

Intensity of Social Needs Case Management Services and Changes in Hospital and Emergency Department Use Among Adult Medicaid Beneficiaries

Crystal Guo, MPH,* Timothy T. Brown, PhD,* Hector P. Rodriguez, PhD, MPH,*
Margae Knox, PhD, MPH,* Mark D. Fleming, PhD, MS,* Elizabeth A. Hernandez, MS,†
Daniel M. Brown, PhD, MPH,‡ and Amanda L. Brewster, PhD, MSc*

Objectives: We identify the association between high- and low-intensity case management services on hospital and emergency department (ED) use among CommunityConnect patients.

Background: Social needs case management services vary in intensity, including the modality, workforce specialization, and maximum caseload. CommunityConnect is a social needs case management program implemented by Contra Costa Health, a county safety-net health system in California's San Francisco Bay Area.

Methods: Due to the endogeneity of high-intensity services assigned to high-risk patients, we instrument for service intensity using the number of specialist case managers hired each month of enrollment. Zero-inflated negative binomial models with 2-stage residual inclusion estimated total and avoidable hospital admissions and ED visits 12 months post-enrollment for adult Medicaid beneficiaries enrolled between August 2017 and December 2018 ($n = 19,782$).

Results: Compared with low-intensity case management, high-intensity services were associated with a reduction in the incidence rates of inpatient admissions [incidence rate ratio (IRR) = 0.341, 95% CI: 0.106–1.102; $P = 0.072$], ED visits (IRR = 0.608, 95% CI: 0.188–1.965; $P = 0.058$), and avoidable ED visits (IRR = 0.579, 95% CI: 0.179–1.872; $P = 0.091$). No significant association was found between service intensity and the likelihood of an event being an excess zero.

Conclusions: High-intensity social needs case management may be more effective than low-intensity service at reducing health care use for individuals with non-zero use, suggesting that intensive case management may be especially helpful in supporting discharge and transitions of care.

Key Words: social needs, case management, instrumental variable, hospital use, Medicaid beneficiaries

(*Med Care* 2024;00:000–000)

Case management plays an increasingly important role for individuals with complex medical and social needs.^{1–5} Case management programs support the delivery of comprehensive and patient-centered care by employing case managers that conduct assessments, create individualized care plans, provide frequent monitoring, and coordinate care across multiple health care and social service providers.⁶ These interventions have been implemented across diverse health care settings, encompassing primary care⁶ and behavioral health.⁷ Investment in case management interventions is often motivated by the need to reduce unnecessary hospital and emergency department (ED) utilization in addition to improving health outcomes.^{8,9} High-intensity case management has been defined by small caseloads, time spent face-to-face, and specialist case management personnel such as nurses or social workers.⁶ However, more recently, the adoption of community health worker (CHW) interventions has increased along with the adoption of telephonic or virtual modes of service.^{10–14} These alternative, lower-intensity models offer potential advantages for access and reductions in service cost. However, few studies have been able to directly compare different approaches to case management, and those that have are limited by program heterogeneity, small sample size, and short-term follow-up.^{6,8,15} Further research is needed to understand how outcomes differ based on patient population and service intensity designs.

From 2017 to 2019, Contra Costa Health implemented CommunityConnect, a case management program established through California's Whole Person Care Pilot that provided social needs case management services to adult Medicaid beneficiaries in Contra Costa County,

From the *University of California, Berkeley, School of Public Health, Health Policy and Management, Berkeley, CA; †Contra Costa Health, Contra Costa County, Martinez, CA; and ‡Carelton Digital, Palo Alto, CA.

M.K. was supported by the Agency for Healthcare Research and Quality (AHRQ) under the Ruth L. Kirschstein National Research Service Award (#T32HS022241), and M.D.F. was supported by an AHRQ Career Development Award (#K01HS027648).

All work is the author's own and does not represent the views of the funders. Authors have no conflict of interest to declare.

The authors declare no conflict of interest.

Correspondence to: Crystal Guo, MPH, University of California, Berkeley, School of Public Health, 2121 Berkeley Way, Berkeley, CA 94704. E-mail: cguo255@berkeley.edu.

Supplemental Digital Content is available for this article. Direct URL citations are provided in the HTML and PDF versions of this article on the journal's website, www.lww-medicalcare.com.

Copyright © 2024 Wolters Kluwer Health, Inc. All rights reserved.

DOI: 10.1097/MLR.0000000000002071

California. Eligible individuals enrolled in the program were offered 12 months of either high-intensity, in-person case management services administered by specialist case manager types, including nurses, social workers, substance use counselors, mental health clinical specialists, and housing specialists, or low-intensity, telephonic case management services administered by a CHW. In-person specialist case managers held caseloads of up to 90 patients and were expected to reach out to patients on a monthly basis, whereas telephonic CHWs held caseloads of up to 350 patients and were expected to reach out every 60 days. Henceforth, in-person services are referred to as high-intensity, and telephonic services are referred to as low-intensity. Additional information about the case management program services and workflow is available in the appendix of Brown et al (2022).¹⁶

