Effects of a social health integration program on patient social needs, utilization, and cost outcomes in Kaiser Permanente Washington clinics

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A dissertation submitted in partial fulfillment of the requirements for the degree of

Doctor of Philosophy

University of Washington

2024

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Abstract

Effects of a social health integration program on patient social needs, utilization, and cost outcomes in Kaiser Permanente Washington clinics

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As health care systems increasingly adopt social need screening and intervention activities, also known as social health integration (SHI), it is essential to understand the effect of these programs on patients' social health and health system-level outcomes. Two Kaiser Permanente Washington clinics implemented a pilot SHI program in which patients who reported social needs were randomized to support through one of two social health support programs: a clinic-based worker Community Resource Specialist (CRS) or a centralized Connections Call Center (CCC). This dissertation used data from EHRs, surveys, case notes, and claims for participants enrolled in Kaiser Permanente Washington's pilot SHI program to understand the effects of a primary care-based SHI intervention on patient-reported social needs, and health system-level utilization and cost outcomes. The specific aims included: (1) assessing differences in resolution of need, defined by a reduced count of total social needs, over 5 months and between both social health support programs; (2) examining the effect of CRS, relative to CCC, on utilization outcomes over 9 months; and (3) examining effects of the SHI program on costs over 9 months in CRS compared to CCC. We found that there were no statistically significant differences in social needs resolution between CRS and CCC over time. We also found that CRS participants had higher primary care encounters and costs than CCC over 9

months. Our results from secondary analyses assessing differences between patients who received support from CRS relative to those who did not receive any assistance suggest that CRS support may lead to reduced social needs, and more engagement with the health care system through greater primary care visits, specialty care visits, and patient messages. These findings can inform health care systems in developing their SHI programs and understanding expected effects in response to these interventions.

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Acknowledgements

My deepest gratitude goes to my dissertation committee: Edwin Wong, Cara Lewis, India Ornelas, Meagan Brown, and Anjum Hajat. Thank you for your guidance, mentorship, and patience these past few years, and for shaping my growth and development as a researcher. I am also grateful for the Health Systems and Population Health faculty and staff for leading by example what it means to be a collaborative researcher and for building a supportive environment these past 5 years.

I am also extremely grateful for my Kaiser Permanente Washington Research Health Institute’s Social Health team members: Kat Barnes, Meagan Brown, Heidi Den Haan, Sophia Mun, Roy Pardee, Annie Piccorelli, Ariel Singer, Rob Wellman, Emily Westbrook, Cindy Burdick, and Cara Lewis.

I am so thankful that I had such a supportive community of peers in the Health Services PhD program. It was such a unique journey navigating this program during a pandemic, and I am appreciative of the advice, writing sessions, pep talks, and support that I received from both alumni and peers of this program. This is especially true for my cohort: Carolyn Fan, Maddie Frost, Anna Localio, and Shanise Owens.

Lastly, I cannot express my deep appreciation for my family and friends’ unwavering support through this journey. You have been a constant source of strength and encouragement.

1: Introduction

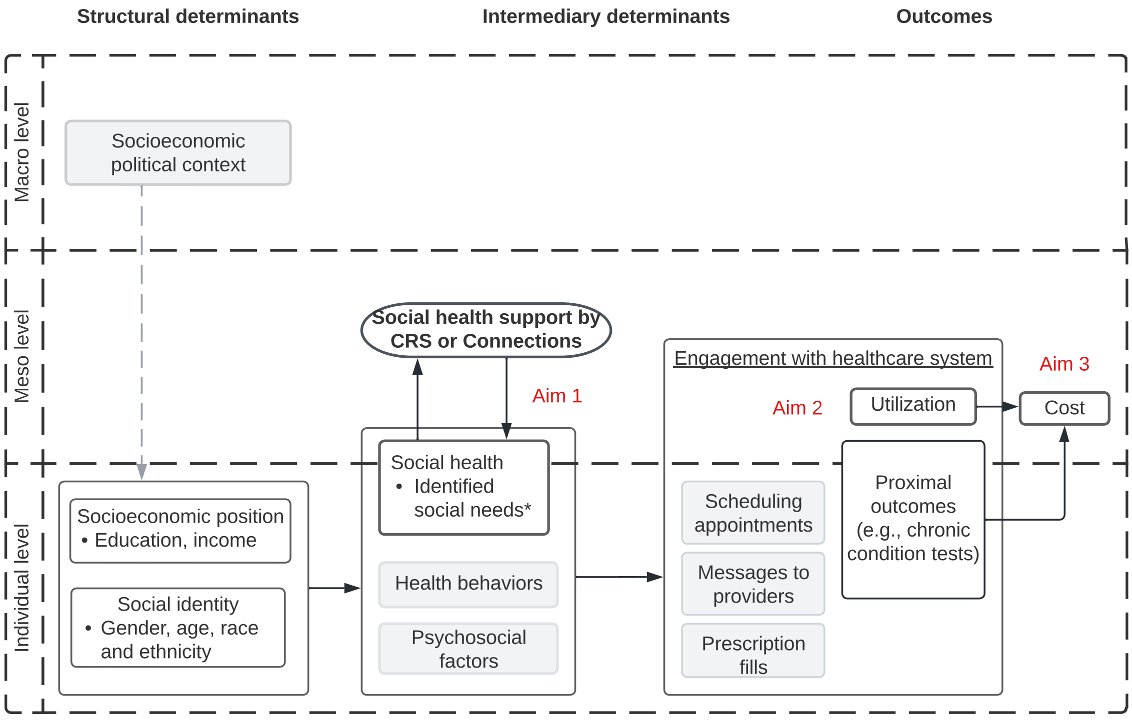
Social determinants of health—consisting of conditions in which individuals are born, live, and work—influence all aspects of health across the life course.[1] Social risk factors are downstream, individual-level adverse conditions that are associated with poor health outcomes.[2] Examples of this include food insecurity, housing instability, and limited transportation. If individuals indicate that they would like assistance with their social risks, these factors are known as social needs.[3] Social needs acknowledge patients' preference for social health interventions. Related to this, efforts from health care systems to identify and respond to social needs is known as social health integration (SHI). Evidence from SHI activities have shown that receiving social services can improve patient health outcomes.[4–8] The potential for these programs to influence long-term outcomes has led to a recent increase in SHI interventions.

In response to the anticipated increase of SHI programs, the National Academies of Sciences, Engineering, and Medicine offers guidance across five types of social health integration roles: (1) awareness through identification of social risks, (2) adjustment by altering care that acknowledges patients' social health, (3) assistance through resource connection, (4) alignment of health systems with community resources to address patient needs, and (5) advocacy by promoting policy change.[5] Health systems and clinics commonly pursue tools to screen for social adversity (awareness) or provide resources and referral information to CBOs.[6]

Additionally, SHI programs have grown in response to Medicare and Medicaid payment policies incentivizing the adoption of SHI practices, as well as a HEDIS quality measure to increase screening and resource connection for patients.[9–12] However, there is a need to better understand the effectiveness of these programs as they continue to expand. This information can also help inform health systems design their SHI programs and identify how to best allocate their resources. Previous studies often focus on a limited set of social needs, targeted populations, or within individual clinical departments.[13–15] This limits the generalizability of these findings to inform health care systems that adopt SHI practices more broadly, across different clinical settings and patient populations. Additionally, much of the available evidence on SHI programs focus on intermediate or process measures, such as the number of patients screened or the prevalence of social needs at one timepoint.[14,16] While this is helpful for establishing an evidence base about social health integration, it does not determine if it impacts patient outcomes. **This dissertation used electronic health record (EHR), longitudinal patient survey, and claims data to understand the effects of a pilot SHI program on patient-reported social needs and health care system-level measures of utilization and costs.** Figure 1 illustrates that individual-level social factors stem from structural determinants, and shows how social health interventions can influence patients' social needs, health care utilization, and cost.

Kaiser Permanente (KP) is a nationally integrated health care system that provides both health insurance and medical care to patients. In response to rising attention towards social health, KP had multiple initiatives to prioritize SHI programming, including the development of the KP Social Needs Network for Evaluation & Translation, KP National's implementation of a centralized call center, and KP Washington's (KPWA) scaling of a resource specialist program. In 2022, two primary care clinics in KPWA received support to implement a universal screener asking patients about their social health. If patients requested assistance for any social health factor, indicating a social need, patients were randomized to receive social health support from one of two programs: Community Resource Specialists (CRS), consisting of clinic-based health workers, or Connections Call Center (CCC), a centralized call center overseen by KP National.

Figure 1: Conceptual model



*Social needs include: food, housing, utilities, finances, transportation, loneliness or social isolation, personal safety, employment, childcare

Specific Aim 1 assessed the effectiveness of CRS relative to CCC on resolving social needs, defined as a reduced count of participants' social needs over a five-month period. The analytic sample for this aim included participants who responded to a follow-up survey at 2 months or 5 months that asked them about their social needs. This study compared count of needs at 2 months and 5 months to the number reported at baseline. Among those who completed any follow-up survey, an intent-to-treat design was used to compare differences between assigned social health support group. This study also included an as-treated analysis comparing those who received CRS and those who did not, with receipt defined as referral or resources received from a CRS. A generalized linear mixed effects model was used to estimate outcomes at 2 months and 5 months.

Specific Aim 2 examined the effect of CRS assistance, relative to CCC, on eight utilization outcomes: primary care encounters, specialty care encounters, behavioral health encounters, emergency department visits, inpatient admissions, urgent care encounters, patient messages, and a missed/cancelled appointment rate over 9 months. While improving health outcomes is a long-term goal of SHI, health care utilization measures can serve as more proximal outcomes to help health care systems understand impacts of SHI activities. Claims data were used to construct utilization measures, and internal scheduling data allowed us to construct a missed/cancelled appointment rate. This study used intent-to-treat analyses to assess differences between those assigned to CRS versus CCC as well as a secondary as-treated analysis that examined utilization differences between those who received CRS relative to those who did not receive any support from CRS or CCC staff. CRS receipt was defined as receipt of any resource or referral from a CRS. Negative binomial regression models were used to compare visit counts between groups. A fractional regression model was used to estimate differences in missed/cancelled appointment rates between CCC and CRS. **Specific Aim 3 examined the effect of CRS assistance on cost outcomes relative to CCC**. Costs were measured from the perspective of the health care system over 9 months and included primary care, specialty care, behavioral health, emergency department, inpatient admissions, and total costs. The current evidence base suggests that a shift in less resource intensive services would decrease expenses incurred by the health care system, and there has been an increase in payment policy reforms to motivate SHI program adoption. Effects of SHI programs on cost outcomes provide essential information for health systems considering these interventions. This aim used the same analytic sample, intent-to-treat, and as-treated samples as Aim 2. Two-part models for behavioral health, ED, inpatient admissions, and urgent care costs were used given that over 50% of participants had zero costs for these measures. The first part consisted of a logit model and the second part used a generalized linear model (GLM). Single part GLM models were estimated for primary care, specialty care, and total costs.

This evaluation examined the effects of a SHI program as a delivery model within an integrated health system. This study's findings on patient-level social needs, as well as health care system-level utilization and cost outcomes can inform KPWA's business case, support the development of future SHI standards, and offer a concrete example for other health systems interested in adopting similar screening and assistance-type social care activities.

Chapter 2: Comparison of clinic-based assistance versus a centralized call center on patient-reported social needs: Findings from a randomized pilot social health integration program

Abstract

Background: As social need screening and intervention activities increase, the long-term objective of our work is to inform how to implement social health into healthcare settings. The purpose of this study is to assess changes in social needs over time between two social health support programs as part of a social health integration effort in two primary care clinics within an integrated health system in Washington state.

Methods: We used stratified randomization to assign 535 patients who self-reported social needs on a screener between October 2022-January 2023 to one of two social health support programs: local, clinic-based Community Resource Specialists (CRS) or a centralized Connections Call Center (CCC). Participants were assessed at 2- and 5-months post-randomization. We compared the count of social needs across programs at each timepoint using joint tests, and estimated differences between programs using generalized linear mixed effects models at each timepoint.

Results: We randomized 535 participants, with 266 assigned to CCC and 269 to CRS. Of those randomized, 61% completed at least one follow-up survey (N = 329). This analytic sample consisted of 153 CCC participants and 176 participants under CRS. CRS participants reported 0.08 (95% CI: -0.710, 0.864) more needs at 2 months and 0.42 (CI: -0.288, 1.126) more needs at 5 months compared to CCC participants ($p > 0.05$). An exploratory as-treated analysis within the CRS group suggested that referral receipt was associated with fewer needs over time.

Conclusions: There were no significant differences between CRS and CCC participants' social needs over time. However, receiving referrals to social services may lead to reduced social needs.

Introduction

Previous research estimates that social factors contribute to approximately 40% of individuals' health status, compared to healthcare which accounts for about 20% of patients' health status.[17] Individual-level social factors such as housing instability, food insecurity, and limited transportation manifest from social determinants of health and are associated with poor health outcomes, including cardiovascular disease, diabetes and poor diabetes management, as well as behavioral health conditions.[2,18] When patients in healthcare settings request assistance with social factors, these are known as social needs.[3] Evidence from efforts to identify and respond to social needs in clinic and community settings, also known as social health integration, suggests that there is a positive association between receipt of social services and patient health outcomes.[4–8]

As clinics increasingly engage in social health integration activities, the National Academies of Science, Engineering, and Medicine has provided guidance about different types of integration activities.[19] Clinics often prioritize "awareness" and "assistance" activities by using tools to screen for social needs and providing patients with resources and referrals to social service organizations, respectively.[20] Examples of interventions that link patients to resources can range from on-site community health workers to service call lines who help with resource navigation.[20–22] The Centers for Medicare and Medicaid Services supported 28 sites to implement an Accountable Health Communities Model in which Medicare and Medicaid beneficiaries received screening, referrals, and navigation services to address social needs.[23] Professional and accreditation organizations have also emphasized the need to identify and address patients' social health.[24] This aligns with recent payment policy reforms to incentivize these activities.[25] Most recently, the National Committee of Quality Assurance released a new Healthcare Effectiveness Data and Information Set quality measure for social need screening and intervention.[26]

As these activities increase, it is essential to understand their effectiveness to further support patients. However, few studies have evaluated these types of programs and more rigorous studies are needed. Previous studies often also focused within individual clinical departments, or on a limited set of needs and subpopulations such as publicly insured beneficiaries, unhoused adults, or those with multiple chronic conditions.[13–15] Additionally, many studies have focused on intermediate process measures, such as the number of patients screened, rather than social needs or health outcomes.[16]

There is also a need for greater research that includes more appropriate and stronger operationalization of measures. Previous studies have been inconsistent in how social needs and their resolution are operationalized as outcomes. For example, some have used the case manager responses or patient enrollment in resources as proxies for needs resolution.[23,27,28] This variability makes it difficult to synthesize findings and best practices across multiple studies. Additionally, most previous studies have used pre-post or cross-sectional study designs, leaving potential confounders or biases unaddressed.[14,29]

The purpose of our study was to examine the effects of a social health integration pilot program on patients' social needs in a health care system. Kaiser Permanente (KP) is a national, not-for-profit integrated health care system and this program took place in the KP Washington region (KPWA) which provides medical coverage to about 700,000 members in Washington State. Under this program, participants in two primary care clinics could receive social health support from one of two interventions: a Community Resource Specialist (CRS) program, consisting of clinic-based health workers, or the Connections Call Center (CCC), a centralized call center program. The purpose of this study is to characterize and compare the presence of 10 social needs following the two interventions over time.

Methods

KPWA identified two primary care clinics to receive implementation support for social health integration activities between July 2021– January 2023 as part of a quality improvement project. Examples of implementation support activities include virtual practice facilitation support to develop social health integration workflows and documentation to share with care teams, IT collaboration on tool design and training, and a monthly panel with patients with social needs to codesign integration workflows. Clinics were chosen based on their patient population diversity compared to other clinics in Washington State, and range in clinic size. They received implementation support to administer universal social health screening using a 9-item Social Health Questionnaire (SHQ). The SHQ consists of 8 items asking patients about the following social risks: food insecurity, housing insecurity, financial strain, and transportation issues. The final item asks patients if they desire assistance with up to 10 types of social needs (Appendix). The SHQ is unique to KPWA and includes items that align with social risks that can be flagged in patients' electronic health record (EHR). This instrument is available in English, Spanish, Russian, Mandarin, Korean, and Vietnamese. For patients younger than 18 years of age, the accompanying caregiver completed the SHQ on the patient's behalf. Additional details about the development of the SHQ can be found in the Appendix. Patients could complete their SHQ was online in advance during electronic check-in, or in-person on paper or tablet at their visit. Responses were entered into patients' EHR.

Patients who self-reported at least one social need on the last item of the SHQ during the enrollment period were assigned to one of two social health support programs: a local, clinic-based Community Resource Specialist (CRS) or a centralized national call center, Connections Call Center (CCC). Randomization occurred within strata based on clinic, age, and sex. We hypothesized that participants assigned to CRS would have a lower total count of social needs at each time point, indicating resolved social needs. We also reported the prevalence of all ten social needs by assigned social health support group at each time point. The KPWA Institutional Review Board determined that this was a quality improvement project and did not require Institutional Review Board review.

