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Social Needs Resource Connections: A Systematic Review of Barriers, Facilitators, and Evaluation

Katherine DuBose Broadwell
Oregon Health & Science University

Dawn Michele Richardson
OHSU-PSU School of Public Health, dawn.richardson@pdx.edu

Christina M. Nicolaidis
Portland State University, christina.nicolaidis@pdx.edu

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Social needs resource connections: A systematic review of barriers, facilitators and evaluation

Author names and affiliations:
Anna Louise Steeves-Reece, MPH, MA[1-2], Annette Marie Totten, PhD, MPA, MA[1-4], Katherine DuBose Broadwell, BA[2], Dawn Michele Richardson, DrPH, MPH[1], Christina Nicolaidis, MD, MPH[5-6], Melinda Marie Davis, PhD, MCR[1,2,7]

1. Oregon Health & Science University-Portland State University School of Public Health, Portland, Oregon
2. Oregon Rural Practice-based Research Network, School of Medicine, Oregon Health & Science University, Portland OR
3. Pacific Northwest Evidence-based Practice Center, Oregon Health & Science University, Portland, OR
4. Department of Medical Informatics & Clinical Epidemiology, School of Medicine, Oregon Health & Science University, Portland, OR
5. School of Social Work, Portland State University, Portland, OR
6. Division of General Internal Medicine and Geriatrics, School of Medicine, Oregon Health & Science University, Portland, OR
7. Department of Family Medicine, School of Medicine, Oregon Health & Science University, Portland, OR

Corresponding author information:
Anna Louise Steeves-Reece[1-2]
Mail Code: VPT
3181 SW Sam Jackson Park Road
Portland, OR 97239
(541) 206-4824
steevesr@ohsu.edu

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Abstract:

Introduction. Healthcare organizations are increasingly screening patients for social needs (e.g., food, housing) and referring them to community resources. We conducted a systematic mixed studies review to a) assess how studies evaluate social needs resource connections and b) identify patient and caregiver-reported factors that may inhibit or facilitate resource connections.

Methods. We searched PubMed and CINAHL for articles published from October 2015 to December 2020 and used dual review to determine inclusion based on our a priori selection criteria. We abstracted data related to study design, setting, population of interest, intervention, and outcomes. Articles' quality was assessed using the Mixed Methods Appraisal Tool (MMAT). Data analysis was conducted in 2021.

Results. We identified 34 articles from 32 studies. We created a taxonomy of quantitative resource connection measures with 4 categories: whether participants made contact with resources; received resources; had their social needs addressed; and/or rated some aspect of their experience with resources. Barriers to resource connections were inadequacy, irrelevancy, or restrictiveness; inaccessibility; fears surrounding stigma or discrimination; and factors related to staff training and resource information sharing. Facilitators were referrals' relevancy; the degree of support and simplicity embedded within the interventions; and interventions being comprehensive and inclusive.

Discussion. Our synthesis of barriers and facilitators indicates areas where healthcare organizations may have agency to improve the efficacy of social needs screening and referral interventions. We also recommend that resource connection measures be explicitly defined and focus on whether participants received new resources and/or whether their social needs were addressed.

INTRODUCTION

Numerous health disciplines, including public health and primary care, have long recognized the interconnections between social justice, social conditions, and health outcomes.[1-3] Recently, the healthcare sector revitalized "an explosion of interest"[4] in both identifying patients' social risks (e.g. housing instability and food insecurity) and addressing patients' social needs (the social risks they wish to have addressed).[5] In the United States, this renewed focus on healthcare-based social interventions corresponds with an ongoing shift towards value-based care, reflecting the intentions of multiple policies and incentives, especially the Affordable Care Act, to foster better care, better health, and lower costs.[6-9] The COVID-19 pandemic further accelerated these efforts by highlighting and exacerbating longstanding social injustices that cause health disparities.[10-13]

Healthcare-based social interventions encompass a wide range of contexts and approaches and may potentially improve patients' health through a variety of mechanisms, including by connecting patients with resources to decrease their unmet social needs.[14,15] In the U.S., prominent organizations—especially the American Academy of Pediatrics (AAP) and the American Academy of Family Physicians (AAFP)[16]—and initiatives have been influential in promoting screening and referral strategies to facilitate access to resources. For example, since 2015 the AAP has recommended pediatricians implement routine screening and referral interventions for food insecurity.[16,17] Likewise, the Centers for Medicare & Medicaid Services (CMS) is currently testing whether systematically identifying social risks and addressing social needs among Medicare and Medicaid beneficiaries can reduce healthcare costs and utilization through their Accountable Health Communities (AHC) model.[18]

A key component of healthcare-based social interventions is facilitating resource connections for patients, yet the idea of what a "resource connection" entails is neither straightforward nor universally understood by healthcare organizations. For example, it may refer to a patient speaking with a staff member at a food bank, enrolling in a program to receive food boxes, or acquiring sufficient food through having received food boxes. Definitions matter because they inform how organizations design interventions and evaluate their impact. As health systems increasingly respond to patients' social needs, clarifying the range of "resource connection" definitions currently in use (as well as their potential advantages and drawbacks) is critical. Additionally—regardless of the definition(s) an organization selects—it is vital to understand what factors patients say do or do not allow them to connect with needed resources.

Therefore, the authors conducted a systematic mixed studies review (SMSR)[19,20] of social needs screening and referral interventions to a) assess the ways in which healthcare organizations define—and subsequently measure—resource connections; and b) identify patient-reported factors that may inhibit or facilitate all types of resource connections. A SMSR follows the same guidelines as a traditional systematic review, but places greater emphasis on synthesizing results across diverse study designs. This type of review may be particularly helpful when synthesizing "complex and highly context-sensitive interventions."[19] A SMSR was salient for this project, as the authors knew a priori that articles would include diverse contexts, study designs, populations of interest, and interventions.[21]

METHODS

Data Sources and Search Strategy

The review followed PRISMA guidelines and is registered in PROSPERO (CRD42021232123). Working with a health sciences librarian, the authors developed search strategies for MEDLINE and CINAHL databases. They identified a combination of subject terms and keywords for each of 3 concepts: screening, social needs, and referral. These concepts were combined using "AND" to ensure inclusion of all three concepts. The search was restricted to English-language studies published from October 2015 (when the AAP began recommending pediatricians screen for food insecurity)[22] through December 23, 2020. The full search strategy for MEDLINE is available as Supplemental Material 1. The authors identified additional articles through the SIREN (Social Interventions Research & Evaluation Network) Evidence & Resource Library.[23]