A randomized controlled trial identified that the case management program led to an 11% reduction in hospitalizations, a 3% increase in primary care visits, and a 5% increase in COVID-19 vaccinations for individuals offered the intervention.¹⁶⁻¹⁸ Within the intervention group, however, it is unknown whether the impact on hospital use differed based on the type of case management service offered. This study aims to compare the impact of high-intensity social needs case management services to low-intensity services using an instrumental variables approach. Patients with greater health risks of avoidable care use were prioritized for high-intensity case management, although the threshold for assignment to high-intensity versus low-intensity services varied over the course of the program based on the availability of specialist case managers. This was because the need for specialist case managers was often more than the number of case managers available. This resulted in patients near the threshold for assignment to specialist case managers being assigned to in-person or telephonic care based on the current availability of case managers, which was externally determined. We instrument for service intensity using the number of specialist case managers hired by CommunityConnect in the month of patient enrollment. This leverages random

variation from the fact that patients with similar risk levels are more likely to be assigned to high-intensity case management services in months just after specialist case managers are hired. In alignment with prior studies that have evaluated the intensity of case management services through the frequency of contact,^{19,20} case manager background,²¹ caseload size,^{6,22-24} and modality of service,^{14,22,23} we hypothesized that assignment to high-intensity services would be associated with lower hospital and ED use compared with low-intensity services.

METHODS

Study Design

CommunityConnect automatically assigned enrollees to a best-fit case manager using an internally developed case manager assignment system. Criteria included current caseloads for balance across case managers, patient demographics, and patient health indicators available in the electronic medical record. For example, individuals with a prior psychiatric emergency visit were given a preferential assignment to a mental health clinician case manager, individuals with a substance use diagnosis were given a preferential assignment to a substance abuse counselor case manager, and individuals with an indicator of homelessness were given a preferential assignment to a homeless services specialist case manager. In other words, the highest-risk enrollees were assigned to specialist case managers—public health nurses, social workers, substance abuse counselors, mental health clinicians, homeless services specialists, and CHW specialists—who provided in-person case management services with up to 90 individuals on their caseload. Lower-risk enrollees were offered telephonic case management services provided by a CHW who has caseloads of up to 350 individuals. A more detailed breakdown of the assignment process is outlined in Table 1.

Individuals with greater risk for avoidable hospital utilization were preferentially matched to specialist case managers providing high-intensity services. The need for

TABLE 1. CommunityConnect Case Manager Assignment Process

| # | Steps | Result |
|----|--|--|
| 1. | If there is another patient at the same address (same household) previously assigned to a case manager | Assign patient to same case manager |
| 2. | Providers with < 90% of their caseload maximum (for balance across case managers) | #1 weight |
| 3. | Prior mental health incident (psych emergency, hospitalization related to behavioral health, psychosis diagnosis, etc) | #2 weight for assignment to mental health clinician |
| | Substance abuse diagnosis | #2 weight for assignment to substance abuse counselor |
| | Homelessness indicators | #2 weight for assignment to homeless services specialist |
| | Tier 2 patient (based on risk score cutoff calculated at the time of enrollment) | #2 weight for assignment to CHW (telephonic) |
| 4. | Non-English language match | #3 weight for assignment to case manager with same language (if available) |
| 5. | Assess patient risk score based on higher risk scores being assigned to more intensive disciplines/case manager types | #4 weight for assignment to case manager type in the following order: public health nurse, social worker, and CHW specialist |
| 6. | If patient has previously been assigned to a case manager | #5 weight for assignment to same case manager |

CHW indicates community health worker.

specialist case managers was often greater than the number available. Therefore, we instrument for case management intensity using the number of specialist case managers hired each month of enrollment. As described elsewhere,^{16,25,26} all case managers assessed patients' social needs and provided ongoing support, including community resource referrals, coordination with providers, and collaboration on applications for public benefits. The follow-up period for individuals enrolled in CommunityConnect was 12 months from the date of enrollment.

Setting and Data

Contra Costa Health, the safety-net health system of Contra Costa County, California, implemented CommunityConnect, including hiring and training over 150 full-time case managers employed by the county, establishing new data infrastructure, and implementing a quality improvement framework for program development. Data for participant selection and analysis of outcomes came from a data warehouse combining information from Medicaid claims, electronic health records, and county social services and was extracted by the Contra Costa Health business intelligence unit.

Participants and Eligibility

Adult (18 y or older) residents of Contra Costa County enrolled in full-scope Medicaid were eligible for CommunityConnect. Individuals could not be currently enrolled in duplicative case management services, in detention for more than 30 days, or in a vegetative state. CommunityConnect enrolled individuals from an eligible pool each month within an upper range of risk scores, computed using a predictive model for the risk of avoidable ED visits and inpatient admissions.¹⁶ The number of participants and the risk score threshold for enrollment eligibility varied monthly depending on the availability of program slots. These risk scores were also used for case management assignments upon enrollment into the intervention. The institutional review committee of the contra costa regional medical center and health centers granted approval for the study (protocol #09172018).

