BMJ. 2020; 369: m2482.
Published online 2020 Jun 29. doi: 10.1136/bmj.m2482: 10.1136/bmj.m2482
Food for Thought 2020

PMCID: PMC7322667
PMID: 32601089

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Food is medicine: actions to integrate food and nutrition into healthcare

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Sarah Downer and colleagues review new efforts to incorporate food and nutrition into prevention, management, and treatment of diet related disease in healthcare systems

Key messages

- In the face of the global epidemic of diet related chronic disease, there is increased experimentation with the use of "food is medicine" interventions to prevent, manage, and treat illness
- Interventions used with increasing frequency in the US and piloted to some extent in other countries include medically tailored meals, medically tailored groceries, and produce prescription programmes
- Scaled integration of these and other emerging nutrition interventions into healthcare would require significant investment in rigorous research to test different approaches and address knowledge gaps
- Clinicians need more and better education and training on the appropriateness and use of these interventions
- We also need to identify sustained funding streams to ensure equitable access and availability for patients

A global epidemic of diet related chronic disease has prompted experimentation using food as a formal part of patient care and treatment. One of every five deaths across the globe is attributable to suboptimal diet, more than any other risk factor including tobacco.[1] Individual interactions with the healthcare system are an important opportunity to offer evidence based food and nutrition interventions. An emerging but compelling body of research indicates that such interventions delivered in the healthcare system might be associated with improved health outcomes and reduced healthcare usage and costs.[2,3,4,5,6,7,8,9,10] These data point to the potential for food and nutrition interventions to play a prominent role in the prevention, management, treatment, and even in some cases reversal of disease.[11] When broadly deployed, interventions that are effective for individual patients have the potential to affect population health and shape broader food and health policy reform. Realisation of health benefits is, however, hampered by lack of investment in research, low levels of clinician nutrition knowledge and awareness of interventions, and narrow access to appropriate services and programmes. Tackling each of these challenges is critical to achieving a healthcare system in which nutrition and food are a routine part of evidence based disease prevention and treatment.

We argue for increased integration of specific food and nutrition interventions in—or closely coordinated with—the healthcare system, an initiative often known as "food is medicine." We focus on novel interventions such as medically tailored meals and prescriptions for produce that incorporate food strategies to improve health in the structure and funding of the healthcare system rather than traditional medical nutrition interventions such as those that focus on vitamin or other nutrient supplements or medical foods.

Food is medicine interventions

Food is medicine interventions include medically tailored meals (also called therapeutic meals), medically tailored groceries (sometimes known as food "farmacies" or healthy food prescriptions), and produce prescriptions (table 1). They are typically directed by clinicians through the healthcare system, provided at no cost or very low cost to the patient, and funded by healthcare, government, or philanthropy.

Through a PubMed database search and by polling our network of international colleagues, we found 32 studies in the literature evaluating food is medicine interventions. Most of the examples we found were in the United States, with a few in other Western nations including Australia, Canada, and the United Kingdom.[13,14,15,16] We found none in Brazil, Finland, Germany, Ireland, or Mexico. Most interventions were dependent on philanthropic rather than organisational or institutional support. Reflecting the relative novelty of these efforts, data on the health impacts of food is medicine programmes were variably available in the peer reviewed literature.

These interventions vary widely in intensity and breadth of patient coverage. Medically tailored meals are the highest intensity intervention, necessary for a small but high needs group—those with complex medical conditions who are unable to shop or prepare meals. Over the past three years, the US has launched multiple large medically tailored meal projects for this population in their public insurance programmes, with additional use for elderly people proposed through legislation.[17,18,19] The research on medically tailored meals cited in this article includes larger sample populations and more robust research designs (instrumental variable analyses, statistical matching, and a randomised crossover trial) than for the other interventions.[2,3,6,7] In a retrospective cohort study with 1020 participants, for example, receipt of medically tailored meals was associated with a 16% net reduction in overall healthcare costs, 49% fewer inpatient hospital admissions, and 72% fewer admissions into skilled nursing facilities compared with the control group.[2]

Medically tailored groceries are appropriate for a broader range of patients—those with diet related chronic and acute conditions but who can cook and prepare food at home. Peer reviewed research on the impact of tailored packages of unprepared foods is scant, but co-location of food pantries and hospitals or health centres is increasingly common, along with ability to access this intervention at food banks.[14,20,21] Two randomised control trials are currently under way to assess recipient health impacts, one evaluating the impact of receiving nutritionally appropriate staple foods from a hospital located food pantry for people with diabetes and the second assessing home delivery of a medically tailored meal kit for low income pregnant women that meets certain diet related health eligibility criteria.[22,23]

