlikova I, Mathews GC. Dietary treatment in adults with refractory epilepsy: a review. *Neurology*. 2014 Nov 18;83(21):1978-85. Accessed January 1, 2022. doi: 10.1212/WNL.0000000000001004. Holden K. Parkinson's Disease: Nutrition Matters. National Parkinson Foundation. Accessed January 12, 2022. https://www.parkinson.org/sites/default/files/Nutrition_Matters.pdf; Christodoulou CC, Demetriou CA, Zamba-Papanicolaou E. Dietary Intake, Mediterranean Diet Adherence and Caloric Intake in Huntington's Disease: A Review. *Nutrients*. 2020 Sep 25;12(10):2946. Accessed Jan 10, 2022. doi: 10.3390/nu12102946; Bagur MJ, Murcia MA, Jiménez-Monreal AM, Tur JA, Bibiloni MM, Alonso GL, et al. Influence of Diet in Multiple Sclerosis: A Systematic Review. *Adv Nutr*. 2017 May 15;8(3):463-472. Accessed January 1, 2022. doi: 10.3945/an.116.014191; Kellogg J, Bottman L, Arra EJ, Selkirk SM, Kozlowski F. Nutrition management methods effective in increasing weight, survival time and functional status in ALS patients: a systematic review. *Amyotroph Lateral Scler Frontotemporal Degener*. 2018 Feb;19(1-2):7-11. Accessed January 1, 2022. doi: 10.1080/21678421.2017.1360355; Shaito A, Hassan H, Habashy KJ, Fakih W, Abdelhady S, Ahmad Fet al. Western Diet Aggravates Neuronal Insult in Post-traumatic Brain Injury: Proposed pathways for Interplay. *EBioMedicine*. 2020 57:102829. Accessed January 1, 2022. https://doi.org/10.1016/j.ebiom.2020.102829.

28 USDA and HHS. *Dietary Guidelines for Americans, 2020-2025. 9th ed*. Part D: Ch. 2: Food, Beverage, and Nutrition Consumption During Pregnancy. December 2020. Accessed January 1, 2022. https://www.dietaryguidelines.gov/sites/default/files/2020-07/PartD_Ch2_Pregnancy_first-print.pdf; Marshall NE, Abrams B, Barbour LA, Catalano P, Christian P, et al. The Importance of Nutrition in Pregnancy and Lactation: Lifelong Consequences. *Amer J of Obstetrics and Gynecology*. 2022. https://doi.org/10.1016/j.ajog.2021.12.035;

29 Kris-Etherton PM, Petersen KS, Velarde G, Bardnard ND, Miller M, Ros E et al. Barriers, Opportunities, and Challenges in Addressing Disparities in Diet-Related Cardiovascular Disease in the United States. *J Am Heart Assoc.* 2020;9 e014433. Accessed January 1, 2020. https://doi.org/10.1161/JAHA.119.014433.

30 Bailey ZD, Kreiger N, Agenor M, Graves J, Linos N, Bassett MT. Structural racism and health inequities in the USA: evidence and interventions. *Lancet*. 2017 389(10077): P1453-1463. https://doi.org/10.1016/S0140-6736(17)30569-X

31 Rothstein R. The Color of Law. Liveright; 2017. Chapter 1; Elbel B, Tamura K, McDermott ZT, Duncan DT, Athens JK, et al. (2019) Disparities in food access around homes and schools for New York City children. *PLOS ONE* 14(6): e0217341. https://doi.org/10.1371/journal.pone.0217341; Walker RE, Keane CR, Burke JG. Disparities and access to healthy food in the United States: a review of food deserts literature. *Health & Place*. 2010 16(876-884. https://doi.org/10.1016/j.healthplace.2010.04.013.

32 Williams DR, Lawrence JA, Davis BA. Racism and health: evidence and needed research. *Annu Rev Public Health.* 2019; 40:105-125. Accessed January 1, 2022. https://doi.org/10.1146/annurev-publhealth-040218-043750.

33 Tikkanen R, Abrams MB. US Health Care from a Global Perspective, 2019: Higher Spending, Worse Outcomes? January 30, 2020. Commonwealth Fund. Accessed January 1, 2022. https://www.commonwealthfund.org/publications/issue-briefs/2020/jan/us-health-care-global-perspective-2019.

34 Berwick DM, Nolan TW, Whittington J. The Triple Aim: Care, Health, and Cost. *Health Affairs.*2008 27(3). Accessed January 1, 2022. https://doi.org/10.1377/hlthaff.27.3.759.

35 Bodenheimer T, Sinsky C. From triple to quadruple aim: care of the patient requires care of the provider. A*nn Fam Med*. 2014 Nov-Dec;12(6):573-6. Accessed January 1, 2022. doi: 10.1370/afm.1713.

36 Egan MC. Public health nutrition: A historical perspective. *J Amer Dietetics Assoc.* 1994 94(3):298-304. Accessed January 1, 2022. https://doi.org/10.1016/0002-8223(94)90372-7.

37 Garfield K, Scott E, Sukys S, Downer S, Landauer R, Orr J, et al. Mainstreaming Produce Prescriptions: A Policy Strategy Report. Harvard Law School Center for Health Law & Policy Innovation. March 2021. Accessed January 1, 2022. https://chlpi.org/wp-content/uploads/2013/12/Produce-RX-March-2021.pdf.

38 Proceedings of the National Nutrition Conference for Defense: May 26, 27, and 28, 1941, Called by President Franklin D. Roosevelt. Federal Security Agency. Washington DC: United States Government Printing Office. Accessed January 1, 2022. https://books.google.com/books?id=WOw-BAAAAMAAJ&pg=PA226&lpg=PA226&dq.

39 Proceedings of the National Nutrition Conference for Defense: May 26, 27, and 28, 1941, Called by President Franklin D. Roosevelt. Federal Security Agency. Washington DC: United States Government Printing Office. Accessed January 1, 2022. https://books.google.com/books?id=WOw-BAAAAMAAJ&pg=PA226&lpg=PA226&dq.

40 Proceedings of the National Nutrition Conference for Defense: May 26, 27, and 28, 1941, Called by President Franklin D. Roosevelt. Federal Security Agency. Washington DC: United States Government Printing Office. Accessed January 1, 2022. https://books.google.com/books?id=WOw-BAAAAMAAJ&pg=PA226&lpg=PA226&dq.

41 Proceedings of the National Nutrition Conference for Defense: May 26, 27, and 28, 1941, Called by President Franklin D. Roosevelt. Federal Security Agency. Washington DC: United States Government Printing Office. Accessed January 1, 2022. https://books.google.com/books?id=WOw-BAAAAMAAJ&pg=PA226&lpg=PA226&dq.

42 The National School Lunch Act, Act of June 4, 1946. ch. 281 s. 2-11, 60 Stat. 230. 42 U.S.C. s. 1751-63 (1970).

43 Food Stamp Act of 1964. Pub. L. No. 88-525, 78 Stat. 103 (1964) (codified at 7 U.S.C. s. 2011-2030 (1988)).

44 The Child Nutrition Act of 1966, Pub. L. No., 89-642, 80 Stat. 885 (1966).

45 Garfield K, Scott E, Sukys S, Downer S. Landauer R, Orr J et al. Mainstreaming Produce Prescriptions: A Policy Strategy Report. Harvard Law School Center for Health Law & Policy Innovation. March 2021. Accessed January 1, 2022. https://chlpi.org/wp-content/uploads/2013/12/Produce-RX-March-2021.pdf.

46 Mande J, Willett W, Auerbach J, Bleich S, Broad Leib E, Economos C et al. Report of the 50th
Anniversary of the White House Conference on Food, Nutrition, and Health: Honoring the Past, Taking
Actions for our Future. Boston, MA; March 2020.

47 Kennedy E, Dwyer J. The 1969 White House Conference on Food, Nutrition and Health: 50 Years Later. *Curr Dev Nutr*. 2020;4(6):nzaa082. Published 2020 May 15. Accessed January 1, 2022. doi:10.1093/cdn/nzaa082.

48 *1971 White House Conference on Aging: A Report to the Delegates from the Conference Sections and Special Concerns Sessions*. Dec. 1971. p. 19. Washington DC:US Government Printing Office. Accessed January 1, 2022. https://www.aging.senate.gov/imo/media/doc/reports/rpt1371.pdf.

49 Nutrition Program for the Elderly, 42 U.S.C. § 3045, 1972 (repealed 1978); Katherine Gigliotti, Addressing Hunger and Nutrition: A Toolkit for Positive Results, National Conference of State Legislatures, Jun. 2005, https://www.ncsl.org/print/statefed/humserv/NutandEld.pdf.

50 USDA. A Short History of SNAP. Accessed January 1, 2022. https://www.fns.usda.gov/snap/short-history-snap#1974.

51 Pub L. No. 94-104, 89 Stat. 511 (1975).

52 Home and Community-Based Services Authorities, Medicaid.gov. Accessed January 10, 2022. https://www.medicaid.gov/medicaid/home-community-based-services/home-community-based-services-authorities/index.html.

53 God's Love We Deliver. Our History. Glwd.org. Accessed January 1, 2022. https://www.glwd.org/about-us/history/.

54 Ryan White Comprehensive AIDS Resources Emergency Act (Ryan White CARE Act), Pub. L. No. 101-38, 104 Stat. 576 (1990).

55 God's Love We Deliver. Our History. Glwd.org. Accessed January 1, 2022. https://www.glwd.org/about-us/history/.

56 God's Love We Deliver. Our History. Glwd.org. Accessed January 1, 2022. https://www.glwd.org/about-us/history/.

57 Patient Protection and Affordable Care Act, Pub. L. No. 111-148, 124 Stat 119 (2010).

58 God's Love We Deliver. Our History. Glwd.org. Accessed January 1, 2022. https://www.glwd.org/about-us/history/.

59 Vericker T, Dixit-Joshi S, Taylor J, Giesen L, Gearing M, Baiser K et al. *The evaluatuion of Food Insecurity Nutrition Incentives (FINI): Interim report*. USDA. May 2019. Accessed January 10, 2022. https://fns-prod.azureedge.net/sites/default/files/resource-files/FINI-InterimReport_1.pdf

60 Centers for Medicare & Medicaid Services (CMS). Accountable Health Communities Model. Cms.gov. Accessed January 1, 2022. https://innovation.cms.gov/innovation-models/ahcm.

61 CMS, MassHealth Section 1115 Demonstration Special Terms and Conditions 57. CMS.gov. November 2016. Accessed January 1, 2022. https://www.medicaid.gov/Medicaid-CHIP-Program-Information/By-Topics/Waivers/1115/downloads/ma/MassHealth/ma-masshealth-stcs-11042016.pdf; NC Medicaid. Healthy Opportunities Pilots Fact Sheet. Medicaid.ncdhhs.gov. November 2018. Accessed January 1, 2022. https://files.nc.gov/ncdhhs/SDOH-HealthyOpptys-FactSheet-FINAL-20181114.pdf.

62 Kornfield T, Kazan M, Frieder M, Duddy-Tenbrunsel R, Donthi S, Fix A. Medicare Advantage Plans Offering Expanded Supplemental Benefits: A Look at Availability and Enrollment. Commonwealth Fund. February 10, 2021. Accessed January 1, 2022. https://www.commonwealthfund.org/publications/issue-briefs/2021/feb/medicare-advantage-plans-supplemental-benefits.

63 California Department of Health Care Services, Medically Tailored Meals Pilot Program, Dhcs.ca.gov. Accessed January 1, 2022. https://www.dhcs.ca.gov/services/ltc/Pages/Medically-Tailored-Meals-Pilot-Program.aspx.

64 Bipartisan members of congress launch Food is Medicine working group to highlight impacts of hunger on health. Washington, DC: Congressman Jim McGovern. January 17, 2018. Accessed January 1, 2022. https://mcgovern.house.gov/news/documentsingle.aspx?DocumentID=397179.

65 Agriculture Improvement Act of 2018. Pub. L. No. 115-334 (2018), codified at 7 U.S.C. s. 7517.

66 About. National Produce Prescription Collaborative. Accessed January 1, 2022. https://nationalproduceprescription.org/about.

67 H.B. 1105 (Coronavirus Relief Act 3.0), 2019-2020 Session. North Carolina General Assembly. Accessed January 1, 2022. https://www.ncleg.gov/BillLookUp/2019/h1105.

68 New York State Department of Health. Medicaid Managed Care Alternative Services and Settings. Health.ny.gov. Accessed January 1, 2022. https://www.health.ny.gov/health_care/managed_care/app_in_lieu_of_svs_mmc.htm.

69 House Appropriations Committee. *Report of the Committee on Appropriations House of Representatives on H.R. 2740 together with Minority Views*. House Report 116-62, 116th Congress, 1st. Session. 2020. https://www.congress.gov/congressional-report/116th-congress/house-report/62/1.

70 NIH. *2020-2030 Strategic Plan for NIH Nutrition Research*. Dpcpsi.nih.gov. Accessed January 1, 2022. https://dpcpsi.nih.gov/sites/default/files/2020NutritionStrategicPlan_508.pdf.

71 Massachusetts Senate. An Act Relative to Establishing and Implementing a Food and Health Pilot Program. S. 1403. MA 192nd Session. https://malegislature.gov/Bills/192/SD1547.

72 Medically Tailored Home Delivered Meals Demonstration Pilot Act of 2020, H.R. 6774 (116th Congress); Medically Tailored Home Delivered Meals Demonstration Pilot Act of 2021, H.R. 5370 (117th Congress). Accessed January 1, 2022. https://www.congress.gov/bill/117th-congress/house-bill/5370/text.

73 USDA Modernizes the Thrifty Food Plan, Updates SNAP Benefits. Washington, DC: USDA, Food and Nutrition Service; 2021. USDA No. 0179.21; Fact Sheet: Biden-Harris Administration's Actions to Reduce Food Insecurity Amid the COVID-19 Crisis. Washington, DC: USDA, Food and Nutrition Service; 2021. USDA No. 0037.21. https://www.fns.usda.gov/news-item/usda-003721.

74 House Appropriations Committee. *House Report 117-81 to accompany H.R. 4355, 117th Congress (2021)*. https://www.govinfo.gov/content/pkg/CRPT-116hrpt445/html/CRPT-116hrpt445.htm; House Appropriations Committee, *House Report 117-83 to accompany H.R. 4372, 117th Congress (2021)*. https://www.congress.gov/117/crpt/hrpt83/CRPT-117hrpt83.pdf.