Outcomes

The primary outcomes include total and avoidable inpatient hospital admissions and ED visits 12 months post-enrollment in CommunityConnect. Avoidable hospital admissions were defined as any admission for an ambulatory care-sensitive condition.²⁷ Avoidable ED visits were defined by the New York University Emergency Department Algorithm.²⁸

Statistical Analysis

The independent variable of interest is a binary indicator of the patient's first assignment to high-intensity social needs case management services compared with low-intensity services. Because the case manager assignment process preferentially matched specialist case managers providing high-intensity services to higher-risk patients, service intensity is endogenous to hospital use. To address this, we use instrumental variables. In-

strumental variables models must satisfy 3 criteria: (1) the instrument must be exogenous, (2) strongly correlated with the endogenous variable of interest, and (3) not correlated with the error term. We instrument for service intensity assignment using the number of specialist case managers hired by CommunityConnect each month of patient enrollment. One of the most highly weighted factors in the case manager assignment process was an assignment of new patients to case managers with <90% of their caseload maximum (see step #2 in Table 1), meaning that newly hired case managers with no existing caseload tended to be favored for patient assignments. As the program was newly developed, there were consistent staffing shortages for specialist case managers, and new case managers were hired throughout the study period. These staffing constraints occurred exogenously as the patients being assigned in the case management assignment process could not influence or predict the staffing pipeline. We thus use the number of specialist case managers hired per month as an instrument strongly correlated with an increased probability of assignment to high-intensity services for that same month. We are unaware of any unobserved variable in the error term of the equations described below that this instrument might be correlated with.

As such, the first-stage regression can be estimated by the following equation:

$$\text{HighIntensity}_i = \alpha_0 + \alpha_1 \text{NumSpecialistCaseManagersHired}_i + \alpha'W_i + \epsilon_i \tag{1}$$

where "HighIntensity" is a binary variable for whether a patient was assigned to high-intensity services or not, "NumSpecialistCaseManagersHired" is a continuous variable for the number of specialist case managers hired the same month of enrollment as the patient, and "W" is the index of additional patient characteristics we are controlling for (ie, risk score, geographic region, age, sex, race/ethnicity, preferred language, homelessness indicator, employment indicator, detention history indicator, disability indicator, alcohol or drug dependence indicator, mood disorder indicator, psychosis disorder indicator, behavioral health acuity level, and enrollment quarter).

The second-stage regressions are estimated using a zero-inflated negative binomial (ZINB) model to account for overdispersion and excess zeros in the outcome. Given the nonlinear second-stage specification, we implement 2-stage residual inclusion (2SRI) as recommended by Terza et al (2008).²⁹ The residuals from equation (1) are included as additional regressors in equation (2) and equation (3):

$$\begin{aligned} \Pr(\text{Outcome}_i = 0) &= \frac{1}{1 + \exp\left(-(\gamma_0 + \gamma_1 \text{HighIntensity}_i + \gamma_2 \hat{\epsilon}_i + \gamma'W_i)\right)} \tag{2} \end{aligned}$$

Downloaded from http://journals.lww.com/ww-medicalcare by BHD/MK/EP/HK/AV1zEounm1Q/Nk+K/LNEZgbsH0d4XM on 10/14/2024

$$\Pr(\text{Outcome}_i = k \mid \text{Outcome}_i > 0) = \frac{\Gamma(k+r)}{k! \Gamma(r)} \left(\frac{\lambda_i^k r^r}{(\lambda_i+r)^{k+r}} \right) \quad (3)$$

with the mean parameter λ_i modeled as $\log(\lambda_i) = \beta_0 + \beta_1 \text{HighIntensity}_i + \beta_2 \hat{\epsilon}_i + \beta' W_i$

where γ and β are the coefficients to be estimated, r is the dispersion parameter of the negative binomial distribution, λ_i is the mean parameter of the negative binomial distribution, Γ represents the gamma function, and k is the count value for the outcome variable. Each health care utilization outcome for individual i includes inpatient admissions, avoidable inpatient admissions, ED visits, and avoidable ED visits.

RESULTS

Sample Characteristics

From August 2017 to December 2018, a total of 21,422 adults were enrolled in CommunityConnect. Of these, 1357 were not assigned to a case manager due to opting out of the program, and an additional 283 were excluded from the analysis sample due to being a repeat enrollment, part of a special enrollment population, assigned to a community provider network, or assigned to an unknown service intensity. The final analytic sample includes 19,782 patients. The study flow diagram is illustrated in Figure 1.

Approximately 30% of adults in the analytic sample were assigned to high-intensity case management services and 70% to low-intensity services. Those assigned to high-intensity case management services were more likely to be White/Caucasian, be experiencing homelessness, have a higher predictive risk score, have a moderate to severe behavioral health acuity level, and have a history of the following: detention, disability, alcohol or other drug dependence, mood disorder, and/or psychosis disorder. They were less likely to be Hispanic/Latino or Asian. Health care utilization 12 months post-enrollment in CommunityConnect was higher across all 4 outcomes for those assigned to high-intensity case management services. Additional descriptive statistics are provided in Table 2.