Participants

Participants were included in the evaluation if they completed the SHQ during the enrollment period between October 2022 – January 2023, for a visit scheduled at one of the two pilot clinics, and reported any social need. Eligible visits included office visits with a primary care provider (excluding nurse and walk-in clinic visits) at primary care departments (Family Practice, Pediatrics, and General Internal Medicine). They were excluded if they already had a recent referral to or encounter with a CRS, had a household member who was already randomized in the evaluation, spoke a language other than English or Spanish, or indicated opting-out of all research outreach activities under the health system in their EHR.

The KPWA Research Institute Survey Research Program contacted participants to complete follow-up surveys at 2- and 5-months post-randomization. These surveys included SHQ items in addition to questions about their overall experiences. During the follow-up window, participants received an advance letter with a web link to the survey and a $2 pre-incentive, as well as an email or text message for the 5-month survey if they opted in to those contact methods at their 2-month survey. If the web version was not completed within a week, survey team members made 5 call attempts for participants to complete the survey over the phone. A paper survey was also sent to participants who did not respond to prior outreach attempts. A $25 incentive was provided for each survey that was completed. Our final analytic cohort included respondents who completed at least one follow-up survey, resulting in a final sample size of 329 participants (response rate = 61%).

Social health support programs

Participants were assigned to receive social health support through one of two programs. CRSs are local, in-person specialists embedded in the care team and who reach out to participants to provide assistance.[21] CCC is a centralized call center administered by KP National. Both modalities provide participants with resource information for social needs and aim for the original agent to conduct follow-up. CRS and CCC staff have access to Thrive Local, a centralized resource database, and can share information from this platform with participants. In addition to this, CRSs have local knowledge about community-based resources to which they can refer participants. CRSs are also embedded within care teams and receive training on motivational interviewing techniques to support participants' social needs resolution.

CCC agents provide resources using Thrive Local and similarly initiate contact with participants. Prior to this evaluation, patients initiated contact to CCC to receive assistance. However, during a two-month period, we observed that less than 1% (2/214) of those who received CCC contact information in their after visit summary reached out to CCC. Given the quality improvement initiative driving this evaluation, we revised the CCC workflow so that the study team provided randomized participants' contact information to CCC staff so they could initiate outreach.

Outcomes

The primary outcome was the total count of social needs, ranging from 0-10, among participants randomized to the CRS program relative to CCC at each timepoint. We assessed this outcome using the SHQ item asking participants if they would like assistance and to select all that apply from the following social needs: food, housing, utilities, finances, transportation, loneliness or social isolation, employment, caregiving, childcare, or paying for medical care, medicine, or medical supplies.

Predictors and covariates

The assigned social health support program was the main independent variable (CCC; CRS). Covariates included variables used for stratified randomization: administrative sex, age (<18; 18-40; 41-60; 60+), and clinic (A or B). We also included baseline count of social needs as a covariate. This aligns with best practices to include stratification variables and the baseline value for a continuous outcome as covariates in longitudinal, randomized studies.[30,31] An analysis of the association between patient characteristics and outcome missingness led us to include insurance type (commercial; individual; Medicaid; Medicare; no coverage), race and ethnicity, and Johns Hopkins' Adjusted Clinical Group (ACG) resource utilization band as covariates. ACGs are derived from patients' previous utilization patterns using claims data, and categorizes patients into comorbidity levels based on their expected resource use.[32] We used administrative data instead of self-reported data from the survey for race and ethnicity due to high missingness for this item in the survey. We aggregated the race and ethnicity variable to six categories (African American/Black; Hispanic; Multiracial; White; Other; Unknown) due to small cell sizes. The "unknown" category includes individuals who refused or for whom the data was not collected. The "other" category consists of patients who selected "other" as their race and ethnicity, and those who identified as Native American or Alaska Native, Asian, or Native Hawaiian or Pacific Islander. We also used a binary ACG variable (No User/Low/Healthy; Moderate/High/Very High).

Statistical analysis

We calculated descriptive statistics (proportions and standardized mean differences (SMD)) for the total sample and by social health support programs, and identified meaningful differences between groups based on a SMD > 0.02. We estimated the difference in the count of social needs between CRS and CCC at each follow-up time point using a generalized linear mixed effects model assuming a Poisson distribution with log link and individual-level random effects for participants. We reported the unadjusted and adjusted mean counts of endorsed needs between programs for easier interpretation, in addition to risk ratios. Joint tests and associated p-values assessed if there was a significant association at each timepoint between programs. Primary analyses used an intent-to-treat approach. We conducted sensitivity analyses to account for potential self-selection bias as the analytic sample only included participants who responded to at least one follow-up survey.[33] Specifically, we used a two-part Heckman selection model which focused on who was included in the sample in the first part and used a main outcomes Poisson model as the second part (Appendix).[34] This method produces unbiased estimates when working with missing data.[35]

We also conducted an as-treated analysis using propensity score weights to measure the effect of receiving resources from CRS on the count of social needs compared to those who did not receive resources. Randomization did not guarantee that participants received assistance or used recommended services, and this secondary analysis focused on receipt of resources based on available data. We focused on CRS for the as-treated analysis because CRS is a unique, high touch program and we wanted to better understand effects among those who received this intervention. We defined receipt as those who spoke to a CRS and received resource information, and identified these participants by reviewing case notes. Our comparison group consisted of participants who did not receive any information from CRS or CCC. We estimated a balanced comparison group using propensity score weights. Covariates used to create a comparison group included individual-level demographics and documented diagnoses for 26 comorbid conditions, clinic-level counts of primary care providers and full time CRSs, as well as a neighborhood-level deprivation index which measures regional socioeconomic conditions and is derived from geo-demographic data.[36] The sample size for those who received CRS was 104 and the comparison group consisted of 144 participants. Due to the small cell size of participants who received CCC, we could not create a balanced comparison group using propensity score weights and we were unable to conduct an as-treated analysis for CCC. Additional details about developing the as-treated dataset can be found in the Appendix. We used Stata 17 and RStudio 4.2.1 for analyses.

Results

Participant characteristics

During the enrollment period, 80% of patients who were eligible across both clinics completed the SHQ and 535 were ultimately randomized (Figure 2): 269 to CCC and 266 to CRS. 329 (61%) completed at least one follow-up survey and were included in analyses (Table 1). About two-thirds of the sample were female and 40% were over the age of 60 and more than half (58%) identified as White. Almost two-thirds of participants fell into a moderate or higher morbidity ACG category. The majority of participants in this study were from Clinic A (71%) which serves about three times the number of patients at Clinic B.

Participant demographics were mostly balanced between programs, except for race and ethnicity. There were more participants who identified as Hispanic in CRS (7.4%) than CCC (3.9%) and a smaller proportion of White participants in CRS (52.2%) compared to CCC (65.4%). We observed that more CRS participants had a “Low” ACG level compared to CCC (2.0 and 5.7%, respectively). Fewer CRS participants also fell into a “High” ACG level relative to CCC (15.3% and 22.2%, respectively).

Descriptive analyses

The unadjusted baseline mean count of needs for CCC participants was 1.63 (SD=1.25) (Figure 3). This increased to 1.90 (SD=1.98) at 2 months and slightly fell to 1.86 (SD=1.90) at 5 months. Among CRS participants, the mean count of needs at baseline was 1.78 (SD=1.23) and this was not significantly different from CCC. Participants in CRS reported 2.09 (SD=2.12) needs at 2 months followed by 2.04 (SD=1.98) needs at 5 months. Financial strain, utilities assistance, and difficulty paying for medical care, medicine, or medical supplies were the top three needs reported among all participants and across timepoints. Specifically, 17% of all participants reported financial strain at baseline, followed by 24% at 2 months and 27% at 5 months. We found that 27% requested utilities assistance at baseline, 24% at 2 months, and 32% at 5 months. Lastly, 35% reported difficulty paying for medical care at baseline and this slightly decreased over time with 33% at 2 months and 31% at 5 months.

Intent-to-treat regression analyses

Unadjusted results showed no statistically significant differences between programs at both 2- and 5-month follow-up timepoints (Table 3). We found that CRS participants reported

0.23 (95% CI: -0.725, 1.183) more needs at 2 months and 0.65 (CI: --0.233, 1.540) more needs at 5 months, relative to CCC participants. Our adjusted analysis results were also not statistically significant. We found that CRS had 0.08 (95% CI: -0.710, 0.864) more needs at 2 months and 0.42 (CI: -0.288, 1.126) more needs at 5 months compared to CCC. Our findings from the sensitivity analysis to account for selection bias were consistent with these results (Appendix).

As-treated analysis

Weighted results showed a statistically significant relationship between receipt of CRS and time (p = 0.001). We found a similar trend in that those who received CRS reported 0.91 fewer needs at 2 months (95% CI: -1.975, 0.161) and a significant difference at 5 months with participants who received CRS reporting 2.38 fewer needs (95% CI: -3.432, -1.324) compared to those who did not receive CRS or CCC.

Discussion

Our study aimed to examine the effects of primary care-based social health integration on social needs by comparing two social health support programs over time. This study advances the social health literature by documenting the impact of one of the first social health integration programs in a primary care setting to address a broad set of social needs among a general patient population. We also reported patient-level outcomes to understand the effects on needs resolution over time.

Our findings from the primary intent-to-treat analysis showed that those assigned to CRS, a local and clinic-based program, did not significantly change the number of social needs that participants reported compared to those assigned to CCC, a national-level centralized call center that provides participants with resource information. These findings remained consistent after accounting for potential selection bias. However, our as-treated analysis results indicate that those who received support from CRS had a lower count of social needs over time than those who did not.

There are several factors to consider when interpreting these findings. For our primary intent-to-treat analysis, we compared CRS to an active comparison group of CCC which was modified from a participant-activated program to one in which CCC staff-initiated contact. Additionally, CRS worked on-site and received warm handoffs prior to the pandemic. During the evaluation, nearly all CRS contacts occurred virtually and after participants were randomized which means these initial contacts occurred after their primary care appointment. This created more similarity between CRS and CCC, contributing towards greater difficulty in distinguishing the effects between programs over time. We observed similar counts of needs across both programs and did not find significant differences over time.

Higher counts of social needs at follow-up compared to baseline may reflect an increase in participants' trust in the healthcare system, leading to higher comfort in reporting social needs. It is also important to note that the timing of the 2-month follow-up survey window fell during winter 2022. Individuals faced higher prices for utilities and other goods, and there was an increased risk of economic downturn during this time.[37,38] This may have been reflected in the increase of social needs at 2 months in the entire sample.

There is also no consistent method to measure social needs resolution or timeline during which we can expect to observe resolution. We measured resolution by participants' self-report data. It may be more beneficial to use successful resource connection as a measure rather than the presence of social needs. This would require investment in social service organizations to ensure they have the ability and capacity to support social needs.[39,40] There would also need to be greater communication and data management capacity to ensure that information is shared between healthcare systems and organizations. Lastly, social health resources and referrals for patients often temporarily address social needs, rather than provide systemic or structural solutions to social needs.[41] The cyclical nature of social needs is reflective of these short-term solutions.

Additionally, our as-treated findings highlighted the importance of communication and follow-up between social health support staff and participants to ensure adequate assistance was provided. However, it is possible that those who received resources from CRS may already be more engaged with the healthcare system, giving them greater ability to seek out assistance and pursue resources to address their social health needs. An encounter with CRS or receipt of resources does not guarantee that participants actively used those resources or that participants' needs were ultimately addressed.

There were a few limitations to this study. First, there may be concerns about the generalizability of our findings to other settings. However, recent literature suggests that characteristics of patients attributed to KP clinics are generally reflective of their communities.[42] Our results are also from a primary care-based program and this setting often serves more generalized patient populations. Second, our analyses compared CRS to an active comparison group due to external factors, minimizing potential differences between CRS and a true control group. Third, patients were only eligible for randomization if they had a primary care appointment scheduled during the enrollment period, meaning that patients had to already be engaged with the healthcare system. It is possible that patients with complex needs, and who could also benefit from these programs, are not interacting with their primary care providers. Lastly, it was not possible to measure patients' engagement with the resources they received through CRS, CCC, or from elsewhere. Patients' successful connection with resources could serve as an alternative outcome measure of social health integration programs, and serves as a future area of research.

Conclusion

This study provided an example of social health universal screening and subsequent connection to a social health support program in a primary care setting. Health systems will continue to adopt social health integration initiatives, particularly in response to new policy and reporting requirements. It is essential to understand the effectiveness of these types of programs in real-world settings so that health systems can identify appropriate resources and strategies. While we did not observe significant differences in our intent-to-treat analysis between social health support programs over time, our as-treated analysis showed statistically significant and meaningful differences when we assessed the effect of receiving CRS support.

Future research should continue to build upon this study by strengthening intervention and evaluation components in order to identify best practices and their associated effectiveness. For example, a distinctly different or true comparison group would allow researchers to determine if certain program components work well for reducing social needs and provide justification for health systems to invest in necessary resources. While there is no standard measure of social needs resolution, our definition focused on the change in count of needs over time and did not guarantee participants' successful resource connection or interaction with a CRS or CCC agent. Examining these process measures or focusing on successful social service connection may be more relevant to better understand these programs. Additionally, a larger sample size for as-treated analyses would be extremely beneficial to assess the effects of full engagement with social health support programs on social needs.

Figure 2: CONSORT Flow Diagram for Randomized Participants and Analytic Sample

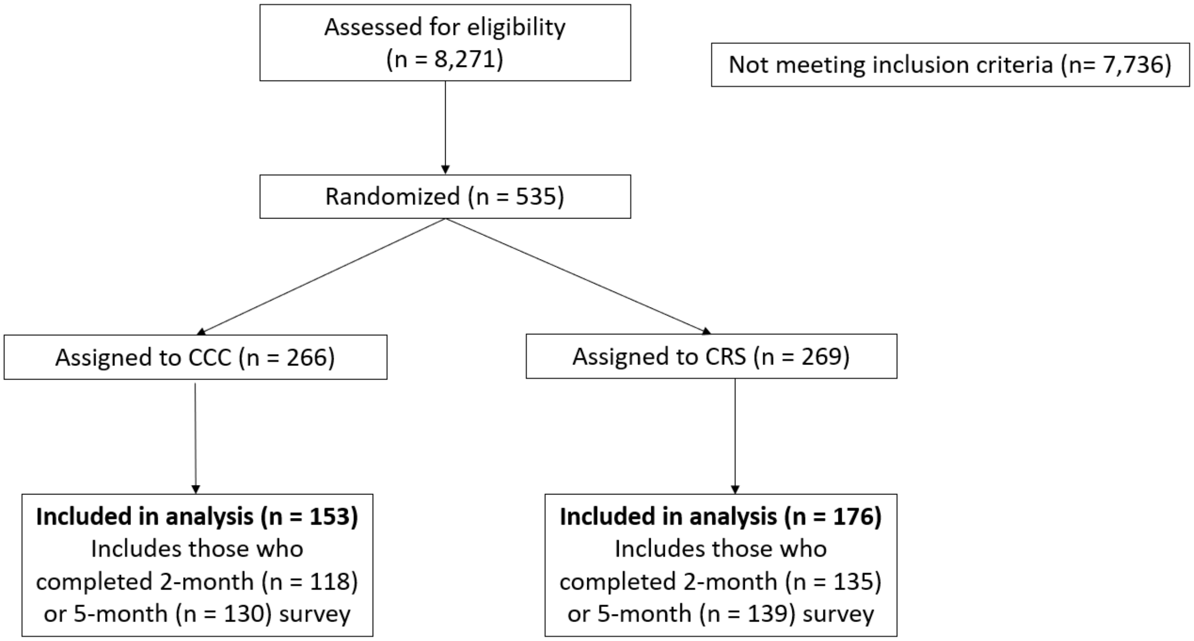


Table 1: Analytic sample characteristics

Characteristics	CCC (n = 153)	CRS (n = 176)	Total (n = 329)	Standardized mean differences
Administrative sex, n(%)				0.016
Female	102 (66.7%)	118 (67.0%)	220 (66.9%)	
Male	51 (33.3%)	58 (33.0%)	109 (33.1%)	
Age, n(%)				0.021
<18	9 (5.9%)	14 (8.0%)	23 (7.0%)	
18-40	41 (26.8%)	50 (28.4%)	91 (27.7%)	
41-60	38 (24.8%)	46 (26.1%)	84 (25.5%)	
60+	65 (42.5%)	66 (37.5%)	131 (39.8%)	
Race and ethnicity , n(%)				0.214
African American or Black	9 (5.9%)	8 (4.5%)	17 (5.2%)	
Native American or Alaska Native	0 (0%)	1 (0.6%)	1 (0.3%)	
Asian	3 (2.0%)	5 (2.8%)	8 (2.4%)	
Hispanic	6 (3.9%)	13 (7.4%)	19 (5.8%)	
Multiracial	6 (3.9%)	9 (5.1%)	15 (4.6%)	
Native Hawaiian or Pacific Islander	3 (2.0%)	3 (1.7%)	6 (1.8%)	
White	100 (65.4%)	92 (52.2%)	192 (58.4%)	
Other	3 (2.0%)	5 (2.8%)	8 (2.4%)	
Unknown	23 (15.0%)	40 (22.7%)	63 (19.1%)	
Insurance type, n(%)				0.076
Commercial	51 (33.3%)	71 (40.3%)	122 (37.1%)	
Individual	5 (3.3%)	5 (2.8%)	10 (3.0%)	
Medicaid	21 (13.7%)	26 (14.8%)	47 (14.3%)	
Medicare	67 (43.8%)	56 (31.8%)	123 (37.4%)	
No coverage	9 (5.9%)	18 (10.2%)	27 (8.2%)	
Adjusted clinical group utilization bands, n(%)				0.196
Non-user	2 (1.3%)	6 (3.4%)	8 (2.4%)	
Healthy users	5 (3.3%)	6 (3.4%)	11 (3.3%)	
Low	3 (2.0%)	10 (5.7%)	13 (4.0%)	
Moderate	53 (34.6%)	57 (32.4%)	110 (33.4%)	
High	34 (22.2%)	27 (15.3%)	61 (18.5%)	
Very High	24 (15.7%)	20 (11.4%)	44 (13.4%)	
Missing	32 (20.9%)	50 (28.4%)	82 (24.9%)	
Clinic				0.01
A	109 (71.2%)	126 (71.6%)	235 (71.4%)	
B	44 (28.8%)	50 (28.4%)	94 (28.6%)	
Baseline count of needs, mean (SD)	1.63 (1.25)	1.78 (1.23)	1.71 (1.24)	

