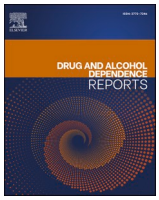
Drug and Alcohol Dependence Reports 11 (2024) 100224

Contents lists available at ScienceDirect

Drug and Alcohol Dependence Reports

journal homepage: www.elsevier.com/locate/dadr



Evaluation of peer recovery services for substance use disorder in Minnesota: Impact of peer recovery initiation on SUD treatment and recovery

Cody R. Tuttle *, Aaron T. Berger, Sean L. Barton, Ben Nguyen, Weston Merrick

Minnesota Management and Budget, Impact Evaluation Unit, United States

HIGHLIGHTS

- Used administrative data to assess the impact of Medicaid-reimbursed peer recovery on substance use and treatment outcomes.
- Peer recovery patients more likely to complete outpatient treatment in the follow-up year than comparison patients.
- No impact on non-fatal overdose, mortality, or inpatient treatment admission.
- Findings suggest challenges taking peer services from small clinical settings to a statewide implementation.

ARTICLE INFO

Keywords:
Peer recovery services
Substance use disorder
Recovery

ABSTRACT

Substance use disorder (SUD) remains one of the most persistent public health challenges across the nation and in Minnesota. One intervention to help people with SUD is peer recovery services (PRS). PRS is a form on non-clinical support where trained individuals who are more established in recovery come alongside people currently in the recovery journey and provide guidance in the treatment process, help in accessing resources, and offer an empathetic ear. In combination with other services in the continuum of care, PRS seeks to reduce harm from disordered use. In 2018, Minnesota made PRS for SUD a Medicaid reimbursable service. While prior literature demonstrates promising effects of PRS for SUD, especially in treatment retention and participant experience, most studies evaluated PRS in limited settings, rather than in a large-scale implementation. Our retrospective, matched-cohort study used administrative data to estimate the impact of initiating Medicaid-reimbursable PRS for SUD on treatment, overdose, and mortality. Our results align, in some dimensions, with prior literature evaluating smaller-scale programs with positive impacts on treatment completion. We also find, however, that PRS at scale did not produce other positive outcomes that past studies have documented, particularly around overdose and inpatient treatment. This suggests that PRS follows a common challenge of implementing promising ideas at scale.

1. Introduction

1.1. Background

Peer Recovery Services (PRS) is a strategy available in a variety of clinical and non-clinical settings to assist in recovery for individuals with SUD. In Minnesota, PRS uses credentialed peer specialists who are a year or more into their SUD recovery to provide people with SUD who are in early recovery or currently using with informational, emotional, social, or other support. The credentialing process for Certified Peer Recovery Specialists (CPRS) includes training in ethics and boundaries, advocacy, mentoring and education, and recovery and wellness support, with ongoing supervision by an LADC counselor (State of Minnesota Revisor of Statutes, 2021).

PRS and other similar programs have long been available through a variety of funding streams. To increase its availability, Minnesota began Medicaid reimbursement of PRS in 2018. Medicaid-reimbursable PRS must be conducted by CPRS who are supervised under authorized clinicians at eligible, certified providers. Clients must be financially eligible for Minnesota Health Care Programs, be diagnosed with an SUD,

* Corresponding author.
E-mail address: cody.tuttle@state.mn.us (C.R. Tuttle).

https://doi.org/10.1016/j.dadr.2024.100224
Received 25 September 2023; Received in revised form 8 February 2024; Accepted 26 February 2024
Available online 6 March 2024

complete a behavioral health assessment, and have risk ratings that support medical necessity.

Throughout Minnesota, peers can be employed by treatment providers, recovery organizations, or other community organizations, and can work in the community, clinics or treatment programs, or other settings, such as incarceration or child protection courts. Medicaid-reimbursed PRS is more common in treatment clinics than recovery organizations, but the split is close. The types of activities peers do with clients are often tailored to individual needs and the population served by providers, though specific activities are not reported in claims data.

The efficacy of PRS for SUD recovery has received growing attention in the literature. Three systematic reviews from Reif et al. (2014), Bassuk et al. (2016), and Eddie et al. (2019) show consistent findings of improved treatment retention and patient satisfaction among people with SUD who received PRS. Evidence for reductions in substance use and hospitalization was mixed, though most studies reviewed found modest improvements in these outcomes.

Notably, the reviewed studies varied in populations studied and the study design. Most studies assessed PRS in small-scale settings (among the peer-reviewed randomized trials and quasi-experimental studies, most had samples under 250; only two had samples over 1000) and studied peers as an adjunct to other behavioral health treatment, or in-hospital detoxification, which may not generalize to a publicly-reimbursed service where the majority of participants have not recently been in treatment. Other studies used a before-after design without a comparison group, which would not identify the effect of the peer component on recovery. The reviews also point to variation in definitions of PRS as a limitation in understanding of the impact; for example, many interventions studied had goals narrower than the employment and housing goals, along with recovery support, identified by our partners.