First-Stage Regression

The first-stage linear regression outcome demonstrated a very strong relationship between the instrumental variable, the number of specialist case managers hired, and whether a patient was assigned to high-intensity case management. Controlling for personal characteristics and observable health status indicators, hiring one additional specialist case manager was associated with a 3.6 percentage point (95% CI: 3.1%–4.1%; $P < 0.01$) increase in the likelihood of patients enrolled that month being assigned to high-intensity case management services (Table 3). The corresponding F -statistic is 194.61, which is greater than the 5% critical value of 37.42 from the Montiel-Olea-Pflueger robust weak instrument test. Therefore, the first-stage regression results show the instrument is sufficiently strong. Additional sensitivity

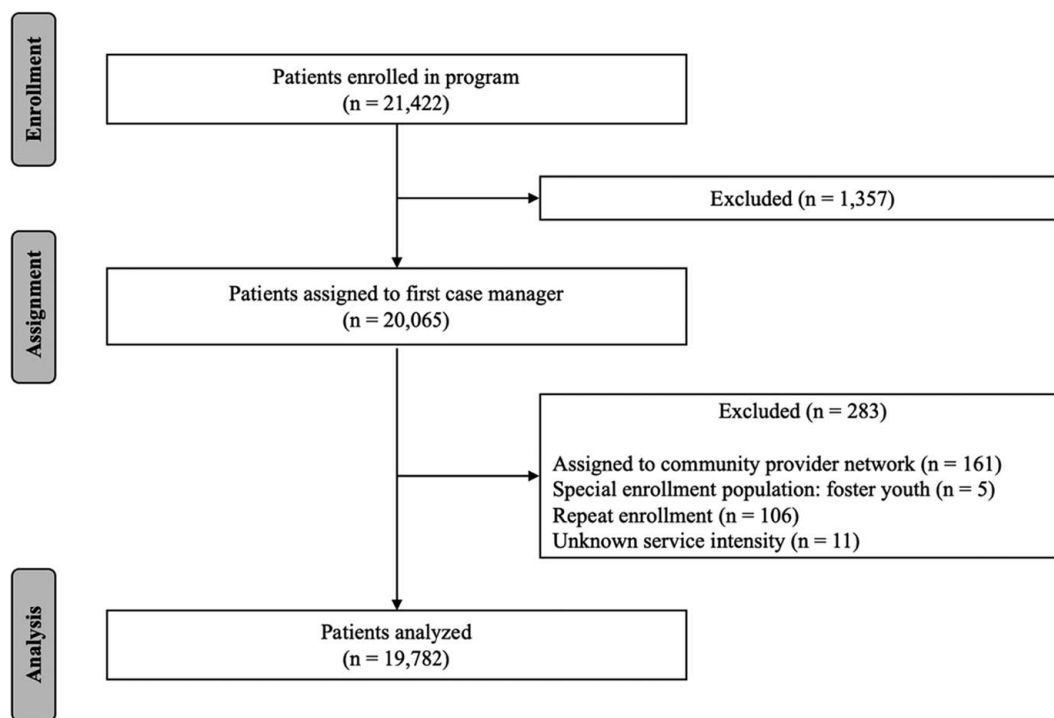


FIGURE 1. CommunityConnect study flow diagram.

