Acute Care Utilization After Recovery Coaching Linkage During Substance-Related Inpatient Admission: Results of Two Randomized Controlled Trials

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BACKGROUND: For patients with substance use disorder (SUD), a peer recovery coach (PRC) intervention increases engagement in recovery services; effective support services interventions have occasionally demonstrated cost savings through decreased acute care utilization.
OBJECTIVE: Examine effect of PRCs on acute care utilization.
DESIGN: Combined results of 2 parallel 1:1 randomized controlled trials.
PARTICIPANTS: Inpatient adults with substance use disorder
INTERVENTIONS: Inpatient PRC linkage and follow-up contact for 6 months vs usual care (providing contact information for SUD resources and PRCs)
MAIN MEASURES: Acute care encounters (emergency and inpatient) 6 months before and after enrollment; encounter type by primary diagnosis code category (mental/behavioral vs medical); 30-day readmissions with Lace+ readmission risk scores.
KEY RESULTS: A total of 193 patients were randomized: 95 PRC; 98 control. In the PRC intervention, 66 patients had a pre-enrollment acute care encounter and 56 had an encounter post-enrollment, compared to the control group with 59 pre- and 62 post-enrollment (odds ratio [OR] = −0.79, P = 0.11); there was no significant effect for sub-groups by encounter location (emergency vs inpatient). There was a significant decrease in mental/behavioral ED visits (PRC: pre-enrollment 17 vs post-enrollment 10; control: pre-enrollment 13 vs post-enrollment 16 (OR = −2.62, P = 0.02)) but not mental/behavioral inpatient encounters or medical emergency or inpatient encounters. There was no significant difference in 30-day readmissions corrected for Lace+ scores (15.8% PRC vs 17.3% control, OR = 0.19, P = 0.65).
CONCLUSIONS: PRCs did not decrease overall acute care utilization but may decrease emergency encounters related to substance use.
TRIAL REGISTRATION: ClinicalTrials.gov (NCT04098601, NCT04098614)

KEY WORDS: substance use disorders; randomized controlled trial; peer recovery coaching; admissions.

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Acronyms

SUD	Substance use disorder
CM	Case management
ED	Emergency department
PRC	Peer recovery coach
AMA	Against medical advice
SAMHSA	Substance Abuse and Mental Health Services Administration
MBD	Mental/behavioral disorders
GLMM	Generalized linear mixed effects models
LMM	Linear mixed-effects models
RCT	Randomized controlled trial

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INTRODUCTION

Patients with substance use disorder (SUD) use acute care services at higher rates than patients without SUD: the diagnosis is associated with a 4 times greater rate of emergency department (ED) visits, 7 times greater rate of hospital admission, and double the rate of recurrent acute care utilization after hospital discharge.[1,2] Early observational studies of acute care utilization suggested that support services, such as case management (CM) programs, for the high-utilizer population would decrease utilization of high-cost acute care.[3–6] Their effect size was overestimated by the observational studies' vulnerability to regression-to-the-mean.[7,8] A conclusively positive effect has not been replicated in the few available randomized controlled trials (RCTs).[9–12] The most recent trial randomized 486 high-risk patients to a case management intervention (409 to control) and found no significant reduction in subsequent acute care utilization.[13] Studies specific to patients with SUD have also found mixed results from support services interventions on acute care utilization[14,15] and merit further research.

These support services are heterogeneous. Inpatient CM most often focuses on discharge planning and follows a brokerage model limited to assessment of needs and assistance with resource acquisition.[16] Several community CM models

adopt smaller caseloads to enable active outreach, deeper relationships, and broader services. Meta-analyses on CM interventions indicate more reliable favorability for treatment-related outcomes, such as linkage and retention, than for substance use, although these studies are often limited by heterogeneity and risk of bias.[17–21] Peer recovery support services extend relationship-based community support beyond the confines of professional services.[22,23] Their impact on acute care utilization is unknown.[24]

Peer recovery support services are delivered by a peer recovery coach (PRC). A PRC is defined here as: an individual in active recovery for a minimum of 1 year, trained and certified as a Peer Support Specialist.[25] The PRC uses assertive community engagement techniques to guide the patient through the recovery process with regular, personal coaching and connection to recovery resources. PRCs use their combined experience and training to provide reliable socioemotional, instrumental, and informational support over an extended time period. PRCs differ from other support services because PRCs represent non-clinical peer mentors with shared substance-related experience and can be a direct confidante (Supplement).[23,26]

Our institution has recently invested in having PRCs physically present in the ED, but resources were insufficient to make PRCs available for inpatients as well. Anticipating beneficial effects of expanding PRC services to the inpatient population, we recently conducted 2 RCTs evaluating the intervention of establishing a PRC relationship during a SUD-related inpatient admission. The first study had favorable results for psychosocial outcomes: inpatient linkage to PRC successfully increased engagement in recovery services[27]; the second is under analysis. These datasets provided an opportunity to rigorously evaluate the intervention's effect on acute care utilization in a high-risk group. We predicted that the intervention would lead to decreased acute care utilization.

