

Passive Social Health Surveillance and Inpatient Readmissions

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Social needs, such as adequate housing, food security, and access to transportation services, affect population health outcomes.^{1,2} Neglecting to integrate social care with medical care may burden the healthcare system with unnecessary or unplanned utilization.^{2,3} Excess inpatient readmissions represent one such problem that US policy makers seek to address.⁴ Significant Medicare payment penalties motivate hospitals to develop strategies to curtail these readmissions. One approach includes hospital-defined algorithms that identify individuals with the greatest risk of readmission at the time of discharge.⁵

Social health surveillance systems, which can identify social needs and connect people to community resources, may support medical and social care integration.⁶ Active social health surveillance uses screening tools to directly identify patient social needs at medical facilities.⁷ However, medical care providers may lack the time, training, and resources to effectively conduct social health screenings or link patients to community service providers.⁸⁻¹¹

A passive social health surveillance system—analogue to public health surveillance systems—consists of the ongoing collection, storage, and classification of social health needs information identified and reported by individuals or their caregivers. Two nationwide passive social health surveillance systems, the 2-1-1 programs^{6,12} and WellCare Health Plan's Community Assistance Line,^{13,14} have been identified as effective approaches for identifying and tracking individual-level social health needs, including financial assistance to pay for utilities, food programs, assistance with medication, housing support, and free or low-cost transportation, among others.

The objective of this study was to determine whether self-identified social service needs collected through a passive social health surveillance system were associated with inpatient readmissions within 30, 90, and 180 days.

METHODS

Study Design and Data Source

WellCare Health Plan's Community Assistance Line, a part of its Center for CommUnity Impact, provides referrals to community-based

ABSTRACT

OBJECTIVES: To determine whether self-identified social needs, such as financial assistance with utilities, food programs, housing support, transportation, and medication assistance, collected using a passive social health surveillance system were associated with inpatient readmissions.

STUDY DESIGN: Cross-sectional, retrospective observational study.

METHODS: This retrospective observational study linked social service referral data collected from a call center-based passive social health surveillance system with healthcare claims data extracted from a managed care organization (MCO). Mixed-effects logistic regression models calculated the odds of all-cause hospital readmissions within 30, 90, and 180 days among individuals with self-identified social service needs compared with those without.

RESULTS: Individuals who identified social service needs had 68% (odds ratio [OR], 1.68; 95% CI, 1.51-1.86), 89% (OR, 1.89; 95% CI, 1.74-2.05), and 101% (OR, 2.01; 95% CI, 1.87-2.17) higher odds of readmission within 30, 90, and 180 days, respectively, after controlling for other study variables. Examining each social service need separately, individuals had higher odds of hospital readmission within 30 days of discharge if they identified a financial (OR, 1.19; 95% CI, 1.07-1.33), food (OR, 1.32; 95% CI, 1.17-1.48), housing (OR, 1.31; 95% CI, 1.09-1.57), or transportation (OR, 1.21; 95% CI, 1.08-1.36) need compared with those without those social needs. In all study outcomes, medication assistance was not associated with readmissions.

CONCLUSIONS: An MCO created a passive social health surveillance program to more effectively integrate medical and social care. Understanding individual-level social health needs provides the insights needed to develop interventions to prevent hospital readmissions.

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social service organizations to individuals who contact the call center and report a social need. This cross-sectional study linked self-identified social needs collected in the social service referral program's database with the managed care organization (MCO)'s health service claims data.

Study Population

The study examined claims and social service referral data from January 1, 2013, through October 19, 2017, from 27,189 individuals insured by WellCare Health Plan's Medicaid managed care and Medicare Advantage programs. The sample included individuals who were at least 18 years of age with at least 1 admission to an acute care hospital. Individuals who were pregnant (n = 638), were younger than 18 years (n = 1469), were transferred to a different hospital (n = 757), had 1 admission but less than 6 months of enrollment and claims data (n = 4210), received chemotherapy (n = 88), lived outside the 13 established states of interest (n = 84), had claims data errors (n = 11), or had incomplete data on study variables (n = 115) were excluded. The final study population included 19,817 individuals from 13 states who were readmitted to 1064 hospitals.