Figure 3: Change in total count of needs over time, by program

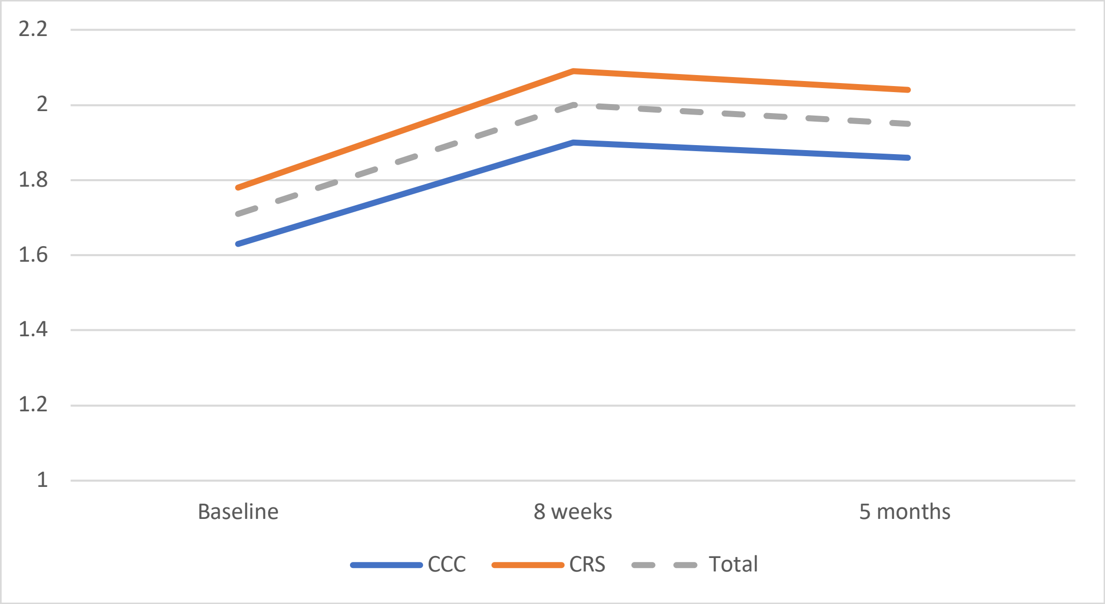


Table 2: Unadjusted and adjusted model results

Variable	Mean count of needs	95% CI		RR	RR 95% CI		p-value	Joint test p-value
Unadjusted results								
2 months								0.343
CCC	5.34	4.634	6.037					
CRS	5.56	4.950	6.178	1.04	0.860	1.226	0.639	
Difference	0.23	-0.725	1.183					
5 months								
CCC	4.62	4.017	5.229					
CRS	5.28	4.667	5.886	1.14	0.936	1.347	0.150	
Difference	0.65	-0.233	1.540					
Adjusted results								
2 months								0.507
CCC	4.406	3.229	5.583					
CRS	4.483	3.232	5.734	1.018	0.838	1.197	0.847	
Difference	0.077	-0.710	0.864					
5 months								
CCC	3.757	2.592	4.923					
CRS	4.177	2.939	5.415	1.112	0.914	1.310	0.244	
Difference	0.419	-0.288	1.126					

Chapter 3: Differences in health care utilization across two social health support modalities: results from a randomized pilot program

Abstract

Objective: To assess differences in utilization outcomes among patients with social needs as part of a social health integration program (SHI) in two Kaiser Permanente Washington primary care clinics.

Methods: Under this pilot program, patients who reported social needs between October 2022 – January 2023 were randomized to receive support from either local, clinic-based Community Resource Specialists (CRS) or a centralized Connections Call Center (CCC). We used administrative and claims data for 534 participants to compare the following utilization outcomes between programs over 9 months post-randomization: primary care encounters, specialty care encounters, emergency department visits, inpatient admissions, urgent care encounters, secure patient messages, and missed/cancelled appointment rates. Using an intent-to-treat approach, we used negative binomial regression models to compare visit counts, logistic regression to estimate differences in the probability of any emergency department visit or inpatient admissions, and fractional regression to compare missed/cancelled appointment rates between groups. We conducted secondary as-treated analyses comparing participants who received resource information from CRS to those who did not receive any support.

Results: Unadjusted results showed no statistically significant differences between CRS and CCC. CRS participants received 1.04 more primary care encounters than CCC participants (95% CI: 0.336, 1.746). As-treated results showed that participants who received CRS had higher primary care encounters, specialty care encounters, and patient messages than those who did not.

Conclusions: As health systems increase efforts to support patients' social health, it is essential to understand the relationship between different interventions and patient utilization. Findings from this primary care social health pilot program showed that local, clinic-based support was associated with greater outpatient utilization compared to a call center.

Introduction

Social factors—such as, food insecurity, housing instability, and limited transportation—are adverse conditions that are associated with poor health outcomes such as chronic health conditions and behavioral health conditions.[2,3,43] Social factors contribute to approximately 40% of individuals' health status compared to healthcare which accounts for 20% of patients' health.[17] For this reason, health care systems have become increasingly interested in identifying and responding to patients' social needs, a practice known as social health integration (SHI). Previous studies suggest that connecting patients to social services can result in improved patient health outcomes.[5,6,8,44]

Social health integration is expected to increase across health care systems, as recent payment policy reforms and a new Healthcare Effectiveness Data and Information Set (HEDIS) quality measure encourage health care systems to adopt these practices.[25,26] Social health integration activities can be summarized in to five categories: (1) *awareness* through identification of social risks, (2) *adjustment* by altering care that acknowledges patients' social health, (3) *assistance* through resource connection, (4) *alignment* of health systems with community resources to address patient needs, and (5) *advocacy* by promoting policy change.[19] The most common types of activities fall under "awareness" and "assistance" categories in which health care systems use tools to screen for social needs and provide patients with resources and referrals to social service organizations, respectively. Social health integration programs can range from on-site community health workers to service call lines with operators who can help with resource navigation.[20–22]

As health care systems continue to implement these activities in response to payment incentives and performance metrics, it is important to understand their impact. Previous research has contributed to frameworks that link SHI activities, such as identifying social needs and connecting patients to resources, to changes in utilization and patient health status in the long-term through multiple potential pathways.[45,46] For example, addressing patients' social needs can reduce their social health burden and in turn, allow them to prioritize their clinical health needs and improve their health by increasing funds available to pay for medication or other services. Discussions about social health can also provide emotional support for patients, increasing their trust and rapport with the health care system. Additionally, greater engagement with patients through SHI initiatives can also influence how patients interact with and access health care services such as scheduling preventive care or other outpatient services. This could ultimately lead to lower demand for certain avoidable services and in turn, reduce costs of care. While optimizing health and reducing costs are long-term goals, health care utilization measures can serve as more proximal outcomes to help health care systems understand impacts of SHI activities.

The current evidence on the effects of SHI on health care utilization is mixed. For example, some studies have found that integration efforts are associated with no changes in the number of primary care visits over 6-month and 2-year timeframes, but these findings come from interventions set in a mix of primary care, clinical, and non-clinical settings.[21,47] Another study set in an academic pediatric practice observed an increase in primary care visits over 2 years.[48]

Looking at overall outpatient utilization which included primary care, specialty care, and urgent care, one study on a social needs intervention found a decrease in these types of visits over 1 year in an integrated health care system setting.[49] Programs that targeted specific populations such as publicly insured individuals or high utilizers reported a decrease in emergency department visits (ED) over 1 or 2-year follow-up periods. Other studies reported an increase or no change in ED visits following patients in an integrated program over 6-month or 2-year follow-up periods.[21,47,49–51] Inpatient admission outcomes also varied across studies regardless of target population, insurance, and modality. For example, programs targeting publicly insured beneficiaries, pediatric settings, or high utilizers reported a decrease in inpatient admissions among intervention participants.[49–51] Other studies that focused on families with children or publicly insured patients reported either an increase or no change in admissions.[47,48,52] While these studies reported conflicting trends, the follow-up periods overlapped and ranged from 6 months to 2 years.

Overall, studies that had a timeframe over a 6-month period reported changes in primary care or outpatient utilization, but the directionality of these outcomes varied. It is unclear if there is a sufficient duration of follow-up to see changes in avoidable utilization such as ED visits and inpatient admissions. Variation in findings across studies is also due to differences in their target populations by age, setting, comorbidity status, or insurance status.[53] Differences in methods, and often the lack of a comparison group, make it difficult to establish causality. These studies also vary in the structure and modality of interventions which were often tailored to their unique setting or patient population, creating difficulty in identifying best practices for SHI interventions. Expected patterns in utilization outcomes is unclear due to the variation in the study designs and intervention components.

While current literature has contributed critical foundational information to the field, there are key limitations and future directions that additional research can address. For example, for studies that screened eligible study participants based on their social health, there was no established way to screen patients for social needs and this influenced who was included in the study samples.[48,51] Additionally, some authors reported being able to access claims for a subset of participants, or were not able to compare all participants' utilization over the same timeframe due to multiple data sources.[23,50] An imbalanced or lack of a comparison group in several studies made it difficult to establish causality and did not address potential confounding.[21,51] Lastly, authors from one of these studies emphasized the importance of disentangling the effects of different intervention components.[51]

The purpose of this study is to report results of a social health integration pilot program on health care utilization outcomes from a primary care-based SHI program in a general patient population. Kaiser Permanente (KP) is a national, not-for-profit, integrated health care system that serves more than 12.4 million members nationwide. The KP Washington State (KPWA) region provides coverage for approximately 700,000 members. As part of a SHI pilot program, patients scheduled for primary care appointments in two clinics in WA state were screened for social needs and randomized to a social health support program, both of which connect patients to community-based resources: (1) Connections Call Center (CCC) which is a centralized call center, and (2) Community Resource Specialists (CRS) which is a local, clinic-based program. We report the relative differences in health care utilization outcomes over a nine-month period. We assessed differences between participants assigned to both programs as well as those who received CRS relative to those who did not.

Methods

Study design

We used a stratified randomized design to examine differences in health care utilization among pilot program participants over time. Patients who indicated a social need on a universal screener during a primary care visit were randomized to one of two social health support programs: a local, clinic-based Community Resource Specialist (CRS) program or a centralized Connections Call Center (CCC). Randomization occurred during the enrollment period between October 2022 – January 2023 within strata of administrative sex, age group, and clinic. Participant baseline characteristics were pulled from electronic health records (EHRs) and claims data from the KPWA database were extracted over a nine-month period. This pilot program was part of a quality improvement initiative and received a determination of not human subjects research.

Setting and Study Population

Two primary care clinics in KPWA were identified to receive implementation support for a SHI program to implement a universal screener asking patients about their social health. They were selected based on their relative range in size and patient diversity compared to other clinics in Washington State. Patients who scheduled office visits with a primary care provider (excluding nurse and walk-in clinic visits) through a primary care department (Family Practice, Pediatrics, General Internal Medicine) received a Social Health Questionnaire (SHQ-9). This is a nine-item screener unique to KPWA and includes 8 items that ask about the presence of 4 social risks: financial strain, housing instability, food insecurity, and transportation issues. The last item asked if they would like assistance with up to 10 social health factors, with endorsement of any indicating a social need. Patients were able to select all that apply from the following list: food, housing, transportation, finances, loneliness or social isolation, employment, utilities, childcare, caregiving, paying for medical care, medicine, medical supplies. Patients were eligible for randomization if they reported at least one need on the SHQ-9 during the enrollment period. This screener could be completed online in advance or in-person either electronically or on paper. For patients younger than 18 years of age, their caregiver would complete the SHQ on their behalf. Patients were excluded from the study if they had a recent encounter or referral with a CRS, had someone in their household who was already in the evaluation, spoke a language other than English or Spanish, opted out of KP research outreach, or died during the follow-up period.

Social health support programs

Participants were randomized to one of two social support programs. CCC is a centralized call center that is administered by KP National. CRSs are local, in-person specialists that are part of the care team and contact patients for assistance. Both CCC and CRS have the policy that the same person that has the initial call with patients conducts follow-up calls to those patients. Both programs provide patients with referrals and resource information by using Thrive Local, a centralized resource database. While patients originally contacted CCC using information from their after-visit summary, we modified the design after observing low patient outreach. Both CRS and CCC initiated contact with patients via phone after participants were randomized.

By design, CRSs have additional local knowledge about community resources that they can share with participants, and they receive motivational interviewing training to support participants toward taking action. CRSs automatically receive a notification if patients report a social need on the SHQ once it is in their EHR, so they can conduct immediate follow-up. However, due to the nature of the pandemic and evaluation processes in which CRS were notified who to contact after patients were randomized, the initial contact often happened virtually and after the visit, rather than in-person on the same day after receiving a warm-handoff.

Data

Patient characteristics were extracted from EHR data. We used claims data to extract health care system encounters from an internal data warehouse over a nine-month follow-up period. Data was extracted for encounters from October 2022 – December 2023 to account for a data lag from externally submitted claims.

Participant characteristics

We imported patient demographics from the EHR, including administrative sex, age at enrollment, as well as age groups (<18; 18-40; 41-60; 60+) that were used for randomized stratification. We also had data on 9 race and ethnicity categories (African American or Black; Native American or Alaska Native; Asian; Hispanic; Multiracial; Native Hawaiian or Pacific Islander; White; Other; Unknown). The Multiracial grouping includes participants who explicitly identified as Multiracial or selected more than one race and ethnicity category. The unknown category includes individuals who refused to respond or for whom this data was not collected. We also accessed participants' insurance types (commercial; individual; Medicaid; Medicare; no coverage). We imported Johns Hopkins' Adjusted Clinical Group (ACG) resource utilization bands from the EHR (non-user, healthy users, low, moderate, high, very high, missing). ACGs are derived from patients' previous utilization patterns using claims data and categorize patients into comorbidity levels based on their expected resource use in the future.[32] Patients' clinic (A; B) and the count of social needs at baseline (0-10) were also extracted from EHRs.

Outcome measures

We used claims data to construct the following utilization outcome measures: primary care encounters, specialty care encounters, behavioral health encounters, ED encounters, inpatient admissions, urgent care encounters, secure patient messages, and missed/cancelled appointment rates over a 9-month period that ranged between October 2022 – September 2023 based on when participants enrolled in the evaluation. Any records that were entered as chargeable claims for these service types were extracted. Patient messages were kept as a separate category to distinguish between asynchronous patient-clinic team contacts and interactive encounters. Both primary care encounters and patient messages excluded any CRS-related contacts. We also imported scheduling data to estimate a missed or cancelled appointment rate. We constructed a measure of missed or cancelled appointments as patient-initiated cancellations within 24 hours of a scheduled appointment and no-show appointments.

For our analyses, we used count measures for the following utilization outcomes: primary care visits, specialty care visits, behavioral health visits, urgent care encounters, and patient messages. We created a binary measure for ED visits and inpatient admissions because of a low frequency of encounters over 9 months. The missed/cancelled appointment rate ranged between 0-1 for each patient.

Independent variable

Our independent variable was social health support program assignment (CCC; CRS) given our intent-to-treat approach.

