Food Insecurity Interventions in Health Care Settings: A Review of the Evidence

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August 20, 2020

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Social Interventions Research & Evaluation Network

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Acknowledgements

We gratefully acknowledge Seth Berkowitz MD, Alicia Cohen, MD, MSc, Stephanie Ettinger de Cuba, MPH, Megan Sandel, MD, MPH, Rich Sheward, MPP, and John Steiner, MD, MPH for reading earlier drafts of this manuscript. Holly Wing, MA, assisted in developing the search protocol and Dylnne Gonzalez formatted the final report.

We also acknowledge the co-authors of the academic manuscript, Jacqueline M. Torres, PhD, MPH, Tara Benesch, MS, Isabel Elaine Allen, PhD, and Evans M. Whitaker, MD, MLIS. The related manuscript can be found at: *De Marchis EH, Torres JM, Fichtenberg C, Gottlieb LM. Identifying food insecurity in health care settings: A systematic scoping review of the evidence. Fam Community Heal. 2019;42(1):20-29. doi:10.1097/FCH.0000000000000208.*

Suggested Citation

De Marchis E, Fichtenberg C, Gottlieb LM. Food insecurity inverventions in health care settings: A review of the evidence. 2020. San Francisco, CA: Social Interventions Research & Evaluation Network. Available online.

Executive Summary

Food insecurity, the limited access to adequate food due to a lack of money or other resources, adversely impacts health across the life course. Spurred by this knowledge and recent health care payment reforms that incentivize keeping patients healthy, health systems around the country are exploring clinical interventions to decrease food insecurity. To help inform health sector food insecurity efforts, this issue brief updates and summarizes the results of a published systematic review of peer-reviewed studies of food insecurity-related interventions in the context of health care delivery settings.[17]

We found 29 peer-reviewed studies on food insecurity interventions, 22 that examine intervention impacts on food resource use, food security, health behaviors, health or health care costs or utilization. Interventions in these studies fell into three major, not mutually exclusive, categories:

- **Food referrals (17 studies):** Programs that provided either passive referrals (patients given information about available food-related resources) or active navigation (assistance given to connect patients with community/government agencies that provide food-related resources).

- **Fruit and vegetable vouchers (9 studies):** Programs that provided vouchers or financial incentives for us at local farmers' markets to purchase fruits and vegetables.

- **Food provision (6 studies):** Programs that provided food, either on site or through meal delivery programs.

A wide range of outcomes is reflected in reviewed studies. The most commonly studied outcomes were process outcomes such as intervention uptake and resource use (17 studies). Four studies examined food insecurity; six reported on health outcomes; seven reported on diet changes; and two measured utilization impacts. Each of the 29 studies examined one or two types of outcomes, but none included all (e.g. process, food security, health, dietary behaviors, utilization). Study quality ranged from moderate to very low; more than half the studies (15 studies) were in the very low category.

Evidence of benefits was strongest for home-delivered meals, which in two well-designed trials were shown to improve food security, healthy eating, and some measures of health and health care utilization. Several less rigorously designed studies found food voucher programs increased access to fruits and vegetables and reduced food insecurity, although results were mixed for health outcomes, and cost/utilization outcomes were not evaluated. Several studies also found that food referral programs can reduce food insecurity and improve diet and health outcomes, but again, results were mixed. Active referral programs appear more impactful than passive referral programs for connecting patients to external resources.

In summary, there is a growing body of research on interventions targeting food insecurity in health care settings that suggests that food referrals, fruit and vegetable vouchers, and home delivered meals may improve food insecurity, health, and health care utilization. But there is not yet sufficient evidence to develop clear and consistent recommendations about the types of interventions that will maximally impact these outcomes. Future research should include larger samples, include random assignment or otherwise adjust for lack of randomization, and measure health and health care impacts.

Introduction

Food insecurity is defined as limited access to adequate food due to a lack of money or other resources.[1] Numerous studies have documented that food insecurity has long lasting adverse impacts on health and development across the life course.[2-5] In 2018, 11.1% of US households reported being food insecure at some point during the year, though some groups experienced higher rates. For instance, over 21.2% of households headed by non-Hispanic Black individuals, 16.2% of households headed by Hispanic individuals, and 13.9% of households with children were food insecure.[6]

Reflecting the health care system's growing interest in identifying and addressing patients' social needs,[7] the American Academy of Pediatrics, American Academy of Family Physicians, and the American Association of Retired Persons (AARP) have recommended clinic-based food insecurity screening and interventions, including referrals to community resources.[8-10] The Food Research & Action Center, in partnership with Children's HealthWatch and Feeding America, has also published broad recommendations for addressing food insecurity in health care settings.[11] Though large, integrated health systems like ProMedica, Kaiser Permanente, and Geisinger are experimenting with programs designed to reduce patient food insecurity,[12-14] there are not yet clear guidelines on how to develop or implement health care-based food insecurity interventions.

This issue brief summarizes the existing peer-reviewed evidence on health care-based food security-related interventions through December 2018. It complements a 2017 SIREN review that focused on approaches to food insecurity screening.[15,16]

Methods

This brief is based on the results of a published systematic review of the peer-reviewed literature that followed PROSPERO systematic review guidelines. The review covered all peer-reviewed literature on food security or food access interventions carried out in a US health care setting and published between January 1, 2000 through September 1, 2018.[16,17] We expanded the search timeframe in this brief through December 31, 2018, as new relevant manuscripts were published in the interim.

We excluded studies that exclusively focused on food security screening, did not occur primarily in a health care setting, or mentioned a food insecurity-related intervention but did not provide information on the impact of the intervention.[18-46] Study quality was rated using GRADE criteria.[47] Details about search terms and other aspects of the review are available in the Appendix: Review Methodology.

Results Overview

We included 29 studies on food insecurity interventions undertaken in health care settings published between January 1, 2000 and December 31, 2018. Twenty-two of these reported on the impacts of the interventions, while 7 only described the uptake of the intervention.