Study Selection and Eligibility Criteria

Articles were imported into EndNote X9 software and duplicates were removed. Two authors (ASR and KB) independently reviewed titles and abstracts for inclusion or exclusion based on the protocol. The same authors read the full texts of the remaining articles, again using the protocol to make inclusion and exclusion decisions. At both stages, the authors compared their choices and resolved any points of confusion or disagreement. Included articles assessed U.S. healthcare-based social needs screening and referral interventions. Interventions screened patients or caregivers for at least 1 of 5 domains from the AHC Health-Related Social Needs Screening Tool: housing, food, transportation, utilities, and safety.[24] Most social needs screening tools include these domains.[25] "Referral" meant any attempt to link participants with needed resources, such as by providing a resource sheet or facilitating a handoff to a community-based organization (CBO). Referrals did not need to depend on screening results. Finally, articles had to report quantitative or qualitative outcomes on participants' ability to access resources and/or

have their social needs addressed. Qualitative outcomes needed to come from patients or caregivers who had participated in an intervention. As the review emphasized material resource connections, studies focusing exclusively on interpersonal safety were excluded.

Data Abstraction, Analysis, and Quality Appraisal

The authors abstracted information on study design, setting, population, intervention, and outcomes into a spreadsheet. The raw data is available from the lead author upon request. The analytic process was inductive, iterative, and applied a parallel-results convergent synthesis design, an optional synthesis approach for SMSRs.[20] First, one author (ASR) reviewed abstracted data for the outcomes of interest at the level of individual studies (i.e., resource connection measures, barriers and facilitators) using codes generated directly from the text. In a second pass, ASR identified emerging themes across studies.[26] Initial codes and themes were shared with the senior author (MD), practitioners of healthcare-based social interventions, and an expert in the field for further validation. Next, three authors (ASR, MD, and KB) used negative case analysis[27]—a process in which a theory is proposed and then tested and refined based on the data—to categorize resource connection measures into a taxonomy. Regarding barriers and facilitators to resource connections, the same three authors collaborated to summarize the breadth and prevalence of themes initially developed by ASR.

Authors used the Mixed Methods Appraisal Tool (MMAT) to assess articles' quality.[28] The MMAT assesses 5 types of designs: quantitative descriptive, non-randomized, randomized controlled trials (RCTs), qualitative, and mixed methods. Reviewers identify the study type and then assess 5 corresponding methodological criteria, rating each as 'yes', 'no', or 'can't tell'. The

MMAT recommends against quality scores, as this can obscure patterns in the types of weaknesses or strengths that exist.[28] One author (ASR) completed quality appraisals for all included studies. A second individual (either AT or a research assistant) independently completed second quality appraisals for a subset of the articles. The 2 quality appraisers for each article met to compare their work and draw conclusions through dialogue and consensus.

RESULTS

Two authors (ASR and KB) reviewed 1,826 unique abstracts, of which 118 articles underwent full-text review. Eighty-four articles were excluded due to interventions or outcomes being out of scope. Thirty-four articles met inclusion criteria (see Figure 1) that report results from 32 studies.

Mixed Methods Appraisal Tool (MMAT) Results

Included articles encompassed diverse study designs, including descriptive (n=14),[29-42] qualitative (n=9),[43-51] articles with descriptive and qualitative components (n=2),[52,53] explicitly mixed methods (n=4),[54-57] RCTs (n=4),[58-61] and a non-randomized approach (n=1),[62] see Supplemental Material 2 for each article's full MMAT assessment. The majority of articles adhered with all or most of their respective quality criteria on the MMAT, though descriptive studies appeared particularly prone to selection biases.

Study Participants and Settings

As summarized in Supplemental Material 3, 16 studies focused on caregivers of pediatric patients[29,31,33,34,38,39,42,43,47,48,51-53,56,58-61]; 12 focused on adults[30,37,40,44-46,49,50,54,55,57,62]; 3 appeared to include participants of all ages[35,36,41]; and 1 focused on adolescents.[32] Some articles further

incorporated participants with certain characteristics, including veterans,[30,44,55] adults with diabetes,[40,46] and children with certain chronic diseases.[34,42] Common exclusion criteria were language (e.g., non-English or Spanish speakers) and health status (e.g., severe illness).

The studies represented many healthcare settings (see Supplemental Material 3), including community health centers, federally qualified health centers, specialty clinics, emergency departments, and others. Twenty-three studies (72%) came from 5 states (California, Massachusetts, Pennsylvania, Minnesota, and New York) and most studies (n=20, 63%) were conducted in urban environments.

Screening and Resource Connection Strategies

Screening tools

As shown in Table 1, 12 studies (38%) concentrated on food insecurity, using either the Hunger Vital Sign™ or U.S. Household Food Security Survey Module screening tools.[29,31,36,37,41-43,46-48,52,54,56] Three studies (9%) focused on housing instability, using the Homelessness Screening Clinical Reminder (HSCR).[30,44,55] The remaining 17 studies (53%) identified multiple social needs using 8 screening tools; the most common being modifications of a tool developed by Health Leads (n=7 studies).[33,35,39,45,50,57,62] All tools with multiple social needs included food and housing and several included childcare, transportation, employment, finances, and utilities.