Covariates

We included sex, age group, and clinic as covariates in our model as these variables were used for stratified randomization in assigning participants to CCC or CRS. For longitudinal studies that use a randomized design, it is recommended to use stratification variables as covariates in the outcome models.[31] We also used race and ethnicity, and ACG resource utilization band as covariates as these two variables were not balanced between CCC and CRS participants. Standardized mean differences (SMDs) were used to identify imbalance between CCC and CRS participants based on a threshold of a SMD greater than 0.2. We operationalized ACG as a binary measure denoting No User/Low/Healthy vs. Moderate/High/Very High resource bands to increase cell sizes across categories. A composite race and ethnicity variable was also aggregated into six categories (African American/Black; Hispanic; Multiracial; White; Other; Unknown) due to small cell sizes. The "unknown" category includes individuals who refused or for whom the data was not collected. For the five count outcome models, we also included the respective count of encounters from nine months before randomization to baseline as a covariate to adjust for utilization at baseline.[31]

Statistical analyses

We described differences in utilization over a nine-month period using an intent-to-treat approach by comparing participants assigned to CRS relative to those assigned to CCC. We calculated descriptive statistics (proportions, mean, and SMDs) for the total sample and by social health support program.

We used negative binomial regression models to compare visit counts between groups for primary care visits, specialty care visits, behavioral health visits, urgent care visits, and patient messages. Differences in the probability of any ED visit or inpatient admission between groups were estimated using logistic regression. We used a fractional regression model to estimate differences in missed or cancelled appointment rates between groups. We reported average marginal effects (AMEs) to convey absolute differences between programs. The AMEs can be interpreted as absolute counts for count outcomes, probabilities for the binary outcomes, and percentages for the rate outcome. Stata 17 and RStudio 4.2.1 were used for analyses.

Secondary as-treated analyses

While our primary intent-to-treat analyses examined outcomes by randomized group, randomization did not guarantee that participants received resources from their assigned program. We conducted secondary as-treated analyses to assess utilization among those who received CRS compared to those who did not receive CCC or CRS. We defined program receipt if participants received resource or referral information from a CRS. We identified these participants by reviewing CRS case notes. This allowed us to compare full CRS engagement against a true comparison, rather than an active comparison group. As CRS is more resource intensive than CCC, these findings will also help inform health care systems about anticipated utilization outcomes in response to a care team navigator program.

The CRS comparison group consisted of participants who did not receive any information from their assigned social health support group based on CCC and CRS case notes. To address potential differences between groups receiving and not receiving CRS, we constructed a balanced comparison group using propensity score methods. This was accomplished by estimating propensity score weights using the “twang” package in R to balance groups who received and did not receive CRS using observable characteristics measured at baseline.[54] This package uses machine learning models that include non-linearities and covariate interactions that are data-driven into the propensity score model. We extracted the propensity score weights from the model and applied them to data restricted to the as-treated sample using the “svyset” command in Stata.[55] Additional details about the development of the as-treated sample using propensity score weights can be found in the Appendix.

Results

Of those who were eligible to be screened during the enrollment period and completed the SHQ, 534 participants were randomized and included in analyses (Figure 4). CCC consisted of 266 participants and 268 individuals were assigned to CRS. Table 3 shows two-thirds of the sample were female (66%). The largest age group was patients 18-40 years of age, representing over one-third of the sample. Patients 60 years and older were the second largest group representing 33% of the sample. More than half of participants identified as White (55%) and about 40% had commercial health insurance. The majority of participants also fell into moderate or higher ACG levels. About 74% of participants were from Clinic A which serves about three times the number of patients as Clinic B.

Participants' demographics were mostly balanced between CCC and CRS, except race and ethnicity and ACG level. There were fewer participants who identified as Hispanic in CCC (4.5%) than CRS (7.8%), and a larger proportion of White participants in CCC (57.5%) compared to CRS (53.4%). We also observed that fewer CCC participants fell into a "Low" ACG level compared to CRS (3.8% and 6.0%, respectively), and more CCC participants were in a "High" ACG level relative to CRS (18.8% and 15.3%, respectively). Table 4 shows the mean utilization of our outcomes over 9 months and by assigned program. For example, participants had an average of 5.2 (SD = 5.4) primary care encounters, with CCC participants having fewer visits (4.8, SD = 4.7) than CRS participants (5.6 visits, SD = 6.0). The number of primary care encounters was slightly higher in the earlier half of the follow-up period (Figure 5).

Intent-to-treat unadjusted regression results showed that participants assigned to CRS had 0.92 (95% CI: 0.310, 1.528) more primary care encounters than CCC participants (Table 5). Adjusted results showed that CRS participants had 1.04 (95% CI: 0.336, 1.746) more primary care encounters than CCC participants over a nine-month period. While statistically significant differences between groups were not identified for all other utilization categories, we observed a trend of slightly higher specialty, behavioral, and urgent care utilization, and patient messages among CRS compared to CCC participants. Our findings from a sensitivity analysis that excluded specialty care outliers were consistent with the main specialty care results.

Secondary as-treated analyses

We found that participants who received CRS had 1.66 (95% CI: 0.303, 3.008) more primary care encounters and 3.90 (95% CI: 1.010, 6.794) more specialty care encounters relative to those not receiving CRS (Table 6). Those who received CRS also had 3.85 (95% CI: 1.426, 6.276) more messages than those not receiving CRS. Similar to the intent-to-treat results, we observed a slightly higher trend of behavioral health visits. however, we did not observe any statistically significant differences for all other utilization categories.

Discussion

This study assessed the effects of a pilot social health integration program on health care utilization. Specifically, this study compared the impact of two social health support programs on utilization outcomes in a general patient population over 9 months. Our intent-to-treat findings showed that participants assigned to CRS, a local, care-team based program, had more primary care encounters than those assigned to receive support from CCC, a centralized operator call center that connects patients with resources. Our as-treated results showed that those who spoke to and received support from CRSs not only had more primary care visits, but also more specialty care visits and patient messages from their care team than those not receiving CRS support. This suggests that the program in which participants spoke to an agent who provided resources was associated with increased non-urgent/emergent health care utilization.

There are a few things to consider when interpreting these findings and understanding how they may apply to other health care systems. First, an increase in primary care visits in the intent-to-treat findings, as well as specialty care and patient messages in the as-treated results, may reflect the CRS program structure. CRSs are embedded in care teams and can support participants by following up with them after appointments and assisting with future scheduling, contributing to greater continuity of care. Additionally, increased engagement between CRSs and participants can increase trust and rapport with both their care teams and the health care system. This may help explain increased engagement in preventive and outpatient services among CRS participants to address their medical needs.

Second, it is important to understand the types of services that were captured through primary and specialty care claims. High frequency services that fell under primary care included office and telehealth visits, sick-visit consultations, and vaccines. For specialty care, the most common services consisted of office visits, eye-care related visits, and lab, imaging, and radiology services. This suggests that the visits were most often for preventive, primary and specialty care services. Third, the changes we observed align with the conceptual relationship between SHI programs and utilization outcomes. For example, CRSs can assist patients with scheduling appointments and may help with participants' continuity of care after their primary care visits. CRSs also provide emotional support as members of the care team and may encourage participants to follow through on their treatment plan, scheduling necessary appointments to address their medical needs. Resolution of social needs after meeting with CRS could also be another pathway to influence utilization patterns by improving participants' access to care. However, previous research did not find differences in social needs resolution between CCC and CRS participants.[56]

Fourth, it is likely that we did not observe differences in other utilization outcomes because of the frequency of these visits in this sample and the study timeline. For example, the count of behavioral health and urgent care visits among CCC and CRS participants were close to 1 or lower, meaning that these were not highly used services for this sample. This made it difficult to detect differences between groups. Behavioral health visits as an outcome were a subset of specialty care visits and it is possible there may be provider capacity or access issues that contributed to the low frequency of visits, especially during the pandemic. Additionally, it is likely that mild to moderate behavioral health concerns were addressed in primary care while specialty care behavioral health encounters are often reserved for moderate to severe concerns in this health system. This suggests that our findings from a primary care-based SHI program are informative about more immediate patterns of utilization, such as primary care, in addition to specialty care visits and patient messages for participants who had a more intensive form of the care-team navigator CRS program.

Limitations

There are a few limitations to this study. Our intent-to-treat analysis compared participants between CCC, which acted as an active comparison group, to CRS. Due to external factors, there were more similarities than originally anticipated and this may have minimized potential differences between programs. However, the as-treated analysis allowed us to assess differences between those who received CRS and participants who did not receive resource information from any program. In addition, we were only able to measure utilization within the KP health care system or through any external claims that were submitted to KPWA. While we incorporated additional time to ensure we included external claims that were processed late, it is possible that participants had out-of-insurance visits. A larger sample size or a longer follow-up period could also have allowed us to detect larger counts and any potential changes in ED visits or inpatient admissions. In looking at utilization patterns nine months prior to randomization to understand baseline utilization, we observed low counts of ED visits and inpatient admissions among our study sample. A larger sample size would have also allowed us to conduct an as-treated analysis of CCC to better understand how patients who received support from an operator center modality differed in their utilization to non-recipients. Lastly, patients were only eligible for randomization if they scheduled and completed a primary care appointment at one of the two clinics. This limited our eligible sample to patients who were already engaged with the health care system. It is possible that patients with little or no original engagement with the health care system may have a larger magnitude of changes in utilization in response to these types of interventions. However, our study design aligns with other SHI programs in which patients are recruited based on an encounter with the health care system. Conducting patient outreach or including patients from multiple settings for future SHI initiatives may capture patients with varying levels of baseline engagement, but would require cross-departmental coordination.

Implications

In our study, participants who fully engaged with our more resource-intensive CRS program had higher specialty and patient messages, in addition to primary care visits, than those who did not. These findings can help inform decision makers about how to distribute resources as their health care systems develop SHI programming. There are a variety of ways that health care systems can allocate resources towards screening and resource connection practices and it is possible, given the nature of social risk, that more intensive support is necessary to realize change.

CRS was the more resource and contact intensive social support program and health care systems that adopt a similar intervention should anticipate an increase in primary and specialty care utilization in the short-term. These findings align with the conceptual framework that SHI programs can influence utilization, supporting the potential of the CRS program. However, our study's findings on the impact on long-term, and often avoidable utilization outcomes, remains unclear. To understand these long-term effects, additional research over a longer time frame would be beneficial for health systems to understand how long to expect higher counts of outpatient services and the extent of changes on other avoidable, emergent utilization.

Tables and Figures

Figure 4: CONSORT diagram for Randomized Participants

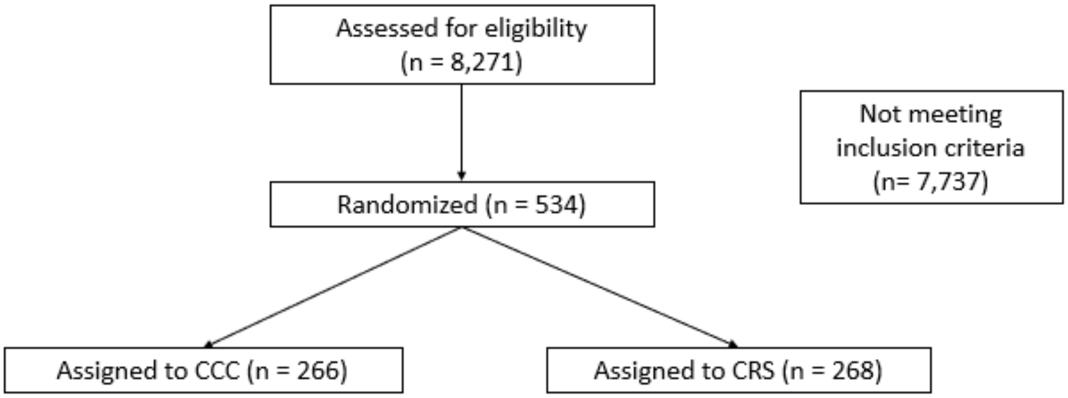


Table 3: Participant characteristics

Characteristic	CCC (n = 266)	CRS (n = 268)	Total (n = 534)	Standardized mean difference
Sex, n(%)				0.01
Female	176 (66.2%)	176 (65.7%)	352 (65.9%)	
Male	90 (33.8%)	92 (34.3%)	182 (34.1%)	
Age, n(%)				0.018
<18	23 (8.6%)	24 (9.0%)	47 (8.8%)	
18-40	95 (35.7%)	94 (35.1%)	189 (35.4%)	
41-60	62 (23.3%)	62 (23.1%)	124 (23.2%)	
60+	86 (32.3%)	88 (32.8%)	174 (32.6%)	
Race and ethnicity, n(%)				0.188
African American or Black	12 (4.5%)	12 (4.5%)	24 (4.5%)	
Native American or Alaska Native	1 (0.4%)	2 (0.7%)	3 (0.6%)	
Asian	7 (2.6%)	8 (3.0%)	15 (2.8%)	
Hispanic	12 (4.5%)	21 (7.8%)	33 (6.2%)	
Multiracial	10 (3.8%)	13 (4.9%)	23 (4.3%)	
Native Hawaiian or Pacific Islander	6 (2.3%)	3 (1.1%)	9 (1.7%)	
White	153 (57.5%)	143 (53.4%)	294 (55.0%)	
Other	5 (1.9%)	6 (2.2%)	11 (2.1%)	
Unknown	60 (22.6%)	60 (22.4%)	120 (22.5%)	
Insurance type, n(%)				0.079
Commercial	112 (42.1%)	116 (43.3%)	228 (42.7%)	
Individual	8 (3.0%)	6 (2.2%)	14 (2.6%)	
Medicaid	36 (13.5%)	41 (15.3%)	77 (14.4%)	
Medicare	81 (30.5%)	76 (28.4%)	157 (29.4%)	
No coverage	29 (10.9%)	29 (10.8%)	58 (10.9%)	
Adjusted clinical group utilization band, n(%)				0.104
Non-user	7 (2.6%)	11 (4.1%)	18 (3.4%)	
Healthy users	10 (3.8%)	7 (2.6%)	17 (3.2%)	
Low	10 (3.8%)	16 (6.0%)	26 (4.9%)	
Moderate	84 (31.6%)	82 (30.6%)	166 (31.1%)	
High	50 (18.8%)	41 (15.3%)	91 (17.0%)	
Very High	36 (13.5%)	33 (12.3%)	69 (12.9%)	
Missing	69 (25.9%)	78 (29.1%)	147 (27.5%)	
Clinic				0.013
A	197 (74.1%)	197 (73.5%)	394 (73.8%)	
B	69 (25.9%)	71 (26.5%)	140 (26.2%)	
Count of BL needs, mean (SD)	1.74 (1.36)	1.85 (1.33)	1.80 (1.35)	0.079

Table 4: Utilization summary over 9 months, by social health support program

	CCC (n = 266)	**CRS (n = 268)**	**Total (n = 534)**
Utilization measure	Mean (SD)	Mean (SD)	Mean (SD)
Primary care encounters	4.77 (4.66)	5.58 (5.99)	5.18 (5.38)
Specialty care encounters	5.62 (8.10)	6.03 (9.81)	5.82 (8.99)
Behavioral health encounters	2.01 (5.41)	2.05 (5.32)	2.03 (5.36)
Urgent care encounters	0.726 (1.85)	0.970 (3.55)	0.848 (2.84)
Emergency department visits	0.628 (2.54)	0.537 (1.70)	0.582 (2.16)
Inpatient admissions	0.586 (2.86)	0.638 (4.70)	0.612 (3.89)
Patient messages	7.02 (7.49)	7.91 (10.1)	7.47 (8.89)
Missed/cancelled rate	17.5 (25.4)	18.3 (23.5)	17.9 (24.5)

Figure 5: Average primary care encounters, by month and social health support program