In theory, produce prescriptions are appropriate for the broadest number of recipients, for both disease prevention and management. Several studies have explored the impact of these programmes on participant attitudes, behaviours, and consumption of fruits and vegetables, but research assessing clinical outcomes and claims data are relatively recent. Research on this intervention is trending in recent years towards more robust study designs with larger sample sizes.[5,8,9] Modelling studies indicate that prescriptions for an array of healthful foods can be highly cost effective or even cost saving for the healthcare system when targeting key sociodemographic subgroups at highest risk, such as elderly people, adults with disabilities, and people with low income.[10] Researchers in the US found, for example, that, over a lifetime, a 30% subsidy incentive on fruits and vegetables would prevent 1.93 million cardiovascular disease events and save approximately $40bn (32bn; €36bn) in healthcare costs.

Food insecurity

We distinguish food is medicine interventions from programmes that respond to general food insecurity by being designed or administered with the express purpose of tackling health concerns. Food banks in the UK are an example of food insecurity response; access to food banks sometimes requires a referral from a healthcare provider, but the food received is not tailored, or not always appropriate, for people living with or at risk of specific health conditions.[24] By contrast, at a preventive food pantry for people with food insecurity in a hospital in the US a hospital dietitian reviews the patient's medical record before selecting a mix of shelf stable and fresh foods that are nutritionally appropriate based on the individual's health profile and personal preferences.[20]

Given what we know about the impact of food insecurity on individual health and the healthcare system,[25,26] programmes like the UK's food bank voucher system, the US Supplemental Nutrition Assistance Program (formerly known as Food Stamps), and Brazil and Mexico's conditional cash transfer programmes are likely to provide some protection against adverse health outcomes. But the support they provide is not coordinated with the healthcare system, so specific health impacts are difficult to measure. Innovations that include clinical evaluations, clinical guidance, and financial support for food is medicine interventions in the healthcare system might be effective and expedient ways to improve both food insecurity and health, even if they do not comprehensively tackle the root structural causes of suboptimal diet.

In the US, government and private health insurers are adopting food and nutrition interventions in the hope of a return on their investment due to reductions in high expenditure healthcare claims. In light of emerging evidence, policy makers are experimenting with loosening the parameters of value based or capitated payment structures to allow public insurance money to be spent on food is medicine interventions. This flexibility can be expanded, administratively or through legislation, to all public health insurance programmes. However, large scale uptake of newly created flexibility to pay for food depends on confidence that food is medicine interventions are clinically effective and cost effective compared with other aspects of medical care.

Benefits of food is medicine

Referring patients to food is medicine interventions can change their ability to follow dietary recommendations, tackling several barriers to healthy eating, including the inability to afford or access recommended foods.[24,25,27,28,29] Providing food or food focused financial assistance can also alleviate budget constraints that prevent patients from affording medications and paying bills.[28] Some food is medicine interventions model appropriate portion size and ingredient selection, enabling recipients to maintain healthful diets past the intervention duration.[28]

Clinicians who refer patients to food is medicine interventions might also see better disease management and fewer admissions to hospital.[2,3,4,6,7] A patient with diabetes who typically runs out of food when monthly assistance is exhausted, for example, could be given anticipatory nutrition guidance and vouchers for supplemental food to avoid an episode of hypoglycaemia.

Integration in healthcare

Healthcare systems are a logical delivery or connection point for food is medicine interventions, but integration depends on many factors. We discuss the need for additional data on effectiveness of different food and nutrition interventions, increased clinician knowledge and familiarity, and sustainable funding.

We need more data

Most studies to date are quasi-experimental or small, short term pilot interventions. Key evidence gaps include the comparative efficacy of different interventions on physical, social, and mental health outcomes and healthcare utilisation, heterogeneity of treatment effects (which interventions work best for which groups, defined by both clinical and social circumstances), and the optimal intensity and duration of intervention needed for different situations. Given that the interventions might have effects throughout life, the appropriate timescale to assess benefits should also be considered.

Supportive evidence can be derived from careful modelling and microsimulation studies to forecast and compare dietary, health, and utilisation and cost benefits for different interventions and scenarios over the short and long term.