We grouped the food insecurity interventions in the included studies into three primary categories based on the kind of assistance provided:

- **Food referrals (17 studies):** Programs that provided either passive referrals (patients given information about available food-related resources) or active navigation (assistance given to connect patients with community/government agencies that provided food-related resources).

- **Produce vouchers (9 studies):** Programs that provided vouchers or financial incentives for us at local farmers' markets to purchase fruits and vegetables.

- **Food provision (6 studies):** Programs that provided food, either on site or through meal delivery programs.

Three studies provided two types of food interventions and are included in two groups.[48-51] Ten studies examined interventions that targeted a broader set of patients' social needs (e.g. housing, transportation, utilities) but also included food insecurity as an intervention target.[46,52-60]

A wide range of outcomes was included across the studies in the review. Outcomes fell into four groups:

1. **Process outcomes:** Program activity metrics, such as intervention uptake and use of resources (17 studies).

2. **Food insecurity outcomes:** Food insecurity status (4 studies).

3. **Health and health behavior outcomes:** Patient health outcomes (e.g. BMI, blood pressure) or health-related behaviors (e.g. diet) (11 studies).

4. **Cost and utilization outcomes:** Health care utilization patterns and changes, such as changes in ED visits or attendance at well person visits (2 studies).

Each of the 29 studies examined only 1-2 types of outcomes; no studies examined all four types. The most commonly studied outcomes were process outcomes such as intervention uptake and resource use (17 studies). In contrast, 4 studies examined food insecurity; 6 reported on health outcomes; 7 reported on diet changes; and 2 measured utilization impacts.

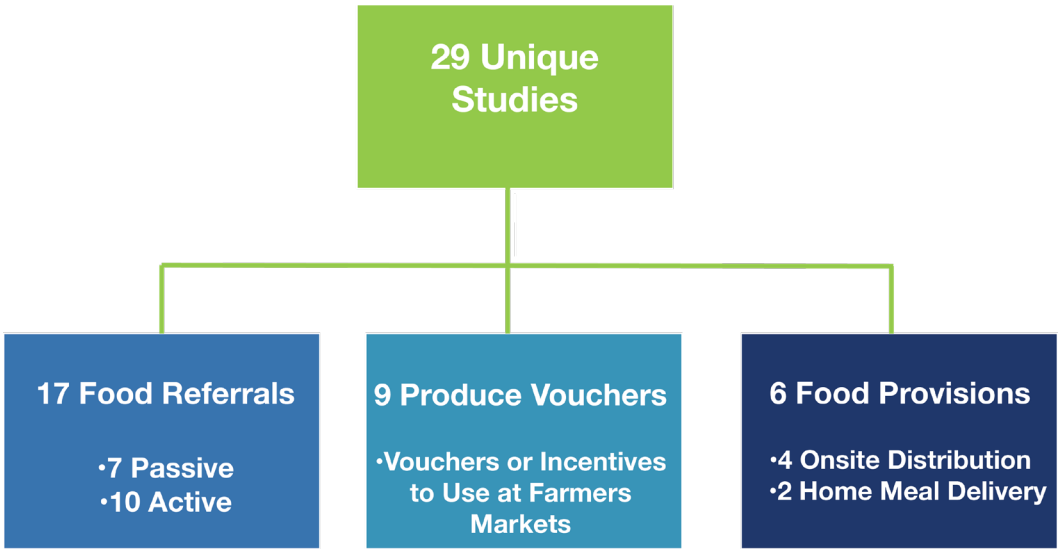
Study quality ranged from moderate to very low, with more than half the studies in the very low category:

- **Moderate quality:** Pre-post study with a control group where the intervention is randomly assigned (i.e. randomized controlled trial, RCT) but the sample size is small, or where statistical techniques are used to control for differences between intervention and control groups (7 studies).

- **Low quality:** Pre-post study with a control group but where the intervention is not randomly assigned and no statistical adjustment controls for differences between the intervention and control group (7 studies).

- **Very low quality:** Pre-post without a control group, or with a control group but with a very small sample size, or cross-sectional study (15 studies).

Figure 1. Number of studies by type of intervention (n=29)



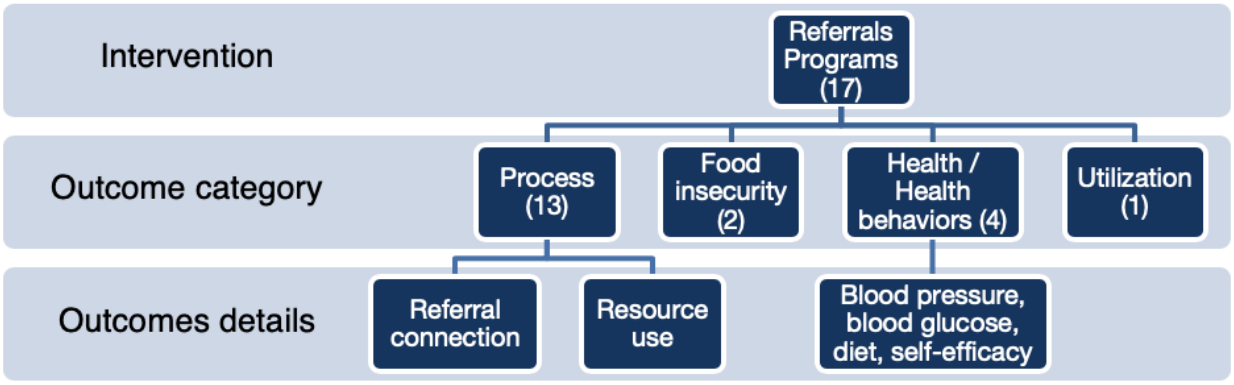
Food Referrals

Seventeen studies described results of programs that provided either passive[46,52,53,55,56,59,61,62] or active referrals to address food insecurity.[14,54,58,60,63-66] Passive referral programs generally provided a list of local resources. Active referrals included programs that provided navigation services, as well as programs that directly linked patients to food resources (for example through an electronic referral that triggers a follow up call from a food resource). Fifteen of the interventions referred patients to food banks and/or organizations providing benefits enrollment assistance. Two interventions provided referrals to a medical-legal partnership[57,60] and one provided referrals to a medical-legal partnerships and food banks.[48]