75 Virginia House of Representatives. HB 2065 Produce Rx Program; Dept. of Social Services, et al., to develop a plan for a 3-yr. pilot program. 2021 Session. https://lis.virginia.gov/cgi-bin/legp604.exe?211+sum+HB2065.

76 California Department of Health Care Services. California Advancing & Innovating Medi-Cal Proposal (CalAIM proposal). Dhcs.ca.gov. January 2021. Accessed January 10, 2022. https://www.dhcs.ca.gov/provgovpart/Documents/CalAIM-Proposal-Updated-1-8-21.pdf.

77 Chinese medicine: Zou P. Traditional Chinese Medicine, Food Therapy and Hypertension Control: A Narrative Review of Chinese Literature. *American Journal of Chinese Medicine*. 2016:44(8):1579-1594. https://doi.org/10.1142/S0192415X16500889; North American indigenous cultures: National Library of Medicine. Native Peoples' Concept of Health and Wellness: Medicine Ways. Nlm.nih.gov. Accessed January 1, 2022. https://www.nlm.nih.gov/nativevoices/exhibition/healing-ways/medicine-ways/healing-plants.html

78 For example, Further Food, https://shop.furtherfood.com/pages/affiliate-program ("At Further Food, we believe that food is medicine."). Accessed January 1, 2022; North Coast Naturals, https://northcoastnaturals.com ("Food is life. Food is medicine."). Accessed January 1, 2022.

79 God's Love We Deliver. Our History. Glwd.org. Accessed January 1, 2022. https://www.glwd.org/about-us/history/.

80 Ryan White Comprehensive AIDS Resources Emergency Act (Ryan White CARE Act), Public Law 101-381 Sec. 2613 (1990).

81 Silberner J. H Jack Geiger: a doctor takes on poverty, racism, and nuclear war. *BMJ*. 2021; 372:n758. Accessed January 1, 2022. https://doi.org/10.1136/bmj.n758.

82 See e.g. Farmers Market Coalition. WIC Farmers Market Nutrition Program. Accessed January 1, 2022. https://farmersmarketcoalition.org/advocacy/wic-farmers-market-nutriton-program; Farmers Market Coalition. Senior Farmers Market Nutrition Program. Accessed January 1, 2022. https://farmersmarketcoalition.org/advocacy/sfmnp.

83 USDA. Farmers Market Nutrition Program. Fns.usda.gov. Accessed January 1, 2022. https://www.fns.usda.gov/fmnp/wic-farmers-market-nutrition-program

84 Agriculture Improvement Act of 2018, Pub. L. 115-334, § 4205, 132 Stat. 4490, 4659–60, https://www.congress.gov/115/plaws/publ334/PLAW-115publ334.pdf

85 The Medically Tailored Meal Intervention. Food is Medicine Coalition. Accessed January 10, 2022. http://www.fimcoalition.org/our-model.

86 Interviews with several medically-tailored meal organizations, conducted January 1, 2020 through December 2020. Notes on file with authors.

87 Randall K. Food & Friends Partnership Helps New and Expectant Mothers in DC's Food Deserts. Washington City Paper. March 4, 2019. Accessed January 1, 2022. https://washingtoncitypaper.com/article/181430/food-friends-partnership-helps-new-and-pregnant-mothers-in-dc-food-deserts/.

88 Interviews conducted with several medically-tailored grocery providers, conducted January 1, 2020 through December 2020. Notes on file with authors.

89 The definition of eligible foods for the Gus Shumacher Nutrition Incentive Program, or GusNIP, is "any variety of fresh, canned, dried, or frozen whole or cut fruits and vegetables without added sugars, fats, or oils, and salt (i.e. sodium)." It also includes seeds for plants cultivated for consumption and fresh herbs. National Institute of Food & Agriculture. The Gus Schumacher Nutrition Incentive Program FY 21 Request for Applications. nifa.usda.gov. https://nifa.usda.gov/sites/default/files/rfa/FY21-GusNIP-Mand-Mod-RFA-V4-508.pdf; The recently formed National Produce Prescription Collaborative, a national association of produce prescription stakeholder entities, defines produce prescriptions as "a medical treatment or preventative service for patients who are eligible due to diet-related health risk or condition, food insecurity, or other documented challenges in access to nutritious foods, and are referred by a healthcare provider or health insurance plan. These prescriptions are fulfilled through food retail and enable patients to access healthy produce with no added fats, sugars, or salt, at low or not cost to the patient." National Produce Prescription Collaborative. Produce Prescription Definition. nationalproduceprescription.org. Accessed January 10, 2022. https://nationalproduceprescription.org/.

90 Berkowitz SA and Basu S. Unemployment Insurance, Health-Related Social Needs, Health Care Access, and Mental Health During the COVID-19 Pandemic. *JAMA Intern. Med*. 2021, 181(5):699-702. doi:10.1001/jamainternmed.2020.7048; Raifman J, Bor J, Venkataramani A. Association between receipt of unemployment insurance and food insecurity among people who lost employment during the COVID-19 pandemic in the United States. *JAMA Netw. Open*. 2021 Jan 4;4(1):e2035884. doi:10.1001/jamanetworkopen.2020.35884.

91 American Rescue Plan Act of 2021 (ARPA), Pub. Law No. 117-2, 135 Stat. 4; Pulliam C and Reeves RV. New child tax credit could slash poverty now and boost social mobility later. Published Mar. 11, 2021. Brookings website, https://www.brookings.edu/blog/up-front/2021/03/11/new-child-tax-credit-could-slash-poverty-now-and-boost-social-mobility-later/. Accessed Oct. 30, 2021.

92 Center on Budget and Policy Priorities. National spend on Medicaid, Medicare, CHIP, and ACA subsidies in 2019. Policy Basics: Where do Our Federal Tax Dollars Go? Updated April 9, 20202. Accessed January 1, 2022. https://www.cbpp.org/research/federal-budget/where-do-our-federal-tax-dollars-go.

93 M Lefevre, N Lefevre. Vitamin D Screening and Supplementation in Community-Dwelling Adults: Common Questions and Answers, *Am. Fam. Physician*, 2018, https://www.aafp.org/afp/2018/0215/p254.html; Harvard Pilgrim Health Care. Medical Policy: Vitamin B12 Screening & Testing. Approved by Medical Policy Committee September 28, 2021. Accessed January 1, 2022. https://www.harvardpilgrim.org/provider/wp-content/uploads/sites/7/2020/12/Vitamin-B12-Screening-Testing-MP.pdf.

94 Institute of Medicine 2006. *WIC Food Packages: Time for a Change*. Pp. 23-25. Washington, DC: The National Academies Press. https://doi.org/10.17226/11280.

95 Magrach A, Sanz MJ. Environmental and social consequences of the increase in the demand for 'superfoods' world-wide. *People and Nature*. 2020 April 2(2):267-278. https://doi.org/10.1002/pan3.10085.

96 HHS Food & Drug Administration (FDA). Frequently Asked Questions About Medical Foods, 2nd ed: Guidance for Industry. May 2016. Accessed January 1, 2022. https://www.fda.gov/media/97726/download.

97 Crowley J, Ball L, Hiddink GJ. Nutrition in medical education: a systematic review. *Lancet*. 2019 September 3(9):E379-E389. https://doi.org/10.1016/S2542-5196(19)30171-8; Broad Leib E, Shapiro M, Chan A, Negowetti N, Borzi L, Etessami S, et al. Doctoring Our Diet: Policy Tools to Include Nutrition in U.S. Medical Training. Published September 2019. chlpi.org. Accessed January 1, 2022. https://chlpi.org/wp-content/uploads/2013/12/Doctoring-Our-Diet_-September-2019-V2.pdf.

98 Wetherill MS, Davis GC, Kezbers K, Carter V, Wells E, Williams MB, et al. Development and Evaluation of a Nutrition-Centered Lifestyle Medicine Curriculum for Physician Assistant Students. *Med Sci Educ*. 2018 Dec 6;29(1):163-172. doi: 10.1007/s40670-018-00655-4; Trilk JL, Worthman S, Shetty P, Studer KR, Wilson A, Wetherill M, et al. Undergraduate Medical Education: Lifestyle Medicine Curriculum Implementation Standards. *American Journal of Lifestyle Medicine*. 2021 April 15(5). https://doi.org/10.1177/15598276211008142.

99 Berkowitz SA, Delahanty LM, Terranova J, et al. Medically tailored meal delivery for diabetes patients with food insecurity: A randomized cross-over trial. *J Gen Intern Med*. 2019;34(3):396-404. doi:10.1007/s11606-018-4716-z; Cheyne K, Smith M, Felter EM, et al. Food bank-based diabetes prevention intervention to address food security, dietary intake, and physical activity in a food-insecure cohort at high risk for diabetes. *Prev Chronic Dis*. 2020;17(190210):E04. doi:10.5888/pcd17.190210; Watt TT, Appel L, Lopez V, Flores B, Lawhon B. A primary care-based early childhood nutrition intervention: Evaluation of a pilot program serving low-income Hispanic women. *J Racial Ethn Health Disparities*. 2015;2(4):537-547. doi:10.1007/s40615-015-0102-2; Jennifer N. Aiyer JN, Raber M, Bello RS, et al. A pilot food prescription program promotes produce intake and decreases food insecurity. *Transl Behav Med*. 2019;9(5):922-930. doi:10.1093/tbm/ibz112

100 Berkowitz SA, Terranova J, Randall L, Cranston K, Waters DB, Hsu J. Association between receipt of a medically tailored meal program and health care use. *JAMA Intern Med*. 2019;179(6):786-793. doi:10.1001/jamainternmed.2019.0198; Berkowitz SA, Terranova J, Hill C, et al. Meal delivery programs reduce the use of costly health care in dually eligible Medicare and Medicaid beneficiaries. *Health Aff (Millwood)*. 2018;37(4):535-542. doi:10.1377/hlthaff.2017.0999; Tapper EB, Baki J, Nikirk S, Hummel S, Asrani SK, Lok AS. Medically tailored meals for the management of symptomatic ascites: the SALTYFOOD pilot randomized clinical trial. *Gastroenterol Rep (Oxf)*. 2020;8(6):453-456. doi:10.1093/gastro/goaa059

101 Berkowitz SA, Shahid NN, Terranova J, et al. "I was able to eat what I am supposed to eat"-- patient reflections on a medically-tailored meal intervention: a qualitative analysis. *BMC Endocr Disord*. 2020;20(1):10. doi:10.1186/s12902-020-0491-z

102 Kopparapu A, Sketas G, Swindle T. Food insecurity in primary care: Patient perception and preferences. *Fam Med*. 2020;52(3):202-205. doi:10.22454/FamMed.2020.964431

103 The Right to Food Around the Globe. Food and Agriculture Organization, United Nations. Updated April 1, 2021. Accessed January 14, 2022. https://www.fao.org/right-to-food-around-the-globe/en/

104 Barnidge EK, Stenmark SH, DeBor M, Seligman HK. The right to food: Building upon "food is medicine." *Am J Prev Med*. 2020;59(4):611-614. doi:10.1016/j.amepre.2020.04.011

105 Schwarzenberg SJ, Georgieff MK, Comittee on Nutrition. Advocacy for improving nutrition in the first 1000 days to support childhood development and adult health. *Pediatrics*. 2018;141(2). doi:10.1542/peds.2017-3716

106 Murcott A. The cultural significance of food and eating. *Proc Nutr Soc*. 1982;41(2):203-210. doi:10.1079/pns19820031

107 Fischler C. Food, self and identity. *Soc Sci Inf (Paris)*. 1988;27(2):275-292. doi:10.1177/053901888027002005; Bowen S, Brenton J, Elliott S. Pressure Cooker: Why Home Cooking Won't Solve Our Problems and What We Can Do about It. Oxford University Press; 2020.

108 Valentine G. Eating in: Home, consumption and identity. *Sociol Rev*. 1999;47(3):491-524. doi:10.1111/1467-954x.00182; Kaneko D, Toet A, Brouwer AM, Kallen V, van Erp JBF. Methods for evaluating emotions evoked by food experiences: A literature review. *Front Psychol*. 2018;9. doi:10.3389/fpsyg.2018.00911

109 Dalenberg JR, Gutjar S, ter Horst GJ, de Graaf K, Renken RJ, Jager G. Evoked emotions predict food choice. *PLoS One*. 2014;9(12):e115388. doi:10.1371/journal.pone.0115388

110 Bowen S, Brenton J, Elliott S. *Pressure Cooker: Why Home Cooking Won't Solve Our Problems and What We Can Do about It*. Oxford University Press; 2020.

111 Nyéléni. Declaration of Nyéléni. Published February 27, 2007. Accessed January 14, 2022. https://nyeleni.org/spip.php?article290 (this definition has been endorsed by the U.S. Food Sovereignty Alliance); Gurney RM, Caniglia BS, Mix TL, Baum KA. Native American food security and traditional foods: A review of the literature: Native American food security and traditional foods. *Sociol Compass*. 2015;9(8):681-693. doi:10.1111/soc4.12284

112 Castro A, Willingham C. Progressive governance can turn the tide for black farmers. Center for American Progress. https://www.americanprogress.org/issues/economy/reports/2019/04/03/467892/progressive-governance-can-turn-tide-black-farmers. Published April 3, 2019. Accessed January 17, 2022.

113 Castro A, Willingham C. Progressive governance can turn the tide for black farmers. Center for American Progress. https://www.americanprogress.org/issues/economy/reports/2019/04/03/467892/progressive-governance-can-turn-tide-black-farmers. Published April 3, 2019. Accessed January 17, 2022.

114 Gurney RM, Caniglia BS, Mix TL, Baum KA. Native American food security and traditional foods: A review of the literature: Native American food security and traditional foods. *Sociol Compass*. 2015;9(8):681-693. doi:10.1111/soc4.12284

115 Warne D, Wescott S. Social determinants of American Indian nutritional health. *Curr Dev Nutr*. 2019;3(Suppl 2):12-18. doi:10.1093/cdn/nzz054

116 Wetherill MS, Duncan AR, Bowman H, et al. Promoting nutrition equity for individuals with physical challenges: A systematic review of barriers and facilitators to healthy eating. *Prev Med*. 2021;153(106723):106723. doi:10.1016/j.ypmed.2021.106723; Cheyne K, Smith M, Felter EM, et al. Food Bank-Based Diabetes Prevention Intervention to Address Food Security, Dietary Intake, and Physical Activity in a Food-Insecure Cohort at High Risk for Diabetes. *Prev Chronic Dis*. 2020;17:E04. Published 2020 Jan 9. doi:10.5888/pcd17.190210; Silver HJ, Wellman NS. Nutrition Education May Reduce Burden in Family Caregivers of Older Adults. *J Nutr Educ Behav*. 2002;34:S53-S58. https://doi.org/10.1016/S1499-4046(06)60312-6.