Outcome Measures

Outcome measures consisted of 3 all-cause hospital readmissions: individuals who were admitted within 30, 90, and 180 days of prior inpatient discharge. An admission was considered a readmission only if it occurred within the stipulated time frame (eg, 30 days) and was not a transfer to a different hospital. To identify a readmission, we calculated the difference between the first and subsequent admission and categorized the individuals as having 30-, 90-, and 180-day readmissions. Individuals with a single admission and who had utilization data for at least 6 months were classified as not having a readmission.

Study Groups

The study population was further classified into 2 groups: (1) individuals with self-identified social service needs reported to the Community Assistance Line and (2) individuals without self-identified social service needs. The study further classified individuals with a self-identified need based on the presence of any of the following 5 social service needs: financial assistance for utilities, food programs, housing support, transportation, and medication assistance. Individuals contacting the Community Assistance Line with self-identified social needs either had exhausted their defined health insurance benefit for services such as food programs, transportation, or medication assistance, or the social service was not a part of the health plan benefit, such as financial assistance and health literacy programs. These 5 domains of social needs were selected based on the recommendation by CMS and their previous

TAKEAWAY POINTS

- ▶ A passive social health surveillance system—a managed care organization (MCO)'s call center–based social service referral program—enabled examination of whether self-identified social needs are associated with inpatient readmissions.
- ▶ This study linked referral and claims data for 19,817 individuals to examine the odds of inpatient readmissions for individuals with self-identified social needs, such as food and housing insecurity, compared with those without self-identified needs.
- ▶ Results showed that individuals with self-identified social needs had higher odds of 30-day inpatient readmissions.
- ▶ Passive social health surveillance systems could enable MCOs to play an important role in integrating medical and social care by complementing the social health screenings of medical care providers.

associations with health outcomes.¹⁵⁻¹⁸ The study also examined the individuals with each of these 5 aforementioned domains of social needs separately compared with individuals without them.

Study Variables

To account for the maldistribution of established risk factors for hospital readmissions between study groups, several variables were included in our analyses. These variables included state of residence (Arkansas, Florida, Georgia, Illinois, Kentucky, Louisiana, Mississippi, Missouri, New Jersey, New York, South Carolina, Tennessee, or Texas), age at index admission, sex, race (black, white, Hispanic, or other), type of insurance (Medicaid managed care or Medicare Advantage), length of stay of the index admission, and whether the individual received case management services before the date of readmission.

The study also quantified the illness severity of individuals by calculating the Charlson Comorbidity Index (CCI) score using *International Classification of Diseases, Ninth Revision (ICD-9)* diagnosis codes from claims data within the 12 months before hospitalization.¹⁹ Using *ICD-9* diagnosis codes, the study further identified individuals with alcohol abuse, severe mental illness, and anxiety and depression. To account for neighborhood characteristics, the study included 2 measures of the socioeconomic status of the individual's community: percentage of people 25 years or older with less than a high school diploma and percentage of people 25 years or older living below the poverty level.

Statistical Analyses

The characteristics of individuals who identified a social need and those who did not were described using frequencies, proportions, means, and medians. The differences in these characteristics were tested using χ^2 tests of independence for proportions, 2 independent sample *t* tests for differences in means, and Wilcoxon tests for differences in medians. Tables were created to describe the distribution of the identified social needs among applicable individuals.

The study accounted for the hierarchical nature of the data by performing mixed-effects logistic regression with the hospital included as a random intercept to account for clustering of individuals within hospitals. This modeling approach accounts for the variation of hospital-related factors on readmission and controls the

TABLE 1. Distribution of the 10 Most Frequently Self-identified Social Needs Among 13,708 Individuals Seeking Social Service Referrals

Self-identified Social Need	Count (n)	Percentage (%)
Financial assistance, including utilities	5043	20.3
Transportation	4091	16.5
Free or reduced-cost care services	3837	15.4
Food programs	3716	14.9
Medication assistance	1697	6.8
Housing support	1457	5.9
Support service	1205	4.8
Health literacy program	374	1.5
Area Agency on Aging (and Disabilities)	341	1.4
Elder assistance	305	1.2