Studies on food referrals were based in diverse health care settings and targeted a range of populations, including: caregivers of pediatric patients at well-child visits;[14,46,48,52,53,59,63,65-67] adolescents/young adult primary care patients;[54] pregnant women receiving care in an obstetrics clinic;[64] adult patients visiting an urban county emergency department [61] or a health center;[50] recently hospitalized adult patients;[62] and adult outpatients with diabetes (one in older Hispanic patients at a health center[55] and the other in patients at an Endocrinology Clinic).[56]

Thirteen of the food referrals studies reported on process outcomes (e.g. referrals and use of resources) and of those, six studies were purely descriptive. Five studies examined impacts on other outcomes including food security status,[54,58] health behaviors,[55,58,64,68] and utilization.[66]
Of 10 studies that examined the impacts of referral interventions, seven found positive impacts on at least one of the following outcomes: connections to or use of food resources, food insecurity, diet, and systolic blood pressure. However, 6 of the 10 studies did not include a comparison group. Many of

Figure 2. Outcomes included in studies of food referrals programs (n=17)



the studies also had small sample sizes, which means results are more likely to be due to chance.

Interest in assistance varied fairly widely across studies. Five studies found relatively high interest in or acceptance of resources:

- 80%-84% of enrolled patients accepted help from a hunger organization after agreeing to such a referral during a clinical encounter.[14,61]
- 75% of food insecure families not enrolled in SNAP agreed to be referred to an organization that could help them enroll.[63]
- 67% of participants enrolled in a program designed to connect food insecure patients to food benefit programs and food pantries.[64]
- 89% of families identified as food insecure and who viewed food insecurity as a problem accepted a resource handout. [59]

Of the 66/118 patients who perceived food insecurity as a problem and accepted assistance, 89% accepted a resource handout, 6% agreed to a nonroutine follow-up clinic visit, and 2% accepted an external referral.

Two other studies reported lower rates of interest in assistance. In one study of a web-based screening tool, 35% (24/68) of food insecure patients opted to receive referrals for food resources;[54] in a separate study of passive referrals provided by trained volunteers only 33% (6/18) of older Hispanic diabetic patients requested food resources.[55] Active referrals seem more effective than passive referrals for linking patients to resources. Offering referrals during clinic visits seems more effective than offering them via follow up telephone calls. Resource connection rates in active referral

intervention studies were 50%, 74% and 75%,[14,61,63] compared to 20%, 22%, and 67% in passive referral intervention[52,54,55] studies. One study reported that connections to resources increased from 5 to 75% after clinics switched from providing passive referrals to facilitating direct referrals.[14] When referrals were offered through a phone call (as opposed to during an in person clinic visit), interest in assistance seemed lower (22%[62] and 37%[66]).

Results were mixed about whether food referrals impact benefits enrollment or resource use. A pre-post study of a medical legal partnership offered to patients at a children's hospital and a health center found relatively large increases in WIC and SNAP enrollment from baseline to follow-up (33% to 50% enrollment in WIC; 13% to 30% SNAP enrollment[57]). A cluster RCT of a tailored resource handout intervention found that patients at the intervention clinics were slightly more likely to be enrolled in food benefits (SNAP, WIC) (11% vs. 9%) and twice as likely to have utilized a food pantry (4% vs. 2%[53]) at 12-month follow up. However, a randomized controlled trial of an intervention that provided help from a family resource specialist and a medical legal partnership among families of newborns found no statistically significant differences in awareness or use of food programs (food pantries, SNAP, and WIC) between the intervention or control group.[60] In an pre-post study of an online financial resources tool for diabetic patients, there was no statistically significant change in use of farmers markets/groceries that accept food assistance.[56]

Two studies found that food referrals improved food security. One retrospective study 1-2 months post use of a multi-need online screening and referral tool found that among 13 patients who had identified food insecurity as their highest social need at baseline, 7 (58%) reported that this problem was "completely" or "mostly" resolved.[54] A pre-post uncontrolled study of an active referral patient advocate program found that 26% of those who were food insecure at baseline became food secure; an equivalent number who had not been food insecure at baseline became food insecure at follow up.[58]

There is limited evidence that food referrals affect health behaviors, beliefs, health outcomes, or health care utilization.

A pre-post uncontrolled study found that patient advocate program targeting multiple social needs contributed to reduced patient sugar intake but led to no change in other measures of dietary intake (daily whole grain intake, dairy intake, or fruit/vegetable/legume intake).[58] A small (18 patient) pre-post study without a control group examined the impacts of a program that offered passive food referrals among older Hispanic patients with uncontrolled diabetes. The authors found no change in diabetes management self-efficacy.[55] A different pre-post study (with a statistically matched control group) evaluated a program that provided food insecure pregnant women with information about nearby food pantries and enrollment assistance for SNAP and WIC and nutrition education. The authors found improvements in systolic blood pressure but no differences in diastolic blood pressure or blood sugar control.[64] A pre-post study with a control group that examined the impacts of providing supplemental formula, educational materials, and as needed social work, medical-legal, and food pantry referrals to food insecure or at-risk families of infants <12 months found no impacts on health indicators, including weight-for-length percentile, blood lead

levels, or developmental screening scores. Intervention infants were more likely to have received preventive care services, but intervention families had increased numbers of ED visits over the follow up period.

Food Vouchers & Food Provisions

Nine studies examined the impacts of interventions that provided fruit and vegetable vouchers for use in local farmers' markets and six studies evaluated the impact of food provision. These interventions occurred in a range of health care settings and with different target populations, including families with infants;[68] families of general pediatric patients;[49,69] pregnant patients (one in pregnant women with diabetes,[51] the other in pregnant Hispanic women[70]); and other adult patients[50,71-78] (including diabetic[74,76,78] and cancer patients[77]).