TABLE 2. CommunityConnect Patient Characteristics

| Patient characteristics | High-intensity services; N = 5898 (29.8%) | Low-intensity services; N = 13,884 (70.2%) | Total; N = 19,782 |
|--|---|--|-------------------|
| Predictive risk score | | | |
| Mean (SD) | 0.183 (0.212) | 0.115 (0.131) | 0.135 (0.163) |
| Range | 0.00–4.46 | 0.03–1.53 | 0.00–4.46 |
| Region; n (%) | | | |
| East | 2453 (41.6) | 6032 (43.4) | 8485 (42.9) |
| Central | 1719 (29.1) | 3615 (26.0) | 5334 (27.0) |
| West | 1471 (24.9) | 3681 (26.5) | 5152 (26.0) |
| Far East | 158 (2.7) | 379 (2.7) | 537 (2.7) |
| Other | 97 (1.6) | 177 (1.3) | 274 (1.4) |
| Age; n (%) | | | |
| 0–< 35 | 2157 (36.6) | 5491 (39.5) | 7648 (38.7) |
| 35–< 50 | 1539 (26.1) | 3566 (25.7) | 5105 (25.8) |
| 50–< 65 | 1673 (28.4) | 3559 (25.6) | 5232 (26.4) |
| 65 and over | 529 (9.0) | 1268 (9.1) | 1797 (9.1) |
| Sex; n (%) | | | |
| Female | 3336 (56.6) | 8597 (61.9) | 11933 (60.3) |
| Male | 2562 (43.4) | 5287 (38.1) | 7849 (39.7) |
| Race/ethnicity; n (%) | | | |
| White/Caucasian | 2160 (36.6) | 3929 (28.3) | 6089 (30.8) |
| Hispanic/Latino | 1414 (24.0) | 4262 (30.7) | 5676 (28.7) |
| Black/African American | 1412 (23.9) | 3117 (22.5) | 4529 (22.9) |
| Asian | 363 (6.2) | 1202 (8.7) | 1565 (7.9) |
| Other | 549 (9.3) | 1374 (9.9) | 1923 (9.7) |
| Preferred language; n (%) | | | |
| English | 5113 (86.7) | 11101 (80.0) | 16214 (82.0) |
| Spanish | 566 (9.6) | 1992 (14.3) | 2558 (12.9) |
| Punjabi | 34 (0.6) | 94 (0.7) | 128 (0.6) |
| Other | 185 (3.1) | 697 (5.0) | 882 (4.5) |
| Is homeless; n (%) | 531 (9.0) | 414 (3.0) | 945 (4.8) |
| Is employed; n (%) | 4747 (80.5) | 10314 (74.3) | 15061 (76.1) |
| History of detention; n (%) | 1226 (20.8) | 1532 (11.0) | 2758 (13.9) |
| History of disability; n (%) | 1384 (23.5) | 2119 (15.3) | 3503 (17.7) |
| History of alcohol or other drug dependence; n (%) | 2604 (44.2) | 2351 (16.9) | 4955 (25.0) |
| History of mood disorder; n (%) | 2706 (45.9) | 3997 (28.8) | 6703 (33.9) |
| History of psychosis disorder; n (%) | 1144 (19.4) | 800 (5.8) | 1944 (9.8) |
| Behavioral health acuity level; n (%) | | | |
| None to mild | 4492 (76.2) | 11709 (84.3) | 16201 (81.9) |
| Mild to moderate | 684 (11.6) | 1415 (10.2) | 2099 (10.6) |
| Moderate to severe | 722 (12.2) | 760 (5.5) | 1482 (7.5) |
| Enrollment quarter; n (%) | | | |
| Q3 2017 | 1440 (24.4) | 3816 (27.5) | 5256 (26.6) |
| Q4 2017 | 481 (8.2) | 449 (3.2) | 930 (4.7) |
| Q1 2018 | 1565 (26.5) | 2350 (16.9) | 3915 (19.8) |
| Q2 2018 | 303 (5.1) | 3397 (24.5) | 3700 (18.7) |
| Q3 2018 | 845 (14.3) | 1470 (10.6) | 2315 (11.7) |
| Q4 2018 | 1264 (21.4) | 2402 (17.3) | 3666 (18.5) |
| Inpatient admits | | | |
| At least 1; n (%) | 907 (15.4) | 1209 (8.7) | 2116 (10.7) |
| Mean (SD) | 0.26 (0.88) | 0.12 (0.49) | 0.16 (0.63) |
| Quantiles 0–1 by 0.25 | 0, 0, 0, 0, 17 | 0, 0, 0, 0, 12 | 0, 0, 0, 0, 17 |
| Avoidable inpatient admits | | | |
| At least 1; n (%) | 152 (2.6) | 157 (1.1) | 309 (1.6) |
| Mean (SD) | 0.04 (0.37) | 0.02 (0.17) | 0.02 (0.25) |
| Quantiles 0–1 by 0.25 | 0, 0, 0, 0, 11 | 0, 0, 0, 0, 7 | 0, 0, 0, 0, 11 |
| ED visits | | | |
| At least 1; n (%) | 3367 (57.1) | 5974 (43.0) | 9341 (47.2) |

TABLE 2. (continued)

| Patient characteristics | High-intensity services; N = 5898 (29.8%) | Low-intensity services; N = 13,884 (70.2%) | Total; N = 19,782 |
|-------------------------|---|--|-------------------|
| Mean (SD) | 1.81 (3.41) | 0.90 (1.62) | 1.18 (2.34) |
| Quantiles 0–1 by 0.25 | 0, 0, 1, 2, 65 | 0, 0, 0, 1, 54 | 0, 0, 0, 2, 65 |
| Avoidable ED visits | | | |
| At least 1; n (%) | 2718 (46.1) | 4478 (32.3) | 7196 (36.4) |
| Mean (SD) | 1.18 (2.46) | 0.57 (1.17) | 0.75 (1.69) |
| Quantiles 0–1 by 0.25 | 0, 0, 0, 2, 49 | 0, 0, 0, 1, 36 | 0, 0, 0, 1, 49 |

ED indicates emergency department.

analyses are reported in the Supplemental Digital Content (Supplemental Table 1, Supplemental Digital Content 1, <http://links.lww.com/MLR/C895>), which demonstrate falsification tests for leading indicators of hiring.

TABLE 3. Impact of Specialist Case Manager Hiring on Patient Assignment to High-Intensity Services