The promising findings observed in studies to date must be evaluated with larger implementation studies, including randomised trials with appropriate comparison groups. These might not always be feasible because nutrition research questions often involve long timeframes with treatments that might be difficult to standardise. Instead, quasi-experimental designs with low risk of bias can be used, when appropriate. These could include analyses of natural experiments, instrumental variable analyses, regression discontinuity studies, interrupted time series approaches, and difference-in-difference designs.

For food is medicine interventions to be most effective, the participant should be engaged and their experience evaluated. Qualitative research will better integrate individual perspectives into the design of food is medicine programmes and reveal how, why, and in what context they work best for participants.[30] To tackle historical mistrust of the healthcare system and ensure cultural appropriateness of offerings, research to integrate food is medicine services into healthcare and bring them to scale should contemplate co-design of interventions with eligible participants and appropriate community based organisations.[31]

Improving clinicians' knowledge

Clinicians should be knowledgeable enough to recognise a patient's nutritional needs and understand the potential impact of available services, but this is not the case in many countries. In the US, for example, healthcare professionals (other than registered dietitians) receive very little or no food and nutrition education during training, with less than 1% of lecture hours spent on nutrition education in medical school.[32] An assessment of medical nutrition education initiatives in six countries outside Europe and 15 in Europe found that "nutrition is insufficiently incorporated into medical education, regardless of country, setting, or year of medical education."[33]

Numerous recommendations have been made over the past 20 years to advance policies to increase nutrition education, but change remains elusive.[34] Theories for the lack of progress include lack of leadership or faculty level nutrition champions at many medical schools, lack of compelling training opportunities (such as fellowships) focused on nutrition, and rapidly advancing nutrition science coupled with rampant public nutrition misinformation might have minimised the perceived credibility of nutrition science among physicians.[34,35,36,37] Most physicians, however, recognise their lack of sufficient nutrition education, and would like more information to tackle this key driver of health.[38]

Nutrition training delivered across disciplines holds the promise of more effective patient nutrition education and treatment.[39] In the US, UK, and Spain, "culinary medicine" movements are blending clinical medicine with individual nutrition education focused on the practical aspects of food preparation and cooking. This supports a healthcare professional's willingness and ability to recognise nutrition needs and provide appropriate and practical advice to patients.[40,41] Clinicians should have familiarity with validated nutrition assessment tools, the range of available food is medicine interventions, and the systems and incentive structures that enable and encourage their use in clinical practice. Doctors should also understand the role of, and actively collaborate with, dietitians to appropriately treat people who are at nutritional risk. Increasing nutrition education among doctors might also encourage use of dietitians' expertise in patient care; rates of referral from physicians to dietitians are often quite low, even when diagnoses have a clear nutritional link.[42]

Requiring comprehensive nutrition training as a component of healthcare clinician education will ensure equitable patient access to nutrition expertise across specialties and geographies. Ways to ensuring incorporation of nutrition into clinician curriculums include legislative mandates, making government funding for schools contingent upon such requirements, integration into accreditation standards, and inclusion of nutrition questions on board and other qualifying examinations.[43]

Sustainable funding in and out of healthcare

The food is medicine interventions we found were largely funded by philanthropy and thus vulnerable to downturns in charitable giving and time limits on grants. The absence of sustainable funding mechanisms means that, in many locations, these services might simply not be available because health systems or community based organisations lack the resources. Thus, widespread implementation of food is medicine interventions, particularly those delivered in or with the healthcare system, requires financing models that consistently support these services. Sustainable support could be through public or private healthcare money or through other government funds.

In many healthcare systems, healthcare dollars pay for interventions such as enteral or intravenous feeding support and nutrition supplements for defined clinical deficiencies. But payment for food or meals is often allowed in only narrow circumstances—for example, for inpatients, people in assisted living facilities or nursing homes, or for specific nutritional items (as in the UK's prescription for gluten-free breads and mixes).[44] This restrictive strategy might not be wise. In the US, an individual can receive seven months of medically tailored meals, nutrition counselling, and case management for the average cost of one inpatient hospital admission.[45,46] Because many of these interventions are provided in outpatient settings, trends towards shorter hospital stays would not decrease their efficacy and might make them even more important. If the provision of food was found to affect the rate of hospital admissions and other high cost services,[2,3] health policy makers would have a powerful incentive to alter healthcare funding restrictions. Some US health system entities, including healthcare payers and provider organisations, are using recent changes to healthcare funding parameters to provide nutrition interventions to patients who meet certain criteria (box 1).[17,18]

Box 1

Examples of integration of food in medicine interventions in healthcare in the US