Outcomes included in Food Vouchers and Food Provision studies:

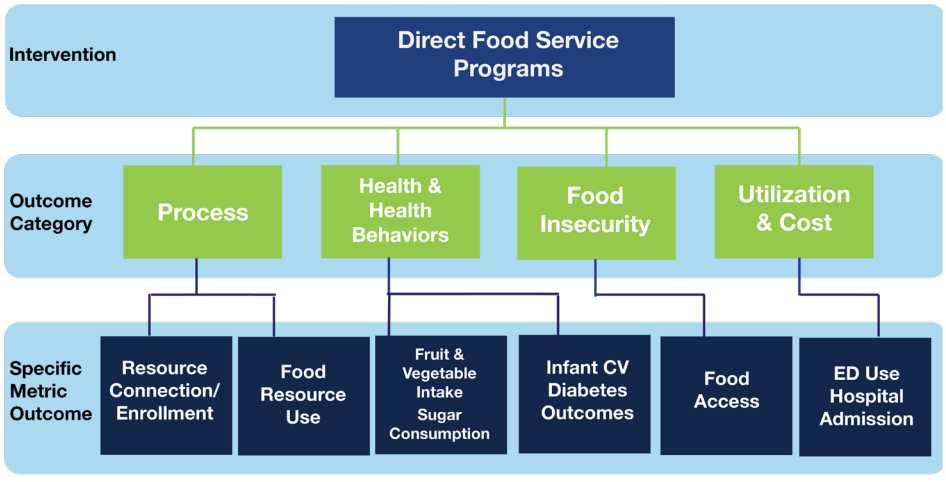
- Process metrics, (e.g. intervention uptake);[50,73,77]
- Food security status;[49,69,74]
- Fruit and vegetable consumption;[70,72,74,75,78]
- Health outcomes;[51,68,74,76]
- Health care utilization;[68,71]
- Health care costs.[71]

Three of the food and/or food voucher studies met GRADE moderate study quality criteria;[71,74,76] the remainder were rated low or very low quality, again based on study design and sample size limitations.

Food Vouchers

Three studies examined how food vouchers influenced use of farmers' markets and all three found increased market use.[49,73,75] One study found that use of government assistance to purchase food at farmers' markets increased from 10% to 25% after implementation of an incentive program.[73] In a separate study of a voucher program, 88% of participants (adult

Figure 3. Outcomes used in studies on food vouchers and food provisions (n=14)



hypertensive patients) reported an increase in their use of farmers' markets, and 86% of participants redeemed at least 1 voucher.[75] In a different study, authors interviewed 32 caregivers of pediatric patients about their experiences with a new produce voucher or bag program.[49] Caregivers reported appreciating the food vouchers and saying that the vouchers improved access to and increased consumption of fruits and vegetables. Caregivers also expressed preference for the vouchers over the pre-prepared food bags due to the ability to self-select the produce.

A pre-post study of a program that provided nutrition education, health education, dietary recommendations, and prescriptions for fruits/vegetable that could be used at participating farmers' markets to families with an overweight/obese child found that high or marginal food security increased from 58% to 76% over the study period, with reciprocal drops in low and very low food security.[69] In a qualitative study of a program offering produce vouchers or produce bags, caregivers shared that the access to free produce was particularly helpful when food was running out, suggesting that the program helped reduce food insecurity.[49]

Among the five intervention studies that examined healthy eating; three found improvements in fruit and vegetable consumption;[49,72,75] one found improvements in fruit but not vegetable intake;[70] and one found slight but not statistically significant increase in fruit and vegetable consumption.[78]

No food voucher studies examined the impacts of vouchers on health care utilization or costs.

There were mixed results in different studies on the impacts of health care-based food voucher programs on health.Three studies examined health impacts. One found a small decrease in body mass index in the intervention group compared to a matched control group.[76] The two other studies showed mixed results. A study of patients with uncontrolled Type 2 diabetes observed a drop-in hemoglobin A1c but no statistically significant changes in weight or blood pressure. The second study that included health impacts examined the impacts of a pre/perinatal nutrition intervention in pregnant women.[70] Although women in the intervention group reported some dietary improvements, there were no impacts on excessive maternal weight gain or infant weight-related goals. No food voucher studies examined the impacts of vouchers on health care utilization or costs.

Food Provision

Two moderate quality studies by Berkowitz et al examined the impacts of home delivered meals. A 2018 study used a matched control design to compare utilization and cost impacts of medically tailored and non-medically tailored home delivered meals among Medicare/Medicaid dual eligible adults. This study found that compared to no meals, both types of meals programs reduced emergency department utilization, emergency transportation use, and health care costs; only medically tailored meals reduced inpatient utilization. A 2019 randomized cross-over trial compared 12 weeks of medically tailored home delivered food to usual care and healthy eating information among adult patients with poorly controlled diabetes and food insecurity. The study found improvements in food insecurity, healthy dietary intake, hypoglycemic events, and days where mental health interfered with quality of life, but found no improvements

Table 1. Summary of review results: Food insecurity interventions

Outcome	Impact		
	Referrals	Vouchers	Food*
Resource use	Mixed (4)	Improved (3)	-
Food security status	Improved^ (2)	Improved (2)	Improved (1)
Health behaviors	Mixed (2)	Improved# (5)	Improved (1)
Health	Mixed (1)	Mixed (3)	Mixed (2)
Cost/utilization	Mixed (1)	-	Mixed (1)

Numbers in parentheses indicate the number of studies that reported on each outcome.
* Based on two studies of home-delivered meals, and one study of an intervention offering infant formula, nutrition educational materials, and referrals to social work, a medical-legal partnership, and food banks
^ Based on a study with a sample size 13 and a qualitative retrospective study so should be interpreted with caution.
# All five studies found improvements, although in one case only for fruit consumption and in another the improvements were not statistically significant.