117 National Alliance for Caregiving, AARP. Caregiving in the US: 2020 Report. https://www.aarp.org/content/dam/aarp/ppi/2020/05/full-report-caregiving-in-the-united-states.doi.10.26419-2Fppi.00103.001.pdf. Published May, 2020. Accessed January 14, 2022; Pew Research Center, November, 2015, "Raising Kids and Running a Household: How Working Parents Share the Load". https://www.pewresearch.org/social-trends/2015/11/04/raising-kids-and-running-a-household-how-working-parents-share-the-load/. Published November 4, 2015. Accessed January 19, 2022.

118 Nord M. *Food insecurity in households with children: Prevalence, Severity, and Household Characteristics*. Economic Research Service, United States Department of Agriculture. https://www.ers.usda.gov/webdocs/publications/44419/9360_eib56_1_.pdf?v=0. Published September, 2009. Accessed January 14, 2022; Addressing Teen Hunger. Feeding America. https://www.feedingamerica.org/sites/default/files/2021-05/Addressing%20Teen%20Hunger_0.pdf. Published May, 2021. Accessed January 14, 2022.

119 Tana C, Lauretani F, Ticinesi A, et al. Impact of nutritional status on caregiver burden of elderly outpatients. A cross-sectional study. *Nutrients*. 2019;11(2):281. doi:10.3390/nu11020281

120 J Siers-Poisson, Family Living Educator Identifies Obstacles, Solutions For Elder Nutrition, Aug. 5, 2014, https://www.wpr.org/older-adults-face-challenges-getting-right-nutrition; Wu LL, Cheung KY, Lam PYP, et al. Oral health indicators for risk of malnutrition in elders. *J Nutr Health Aging* 2018;22:254–26. Published February 21, 2017. https://doi-org.ezp-prod1.hul.harvard.edu/10.1007/s12603-017-0887-2; o Roberts HC, Lim SER, Cox NJ, Ibrahim K. The Challenge of Managing Undernutrition in Older People with Frailty. *Nutrients*. 2019;11(4):808. Published April 10 2019. doi:10.3390/nu11040808.

121 Hinson WR. Lands Gains, Land Losses: The Odyssey of African Americans Since Reconstruction. Amer. Journal of Econ. & Soc., Oct. 29, 2018; Dimitri C, Effland A. From farming to food systems: the evolution of US agricultural production and policy into the 21st century. *Renewable Agriculture and Food Systems*. 2020;35(4):391-406. Published November 12, 2018. doi:10.1017/S1742170518000522; Popkin BM. Agricultural policies, food and public health. *EMBO Rep*. 2011;12(1):11-18. Published December 10, 2010. doi:10.1038/embor.2010.200.

122 Rothstein R. *The Color of Law: A Forgotten History of How Our Government Segregated Americ*a. Liveright Publishing Corporation; 2018.

123 Zimmerman FJ, Shimoga SV. The effects of food advertising and cognitive load on food choices. *BMC Public Health*. 2014;14(1):342. doi:10.1186/1471-2458-14-342; Sadeghirad B, Duhaney T, Motaghipisheh S, Campbell NRC, Johnston BC. Influence of unhealthy food and beverage marketing on children's dietary intake and preference: a systematic review and meta-analysis of randomized trials: Meta-analysis of unhealthy food and beverage marketing. *Obes Rev*. 2016;17(10):945-959. doi:10.1111/obr.12445

124 *Increasing disparities in unhealthy food advertising targeted to Hispanic and Black youth*. Rudd Center, Council on Black Health, Salud America. https://media.ruddcenter.uconn.edu/PDFs/TargetedMarketingReport2019.pdf. Published January, 2019. Accessed January 14, 2022; *Food advertising targeted to Black and Hispanic youth: Contributing to health disparities*. Rudd Center, AACORN, Salud America. https://media.ruddcenter.uconn.edu/PDFs/272-7%20%20Rudd_Targeted%20Marketing%20Report_Release_081115%5B1%5D.pdf. Published August, 2015. Accessed January 14, 2022.

125 *Draining the big food swamp*. Feed the Truth. https://feedthetruth.org/wp-content/uploads/2021/07/FeedtheTruth_WhitePaper_210401.pdf. Published February, 2021. Accessed January 14, 2022.

126 Brones A. Karen Washington: It's not a food desert, it's food apartheid. Guernica. Published May 7, 2018. Accessed January 18, 2022. https://www.guernicamag.com/karen-washington-its-not-a-food-desert-its-food-apartheid; Akom AA, Shah A, Nakai A. Kids, kale, and concrete: Using participatory technology to transform an urban American food desert. In*: Race, Equity, and Education*. Springer International Publishing; 2016:75-102; Penniman L. *Farming While Black: Soul Fire Farm's Practical Guide to Liberation on the Land*. Chelsea Green Publishing; 2018.

127 *Survey: nutrition information abounds, but many doubt food choices*. International Food Information Council Foundation. https://foodinsight.org/survey-nutrition-information-abounds-but-many-doubt-food-choices. Published May, 2017. Accessed January 14, 2022.

128 Nestle M. *Food Politics: How the Food Industry Influences Nutrition and Health*. University of California Press; 2019. doi:10.1525/9780520955066

129 Nagler RH. Adverse outcomes associated with media exposure to contradictory nutrition messages. *J Health Commun*. 2014;19(1):24-40. doi:10.1080/10810730.2013.798384; Lee CJ, Nagler RH, Wang N. Source-specific exposure to contradictory nutrition information: Documenting prevalence and effects on adverse cognitive and behavioral outcomes. *Health Commun*. 2018;33(4):453-461. doi:10.1080/10410236.2016.1278495; Clark D, Nagler RH, Niederdeppe J. Confusion and nutritional backlash from news media exposure to contradictory information about carbohydrates and dietary fats. *Public Health Nutr*. 2019;22(18):3336-3348. doi:10.1017/S1368980019002866

130 Lee CJ, Nagler RH, Wang N. Source-specific exposure to contradictory nutrition information: Documenting prevalence and effects on adverse cognitive and behavioral outcomes. *Health Commun*. 2018;33(4):453-461. doi:10.1080/10410236.2016.1278495; *2014 FDA Health and Diet Survey*. Center for Food Safety and Applied Nutrition, Food and Drug Administration. https://www.fda.gov/media/96883/download. Published May, 2016. Accessed January 18, 2022.

131 *2018 food and health survey*. International Food Information Council Foundation. https://foodinsight.org/wp-content/uploads/2018/05/2018-FHS-Report.pdf. Published May, 2018. Accessed January 18, 2022.

132 *Medicaid's Role in Addressing Social Determinants of Health*. Robert Wood Johnson Foundaiton. https://www.rwjf.org/en/library/research/2019/02/medicaid-s-role-in-addressing-social-determinants-of-health.html. Published February, 2019. Accessed January 18, 2022.

133 *A conceptual framework for action on the social determinants of health*. World Health Organization. https://apps.who.int/iris/bitstream/handle/10665/44489/9789241500852_eng.pdf. Published October, 2010. Accessed January 18, 2022; Social Determinants of Health. Office of Disease Prevention and Health Promotion, United States Department of Health and Human Services. https://health.gov/healthypeople/objectives-and-data/social-determinants-health. Accessed January 18, 2022.

134 Social determinants of health. World Health Organization. https://www.who.int/health-topics/social-determinants-of-health. Accessed January 18, 2022. Determinants of health. Office of Disease Prevention and Health Promotion, United States Department of Health and Human Services.https://www.healthypeople.gov/2020/about/foundation-health-measures/Determinants-of-Health. Accessed January 18, 2022; Alderwick H, Gottlieb LM. Meanings and misunderstandings: A social determinants of health lexicon for health care systems. *Milbank Q*. 2019;97(2):407-419. doi:10.1111/1468-0009.12390

135 Models and frameworks for the practice of community engagement. Centers for Disease Control. https://www.atsdr.cdc.gov/communityengagement/pce_models.html. Updated June 25, 2015. Accessed January 18, 2022.

136 CDC. The Social-Ecological Model: A Framework for Prevention. CDC.gov. Accessed January 10, 2022. https://www.cdc.gov/violenceprevention/about/social-ecologicalmodel.html; Garfield K, Scott E, Sukys S, Downer S, Landauer R, Orr J, et al. Mainstreaming Produce Prescriptions: A Policy Strategy Report. Harvard Law School Center for Health Law & Policy Innovation. March 2021. Accessed January 1, 2022. https://chlpi.org/wp-content/uploads/2013/12/Produce-RX-March-2021.pdf.

137 Social determinants of health. World Health Organization. https://www.who.int/health-topics/social-determinants-of-health. Accessed January 18, 2022.

138 Berkowitz SA, Berkowitz TSZ, Meigs JB, Wexler DJ. Trends in food insecurity for adults with cardiometabolic disease in the United States: 2005-2012. *PLoS One*. 2017;12(6):e0179172. doi:10.1371/journal.pone.0179172

139 Berkowitz SA, Seligman HK, Meigs JB, Basu S. Food insecurity, healthcare utilization, and high cost: a longitudinal cohort study. *Am J Manag Care*. 2018;24(9):399-404. Accessed January 18, 2022. https://pubmed.ncbi.nlm.nih.gov/30222918/

140 Tolbert J, Orgera K. *Key facts about the uninsured*. Kaiser Family Foundation. https://www.kff.org/uninsured/issue-brief/key-facts-about-the-uninsured-population. Published November 6, 2020. Accessed January 18, 2022.

141 Artiga S, Hill L, Orgera K. *Health coverage by race and ethnicity*. Kaiser Family Foundation. https://www.kff.org/racial-equity-and-health-policy/issue-brief/health-coverage-by-race-and-ethnicity. Published July 16, 2021. Accessed January 18, 2022.

142 Health coverage of immigrants. Kaiser Family Foundation. https://www.kff.org/racial-equity-and-health-policy/fact-sheet/health-coverage-of-immigrants. Published July 15, 2021. Accessed January 18, 2022.

143 Freed M, Damico A, Neuman T. A dozen facts about Medicare Advantage in 2020. Kaiser Family Foundation. https://www.kff.org/medicare/issue-brief/a-dozen-facts-about-medicare-advantage-in-2020. Published January 13, 2021. Accessed January 18, 2022. Total number of Medicare beneficiaries: 2020. Kaiser Family Foundation. https://www.kff.org/medicare/state-indicator/total-medicare-beneficiaries. Accessed January 18, 2022.

144 Nong P, Raj M, Creary M, Kardia SLR, Platt JE. Patient-reported experiences of discrimination in the US health care system. *JAMA Netw Open*. 2020;3(12):e2029650. doi:10.1001/jamanetworkopen.2020.29650

145 Knowles M, Khan S, Palakshappa D, et al. Successes, challenges, and considerations for integrating referral into food insecurity screening in pediatric settings. *J Health Care Poor Underserved*. 2018;29(1):181-191. doi:10.1353/hpu.2018.0012

146 Knowles M, Khan S, Palakshappa D, et al. Successes, challenges, and considerations for integrating referral into food insecurity screening in pediatric settings. *J Health Care Poor Underserved*. 2018;29(1):181-191. doi:10.1353/hpu.2018.0012

147 Loftus EI, Lachaud J, Hwang SW, Mejia-Lancheros C. Food insecurity and mental health outcomes among homeless adults: a scoping review. *Public Health Nutr*. 2021; 24(7):1766-1777. https://doi.org/10.1017/s1368980020001998; Coffino JA, Spoor SP, Drach R, Hormes JM. Food insecurity among graduate students: prevalence and association with depression, anxiety and stress. *Public Health Nutr*. 2021; 24(7):1889-1894. https://doi.org/10.1017/s1368980020002001; Pourmotabbed A, Moradi S, Babaei A, Ghavami A, Mohammadi H, Jalili C et al. Food insecurity and mental health: a systematic review and meta-analysis. *Public Health Nutr*. 2020; 23(10):1778-1790. https://doi.org/10.1017/s136898001900435x; Knowles M, Rabinowich J, Ettinger de Cuba S, Cutts DB, Chilton M. "Do You Wanna Breathe or Eat?": Parent Perspectives on Child Health Consequences of Food Insecurity, Trade-Offs, and Toxic Stress. *Matern Child Health J*. 2016; 20(1), 25-32. https://doi.org/10.1007/s10995-015-1797-8; Whittle HJ, Palar K, Seligman HK, Napoles T, Frongillo EA, Weiser SD. How food insecurity contributes to poor HIV Health outcomes: Qualitative evidence from the San Francisco Bay Area. *Soc Sci Med*. 2016; 170: 228-236. https://doi.org/10.1016/j.socscimed.2016.09.040; Silverman J, Krieger J, Kiefer M, Herbert P, Robinson J, Nelson K. The Relationship Between Food Insecurity and Depression, Diabetes Distress and Medication Adherence Among Low-Income Patients with Poorly-Controlled Diabetes. *J Gen Intern Med*. 2015; 30(10): 1476-80. https://doi.org/10.1007/s11606-015-3351-1; Cook JT, Black M, Chilton M, Cutts D, Ettinger de Cuba S, Heeren TC, et al. Are food insecurity's health impacts underestimated in the U.S. population? Marginal Food Security Also Predicts Adverse Health Outcomes in Young U.S. Children and Mothers. *Adv Nutr*. 2013; 4(1): 51-61. https://doi.org/10.3945/an.112.003228.

148 Coffino JA, Spoor SP, Drach R, Hormes JM. Food insecurity among graduate students: prevalence and association with depression, anxiety and stress. *Public Health Nutr.* 2021; 24(7):1889-1894. https://doi.org/10.1017/s1368980020002001; Pourmotabbed A, Moradi S, Babaei A, et al. Food insecurity and mental health: a systematic review and meta-analysis. *Public Health Nutr*. 2020; 23(10):1778-1790. https://doi.org/10.1017/s136898001900435x.