TABLE 2. Descriptive Characteristics of Study Population by the Presence of a Self-identified Social Need (N = 19,817)

	Self-identified Social Needs (n = 13,708)	No Self-identified Social Needs (n = 6109)	P
Age in years, mean (SD)	55.8 (15.8)	58.2 (16.9)	<.0001
CCI score, median (IQR)	1.0 (2.0)	0.0 (1.0)	<.0001*
Length of prior admission in days, median (IQR)	3.0 (3.0)	3.0 (3.0)	<.0001*
Percentage of adults 25 years or older below poverty level in neighborhood, mean (SD)	23.4 (10.4)	23.1 (10.3)	.13
Percentage of adults 25 years or older with less than a high school diploma in neighborhood, mean (SD)	32.8 (11.9)	32.2 (12.0)	.002
	n (%)	n (%)	
30-day all-cause readmission			<.0001
No	11,858 (86.5)	5595 (91.6)	
Yes	1850 (13.5)	514 (8.4)	
90-day all-cause readmission			<.0001
No	10,286 (75.0)	5197 (85.1)	
Yes	3422 (25.0)	912 (14.9)	
180-day all-cause readmission			<.0001
No	8912 (65.0)	4824 (79.0)	
Yes	4796 (35.0)	1285 (21.0)	

(continued)

type I error rate.²⁰ A test of multicollinearity was performed between variables with potentially common underlying determinants using the variance inflation factor (VIF). All selected covariates had a VIF of less than 10, indicating that the variables included in the model

were not strongly correlated (eAppendix Tables 1 and 2 [eAppendix available at ajmc.com]). Odds ratios (ORs) and their 95% CIs were used to compare the odds of readmission (within 30, 90, and 180 days) between the 2 study groups before and after adjusting for risk factors. This sequential approach highlights the change in odds of readmission in the presence of known risk factors for readmission.

Three groups of analyses were conducted according to the study groups under observation. First, a model was created to compare the odds of readmission on all study outcomes between individuals with any self-identified social need and those without. Second, the study compared the odds of readmission among individuals with at least 1 of the 5 domains of social needs (financial assistance with utilities, food programs, housing support, transportation, and medication assistance) and individuals with other social needs with those without any social need. The final model compared the odds of readmission on all study outcomes for individuals with a social need except for financial assistance, food programs, housing support, transportation, and medication assistance versus those without any of these needs. All 3 models controlled for the differences in risk factors including age, gender, race, state of residence, type of insurance, length of stay, comorbidities, case management status, severe mental illness, anxiety/depression, alcohol abuse, and, in their neighborhood, percentage of people 25 years or older with less than a high school diploma and percentage of people 25 years or older living below the poverty level.

All statistical tests were 2-sided and conducted using SAS 9.4 (SAS Institute Inc; Cary, North Carolina). P values and ORs, along with their 95% CIs, were calculated. P values <.05 were considered statistically significant.

The study was classified as exempt by the University of South Florida Institutional Review Board (#Pro00028372), as the data used in the study were previously collected for existing program operations by WellCare Health Plans.

RESULTS

Our study population consisted of 19,817 individuals with a mean (SD) age of 56.6 (16.2) years; 64.4% were female, and 75.3% were white. About 69.2% of the study population identified at least 1 social need, resulting in 24,867 social service referrals. The 10 most frequent social service referrals, accounting for approximately 88.7% of referrals in this population, are shown in Table 1.

Compared with members who did not identify a social need, members with a self-identified social need were younger (55.8 vs 58.2 years) and had a higher median CCI score (1.0 vs 0.0). They were more likely to be female (66.4% vs 60.0%), be insured by Medicaid (50.0% vs 41.6%), be in case management (88.8% vs 86.0%), have a severe mental illness diagnosis (9.5% vs 4.9%), have anxiety or depression (22.3% vs 13.6%), abuse alcohol (1.3% vs 0.8%), and live in neighborhoods with a higher proportion of adults with less than a high school diploma (32.8% vs 32.2%). These differences were statistically significant (Table 2).