The states of Massachusetts[17] and California[18] are using food in medicine interventions with high risk populations. The government pays for these services through the healthcare system. The Massachusetts programme, launched in 2019, provides home delivered meals (medically tailored and non-medically tailored), groceries, assistance applying for non-healthcare nutrition programmes and legal advocacy for benefits, household supplies to meet dietary needs (cooking implements), nutrition skills development through education and cooking classes, and transportation to meet nutritional needs. To be eligible, patients must have one health needs based criterion (mental health condition, high risk pregnancy, complex health condition, has visited the emergency department more than twice in the past six months, has one or more limitations in activities of daily living) and one risk factor (homelessness, risk of homelessness, risk of nutritional deficiency or imbalance due to food insecurity). The programme measures the following outcomes: emergency department use, inpatient hospital admissions, overall healthcare expenditures, clinical outcomes, and the ability to live independently in the community. Results from the demonstration will be reported in 2022.

In addition to the food is medicine programmes funded through the healthcare system, the government has also appropriated millions of dollars of agriculture funding to establish produce prescription programmes in eight states around the country.

Payment mechanisms need not necessarily involve the healthcare system, as long as they are designed with health promotion in mind and are coordinated with interventions administered through the healthcare system. Health professionals in Alberta, Canada, for example, can confirm diagnosis of qualifying health conditions to enable social service recipients to receive an additional C$21-C$113 a month in cash to subsidise the costs of recommended foods.[15]

When food is medicine interventions meet a standard of evidence that shows desired levels of impact on individual health outcomes and/or other desirable outcome measures, these services should be fully integrated into healthcare or other sustainable financing models. Reimbursement will support access to interventions, especially more complex services like medically tailored meals, by helping to create and sustain an infrastructure of organisations that can work with complicated and sensitive health information to deliver sophisticated interventions to anyone who meets eligibility criteria, whether they reside in urban or rural locations.

The food is medicine interventions reviewed in table 1, administered in or closely coordinated with healthcare systems, are often enhanced and more targeted versions of services provided in anti-hunger programmes (see supplementary table online). These might include Germany's food bank system, which is entirely divorced from the healthcare system; universal school meals programmes (in Finland and other European countries); and services delivered through cash transfers conditional on receipt of certain healthcare services (such as those in Brazil and Mexico) or health diagnoses (in Canada).[15,47,48,49,50]

Future directions

Integration of food is medicine interventions into healthcare depends in large part on new investment in research to add to the evidence base. Improved clinician training and referral capacity, together with increased financial support for interventions both in and outside the healthcare system, will help to ensure that patients are assessed and referred to appropriate interventions available in every community. Access to interventions will be supported by the proliferation of organisations and entities that are able to deliver a range of food and nutrition interventions, some of which are quite complex. In the US, for example, an increasing number of non-profit and for-profit entities are contracting with the healthcare system to provide these services, many for the first time.

The global pandemic of covid-19 has brought the fragility of food and healthcare systems across the globe into sharp relief, with skyrocketing rates of food insecurity and people with diet related illness struggling with increased barriers to accessing healthy food.[25,26] Healthcare systems that integrate food is medicine interventions will enable more resilient systemic responses to such crises. An integrated system will support an infrastructure of food is medicine providers and access pathways that can be used to immediately meet increased demand for healthy food support.

The consequences of poor health caused by poor diet affect many sectors (resulting in high healthcare spending that diverts funds from other policy priorities such as education and enhancing economic prosperity); clinicians working to advance integration have a compelling case to make to a diverse range of decision makers. As healthcare systems continue to evolve to tackle the global crisis of nutrition related disease, food is medicine interventions should be held to rigorous standards when decisions about implementation, coverage, and care are made. But they can no longer be categorically excluded as outside of or ancillary to healthcare delivery, as they have been in the past across many healthcare systems. Integration of food and nutrition interventions into healthcare holds significant promise for meeting immediate nutrition needs while working in harmony with broader, long term health and food system reforms.

Acknowledgments

This article draws from the law and policy expertise and research of so many, especially Kathryn Garfield, Kristin Sukys, Emily Broad Leib, and Robert Greenwald.

Web extra.