149 Coffino JA, Spoor SP, Drach R, Hormes JM. Food insecurity among graduate students: prevalence and association with depression, anxiety and stress. *Public Health Nutr*. 2021; 24(7):1889-1894. https://doi.org/10.1017/s1368980020002001; Pourmotabbed A, Moradi S, Babaei A, et al. Food insecurity and mental health: a systematic review and meta-analysis. *Public Health Nutr*. 2020; 23(10):1778-1790. https://doi.org/10.1017/s136898001900435x. Knowles M, Rabinowich J, Ettinger de Cuba S, Cutts DB, Chilton M. "Do You Wanna Breathe or Eat?": Parent Perspectives on Child Health Consequences of Food Insecurity, Trade-Offs, and Toxic Stress. *Matern Child Health J.* 2016; 20(1), 25-32. https://doi.org/10.1007/s10995-015-1797-8.

150 Smith MD, Coleman-Jensen A. Food insecurity, acculturation and diagnosis of CHD and related health outcomes among immigrant adults in the USA. *Public Health Nutr.* 2020; 23(2):416-431. https://doi.org/10.1017/s1368980019001952; Berkowitz SA, Basu S, Meigs JB, Seligman HK. Food Insecurity and Health Care Expenditures in the United States, 2011-2013. *Health Serv Res.* 2018; 53:3: 1600-1620. https://doi.org/10.1111/1475-6773.12730; Berkowitz SA, Berkowitz TS, Meigs J, Wexler D. Trends in food insecurity for adults with cardiometabolic disease in the United States: 2005-2012. *PLoS One*. 2017; 12(6): 1-14. https://doi.org/10.1371/journal.pone.0179172.

151 Negata JM, Palar K, Goodling HC, Garber AK, Bibbins-Domingo K, Weiser SD. Food Insecurity and Chronic Disease in US Young Adults: Findings from the National Longitudinal Study of Adolescent to Adult Health. *J Gen Intern Med*. 2019; 34(12): 2756-2762. https://doi.org/10.1007/s11606-019-05317-8; Jernigan VBB; Wetherill MS, Hearod J, Jacob T, Salvatore AL, Cannady T, et al. Food Insecurity and Chronic Diseases Among American Indians in Rural Oklahoma: The THRIVE Study, *Am J Public Health*. 2017 Mar;107(3):441-446. https://dx.doi.org/10.2105%2FAJPH.2016.303605; Berkowitz SA; Berkowitz TSZ, Meigs J, Wexler D. Trends in food insecurity for adults with cardiometabolic disease in the United States: 2005-2012. *PLoS One*. 2017; 12(6): 1-14. https://doi.org/10.1371/journal.pone.0179172; Larson NI, Story MT. Food Insecurity and Weight Status Among U.S. Children and Families: A Review of the Literature. *Am J Prev Med*. 2011; 40(2): 166-173. https://doi.org/10.1016/j.amepre.2010.10.028.

152 Negata JM, Palar K, Goodling HC, Garber AK, Bibbins-Domingo K, Weiser SD. Food Insecurity and Chronic Disease in US Young Adults: Findings from the National Longitudinal Study of Adolescent to Adult Health. *J Gen Intern Med.* 2019; 34(12): 2756-2762. https://doi.org/10.1007/s11606-019-05317-8; Jernigan VBB; Wetherill MS, Hearod J, Jacob T, Salvatore AL, Cannady T, et al. Food Insecurity and Chronic Diseases Among American Indians in Rural Oklahoma: The THRIVE Study, *Am J Public Health*. 2017 Mar;107(3):441-446. https://dx.doi.org/10.2105%2FAJPH.2016.303605; Berkowitz SA, Basu S, Meigs JB, Seligman HK. Food Insecurity and Health Care Expenditures in the United States, 2011-2013. *Health Serv Res*. 2018; 53:3: 1600-1620. https://doi.org/10.1111/1475-6773.12730; Silverman J, Krieger J, Kiefer M, Herbert P, Robinson J, Nelson K. The Relationship Between Food Insecurity and Depression, Diabetes Distress and Medication Adherence Among Low-Income Patients with Poorly-Controlled Diabetes. *J Gen Intern Med*. 2015; 30(10): 1476-80). https://doi.org/10.1007/s11606-015-3351-1; Berkowitz SA, Baggett TP, Wexler DJ, Huskey KW, Wee CC. Food Insecurity and Metabolic Control among U.S. Adults with Diabetes. *Diabetes Care*. 2013; 36(10): 3093-3099. https://doi.org/10.1007/s11606-019-05317-8; Seligman HK, Jacobs EA, Lopez A, Tschann J, Fernandez A. Food insecurity and glycemic control among low-income patients with type 2 diabetes. *Diabetes Care*. 2012; 35(2): 233-8. https://doi.org/10.2337/dc11-1627; Seligman HK, Laraia BA, Kushel MB. Food Insecurity is Associated with Chronic Disease among Low-Income NHANES Participants. *J Nutr*. 2010 140(2): 304 -310. https://dx.doi.org/10.3945%2Fjn.109.112573.

153 Negata JM, Palar K, Goodling HC, Garber AK, Bibbins-Domingo K, Weiser SD. Food Insecurity and Chronic Disease in US Young Adults: Findings from the National Longitudinal Study of Adolescent to Adult Health. *J Gen Intern Med*. 2019; 34(12): 2756-2762. https://doi.org/10.1007/s11606-019-05317-8; Jernigan VBB; Wetherill MS, Hearod J, Jacob T, Salvatore AL, Cannady T, et al. Food Insecurity and Chronic Diseases Among American Indians in Rural Oklahoma: The THRIVE Study, *Am J Public Health*. 2017 Mar;107(3):441-446. https://dx.doi.org/10.2105%2FAJPH.2016.303605; Berkowitz SA, Basu S, Meigs JB, Seligman HK. Food Insecurity and Health Care Expenditures in the United States, 2011-2013. *Health Serv Res*. 2018; 53:3: 1600-1620. https://doi.org/10.1111/1475-6773.12730; Berkowitz SA; Berkowitz TSZ, Meigs J, Wexler D. Trends in food insecurity for adults with cardiometabolic disease in the United States: 2005-2012. *PLoS One*. 2017; 12(6): 1-14. https://doi.org/10.1371/journal.pone.0179172. Seligman HK, Laraia BA, Kushel MB. Food Insecurity is Associated with Chronic Disease among Low-Income NHANES Participants. *J Nutr*. 2010 140(2): 304 -310. https://dx.doi.org/10.3945%2Fjn.109.112573.

154 Seligman HK, Laraia BA, Kushel MB. Food Insecurity is Associated with Chronic Disease among Low-Income NHANES Participants. *J Nutr.* 2010 140(2): 304 -310. https://dx.doi.org/10.3945%2Fjn.109.112573.

155 Drennen CR, Coleman SM, Ettinger de Cuba S, et al. Food Insecurity, Health, and Development in Children Under Age Four Years. *Pediatrics (Evanston).* 2019; 144(4), E20190824. https://doi.org/10.1542/peds.2019-0824; Knowles M, Rabinowich J, Ettinger de Cuba S, Cutts DB, Chilton M. "Do You Wanna Breathe or Eat?": Parent Perspectives on Child Health Consequences of Food Insecurity, Trade-Offs, and Toxic Stress. *Matern Child Health J*. 2016; 20(1), 25-32. https://doi.org/10.1007/s10995-015-1797-8; Cook JT, Black M, Chilton M, et al. Are food insecurity's health impacts underestimated in the U.S. population? Marginal Food Security Also Predicts Adverse Health Outcomes in Young U.S. Children and Mothers. *Adv Nutr*. 2013; 4(1): 51-61. https://doi.org/10.3945/an.112.003228; Chilton M, Black MM, Berkowitz C, Casey PH, Cook J, Cutts D et al. Food insecurity and risk of poor health among US-born children of immigrants. *Am J Public Health*. 2009; 99(3): 556-562. https://dx.doi.org/10.2105%2FAJPH.2008.144394.

156 Wetherill MS, Williams MB, White KC, Seligman HK. Characteristics of Households of People with Diabetes Accessing US Food Pantries, *Diabetes Educ*. 2019;45(4): 397-407. https://doi.org/10.1177/0145721719857547; Jernigan VBB, Wetherill MS, Hearod J, Jacob T, Salvatore AL, Cannady M, et al. Food Insecurity and Chronic Diseases Among American Indians in Rural Oklahoma: The THRIVE Study, *Am J Public Health.* 2017;107(3):441-446. https://dx.doi.org/10.2105%2FAJPH.2016.303605; Silverman J, Krieger J, Kiefer M, Herbert P, Robinson J, Nelson K. The Relationship Between Food Insecurity and Depression, Diabetes Distress and Medication Adherence Among Low-Income Patients with Poorly-Controlled Diabetes. J *Gen Intern Med*. 2015; 30(10): 1476-80. https://doi.org/10.1007/s11606-015-3351-1.

157 Hooper L, Telke S, Larson N, Mason SM, Neumark-Sztainer D. Household food insecurity: associations with disordered eating behaviors and overweight in a population-based sample of adolescents. *Public Health Nutr.* 2020; 23(17):3126-3135. https://doi.org/10.1017/s1368980020000464; Negata JM, Palar K, Goodling HC, Garber AK, Bibbins-Domingo K, Weiser SD. Food Insecurity and Chronic Disease in US Young Adults: Findings from the National Longitudinal Study of Adolescent to Adult Health. *J Gen Intern Med*. 2019; 34(12): 2756-2762. https://doi.org/10.1007/s11606-019-05317-8.

158 Hooper L, Telke S, Larson N, Mason SM, Neumark-Sztainer D. Household food insecurity: associations with disordered eating behaviors and overweight in a population-based sample of adolescents. *Public Health Nutr*. 2020; 23(17):3126-3135. https://doi.org/10.1017/s1368980020000464

159 Wetherill MS, Williams MB, White KC, Seligman HK. Characteristics of Households of People with Diabetes Accessing US Food Pantries, *Diabetes Educ.* 2019;45(4): 397-407. https://doi.org/10.1177/0145721719857547; Silverman J, Krieger J, Kiefer M, Herbert P, Robinson J, Nelson K. The Relationship Between Food Insecurity and Depression, Diabetes Distress and Medication Adherence Among Low-Income Patients with Poorly-Controlled Diabetes. *J Gen Intern Med.* 2015; 30(10): 1476-80. https://doi.org/10.1007/s11606-015-3351-1.

160 Whittle HJ, Palar K, Seligman HK, Napoles T, Frongillo EA, Weiser SD. How food insecurity contributes to poor HIV Health outcomes: Qualitative evidence from the San Francisco Bay Area. *Soc Sci Med*. 2016; 170: 228-236. https://doi.org/10.1016/j.socscimed.2016.09.040; Silverman J, Krieger J, Kiefer M, Herbert P, Robinson J, Nelson K. The Relationship Between Food Insecurity and Depression, Diabetes Distress and Medication Adherence Among Low-Income Patients with Poorly-Controlled Diabetes. *J Gen Intern Med.* 2015; 30(10): 1476-80. https://doi.org/10.1007/s11606-015-3351-1; Singer AW, Weiser SD, McCoy SI. Does Food Insecurity Undermine Adherence to Antiretroviral Therapy? A Systematic Review. *AIDS Behav*. 2015; 19(8): 1510-26. DOI:10.1007/s10461-014-0873-1

161 Whittle HJ, Palar K, Seligman HK, Napoles T, Frongillo EA, Weiser, SD. How food insecurity contributes to poor HIV Health outcomes: Qualitative evidence from the San Francisco Bay Area. *Soc Sci Med*. 2016; 170: 228-236. https://doi.org/10.1016/j.socscimed.2016.09.040.

162 Berkowitz SA, Basu S, Meigs JB, Seligman HK. Food Insecurity and Health Care Expenditures in the United States, 2011-2013. *Health Serv Res*. 2018; 53(3):1600-1620. https://doi.org/10.1111/1475-6773.12730; Berkowitz SA, Seligman HK, Meigs JB, Basu S. Food Insecurity, Healthcare Utilization and High Cost: A Longitudinal Cohort Study. *Am J Manag Care.* 2018; 24(9): 399-404. https://www.ncbi.nlm.nih.gov/pubmed/30222918.

163 Berkowitz SA, Seligman HK, Meigs JB, Basu S. Food Insecurity, Healthcare Utilization and High Cost: A Longitudinal Cohort Study. *Am J Manag Care*. 2018; 24(9): 399-404. https://www.ncbi.nlm.nih.gov/pubmed/30222918.

164 Berkowitz SA, Basu S, Meigs JB, Seligman HK. Food Insecurity and Health Care Expenditures in the United States, 2011-2013. Health Serv Res. 2018; 53(3):1600-1620. https://doi.org/10.1111/1475-6773.12730.

165 Wright V, Kaushal N, Waldfogel J, Garfinkel I. Understanding the link between poverty and food insecurity among children: does the definition of poverty matter? *J Child Poverty*. 2014 Jan2: 20(1): 1-20. https://dx.doi.org/10.1080%2F10796126.2014.891973.

166 Wright V, Kaushal N, Waldfogel J, Garfinkel I. Understanding the link between poverty and food insecurity among children: does the definition of poverty matter? J Child Poverty. 2014 Jan2: 20(1): 1-20. https://dx.doi.org/10.1080%2F10796126.2014.891973.

167 Smith MD, Coleman-Jensen A. Food insecurity, acculturation and diagnosis of CHD and related health outcomes among immigrant adults in the USA. *Public Health Nutr*. 2020; 23(2):416-431. https://doi.org/10.1017/s1368980019001952.

168 Smith MD, Coleman-Jensen A. Food insecurity, acculturation and diagnosis of CHD and related health outcomes among immigrant adults in the USA. *Public Health Nutr*. 2020; 23(2):416-431. https://doi.org/10.1017/s1368980019001952; Negata JM, Palar K, Goodling HC, Garber AK, Bibbins-Domingo K, Weiser SD. Food Insecurity and Chronic Disease in US Young Adults: Findings from the National Longitudinal Study of Adolescent to Adult Health. *J Gen Intern Med*. 2019; 34(12): 2756-2762. https://doi.org/10.1007/s11606-019-05317-8.

169 Negata JM, Palar K, Goodling HC, Garber AK, Bibbins-Domingo K, Weiser SD. Food Insecurity and Chronic Disease in US Young Adults: Findings from the National Longitudinal Study of Adolescent to Adult Health. *J Gen Intern Med*. 2019; 34(12): 2756-2762. https://doi.org/10.1007/s11606-019-05317-8.