Before adjusting for other study variables, individuals with any self-identified social service need had 70%, 90%, and 102% higher odds of readmission within 30, 90, and 180 days, respectively (30 days: OR, 1.70; 95% CI, 1.53-1.88; 90 days: OR, 1.90; 95% CI, 1.75-2.05; 180 days: OR, 2.02; 95% CI, 1.88-2.17), compared with individuals without a self-identified social need. After controlling for other study variables, the odds of readmission attenuated slightly but remained higher in all study periods for individuals with a social need compared with those without one (30 days: OR, 1.68; 95% CI, 1.51-1.86; 90 days: OR, 1.89; 95% CI, 1.74-2.05; 180 days: OR, 2.01; 95% CI, 1.87-2.17) (Table 3).

Table 4 shows the results of the 30-day readmission adjusted mixed-effects logistic regression model, including the independent variables, where the odds of readmission for those with a self-identified need were 68% higher (95% CI, 1.51-1.86). Length of stay of index admission showed increased odds of readmission (OR, 1.04; 95% CI, 1.03-1.05) for every day spent in the hospital. Female sex (OR, 0.90; 95% CI, 0.82-0.98) and case management before readmission (OR, 0.57; 95% CI, 0.48-0.67) were each associated with reduced odds of 30-day readmission in the adjusted logistic regression model.

The odds of readmission remained higher in all study periods for individuals who identified at least 1 of the 5 social service needs (financial assistance for utilities, food programs, housing support, transportation, or medication assistance). The odds of readmission observed in this group were comparable with the effect observed in the main group but slightly higher in most study outcomes than in the group with other social needs (Table 5).

The results in Table 5 show that individuals needing financial assistance had 19% higher odds of being readmitted within 30 days of discharge (95% CI, 1.07-1.33) after controlling for other study variables. The increased statistical significance was maintained within 90 (OR, 1.18; 95% CI, 1.08-1.29) and 180 (OR, 1.25; 95% CI, 1.16-1.35) days. Similarly, individuals with food needs (30 days: OR, 1.32; 95% CI, 1.17-1.48; 90 days: OR, 1.31; 95% CI, 1.19-1.44; 180 days: OR, 1.31; 95% CI, 1.20-1.42), housing needs (30 days: OR, 1.31; 95% CI, 1.09-1.57; 90 days: OR, 1.28; 95% CI, 1.10-1.48; 180 days: OR, 1.44; 95% CI, 1.26-1.65), and transportation service needs (30 days: OR, 1.21; 95% CI, 1.08-1.36; 90 days: OR, 1.34; 95% CI, 1.23-1.47; 180 days: OR, 1.43; 95% CI, 1.31-1.55) had higher odds of readmission within 30, 90, and 180 days compared with others who did not identify these needs. In all study outcomes, individuals needing medication assistance did not have higher odds of inpatient readmissions compared with individuals who did not identify assistance with medication as a need (30 days: OR, 1.05; 95% CI, 0.89-1.24; 90 days: OR, 1.11; 95% CI, 0.97-1.26; 180 days: OR, 1.08; 95% CI, 0.96-1.22).

DISCUSSION

This study examined the association between self-identified social needs collected from a passive social service surveillance system and inpatient readmissions extracted from healthcare claims covering almost 5 years. Combining social service referrals with healthcare

TABLE 2. (Continued) Descriptive Characteristics of Study Population by the Presence of a Self-identified Social Need (N = 19,817)