| Coefficient | Estimate | SE | T-stat | P |
|------------------------------------|----------|-------|--------|-------|
| Intercept | 0.13 | 0.013 | 9.62 | 0.000 |
| No. specialist case managers hired | 0.04 | 0.002 | 14.63 | 0.000 |
| Predictive risk score | 0.31 | 0.027 | 11.46 | 0.000 |
| Region | | | | |
| Central | −0.01 | 0.007 | −1.01 | 0.312 |
| West | −0.02 | 0.007 | −2.89 | 0.004 |
| Far East | −0.04 | 0.019 | −2.02 | 0.043 |
| Other | −0.01 | 0.025 | −0.33 | 0.739 |
| Age | | | | |
| 35–< 50 | 0.01 | 0.008 | 0.97 | 0.331 |
| 50–< 65 | 0.04 | 0.008 | 4.43 | 0.000 |
| 65 and over | 0.09 | 0.012 | 7.53 | 0.000 |
| Sex (F) | 0.01 | 0.006 | 1.05 | 0.294 |
| Race/ethnicity | | | | |
| Hispanic/Latino | −0.01 | 0.009 | −1.58 | 0.113 |
| Black/African American | −0.01 | 0.009 | −1.04 | 0.299 |
| Asian | 0.00 | 0.013 | 0.32 | 0.747 |
| Other | −0.02 | 0.011 | −1.50 | 0.135 |
| Preferred Language | | | | |
| Spanish | −0.01 | 0.011 | −0.69 | 0.490 |
| Punjabi | 0.05 | 0.038 | 1.38 | 0.168 |
| Other | −0.02 | 0.016 | −1.12 | 0.263 |
| Is homeless | 0.12 | 0.014 | 8.41 | 0.000 |
| Is employed | 0.02 | 0.007 | 2.96 | 0.003 |
| History of detention | 0.06 | 0.009 | 6.52 | 0.000 |
| History of disability | 0.04 | 0.008 | 4.89 | 0.000 |
| History of AOD dependence | 0.21 | 0.008 | 28.23 | 0.000 |
| History of mood disorder | 0.06 | 0.007 | 9.20 | 0.000 |
| History of psychosis disorder | 0.14 | 0.011 | 12.99 | 0.000 |
| Behavioral health acuity level | | | | |
| Mild to moderate | 0.02 | 0.010 | 1.59 | 0.112 |
| Moderate to severe | 0.04 | 0.012 | 3.42 | 0.001 |
| Enrollment quarter | | | | |
| Q32017 | −0.20 | 0.010 | −19.22 | 0.000 |
| Q42017 | −0.05 | 0.017 | −2.88 | 0.004 |
| Q12018 | 0.03 | 0.010 | 3.24 | 0.001 |
| Q22018 | −0.23 | 0.010 | −23.68 | 0.000 |
| Q32018 | 0.03 | 0.011 | 3.21 | 0.001 |

Montiel-Pflueger robust weak instrument test:
 Effective F-statistic = 194.610.
 Critical value (Tau 5%) = 37.418.
 AOD indicates alcohol or other drug.

Downloaded from <http://journals.lww.com/ww-medicalcare> by BHD/MS/PH/Kav1zEoun1/01N4+hkLHEZgshH04XM
 0hCwCk1AWwYQp/10HHD33D00dFy/7TVSFIACI3VC1y0abgQZx0dgGj2MwIzIeI on 10/14/2024

TABLE 4. Association Between High-Intensity Service Assignment and Hospital Use Outcomes Using ZINB Models and 2SRI

| Outcome | Count estimate; equation (3) | Excess zero estimate; equation (2) |
|----------------------------|---------------------------------|---------------------------------------|
| Inpatient admits | | |
| Coefficient estimate | 0.341† | 3.887 |
| P | 0.072 | 0.745 |
| Avoidable inpatient admits | | |
| Coefficient estimate | 0.000* | 0.005 |
| P | 0.000 | 0.378 |
| ED visits | | |
| Coefficient estimate | 0.608† | 0.311 |
| P | 0.058 | 0.595 |
| Avoidable ED visits | | |
| Coefficient estimate | 0.579† | 0.229 |
| P | 0.091 | 0.517 |

Count estimate reported as incidence rate ratio, the associated change in incidence rate for assignment to high-intensity services.

Excess zero estimate reported as odds ratio, the associated change in odds of being an excess zero for assignment to high-intensity services.

* $P < 0.01$.

† $P < 0.1$.

ED indicates emergency department; 2SRI, 2-stage residual inclusion; ZINB, zero-inflated negative binomial.

Second-Stage Regressions

The analysis using ZINB models with 2SRI revealed that none of the outcomes were statistically significant in the excess zero part of the model (equation 2), suggesting no significant association between assignment to high-intensity case management and the likelihood of an event being an excess zero (Table 4). For the count part of the ZINB models, the estimate for avoidable inpatient admissions was highly extreme, likely due to the rarity of this event, making the result less interpretable. However, for relatively more common outcomes such as total inpatient admissions, ED visits, and avoidable ED visits, high-intensity case management was associated with a reduction in these occurrences. Specifically, the incidence rate ratio (IRR) for inpatient admissions was 0.341 (95% CI: 0.106–1.102; $P = 0.072$), indicating that high-intensity case management was associated with a 65.9% reduction in the incidence rate of inpatient admissions. The IRR for ED visits was 0.608 (95% CI: 0.188–1.965; $P = 0.058$), suggesting a 39.2% reduction in the incidence rate of ED visits associated with high-intensity case management. Similarly, the IRR for avoidable ED visits was 0.579 (95% CI: 0.179–1.872; $P = 0.091$), indicating a 42.1% reduction in the incidence rate of avoidable ED visits. Although these associations were only marginally statistically significant, with P values between 5% and 10%, they suggest that high-intensity case management may be associated with reduced health care utilization. Additional sensitivity analyses are presented in the Supplemental Digital Content, Supplemental Tables 2 through 5 (Supplemental Digital Content 1, <http://links.lww.com/MLR/C895>), which provide further evidence that the 2SRI approach mitigates positive bias in the treatment assignment.

DISCUSSION

Conditional on having any health care utilization, assignment to high-intensity CommunityConnect services was associated with reduced utilization. This outcome could suggest that intensive services better support discharge and transition of care processes after initial hospital admission or ED visit, avoiding the need for patients to revisit the hospital or ED.³⁰ For example, case managers working in-person could be physically present during discharge and conduct home visits to ensure a successful transition. Specialist case managers, such as nurses, could also conduct medication reviews in the home and monitor patients' vitals. It is important to note that while the percentage reductions appear substantial, the absolute changes in event counts are likely to be small due to the relatively low baseline rates of these events in the study population.