Screening processes

In 14 studies (44%), participants appeared to complete the screening for themselves, either through paper, tablet, or a web-based platform (see Table 1).[29,31,32,34,37-39,42,45,47,51,53,57,59] In many

cases, healthcare staff were available to support completion when challenges arose (e.g., comprehension, literacy, vision). The screening was administered verbally for 12 studies (38%), either in person or by phone.[30,36,40,41,44,46,48,54-56,58,60-62] In 5 studies (16%), the screenings were both self- and staff-administered.[33,35,43,50,52]

Resource connection strategies

The authors identified 4 types of referral/resource connection strategies (see Table 1). Approximately 30% of studies applied more than one type of strategy. These strategies included one-to-one navigation support; the provision of written materials or resource sheets; a community partner facilitating the resource connections; and other community collaboration or on-site resources. The authors defined one-to-one navigation support as personalized assistance to understand and connect with relevant resources; varied types of healthcare staff or trained volunteers provided this help. Sixteen studies (50%) used one-to-one navigation support, most of which screened for multiple social needs.[32,33,35,37-40,45,46,50,51,54,57,58,60-62] Ten studies (31%) provided written materials or resources sheets.[29,32,34,40,43,46,47,53,58,59] Eight studies (25%), all of which focused on food insecurity, worked with a community partner who was responsible for facilitating the resource connections.[31,36,41-43,48,52,54,56] Finally, 7 studies (22%) described additional types of community partnerships and/or offered on-site resources.[37-39,46,47,51,54]

Resource Connection Outcome Measures

Twenty-five studies included diverse quantitative outcome measures related to participants' (i.e., patients or caregivers) social needs resource reconnections. The authors created a taxonomy of these measures, classifying them into 4 categories (see Table 2).

Whether participants made contact with services, organizations, or other resources

Most studies with quantitative outcomes discussed resource connections as participants having made contact with services or organizations (n=22, 88%).[29-42,46,52-56,59,62] This was stated explicitly in most cases. For example, the number of participants who were "successfully contacted by [the community partner]"[41]; or reported that more intervention than control group participants "had contacted a community resource."[59] At other times, resource connections were indicated despite ambiguous language used by the study authors. For example, the percentage of participants who "received services"[55] or "successfully utilized program-provided resources."[38]

Whether participants enrolled in or received new services

Fewer studies (n=13, 52%) provided evidence for whether participants enrolled in or received new services.[31,33,35-37,39-42,46,52,56,59] This mostly occurred in the food-related studies, which often reported on whether or not participants enrolled in SNAP. Other studies provided specific details around what types of resources participants appeared to access through the intervention. Garg et al. reported a higher proportion of participants in the intervention group enrolled in a job training program, enrolled children in childcare, and were receiving fuel assistance.[59]

Whether social needs were successfully addressed

Six studies (24%) included outcomes on whether participants' social needs resolved, which may or may not have been attributed to the intervention.[32,33,35,57,58,60,61] Hassan et al. provided information regarding the percentage who "reported resolution of their top-priority problem."[32] Berkowitz et al. collected pre- and post-intervention data regarding the types of needs, and

reported whether there were significant decreases in the prevalence of each need.[57] Two randomized controlled trials by Gottlieb et al. examined changes in the number and types of "social needs"[60,61] or "social risk factors."[58] For example, Gottlieb et al. (2016 and 2018) found significant reductions in social needs for intervention versus control groups.[60,61]

Participants' ratings of their experiences with resources

Finally, 2 studies included quantitative outcome measures that seemed to reflect an aspect of participants' experiences with the resources. Bottino et al. asked participants whether they were getting "[none, a little, most, or all] of the help they needed with their referral selection."[29] And Power-Hays et al. reported on the percentage who found organizations to be "helpful."[34]

Participant-Reported Barriers and Facilitators to Resource Connections for Social Needs

Table 3 summarizes participant-reported barriers and facilitators to resource connections across the qualitative components of the studies. Results also include the ways in which additional sources of data from the studies (e.g., quantitative data, clinicians' perspectives) corroborate and expand upon participants' perspectives.

Barriers to resource connections

Inadequate, Irrelevant, or Restrictive Resources. The most frequent participant-reported barrier included the resources being inadequate or irrelevant. Inadequacy related to a lack of resources in the community (e.g., housing)[45,50] and/or the resources offered not being tailored to or adequately addressing participants' social needs.[44-46,48,51,52,54,57] For example, an inability to take advantage of food resources due to not having a place to cook[46] or food resources not being

tailored to medical recommendations.[54] A related barrier was restrictive eligibility criteria.[44,45,48,54] Articles with quantitative outcomes also found participants disclosing food insecurity, but being ineligible for or already enrolled in in SNAP.[31,36,41,42,52]

Inaccessible Resources. Multiple factors related to resource inaccessibility. Broadly, participants discussed challenges of navigating complex systems and applications,[44,45,48,49] including delayed or absent resource follow-up.[51,54] Inaccessibility also included mobility and transportation. Those with certain diseases or disabilities reported difficulty in accessing services[45,57] and resources were sometimes geographically inconvenient.[43,46,47,50] Other barriers were language and/or literacy inaccessibility.[45,50,54,57] Zhu et al. reported that participants described language barriers when filling out social services forms.[50] In a descriptive study, Spanish speakers had significantly lower odds of successfully acquiring resources compared to English speakers in 3 of 4 regions examined.[33] Finally, participants' competing demands inhibited accessibility (e.g., not having childcare).[43,46,47,49,50,54,57]

Stigma, Discrimination, Fear. Studies discussed participants' concerns around stigma or discrimination in relation to both disclosure of social needs, as well as pursuing resource referrals.[43,45,46,52] In particular, 2 studies (1 from participants' and 1 from clinicians' perspectives) pointed out fear due to immigration policies.[46,52] In another study, a participant-reported systems barrier was immigration status and policies.[45] One descriptive study explicitly examined disparities related to immigration status. It found families with a non-U.S. citizen were most likely to be lost to follow-up, but were also most likely to utilize resources if they did engage.[38]

Staff Training, Resource Information Sharing. Some participants noted unsatisfactory experiences with healthcare or social services personnel. One study described mistreatment,[52] but most reported staff not having the necessary knowledge, skills, or time to support with resource connections.[44,45,49] A descriptive study found the type of professional conducting the screening was associated with participants receiving services.[55] Other barriers were resource information sharing and perceived information quality. Information retention, misplacing resource sheets, and/or participants inconsistently being told about resources may have inhibited connections.[43,44,46,47,49,53,54] Additionally, participants reported low-quality information, such as when resources were out of date or hyperlinks were nonfunctional.[45,57]