in other measures of health-related quality of life, cost-related medication under-use, food-medication tradeoffs, self-reported health status, diabetes distress, or PHQ-8 scores.[74] The study also explored impacts of the intervention on biometric measures such as hemoglobin A1c, blood pressure, cholesterol, and BMI and found no significant differences. Together these two studies suggest that home delivered meals can improve some measures of dietary intake, health, health care utilization, and costs.[i]

One pre-post study with a control group examined the impacts of providing supplemental formula, educational materials, and as needed social work, medical-legal, and food pantry referrals to food insecure or at-risk families of infants <12 months.[68] After at least 14 months of follow up, intervention infants were more likely than those not receiving the intervention to have received preventive care services. However, infants in the intervention group did no better on health indicators, including weight-for-length percentile, blood lead levels, or developmental scores. Intervention families also had more frequent ED visits and were more likely to report parental depression and issues related to housing, public benefits, and domestic violence.

Two additional studies described programs that provided access to on-site food pantries (Gany et al.)[77] or referrals to food resources and monthly onsite diabetes-appropriate food (Smith et al.).[50] These studies did not report on any program impacts.

Summary and discussion

In our systematic review of the peer-reviewed literature published between 2000 and 2018, we found 22 articles that examined impacts of health care-based

programs that address food insecurity. We found an additional 7 studies that were purely descriptive. We identified three types of interventions: (1) food referral programs that aim to connect patients with external resources such as food banks and benefit enrollment services; (2) fruit and vegetable voucher programs, which provide vouchers or incentives for purchasing fruit and vegetables at farmers' markets; and (3) food provision programs, which distribute food, such as infant formula, produce bags, or deliver meals to patients' homes.

Evidence of benefits was strongest for home-delivered meals, which in two well-designed trials were shown to improve food security, healthy eating, and some measures of health and health care utilization. Several less rigorously designed studies found food voucher programs increase access to fruits and vegetables and reduce food insecurity, although results were mixed for health outcomes, and cost/utilization outcomes were not evaluated. Several studies also found that referral programs can reduce food insecurity and improve diet and health outcomes, but again, results were mixed. Active referral programs appear more impactful than passive referral programs for connecting patients to external resources. Knowledge about the impacts of food insecurity interventions is limited both by the low study design quality and the lack of studies examining food insecurity, health and health care impacts. Only 15 of the 22 studies reported food security, health behavior, health, or utilization outcomes. The remainder only reported food resource use data. Of the studies that included patient impacts, only four were of moderate quality.[58,64,64,76] Future research should include random assignment or other designs that statistically adjust intervention and control groups to strengthen the quality of evidence in this field.

An additional barrier to synthesizing the literature in this area is the variability in outcome measures used across studies, particularly those used to describe resource uptake, health behaviors, and health impacts.

Consensus on key measures will increase the capacity to compare the effectiveness of different interventions.

Readers should note several important additional limitations. First, included interventions were often multi-faceted, addressing multiple social risk factors or combining multiple types of interventions. This makes understanding the unique contribution of different intervention components more challenging. As seen in the literature on health care-based transportation interventions,[79, 80] it is possible that multi-domain interventions may be more successful because food insecurity does not exist in isolation from other social and financial barriers to health. Second, to the extent that they free up financial resources that may allow patients to address food-related needs, interventions to address other social risk factors may have positive impacts on food insecurity (and health and utilization). By confining this review to interventions that explicitly report on food insecurity intervention components or outcomes, we may have unintentionally missed relevant programs. Third, in this review we included studies of interventions offered in clinical settings or facilitated by health care teams. Other studies of home-delivered meals that were not based in health care settings have also documented health benefits.[4,37] Finally, all research conducted on food security-related interventions may not be reflected in the peer-reviewed literature since some health systems and payers conduct evaluations that are not published. The literature around food insecurity screening

and interventions is rapidly evolving;[81,82] it will be important to repeat this review to update findings as new evidence emerges.

In summary, there is newly emerging evidence on interventions targeting patient food insecurity in health care settings that suggests that food referrals, fruit and vegetable vouchers, and home delivered meals may improve food insecurity, health, and health care utilization. There is not yet sufficient evidence on the types of interventions or key design elements that maximally influence food intake, health, and health care utilization and cost.

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Appendix Table 1. Peer-reviewed articles related to interventions to address food insecurity in the healthcare setting, either alone or in combination with other social needs, by intervention type

	Article/ Intervention	Setting	Population	Intervention Type	Resource connection or use	Food Insecurity	Health Behaviors	Health	Cost Utilization	Impact Summary	Study Quality	Study Design
Berkowitz et al. (2018) Health Aff	**Home meal delivery.** Adult patients with dual Medicaid/ Medicare were recruited for home delivery of medically tailored meals or nontailored food.	Not for profit community-based plan for dual eligibles in MA	Adults (dually eligible)	Food: Home delivered meals					Positive impact	**Positive:** Reduced ED utilization, emergency transportation use, and health care costs; reduced inpatient utilization in 1 of 2 intervention groups +L4	Moderate	Matched Cohort
Berkowitz et al. (2019) J Gen Intern Med.	**Home meal delivery.** Adult patients with poorly controlled diabetes (hemoglobin A1c > 8.0%) and food insecurity were assigned to 12 weeks of medically tailored home delivered food (10 meals/ week) or 12 weeks of usual care and healthy eating information. Food provided by CBO.	Primary care	Adults	Food: Home delivered meals		Postive impact	Positive impact	Mixed impact		**Positive/ null:** Improvements in dietary intake, food insecurity, hypglycemic events and mental health; no imporovements in other health indicators (self-reported health status, other measures of health-related quality of life, diabetes distress, cost-related medication underuse, food-medication tradeoffs, and PHQ8 scores (depression)	Moderate	Randomized crossover trial
Beck et al. (2014) Pediatrics.	**Keeping Infants Nourished and Developing (KIND).** Direct provision of supplemental formula and educational materials for families and infants <12 months of age that screened positive for food insecurity, indicated they stretched formula, or when infants were diagnosed with failure-to-thrive. As-needed referrals were provided (e.g. to social workers, medical-legal partnerships, or food pantries).	Urban academic clinic	Infants	Food: Infant -formula plus passive referrals to food banks, MLPs, and social workers				No impact	Mixed impact	**Positive/null:** Increase in preventive care services/ access but no change in infant health outcomes (weight-for-length percentile, lead level, or ASQ failure).	Low	Pre/post-intervention; non randomized intervention and control groups, control group was those not enrolled in program