METHODS

Two consecutive investigator-initiated, single-center studies at Greenville Memorial Hospital in Greenville, SC, recruited patients for evaluation of the same PRC intervention from April 2018 to June 2019 (study 1) and July 2019 to March 2020 (study 2); both studies were approved by the institutional review board at Prisma Health and registered on ClinicalTrials.gov (NCT04098601 and NCT04098614). Patients with SUD were identified by their primary provider and referred to the study team.

No changes were made to eligibility during each study period but 4 exclusion criteria were added for study 2 after study 1 was found to have limitations of losing patients to follow-up and too few patients in the cocaine-only and benzodiazepine-only group for sub-analyses:

Inclusion criteria for both studies:
1)Age ≥ 18 years
2)Admitted to internal medicine or receiving infectious disease consultation
3)Identified by healthcare provider as having SUD

Exclusion criteria for both studies:
1)Age < 18 years
2)Unable to provide informed consent (intubation, confusion) during hospitalization
3)Admitted for cannabis use only
4)Pregnant

Additional exclusion criteria for study 2:

5) Age > 60 years
6) Admitted for cocaine use only or benzodiazepine use only (to decrease heterogeneity)
7) Lack of at least 1 verifiable point of contact for follow-ups (phone, email, etc.)
8) Non-English speaker

Parallel 1:1 allocation was performed with allocation concealment maintained using Redcap[28] (Supplement). The primary provider was not blinded to the study condition.

Intervention and Control Conditions

Patients allocated to the intervention received a bedside visit from a PRC within 24 h of consent, during their baseline hospitalization, without the patient needing to do anything to initiate contact. The PRC contacted the patient at least twice weekly in a persistent but respectful patient-centered approach for the 6-month study duration. Following the March 2020 pandemic onset, communication transitioned from face-to-face to telephone contact.

At the time of this study, this hospital did not have an inpatient addiction consultation service. Inpatient psychiatry consultation was not routinely called for treatment of SUD, generally considered the responsibility of the primary service. The standard of care involved a social work consult through which the patient was provided a type-written list of SUD resources in the local area. The list included PRCs: patients allocated to the control had a telephone in their room and were given the PRC group's phone number; the patient was independently responsible for initiating contact. Given that both intervention and control groups were given access to PRCs, the subjects were not aware of the alternative condition nor whether they were considered intervention or control.

Outcome Measures

The primary outcome was number of acute care encounters, and proportion of patients with an acute care encounter, during the 6 months after study enrollment, as compared to during the preceding 6 months. Encounter sub-groups included encounter location (ED or inpatient)

and primary type of visit. The primary outcome was assessed for study 1 upon completion of study 1 and assessed for study 2 and combined studies 1 + 2 upon completion of study 2.

The Medicare quality metric 30-day readmissions was added after analysis of study 1 showed nonsignificant change in overall utilization. This was first assessed for study 1 + study 2 upon completion of study 2. The discharge date from the consent admission began the 30-day return period for each participant, even if that discharge was against medical advice (AMA). Lace+30-day readmission risk scores[29] were used to incorporate the following predictors to correct for readmission risk: age, sex, comorbidities, prior utilization, admission acuity, and length of stay.

Data Sources and Coding

The data collector and outcome assessor remained blinded to group allocation for all study activities.

Hospital system administrative records were supplemented by individual chart review to collect: encounters for each subject for the time period 6 months preceding and 6 months following the subject's date of consent; encounter locations; encounter diagnosis codes; hospital disposition location; LACE+ score upon enrollment encounter discharge date as calculated by the electronic medical record. Encounter location was defined as ED if the patient remained in the ED and was discharged by an emergency medicine physician and defined as inpatient if the patient received care in the inpatient unit and was discharged by an inpatient service. Encounters linked by hospital transfers for ongoing acute medical care (ED to inpatient or from one inpatient medical hospital to another) were consolidated into a single inpatient encounter. With these methods, the ED and inpatient encounter subsets are mutually exclusive and collectively exhaustive subsets of the full set of acute care encounters. The encounter ended when the patient discharged to home or transferred to external sites.