Facilitators to resource connections

Relevancy. A finding across many studies was participants' desire for referrals relevant to their needs and contexts.[46,48,50,51,53,54,57] This included referrals to resources that existed in the community, that were geographically convenient, for which participants met the eligibility criteria, and that adequately aligned with the needs disclosed. For example, 2 articles indicated the importance of food resources beyond SNAP,[48,54] especially given some participants already receiving SNAP remained food insecure. Two similar RCTs compared the effectiveness of resource sheets (control group) versus navigation (intervention group) in decreasing participants' social needs.[58,60] While the first study only found decreases in the intervention group, the second found decreases in both groups. Authors speculated this might have occurred due to improved resource sheets in the second study, with better updated information, listing contact names at the relevant agencies, and highlighting the resources that most aligned with participants' priorities.[58]

Support, Simplicity. Patients and caregivers shared the importance of receiving help navigating systems and enrolling in services,[44,45,48-50,52,54] including effective communication to establish trust and rapport. Similarly, participants expressed a desire for prompt, simple, and convenient follow-ups.[44,46,51] In 2 of the descriptive articles, more follow-ups were associated with "successful referrals"[39] and "optimally successful resource connections."[35] In 1 of these studies, outreach occurring within 30 days from the start of the intervention was associated with a higher proportion of "successful referrals."[39] Participants also suggested receiving resource information in one form versus another (e.g., electronic versus printout) could ease connections.[43,44]

Comprehensive, Inclusive Approaches. Final facilitating factors addressed the kinds of resources offered and who is helped. A finding by Berkowitz et al. described "nonlinearity" between which resources addressed which needs. For instance, getting help with medication costs could free up monies for food.[57] This may suggest an advantage of offering resources for multiple needs. In 2 studies, participants suggested resources be advertised to everyone versus only those with positive screening results.[43,53] This recommendation is supported by quantitative findings from Bottino et al. that 14.7% of participants selected referrals despite not disclosing food insecurity.[29]

DISCUSSION

While a number of reviews explore various facets of healthcare-based social interventions,[21,63-68] this is the first to focus squarely on resource connections across varied social needs. The review makes 3 notable contributions: a taxonomy of resource connection measures; a synthesis of

patient- and caregiver-reported barriers and facilitators to resource connections; and the application of a SMSR approach that may be useful for both practitioners and researchers.

Taxonomy of Resource Connection Measures

The findings on resource connection measures indicate most of the included studies had outcomes about whether participants contacted services or organizations, and fewer provided details on participants' ability to enroll in or receive new services, success with addressing social needs, or experiences with resource connection processes. Additionally, vague language in some of the studies made process measures difficult to interpret or categorize. As others have pointed out, a key aspect of determining whether healthcare-based social interventions improve participants' health is first establishing whether the interventions perform as intended.[15,21] As screening and referral programs are meant to link participants with resources that will address their needs, the authors argue study designs and measures demonstrating enrollment in new services and whether needs are reduced are likely the most meaningful outcomes. By identifying distinct forms of resource connections, the review's taxonomy may help lay the groundwork for future comparative work, including meta-analyses, on the extent to which screening and referral interventions connect patients with resources.

Synthesis of Participant-Reported Barriers and Facilitators to Resource Connections

The barriers and facilitators synthesis suggests areas where healthcare organizations may have agency to improve the likelihood of success across all components of the resource connection taxonomy: making contact with community-based organizations, enrolling in services, getting needs resolved, and having a good experience with the process at large. Namely—given the

299 complexity of U.S. healthcare and social services systems; the priorities that patients and
300 caregivers are juggling; and stigma and discrimination concerns—the authors recommend
301 simplicity, accessibility, adequate training for healthcare teams, and more CBO partnerships.
302 Interventions could minimize the number of handoffs and follow up quickly with participants.
303 Healthcare organizations could consider whether programs are inclusive of those with limited
304 English proficiency, low health literacy, disabilities, and/or other factors that may inhibit
305 accessibility. It is also crucial referrals be tailored to the unique needs and preferences of
306 participants to the extent possible. This includes referrals corresponding with social needs, being
307 geographically convenient, and for which participants are eligible. Adequate training for
308 healthcare personnel, both in terms of communication skills (e.g., empathic inquiry)[69] and an
309 understanding of local resources could also enhance connections. This is particularly salient for
310 easing participants' legitimate concerns around stigma or discrimination (e.g., fears related to
311 child welfare involvement and/or immigration policies),[70,71] which could impact decisions to
312 pursue referrals. Finally, many studies in our review did not describe CBO partnerships, a critical
313 dimension given these are likely crucial for improving connections.[68,72,73] Future research could
314 focus on effective collaboration strategies and how to overcome structures that make health and
315 social services organizations reluctant to collaborate.[74]
316
317 Results around the frequent unavailability and inadequacy of resources also reaffirm the limits of
318 healthcare organizations to address participants' social needs without major upstream
319 investments in public health initiatives and policies.[75,76] As healthcare settings collect more data
320 about resource gaps within their communities, the authors suggest they advocate for population-
321 level investments to improve the conditions in which people live.[77] In that regard, it is notable

that few studies in the review explicitly included rural areas, which often experience a scarcity of healthcare and social services resources.[76,78,79]

While the review focuses on barriers and facilitators at the point when participants had disclosed social risks and consented to receive help with social needs, other researchers have noted the importance to understanding what affects connections along the entire "pathway" of screening and referral interventions; there are other instances in which "drop-offs" in participant engagement occur (A Schweitzer, Senior Fellow, Mossavar-Rahmani Center for Business & Government, Harvard Kennedy School, unpublished work, 2021). For example, many studies report drop-offs in terms of participants declining resource navigation assistance after having disclosed social risks.[80] Also, interventions only including certain groups (e.g. those with medical complexity) are prone to bias and may overlook people who would otherwise benefit.[81]

Systematic Mixed Studies Review Approach

A third contribution is the use of a SMSR approach to highlight the ways in which findings garnered from diverse methodologies coalesced around the topic of interest. To avoid privileging one form of evidence over another, the authors used the MMAT[28] to assess the quality of study designs in their own right, keeping in mind that all methodologies operate through distinct epistemologies[82] and inform different aspects of theory creation and practice. While RCTs are frequently identified as the gold standard when it comes to establishing causality, other study designs are also vital for understanding real-world applications of complex interventions across multiple contexts.[83-87] Instead of jumping to whether healthcare-based social interventions connect patients and caregivers with needed resources, a SMSR approach prompted and allowed

the authors to explore the paradigmatically pragmatic[88] questions of *how* to meaningfully define "resource connections" and *why* resource connections may or may not be successful across diverse contexts. Due to the highly complex nature of healthcare-based social interventions, other researchers may find a SMSR approach to be beneficial for their research questions.