170 Berkowitz SA, Basu S, Meigs JB, Seligman HK. Food Insecurity and Health Care Expenditures in the United States, 2011-2013. *Health Serv Res*. 2018; 53(3):1600-1620. https://doi.org/10.1111/1475-6773.12730; Ding M, Wilson NLW, Garza KB, Zizza CA. Undiagnosed Prediabetes Among Food Insecure Adults, *Am J Health Behav*. 2014;38(2):225-33. https://doi.org/10.5993/ajhb.38.2.8; Whittle HJ, Palar K, Seligman HK, Napoles T, Frongillo EA, Weiser SD. How food insecurity contributes to poor HIV Health outcomes: Qualitative evidence from the San Francisco Bay Area. *Soc Sci Med*. 2016; 170: 228-236. https://doi.org/10.1016/j.socscimed.2016.09.040.

171 Whittle HJ, Palar K, Seligman HK, Napoles T, Frongillo EA, Weiser SD. How food insecurity contributes to poor HIV Health outcomes: Qualitative evidence from the San Francisco Bay Area. *Soc Sci Med*. 2016; 170: 228-236. https://doi.org/10.1016/j.socscimed.2016.09.040.

172 Pourmotabbed A, Moradi S, Babaei A, Ghavami A, Mohammadi H, Jalili C et al. Food insecurity and mental health: a systematic review and meta-analysis. *Public Health Nutr*. 2020; 23(10):1778-1790. https://doi.org/10.1017/s136898001900435x.

173 Whittle HJ, Palar K, Seligman HK, Napoles T, Frongillo EA, Weiser SD. How food insecurity contributes to poor HIV Health outcomes: Qualitative evidence from the San Francisco Bay Area. *Soc Sci Med*. 2016; 170: 228-236. https://doi.org/10.1016/j.socscimed.2016.09.040.

174 USDA. SNAP Data Tables: National and/or State Level Monthly and/or Annual Data. Fns.usda.gov. Accessed January 10, 2022. https://fns-prod.azureedge.net/sites/default/files/resource-files/34SNAPmonthly-1.pdf.

175 Id.

176 USDA Modernizes the Thrifty Food Plan, Updates SNAP Benefits. Washington, DC: USDA, Food and Nutrition Service; 2021. USDA No. 0179.21.

177 USDA. What can SNAP Buy? Fns.usda.gov. Accessed January 10, 2022. https://www.fns.usda.gov/snap/eligible-food-items

178 USDA. National School Lunch Program. Ers.usda.gov. Accessed January 10, 2022. https://www.ers.usda.gov/topics/food-nutrition-assistance/child-nutrition-programs/national-school-lunch-program/

179 Cullen KW, Chen TA. The contribution of the USDA school breafkast and lunch program meals to student daily dietary intake. *Prev Med Reports*. 2017 March: 5:82-85. https://doi.org/10.1016/j.pmedr.2016.11.016.

180 Healthy, Hunger-Free Kids Act of 2010. Pub L No. 111-296 (Dec. 13, 2010), 124 Stat. 3183.

181 Congressional Research Service. *Older Americans Act: Nutrition Services Program*. Updated May 4, 2020. Accessed January 10, 2022. https://crsreports.congress.gov/product/pdf/IF/IF10633.

182 Administration of Community Living (ACL). Older Americans Nutrition Act Program. Acl.gov. Accessed January 10, 2022. https://acl.gov/sites/default/files/news%202017-03/OAA-Nutrition_Programs_Fact_Sheet.pdf.

183 Id.

184 Congressional Research Service. *Older Americans Act: Nutrition Services Program*. Updated May 4, 2020. Accessed January 10, 2022. https://crsreports.congress.gov/product/pdf/IF/IF10633.

185 Singleton CR, Young SK, Kessee N, Springfield SE, Sen BP. Examining disparities in diet quality between SNAP participants and non-participants using Oaxaca-Blinder decomposition analysis. *Prev Med Rep*. 2020;19:101134. Published 2020 May 28. doi:10.1016/j.pmedr.2020.101134; Bitler, M. The Health and Nutrition Effects of SNAP: Selection Into the Program and a Review of the Literature on Its Effects. University of Kentucky Center for Poverty Research Discussion Paper Series, DP2014-02. Accessed January 10, 2022. http://www.ukcpr.org/Publications/DP2014-02.pdf; Conrad Z, Rehm C, Wilde P, Mozaffarian D. Cardiometabolic Mortality by Supplemental Nutrition Assistance Program Participation and Eligibility in the United States. *Am J Public Health*. 2017 March:107(3):466-474. https://doi.org/10.2105/ajph.2016.303608. USDA. *Characteristics of Supplemental Nutrition Assistance Program Households: Fiscal Year 2018. Report No. SNAP-19-CHA*R. Accessed January 10, 2022. https://fns-prod.azureedge.net/sites/default/files/resource-files/Characteristics2018.pdf.

186 See, e.g., Rigdon J, Berkowitz SA, Seligman HK, Basu S. Re-evaluating associations between the Supplemental Nutrition Assistance Program participation and body mass index in the context of unmeasured confounders. *Soc Sci Med*. 2017;192:112-124. doi:10.1016/j.socscimed.2017.09.020

187 USDA. SNAP Data Tables: National and/or State Level Monthly and/or Annual Data. Fns.usda.gov. Accessed January 10, 2022. https://fns-prod.azureedge.net/sites/default/files/resource-files/34SNAPmonthly-1.pdf.

188 USDA. SNAP Eligibility. Fns.usda.gov. Accessed January 10, 2022. https://www.fns.usda.gov/snap/recipient/eligibility.

189 USDA. What can SNAP Buy? Fns.usda.gov. Accessed January 10, 2022. https://www.fns.usda.gov/snap/eligible-food-items

190 Nguyen BT, Shuval K, Bertmann F, Yaroch AL. The Supplemental Nutrition Assistance Program, Food Insecurity, Dietary Quality, and Obesity Among U.S. Adults. AM J Public Health. 2015; 105(7): 1453-9. https://doi.org/10.2105/ajph.2015.302580.

191 Id.

192 Gregory CA, Deb P. Does SNAP improve your health? Food Policy. 2015 January:50:11-19. https://doi.org/10.1016/j.foodpol.2014.09.010.

193 Ettinger De Cuba SA, Bovell-Ammon AR, Cook JT, Coleman SM, Black MM, Chilton M et al. SNAP, Young Children's Health, and Family Food Security and Healthcare Access. *Am J Prev Med*. 2019; 57(4): 525-532. https://doi.org/10.1016/j.amepre.2019.04.027.

194 Szanton SL, Samuel LJ, Cahill R, Zielinskie G, Wolff JL, Thorpe Jr. RJ et al. Food assistance is associated with decreased nursing home admissions for Maryland's dually eligible older adults. *BMC Geriatrics* 2017: 17(162). https://doi.org/10.1186/s12877-017-0553-x. Samuel LJ, Szanton SL, Cahill R, Wolff JL, Ong P, Zielinskie G et al. Does the Supplemental Nutrition Assistance Program Affect Hospital Utilization Among Older Adults? The Case of Maryland. *Population Health Management*. 2018 April: 21(2). https://doi.org/10.1089/pop.2017.0055.

195 Berkowitz SA, Seligman HK, Rigdon J, Meigs JB, Basu S. Supplemental Nutrition Assistance Program (SNAP) Participation and Health Care Expenditures Among Low-Income Adults. *JAMA Intern Med.* 2017;177(11):1642–1649. doi:10.1001/jamainternmed.2017.4841

196 Larson NI, Story MT. Food insecurity and weight status among U.S. children and families: a review of the literature. *Am J Prev Med*. 2011 Feb;40(2):166-73. doi: 10.1016/j.amepre.2010.10.028. PMID: 21238865

197 Kinsey EW, Dupuis R, Oberle M, Cannuscio CC, Hillier A. Chronic disease self-management within the monthly benefit cycle of the Supplemental Nutrition Assistance Program. *Public Health Nutr*. 2019 Aug;22(12):2248-2259. doi: 10.1017/S1368980019001071.

198 Conrad Z, Rehm CD, Wilde P, Mozaffarian D. Cardiometabolic Mortality by Supplemental Nutrition Assistance Program Participation and Eligibility in the United States. *Am J Public Health*. 2017 Mar;107(3):466-474. doi: 10.2105/AJPH.2016.303608.

199 Leung CW, Epel ES, Willett WC, Rimm EB, Laraia BA. Household food insecurity is positively associated with depression among low-income supplemental nutrition assistance program participants and income-eligible nonparticipants. *J Nutr*. 2015 Mar;145(3):622-7. doi: 10.3945/jn.114.199414; Adynski H, Schwartz TA, Santos HP. Does Participation in Food Benefit Programs Reduce the Risk for Depressive Symptoms? *J Am Psychiatr Nurses Assoc*. 2021 Jan 3:1078390320983904. doi: 10.1177/1078390320983904.

200 Guo B, Huang J, Porterfield SL. Food security and health in transition to adulthood for individuals with disabilities. *Disability and Health J*. 2020 October: 13(4):100937. https://doi.org/10.1016/j.dhjo.2020.100937.

201 Ettinger de Cuba SA, Bovell-Ammon AR, Cook JT, Coleman SM, Black MM, Chilton MM, Casey PH, Cutts DB, Heeren TC, Sandel MT, Sheward R, Frank DA. SNAP, Young Children's Health, and Family Food Security and Healthcare Access. *Am J Prev Med*. 2019 Oct;57(4):525-532. doi: 10.1016/j.amepre.2019.04.027

202 Hudak KM, Racine EF. The Supplemental Nutrition Assistance Program and Child Weight Status: A Review. *Am J Prev Med*. 2019 Jun;56(6):882-893. doi: 10.1016/j.amepre.2019.01.006

203 Ettinger de Cuba SA, Bovell-Ammon AR, Cook JT, Coleman SM, Black MM, Chilton MM, Casey PH, Cutts DB, Heeren TC, Sandel MT, Sheward R, Frank DA. SNAP, Young Children's Health, and Family Food Security and Healthcare Access. *Am J Prev Med*. 2019 Oct;57(4):525-532. doi: 10.1016/j.amepre.2019.04.027; Kinsey EW, Dupuis R, Oberle M, Cannuscio CC, Hillier A. Chronic disease self-management within the monthly benefit cycle of the Supplemental Nutrition Assistance Program. *Public Health Nutr*. 2019 Aug;22(12):2248-2259. doi: 10.1017/S1368980019001071; Hudak KM, Racine EF. The Supplemental Nutrition Assistance Program and Child Weight Status: A Review. *Am J Prev Med*. 2019 Jun;56(6):882-893. doi: 10.1016/j.amepre.2019.01.006.

204 Nguyen BT, Shuval K, Bertmann F, Yaroch AL. The Supplemental Nutrition Assistance Program, Food Insecurity, Dietary Quality, and Obesity Among U.S. Adults. *Am J Public Health*. 2015 Jul;105(7):1453-9. doi: 10.2105/AJPH.2015.302580.

205 Nguyen BT, Shuval K, Bertmann F, Yaroch AL. The Supplemental Nutrition Assistance Program, Food Insecurity, Dietary Quality, and Obesity Among U.S. Adults. *Am J Public Health.* 2015 Jul;105(7):1453-9. doi: 10.2105/AJPH.2015.302580; Kinsey EW, Dupuis R, Oberle M, Cannuscio CC, Hillier A. Chronic disease self-management within the monthly benefit cycle of the Supplemental Nutrition Assistance Program. *Public Health Nutr*. 2019 Aug;22(12):2248-2259. doi: 10.1017/S1368980019001071.

206 Ettinger de Cuba S, Chilton M, Bovell-Ammon A, Knowles M, Coleman SM, Black MM et al. Loss of SNAP is Associated with Food Insecurity and Poor Health in Working Families With Young Children. *Health Affairs* 2019: 38(5). https://doi.org/10.1377/hlthaff.2018.05265.

207 Ettinger de Cuba SA, Bovell-Ammon AR, Cook JT, Coleman SM, Black MM, Chilton MM et al. SNAP, Young Children's Health, and Family Food Security and Healthcare Access. *Am J Prev Med*. 2019 Oct;57(4):525-532. doi: 10.1016/j.amepre.2019.04.027

208 Leung CW, Epel ES, Willett WC, Rimm EB, Laraia BA. Household food insecurity is positively associated with depression among low-income supplemental nutrition assistance program participants and income-eligible nonparticipants. *J Nutr*. 2015 Mar;145(3):622-7. doi: 10.3945/jn.114.199414; Adynski H, Schwartz TA, Santos HP. Does Participation in Food Benefit Programs Reduce the Risk for Depressive Symptoms? *J Am Psychiatr Nurses Assoc*. 2021 Jan 3:1078390320983904. doi: 10.1177/1078390320983904.

209 USDA. National School Lunch Program. Ers.usda.gov. Accessed January 10, 2022. https://www.ers.usda.gov/topics/food-nutrition-assistance/child-nutrition-programs/national-school-lunch-program/

210 Cullen KW, Chen TA. The contribution of the USDA school breafkast and lunch program meals to student daily dietary intake. *Prev Med Reports.* 2017 March: 5:82-85. https://doi.org/10.1016/j.pmedr.2016.11.016.

211 USDA. National School Lunch Program. Ers.usda.gov. Accessed January 10, 2022. https://www.ers.usda.gov/topics/food-nutrition-assistance/child-nutrition-programs/national-school-lunch-program/

212 Id.

213 USDA. The National School Lunch Program. 2017. Accessed January 10, 2022. https://fns-prod.azureedge.net/sites/default/files/resource-files/NSLP-FactSheet.pdf.

214 Gundersen C, Kreider B, Pepper J. The impact of the National School Lunch Program on child health: a nonparametric bounds analysis. *J Econometrics* 2012 January:166(1):79-91. https://doi.org/10.1016/j.jeconom.2011.06.007; Kenney EL, Barrett JL, Bleich SN, Ward ZJ, Cradock AL, Gortmaker SL. Impact of the Healthy, Hungry-Free Kids Act on Obesity Trends. *Health Affairs.* 2020 July 39(7). https://doi.org/10.1377/hlthaff.2020.00133.

215 Gundersen C, Kreider B, Pepper J. The impact of the National School Lunch Program on child health: a nonparametric bounds analysis. *J Econometrics* 2012 January:166(1):79-91. https://doi.org/10.1016/j.jeconom.2011.06.007

216 Matsuzaki M, Sánchez BN, Rebanal RD, Gittelsohn J, Sanchez-Vaznaugh EV. California and federal school nutrition policies and obesity among children of Pacific Islander, American Indian/Alaska Native, and Filipino origins: Interrupted time series analysis. *PLoS Med*. 2021 May 24;18(5):e1003596. doi: 10.1371/journal.pmed.1003596; Sanchez-Vaznaugh, E.V., Matsuzaki, M., Braveman, P. et al. School nutrition laws in the US: do they influence obesity among youth in a racially/ethnically diverse state?. *Int J Obes* 45, 2358–2368 (2021). https://doi.org/10.1038/s41366-021-00900-8.