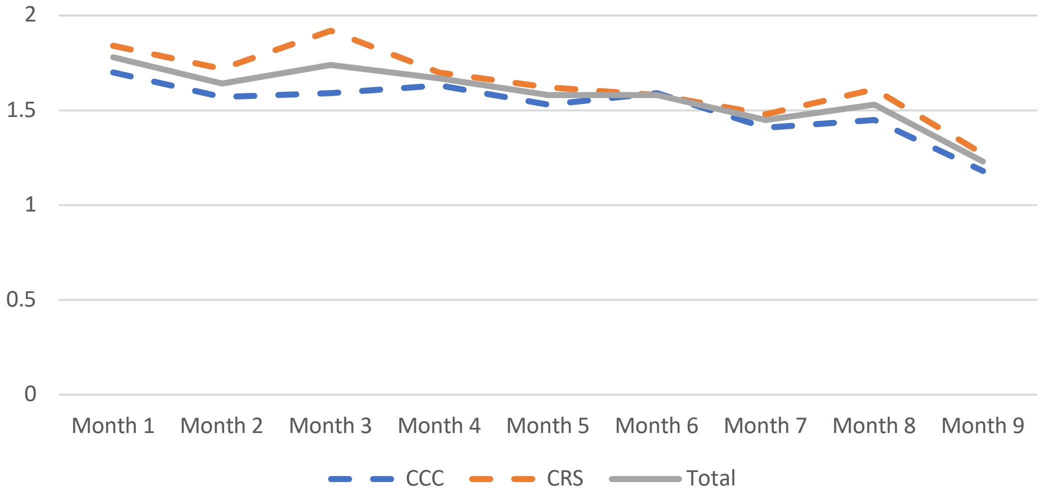


Table 5: Intent-to-treat unadjusted and adjusted utilization results

Unadjusted									
Outcome	CCC			CRS			Difference		
	Estimate	95% CI		Estimate	95% CI		AME	95% CI	
Primary care encounters	3.85	3.412	4.296	4.77	4.244	5.302	0.92	0.310	1.528
Specialty care encounters	4.26	3.455	5.056	5.00	3.929	6.067	0.74	-0.397	1.883
Behavioral health encounters	0.80	0.531	1.076	1.09	0.661	1.524	0.29	-0.137	0.715
Urgent care encounters	0.47	0.339	0.605	0.62	0.442	0.791	0.14	-0.037	0.325
Patient messages	5.91	5.182	6.638	6.16	6.940	6.940	0.64	-0.337	1.623
ED visits (any)	0.12	0.078	0.155	0.13	0.093	0.175	0.02	-0.039	0.073
IP admissions (any)	0.07	0.040	0.102	0.06	0.028	0.083	-0.02	-0.057	0.026
Missed/cancelled rate	0.17	0.143	0.206	0.18	0.154	0.213	0.01	-0.034	0.052
Adjusted									
Outcome	CCC			CRS			Difference		
	Estimate	95% CI		Estimate	95% CI		AME	95% CI	
Primary care encounters	4.37	3.874	4.859	5.41	4.732	6.084	1.04	0.336	1.746
Specialty care encounters	3.67	2.866	4.471	4.31	3.343	5.282	0.64	-0.332	1.619
Behavioral health encounters	0.78	0.460	1.093	1.06	0.658	1.454	0.28	-0.113	0.673
Urgent care encounters	0.38	0.251	0.501	0.49	0.337	0.644	0.11	-0.028	0.258
Patient messages	5.38	4.485	6.285	5.97	5.009	6.932	0.59	-0.301	1.473
ED visits (any)	0.12	0.084	0.163	0.16	0.112	0.201	0.03	-0.027	0.093
IP admissions (any)	0.08	0.045	0.112	0.07	0.035	0.097	-0.01	-0.058	0.033
Missed/cancelled rate	0.18	0.145	0.207	0.18	0.153	0.211	0.01	-0.037	0.049

*Note: ED = Emergency department; IP = Inpatient; AME = Average marginal effect

Table 6: As-treated CRS weighted utilization results

CRS									
Outcome	Comparison group			CRS receipt (n = 119)			Difference		
	Estimate	95% CI		Estimate	95% CI		AME	95% CI	
Primary care encounters	4.68	4.095	5.275	6.34	5.124	7.557	1.66	0.303	3.008
Specialty care encounters	4.57	3.871	5.263	8.47	5.661	11.275	3.90	1.010	6.794
Behavioral health encounters	1.88	1.312	2.442	2.66	1.418	3.902	0.78	-0.582	2.147
Urgent care encounters	0.76	0.583	0.944	1.49	-0.004	2.990	0.73	-0.779	2.237
Patient messages	6.10	5.342	6.859	9.95	7.648	12.255	3.85	1.426	6.276
ED* visits (any)	0.11	0.075	0.142	0.17	0.091	0.246	0.06	-0.024	0.144
IP* admissions (any)	0.06	0.039	0.085	0.06	0.017	0.109	0.00	-0.050	0.053
Missed/cancelled rate	0.19	0.162	0.222	0.16	0.126	0.204	-0.03	-0.077	0.022

*Note: ED = Emergency department; IP = Inpatient; AME = Average marginal effect

Chapter 4: Differences in health care costs between two social health support programs: findings from a randomized social health integration pilot program

Abstract

Introduction: More health systems are implementing strategies to understand and address patient social health, also known as social health integration. We examine the impact of a pilot social health integration program in two Kaiser Permanente Washington primary care clinics on costs.

Methods: We randomized 534 patients who reported any social need between October 2022 – January 2023 to receive support from a centralized Connections Call Center (CCC) or clinic-based Community Resource Specialists (CRS). We used administrative and claims data to compare costs incurred by the health care system over 9 months. Using an intent-to-treat approach, we used two-part models to estimate costs for behavioral health, emergency department, inpatient admissions, and urgent care cost outcomes. We estimated single-part models using generalized linear models for primary care, specialty care, and total costs. Our secondary as-treated analyses compared costs among those who received support from CRS to those who did not.

Results: Unadjusted results did not show significant differences between CRS and CCC participants. Adjusted findings showed that CRS participants had $286 higher primary care costs than CCC participants (95% CI: $63.61, $508.89). As-treated findings showed that those who received CRS assistance had $2356 more specialty care costs (95% CI: $231, $4480) than those who did not.

Conclusions: Changes in primary and specialty care costs may be in result of positive engagement with the health system that will support patients in managing their health and ideally

prevent avoidable utilization in the long-term. These findings can help inform others who are interested in adopting similar interventions in primary care.

Introduction

A recent rise in payment policy reform and incentives are intended to encourage health systems to address patients' non-medical social factors such as housing, employment, or transportation. Prior studies have demonstrated that individuals experiencing challenges with these social factors are also more likely to have complex medical needs and use avoidable health services, which ultimately increases costs and the resource burden on health systems.[2,3,43,57–59] There is increasing attention towards how policies can incentivize health care systems to address patient social health, ideally influencing their medical needs and use of health care resources. Examples of revised payment policies to support patients with their social health include Section 1115 Medicaid waivers and certain Medicare Advantage plans' benefits for individuals with chronic conditions.[60,61] Additionally, there has been greater attention towards how value-based purchasing and Accountable Health Communities models can be leveraged to address patients' social needs.[23,62] In response to the relationship between social health factors and patient health, as well as an increase in incentives, health systems may adopt practices to identify and respond to patients' social needs through clinic and community settings, which is also known as social health integration (SHI).[5,6,8,44]

SHI activities fall in to five categories: (1) awareness through identification of social risks, (2) adjustment by modifying care that acknowledges patients' social health, (3) assistance through resource connection, (4) alignment of health systems with the community to address patient needs, and (5) advocacy by promoting policy change.[19] Awareness and assistance categories are the most common and consist of health care systems screening patients for social needs and providing them with resources or referrals to social services, respectively.[63] These activities can range from call line operators to help with resource navigation to on-site community health workers.[20–22]

SHI is hypothesized to impact health outcomes, including cost and utilization, through multiple pathways.[45,46] For example, SHI programs may directly address patients' social needs which allows patients to access or afford social services, and prioritize their health. This can give patients greater capacity and confidence in managing their health. Additional contact and engagement with patients through SHI programs can also influence how they interact with the health care system. For example, patients might be encouraged to schedule timely preventive care or other outpatient services which can prevent avoidable utilization. This shift towards less resource intensive services can decrease expenses incurred by the health care system.[45,46]

Previous studies have provided some support for these hypothesized relationships. Research assessing both the cost of investing in SHI interventions and changes in costs over time commonly reported positive returns on investments (ROIs). For example, one program focused on Medicaid beneficiaries and uninsured individuals found that Medicaid payers received a return of $2.47 for every dollar invested in the SHI intervention, and these savings were largely from decreases in inpatient admissions and outpatient services over a year.[52] Another study on uninsured and publicly insured adults who participated in a social support resource connection program after being discharged found a ROI of $1.80 to the health care system for every dollar invested in the program.[64] Similarly, another hospital reported positive ROI from a social health navigator program and these savings were from changes in inpatient admissions and ED visits.[65]

Other studies that reported changes in costs incurred by the payer or clinic more commonly reported decreases or no effects on health care cost outcomes.[66] These mixed findings stem from the variation in the type of SHI interventions and how costs were measured. For example, one study assessed the effects of two social health interventions, an acute care coordination model and a community integrated behavioral health model, on publicly insured beneficiaries' cost of care from the perspective of the Centers for Medicare and Medicaid Services (CMS). The authors observed a decrease in total costs by $24.4 million for CMS only among the 2,500 Medicaid participants who were enrolled in the community-level integrated intervention.[50] Another study found an 11% decrease in total costs incurred by a managed care organization (MCO) among Medicare and Medicaid MCO beneficiaries whose social needs were met.[67] Other studies examining effects of social health navigator programs found that hospitals incurred lower costs for these participants over time.[68,69] Changes in total costs were commonly driven by reductions in emergency department and inpatient admissions expenses. Overall, most evidence suggests that these programs can lead to net cost savings or reduced total costs, but given the wide variation in the types of programs, target populations, and associated cost savings, more research is needed to inform health care systems about expected effects from SHI programs that target general patient populations.

The purpose of this study is to examine the effects of a primary care-based SHI pilot program on costs incurred by the health care system over nine months. Kaiser Permanente (KP) is a national, not-for-profit integrated health care system. The KP Washington (KPWA) region serves approximately 700,000 patients in Washington State and this pilot program took place in two KPWA clinics. Through this SHI program, participants in two primary clinics were randomized to receive social health support from one of two interventions: Connections Call

Center (CCC), a centralized call center program, or a Community Resource Specialist (CRS) program which consists of clinic-based resource navigators. We report the relative differences between social health support programs in health care costs over nine months.

Methods

Overview of Study Design

We used a stratified randomization design to observe differences in cost outcomes measured from a health system level. Patients who reported any social need on a universal screener were randomized to receive assistance through CCC or CRS. Patients were randomized between October 2022 – January 2023 within strata of administrative sex, age group, and clinic. We extracted participant characteristics from electronic health records (EHRs) and claims data over a nine-month follow-up period from the KPWA database. This pilot program was deemed a quality improvement project and not human subjects research by the KPWA Institutional Review Board.

Social health support programs

There were two social health support programs to which participants could be randomized following screening positive for a social need. CCC is a centralized call center and is administered by KP National. CRSs are local, in-person specialists that are also part of patients' care teams. Both CCC and CRS have access to a centralized resource directory to provide patients with referrals and resource information. CRS also have local knowledge about community resources and are trained in motivational interviewing techniques to support patients. Staff in both programs initiate contact with patients after randomization and require that the same agent who makes the initial call with a patient also conduct the follow-up calls. Before this evaluation, participants who were randomized to CCC received contact information for CCC through their after-visit summary and were responsible for initiating contact with CCC in order to receive assistance. However, less than 1% (2/214) of those who received CCC information contacted CCC. For this evaluation, the CCC workflow was revised so that CCC proactively reached out to participants randomized to this program. For this evaluation, CRS similarly received information about participants after they were randomized rather than the same day they completed their screeners. This differed from their normal workflow to accommodate the evaluation.

Setting and study sample

KPWA identified two clinics in WA state to receive implementation support to adopt a universal screener that asked patients about their social health as part of a SHI initiative. The clinics were selected because they differed in size and had a range of patient diversity compared to other clinics in the KPWA region. These clinics were located in different regions of WA state, and it was unlikely that patients would visit both. Patients received a Social Health Questionnaire (SHQ) if they scheduled an office visit with a primary care provider (excluding nurse and walk-in clinic visits) at a primary care clinic (Family Practice, Pediatrics, General Internal Medicine).

The SHQ is a screener unique to KPWA and includes 9 items asking about patients' social health. One item asks if they would like assistance with up to 10 social health factors, with endorsement indicating a social need. Patients could select all that apply from the following list of social needs: food, housing, transportation, finances, loneliness or social isolation, employment, utilities, childcare, caregiving, paying for medical care, medicine, medical supplies. This screener could be completed in advance or in-person either electronically or on paper.

Patients were eligible for randomization if they reported any need (i.e., desire for help with 1 or more factor(s)) on the SHQ during the enrollment period. Caregivers completed the

SHQ on behalf of any patients who were younger than 18 years of age. Eligible participants were excluded from the study if they had a same-day referral to or encounter in the past month with a CRS, had someone in their household that was already a participant in this evaluation, spoke a language other than English or Spanish, opted out of outreach activities based on documentation in their EHR, or died during the follow-up period.

Data

We extracted participant characteristics from KPWA's data warehouse where EHR data is stored. Claims data from an internal data warehouse were used to extract expenses incurred by the health care system over a nine-month follow-up period. We used claims data from October 2022 – December 2023 to account for a data lag from externally submitted claims.

Participant characteristics

We extracted demographic data from patients' EHRs which included administrative sex, age at enrollment, age groups (<18; 18-40; 41-60; 60+). These characteristics were used for stratified randomization. Race and ethnicity data was self-reported during patients' appointments and was stored in their EHRs. We imported this administrative data that consisted of 9 categories (African American or Black; Native American or Alaska Native; Asian; Hispanic; Multiracial; Native Hawaiian or Pacific Islander; White; Other; Unknown). The unknown category includes patients for whom this data was not collected or that refused to answer. We modified the Multiracial group which included participants who identified as Multiracial to also include those who identified with more than one race and ethnicity category. We constructed a categorical measure denoting participants' type of insurance (commercial; individual; Medicare; Medicaid; no coverage) derived from administrative data

We also accessed Johns Hopkins' Adjusted Clinical Group (ACG) resource bands (non-user; healthy users; low; moderate; high; very high; missing) from participants' EHRs. ACGs predict patients' expected resource use in the future based on their previous claims data.[32] We imported participants' clinic (A;B) based on where their eligible primary care appointment was scheduled.

Outcome measures

We used claims data to construct the following types of costs using claims data: primary care, specialty care, behavioral health, ED visit, inpatient admissions, urgent care, and total costs. Each measure was constructed using a combination of service type, service subcategories, and place of service variables (Appendix). These outcomes reflect costs incurred by the health care system over nine months and include direct and indirect costs. Examples of direct costs include labor and benefits for medical and non-medical staff, billable medical supplies and drugs, other internal expenses (e.g., equipment, repairs, office supplies), and externally delivered claims. Indirect costs include expenses related to regional and care delivery administration, IT support, overhead, medical and non-medical benefits for employees, facility and clinic, and malpractice insurance expenses. CRS-related expenses were excluded in these outcomes.

Independent variable

In the primary intent-to-treat analysis, the independent variable was a binary indicator denoting the social health support program (CCC or CRS) participants were randomized to. We also conducted a secondary as-treated analysis focused on participants who received CRS, defined by receipt of resources from a CRS. The independent variable for the as-treated analyses was a binary variable indicating CRS receipt (0/1).

Covariates

We included sex, age group, and clinic as covariates in our adjusted models. These variables were used in the stratified randomization process to assign participants to CCC or CRS. It is recommended to include variables used for stratification as covariates in longitudinal studies with a randomized design.[31]

We also included race and ethnicity and ACG resource utilization band as covariates. After participants were randomized, we found that these two variables were not balanced between those assigned to CCC and CRS. We confirmed this by calculating standardized mean differences (SMDs) and found that both characteristics had a SMD > 0.2, suggesting imbalance.[70] For our models, we operationalized ACG resource bands into a binary measure (No User/Low/Healthy; Moderate/High/Very High) to increase cell sizes across categories. We also aggregated the race and ethnicity variable so it consisted of fewer categories (African American/Black; Hispanic; Multiracial; White; Other; Unknown) given the small cell sizes of the original categories. For our final covariate to adjust for costs at baseline, we extracted the respective cost amount for each category from nine months before randomization to baseline.[31]

Statistical analyses

We calculated descriptive statistics for individual characteristics (proportions, means, and standardized mean differences) for all participants, and by intervention arm. We also described differences in cost outcomes over a nine-month period across programs.

We estimated separate models for each cost outcome. For outcomes in which over half of participants did not have any costs, we used two-part models to estimate costs.[71] With this approach, we estimated a first part model using logistic regression to estimate the probability of having any cost in a given category. The second part model used generalized linear models

(GLMs) to estimate the expected costs among participants with non-zero costs. Two-part models were estimated for behavioral health, ED, inpatient admissions, and urgent care cost outcomes. We estimated single-part models using GLMs for primary care, specialty care, and total costs as over half of participants reported any costs for these categories. We applied modified Park tests to identify the most appropriate distribution function for the each of these outcome models.[72] For all outcomes, we reported average marginal effects (AME) to capture the absolute dollar difference between CCC and CRS participants over the follow-up period. Average effects of the two-part models take into account both parts of the models.[73] Stata 17 and RStudio 4.2.1. were used for analyses.

As-treated analysis

Because assignment to a social health support program did not guarantee participant uptake or receipt of resources, we conducted a secondary as-treated analysis in which we compared costs among those who received resource information from CRS compared to those who did not receive any support from CRS or CCC. This allowed us to assess differences between a more resource intensive program such as CRS against a comparison group not exposed to the program.

The comparison group consisted of participants who were assigned to CRS or CCC but did not receive resources from any agent. We identified participants who fell in our treatment and comparison groups by reviewing CRS and CCC case notes which were free text fields and would include details about resources or referrals provided to participants. We used propensity score weights to create a balanced comparison group. Specifically, we used the “twang” package in R to balance both groups using observable characteristics at baseline and estimate propensity score weights.[54] This package uses machine learning models to determine inclusion of covariate interactions and non-linearities that are data driven into the propensity score model. This means that regardless of the amount or types of covariates, this package allows for a rapid distribution of variables. We extracted the propensity score weights from the model and applied them to the data restricted to the as-treated sample using the "svyset" command in Stata. The independent variable for the two-part and single-part models using this sample was a binary indicator of CRS receipt or no receipt. Further details about developing the as-treated sample can be found in the Appendix.