1.2. Objectives

To address these limitations, we conducted a retrospective matched-cohort study to evaluate the impact of Medicaid-reimbursed PRS services for SUD on substance use disorder severity and recovery. Our study draws on an administrative dataset of medical claims and SUD treatment records. We hypothesized that adult Medicaid patients who initiated PRS would be:

1. less likely to be diagnosed with drug or alcohol poisoning,
2. less likely to die from any cause,
3. less likely to be admitted to inpatient treatment, and
4. more likely to successfully complete outpatient treatment,

compared with matched patients who were eligible but did not initiate PRS. We chose these outcomes after review of prior literature, alongside partner engagement and administrative data availability.

An earlier version of this analysis was presented to the Minnesota legislature (https://mn.gov/mmb/assets/MMB_PRS_report_final_20220718_tcm1059-534084.pdf) and pre-registered with the Open Science Framework (https://osf.io/7w6at). This study differs from the prior report in focusing on four primary outcomes reflecting SUD treatment and severity. The prior report also reported findings from analysis of sustained PRS participation and subgroup analyses (See Appendix C).

We engaged with community partners and providers to inform our understanding of PRS in Minnesota and help contextualize findings. This group was comprised of recovery organizations, treatment providers, certification boards, and tribal recovery organizations.

2. Methods

2.1. Study design

In this retrospective matched-cohort study, we aimed to investigate the relationship between participation in Medicaid-reimbursed PRS and various outcomes of SUD treatment and severity. Our study cohort consisted of patients with a prior SUD diagnosis who were enrolled in Medicaid and met the administrative criteria for PRS reimbursement. We utilized a Target Trial design to emulate a pragmatic trial in which the treatment is implemented without tight adherence monitoring and in which the participant is not blinded to his or her condition (Hernán and Robins, 2016). Our estimated effects are analogous to the intention-to-treat effects that would be observed if randomization and treatment initiation occur simultaneously (Hernán and Robins, 2016). We used a difference-in-differences analysis.

The research was reviewed and approved by DHS Institutional Review Board. Because our analysis utilized solely administrative data and involved minimal risk to participants, informed consent was waived. This study followed the Strengthening the Reporting of Observational Studies in Epidemiology reporting guideline (Von Elm et al., 2007).

2.2. Data sources

This study was conducted with State of Minnesota administrative data. Our two primary sources were the Medicaid Management Information System (MMIS) and the Drug and Alcohol Abuse Normative Evaluation System (DAANES). MMIS contained Medicaid enrollment, peer recovery claims, and other demographic information. DAANES contained substance use treatment and assessment records as well as treatment discharge reason. We also used administrative records to collect on covariates, including child welfare involvement, housing stability, and criminal justice history.

2.3. Participants and setting

We identified individuals in MMIS aged 18 or older, enrolled in Medicaid for at least 3 consecutive months prior to their index date, had a primary SUD diagnosis (ICD10 codes F10-F19), and met severity score criteria for PRS reimbursement on a standardized chemical health assessment. The assessment criteria are included in Appendix D. Assessments are administered by county behavioral health staff or a treatment provider; clients are required to have a valid assessment before belling Medicaid. Participation in an assessment is typically voluntary, though some individuals are referred by criminal justice or law enforcement officials. While all treatment and comparison individuals do have a recorded assessment, this population may be different than other individuals with SUD who do not have a recorded assessment.

PRS claims were identified in MMIS by billing code. Unique identifiers for PRS initiators were then linked with assessment records; if no qualifying assessment prior to the PRS claim could be identified the person was screened out. Medicaid enrollment records were also queried to exclude persons with less than 3 months continuous enrollment prior to PRS initiation. A participant flow chart is in Appendix A.

The study period spanned from January 1, 2019 to June 30, 2021. The eligibility date, the earliest date a person could enter the cohort, was the latter of the date the person met all eligibility criteria and January 1, 2019, the date when Medicaid reimbursement for PRS began.

The exposure of interest was any utilization of Medicaid-reimbursed PRS. We defined the index date for the exposed population (PRS recipients) as the date of the first PRS claim. The comparison population was drawn from eligible Medicaid recipients who had no PRS claims during the study period.

The index date for the comparison group was a date that the person could have counterfactually initiated PRS, given their diagnosis history. To select this date, we identified the earliest date a comparison person could have initiated PRS, their eligibility date, defined identically to the eligibility date for the exposed population. We then calculated the lag between eligibility and index dates for recipients, to represent the range of observed delays between eligibility and engagement. We assigned a

random draw from this distribution to each comparison person. Their index date was assigned as their eligible date plus the randomly-selected lag time, to prevent comparison persons from being "enrolled" on their diagnosis date (where the disease would differ systematically between exposed and unexposed persons) or on January 1, 2019 (where calendar time would differ systematically). All participants were followed from their index date until loss of Medicaid enrollment, death, 12 months of follow-up, or administrative censoring on June 30, 2021.

We selected the comparison population in a one-to-one ratio to the exposed population using propensity score matching. Variables used to construct propensity scores are discussed below.