217 Bardin S, Gola AA. Analyzing the Association between Student Weight Status and School Meal Participation: Evidence from the School Nutrition and Meal Cost Study. *Nutrients*. 2020 Dec 23;13(1):17. doi: 10.3390/nu13010017; Mirtcheva DM, Powell LM. National School Lunch Program Participation and Child Body Weight. *Eastern Economic Journal*. 2013: 39(3):328-345. https://www.jstor.org/stable/23524332?seq=1#metadata_info_tab_contents; Hinrichs P. The effects of the National School Lunch Program on education and health. *J Policy Analysis Manage*. 2010 Summer;29(3):479-505. doi: 10.1002/pam.20506.

218 Capogrossi K, You W. The Influence of School Nutrition Programs on the Weight of Low-Income Children: A Treatment Effect Analysis. *Health Econ*. 2017 Aug;26(8):980-1000. doi: 10.1002/hec.3378; Peterson C. Investigating the historic long-term population health impact of the US National School Lunch Program. *Public Health Nutr*. 2014 Dec;17(12):2783-9. doi: 10.1017/S1368980013003200.

219 Bardin S, Gola AA. Analyzing the Association between Student Weight Status and School Meal Participation: Evidence from the School Nutrition and Meal Cost Study. *Nutrients*. 2020 Dec 23;13(1):17. doi: 10.3390/nu13010017.

220 Kenney EL, Barrett JL, Bleich SN, Ward ZJ, Cradock AL, Gortmaker SL. Impact of the Healthy, Hungry-Free Kids Act on Obesity Trends. *Health Affairs.* 2020 July 39(7). https://doi.org/10.1377/hlthaff.2020.00133.

221 Nguyen BT, Ford CN, Yaroch AL, Shuval K, Drope J. Food Security and Weight Status in Children: Interactions With Food Assistance Programs. *Am J Prev Med*. 2017 Feb;52(2S2):S138-S144. doi: 10.1016/j.amepre.2016.09.009.

222 Mirtcheva DM, Powell LM. National School Lunch Program Participation and Child Body Weight. *Eastern Economic Journal*. 2013: 39(3):328-345. https://www.jstor.org/stable/23524332?seq=1#metadata_info_tab_contents; Nguyen BT, Ford CN, Yaroch AL, Shuval K, Drope J. Food Security and Weight Status in Children: Interactions With Food Assistance Programs. *Am J Prev Med*. 2017 Feb;52(2S2):S138-S144. doi: 10.1016/j.amepre.2016.09.009; Matsuzaki M, Sánchez BN, Rebanal RD, Gittelsohn J, Sanchez-Vaznaugh EV. California and federal school nutrition policies and obesity among children of Pacific Islander, American Indian/Alaska Native, and Filipino origins: Interrupted time series analysis. *PLoS Med*. 2021 May 24;18(5):e1003596. doi: 10.1371/journal.pmed; Hernandez DC, Francis LA, Doyle EA. National School Lunch Program participation and sex differences in body mass index trajectories of children from low-income families. *Arch Pediatr Adolesc Med*. 2011 Apr;165(4):346-53. doi: 10.1001/archpediatrics.2010.253.

223 Bardin S, Gola AA. Analyzing the Association between Student Weight Status and School Meal Participation: Evidence from the School Nutrition and Meal Cost Study. *Nutrients*. 2020 Dec 23;13(1):17. doi: 10.3390/nu13010017.

224 Congressional Research Service. *Older Americans Act: Nutrition Services Program*. Updated May 4, 2020. Accessed January 10, 2022. https://crsreports.congress.gov/product/pdf/IF/IF10633.

225 ACL. Nutrition Services. Acl.gov. Accessed January 10, 2022. https://acl.gov/programs/health-wellness/nutrition-services.

226 Congressional Research Service. *Older Americans Act: Nutrition Services Program*. Updated May 4, 2020. Accessed January 10, 2022. https://crsreports.congress.gov/product/pdf/IF/IF10633.

227 Mabli J, Ghosh A, Schmitz B, Shenk M, Panzarella E, Carlson B et al. *Final Report: Evaluation of the Effect of the Older Americans Act Title III-C Nutrition Services Program on Participants' Health Care Utilization*. Acl.gov. September 14, 2018. Accessed January 1, 2022. https://acl.gov/sites/default/files/programs/2018-10/NSPevaluation_healthcareutilization.pdf.

228 Id.

229 Id.

230 Sahyoun NR, Vaudin A. Home-Delivered Meals and Nutrition Status Among Older Adults. *Nutr Clin Pract*. 2014 Aug;29(4):459-465. doi: 10.1177/0884533614536446.

231 Id.

232 Id.

233 Mabli J, Ghosh A, Schmitz B, Shenk M, Panzarella E, Carlson B et al. *Final Report: Evaluation of the Effect of the Older Americans Act Title III-C Nutrition Services Program on Participants' Health Care Utilization*. Acl.gov. September 14, 2018. Accessed January 1, 2022. https://acl.gov/sites/default/files/programs/2018-10/NSPevaluation_healthcareutilization.pdf.

234 Id.

235 Sahyoun NR, Vaudin A. Home-Delivered Meals and Nutrition Status Among Older Adults. *Nutr Clin Pract*. 2014 Aug;29(4):459-465. doi: 10.1177/0884533614536446.

236 Id.

237 Vieira ER, Vaccaro JA, Zarini GG, Huffman FG. Health Indicators of US Older Adults Who Received or Did Not Receive Meals Funded by the Older Americans Act. *J of Aging Research*. 2017:2160819. https://doi.org/10.1155/2017/2160819; Lee JS, Sinnett S, Bengle R, Johnson MA, Brown A. Unmet Needs for the Older Americans Act Nutrition Program. *Journal of Applied Gerontology*. 2011 30(5):587-606. DOI: 10.1177/0733464810376512; Sahyoun NR, Vaudin A. Home-Delivered Meals and Nutrition Status Among Older Adults. *Nutr Clin Pract*. 2014 Aug;29(4):459-465. doi: 10.1177/0884533614536446.

238 Sahyoun NR, Vaudin A. Home-Delivered Meals and Nutrition Status Among Older Adults. *Nutr Clin Pract*. 2014 Aug;29(4):459-465. doi: 10.1177/0884533614536446.

239 Pub. L. No. 92-433, 49 Stat. 774 (1972).

240 WIC frequently asked questions. Food and Nutrition Service, United States Department of Agriculture. https://www.fns.usda.gov/wic/frequently-asked-questions. Updated July 1, 2019. Accessed January 18, 2022.

241 WIC eligibility requirements. Food and Nutrition Service, United States Department of Agriculture. https://www.fns.usda.gov/wic/wic-eligibility-requirements. Updated June 16, 2020. Accessed January 18, 2022.

242 WIC food packages – maximum monthly allowances. Food and Nutrition Service, United States Department of Agriculture. https://www.fns.usda.gov/wic/wic-food-packages-maximum-monthly-allowances. Updated March 25, 2021. Accessed January 18, 2022.

243 WIC frequently asked questions. Food and Nutrition Service, United States Department of Agriculture. https://www.fns.usda.gov/wic/frequently-asked-questions. Updated July 1, 2019. Accessed January 18, 2022.

244 WIC eligibility requirements. Food and Nutrition Service, United States Department of Agriculture. https://www.fns.usda.gov/wic/wic-eligibility-requirements. Updated June 16, 2020. Accessed January 18, 2022.

245 Id.

246 Id. .

247 Id.

248 About WIC: How WIC helps. Food and Nutrition Service, United States Department of Agriculture. https://www.fns.usda.gov/wic/about-wic-how-wic-helps. Updated October 10, 2013. Accessed January 18, 2022.

249 We excluded studies before conducted before 2009 in order to account for changes to the WIC the food package.

250 Hamad R, Collin DF, Baer RJ, Jelliffe-Pawlowski LL. Association of revised WIC food package with perinatal and birth outcomes: A quasi-experimental study: A quasi-experimental study. *JAMA Pediatr*. 2019;173(9):845-852. doi:10.1001/jamapediatrics.2019.1706

251 Hamad R, Collin DF, Baer RJ, Jelliffe-Pawlowski LL. Association of revised WIC food package with perinatal and birth outcomes: A quasi-experimental study: A quasi-experimental study. *JAMA Pediatr*. 2019;173(9):845-852. doi:10.1001/jamapediatrics.2019.1706; Sonchak L. The impact of WIC on birth outcomes: New evidence from South Carolina. *Matern Child Health J*. 2016;20(7):1518-1525. doi:10.1007/s10995-016-1951-y; Blakeney EL, Herting JR, Zierler BK, Bekemeier B. The effect of women, infant, and children (WIC) services on birth weight before and during the 2007-2009 great recession in Washington state and Florida: a pooled cross-sectional time series analysis. *BMC Pregnancy Childbirth*. 2020;20(1):252. doi:10.1186/s12884-020-02937-5

252 Sonchak L. The impact of WIC on birth outcomes: New evidence from South Carolina. *Matern Child Health J*. 2016;20(7):1518-1525. doi:10.1007/s10995-016-1951-y; Khanani I, Elam J, Hearn R, Jones C, Maseru N. The impact of prenatal WIC participation on infant mortality and racial disparities. *Am J Public Health*. 2010;100 Suppl 1(S1):S204-9. doi:10.2105/AJPH.2009.168922; Hamad R, Collin DF, Baer RJ, Jelliffe-Pawlowski LL. Association of revised WIC food package with perinatal and birth outcomes: A quasi-experimental study: A quasi-experimental study. *JAMA Pediatr*. 2019;173(9):845-852. doi:10.1001/jamapediatrics.2019.1706

253 Khanani I, Elam J, Hearn R, Jones C, Maseru N. The impact of prenatal WIC participation on infant mortality and racial disparities. *Am J Public Health*. 2010;100 Suppl 1(S1):S204-9. doi:10.2105/AJPH.2009.168922

254 Testa A, Jackson DB. Race, ethnicity, WIC participation, and infant health disparities in the United States. *Ann Epidemiol*. 2021;58:22-28. doi:10.1016/j.annepidem.2021.02.005; Blakeney EL, Herting JR, Zierler BK, Bekemeier B. The effect of women, infant, and children (WIC) services on birth weight before and during the 2007-2009 great recession in Washington state and Florida: a pooled cross-sectional time series analysis. *BMC Pregnancy Childbirth*. 2020;20(1):252. doi:10.1186/s12884-020-02937-5; Sonchak L. The impact of WIC on birth outcomes: New evidence from South Carolina. *Matern Child Health J*. 2016;20(7):1518-1525. doi:10.1007/s10995-016-1951-y; Khanani I, Elam J, Hearn R, Jones C, Maseru N. The impact of prenatal WIC participation on infant mortality and racial disparities. *Am J Public Health*. 2010;100 Suppl 1(S1):S204-9. doi:10.2105/AJPH.2009.168922

255 Soneji S, Beltrán-Sánchez H. Association of Special Supplemental Nutrition Program for Women, infants, and Children with preterm birth and infant mortality. *JAMA Netw Open*. 2019;2(12):e1916722. doi:10.1001/jamanetworkopen.2019.16722

256 USDA. *Indicators of diet-quality, nutrition, and health for Americans by program participation status, 2011-2016: Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) Report (Summary)*. Usda.gov. https://fns-prod.azureedge.net/sites/default/files/resource-files/Indicators-Diet-QualityWIC-Summary.pdf. Published October, 2021. Accessed January 18, 2022.

257 About WIC – WIC at a glance. Food and Nutrition Service, United States Department of Agriculture. https://www.fns.usda.gov/wic/about-wic-glance. Updated October 10, 2013. Accessed January 18, 2022.

258 Pub. L. No. 92-433, 49 Stat. 774 (1972); USDA. About WIC: WIC's mission. Fns.usda.gov. https://www.fns.usda.gov/wic/about-wic-wics-mission. Updated October 10, 2013. Accessed January 18, 2022.

259 Oliveira V, Frazão E. *Legislative and regulatory history of the WIC program*. Economic Research Service, United States Department of Agriculture. https://www.ers.usda.gov/webdocs/publications/46165/17227_err73c_3_.pdf. Published April, 2009. Accessed January 18, 2022.

260 *Review of WIC food packages: Improving balance and choice (final report)*. National Academies of Sciences, Engineering, and Medicine. https://www.nap.edu/catalog/23655/review-of-wic-food-packages-improving-balance-and-choice-final. Published January, 2017. Accessed January 18, 2022.

261 Special Supplemental Food Program for Women, Infants, and Children (WIC); Enhanced Food Package for Breastfeeding Women, 57 Fed. Reg. 56235 (November 27, 1992); Oliveira V, Frazão E. *Legislative and regulatory history of the WIC program*. Economic Research Service, United States Department of Agriculture. https://www.ers.usda.gov/webdocs/publications/46165/17227_err73c_3_.pdf. Published April, 2009. Accessed January 18, 2022.

262 Special Supplemental Food Program for Women, Infants, and Children (WIC): Revisions in the WIC Food Packages,76 Fed. Reg. 68966 (December 6, 2007); Oliveira V, Frazão E. *Legislative and regulatory history of the WIC program.* Economic Research Service, United States Department of Agriculture. https://www.ers.usda.gov/webdocs/publications/46165/17227_err73c_3_.pdf. Published April, 2009. Accessed January 18, 2022.

263 *Review of WIC food packages: Proposed framework for revisions (interim report)*. National Academies of Sciences, Engineering, and Medicine. https://www.ncbi.nlm.nih.gov/books/NBK379076. Published July, 2016. Accessed January 18, 2022.

264 Families First Coronavirus Response Act, Pub, L. No. 116-127, §1101, 134 Stat. 180, 181 (2020); WIC COVID-19 waivers. Food and Nutrition Service, United States Department of Agriculture. https://www.fns.usda.gov/programs/fns-disaster-assistance/fns-responds-covid-19/wic-covid-19-waivers. Updated January 18, 2022. Accessed January 18, 2022.

265 *Review of WIC food packages: Proposed framework for revisions (interim report)*. National Academies of Sciences, Engineering, and Medicine. https://www.ncbi.nlm.nih.gov/books/NBK379076. Published July, 2016. Accessed January 18, 2022.