Results

We included 534 participants in this evaluation and 266 were randomized to CCC while 268 were assigned to CRS (Figure 4). Table 3 shows that most participants were female (66%). Over one-third of participants were between 18-40 years of age and 33% were 60 years or older. The majority of participants identified as White (55%) and about 40% were enrolled in commercial insurance. Of those that had a documented ACG level, the majority fell into moderate (31%), high (17%), or very high (13%) categories. Almost three-quarters of participants were from Clinic A, which is proportional to the amount of patients in Clinic A compared to Clinic B.

Participant characteristics between CCC and CRS were mostly balanced with the exception of race, ethnicity and ACG level. Specifically, CCC had fewer participants that identified as Hispanic relative to CRS participants (4.5% vs. 7.8%). A larger proportion off CCC participants identified as White compared to CRS (57.5% vs. 53.4%, SMD= 0.188). Compared to CCC participants, a higher proportion of CRS participants were classified as "Low" ACG (3.8% vs. 6.0%) and a lower proportion were classified as "High" ACG (18.8% vs. 15.3%, SMD = 0.104).

Table 7 shows average costs for each outcome for the total sample and by social health support group over nine months. We found through an exploratory assessment that costs 9 months before randomization were similar to post-9 months costs. We did not observe any significant differences between CCC and CRS participants in our unadjusted intent-to-treat results (Table 8). Our adjusted results showed that CRS participants had approximately $286 higher primary care costs than CCC participants (95% CI: $63.61, $508.89) over the 9-months following randomization. We did not observe statistically significant differences for other cost categories.

As-treated findings

We found that participants who received CRS had approximately $2356 more specialty care costs (95% CI: $231, $4480) than those who did not receive CRS or CCC over a nine-month period (Table 9). We did not observe statistically significant differences for any other cost categories in the as-treated analysis. Average costs for this weighted sample over nine months can be found in the Appendix.

Discussion

The purpose of this study was to evaluate changes in costs incurred by a health care system in response to a pilot SHI program. Specifically, we reported effects on health care costs in response of two SHI interventions—a local CRS navigator program and CCC, and operator call center modality—in a primary care setting. Our intent-to-treat results showed that participants assigned to CRS had $286 higher primary care costs than participants assigned to CCC. This made up approximately 21% of average primary care costs over 9 months among participants. Our as-treated analyses findings showed that participants who fully engaged with CRS through conversations and receipt of resources had higher specialty care costs compare to those who did not receive resource support from CRS or CCC. This accounted for about 76% of specialty care costs over 9 months for this sample. Overall, both SHI programs were associated with increased health care costs.

Previous studies of SHI interventions have varied in how they reported cost outcomes, making it difficult to compare our findings in terms of the magnitude of cost differences. For example, studies that reported large, significant cost differences over time often focused on large payer beneficiaries, such as Medicare, Medicaid, or Medicare Advantage beneficiaries, and these changes were often driven by a shift away from ED or inpatient admissions costs. These studies also varied in follow-up time periods, ranging up to 2 years. However, the measures used in our study (percent differences in primary and specialty care costs relative to mean costs over 9 months) may be more meaningful for health systems or clinics that are trying to understand potential relative changes in costs in response to SHI initiatives.

There are practical and conceptual considerations that offer important context for interpreting these results. First, the findings may reflect the practical nature of the CRS program. CRS conduct follow-up calls to encourage patients to manage their health and assist in scheduling health care appointments as needed, not just appointments with community-based organizations related to their social health. An increase in primary care costs in the intent-to-treat sample and specialty care costs in the as-treated sample may have been due to CRS following up with patients after their primary care appointment and assisting with scheduling specialty care visits. Second, the increases in primary and specialty care costs may reflect an increase in preventive and other outpatient service utilization in the short-term. Common service types contributing to primary care costs that we identified in claims data included office and telehealth visits, sick-visits, and vaccines. High frequency claims for specialty care costs consisted of office visits, eye-care related visits, and lab, imaging, and radiology services. Although we did not observe decreases in urgent services or avoidable costs that stem from changes in ED visits or inpatient admissions, we would likely need a longer follow-up period to observe changes in these lower base-rate events.

It is also important to recognize that our findings report costs incurred by the health care system in response to two active social health support programs without a true control group, and we were unable to include costs for implementing each of these programs in our analysis. While these outcomes are informative about anticipated cost changes for specific departments and service types, understanding net costs may be more meaningful for health care systems who are still in the decision-making process about SHI implementation.

Limitations

There are a few limitations to this study. First, the study sample size did not allow us to conduct as-treated analyses for participants who received CCC. For the CRS as-treated results, it is likely that the use of inverse weighing methods with this sample size contributed to the confidence intervals for our marginal effects. While primary care costs were not significantly different, the directionality of this outcome was consistent with the intent-to-treat results. Second, it is possible that a longer follow-up period would have allowed us to identify potential changes in costs associated with avoidable or emergent care. However, our current findings are still informative for health care systems wanting to understand potential short-term changes in costs. Third, we compared costs for CRS participants to an active comparison group. Our secondary as-treated analyses aimed to address this by assessing differences between CRS receipt and a true comparison group consisting of those who did not receive any social health support.

Conclusion

Participants assigned to the more resource-intensive CRS program had higher primary care costs than CCC, and those who received CRS support had higher specialty care costs relative to those who did not receive any support. These findings may help health care systems interested in adopting similar SHI awareness and assistance activities in a primary care setting understand potential changes in costs by department or types of services. These changes in costs may reflect positive patient engagement with the health system that will support them in managing their health and ideally prevent avoidable utilization in the long-term. Additional research is needed to understand if primary care-based SHI programs are associated with changes in costs related to ED visits and inpatient admissions over a longer duration of time. While it is beneficial to understand changes in costs, health care systems should also consider investment costs and potential ROIs in their decision making.

Table 7: Costs by social health support group over 9 months

	CCC (n = 266)	CRS (n = 268)	Total (n = 534)
Cost category			
Primary care, mean (SD)	1370 (2450)	1420 (2010)	1390 (2240)
Specialty care, mean (SD)	3310 (13500)	3100 (9550)	3200 (11700)
Behavioral health, mean (SD)	593 (2390)	572 (2030)	582 (2210)
ED, mean (SD)	404 (1780)	326 (1310)	365 (1560)
Inpatient admissions, mean (SD)	2020 (11400)	1570 (8620)	1790 (10100)
Urgent care, mean (SD)	335 (783)	393 (855)	364 (820)
Total costs	11200 (24500)	9340 (18900)	10300 (21900)

Note: AME = Average marginal effect; ED = Emergency department; IP = Inpatient

Table 8: Unadjusted and adjusted intent-to-treat results

Outcome	CCC			CRS			Difference		
	AME ($)	95% CI		AME ($)	95% CI		AME ($)	95% CI	
Unadjusted									
Primary care costs	1499	1199	1798	1607	1355	1858	108	-283	499
Specialty care costs	3312	1694	4931	3025	1902	4147	-288	-2257	1682
Behavioral health costs	613	323	903	573	329	817	-40	-419	339
ED costs	403	189	617	318	163	473	-85	-349	180
IP admission costs	1939	650	3228	1545	504	2587	-394	-2051	1263
Urgent care costs	335	241	429	387	285	488	52	-86	190
Total costs	11258	8369	14148	9437	7199	11676	-1821	-5476	1834
Adjusted									
Primary care costs	1272	1095	1448	1558	1363	1753	286	64	509
Specialty care costs	2171	1342	3000	2356	1618	3094	185	-695	1064
Behavioral health costs	595	363	827	591	425	757	-4	-274	267
ED costs	376	173	579	411	234	588	34	-212	281
IP admission costs	1559	249	2870	2440	798	4083	881	-1327	3089
Urgent care costs	338	255	421	384	298	469	45	-73	164
Total costs	8402	5867	10937	8550	6485	10614	148	-2345	2640

Note: AME = Average marginal effect; ED = Emergency department; IP = Inpatient

Table 9: CRS as-treated weighted results

Outcome	No receipt			CRS			Difference		
	AME ($)	95% CI		AME ($)	95% CI		AME ($)	95% CI	
Primary care costs	1241	1021	1461	1615	1239	1992	374	-62	810
Specialty care costs	2027	1385	2668	4382	2357	6408	2356	231	4480
Behavioral health costs	563	278	849	617	263	971	54	-401	509
ED costs	262	112	411	682	206	1159	421	-79	920
IP admission costs	1538	505	2570	2065	227	3902	527	-1581	2634
Urgent care costs	334	261	406	486	228	745	152	-116	421
Total costs	8651	6675	10628	12726	8255	17197	4074	-814	8963

Note: AME = Average marginal effect; ED = Emergency department; IP = Inpatient

Chapter 5: Conclusion

There is a strong evidence base that establishes the relationship between social factors and health outcomes. Social health integration consists of health care system efforts to identify and address patients' social needs through resource connection. In response to changing payment reforms through Medicare Advantage plans and Medicaid waivers, as well as a HEDIS quality measure, to incentivize and motivate health systems to adopt SHI practices, there has been a rise in SHI interventions.[26,74] The settings and components of these SHI interventions can vary as there are no established best practices, and findings from these programs are largely mixed.[16,66]

SHI programs so far have been beneficial in solidifying the conceptual framework to understand how these efforts can influence patient-level and health care system-level outcomes. As health care systems continue to increase SHI efforts, it is essential for health care systems to understand the magnitude of anticipated effects to inform them in the decision-making process about intervention components and resource allocation. As part of a pilot SHI evaluation in two Kaiser Permanente Washington clinics, patients who reported any social need on a screener were randomized to receive social health support from either CCC, a centralized call center, or CRS, who are local navigators embedded in care teams. This dissertation compared the effects of two social health modalities on patients' social health, and health care utilization and costs. A combination of electronic health records, longitudinal survey, and claims data were used to assess the effects of a primary care-based SHI program over time.

First, we used survey data to examine differences in the total count of social needs at 2-months and 5-months post-randomization between CCC and CRS. We found no significant differences in the count of needs between CCC and CRS at both follow-up timepoints, and observed that CRS participants had slightly fewer social needs at 2 months only. As part of an as-treated sensitivity analysis on CRS participants, we found that those who received resource information from CRS had significantly fewer needs at 5 months relative to those who did not. This suggests that engagement and receipt of support from a local, clinic-based specialist was associated with fewer social needs over time.

Second, we used claims data to assess differences in health care utilization between participants assigned to CCC and CRS over 9 months. In the intent-to-treat findings, we found that participants assigned to CRS had significantly higher primary care visits than CCC participants. In a secondary analysis, we found greater primary care visits, specialty care visits, and patient messages from the care team among patients receiving CRS resources compared to patients not receiving information from CRS or CCC. Third, we also used claims data to examine differences in costs incurred from the perspective of the health care system between participants assigned to both social health support groups over 9 months. We found that CRS participants had higher primary care costs compared to those assigned to CCC, accounting for approximately 21% of average total primary care costs over 9 months. Findings from our as-treated analysis showed that participants who received CRS support had higher specialty care visits compared to those who did not, and this consisted of about 76% of the average specialty care costs over the evaluation period.

This dissertation compared CRS to an active intervention of CCC. We found no significant differences between groups in the count of social needs over time, and higher primary care utilization and costs among CRS participants relative to CCC participants. Our attempt to compare participants who fully engaged with CRS compared to those who did not receive CRS support allowed us to understand the effects of CRS, a more resource intensive program, against true control group. These findings suggest that conversations and receipt of resources from CRS reduced social needs, but increased outpatient visits consisting of primary care and specialty care. We also saw greater interaction with care teams through patient messages. There were also higher specialty care costs among this group relative to those who did not receive CRS support.

Our findings align with the conceptual pathways in how SHI programs can influence long-term outcomes through resolving social needs, improving patients' ability to manage their health, and increasing support to patients by speaking about their needs.[46] While we were unable to detect changes in more long-term emergency department and inpatient admissions outcomes, our findings provide insight on more immediate health care system-level outcomes. These results suggest that patient engagement with a local, clinic-based, and more resource-intensive program was necessary to generate changes in social needs and preventive or nonemergent utilization outcomes. The mechanisms through which SHI programs influence outcomes are reflected in our as-treated findings in which patients reduced their social health burden by receiving resources and increased their engagement with the health care system through greater outpatient visits and care team messages. We hypothesize that this will ideally encourage patients to stay within the system.

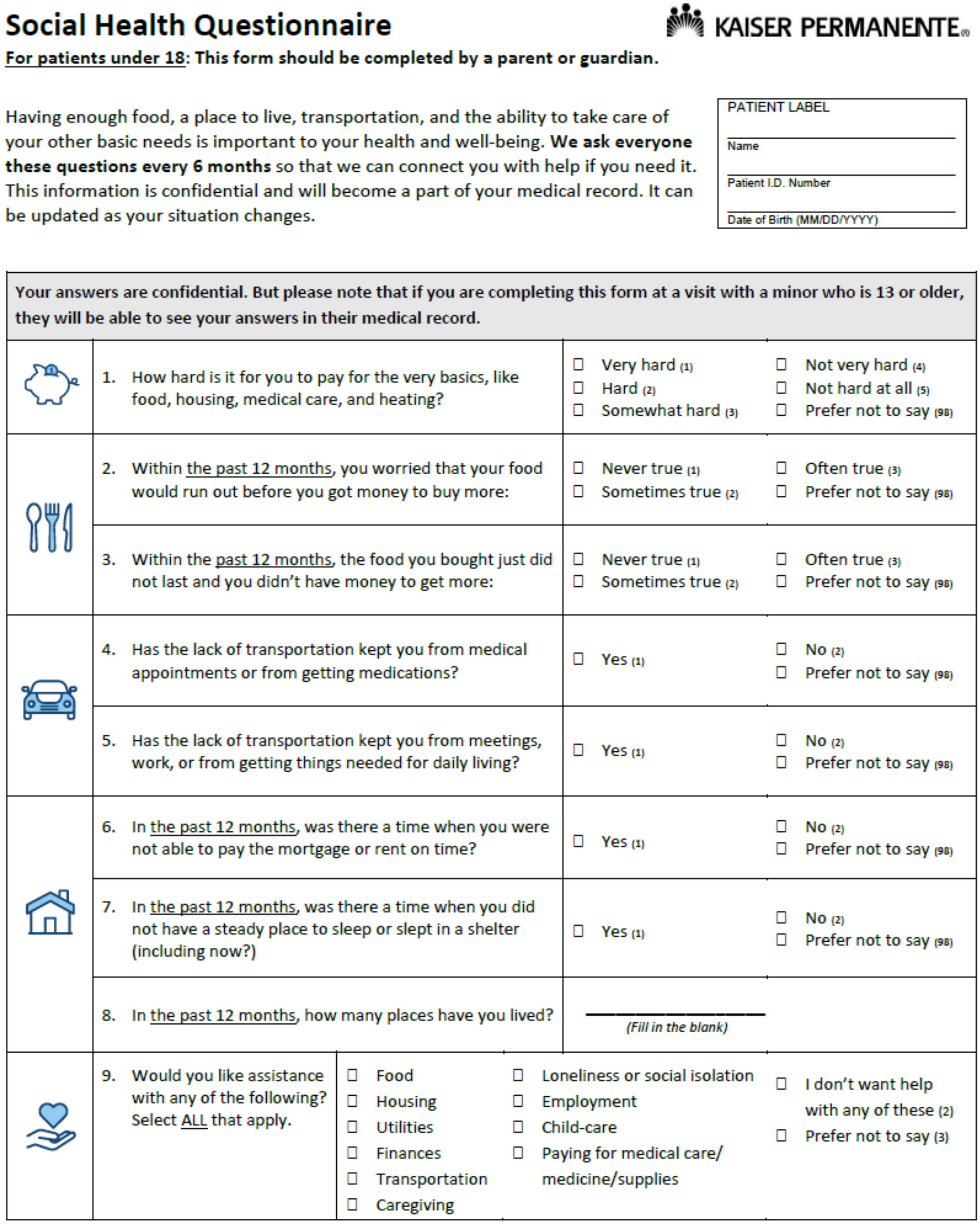
Health care systems that invest in a similar resource-intensive navigator social health support intervention can expect resolution of needs, greater use of non-urgent outpatient services, and more spending for these services in the short term. It is also important to ensure that there is patient uptake with these interventions. Future research should examine these outcomes in a similar primary care setting over a longer follow-up time period to identify when and the extent to which the health care system may experience reduced costs by averting high cost utilization. Additionally, researchers should explore different outcomes when evaluating SHI programs such as social needs resolution based on resource use, rather than prevalence of social needs or receipt of resources, and return on investment to estimate net costs over time.

Appendix

Universal screener

Patients received a Social Health Questionnaire (SHQ-9) during their check-in for primary care appointments (Appendix Figure 1). The first 8 items ask patients about four social risks: financial strain, food insecurity, transportation issues, and housing insecurity. The final item asks patients if they would like to receive assistance for any of the 10 social needs listed. This screener is unique to the Washington Region of Kaiser Permanente (KPWA) and the items were derived from two sources. First, items were selected to align with Epic's established Social Determinants of Health (SDOH) Wheel for the social risk domains. The Washington Region had previously used the "Your Current Life Situation" (YCLS) survey which asked patients about their social and economic needs.[75] The YCLS has been psychometrically tested among Accountable Communities of Health patients and the item asking specifically about social needs was pulled from the YCLS.[76]

Appendix Figure 1: Social Health Questionnaire



Social Health Questionnaire

KAISER PERMANENTE®

For patients under 18: This form should be completed by a parent or guardian.