Limitations

The review has 2 primary limitations. First, by focusing on interventions with a screening component, studies using alternative strategies to link participants with resources (e.g., "CommunityRx")[89,90] were excluded. All approaches to resource connections merit exploration, but the authors narrowed the scope to screening and referral interventions given their current prominence across various healthcare organizations and initiatives. Second, the search terms and strategy removed certain types of information that are likely salient for better understanding this topic, including evidence from the gray literature; articles published outside the U.S.; and those published before October 2015. Regarding the cutoff date, this decision would have been more problematic had the authors intended to perform a meta-analysis. Instead, the goal was to synthesize current evaluation approaches and narratives, beginning at a time when there was a notable momentum shift surrounding these interventions. Lastly, although authors consulted with a health sciences librarian, it is possible that different or additional search terms may have identified more studies.

CONCLUSIONS

As healthcare organizations increasingly develop interventions to connect patients and caregivers with resources for social needs, the review summarizes current efforts and offers specific

recommendations regarding design and evaluation. To the extent that is feasible, organizations should be thoughtful about how to create programs that are simple, accessible, and incorporate adequate training for all healthcare personnel involved. Evaluation measures of resource connection should be clearly stated, and ideally focus on whether participants accessed new resources and whether the resources were able to address their needs. Effective partnerships with CBOs may increase the likelihood of both resource connections and the ability to track outcomes. Finally, advocacy for upstream public health policies is critical to the success of healthcare-based social interventions, as a primary challenge for healthcare is to connect patients when resources are not available in their local communities.

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reviewer for article selection, supported with data analysis and studies' quality appraisal, and double checked all figures and tables for accuracy. Dawn Richardson and Christina Nicolaidis both provided guidance at multiple points in the conception of the review process. They both reviewed the manuscript and gave important feedback and edits to strengthen the writing. Melinda Davis supported in the conception of the review approach, provided significant guidance and input regarding all steps of the research, and contributed to the writing. All authors reviewed and approved the final manuscript.

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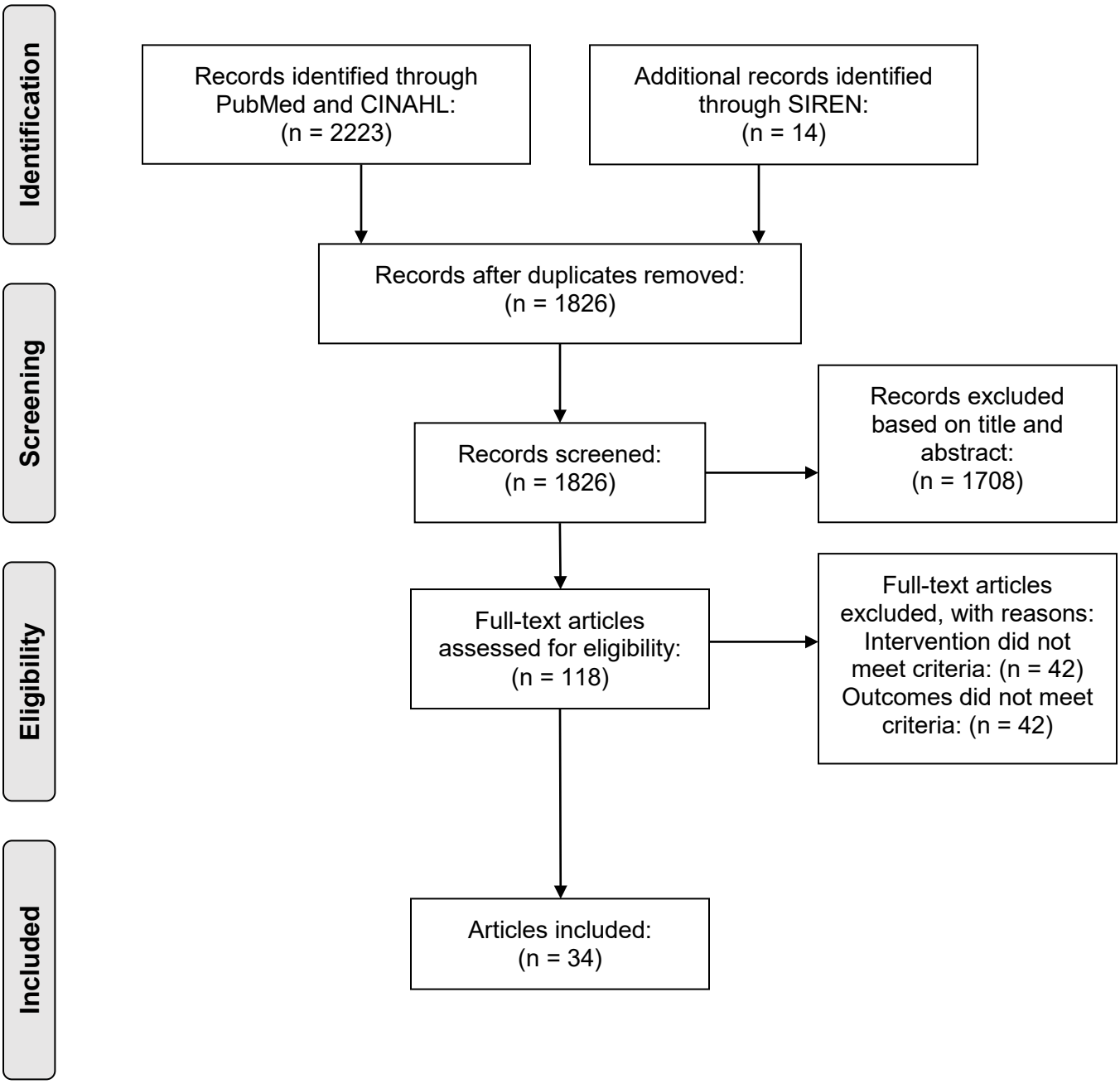
678 **FIGURES**

679 Figure 1. PRISMA Flow Diagram



From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). *P*referred *R*eporting *I*tems for *S*ystematic Reviews and *M*eta-*A*nalyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

For more information, visit www.prisma-statement.org.