	Self-identified Social Needs n (%)	No Self-identified Social Needs n (%)	P
Gender			<.0001
Female	9105 (66.4)	3665 (60.0)	
Male	4603 (33.6)	2444 (40.0)	
Type of insurance			<.0001
Medicaid	6851 (50.0)	2540 (41.6)	
Medicare	6857 (50.0)	3569 (58.4)	
Race			<.0001
Black	1682 (12.3)	622 (10.2)	
White	10,415 (76.0)	4510 (73.8)	
Hispanic	929 (6.8)	616 (10.1)	
Other	682 (5.0)	361 (5.9)	
Case management before readmission			<.0001
No	12,175 (88.8)	5256 (86.0)	
Yes	1533 (11.2)	853 (14.0)	
Anxiety/depression			<.0001
No	10,648 (77.7)	5279 (86.4)	
Yes	3060 (22.3)	830 (13.6)	
Alcohol abuse			.005
No	13,525 (98.7)	6059 (99.2)	
Yes	183 (1.3)	50 (0.8)	
Severe mental illness			<.0001
No	12,401 (90.5)	5809 (95.1)	
Yes	1307 (9.5)	300 (4.9)	
State			<.0001
Arkansas	396 (2.9)	168 (2.8)	
Florida	2459 (17.9)	1312 (21.5)	
Georgia	2041 (14.9)	1117 (18.3)	
Illinois	302 (2.2)	149 (2.4)	
Kentucky	5482 (40.0)	2143 (35.1)	
Louisiana	235 (1.7)	57 (0.9)	
Mississippi	772 (5.6)	300 (4.9)	
Missouri	162 (1.2)	19 (0.3)	
New Jersey	224 (1.6)	59 (1.0)	
New York	492 (3.6)	256 (4.2)	
South Carolina	167 (1.2)	98 (1.6)	
Tennessee	424 (3.1)	107 (1.8)	
Texas	552 (4.0)	324 (5.3)	

CCI indicates Charlson Comorbidity Index; IQR, interquartile range. *Represents P values generated from Wilcoxon rank-sum test.

utilization data supports efforts to integrate medical and social care. Results show that individuals with self-identified social needs have higher odds of 30-, 90-, and 180-day inpatient readmission compared with individuals without a self-identified social need.

TABLE 3. Mixed-Effects Logistic Regression Results Showing the Association Between Self-identified Social Service Needs and Readmission Among Participants With at Least 1 Self-identified Need Versus Participants With None (N = 19,817)^a

Study Outcomes ^b	Unadjusted Model OR (95% CI)	Adjusted Model ^c OR (95% CI)
Self-identified need vs none		
30-day readmission	1.70 (1.53-1.88)	1.68 (1.51-1.86)
90-day readmission	1.90 (1.75-2.05)	1.89 (1.74-2.05)
180-day readmission	2.02 (1.88-2.17)	2.01 (1.87-2.17)

OR indicates odds ratio.

^aAll models were created by treating hospitals as a random effect to adjust for correlation of subjects from similar hospitals.

^bResults generated from 3 models for each outcome.

^cModel was adjusted for age, length of stay, Charlson Comorbidity Index score, neighborhood characteristics, gender, race, type of insurance, case management, state of residence, alcohol abuse, anxiety or depression, and presence of severe mental illness.

TABLE 4. Adjusted Mixed-Effects Logistic Regression for 30-Day Readmission Among Participants With at Least 1 Self-identified Need Versus Participants With None (N = 19,817)^{a,b}

Characteristics	OR (95% CI)
Presence of a self-identified social need upon 30-day readmission	
No	Reference
Yes	1.68 (1.51-1.86)
Sex	
Male	Reference
Female	0.90 (0.82-0.98)
Type of insurance	
Medicaid	Reference
Medicare	1.13 (0.97-1.32)
Length of stay	1.04 (1.03-1.05)
Age at index admission	1.00 (1.00-1.01)
Poverty level of neighborhood	1.00 (0.99-1.01)
Education attainment	1.00 (1.00-1.01)
Charlson Comorbidity Index score	1.01 (0.98-1.04)
Presence of anxiety/depression	
No	Reference
Yes	1.01 (0.89-1.15)
Alcohol abuse	
No	Reference
Yes	1.25 (0.86-1.83)
Presence of severe mental illness	
No	Reference
Yes	0.83 (0.69-1.01)
Case management before readmission	
No	Reference
Yes	0.57 (0.48-0.67)

(continued)

This underscores the potential of passive social health surveillance systems in identifying individuals at risk of inpatient readmissions.