266 USDA. WIC Program Participation and Costs (Data as of January 7, 2022). Accessed. January 20, 2022. https://fns-prod.azureedge.net/sites/default/files/resource-files/wisummary-1.pdf.

267 Berkowitz SA, Delahanty LM, Terranova J, et al. Medically tailored meal delivery for diabetes patients with food insecurity: A randomized cross-over trial. *J Gen Intern Med*. 2019;34(3):396-404. doi:10.1007/s11606-018-4716-z; Cheyne K, Smith M, Felter EM, et al. Food bank-based diabetes prevention intervention to address food security, dietary intake, and physical activity in a food-insecure cohort at high risk for diabetes. *Prev Chronic Dis*. 2020;17(190210):E04. doi:10.5888/pcd17.190210; Watt TT, Appel L, Lopez V, Flores B, Lawhon B. A primary care-based early childhood nutrition intervention: Evaluation of a pilot program serving low-income Hispanic women. *J Racial Ethn Health Disparities*. 2015;2(4):537-547. doi:10.1007/s40615-015-0102-2; Aiyer JN, Raber M, Bello RS, et al. A pilot food prescription program promotes produce intake and decreases food insecurity. *Transl Behav Med*. 2019;9(5):922-930. doi:10.1093/tbm/ibz112

268 Berkowitz SA, Terranova J, Randall L, Cranston K, Waters DB, Hsu J. Association between receipt of a medically tailored meal program and health care use. *JAMA Intern Med*. 2019;179(6):786-793. doi:10.1001/jamainternmed.2019.0198; Berkowitz SA, Terranova J, Hill C, et al. Meal delivery programs reduce the use of costly health care in dually eligible Medicare and Medicaid beneficiaries. *Health Aff (Millwood)*. 2018;37(4):535-542. doi:10.1377/hlthaff.2017.0999; Tapper EB, Baki J, Nikirk S, Hummel S, Asrani SK, Lok AS. Medically tailored meals for the management of symptomatic ascites: the SALTYFOOD pilot randomized clinical trial. *Gastroenterol Rep (Oxf)*. 2020;8(6):453-456. doi:10.1093/gastro/goaa059

269 Bryce R, Guajardo C, Ilarraza D, et al. Participation in a farmers' market fruit and vegetable prescription program at a Federally Qualified Health Center improves hemoglobin A1C in low-income uncontrolled diabetics. *Prev Med Rep*. 2017;7:176-179. doi:10.1016/j.pmedr.2017.06.006; Wetherill MS, Chancellor McIntosh H, Beachy C, Shadid O. Design and implementation of a clinic-based food pharmacy for food insecure, uninsured patients to support chronic disease self-management. *J Nutr Educ Behav*. 2018;50(9):947-949. doi:10.1016/j.jneb.2018.05.014. But see also: Seligman HK, Smith M, Rosenmoss S, Marshall MB, Waxman E. Comprehensive diabetes self-management support from food banks: A randomized controlled trial. *Am J Public Health*. 2018;108(9):1227-1234. doi:10.2105/AJPH.2018.304528

270 Bhat S, Coyle DH, Trieu K, et al. Healthy food prescription programs and their impact on dietary behavior and cardiometabolic risk factors: A systematic review and meta-analysis. *Adv Nutr*. 2021;12(5):1944-1956. doi:10.1093/advances/nmab039; Veldheer S, Scartozzi C, Knehans A, et al. A systematic scoping review of how healthcare organizations are facilitating access to fruits and vegetables in their patient populations. *J Nutr*. 2020;150(11):2859-2873. doi:10.1093/jn/nxaa209

271 White JS, Vasconcelos G, Harding M, et al. Heterogeneity in the effects of food vouchers on nutrition among low-income adults: A quantile regression analysis. *Am J Health Promot*. 2021;35(2):279-283. doi:10.1177/0890117120952991

272 Tapper EB, Baki J, Nikirk S, Hummel S, Asrani SK, Lok AS. Medically tailored meals for the management of symptomatic ascites: the SALTYFOOD pilot randomized clinical trial. *Gastroenterol Rep (Oxf)*. 2020;8(6):453-456. doi:10.1093/gastro/goaa059

273 Berkowitz SA, Shahid NN, Terranova J, et al. "I was able to eat what I am supposed to eat"-- patient reflections on a medically-tailored meal intervention: a qualitative analysis. *BMC Endocr Disord*. 2020;20(1):10. doi:10.1186/s12902-020-0491-z

274 Berkowitz SA, Terranova J, Randall L, Cranston K, Waters DB, Hsu J. Association between receipt of a medically tailored meal program and health care use. *JAMA Intern Med*. 2019;179(6):786-793. doi:10.1001/jamainternmed.2019.0198

275 Berkowitz SA, Delahanty LM, Terranova J, et al. Medically tailored meal delivery for diabetes patients with food insecurity: A randomized cross-over trial. *J Gen Intern Med*. 2019;34(3):396-404. doi:10.1007/s11606-018-4716-z

276 Henstenburg JA, Parvanta C, Pontiggia L, Daugherty S, Laverty N. Food is Medicine: Providing medically tailored meals to community members with disease-associated nutritional risk supports stable BMI and decreased hospitalization (P12-005-19). *Curr Dev Nutr*. 2019;3(Suppl 1). doi:10.1093/cdn/nzz035.P12-005-19

277 Berkowitz SA, Terranova J, Hill C, et al. Meal delivery programs reduce the use of costly health care in dually eligible Medicare and Medicaid beneficiaries. *Health Aff (Millwood)*. 2018;37(4):535-542. doi:10.1377/hlthaff.2017.0999

278 Hummel SL, Karmally W, Gillespie BW, et al. Home-delivered meals postdischarge from Heart Failure hospitalization: The GOURMET-HF pilot study. *Circ Heart Fail*. 2018;11(8):e004886. doi:10.1161/CIRCHEARTFAILURE.117.004886

279 Palar K, Napoles T, Hufstedler LL, et al. Comprehensive and medically appropriate food support is associated with improved HIV and diabetes health. *J Urban Health*. 2017;94(1):87-99. doi:10.1007/s11524-016-0129-7

280 DiMaria-Ghalili RA, Laverty N, Baron K, Nasser JA. Benchmarking a home-delivered meal program's annual satisfaction survey: A Metropolitan Area Neighborhood Nutrition Alliance (MANNA) initiative in Philadelphia. *J Nutr Gerontol Geriatr*. 2015;34(2):189-206. doi:10.1080/21551197.2015.1035824

281 Gurvey J, Rand K, Daugherty S, Dinger C, Schmeling J, Laverty N. Examining health care costs among MANNA clients and a comparison group. *J Prim Care Community Health*. 2013;4(4):311-317. doi:10.1177/2150131913490737

282 Berkowitz SA, Shahid NN, Terranova J, et al. "I was able to eat what I am supposed to eat"-- patient reflections on a medically-tailored meal intervention: a qualitative analysis. *BMC Endocr Disord*. 2020;20(1):10. doi:10.1186/s12902-020-0491-z

283 Berkowitz SA, Terranova J, Randall L, Cranston K, Waters DB, Hsu J. Association between receipt of a medically tailored meal program and health care use. *JAMA Intern Med*. 2019;179(6):786-793. doi:10.1001/jamainternmed.2019.0198

284 Sastre L, Wynn D, Roupe M, Jacobs M. Link between redemption of a medical food pantry voucher and reduced hospital readmissions. *Prev Med Rep*. 2021;23(101400):101400. doi:10.1016/j.pmedr.2021.101400

285 Cheyne K, Smith M, Felter EM, et al. Food bank-based diabetes prevention intervention to address food security, dietary intake, and physical activity in a food-insecure cohort at high risk for diabetes. *Prev Chronic Dis*. 2020;17(190210):E04. doi:10.5888/pcd17.190210

286 Paolantonio L, Kim SY, Ramirez J, et al. Food purchasing behavior of food insecure cancer patients receiving supplemental food vouchers. *Support Care Cancer*. 2020;28(8):3739-3746. doi:10.1007/s00520-019-05183-4

287 Hickey E, Phan M, Beck AF, Burkhardt MC, Klein MD. A mixed-methods evaluation of a novel food pantry in a pediatric primary care center. *Clin Pediatr (Phila)*. 2020;59(3):278-284. doi:10.1177/0009922819900960

288 Aiyer JN, Raber M, Bello RS, et al. A pilot food prescription program promotes produce intake and decreases food insecurity. *Transl Behav Med*. 2019;9(5):922-930. doi:10.1093/tbm/ibz112

289 Feinberg AT, Hess A, Passaretti M, Coolbaugh S, Lee T. Prescribing food as a specialty drug. *NEJM Catalyst*. 2018;4(2). doi:10.1056/CAT.18.0212

290 Greenthal E, Jia J, Poblacion A, James T. Patient experiences and provider perspectives on a hospital-based food pantry: a mixed methods evaluation study. *Public Health Nutr*. 2019;22(17):3261-3269. doi:10.1017/S1368980019002040

291 Ferrer RL, Neira LM, De Leon Garcia GL, Cuellar K, Rodriguez J. Primary care and food bank collaboration to address food insecurity: A pilot randomized trial. *Nutr Metab Insights*. 2019;12:1178638819866434. doi:10.1177/1178638819866434

292 Seligman HK, Smith M, Rosenmoss S, Marshall MB, Waxman E. Comprehensive diabetes self-management support from food banks: A randomized controlled trial. *Am J Public Health*. 2018;108(9):1227-1234. doi:10.2105/AJPH.2018.304528

293 Wetherill MS, Chancellor McIntosh H, Beachy C, Shadid O. Design and implementation of a clinic-based food pharmacy for food insecure, uninsured patients to support chronic disease self-management. *J Nutr Educ Behav*. 2018;50(9):947-949. doi:10.1016/j.jneb.2018.05.014

294 Gany F, Lee T, Loeb R, et al. Use of hospital-based food pantries among low-income urban cancer patients. *J Community Health*. 2015;40(6):1193-1200. doi:10.1007/s10900-015-0048-7

295 Seligman HK, Lyles C, Marshall MB, et al. A pilot food bank intervention featuring diabetes-appropriate food improved glycemic control among clients in Three States. *Health Aff (Millwood)*. 2015;34(11):1956-1963. doi:10.1377/hlthaff.2015.0641

296 Veldheer S, Scartozzi C, Bordner CR, et al. Impact of a prescription produce program on diabetes and cardiovascular risk outcomes. *J Nutr Educ Behav*. 2021;53(12):1008-1017. doi:10.1016/j.jneb.2021.07.005

297 Slagel N, Newman T, Sanville L, et al. The effects of a community- and clinical-based fruit and vegetable prescription program (FVRx)® with expanded nutrition education for low-income individuals. *J Nutr Educ Behav*. 2021;53(7):S71-S72. doi:10.1016/j.jneb.2021.04.443

298 Bryce R, WolfsonBryce JA, CohenBryce A, et al. A pilot randomized controlled trial of a fruit and vegetable prescription program at a Federally Qualified Health Center in low-income uncontrolled diabetics. *Prev Med Rep*. 2021;23(101410):101410. doi:10.1016/j.pmedr.2021.101410

299 Ridberg RA, Marpadga S, Akers MM, Bell JF, Seligman HK. Fruit and vegetable vouchers in pregnancy: Preliminary impact on diet & food security. *J Hunger Environ Nutr*. 2021;16(2):149-163. doi:10.1080/19320248.2020.1778593

300 Burrington CM, Hohensee TE, Tallman N, Gadomski AM. A pilot study of an online produce market combined with a fruit and vegetable prescription program for rural families. *Prev Med Rep*. 2020;17(101035):101035. doi:10.1016/j.pmedr.2019.101035

301 York B, Kujan M, Conneely C, Glantz N, Kerr D. Farming for Life: Pilot assessment of the impact of medical prescriptions for vegetables on health and food security among Latino adults with type 2 diabetes. *Nutr Health*. 2020;26(1):9-12. doi:10.1177/0260106019898995

302 Orsega-Smith E, Slesinger N, Cotugna N. Local pediatricians partner with food bank to provide produce prescription program. *J Hunger Environ Nutr*. 2020;15(3):353-359. doi:10.1080/19320248.2019.1592051

303 Berkowitz SA, O'Neill J, Sayer E, et al. Health center-based community-supported agriculture: An RCT. *Am J Prev Med*. 2019;57(6 Suppl 1):S55-S64. doi:10.1016/j.amepre.2019.07.015

304 Saxe-Custack A, LaChance J, Hanna-Attisha M. Child consumption of whole fruit and fruit juice following six months of exposure to a pediatric fruit and vegetable prescription program. *Nutrients*. 2019;12(1):25. doi:10.3390/nu12010025

305 Emmert-Aronson B, Grill KB, Trivedi Z, Markle EA, Chen S. Group medical visits 2.0: The Open Source Wellness behavioral pharmacy model. *J Altern Complement Med*. 2019;25(10):1026-1034. doi:10.1089/acm.2019.0079

306 Ridberg RA, Bell JF, Merritt KE, Harris DM, Young HM, Tancredi DJ. A pediatric fruit and vegetable prescription program increases food security in low-income households. *J Nutr Educ Behav*. 2019;51(2):224-230.e1. doi:10.1016/j.jneb.2018.08.003

307 Ridberg RA, Bell JF, Merritt KE, Harris DM, Young HM, Tancredi DJ. Effect of a fruit and vegetable prescription program on children's fruit and vegetable consumption. *Prev Chronic Dis*. 2019;16(180555):E73. doi:10.5888/pcd16.180555

308 Marcinkevage J, Auvinen A, Nambuthiri S. Washington State's fruit and vegetable prescription program: Improving affordability of healthy foods for low-income patients. *Prev Chronic Dis*. 2019;16(180617):E91. doi:10.5888/pcd16.180617

309 Schlosser AV, Joshi K, Smith S, Thornton A, Bolen SD, Trapl ES. "The coupons and stuff just made it possible": economic constraints and patient experiences of a produce prescription program. *Transl Behav Med*. 2019;9(5):875-883. doi:10.1093/tbm/ibz086

310 Joshi K, Smith S, Bolen SD, Osborne A, Benko M, Trapl ES. Implementing a produce prescription program for hypertensive patients in safety net clinics. *Health Promot Pract*. 2019;20(1):94-104. doi:10.1177/1524839917754090