Table 1. Screening and Resource Connection Strategies (n=32 studies)

	Screening	Resource Connection Strategy					
	Screening Tool	**Screening Process[a]**	**One-to-one navigation support**	**Written materials/ resource sheets**	**Community partner facilitates resource connections**	**Other community partner or resources on-site**	**Unclear or inconsistent connection strategy**
Marpadga (2019)[46]	Hunger Vital Sign	Healthcare personnel[a]	**X**	**X**		**X**	
Swavely (2019)[54]	Hunger Vital Sign	Healthcare personnel	**X**		**X**	**X**	
Cullen (2020)[43]	Hunger Vital Sign	Healthcare personnel OR Participants[a]		**X**	**X**		
Orr (2019)[47]	Hunger Vital Sign	Participants		**X**		**X**	
Fox (2016)[31]	Hunger Vital Sign	Participants			**X**		
Fritz (2020)[42]	Hunger Vital Sign	Participants			**X**		
Martel (2018)[41]	Hunger Vital Sign	Healthcare personnel			**X**		
Knowles (2018)[52]	Hunger Vital Sign	Healthcare personnel OR Participants			**X**		
Palakshappa (2017a)[56] Palakshappa (2017b)[48]	Hunger Vital Sign	Healthcare personnel			**X**		
Smith A (2020)[36]	Hunger Vital Sign	Healthcare personnel			**X**		
Smith S (2017)[37]	U.S. Household Food Security Survey Module	Participants	**X**			**X**	

Bottino (2017)[29]	U.S. Household Food Security Survey Module (Embedded within Online Advocate, now HelpSteps)	Participants		**X**			
Hassan (2015)[32]	HelpSteps (Online Advocate)	Participants	**X**	**X**			
Cusack (2020)[44]	Homelessness Screening Clinical Reminder (HSCR)	Healthcare personnel					**X**
Fargo (2017)[30]	HSCR	Healthcare personnel					**X**
Montgomery (2020)[55]	HSCR	Healthcare personnel					**X**
Berkowitz (2019)[57]	Health Leads	Participants	**X**				
Fiori (2020)[39]	Health Leads	Participants	**X**			**X**	
Hsu (2020)[45]	Health Leads	Participants	**X**				
Polk (2020)[33]	Health Leads	Healthcare personnel OR Participants	**X**				
Manian (2020)[35]	Health Leads	Healthcare personnel OR Participants	**X**				
Schickedanz (2019)[62]	Health Leads	Healthcare personnel	**X**				
Zhu (2020)[50]	Two different tools, both inspired by Health Leads	Healthcare personnel OR Participants	**X**				
Garg (2015)[b 59]	WE CARE	Participants		**X**			
Power-Hays (2019)[34]	WE CARE	Participants		**X**			
Emengo (2020)[51]	Social Health Alliance to Promote Equity (SHAPE)	Participants	**X**			**X**	

	(Formerly "Family Needs")						
Uwemedimo (2018)[38]	Social Health Alliance to Promote Equity (SHAPE) (Formerly "Family Needs")	Participants	**X**			**X**	
Gottlieb (2020)[b 58]	18-item social risk screening questionnaire (iScreen)	Healthcare personnel	**X**	**X**			
Gottlieb (2018)[b 61] Gottlieb (2016)[b 60]	14-item social and mental health needs questionnaire (iScreen)	Healthcare personnel	**X**				
Nguyen (2016)[40]	7-item social needs checklist	Healthcare personnel	**X**	**X**			
Ray (2020)[53]	59-item survey (7 questions related to social needs)	Participants		**X**			
Hamity (2018)[49]	Your Current Life Situation (YCLS) tool	Unclear					**X**
			16	10	8	7	4

a) Screening process = Person who administered the screening.
Healthcare personnel = People administering the screening to the participants (i.e., study team members, healthcare personnel, volunteers).
Participants = Patients or caregivers completed the screening tool on their own.
b) For the randomized controlled trials, the table reflects what appeared to be done for the intervention groups.

Table 2. Taxonomy of Quantitative Resource Connection Outcome Measures (n=25 studies)

	Whether made contact with a service / organization	**Whether enrolled in or received new services**	**Whether social needs were addressed**	**Participants' ratings of their experiences with resources**
Fargo (2017)[30]	X			
Montgomery (2020)[55]	X			
Ray (2020)[53]	X			
Schickedanz (2019)[62]	X			
Uwemedimo (2018)[38]	X			
Swavely (2019)[54]	X			
Power-Hays (2019)[34]	X			X
Bottino (2017)[29]	X			X
Fiori (2020)[39]	X	X		
Garg (2015)[59]	X	X		
Nguyen (2016)[40]	X	X		
Fox (2016)[31]	X	X		
Knowles (2018)[52]	X	X		
Palakshappa (2017a)[56]	X	X		
Marpadga (2019)[46]	X	X		
Smith S (2017)[37]	X	X		
Fritz (2020)[42]	X	X		
Martel (2018)[41]	X	X		
Smith A (2020)[36]	X	X		
Polk (2020)[33]	X	X	X	
Manian (2020)[35]	X	X	X	
Hassan (2015)[32]	X		X	
Berkowitz (2019)[57]			X	
Gottlieb (2020)[58]			X	
Gottlieb (2018)[61] Gottlieb (2016)[60]			X	

Supplemental Material 1. Systematic Mixed Studies Review Search Strategy

PubMed (MEDLINE) Search Strategy
Concept #1 – Screening
mass screening [MeSH Terms] OR screening [Title/Abstract] OR surveys and questionnaires [MeSH Terms] OR needs assessment [MeSH Terms] OR needs assessment [Title/Abstract] OR assessing [Title/Abstract] OR identifying [Title/Abstract]
Concept #2 – Social Needs
social determinants of health [MeSH Terms] OR social determinants of health [Title/Abstract] OR health-related social needs [Title/Abstract] OR social needs [Title/Abstract] OR social risks [Title/Abstract] OR food [Title/Abstract] OR housing [Title/Abstract] OR violence (Title/Abstract]
Concept #3 – Referral
referral and consultation [MeSH Terms] OR referral [Title/Abstract] OR patient navigation [MeSH Terms] OR navigation [Title/Abstract] OR navigating [Title/Abstract] OR social support [MeSH Terms] OR connecting [Title/Abstract] OR linking [Title/Abstract]
Additional Filters
• English • Articles published from 10/01/2015 through 12/23/2020