Having enough food, a place to live, transportation, and the ability to take care of your other basic needs is important to your health and well-being. **We ask everyone these questions every 6 months** so that we can connect you with help if you need it. This information is confidential and will become a part of your medical record. It can be updated as your situation changes.

PATIENT LABEL
Name
Patient I.D. Number
Date of Birth (MM/DD/YYYY)

Your answers are confidential. But please note that if you are completing this form at a visit with a minor who is 13 or older, they will be able to see your answers in their medical record.

1. How hard is it for you to pay for the very basics, like food, housing, medical care, and heating?	☐ Very hard (1) ☐ Hard (2) ☐ Somewhat hard (3)	☐ Not very hard (4) ☐ Not hard at all (5) ☐ Prefer not to say (98)
2. Within the past 12 months, you worried that your food would run out before you got money to buy more:	☐ Never true (1) ☐ Sometimes true (2)	☐ Often true (3) ☐ Prefer not to say (98)
3. Within the past 12 months, the food you bought just did not last and you didn't have money to get more:	☐ Never true (1) ☐ Sometimes true (2)	☐ Often true (3) ☐ Prefer not to say (98)
4. Has the lack of transportation kept you from medical appointments or from getting medications?	☐ Yes (1)	☐ No (2) ☐ Prefer not to say (98)
5. Has the lack of transportation kept you from meetings, work, or from getting things needed for daily living?	☐ Yes (1)	☐ No (2) ☐ Prefer not to say (98)
6. In the past 12 months, was there a time when you were not able to pay the mortgage or rent on time?	☐ Yes (1)	☐ No (2) ☐ Prefer not to say (98)
7. In the past 12 months, was there a time when you did not have a steady place to sleep or slept in a shelter (including now?)	☐ Yes (1)	☐ No (2) ☐ Prefer not to say (98)
8. In the past 12 months, how many places have you lived?	____________ *(Fill in the blank)*	
9. Would you like assistance with any of the following? Select ALL that apply.	☐ Food ☐ Housing ☐ Utilities ☐ Finances ☐ Transportation ☐ Caregiving ☐ Loneliness or social isolation ☐ Employment ☐ Child-care ☐ Paying for medical care/ medicine/supplies	☐ I don't want help with any of these (2) ☐ Prefer not to say (3)

Heckman selection model to address selection bias

We conducted a sensitivity analysis using our intent-to-treat sample to address potential selection bias as participants were only included in the primary analysis analytic sample in Chapter 2 if they completed at least one follow-up survey. We specifically used the “heckpoisson” command in Stata which consists of a two-part model. The first part consists of the selection model in which the dependent variable is a binary variable indicating if the participant completed any survey and therefore in the analytic sample. The second part is a Poisson outcome model in which the dependent variable is the count of needs at follow-up.

We included the same set of independent variables in both parts of the model which included program, time (2-month; 5-month), sex, age, clinic, comorbidity as measured by the Adjusted Clinical Group (ACG) algorithm, race and ethnicity, and count of needs at baseline. We also added binary variables on the presence of the following individual needs at baseline: finances, utilities, employment, caregiving, and difficulty paying for medical care, medicine, or supplies. We did not include the five other individual needs reported at baseline because of issues with model convergence. An interaction term between program and time was included in the outcome model only.

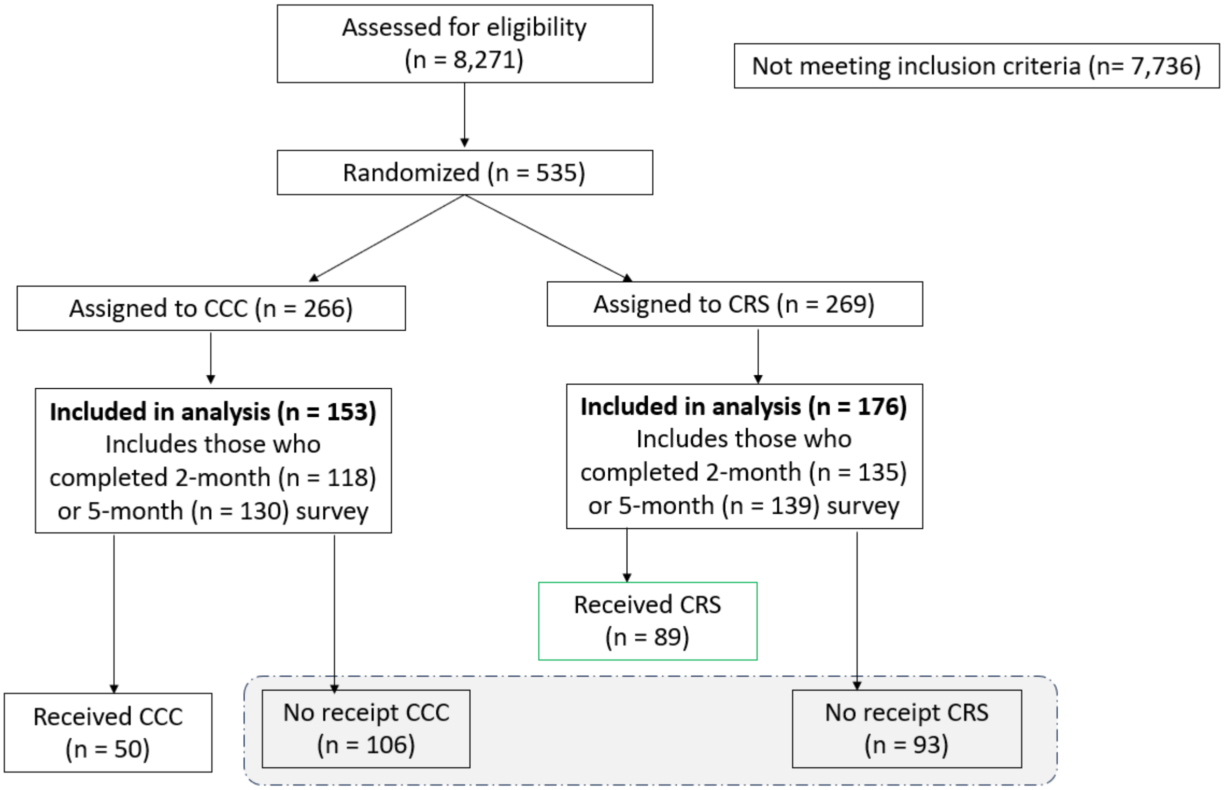
We estimated the marginal effects between groups at each timepoint and found that those in CRS reported 0.05 (95% CI: -0.567, 0.469) fewer needs at 2 months and 0.28 (95% CI: -0.227, 0.782) higher needs at 5 months compared to CCC.

Secondary as-treated sample

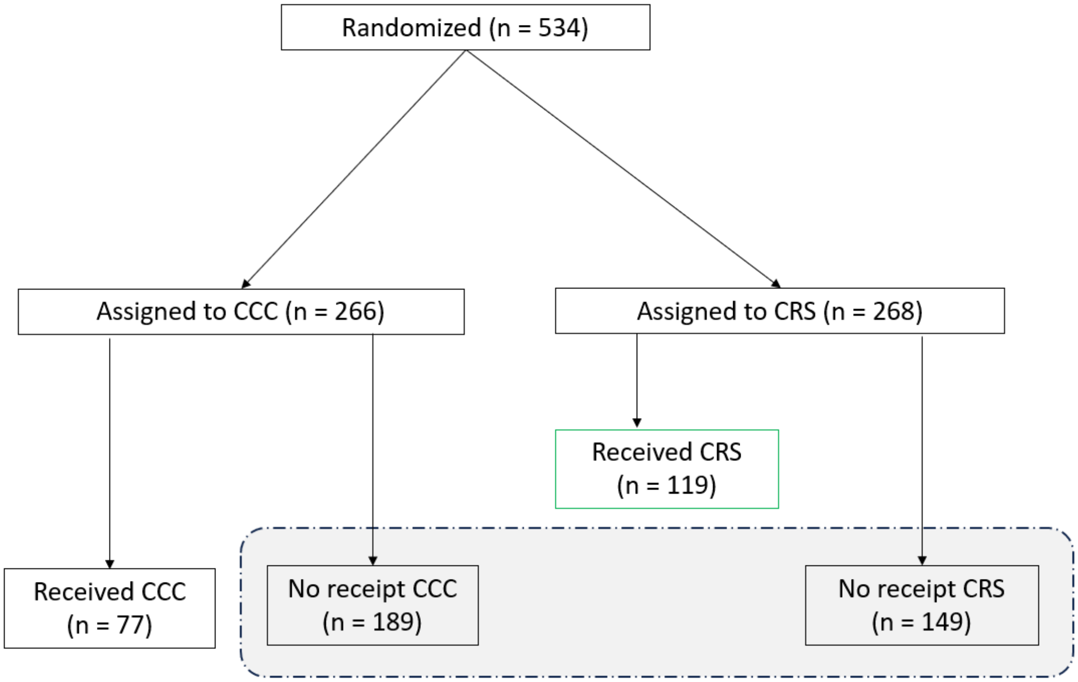
To identify who received CRS, the evaluation team reviewed case notes to categorize patients into one of four levels of engagement: (1) Full, if they had a conversation with the agent and received resource information; (2) Ineligible, if they spoke to an agent and received a referral but were ineligible for the service; (3) Partial, if they had a conversation with an agent but did not receive a referral or refused assistance; and (4) None, if there was no response or they immediately hung up on the agent. Two team members reviewed all case notes. If the case note did not explicitly fall into an engagement category, a subset of the evaluation team made the final decision. We considered patients to have received a program by classifying those who fell in the "Full" and "Ineligible" categories as participants who received program support. We also included participants assigned to CCC but received CRS as part of the CRS as-treated sample. This allowed us to compare participants who received support from CRS against a true comparison group.

Appendix Figure 2 illustrates participants who were included in the analytic sample for the Chapter 2 outcome focused on social needs resolution. Appendix Figure 3 shows participants who were included in the sample for Chapters 3 and 4 utilization and cost secondary analyses. The CRS as-treated samples are indicated by the green boxes, while the participants who contributed to the respective comparison groups are included in the grey shaded boxes.

Appendix Figure 2: As-treated sample for social needs outcome



Appendix Figure 3: As-treated sample for utilization and cost analyses



We used the “twang” package in R to develop balanced comparison groups for the as-treated analyses, and used a combination of individual, neighborhood, and clinic-level characteristics hypothesized to influence receipt CRS. Covariates included individual-level demographics and documented diagnoses for comorbid conditions. We included indicator variables for 28 comorbid conditions for the CRS weights based on if these diagnoses were documented in participants’ EHRs (Appendix Table 2). For the analytic sample in Chapter 2, we excluded lymphoma and pulmonary circulation disease as there was no variation across the treatment and comparison groups for these two variables. We also included clinic-level counts of primary care providers and full time CRSs, as well as a neighborhood deprivation index as covariates in both models. This index is based on geo-demographic data and uses a scale to measure regional and socioeconomic conditions.

Appendix Table 1: Variables used to estimate propensity score weights

Variable	**Description and notes**
Individual level	
Adjusted clinical group (ACG)	Morbidity classification collapsed into binary resource utilization bands: Non-User/Healthy/Low and Moderate/High/Very High at baseline and follow-up
Race and ethnicity	Administrative data categories: African American/Black; Hispanic; Multiracial; White/Caucasian; Other; Unknown
Type of insurance	5 categories: Commercial, Individual, Medicaid, Medicare, or No coverage
Congestive heart failure	Yes/No documented diagnoses
Pulmonary circulation disease	Yes/No documented diagnoses
Valvular disease	Yes/No documented diagnoses
Peripheral vascular disease	Yes/No documented diagnoses
Depression	Yes/No documented diagnoses
Paralysis	Yes/No documented diagnoses
Other neurological disorders	Yes/No documented diagnoses
Chronic pulmonary disease	Yes/No documented diagnoses
Diabetes	Yes/No documented diagnoses
Diabetes with chronic complications	Yes/No documented diagnoses
Hypothyroidism	Yes/No documented diagnoses
Renal failure	Yes/No documented diagnoses
Liver disease	Yes/No documented diagnoses
Peptic ulcer disease	Yes/No documented diagnoses
AIDS	Yes/No documented diagnoses
Lymphoma	Yes/No documented diagnoses
Metastatic cancer	Yes/No documented diagnoses
Tumor	Yes/No documented diagnoses
Rheumatoid arthritis/collagen vascular disease	Yes/No documented diagnoses
Coagulopathy	Yes/No documented diagnoses
Obesity	Yes/No documented diagnoses
Weight loss	Yes/No documented diagnoses
Chronic blood loss anemia	Yes/No documented diagnoses
Deficiency anemia	Yes/No documented diagnoses
Alcohol abuse	Yes/No documented diagnoses
Drug abuse	Yes/No documented diagnoses
Psychoses	Yes/No documented diagnoses
Hypertension	Yes/No documented diagnoses
Neighborhood level	
Neighborhood deprivation index	Neighborhood deprivation index at census tract level in 2020
Clinic level	

Variable	Description and notes
Number of primary care providers	Number of primary care providers at each clinic
Number of full time CRS	Number of full time equivalent CRSs affiliated with each clinic

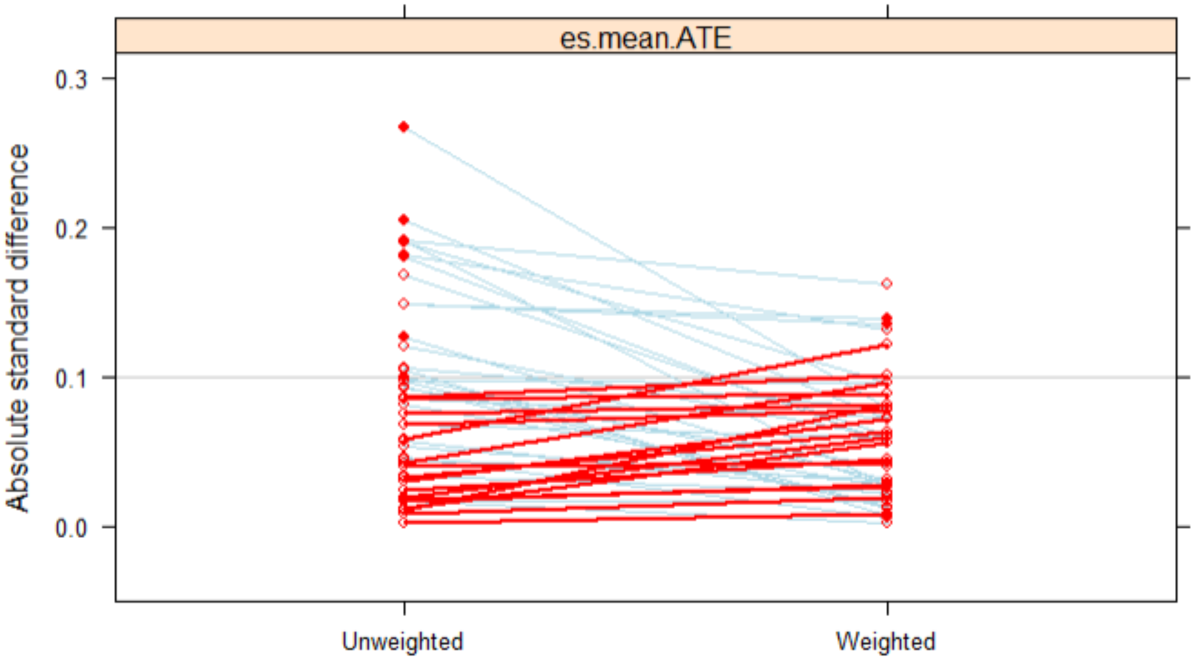
The propensity score model provided predicted values which we used to estimate average treatment effect (ATE) population weights. The “es.mean” stop method balanced covariates between groups. This approach estimates weights by minimizing the standardized absolute mean difference of covariates.