Although the mechanism by which social needs affect readmissions is not confirmed, it is possible that the self-identified social needs exacerbate the health conditions of the original diagnosis or hinder complete recovery and/or adherence to the postdischarge plan. For example, individuals without transportation services might miss doctor's appointments and those in need of food might lack the nutritional requirements for adequate recovery. These social needs, if unmet, could potentially lead to a return to the hospital. Although examining the mediating effect of social needs on subsequent inpatient readmission and access to medical care among people of low socioeconomic status is beyond the scope of this paper, we believe that this might be an opportunity for further research.

In addition, although unmet social needs may be associated with readmissions, it is plausible that the result could be influenced by unmeasured confounders related to both self-reported social service needs and readmissions. For example, the apparent association between social needs and readmission may be that patients lack social support, which, in turn, leads to both contacting the call center to report a social need and returning to the hospital for readmission. Thus, our results may be overestimated. If factors related to social support that were unavailable in the present data were added to the models, the observed association reflected in our results may have been attenuated. However, even if self-reported social needs simply act as a spurious marker for readmissions, from a practical standpoint, this is problematic only if interventions focus solely on addressing the social needs, such as housing instability and food insecurity, while ignoring possible underlying determinants, such as shortage of affordable housing and inconsistent access to food. Additional research should be conducted to elucidate the actual nature of the relationship between social needs and readmission rates in order to properly identify the best interventions for preventing inpatient readmissions.

Individual-level social health surveillance information has not been previously evaluated when estimating inpatient readmission outcomes. Most readmission predictive models have incorporated clinical and demographic variables obtained from administrative databases.^{5,21-24} Other research predicting hospital readmissions used community-level factors as proxies for unmeasured individual-level measures of social health.²⁵⁻²⁷ The results from this study support the addition of individual-level social health factors collected through social health surveillance—both active and passive—to models seeking to predict individuals at risk of readmission.²⁸

The study also analyzed individuals with each of the following social service needs: financial assistance for utilities, food programs, housing support, transportation, and medication assistance. Compared with individuals without each of those social service needs, the odds of readmission for each of these social service types except medication assistance were higher at 30, 90, and 180 days. These findings are consistent with those of previous research showing

TABLE 4. (Continued) Adjusted Mixed-Effects Logistic Regression for 30-Day Readmission Among Participants With at Least 1 Self-identified Need Versus Participants With None (N = 19,817)^{a,b}

Characteristics	OR (95% CI)
Race	
White	Reference
Black	0.84 (0.72-0.98)
Hispanic	1.01 (0.85-1.21)
Other races	0.94 (0.77-1.15)
State of residence	
Texas	Reference
Arkansas	1.10 (0.80-1.51)
Florida	0.97 (0.78-1.22)
Georgia	0.87 (0.68-1.11)
Illinois	1.46 (1.05-2.03)
Kentucky	1.03 (0.80-1.34)
Louisiana	1.00 (0.67-1.48)
Mississippi	0.89 (0.67-1.18)
Missouri	2.15 (1.36-3.41)
New Jersey	1.55 (1.04-2.31)
New York	0.85 (0.63-1.15)
South Carolina	0.79 (0.50-1.26)
Tennessee	0.98 (0.71-1.36)

OR indicates odds ratio.

^aModel was adjusted for age, length of stay, Charlson Comorbidity Index score, neighborhood characteristics, gender, race, type of insurance, case management, state of residence, alcohol abuse, anxiety or depression, and presence of severe mental illness.

^bModel was created by treating hospitals as a random effect to adjust for correlation of subjects from similar hospitals. The ratio of Pearson's χ^2 to degrees of freedom was 0.96.

that a variety of social determinants of health, such as financial insecurity,²⁹ housing instability,^{30,31} transportation difficulties,³² and food insecurity,³³ relate to inpatient readmissions.