Final Search:
Concept #1 AND Concept #2 AND Concept #3

Supplemental Material 2. Mixed Methods Appraisal Tool (MMAT) Results[a]

	Qualitative					RCT					Non-Randomized					Descriptive					Mixed Methods				
	1.1[b]	1.2	1.3	1.4	1.5	2.1	2.2	2.3	2.4	2.5	3.1	3.2	3.3	3.4	3.5	4.1	4.2	4.3	4.4	4.5	5.1	5.2	5.3	5.4	5.5
Bottino (2017)[29]																Y	Y	Y	Y	Y					
Fargo (2017)[30]																Y	Y	Y	Y	Y					
Fox (2016)[31]																Y	Y	Y	Y	Y					
Hassan (2015)[32]																Y	Y	Y	Y	Y					
Polk (2020)[33]																Y	Y	Y	Y	Y					
Power-Hays (2019)[34]																Y	Y	Y	Y	Y					
Manian (2020)[35]																Y	Y	Y	Y	Y					
Smith A (2020)[36]																Y	Y	Y	Y	Y					
Smith S (2017)[37]																Y	Y	Y	Y	Y					
Uwemedimo (2018)[38]																Y	Y	Y	C	Y					
Fiori (2020)[39]																Y	C	Y	C	Y					
Nguyen (2016)[40]																Y	C	Y	C	C					
Martel (2018)[41]																C	C	Y	C	Y					
Fritz (2020)[42]																Y	N	Y	N	Y					
Knowles (2018)[52]	Y	Y	C	Y	Y											Y	Y	Y	Y	Y					
Ray (2020)[53]	N	N	C	Y	N											Y	Y	Y	N	Y					
Cullen (2020)[43]	Y	Y	Y	Y	Y																				
Cusack (2020)[44]	Y	Y	Y	Y	Y																				
Hsu (2020)[45]	Y	Y	Y	Y	Y																				
Marpadga (2019)[46]	Y	Y	Y	Y	Y																				
Orr (2019)[47]	Y	Y	Y	Y	Y																				
Palakshappa (2017b)[c 48]	Y	Y	Y	Y	Y																				
Hamity (2018)[49]	Y	C	Y	Y	C																				
Zhu (2020)[50]	Y	C	C	Y	Y																				
Emengo (2020)[51]	Y	N	Y	Y	C																				
Gottlieb (2020)[58]						Y	Y	Y	Y	Y															
Garg (2015)[59]						C	Y	Y	Y	Y															
Gottlieb (2016&2018)[60,61]						N	Y	N	N	Y															
Swavely (2019)[54]	Y	Y	Y	Y	Y											Y	C	Y	Y	Y	Y	Y	Y	Y	Y
Montgomery (2020)[55]	Y	C	Y	Y	Y											Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Palakshappa (2017a)[c 56]	Y	Y	Y	Y	Y											Y	C	Y	C	Y	Y	Y	Y	Y	Y
Berkowitz (2019)[57]	Y	Y	Y	Y	Y						Y	Y	Y	N	Y						Y	Y	Y	Y	Y
Schickedanz (2019)[62]											Y	Y	Y	Y	Y										

a) "Y" = Yes – study adheres criterion; "N" = No – study doesn't adhere to criterion; "C" = Can't tell – study doesn't include enough information to make a clear judgement about criterion. Detailed descriptions of MMAT criteria are here: http://mixedmethodsappraisaltoolpublic.pbworks.com/w/file/fetch/127916259/MMAT_2018_criteria-manual_2018-08-01_ENG.pdf

b) MMAT methodological quality criteria:

- 1.1. – Is the qualitative approach appropriate to answer the research question?
- 1.2. – Are the qualitative data collection methods adequate to address the research question?
- 1.3. – Are the findings adequately derived from the data?
- 1.4. – Is the interpretation of results sufficiently substantiated by data?
- 1.5. – Is there coherence between qualitative data sources, collection, analysis and interpretation?
- 2.1. – Is randomization appropriately performed?
- 2.2. – Are the groups comparable at baseline?
- 2.3. – Are there complete outcome data?
- 2.4. – Are outcome assessors blinded to the intervention provided?
- 2.5. – Did the participants adhere to the assigned intervention?
- 3.1. – Are the participants representative of the target population?
- 3.2. – Are measurements appropriate regarding both the outcome and intervention (or exposure)?
- 3.3. – Are there complete outcome data?
- 3.4. – Are the confounders accounted for in the design and analysis?
- 3.5. – During the study period, is the intervention administered (or exposure occurred) as intended?
- 4.1. – Is the sampling strategy relevant to address the research question?
- 4.2. – Is the sample representative of the target population?
- 4.3. – Are the measurements appropriate?
- 4.4. – Is the risk of nonresponse bias low?
- 4.5. – Is the statistical analysis appropriate to answer the research question?
- 5.1. – Is there an adequate rationale for using a mixed methods design to address the research question?
- 5.2. – Are the different components of the study effectively integrated to answer the research question?
- 5.3. – Are the outputs of the integration of qualitative and quantitative components adequately interpreted?
- 5.4. – Are divergences and inconsistencies between quantitative and qualitative results adequately addressed?
- 5.5. – Do the different components of the study adhere to the quality criteria of each tradition of the methods involved?

c) While Palakshappa 2017a & 2017b articles came from the same study (i.e., focusing on the same intervention in the same setting), the 2017b article was qualitative and the 2017a article applied mixed methods.