Primary type of visit was assigned by mapping the visit's primary diagnosis billing code via AHRQ's Clinical Classifications Software Refined[30] "default diagnosis" to either "mental/behavioral disorders" (MBD, which includes substance-related diagnoses) or any other category (medical). This coding was chosen based on prior studies' interventions demonstrating stronger effects on utilization related to psychiatric diagnoses than medical.[14,31]

Study 2's consent form included collection of both the primary hospital system and outside hospital data, increasing record availability to 97% of the 25-mile radius hospital beds (Supplement).

At 30, 60, 90, and 180 days post-enrollment, a blinded research team member contacted all participants for a phone or email survey about their involvement with recovery programs.

Statistical Analysis

Demographic comparisons were performed using independent samples *t*-tests and chi-squared tests.

ED encounters, inpatient encounters, and total acute care encounters (ED + inpatient) were evaluated as (1) continuous variables and (2) dichotomized 0 vs 1+ ED/inpatient/either encounters. Predictor variables for all models included Condition (Intervention vs. Control) and Time (Pre- vs. Post-Enrollment). All models were adjusted for death. Generalized linear mixed-effects models (GLMM) assuming a binomial outcome distribution and logit link function were applied to the binary outcome measures (patients who either did or did not have an ED visit, inpatient admission, etc. during the pre- and post-consent time periods). Linear mixed-effects models (LMM) were applied to continuous outcome measures (the total number of ED visits, inpatient admissions, etc. during the pre- and post-consent time periods). These calculations were performed on study 1 upon its completion and the same analytical methods were applied to study 2 upon its completion, and then to the combined study 1 + study 2. Post hoc sub-group analyses by SUD group were performed.

A GLMM was performed for 30-day inpatient readmission status using Condition (Intervention vs. Control) and LACE scores as predictors. Tests were two-tailed.

The sample size was fixed: the original primary outcome of study 1 was to evaluate the effect of the PRC intervention on treatment engagement, for which a priori power analysis suggested a goal enrollment of 100 patients; power analysis for study 2 suggested a goal of 120 patients to evaluate how specific personal and neurocognitive moderators influence the effect of the intervention. This provided an anticipated 220 subjects for the acute care utilization analysis. This number was comparable to the highest-quality[9,31,32] acute care utilization studies available at the time of protocol development finding significant results using 250 participants while achieving an effect size near 50% reduction in ED utilization.

RESULTS

Study 1 successfully enrolled the pre-defined 100 patients. Study 2 enrollment ended early (96 of intended 120 participants) upon implementation of strict hospital access restrictions March 2020 due to COVID-19 (PRCs are not hospital employees).

Given that interim analysis occurred between study 1 and study 2, figures and tables provide all results reported for the studies separately and combined. Of 202 patients who consented and received randomization, 193 completed enrollment, were discharged from the consent hospitalization alive, and were included in analysis (Fig. 1). The mean age was 42 years (SD = 10.3) and the most frequent substance used was alcohol with 45% having alcohol use disorder only. Further demographics are provided in Table 1 and supplement. Demographics between the studies were similar except