Furthermore, this study highlights the contribution of nonclinical organizations to social health surveillance efforts. MCOs³⁴ and social care coordination programs conduct passive social health surveillance that requires adequate investment to operate effectively.^{6,12,34} For example, the social service referral program should be appropriately promoted to ensure awareness by all stakeholders, including individuals with social health needs and medical care providers seeking resources to address patients' social determinants of health. In addition, sufficient staffing of social health surveillance programs facilitates the connection of patients to community resources, supports technologies that track social service referrals, and enables robust program evaluation.¹³

The social health surveillance function highlighted in this study—the Community Assistance Line call center–based social service referral program—could be a useful tactic for accountable care organizations (ACOs). ACOs represent a risk-based financing model similar to the MCO evaluated in this study. ACOs are a type of alternative payment model that holds healthcare organizations

TABLE 5. Mixed-Effects Logistic Regression Results Showing the Association Between Self-identified Social Service Needs and Readmission (N = 19,817)^a

Study Outcomes	OR (95% CI) ^a
At least 1 of financial assistance, food program, housing support, transportation, or medication assistance vs none ^b	
30-day readmission	1.72 (1.54-1.92)
90-day readmission	1.90 (1.74-2.07)
180-day readmission	2.05 (1.89-2.21)
Other social needs excluding financial assistance, food program, housing support, transportation, and medication assistance vs none ^b	
30-day readmission	1.57 (1.37-1.79)
90-day readmission	1.85 (1.66-2.05)
180-day readmission	1.94 (1.76-2.13)
Independent association between financial assistance and readmission ^c	
30-day readmission ^d	1.19 (1.07-1.33)
90-day readmission ^d	1.18 (1.08-1.29)
180-day readmission ^d	1.25 (1.16-1.35)
Independent association between food program and readmission ^c	
30-day readmission ^d	1.32 (1.17-1.48)
90-day readmission ^d	1.31 (1.19-1.44)
180-day readmission ^d	1.31 (1.20-1.42)
Independent association between housing support and readmission ^c	
30-day readmission ^d	1.31 (1.09-1.57)
90-day readmission ^d	1.28 (1.10-1.48)
180-day readmission ^d	1.44 (1.26-1.65)
Independent association between transportation and readmission ^c	
30-day readmission ^d	1.21 (1.08-1.36)
90-day readmission ^d	1.34 (1.23-1.47)
180-day readmission ^d	1.43 (1.31-1.55)
Independent association between medication assistance and readmission ^c	
30-day readmission ^d	1.05 (0.89-1.24)
90-day readmission ^d	1.11 (0.97-1.26)
180-day readmission ^d	1.08 (0.96-1.22)

OR indicates odds ratio.

^aModel was adjusted for age, length of stay, Charlson Comorbidity Index score, neighborhood characteristics, gender, race, type of insurance, case management, state of residence, alcohol abuse, anxiety or depression, and presence of severe mental illness. All models were created by treating hospitals as a random effect to adjust for correlation of subjects from similar hospitals.

^bResults generated from 3 models for each outcome. Each model contained an indicator variable that classified subjects into 3 social needs groups.

^cIndividuals with these needs were compared with other individuals without them.

^dAll models contained all 5 social need domains.

financially responsible for the cost and quality of care of a population.³⁵ Some ACOs also seek to combine their medical care capacity with social service coordination to achieve improved health outcomes, a concept called Accountable Health Communities.^{36,37} However, most ACOs lack the social health surveillance functions and community organization relationships necessary to address their patients' social determinants of health.³⁸ The Community Assistance Line represents 1 potential medical and social care integration model for organizations financially responsible for improving quality and reducing costs of care.

Future studies should examine the benefits of using passive social health surveillance data, such as those presented in this study, to assist in preventing inpatient readmissions. Programs combining social health surveillance with social care interventions, including hospital-based community health workers,³⁹ hospital-based lay health workers,³³ community-based navigators,⁴⁰ and hospital-based social work interns,⁴¹ have demonstrated success at reducing preventable readmissions. In addition, future investigation should build on this retrospective observational study to examine the optimal nature, quantity, and timing of social health surveillance and social care interventions that could prevent readmissions among populations with social care needs.