Supplemental Material 3. Study Participants and Settings (n=32 studies)

	Patient Population[a]	**Exclusion Criteria**	**Sample Size**	**Setting**	**U.S. State**	**Geography**
Smith A (2020)[36]	Pts of all ages	Unspecified	2,314	Large health system (16 primary care clinics)	Massachusetts	Unspecified
Manian (2020)[35]	Pts of all ages	Pts w/o social needs Pts with missing data	38,404	Hospitals & clinics; FQHCs & academic medical centers	Nationwide "11 states"	Unspecified
Martel (2018)[41]	Pts visiting the ED	N/A	1,519	County ED	Minnesota	Urban
Schickedanz (2019)[62]	Adult pts	Not in top 1% of care utilization	34,225	KP Southern California	California	Unspecified
Marpadga (2019)[46]	Adult pts w/diabetes	Non-English or Spanish spkrs	240 total; 31 qual	Hospital-based diabetes clinic	California	Urban
Zhu (2020)[50]	Adult pts	Unspecified	19	Hospital-affiliated primary care center & children's hospital	Rhode Island	Urban
Berkowitz (2019)[57]	Adult pts	Unable to complete screening; Non-English or Spanish spkrs	141 quant; 80 qual	3 academic primary care clinics	Massachusetts	Urban
Hamity (2018)[49]	Adult Medicare pts, w/complex needs: Georgia; primary care panel: Northwest	Unspecified	10 Georgia; 11 Northwest	KP Georgia & Northwest	Georgia & "Northwest"	Unspecified
Nguyen (2016)[40]	Adult pts >60 w/diabetes	Non-English or Spanish spkrs; Not Hispanic; Does not have diabetes	28 total; 18 qual	FQHC	California	Unspecified

Swavely (2019)[54]	Quant: Adult pts >18 Qual: Adult pts 33-69	Unspecified	3,860 total; 123 analysis of interest; 89 qual	Hospital	Pennsylvania	Urban
Hsu (2020)[45]	Adult pts >18	Non-English or Spanish spkrs	102	CHC	California	Urban
Smith S (2017)[37]	Adult pts >18	Unspecified	463	Student-run clinics	California	Urban
Fargo (2017)[30]	Adults, veterans	Unable to perform screening; Prior engagement w/VHA homeless programs; Nursing home residents	5,771,496	VHA, outpatient settings	Nationwide	Unspecified
Montgomery (2020)[55]	Adults, veterans	Veterans w/o housing instability	100,022	VHA, outpatient settings	Nationwide	Varied
Cusack (2020)[44]	Adults, veterans	Veterans w/o housing instability	60	VA medical center, outpatient settings	"Northeast"	Urban
Hassan (2015)[32]	Adolescents/young adult pts 15-25	Distressed at time of visit; Unable to comprehend intervention due to language/developmental barriers	401	Hospital-based adolescent & young adult clinic	Massachusetts	Urban
Polk (2020)[33]	Households w/peds pts	Non-English or Spanish spkrs	10,916	8 peds practices	"Northeast" & "Mid-Atlantic"	Unspecified
Fox (2016)[31]	Caregivers, peds pts	Unspecified	116	University peds weight management clinic	Minnesota	Urban

Fiori (2020)[39]	Caregivers, peds pts	Unspecified	4,948 total; 287 analysis of interest	FQHC	New York	Urban
Knowles (2018)[52]	Caregivers, peds pts	Unspecified	103 total; 19 qual	Children's hospital: 3 peds primary care clinics	Pennsylvania	Urban
Gottlieb (2018)[b] [61]	Caregivers, peds pts	Families seeking health care for a child w/a severe illness; Non-English or Spanish spkrs	1,237	Urgent care at 2 safety-net hospitals	California	Urban
Gottlieb (2016)[60]			1,809	Primary & urgent care at 2 safety-net hospitals		
Power-Hays (2019)[34]	Caregivers, peds pts w/sickle cell disease	Unspecified	132	Peds hematology clinic at academic safety-net hospital	Massachusetts	Urban
Cullen (2020)[43]	Caregivers, pts <18	Those in critical condition; Non-English spkrs; Previously enrolled	40	ED of large children's hospital	Pennsylvania	Urban
Uwemedimo (2018)[38]	Caregivers, pts <18	Unspecified	148	Peds hospital-based primary care practice	New York	Urban
Emengo (2020)[51]	Caregivers, peds pts	Unspecified	6	Peds hospital-based primary care practice	New York	Urban
Gottlieb (2020)[58]	Caregivers, pts <17	Pts seen for abuse; Non-English or Spanish spkrs; Enrolled in similar program; in foster care	611	Peds urgent care clinic at an urban safety-net hospital	California	Urban

Palakshappa (2017a)[b 56]	Caregivers presenting for well-child visits	Unspecified	4,371 total; 122 analysis of interest	Children's hospital: 6 primary care practices	Pennsylvania	Suburban
Palakshappa (2017b)[48]		Did not report food insecurity; Non-English spkrs; Caregivers <18	23			
Fritz (2020)[42]	Caregivers, well-child visits (primary care); Caregivers (Inpatient); Pts w/asthma (ED)	Non-English or Spanish spkrs; Relationship w/social workers; Screened within 6 months	5,735 total; 371 analysis of interest	Children's hospital: 2 primary care clinics, 1 inpatient setting, & 1 ED	Colorado	Varied
Ray (2020)[53]	Caregivers, pts <5	Presenting w/urgent need; Non-English or Spanish spkrs	146 total; 61 analysis of interest	Academic peds ED	Pennsylvania	Varied
Bottino (2017)[29]	Caregivers, pts 3-10	Pts w/special health needs; Non-English spkrs; Previous screening	340	Peds hospital-based primary care clinic	Massachusetts	Urban
Orr (2019)[47]	Caregivers, pts 1-5	Pts premature or w/condition affecting their eating or growth; Non-English or Spanish spkrs	17	Peds clinic affiliated w/academic medical center	North Carolina	Unspecified
Garg (2015)[59]	Caregivers, pts <6 mths	Pts w/special health needs; Non-English or Spanish spkrs; Not pts's mother, mother <18, foster parents	336	8 CHCs	Massachusetts	Urban

CHC = Community Health Center; ED = Emergency Department; FQHC = Federally Qualified Health Center; KP = Kaiser Permanente; Peds = Pediatric; Pts = Patients; Qual = Qualitative Data; Quant = Quantitative Data; Spkrs = Speakers; VA = Veterans Affairs; VHA = Veterans Health Administration

a) While some articles included data from non-patient/caregiver participants, this table focuses on patient/caregiver participants for whom relevant outcome data were collected.
b) Articles by Gottlieb 2016 & 2018 and Palakshappa 2017a & 2017b each came from the same studies (i.e., focusing on the same intervention in the same setting), respectively.