Extra material supplied by authors

Supplementary table: A continuum of international food insecurity and food is medicine programs

Notes

Contributors and sources The expertise of the authors includes dietary patterns (DLO, TSH, SAB, DM), nutrition and health related public policy (SD, DLO, DM), clinician nutrition education and training (TSH, DM), primary care and health related social needs interventions (SAB, DLO), and socioeconomic inequities in diet and health (all). SAB, DLO, TSH, and DM are clinicians. All authors contributed to drafting this manuscript, with SD taking a lead role. All authors gave intellectual input to improve the manuscript and have read and approved the final version. SD is guarantor.

Notes

Conflicts of Interest We have read and understood BMJ policy on declaration of interests and have the following interests to declare: SD reports organisational funding from the Rockefeller Foundation, the Laura and John Arnold Foundation, the MAC AIDS Fund, and the Bristol-Myers Squibb Foundation. She sits on the American Cancer Society's National Lung Cancer Roundtable (unpaid) and on the Advisory Board for the Aspen Institute Food and Society Program's food is medicine initiative. Funding for SAB's work on the studies cited in this article was provided by the National Institute of Diabetes and Digestive and Kidney Diseases of the National Institutes of Health under award number K23DK109200. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health. SAB has also received funding from the Aspen Institute, the US Department of Agriculture, the Robert Wood Johnson Foundation, and the Commonwealth Fund. He serves on the research advisory committee (unpaid) of the Social Intervention Research and Evaluation Network. TH reports past funding from the Robert Wood Johnson Foundation and the Humana Foundation; speaker fees from Optum, Omnia Education, beef.org, NACCME, DairyMAX; serves on the board of the Culinary Medicine Specialist Board; receives book royalties from Pritichett and Hull and Perseus; and is the owner and editor and chief of drgourmet.com and Dr Gourmet published materials. DLO reports research funding from the Canadian Institutes of Health Research, the Social Sciences and Humanities Research Council of Canada, the O'Brien Institute for Public Health, I Can For Kids Foundation, Alberta Innovates, Alberta Health Services, the Canadian Foundation for Dietetic Research, the Calgary Centre for Clinical Research, SecondBite, the University of Calgary, the Heart and Stroke Foundation of Canada, and the Libin Cardiovascular Research Institute of Alberta. DM reports research funding from the National Institutes of Health and the Gates Foundation; personal fees from GOED, Nutrition Impact, Bunge, Indigo Agriculture, Motif FoodWorks, Amarin, Acasti Pharma, Cleveland Clinic Foundation, America's Test Kitchen, and Danone; scientific advisory board, Brightseed, DayTwo, Elysium Health, Filtricine, HumanCo, and Tiny Organics; and chapter royalties from UpToDate.

Provenance and peer review: Commissioned; externally peer reviewed.

This article is part of series commissioned by *The BMJ*. Open access fees are paid by Swiss Re, which had no input into the commissioning or peer review of the articles. *The BMJ* thanks the series advisers, Nita Forouhi, Dariush Mozaffarian, and Anna Lartey for valuable advice and guiding selection of topics in the series.

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Figures and Tables

Table 1

Food is medicine: key food and nutrition interventions used in healthcare systems

Intervention	Definition	Target population	Research outcomes
Medically tailored meals	Fully prepared meals designed by a professional based on an individual assessment. Typically includes individualised nutrition counselling	Patients with complex medical conditions (such as cancer, HIV, chronic heart failure) who are unable to shop and preparing meals	Decreased inpatient hospital admissions,[2] [3]emergency department use,[3] emergency transports,[3] admissions to skilled nursing facilities,[2] overall healthcare costs,[2,3] days where mental health interfered with quality of life,[6] hypoglycaemia in people with diabetes,[6] self-reported depressive symptoms,[7] trade-offs in food versus filling prescription medications[7] Increased diet quality,[6] adherence to medication regimens[7]
Medically tailored groceries	Non-prepared grocery items selected by a nutrition professional as part of a treatment plan. Typically collected at a clinic or community point and prepared at home.	Patients with diet related chronic and acute conditions (such as diabetes, cardiovascular disease) who are also food insecure but able to cook and prepare food at home	Decreased HbA_{1c} in people with diabetes[4] and cost of care where cost data were available[12] Increased medication adherence and fruit and vegetable consumption[4]
Produce prescriptions	Vouchers or debit cards for free or discounted produce, distributed by healthcare providers. Can be redeemed at various locations	Patients who have or are at risk for diet related chronic conditions (such as obesity or prediabetes) and who are food insecure	Decreased HbA1c in people with diabetes,[5] fast food consumption,[8] BMI,[5] need for oral antibiotics in children[13] Increased fruit and vegetable consumption[8]