Our results apply specifically to patients on the margin of being assigned to either service intensity, as those were the patients in our sample who are affected by the exogenous change in the supply of in-person case managers. Neither the patients at the highest risk (who would always be assigned to high-intensity services) nor the patients at the lowest risk (who would always be assigned to low-intensity services) are impacted by the exogenous instrument. The second-stage regressions only control for the variation in the explanatory variable that is associated with variation in the instrument. Therefore, the estimated effect is a local average treatment effect that is only valid for the subpopulation of individuals whose treatment status changes due to the change in the instrument. Focusing on the effect of the change in the instrument allows us to estimate the associated effect of the independent variable for individuals who are most affected by changes in the explanatory variable. The overall target population of CommunityConnect is the top 15% of adult Medicaid patients at an elevated risk for health care use, so although the higher and lower intensity populations may have different needs and acuties, both groups are high-cost, high-risk patients.

Our study shows that evaluating different service intensities through changes in hiring as an exogenous factor is a viable approach for future research. Staffing shortages and high turnover are common in many case management programs, and if changes in hiring are independent of endogenous variables in the program, the assignment to various service intensities can be isolated and studied. Hiring for specialist case managers may be more difficult given the availability of qualified personnel in a geographic area. As observed in the CommunityConnect program, hiring one additional specialist case manager was significantly associated with the likelihood of being assigned to a particular type of service. Changes in funding or regulations could also impact the availability of specialist case managers. For example, if there is a shift toward telehealth services due to changes in reimbursement policies, this could lead to a decrease in the number of specialist case managers hired.

General limitations of this study include data constraints such as the specificity of the instrumental variable to reflect caseload and the 1-year follow-up period for which outcomes were assessed. Though the number of specialist case managers hired for a given month was shown to be a strong instrument correlated with the assignment of high or low-intensity case management services, the instrumental variable does not capture any additional changes in caseload for existing case managers who were hired in previous months. Furthermore, patients enrolled at different times during the study period differ with regard to risk thresholds and other observable characteristics, which may confound the results. Although the use of the 2SRI approach helps to address some potential endogeneity issues, the associations observed in this study do not imply causation and are limited to the context of the CommunityConnect program and its specific population. Further research with more controlled designs or additional methods to account for these differences is needed to establish causal relationships.

It is also possible the time horizon of one year is not long enough to reflect changes in health care utilization as a result of the social needs of case management services. This may be especially true given the high-risk patient population of adult Medicaid beneficiaries, as many individuals already have health-related disabilities and chronic illnesses that make it more difficult for short-term interventions and support services to be effective. Similar to outcomes reported in the primary analysis,¹⁶ individuals were not required to be continuously enrolled for 12 months, which may lead to some missed ED visits or inpatient admissions, particularly among those who lost Medicaid coverage or moved out of the county. This potential loss of data could result in an underestimation of the intervention's impact if high-intensity case management helped enrollees retain Medicaid coverage.

Using an instrument that only varies across 13 enrollment months also limits additional stratification or analyses of heterogeneous effects. While case management assignments were generally fixed at the time of initial enrollment in CommunityConnect, a small proportion of patients did experience reassignments between high and low-intensity services. This reassignment was handled on a case-by-case basis, and our analysis focused on the first assignment, resembling an intent-to-treat approach. Consequently, our estimates may be attenuated, but this method helps maintain the robustness and generalizability of our findings. Finally, we estimate the effects of service intensity, including varying modalities of communication, before the Coronavirus disease 2019 (COVID-19) pandemic. Although we expect these results to generalize, following the COVID-19 pandemic, changes in patient preference and increased familiarity with telehealth could dampen in-person social needs case management effects.

CONCLUSION

The social needs case management program implemented by Contra Costa Health is one of the largest

programs and is among the first programs to utilize a predictive risk model to determine eligibility and case management intensity. Case management programs, in general, vary with regard to eligibility, case manager types, length of program participation, and services provided. Our study highlights that high-intensity case management for adult Medicaid beneficiaries could reduce total hospital and ED use. More evidence about the effective design and implementation of social needs case management programs will be needed as diverse health care systems expand their efforts to address social risk factors.