	Article/ Intervention	Setting	Population	Intervention Type	Resource connection or use	Food Insecurity	Health Behaviors	Health	Cost Utilization	Impact Summary	Study Quality	Study Design
Gany et al. (2015) J Community Health	**Immigrant Heath and Cancer Disparities (IHCD) Service's Cancer Portal Project.** Cancer patients were offered enrollment in the Portal Project, a program to facilitate access and use of health, social and financial services. IHCD opened 5 hospital-based food pantries for low-income urban cancer patients, which worked to accommodate patient schedules. Participants in the food bank could receive weekly bags of healthy food.	Hospitals	Cancer patients	Food distribution	Descriptive[1]					**Null:** Very low use and repeat use	Very low	Nested Cohort, observational
Smith et al. (2017) Prev Med Rep.	**Student-Run Free Clinic Program.** Patients were screened for food insecurity, provided with information regarding local food pantries based on their home address, and asked about eligibility for SNAP. A pilot program was implemented to support patients with same-day SNAP enrollment and another program provided onsite food distributions for diabetic patients in collaboration with a community-based food bank. Students and faculty received training in screening for food insecurity, adding food secure status to the Problem List and medical notes, and the Assessment and Plan; reminders to screen for food insecurity were included during daily clinic announcements. A patient registry was created to allow study volunteers to follow-up on patients at each subsequent visit, identify barriers to using food pantries or receiving SNAP benefits.	Free clinic	Adults	Food and SNAP enrollment assistance	Descriptive					**Null:** Only described findings, but there was distribution of boxes	Very low	Cross-sectional
Ridberg et al. (2019) J Nutr Educ Behav.	**Wholesome Wave FVRx program:** Fruit/vegetable prescription program for families at federally qualified health centers with an overweight/obese child (age 2-18 years). Participants received nutrition education, health education, dietary recommendations, and prescriptions for fruits/vegetable that could be used at participating farmer's markets.	FQHC	Children	Vouchers and education		Postive impact				**Positive:** Improvement in food security status	Low	Pre-/post-intervention, no control group

	Article/ Intervention	Setting	Population	Intervention Type	Resource connection or use	Food Insecurity	Health Behaviors	Health	Cost Utilization	Impact Summary	Study Quality	Study Design
Freedman et al. (2014) Prev Chronic Dis.	**Shop N Save (SNS) financial incentives for fruit & vegetable intake.** Financial incentive program to increase use of an FQHC-based farmer's market. Participants were provided with $5/week incentive to shop at the farmer's market, after spending an initial $5 at the farmer's market through a food assistance program (e.g. WIC, SNAP).	FQHC	Adults	Vouchers	Positive impact					**Positive:** Increase in use of food resources	Low	Pre-/ post-intervention, no control group
Freedman et al. (2013) Prev Med.	**Federally qualified health center (FQHC)-based farmer's market with financial incentive.** A 22-week intervention to increase fruit & vegetable consumption in low-income diabetic patients.	FQHC	Diabetic adults	Vouchers			No impact			**Null:** No significant change in fruit and vegetable consumption	Very low	Pre-/ post-intervention, no control group; pilot
Saxe-Custak et al. (2018) Public Health Nutr.	**Fruit and vegetable prescription program.** Caregivers of pediatric patients were interviewed about their experience after a clinic moved into the same building as a farmer's market and the clinic began distributing food and/or food vouchers for the farmers market. $10 fruit/veggie prescription redeemable at co-located farmer's market 2 days a week, other days get choice of voucher or bag of fruit/veggies	FQHC	Children	Vouchers or food (mostly vouchers		Positive impact	Positive impact (qualitative)			**Positive:** Icrease access to, consumption of fruits and vegetables. Program acceptable to caregivers	Very Low	Qualitiative
Cohen et al (2017) Am J Prev Med	**A Waiting Room Intervention to Increase Use of Double Up Food Bucks.** Double Up Food Bucks (DUFB) is a program to match SNAP funds spent at farmer's markets and grocery stores to incentivize healthy food consumption. This intervention aimed to increase awareness of DUFB among SNAP-enrolled families by approaching patients in the waiting room of a academic outpatient practice and providing them with copies of DUFB promotional materials, a map of participating farmer's markets, and a one-time voucher for their first farmer's market visit.	Academic outpatient practice	Adults	Vouchers			Postive impact			**Positive:** Increase in fruit and vegetable consumption	Low	Longitudinal, repeated measures