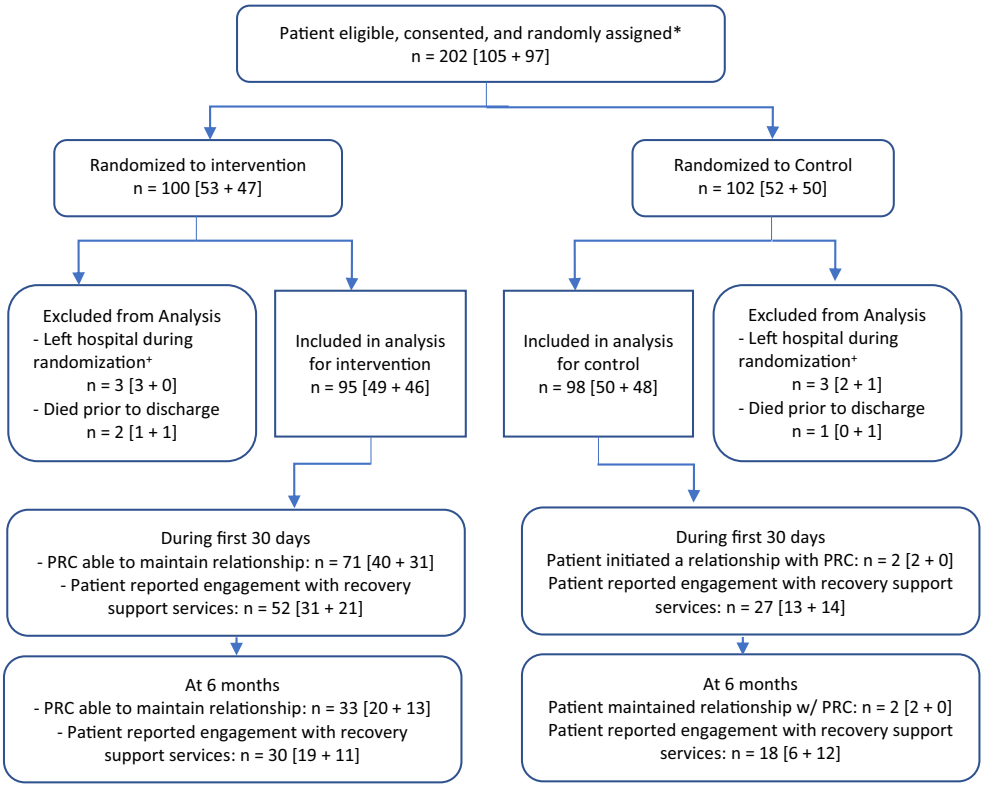

Fig. 1 Participant flow diagram. Numbers are reported as *n* = number for combined studies (*n* for study 1 + *n* for study 2). PRC able to maintain relationship refers to the PRC documenting a phone call, text, or post-initial visit face-to-face interaction during the specified time window (30 days and 6 months, respectively). Patient-reported engagement refers to the patient endorsing involvement in recovery support services outside of PRC services through the self-report follow-up surveys. *Only study 2 tracked number of patients assessed for eligibility but excluded by eligibility criteria (*n* = 32) or eligible but declined study participation (*n* = 79). †The study team member had to leave the patient room to enter their information into REDCap for randomization and then return to the patient room to complete enrollment; patients who ended their hospitalization during this window were randomized but did not complete enrollment nor receive their assigned study condition

the following: study 2 had significantly more patients predominantly using methamphetamine (17% vs 4%, $P = 0.003$) and fewer patients with private insurance (9.6% vs 20.2%, $P = 0.04$).

All analyses utilized an intention-to-treat approach. Of the 98 control participants, only 2 established care with a PRC. Of intervention participants, 100% established care with a PRC by study design; 77.9% remained in contact with their PRC at least once every other month throughout the 6-month study period. Average frequency of contact across all participants in the intervention condition was 6.57 contacts per month (SD = 5.59).

Primary Outcome: Total Acute Care Encounters

The intervention provided a favorable but not statistically significant decrease in the proportion of patients with any acute care encounters and no significant improvement in proportion of patients with any ED-only encounters or inpatient-only encounters pre- vs post-intervention. Table 2 shows results for the primary outcome as a dichotomous variable.

The intervention provided no significant difference in change in number of total acute care encounters from the 6 months pre-enrollment to the 6 months post-enrollment (OR = −0.16, $P = 0.61$). Between intervention and control, there was no significant change in number of pre- and post-enrollment ED-only encounters (OR = −0.23, $P = 0.39$), nor in inpatient-only encounters (OR = 0.07, $P = 0.73$). Over the 12-month period of study participation, 46 subjects (24 intervention; 22 control) had 5 or more acute care encounters, meeting the SC Public Health Institute definition of "frequent user." Table 3 shows the results for the primary outcome as a continuous variable.

Primary Outcome: Mental and Behavioral Disorder–Related Acute Care Encounters

The intervention provided no significant difference in change in total number of MBD-related encounters (OR = −0.19, $P = 0.17$) or proportion of patients with an MBD-related encounter (OR = −1.74, $P = 0.08$). However, the intervention did show a significant decrease in the subgroup of dichotomized ED encounters primarily coded as MBD. Analysis of the combined study results indicated that the percentage of patients in the intervention group having MBD ED visits decreased from 17.9% (SD = 38.5, 95% CI: 10.0–25.7) in the 6 months pre-enrollment to 10.5% (SD = 30.85, 95% CI: 4.2–16.8) in the 6 months post-enrollment. For the control group, these percentages were 13.3% pre-enrollment and 16.3% post-enrollment (OR = −2.62, $P = 0.022$). When the studies were

Table 1 Demographic Variables as Reported or Calculated at Time of Consent, Combined* Sample