REFERENCES

- Gottlieb LM, Wing H, Adler NE. A systematic review of interventions on patients' social and economic needs. *Am J Prev Med.* 2017;53:719–729.
- National Academies of Sciences, Engineering, and Medicine. *Integrating Social Care into the Delivery of Health Care: Moving Upstream to Improve the Nation's Health.* Washington, DC: The National Academies Press; 2019. <https://nap.nationalacademies.org/catalog/25467/integrating-social-care-into-the-delivery-of-health-care-moving-upstream-to-improve-the-nations-health>
- Joynt Maddox KE, Reidhead M, Hu J, et al. Adjusting for social risk factors impacts performance and penalties in the hospital readmissions reduction program. *Health Serv Res.* 2019;54:327–336.
- Mosen DM, Banegas MP, Benuzillo JG, et al. Association Between social and economic needs with future healthcare utilization. *Am J Prev Med.* 2020;58:457–460.
- Cole MB, Nguyen KH. Unmet social needs among low-income adults in the United States: Associations with health care access and quality. *Health Serv Res.* 2020;55(suppl 2):873–882.
- Hudon C, Chouinard MC, Pluye P, et al. Characteristics of case management in primary care associated with positive outcomes for frequent users of health care: a systematic review. *Ann Fam Med.* 2019;17:448–458.
- Dieterich M, Irving CB, Bergman H, et al. Intensive case management for severe mental illness. *Schizophr Bull.* 2017;43:698–700.
- Joo JY, Huber DL. Case Management effectiveness on health care utilization outcomes: a systematic review of reviews. *West J Nurs Res.* 2019;41:111–133.
- Iovan S, Lantz PM, Allan K, et al. Interventions to decrease use in prehospital and emergency care settings among super-utilizers in the United States: a systematic review. *Med Care Res Rev.* 2020;77:99–111.
- Kim SE, Michalopoulos C, Kwong RM, et al. Telephone care management's effectiveness in coordinating care for Medicaid beneficiaries in managed care: a randomized controlled study. *Health Serv Res.* 2013;48:1730–1749.
- Kangovi S, Mitra N, Norton L, et al. Effect of community health worker support on clinical outcomes of low-income patients across primary care facilities: a randomized clinical trial. *JAMA Intern Med.* 2018;178:1635–1643.
- Elston J, Gradinger FP, Streeter AJ, et al. Effectiveness of a targeted telephone-based case management service on activity in an emergency department in the UK: a pragmatic difference-in-differences evaluation. *BMC Health Serv Res.* 2022;22:1038.
- Béland S, Dumont-Samson O, Hudon C. Case management and telehealth: a scoping review. *Telemed E-Health.* 2022;28:11–23.
- Joo JY, Liu MF. A scoping review of telehealth-assisted case management for chronic illnesses. *West J Nurs Res.* 2022;44:598–611.
- Fichtenberg CM, Alley DE, Mistry KB. Improving social needs intervention research: key questions for advancing the field. *Am J Prev Med.* 2019;57:S47–S54.
- Brown DM, Hernandez EA, Levin S, et al. Effect of social needs case management on hospital use among adult Medicaid beneficiaries. *Ann Intern Med.* 2022;175:1109–1117.
- Fleming MD, Guo C, Knox M, et al. Impact of social needs case management on use of medical and behavioral health services: secondary analysis of a randomized controlled trial. *Ann Intern Med.* 2023;176:1139–1141.

18. Knox M, Hernandez EA, Brown DM, et al. Greater COVID-19 vaccine uptake among enrollees offered health and social needs case management: Results from a randomized trial. *Health Serv Res.* 2024;59:14229.
19. Sabik LM, Bazzoli GJ, Carcaise-Edinboro P, et al. The impact of integrated case management on health services use and spending among nonelderly adult Medicaid enrollees. *Med Care.* 2016;54:758–764.
20. Lalani HS, Ephraim PL, Apfel A, et al. Association of care management intensity with healthcare utilization in an all-condition care management program. *Am J Manag Care.* 2019;25:e395–e402.
21. Gary TL, Batts-Turner M, Yeh HC, et al. The effects of a nurse case manager and a community health worker team on diabetic control, emergency department visits, and hospitalizations among urban African Americans with type 2 diabetes mellitus. *Arch Intern Med.* 2009;169:1788–1794.
22. Khanassov V, Vedel I, Pluye P. Barriers to implementation of case management for patients with dementia: a systematic mixed studies review. *Ann Fam Med.* 2014;12:456–465.
23. Pacala JT, Boulton C, Hepburn KW, et al. Case management of older adults in health maintenance organizations. *J Am Geriatr Soc.* 1995;43:538–542.
24. King R, Le Bas J, Spooner D. The impact of caseload on the personal efficacy of mental health case managers. *Psychiatr Serv Wash DC.* 2000;51:364–368.
25. Fleming MD, Safaeinili N, Knox M, et al. Conceptualizing the effective mechanisms of a social needs case management program shown to reduce hospital use: a qualitative study. *BMC Health Serv Res.* 2022;22:1585.
26. Knox M, Esteban EE, Hernandez EA, et al. Defining case management success: a qualitative study of case manager perspectives from a large-scale health and social needs support program. *BMJ Open Qual.* 2022;11:e001807.
27. Agency for Healthcare Research and Quality. *AHRQ Quality Indicators—Guide to Prevention Quality Indicators: Hospital Admission for Ambulatory Care Sensitive Conditions.* Rockville, MD: Agency for Healthcare Research and Quality; 2001. AHRQ Pub. No. 02-R0203.
28. Billings J, Parikh N, Mijanovich T. Emergency department use: the New York story. *The Commonwealth Fund.* 2000:1–12. <https://www.commonwealthfund.org/publications/issue-briefs/2000/nov/emergency-room-use-new-york-story>
29. Terza JV, Basu A, Rathouz PJ. Two-stage residual inclusion estimation: addressing endogeneity in health econometric modeling. *J Health Econ.* 2008;27:531–543.
30. Raven MC, Kushel M, Ko MJ, et al. The effectiveness of emergency department visit reduction programs: a systematic review. *Ann Emerg Med.* 2016;68:467–483.e15.