311 Izumi BT, Higgins CE, Baron A, et al. Feasibility of using a community-supported agriculture program to increase access to and intake of vegetables among Federally Qualified Health Center patients. *J Nutr Educ Behav*. 2018;50(3):289-296.e1. doi:10.1016/j.jneb.2017.09.016

312 Trapl ES, Smith S, Joshi K, et al. Dietary impact of produce prescriptions for patients with hypertension. *Prev Chronic Dis*. 2018;15(180301):E138. doi:10.5888/pcd15.180301

313 Bryce R, Guajardo C, Ilarraza D, et al. Participation in a farmers' market fruit and vegetable prescription program at a Federally Qualified Health Center improves hemoglobin A1C in low-income uncontrolled diabetics. *Prev Med Rep*. 2017;7:176-179. doi:10.1016/j.pmedr.2017.06.006

314 Cavanagh M, Jurkowski J, Bozlak C, Hastings J, Klein A. Veggie Rx: an outcome evaluation of a healthy food incentive programme. *Public Health Nutr*. 2017;20(14):2636-2641. doi:10.1017/s1368980016002081

315 Trapl ES, Joshi K, Taggart M, Patrick A, Meschkat E, Freedman DA. Mixed methods evaluation of a produce prescription program for pregnant women. *J Hunger Environ Nutr*. 2017;12(4):529-543. doi:10.1080/19320248.2016.1227749

316 Omar JY, Heidemann D, Blum-Alexander B, et al. Fresh prescription: Improving nutrition education and access to fresh produce in Detroit. *J Gen Intern Med*. 2017;32(2):S752. https://scholarlycommons.henryford.com/administration_mtgabstracts/1

317 George DR, Manglani M, Minnehan K, et al. Examining feasibility of mentoring families at a farmers' market and community garden. *Am J Health Educ*. 2016;47(2):94-98. doi:10.1080/19325037.2015.1133340

318 Chrisinger A, Wetter A. Fruit and vegetable prescription program: Design and evaluation of a program for families of varying socioeconomic status. *J Nutr Educ Behav*. 2016;48(7):S57. doi:10.1016/j.jneb.2016.04.153

319 Goddu AP, Roberson TS, Raffel KE, Chin MH, Peek ME. Food Rx: a community-university partnership to prescribe healthy eating on the South Side of Chicago. *J Prev Interv Community*. 2015;43(2):148-162. doi:10.1080/10852352.2014.973251

320 Watt TT, Appel L, Lopez V, Flores B, Lawhon B. A primary care-based early childhood nutrition intervention: Evaluation of a pilot program serving low-income Hispanic women. *J Racial Ethn Health Disparities*. 2015;2(4):537-547. doi:10.1007/s40615-015-0102-2

321 Friedman DB, Freedman DA, Choi SK, et al. Provider communication and role modeling related to patients' perceptions and use of a Federally Qualified Health Center-based farmers' market. *Health Promot Pract*. 2014;15(2):288-297. doi:10.1177/1524839913500050

322 Freedman DA, Choi SK, Hurley T, Anadu E, Hébert JR. A farmers' market at a Federally Qualified Health Center improves fruit and vegetable intake among low-income diabetics. *Prev Med*. 2013;56(5):288-292. doi:10.1016/j.ypmed.2013.01.018

323 Hager K, Mozaffarian D. The promise and uncertainty of fruit and vegetable prescriptions in health care. *J Nutr*. 2020;150(11):2846-2848. doi:10.1093/jn/nxaa283

324 Braveman P. A new definition of health equity to guide future efforts and measure progress. *Health Affairs Blog*. June 22, 2017. Accessed January 10, 2022. https://www.healthaffairs.org/do/10.1377/forefront.20170622.060710/full/.

325 Holmes, AGD. Researcher Positionality - A Consideration of Its Influence and Place in Qualitative Research - A New Researcher Guide. *Shanlax Int J of Ed*. 2020; 8(4): 1-10. https://doi.org/10.34293/.

326 White JS, Vasconcelos G, Harding M, Carroll MM, Gardner CD et al. Heterogeneity in the effects of food vouchers on nutrition among low-income adults: a quantile regression analysis. *Am J Health Promot.* 2021 Feb;35(2):279-283. https://doi.org/10.1177/0890117120952991.

327 Siers-Poisson J. Older Adults Face Challenges in Getting Right Nutrition, Wisconsin Public Radio website. https://www.wpr.org/older-adults-face-challenges-getting-right-nutrition. Published Aug. 5, 2014. Accessed Oct. 30, 2021

328 Feeney L, Kopper S, Sautmann A, et al. Ethical conduct of randomized evaluations, Abdul Latif Jameel Poverty Action Lab website. https://www.povertyactionlab.org/resource/ethical-conduct-randomized-evaluations. Accessed Oct. 28, 2021.

329 Pallmann P, Bedding AW, Choodari-Oskooei B, Dimairo M, Flight L, Hampson LV, et al. Adaptive designs in clinical trials: why use them, and how to run and report them. *BMC Med* 2018:16(29). https://doi.org/10.1186/s12916-018-1017-7.

330 Pallmann P, Bedding AW, Choodari-Oskooei B, Dimairo M, Flight L, Hampson LV, et al. Adaptive designs in clinical trials: why use them, and how to run and report them. *BMC Med* 2018:16(29). https://doi.org/10.1186/s12916-018-1017-7.

331 See Table 1. Sanson-Fisher RW, D'Este CA, Carey ML, Noble N, Paul CL. Evaluation of systems-oriented public health interventions: alternative research designs, *Ann Rev Pub Health* 2014 35:1, 9-27. https://doi.org/10.1146/annurev-publhealth-032013-182445.

332 Hemming K, Haines TP, Chilton PJ, Girling AJ, Lilford RJ. The stepped wedge cluster randomized trial: rationale, design, analysis, and reporting. *BMJ* 2015; 350: h391. https://doi.org/10.1136/bmj.h391.

333 Hudson J, Fielding S, Ramsay CR. Methodology and reporting characteristics of studies using interrupted time series design in healthcare. *BMC Med Res Methodol.* 2019: 19(137). https://doi.org/10.1186/s12874-019-0777-x.

334 Wherry L. An Introduction to Regression Discontinuity Design. November 20, 2017. https://ctsi.ucla.edu/education/files/view/rcmar-seminars/2017_November_Wherry.pdf. Accessed Oct. 30, 2021.

335 See Difference-in-Differences. ScienceDirect website, citing Guido S, Woessmann L. *The Economics of Education, 2nd ed*. 2020. The Academic Press. https://www.sciencedirect.com/topics/economics-econometrics-and-finance/difference-in-differences. Accessed January 10, 2022.

336 Craig S, Vittal Katikireddi S, Leyland A, Popham F. Natural experiments: An overview of methods, approaches, and contributions to public health intervention research. *Annu. Rev. Public Health* 2017 Mar. 20; 38:39-56. https://doi.org/10.1146/annurev-publhealth-031816-044327.

337 Medicare Program; Revised Process for Making Medicare National Coverage Determinations 65 Fed. Reg. 55634 (September 26, 2003).

338 CMS. 13.5.4 Reasonable and Necessary Provisions in LCDs,. Medicare Program Integrity Manual, Rev. 863. Issued Feb. 12, 2019. cms.gov. https://www.cms.gov/regulations-and-guidance/guidance/manuals/downloads/pim83c13.pdf. Accessed Oct. 30, 2021.

339 CMS. 13.5.4 Reasonable and Necessary Provisions in LCDs,. Medicare Program Integrity Manual, Rev. 863. Issued Feb. 12, 2019. cms.gov. https://www.cms.gov/regulations-and-guidance/guidance/manuals/downloads/pim83c13.pdf. Accessed Oct. 30, 2021.

340 McLaurin KK, Wade SW, Kong AM, Diakun D, Olajide IR, Germano J. Characteristics and health care utilization of otherwise healthy commercially and Medicaid-insured preterm and full-term infants in the US. *Pediatric Health Med Ther*. 2019 Apr 5;10:21-31. doi: 10.2147/PHMT.S182296.

341 CDC. Cost-Effectiveness Analysis. CDC.gov. https://www.cdc.gov/policy/polaris/economics/cost-effectiveness/index.html. Accessed Oct. 30, 2021.

342 Burke LG, Orav EJ, Zheng J et al. Healthy days at home: a novel population-based outcome measure, *Healthc (Amst)*. 2020 Mar; 8(1):100378. https://doi.org/10.1016/j.hjdsi.2019.100378.

343 NIH. Request for Information (RFI): Research Opportunities to End Hunger, Food and Nutrition Insecurity, NOT-OD-21-183. September 10, 2021. https://grants.nih.gov/grants/guide/notice-files/NOT-OD-21-183.html.

344 NIH. *2020-2030 Strategic Plan for NIH Nutrition Research.* Dpcpsi.nih.gov. https://dpcpsi.nih.gov/sites/default/files/2020NutritionStrategicPlan_508.pdf. Accessed Oct. 30, 2021.

345 House Appropriations Committee. House Report 117-81 to accompany H.R. 4355, 117th Congress (2021). https://www.govinfo.gov/content/pkg/CRPT-116hrpt445/html/CRPT-116hrpt445.htm; House Appropriations Committee, House Report 117-83 to accompany H.R. 4372, 117th Congress (2021). https://www.congress.gov/117/crpt/hrpt83/CRPT-117hrpt83.pdf.

346 USDA Modernizes the Thrifty Food Plan, Updates SNAP Benefits. Washington, DC: USDA, Food and Nutrition Service; 2021. USDA No. 0179.21.

347 Collins AM, Briefel R, Klerman JA, Wolf A, Rowe G, Logan C et al. *Summer Electronic Benefit Transer for Children (SEBTC) Demonstration: Summary Report.* May 2016. Accessed January 10, 2022. https://fns-prod.azureedge.net/sites/default/files/ops/sebtcfinalreport.pdf.

348 USDA. State Agency Option to Temporarily Increase the Cash-Value Voucher/Benefit for Fruit and Vegetable Purchases. WIC Policy Memorandum #2021-3. March 24, 2021. Accessed January 10, 2022. https://www.fns.usda.gov/wic/policy-memorandum-2021-3.

349 Extending Government Funding and Delivering Emergency Assistance Act. Pub. Law No. 117-43, 135 Stat. 344. Sept. 30, 2021.

350 Collins AM, Briefel R, Klerman JA, Wolf A, Rowe G, Logan C et al. *Summer Electronic Benefit Transer for Children (SEBTC) Demonstration: Summary Report*. May 2016. Accessed January 10, 2022. https://fns-prod.azureedge.net/sites/default/files/ops/sebtcfinalreport.pdf.

351 Zippel C. After Child Tax Credit Payments Begin, Many More Families Have Enough to Eat, Center for Budget and Policy Priorities website. Published Aug. 30, 2021. https://www.cbpp.org/blog/after-child-tax-credit-payments-begin-many-more-families-have-enough-to-eat. Accessed Oct. 30, 2021; Berkowitz SA, Basu S. Unemployment Insurance, Health-Related Social Needs, Health Care Access, and Mental Health During the COVID-19 Pandemic, *JAMA Intern. Med*. 2021, 181(5):699-702. doi:10.1001/jamainternmed.2020.7048.

352 West S, Castro Baker A, Samra S, Coltrera E et al. *SEED Preliminary Analysis, SEED'S First Year*. https://static1.squarespace.com/static/6039d612b17d055cac14070f/t/6050294a1212aa40fdaf773a/1615866187890/SEED_Preliminary+Analysis-SEEDs+First+Year_Final+Report_Individual+Pages+.pdf. Accessed Oct. 30, 2021.

353 Id.

354 Id.

Food is Medicine Research Action Plan: Acknowledgments

This report is the result of interviews, consultants, and weekly team meetings of the Food is Medicine Initiative team over nearly two and a half years, in addition to our remarkable and unstintingly generous advisors. Their expertise and generosity of time, insight, and examination greatly contributed to the development of this work, and Food & Society at the Aspen Institute as well as the research action plan authors are extremely grateful to them.

We could never have coordinated the many experts who helped us so greatly, or made the report look as beautiful as it does, without the constant and invaluable help of:

Tracy Anderson, former senior program manager, Food and Society at the Aspen Institute

Mary Castillo, senior program manager, Food and Society at the Aspen Institute

Alexandra Lewin-Zwerdling, PhD, consultant, Food and Society at the Aspen Institute

Paul Viola, partner at Kissane Viola Design

At the Center for Health Law and Policy Innovation, Harvard Law School Research Team, we benefited from the help and leadership of **Katie Garfield**, **Kristin Sukys**, **Erin McCrady**, and **Robert Greenwald**.

We were also fortunate to engage **Kristine Andrews** and **Jenita Parekh**, co-authors of *How to Embed a Racial and Ethnic Equity Perspective in Research*, as expert presenters and facilitators. Their insights contributed many crucial additions to our considerations of how to embed equity throughout the research continuum.

Because of the changes the Covid-19 pandemic made to our plans to convene in person, we moved our initial meeting to several days in the spring of 2020. To our delight and relief, our advisors and participants were able form the kind of lasting bonds that have already resulted in new collaborations and new interchange—a key goal of the Initiative. They continued to inform targeted listening exchanges and working meetings that helped hone the Action Plan at important milestones in its writing. We are grateful for the active help and consultation they generously gave us at many key moments during the Action Plan's creation.

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About Food & Society at the Aspen Institute

Food & Society at the Aspen Institute brings together leaders and decision-makers in the food and beverage industry and the public health community—scientists, nutritionists, environmentalists, entrepreneurs, chefs, restaurateurs, farmers, and food makers of all kinds—to find solutions to production, health, and communications challenges in the food system. The goal is for people of all income levels to eat better and more healthful diets—and to enjoy them bite by bite.

About Harvard Law School Center for Health Law & Policy Innovation

The Harvard Law School Center for Health Law and Policy Innovation (CHLPI) advocates for legal, regulatory, and policy reforms in health and food systems, with a focus on the health, public health, and food needs of systemically marginalized individuals. CHLPI's broad range of initiatives aim to expand access to high-quality health care and nutritious, affordable food; to reduce health- and food-related disparities; to develop community advocacy capacity; and, to promote more equitable, sustainable and effective health care and food systems. CHLPI, a clinical teaching program of Harvard Law School, comprises the Health Law and Policy Clinic and the Food Law and Policy Clinic.

Suggested citation:

Downer S, Clippinger E, Kummer C. Food is Medicine Research Action Plan. Published Jan. 27, 2022.

The principal link to download the Food is Medicine Research Action plan is here.

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