	Article/ Intervention	Setting	Population	Intervention Type	Resource connection or use	Food Insecurity	Health Behaviors	Health	Cost Utilization	Impact Summary	Study Quality	Study Design
Trapl et al. (2018) Prev Chronic Dis.	**Produce Prescription for Hypertension (PRxHTN) program**. Adult patients with hypertension (HTN) and food insecurity were recruited to a month long program that included blood pressure measurements over 3 visits, farmers' market vouchers, and information on food resources and nutrition recommendations.	FQHC	Adults with hypertension (HTN) and food insecurity	Vouchers + Education	Positive impact		Positive impact			**Positive:** Increase in reported health eating and use of farmers' markets	Low	Pre-/ post-intervention, no control group
Watt et al. (2015) J Racial and Ethnic Health Disparities.	**A Primary Care-Based Prenatal Nutrition Intervention.** Pregnant women were recruited during first trimester prenatal visits in a primary care setting serving primarily low-income, Spanish-speaking women. Participants enrolled in group classes that ran until their infant's 6-month well check. Classes included general nutritional information and cooking classes, and participants received vouchers for fruits and vegetables at the local farmer's market.	Primary care	Pregnant women	Vouchers + Education			Mixed impact	Mixed impact		**Mixed:** Decrease in positive depression screens, and self-reported stress, increase in breast feeding and infants passing developmental screen, improved self-reported exercise/some aspects of diet. But no change in excessive maternal weight gain, other aspects of diet, perceived social support, or achievement of infant weight goals. Actually has a negative finding for vegetable consumption.	Very low	Pre-/ post-intervention; non-randomized intervention and control groups
Bryce et al. (2017) Prev Med Rep.	**Fresh Prescription program.** 13-week program to improve access/intake of fruits & vegetables in low-income patients with uncontrolled Type 2 Diabetes (HbA1c >6.5 in past 3 months) at a FQHC. Participants received up to $40 ($10/week x4 weeks over course of 13 weeks) plus an additional $5 if they filled out a health goals sheet (85% did this) to use at a FQHC-based farmer's market, in addition to visits with community health workers for goal setting. Farmer's market included cooking demonstrations.	FQHC	Adults with uncontrolled type 2 diabetes	Vouchers + CHW				Mixed impact		**Mixed:** Decrease in HbA1c; no change in weight or blood pressure	Very Low	Pre-/ post-intervention, no control group; pilot

	Article/ Intervention	Setting	Population	Intervention Type	Resource connection or use	Food Insecurity	Health Behaviors	Health	Cost Utilization	Impact Summary	Study Quality	Study Design
Cavanagh et al. (2017) Public Health Nutrition	**Veggie Rx.** Adult patients with obesity, hypertension and/or type 2 diabetes were recruited from their FQHC by a nutritionist to participate in a food voucher ($7 prescription coupon) program. Vouchers could be redeemed at a weekly mobile produce market. The mobile market stopped at the study FQHC once a week, among other neighborhood locations.	FQHCs	Adults with obesity, hypertension and/or type 2 diabetes	Vouchers				Positive impact		**Positive:** Decrease in BMI	Moderate	Retrospective matched cohort; Pre-/post-intervention
Stenmark et al. (2018) Perm J.	**Kaiser Permanente Colorado's clinical food insecurity screening and referral program.** Parents were screened for food insecurity. Clinicians were given educational handouts about food insecurity, resources and referrals. Clinicians and health care staff were given training on how to discuss food insecurity with patients and offer referrals. Early in the intervention, parents reporting food insecurity were referred to the Hunger Free Colorado (HFC) Food Resource Hotline; later in intervention, the clinics could directly refer parents to HFC. HFC could then assist parents with enrollment in food resources.	Clinics	Children	Referral, active to hunger relief organization, passive at first, then active, also navigation	Positive impact					**Positive:** Active referral increased connection with resource.	Very low	Pre-/post-intervention, no control group; pilot
Weintraub et al. (2010) J. Health Care Poor and Underserved	**Peninsula Family Advocacy Program (FAP).** A Medical-Legal Partnership providing free legal services and social services to patient families; legal services addressed a wide range of needs, including denials of or discontinued public benefits, including Food Stamps.	Hospital and FQHC	Children	Referral, active, to MLP	Positive impact					**Positive:** Increase in WIC & SNAP enrollment	Very Low	Pre-/post-intervention, no control group; pilot
Sege et al. (2015) Pediatrics	**Medical-legal strategies to improve infant health care.** Recruited families with newborns, who were all screened for social risks using the Safe Environment for Every Kid (SEEK) questionnaire. Families were randomized to intervention or control. Intervention group was paired with a trained family specialist who provided support (including home visits) and direct assistance accessing resources, also involved access to MLP. Control group received standard as needed referrals to social work.	Primary care	Newborns	Referral, active, navigation, MLP	No impact					**Null:** No significant change in interest in or use of food resources	Moderate	Randomized Control Trial (RCT)

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Berkowitz et al. (2018) Popul Health Manag.	**Primacy Care Linkage Intervention.** A program in 3 primary care clinics in Massachusetts with linkage programs to assist patients with heath-related social needs. Patients were screened for social risk before visits, and clinicians would review screening results and refer to patient advocate as needed. Patient advocate would work with patient to actively assist with referral to available resources.	Primary care	Adults	Referral, active, navigation		No impact	Mixed impact			**Mixed:** Null results for change in food insecurity, though may have helped some become food secure. There were improvement in sugar intake, but no improvement in other dietary measures.	Low	Pre-post no control for FI but with control for dietary quality.
Morales et al. (2016) Preventing Chronic Disease.	**Food For Families.** Pregnant women were screened for food insecurity at visit check-in. Those who screened positive or were identified by providers as food insecure were connected to food resources, including SNAP, WIC, and food pantries.	Primary care	Pregnant women	Referral, active, assistance with benefit enrollment, information about food pantries				Mixed impact		**Positive:** Improved systolic blood pressure; no difference diastolic blood pressure or blood glucose trends in pregnancy.	Moderate	Quasi-experimental design, using propensity score matching methods to "balance" the characteristics of participating and non-participating women.
Martel et al. (2016) West J Emerg Med.	**Emergency Department Electronic Medical Record Referrals to Food Resources.** Evaluation of a newly integrated electronic medical record (EMR) order for food resources after education on and implementation of the EMR referral system. Evaluated change in referrals to partnered community food bank, Second Harvest.	ER	Adults	Referral active via EMR triggering call from food bank	Descriptive					92% of contacted and referred households were connected with a new resource.	Very low	Descriptive, no control
Swavely et al. (2019) Pop Health Manag.	**Temple Food Insecurity Program.** Adult patients from an academic hospital inpatient service were called within 48-72 hours of discharge by a community health worker (CHW) who screened them for food insecurity and referred them to community resources.	Academic inpatient	Adults	Referral, active (direct transfer to benefits assistance and 211)	Descriptive					22% of patients referred connected with a resource	Very low	Descriptive, no control