	Total (N = 193)	Intervention (N = 95)	Control (N = 98)	p value
Gender**: men (n, %)	115 (59.6%)	60 (63.2%)	55 (56.1%)	*0.32*
Age (mean ± SD)	41.74 (± 10.30)	41.73 (± 10.70)	41.74 (± 9.96)	*0.99*
Years of education	12.04 (± 2.12)	12.00 (± 2.17)	12.08 (± 2.09)	*0.79*
Years of SUD	14.72 (± 11.09)	15.30 (± 12.25)	14.16 (± 9.89)	*0.48*
Days of use in past month	15.68 (± 11.56)	16.68 (± 11.63)	14.71 (± 11.48)	*0.24*
LACE+ Score	52.82 (± 19.38)	53.67 (± 19.25)	52.00 (± 19.58)	*0.55*
Race				
Caucasian	154 (79.8%)	78 (82.1%)	76 (77.6%)	*0.87*
African American	30 (15.5%)	12 (12.6%)	18 (18.4%)	*0.27*
Hispanic	5 (2.6%)	2 (2.1%)	3 (3.1%)	*0.66*
Other	4 (2.1%)	3 (3.2%)	1 (1.0%)	n/a
Employment status				
Full-time	38 (19.7%)	21 (22.1%)	17 (17.3%)	*0.52*
Part-time	13 (6.7%)	7 (7.4%)	6 (6.1%)	*0.78*
Unemployed	86 (44.6%)	40 (42.1%)	46 (46.9%)	*0.52*
Disabled	47 (24.4%)	24 (25.3%)	23 (23.5%)	*0.88*
Other	8 (4.1%)	2 (2.1%)	6 (6.1%)	*0.16*
Insurance status				
No insurance	107 (55.4%)	48 (50.5%)	59 (60.2%)	*0.29*
Private	29 (15.0%)	17 (17.9%)	12 (12.2%)	*0.35*
Medicare+	20 (10.4%)	11 (11.6%)	9 (9.2%)	*0.66*
Medicaid+	34 (17.6%)	16 (16.8%)	18 (18.4%)	*0.73*
Medicare/Medicaid+	50 (25.9%)	25 (26.3%)	25 (25.5%)	*1*
Other (VA., etc.)	7 (3.6%)	5 (5.3%)	2 (2.0%)	*0.26*
Substance used (self-reported)				
Alcohol	87 (45.1%)	46 (48.4%)	41 (41.8%)	*0.59*
Opioids	22 (11.4%)	12 (12.6%)	10 (10.2%)	*0.67*
Methamphetamine	20 (10.4%)	9 (9.5%)	11 (11.2%)	*0.66*
Cocaine	6 (3.1%)	2 (2.1%)	4 (4.2%)	*0.41*
Polysubstance	58 (30.1%)	26 (27.4%)	32 (32.7%)	*0.43*
3+ substances	21 (10.9%)	11 (11.6%)	10 (10.2%)	*0.76*
Opiate/meth	21 (10.9%)	11 (11.6%)	10 (10.2%)	*0.76*
Alcohol/cocaine	7 (3.6%)	1 (1.1%)	6 (6.1%)	*0.06*
Alcohol/meth	3 (1.6%)	1 (1.1%)	2 (2.0%)	-
Alcohol/opiate	3 (1.6%)	2 (2.1%)	1 (1.0%)	-
Primary diagnosis category frequency at consent hospitalization				
Alcohol-related disorders	38 (19.7%)	23 (24.2%)	15 (15.3%)	*0.19*
Septicemia	27 (14.0%)	15 (15.8%)	12 (12.2%)	*0.56*
Suicidal ideation	11 (5.7%)	4 (4.2%)	7 (7.1%)	*0.37*

Demographics reported separately for study 1 and study 2 in supplement tables
**Gender as self-reported. No participants chose non-binary; number of women is difference from total*
+*Four participants had both Medicare and Medicaid insurance*

analyzed individually, this benefit was statistically significant for study 1 (OR = −4.05, P = 0.04) but did not reach significance for study 2 (OR = −1.28, P = 0.33) (Fig. 2). When evaluated as a continuous variable, number of MBD ED encounters pre- vs post-enrollment showed a favorable trend for the intervention but did not reach statistical significance (OR = −0.24, P = 0.06 for the combined study results). There was no statistically significant effect demonstrated for the intervention on evaluation of MBD inpatient encounters (neither as dichotomous nor continuous variables, Tables 2 and 3).

Secondary Outcomes

A 30-day readmission from the consent encounter occurred in 16.6% percent of total subjects (17 in the control condition; 15 in the intervention; OR = 0.19, P = 0.65) (Table 2). There were 5 AMA discharges from the consent encounter (3 in the control condition; 2 in the intervention); post-hoc exclusion of AMA discharges did not significantly change these outcomes. No significant effects for the primary outcomes were observed for any substance-type sub-groups (Supplement).

DISCUSSION

In summary, a PRC intervention for patients with SUD did not significantly decrease overall acute care utilization but did decrease MBD ED visits over a 6-month follow-up period. The decrease in MBD ED visits was most pronounced in study 1 and remained significant when study results were combined.