As-treated sample and analysis for social needs outcome

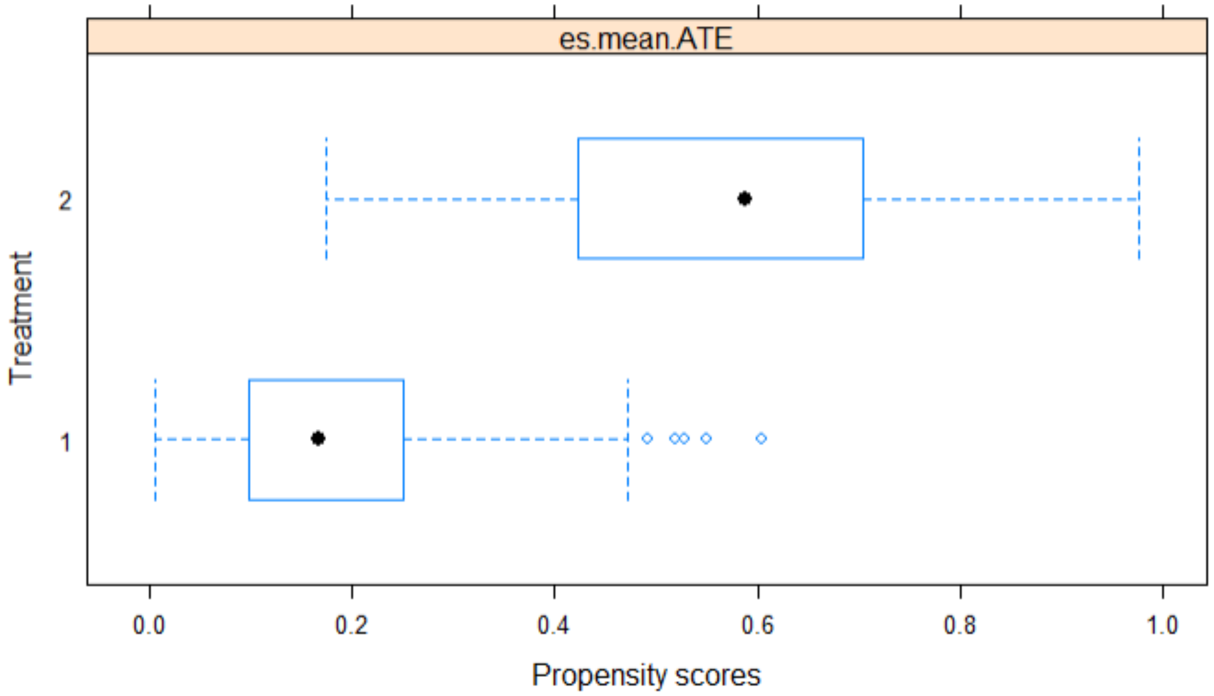
For the sample used to assess social needs resolution as detailed in Chapter 2, we observed 2 variables that were imbalanced. This included participants that identified as White and a diagnosis of psychosis. We verified that all covariates in the weight model had a standardized mean difference (SMD) less than 0.2 after weights were applied (Appendix Figure 4). Appendix Figure 5 illustrates the spread of propensity scores and overlap between the as-treated and comparison groups for the CRS model.

We derived propensity score weights from the model and applied them to the data restricted to the analytic sample for the as-treated analysis using the “svyset” command in Stata.[55] Similar to the primary intent to treat analysis, our outcome model was estimated using generalized mixed effects linear model with a Poisson log link distribution and individual-level random effects.

Appendix Figure 4: Absolute standardized difference of covariates before and after applying weights for social needs as-treated analytic sample



Appendix Figure 5: Spread of propensity scores in treatment and comparison groups for CRS as-treated sample used for social needs analytic sample



Note: 2 = CRS receipt; 1 = Comparison

Appendix Table 2 shows the characteristics of the weighted as-treated sample used in Chapter 2.

Appendix Table 2: Characteristics of as-treated weighted sample used for social needs outcome

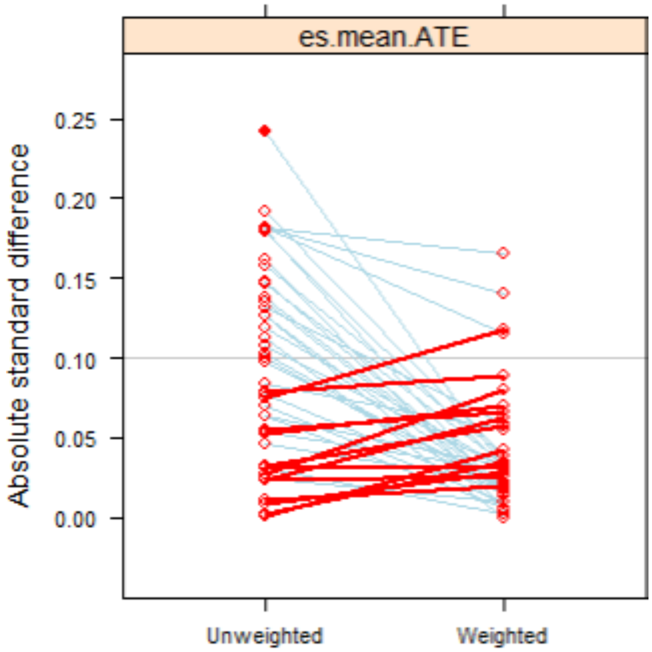
Characteristic	**CRS treated (n = 89)**	**Comparison group (n = 199)**
	Weighted %	Weighted %
Sex		
Female	65.0%	68.2%
Male	35.0%	31.8%
Age		
<18	8.3%	9.3%
18-40	35.4%	30.4%
41-60	23.5%	22.7%
60+	32.8%	37.7%
Race and ethnicity		
African American or Black	5.6%	4.8%
Hispanic	6.3%	6.4%
Multiracial	5.2%	4.6%

Characteristic	**CRS treated (n = 89)**	**Comparison group (n = 199)**
White	55.1%	56.3%
Other	7.8%	8.1%
Unknown	20.0%	19.8%
Insurance type		
Commercial	43.4%	37.2%
Individual	2.4%	3.3%
Medicaid	14.2%	14.3%
Medicare	31.3%	35.5%
No coverage	8.7%	9.6%
Adjusted clinical group utilization band		
No/Healthy/Low	9.9%	9.7%
Mod/High/Very High	63.4%	63.7%
Unknown	26.7%	26.6%
Clinic		
A	77.9%	75.0%
B	22.1%	25.0%

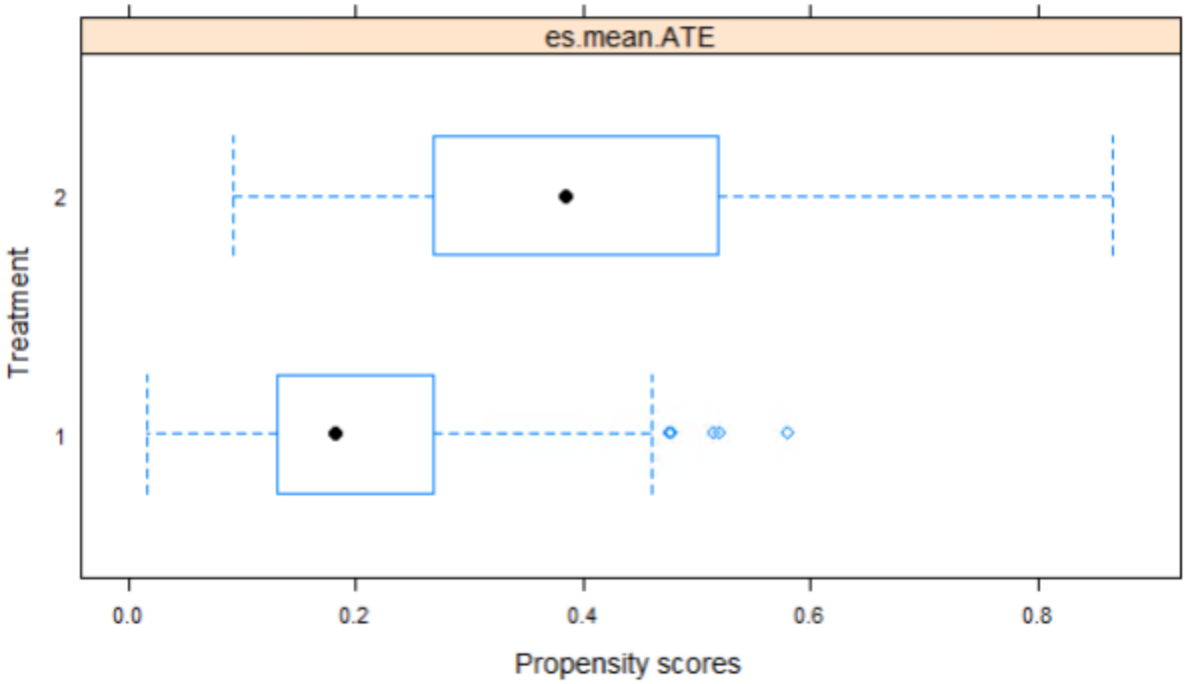
As-treated sample and analyses for utilization and cost outcomes

We repeated these steps for the as-treated sample for the utilization and cost analyses detailed in Chapters 3 and 4. We observed one variable of diagnoses psychoses to be imbalanced and confirmed that all covariates had a SMD less than 0.2 after weights were applied (Appendix Figure 6). Because we observed that the standardized mean difference increased for some variables in order to reduce other imbalance, we also conducted an unweighted sensitivity analysis. Appendix Figure 7 illustrates the spread of propensity scores and overlap between the as-treated and comparison groups for the CRS model. Appendix Figure 8 shows the distribution of the weight variable.

Appendix Figure 6: Absolute standardized difference of covariates before and after applying weights for CRS as-treated analysis sample

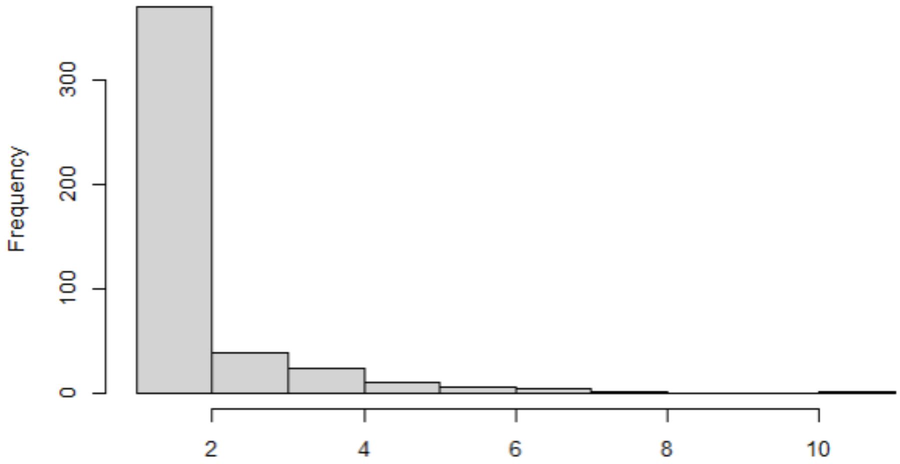


Appendix Figure 7: Spread of propensity scores in treatment and comparison groups for CRS as-treated sample



Note: 2 = CRS receipt; 1 = Comparison

Appendix Figure 8: Histogram of propensity score weights



Weigh

We reported descriptive characteristics for this as-treated sample in Appendix Table 3. Due to missing data of variables (Appendix Table 1) for one individual, we excluded one participant from the as-treated group when estimating a balanced sample.

Appendix Table 3: As-treated sample descriptives for utilization and cost analyses

Characteristic	**CRS treated (n = 118)**	**Comparison group (n = 338)**
	Weighted %	Weighted %
Sex		
Female	68.3%	62.1%
Male	31.7%	37.9%
Age		
<18	8.6%	9.1%
18-40	34.5%	37.8%
41-60	23.7%	20.8%
60+	33.2%	32.2%
Race and ethnicity		
African American or Black	4.5%	3.7%
Native American or Alaska Native	0.7%	0.5%
Asian	2.5%	2.9%
Hispanic	6.4%	5.7%
Multiracial	4.5%	4.7%

Characteristic	CRS treated (n = 118)	Comparison group (n = 338)
Native Hawaiian or Pacific Islander	1.3%	1.8%
White	53.8%	54.5%
Other	2.0%	2.1%
Unknown	24.3%	24.1%
Insurance type		
Commercial	44.2%	44.5%
Individual	1.8%	2.2%
Medicaid	15.2%	13.2%
Medicare	30.0%	29.4%
No coverage	8.7%	10.8%
Adjusted clinical group utilization band		
No/Healthy/Low	3.5%	3.5%
Mod/High/Very High	4.9%	3.6%
Unknown	3.1%	5.6%
Clinic	31.8%	31.1%
A	15.7%	17.0%
B	13.4%	12.8%

Appendix Table 4 shows results from the weighted as-treated sensitivity analyses for the utilization outcomes. Appendix Table 5 includes unadjusted mean costs over 9 months for this sample.

Appendix Table 4: As-treated CRS weighted utilization results

	No receipt			CRS			Difference		
Outcome	**Estimate**	**95% CI**		**Estimate**	**95% CI**		**AME**	**95% CI**	
Primary care encounters	4.59	4.108	5.070	6.39	5.293	7.487	1.80	0.604	2.999
Specialty care encounters	4.56	3.905	5.220	8.55	6.524	10.578	3.99	1.858	6.119
Behavioral health	1.97	1.278	2.662	2.36	0.964	3.764	0.39	-1.168	1.956
Urgent care encounters	0.76	0.589	0.932	1.20	0.769	1.638	0.44	-0.024	0.910
Patient messages	6.05	5.315	6.785	9.94	7.948	11.933	3.89	1.767	6.014
Emergency department visits (any)	0.11	0.079	0.146	0.15	0.088	0.217	0.04	-0.033	0.113
IP admissions (any)	0.06	0.032	0.081	0.07	0.022	0.113	0.01	-0.040	0.063
Missed/cancelled rate	0.19	0.159	0.218	0.16	0.126	0.198	-0.03	-0.073	0.020

Note: ED = Emergency department; AME = Average marginal effect

Appendix table 5: Mean costs over 9 months for weighted as-treated sample

	No receipt (n = 338)	CRS receipt (n = 118)	Total (n = 534)
Cost category			
Primary care, mean (SD)	1241 (112)	1615 (192)	1409 (106)
Specialty care, mean (SD)	2027 (327)	4382 (1033)	3081 (500)
Behavioral health, mean (SD)	563 (146)	617 (183)	587 (115)
ED, mean (SD)	262 (76)	682 (255)	450 (123)
Inpatient admissions, mean (SD)	1538 (522)	2064 (963)	1774 (519)
Urgent care, mean (SD)	334 (37)	486 (128)	402 (61)
Total costs	8651 (1009)	10476 (1157)	10477 (1167)

Note: ED = Emergency department

Defining cost outcomes

We used a combination of service category, service subcategory, and place of service variables to define costs for primary care, specialty care, behavioral health, emergency department, inpatient admissions, and urgent care (Appendix Table 6).

Appendix Table 6: Variable combinations used to develop cost outcomes

Cost outcome	Service category	Service subcategory	Place of service
Primary care costs	Primary care	Family Practice	Ambulatory surgical center
		General Internal Medicine	Patients Home
		Pediatrics	Physicians Office
			Outpatient hospital
			Subacute Rehab Nursing Facility
			Inpatient Skilled Nursing Facility
			Telehealth
			Other Unlisted Facility
Specialty care costs	Ambulatory Surgical Center	Institutional Based ASC	Ambulatory Surgical Center
	Hospital outpatient	CMS-1500 Based ASC	Physicians Office
	Specialty care	Other Outpatient	Outpatient Hospital
		Anesthesiology	Other Unlisted Facility
		Cardiac surgery	Emergency Room Hospital
		Cardiology	Patients Home
		Emergency Medicine	Telehealth
		Eye Care	Independent Laboratory
		Gastroenterology	Subacute Rehab Nursing Facility
		Neurology	
		Neurosurgery	
		Nuclear Medicine	
		OB/GYN	
		Oncology/Hematology	
		Orthopaedic Surgery	
		Other Specialty	
		Otolaryngology	
		Physiatry, Rehabilitation and Sports Medicine	
		Radiation Therapy/Oncology	
		Radiology	
		Urology	
		Vascular Surgery	
Behavioral health costs	Specialty care	Behavioral health	Patients Home
			Physicians Office
			Outpatient hospital
			Telehealth

Cost outcome	Service category	Service subcategory	Place of service
			Other Unlisted Facility
Emergency department costs	Hospital outpatient	Laboratory/Pathology Combined	Emergency Room Hospital
	Primary care	Pediatrics	Outpatient Hospital
	Specialty care	Emergency	
		Family Practice	
		Behavioral health	
		Orthopaedic Surgery	
		Other Specialty	
		Radiology	
Inpatient admission costs	Ancillary care	Laboratory/Pathology Combined	Inpatient Hospital
	Hospital inpatient	General Acute	Residential Substance Abuse Treatment Facility
	Other	Psychiatric	
	Primary care	Institutional Billing on CMS-1500	
	Specialty care	Family Practice	
		General Internal Medicine	
		Anesthesiology	
		Behavioral Health	
		Cardiac Surgery	
		Cardiology	
		Gastroenterology	
		General Surgery	
		Neurology	
		Neurosurgery	
		Nuclear Medicine	
		OB/GYN	
		Oncology/Hematology	
		Orthopaedic Surgery	
		Other Specialty	
		Physiatry, Rehabilitation and Sports Medicine	
		Radiation Therapy/Oncology	
		Radiology	
		Thoracic Surgery	
		Urology	
Urgent care costs	Ancillary care	Laboratory/Pathology Combined	Urgent Care
	Primary care	Family Practice	Physicians Office
	Specialty care	Emergency Medicine	
		Neurosurgery	
		Other Specialty	
		Radiology	

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