	Article/ Intervention	Setting	Population	Intervention Type	Resource connection or use	Food Insecurity	Health Behaviors	Health	Cost Utilization	Impact Summary	Study Quality	Study Design
Fox et al. (2016) J Pediatr Health Care.	**Pilot pediatric weight management program.** A pilot program to increase SNAP enrollment among families in a pediatric weight management clinic in partnership with a food bank (Second Harvest Heartland). Families who screened positive for food insecurity, had public insurance (a proxy for low-income) and were not already enrolled in SNAP were asked if they wanted to enroll in SNAP. Their information was provided to outreach workers from a community-based program aimed at reducing hunger. Second Harvest outreach workers called referred families to provide assistance.	Primary care	Children	Referral, active, navigation	Descriptive					Low rates of follow-up and enrollment in SNAP through clinic partnership with food bank	Very low	Descriptive, no control
Knowles et al. (2018) J Health Care Poor Underserved.	**Food insecurity screening and referrals from pediatric clinics.** Families of pediatric patients at 3 urban academic pediatric clinics were screened for food insecurity and referred to public benefits and community resources. Phone call outreach, then connection to BDT.	Urban academic clinics	Children	Referral, active,to benefits assistance outreach (BDT)	Descriptive					Only 40% of screened families were eligible and unenrolled. 42% completed applications, 32% of applications known to be approved, 12/19 (63%) people enrolled in SNAP successfully.	Very low	Descriptive, no control
Garg et al. (2007) Pediatrics.	**Well Child Care, Evaluation, Community Resources, Advocacy, Referral, Education (WE CARE).** Caregivers are screened for social needs using a 10-item screening tool, which includes food insecurity, and asked whether they desired assistance with addressing these social needs. Clinicians review the results of the survey and provide caregivers with tear-out sheets from a Family Resource book. Tear-out sheets list 2 to 4 community-based resources for each social need.	Urban hospital-based clinic	Children	Referral, passive (handout)	Descriptive	Positive impact				**Positive:** Increase in referrals, and enrollment and use of food resources	Moderate	RCT

	Article/ Intervention	Setting	Population	Intervention Type	Resource connection or use	Food Insecurity	Health Behaviors	Health	Cost Utilization	Impact Summary	Study Quality	Study Design
Garg et al. (2015) Pediatrics.	**Well Child Care, Evaluation, Community Resources, Advocacy, Referral, Education (WE CARE).** Caregivers are screened for social needs using a 10-item screening tool, which includes food insecurity, and asked whether they desired assistance with addressing these social needs. Clinicians review the results of the survey and provide caregivers with tear-out sheets from a Family Resource book. Tear-out sheets list 2 to 4 community-based resources for each social need.	Urban CHCs	Children	Referral, passive (handout)	Positive impact					**Positive:** Increase in referrals, and enrollment and use of food resources	Moderate	Cluster RCT
Hassan et al. (2015) Am J Prev Med.	**The Online Advocate.** A web-based screening and referral tool designed to identify social needs and refer patients of children 0-6 to community-based health and social service agencies. Social needs were identified across nine domains, including food insecurity. A resource specialist was available to address urgent social needs.	Urban hospital-based clinic	Children	Referral, passive self-administered tool with some assistance, follow up for severe needs (eg. IPV, homelessness or severe FI)	Positive impact	Positive impact				**Positive:** Referral system helped some patients connect with food resources, many of whom found the screening/ referral system helpful. A subset resolved their food insecurity concerns.	Low	Post-intervention survey, no control group
Patel et al. (2017) Health Educ Behav	**Financial burden resource tool.** Recruited diabetic patients from an endocrinology clinic to use a financial burden resource tool developed by authors to provide information on low-cost options for diabetes management and health-related social needs. *Patel et al. (2017) Health Educ Behav.*	Endocrinology clinic	Diabetic patients	Referral, passive tailored resource list using eletronic tool	No impact					**Null:** No significant change in use of food resources	Very low	Pre-/ post-intervention, no control group; pilot

	Article/ Intervention	Setting	Population	Intervention Type	Resource connection or use	Food Insecurity	Health Behaviors	Health	Cost Utilization	Impact Summary	Study Quality	Study Design
Nguyen et al. (2015). J Health Environ Educ.	**Health Connectors program.** Hispanic diabetic patients aged 60+ years at a Federally Qualified Health Center were screened for diabetes self-care activities, self-efficacy and general self-efficacy by trained volunteers, and given referrals to local community resources as needed. Follow-up surveys were administered after 3 months. *Nguyen et al. (2015). J Health Environ Educ.*	FQHC	Hispanic diabetic patients aged 60+	Referral, passive volunteers tailor handouts			No impact			**Null:** no change in self-efficacy	Very low	Pre-/post, no control group; pilot
Eismann et al. (2018) Clinical Pediatrics.	**Safe Environment for Every Kid (SEEK).** Model for screening/addressing psychosocial risk factors for child maltreatment. Includes training of health care professional, parent/caregiver screen questionnaire, parent/caregiver handouts, and mental health and/or social work support. This study wanted to test feasibility of using SEEK in different primary care settings. Each setting was allowed to tailor their own process and received training on using SEEK. Site-specific resources were collected at each site. *Eismann et al. (2018) Clinical Pediatrics.*	Primary care	Children	Referral, passive handout, optional social worker	Descriptive					**Mixed:** High rates of food insecure families accepting resource handouts; low rates of interest in direct referrals.	Very low	Mixed-method; Pre-/post-intervention, no control group; pilot

[1] *Descriptive studies included process measures, e.g. numbers of patients referred to a resource. These studies did not otherwise evaluate the impact of the food insecurity intervention.*

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