Study 1 and study 2 were conducted in continuing series and intended to produce homogenous results, but study 2 by itself did not show a significant decrease in MBD ED visits. Differences between the studies may be instructive. Study 2 had more patients using methamphetamines. Moreover, on March 11, 2020, the World Health Organization declared COVID-19 a pandemic: study 1 was already completed, but study 2 only had 15 patients who had completed their 6-month follow-up by that date. Across the country, ED visits dropped by 42%.[33] PRC visits went from face-to-face to telephone. The pandemic likely had 2 diminishing effects on study 2: virtual PRC sessions may be less effective than in-person sessions; overall utilization may have decreased beyond any marginal benefit from the PRC intervention. It was encouraging that,

Table 2 Acute Care Utilization Measured as Binary Events

	Study 1				Study 2				Combined			
	Intervention (n = 49)	Control (n = 50)	OR	p value	Intervention (n = 46)	Control (n = 48)	OR	p value	Intervention (n = 95)	Control (n = 98)	OR	p value
Patients with an acute encounter, n (%)												
Pre	34 (69.4%)	28 (56.0%)	−0.86	0.19	32 (69.6%)	31 (64.6%)	−0.69	0.32	66 (69.5%)	59 (60.2%)	−0.79	0.11
Post	27 (55.1%)	29 (58.0%)			29 (63.0%)	33 (68.8%)			56 (58.9%)	62 (63.3%)		
Pre, including OSH					36 (78.3%)	36 (75.0%)	−0.66	0.40				
Post, including OSH					30 (65.2%)	34 (70.8%)						
Patients with an inpatient admission, n (%)												
Pre	11 (22.4%)	17 (34.0%)	0.58	0.40	19 (41.3%)	15 (31.3%)	−1.11	0.09	30 (31.6%)	32 (32.7%)	−0.26	0.57
Post	16 (32.7%)	18 (36.0%)			20 (43.5%)	25 (52.1%)			36 (37.9%)	43 (43.9%)		
Pre, including OSH					20 (43.5%)	19 (39.6%)	−0.63	0.34				
Post, including OSH					21 (45.7%)	25 (52.1%)						
Patients with an ED visit, n (%)												
Pre	30 (61.2%)	23 (46.0%)	−0.76	0.20	26 (56.5%)	27 (56.3%)	−0.10	0.86	56 (58.9%)	50 (51.0%)	−0.50	0.28
Post	21 (42.9%)	22 (44.0%)			21 (45.7%)	23 (47.9%)			42 (44.2%)	45 (45.9%)		
Pre, including OSH					32 (69.6%)	32 (66.7%)	−0.32	0.67				
Post, including OSH					24 (52.2%)	26 (54.2%)						
Patients with an MBD acute encounter, n (%)												
Pre	11 (22.4%)	5 (10.0%)	−2.45	0.07	8 (17.4%)	10 (20.8%)	−0.49	0.57	19 (20.0%)	15 (15.3%)	−1.74	0.08
Post	8 (16.3%)	7 (14.0%)			10 (21.7%)	15 (31.3%)			18 (18.9%)	22 (22.4%)		
Patients with an MBD inpatient admission, n (%)												
Pre	3 (6.1%)	2 (4.0%)	−0.28	0.92	4 (8.7%)	5 (10.4%)	−2.41	0.29	7 (7.4%)	7 (7.1%)	−1.67	0.39
Post	6 (12.2%)	5 (10.0%)			6 (13.0%)	9 (18.8%)			12 (12.6%)	14 (14.3%)		
Patients with an MBD ED visit, n (%)												
Pre	11 (22.4%)	4 (8.0%)	−4.05	0.04	6 (13.0%)	9 (18.8%)	−1.28	0.33	17 (17.9%)	13 (13.3%)	−2.62	0.02
Post	5 (10.2%)	5 (10.0%)			5 (10.9%)	11 (22.9%)			10 (10.5%)	16 (16.3%)		
Patients with 2 or more acute encounters												
Pre	15 (30.6%)	17 (34.0%)	0.99	0.20	19 (41.3%)	22 (45.8%)	-0.12	0.86	34 (35.8%)	39 (39.8%)	0.38	0.45
Post	20 (40.8%)	15 (30.0%)			18 (39.1%)	22 (45.8%)			38 (40.0%)	37 (37.8%)		
30-day readmission	4 (8.2%)	10 (20.0%)	−1.07	0.10	11 (23.9%)	7 (14.6%)	0.49	0.39	15 (15.8%)	17 (17.3%)	0.19	0.65
(including OSH)					11 (23.9%)	8 (16.7%)	0.33	0.55				