Limitations

Several limitations of this study are worth noting. First, the study design precludes any causal and temporal inferences about the relationships between the self-identified social care needs and readmissions. Although observed group differences were accounted for in the analysis, the impact of unmeasured factors unavailable in our claims data, such as discharge location, marital status, and other social support, is unknown.

Also, this study analyzed individuals enrolled in the Medicare Advantage and Medicaid health plans of a single MCO. Although the large sample size drawn from 1064 hospitals in 13 states supports the generalizability of the results, extrapolation of the findings to other social surveillance systems or the broader US population will require further research.

Furthermore, it should be noted that the classification of readmissions was such that an individual readmitted within 30 days of discharge was also classified in the 90- and 180-day outcomes. Therefore, it is expected that the ORs of all study outcomes would follow an increasing linear response. Thus, we caution the interpretation of the dose-response relationship observed in our results.

In addition, the self-identified need does not mean that the referral resulted in access to or satisfaction with social services. Although these metrics were tracked, the focus on this study was to examine the hospitalization pattern of subjects with a social need. Future prospective randomized studies should determine if the fulfillment of social needs leads to a reduction in readmissions or unnecessary healthcare utilization.

Finally, although it is possible for patients to have been readmitted at hospitals not participating in the MCO's participating network of

hospitals and thus unavailable to the present analysis, there is no reason to believe that the small number of missed claims would have been more likely to occur for individuals in either study group.

CONCLUSIONS

This study examined a form of passive social health surveillance: an MCO's call center-based social service referral program. By linking social service referrals with healthcare claims, this study highlights the potential for nonclinical organizations to support medical and social care integration. Although further studies are needed to clarify the mechanisms involved with social health needs and inpatient readmissions, the current results highlight the promise of passive social health surveillance data used in the development of interventions that improve health outcomes. ■

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eAppendix Table 1. Tests of Multicollinearity of Covariates With Theoretically Similar Underlying Determinants

Covariate	VIF
Age	1.32
Type of insurance	1.09
Case management	1.01
Any social need	1.02
Length of stay	1.01
Alcohol abuse	1.01
Anxiety/depression	1.35
Severe mental illness	1.31
Percentage of adults ≥ 25 in the neighborhood below the poverty level	2.18
Percentage of adults ≥ 25 in the neighborhood with less than a high school diploma	2.21

*VIF indicates Variance Inflation Factor. As a rule of thumb, a value above 10 is indicative of serious collinearity.

eAppendix Table 2. Pearson Correlation Coefficients of Covariates With Theoretically Similar Underlying Determinants

	Any social need	Length of stay of index admission	Case management	Type of Insurance	Age	Alcohol Abuse	Anxiety /Depression	Severe Mental Health	% >25 in the N/hood below the poverty level	% >25 in the N/hood with less than a High School Diploma
Any social need	1.00	0.05	-0.04	0.08	-0.07	0.02	0.10	0.08	0.02	0.02
Length of stay of index admission	0.05	1.00	-0.03	-0.08	0.07	0.00	-0.04	-0.02	0.00	0.00
Case management	-0.04	-0.03	1.00	0.06	0.00	0.00	-0.02	-0.03	-0.01	0.00
Type of insurance	0.08	-0.08	0.06	1.00	-0.49	0.04	0.19	0.10	0.03	0.11
Age	-0.07	0.07	0.00	-0.49	1.00	-0.03	-0.10	-0.08	-0.02	-0.07
Alcohol abuse	0.02	0.00	0.00	0.04	-0.03	1.00	0.10	0.11	0.00	0.00
Anxiety/depression	0.10	-0.04	-0.02	0.19	-0.10	0.10	1.00	0.48	0.01	0.04
Severe mental illness	0.08	-0.02	-0.03	0.10	-0.08	0.11	0.48	1.00	-0.02	0.00
Percentage of adults ≥25 in the neighborhood below the poverty level	0.02	0.00	-0.01	0.03	-0.02	0.00	0.01	-0.02	1.00	0.73
Percentage of adults ≥25 in the N/hood with less than a high school diploma	0.02	0.00	0.00	0.11	-0.07	0.00	0.04	0.00	0.73	1.00