Pre, 6-month period prior to study enrollment, not including the encounter during which enrollment took place; post, 6 months after study enrollment, not including enrollment encounter. Acute encounter, ED visits + inpatient admissions. MBD, AHRQ's "Mental, behavioral and neurodevelopmental disorders" category for primary diagnosis. OSH, outside hospitals; patient consent for collection of this data was only obtained for study 2, and billing codes were not available for these encounters. OR, odds ratio

Table 3 Acute Care Utilization Measured as Numerical Counts of Events

	Study 1				Study 2				Combined			
	Intervention (*n* = 49)	**Control (*n* = 50)**	**OR**	***p* value**	**Intervention (*n* = 46)**	**Control (*n* = 48)**	**OR**	***p* value**	**Intervention (*n* = 95)**	**Control (*n* = 98)**	**OR**	***p* value**
Number of acute encounters, mean (± SD)												
Pre	1.63 (± 2.55)	1.36 (± 1.85)	0.17	0.68	2.43 (± 3.40)	2.52 (± 3.74)	−0.51	0.31	2.02 (± 3.00)	1.93 (± 2.97)	−0.16	0.61
Post	1.90 (± 2.84)	1.46 (± 2.15)			2.11 (± 3.12)	2.71 (± 3.50)			2.00 (± 2.96)	2.07 (± 2.94)		
Pre, including OSH					3.20 (± 4.16)	4.13 (± 5.99)	−0.08	0.92				
Post, including OSH					2.33 (± 3.27)	3.33 (± 4.36)						
Number of inpatient admissions, mean (± SD)												
Pre	0.39 (± 1.02)	0.72 (± 1.44)	0.26	0.25	0.83 (± 1.48)	0.65 (± 1.39)	−0.14	0.66	0.60 (± 1.28)	0.68 (± 1.41)	0.07	0.73
Post	0.63 (± 1.20)	0.70 (± 1.27)			0.93 (± 1.53)	0.90 (± 1.28)			0.78 (± 1.37)	0.80 (± 1.27)		
Pre, including OSH					0.87 (± 1.56)	0.94 (± 1.63)	0.05	0.89				
Post, including OSH					0.98 (± 1.56)	1.00 (± 1.44)						
Number of ED visits, mean (± SD)												
Pre	1.24 (± 1.93)	0.64 (± 0.85)	−0.10	0.74	1.61 (± 2.44)	1.88 (± 3.04)	−0.37	0.41	1.42 (± 2.19)	1.24 (± 2.29)	−0.23	0.39
Post	1.27 (± 2.14)	0.76 (± 1.22)			1.17 (± 2.09)	1.81 (± 2.44)			1.22 (± 2.11)	1.28 (± 2.35)		
Pre, including OSH					2.33 (± 3.18)	3.19 (± 5.23)	−0.12	0.86				
Post, including OSH					1.35 (± 2.18)	2.33 (± 3.93)						
Number of MBD acute encounters, mean (± SD)												
Pre	0.37 (± 0.81)	0.16 (± 0.55)	−0.08	0.66	0.43 (± 1.24)	0.67 (± 2.07)	−0.31	0.15	0.40 (± 1.04)	0.41 (± 1.51)	−0.19	0.17
Post	0.39 (± 1.27)	0.26 (± 0.75)			0.41 (± 1.26)	0.96 (± 2.20)			0.40 (± 1.26)	0.60 (± 1.66)		
Number of MBD inpatient admissions, mean (± SD)												
Pre	0.08 (± 0.34)	0.06 (± 0.31)	0.06	0.48	0.09 (± 0.29)	0.19 (± 0.61)	0.02	0.81	0.08 (± 0.32)	0.12 (± 0.48)	0.04	0.51
Post	0.18 (± 0.57)	0.10 (± 0.30)			0.17 (± 0.49)	0.25 (± 0.60)			0.18 (± 0.53)	0.17 (± 0.48)		
Number of MBD ED visits, mean (± SD)												
Pre	0.29 (± 0.61)	0.10 (± 0.36)	−0.14	0.31	0.35 (± 1.10)	0.48 (± 1.79)	−0.34	0.12	0.32 (± 0.88)	0.29 (± 1.28)	−0.24	0.06
Post	0.20 (± 0.79)	0.16 (± 0.55)			0.24 (± 0.95)	0.71 (± 1.81)			0.22 (± 0.87)	0.43 (± 1.35)		

All encounter count frequencies were right-skewed with median 0. Pre, the 6-month time period prior to the date of study enrollment, not including the encounter during which enrollment took place; post, the 6-month time period after the date of study enrollment, not including the enrollment encounter. Acute encounter, ED visits + inpatient admissions. MBD, AHRQ's "Mental, behavioral and neurodevelopmental disorders" category for primary diagnosis. OSH, outside hospitals; patient consent for collection of this data was only obtained for study 2, and billing codes were not available for these encounters. OR, odds ratio

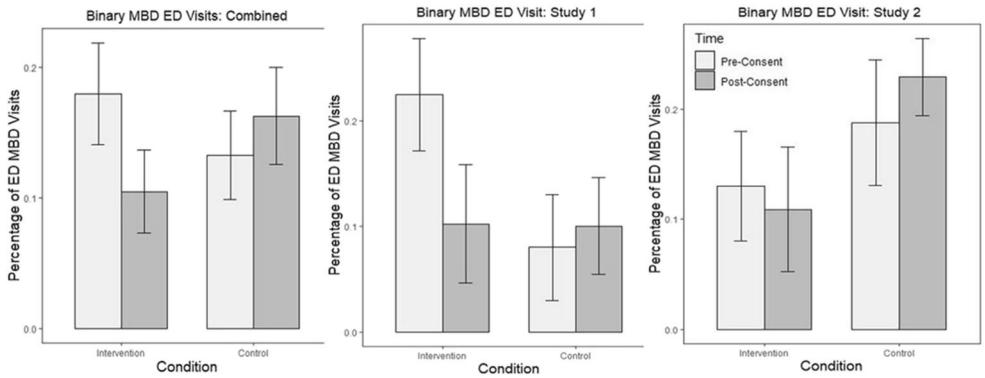

Fig. 2 Percentage of patients with an MBD-related ED visit by condition and time (6 months pre-consent vs. 6 months post-consent)

despite these effects, the combined study results still show a significant decrease in MBD ED visits.

Although there were positive findings on MBD ED visits, the PRC intervention did not significantly impact overall utilization, inpatient utilization, or 30-day readmission. In contrast to these PRC intervention results, a recent RCT evaluating navigation services by master's-level social workers on 282 hospitalized patients with SUD in Baltimore, MD, found significant reductions in subsequent ED visits, inpatient admissions, and 30-day readmissions.[34] Despite a similar population, the control readmission rate in the Baltimore study was nearly double that of the current study (30.0% vs 17.3%, respectively) while the intervention readmission rates were similar (15.5% vs 15.8%, respectively). The Baltimore study excluded methamphetamine-predominant SUD, recent suicide attempt, and discharge to long-term care facility. The predominant SUD type in the Baltimore study was any opioid (78.5%), whereas the substances of the current study had even distribution between any opioid (36.3%) and any methamphetamines (32.1%). Opioid use disorder has more effective treatment options (i.e., buprenorphine/methadone) than methamphetamines, and the Baltimore site had an inpatient addiction service on which to layer the additional social work services.

Another recent study in Camden, NJ, evaluated the effect of a team of nurses, social workers, and community health workers on 800 inpatients with at least 1 prior hospitalization in the preceding 6 months, 44% of whom had comorbid SUD.[35] The intervention provided no significant change in any readmission interval through 365 days, including the 30-day readmission rate (30.6%) despite being much larger than the current study and the Baltimore study, providing a high-intensity intervention, and starting with a high baseline readmission rate.

Given that this study did find a significant decrease in MBD-related ED visits, it is possible that these interventions may be more effective in decreasing acute care visits for lower severity, SUD-related complaints which were best demonstrated in the Baltimore study and diluted by more medical-related acute care visits in the Camden study.

This study had several limitations. Size was relatively small. Heterogeneity in substance type, pre-enrollment utilization, and severity of illness reflected real-world practice but contributed to imprecision. Interim analysis was performed between study 1 and study 2; this possible source of bias was accounted for by including data from both studies separately as well as combined.

Study 1 did not include information regarding outside hospital utilization; this was addressed by adding limited outside records review to the consent process for study 2: adding information from surrounding hospitals in study 2 did not change the primary outcomes, but billing data was unavailable for subgrouping by primary diagnosis code. Due to this data limitation, the significant finding in this study was only able to be observed in a single hospital system.

Patients in the control group were invited to establish care with a PRC on their own initiative which risked diluting the observed effect of the PRC: however, only 2 patients in study 1, and 0 patients in study 2, did so.

In conclusion, a PRC intervention for inpatients with SUD did not decrease overall acute care utilization but may decrease MBD-related ED visits. This contributes to an overall mixed picture in the literature evaluating the effect of social support interventions on acute care utilization.

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