2.3.1. Primary outcomes

Four primary outcome measures were selected in close consultation with PRS partners:

1. Non-fatal drug or alcohol overdose
2. All-cause mortality
3. Completion of outpatient treatment
4. Admission to inpatient treatment

Each outcome was included in the OSF pre-registration along with three other outcomes addressed in the legislative report: having a primary care appointment, child welfare involvement, and housing instability. Completion of outpatient treatment was simplified for pragmatic reasons from our pre-registered outcome, maintaining licensed SUD treatment services and/or medication for opioid use disorder.

Non-fatal drug or alcohol overdose is an indicator of the severity of an individual's SUD. If peers are successful in facilitating better recovery outcomes for clients, we would reasonably expect overdose incidence to decrease. This measure was identified with ICD-10 codes for drug or alcohol poisoning in MMIS, including T40.0 to T40.4 and T40.6 (opioid), T40.5 and T43.6 (stimulant), T42.3 (barbiturate), T42.4 (benzodiazepine), T42.6 (antiepileptic/sedative-hypnotic), T40.7 (cannabis), T40.8 and T40.9 (hallucinogen), T51.0 (ethanol) and T51.9 (unspecified alcohol). We summarized codes as a binary indicator (any/no diagnosis code) during each three-month period from baseline through 12 months of follow-up.

Mortality records in MMIS indicated date of death for deceased patients. Mortality was classified as a cumulative binary indicator for death during or prior to a given three-month period. This is another proxy for SUD severity, which we would expect to decrease if PRS is successful in promoting recovery.

Inpatient and outpatient treatment records are a measure of the ability of peer services to assist clients in connecting to and completing treatment, one of the explicit goals mentioned by community partners and prior literature. Data were obtained from DAANES. Completion of outpatient treatment was a cumulative binary outcome defined as a reason-for-discharge record of completion (as determined by the treatment provider) of a non-residential treatment or methadone program during or before a given three-month period. Alternative reasons for discharge included leaving without approval, patient conduct, expiration of hold order, transfer to another program, assessed as inappropriate, lost financial support, incarceration, and death. Admission to an inpatient treatment program was a cumulative binary outcome indicating if the person is recorded starting any residential or hospital inpatient SUD treatment program during or before a given three-month period. DAANES does not capture specific activities occurring in treatment programs, so we could only assess the broad categories of inpatient and outpatient treatment.

2.3.2. Propensity score covariates and descriptive variables

Variables used in the propensity score model included both time-invariant characteristics and time-varying baseline SUD history, demographic factors, and measures of outcomes prior to the index date (see Appendix B for covariates, sources, and time periods). Depending on the measure, covariates were measured with different time periods (see Table 1 for all baseline periods and measures). The caliper was set to 0.2 standard deviations of the logit of the propensity score (Austin, 2011).

Although not part of our exposure definition, we worked with community partners and clinical providers to define a minimum desired PRS usage. This was defined as at least three consecutive months with PRS claims, or at least six total claims within the first three months. We used this to characterize treatment history but not in matching or weighting for our primary analyses. An analysis of the effectiveness of

Table 1
Descriptive statistics of PRS initiators and comparison population in propensity score-matched cohorts, Minnesota peer recovery services 2019–2021.

Subgroup		Comparison (n = 1227) No. (%)	PRS Initiators (n = 1227) No. (%)	*P* value[a]
Age Group, N (%)				
	18–25 years	161 (13.1)	156 (12.7)	0.97
	26–35 years	523 (42.6)	517 (42.1)	
	36–45 years	297 (24.2)	304 (24.8)	
	46–55 years	154 (12.6)	161 (13.1)	
	56–64 years	81 (6.6)	75 (6.1)	
	65+	11 (0.9)	14 (1.1)	
Sex, N (%)				
	Female	505 (41.2)	476 (38.8)	0.25
	Male	722 (58.8)	751 (61.2)	
Race, N (%)				
	Hispanic (any race)	54 (4.4)	57 (4.6)	0.91
	NH American Indian/ Alaskan Native	99 (8.1)	110 (9.0)	
	NH Black	144 (11.7)	150 (12.2)	
	NH White	609 (49.6)	599 (48.8)	
	Other Non-White	63 (5.1)	54 (4.4)	
	Unknown	258 (21.0)	257 (20.9)	
Inpatient Admission, 3-Month Baseline, N (%)				
	0	1191 (97.1)	1189 (96.9)	0.91
	1	36 (2.9)	38 (3.1)	
Inpatient Completion, 3-Month Baseline, N (%)				
	0	1203 (98.0)	1201 (97.9)	0.89
	1	24 (2.0)	26 (2.1)	
Outpatient Admission, 3-Month Baseline, N (%)				
	0	769 (62.7)	747 (60.9)	0.38
	1	458 (37.3)	480 (39.1)	
Outpatient Completion, 3-Month Baseline, N (%)				
	0	1097 (89.4)	1091 (88.9)	0.74
	1	130 (10.6)	136 (11.1)	
Inpatient Ever (N [%])				
	0	405 (33.0)	392 (31.9)	0.6
	1	822 (67.0)	835 (68.1)	
Outpatient Ever (N [%])				
	0	157 (12.8)	158 (13.0)	0.95
	1	1070 (87.2)	1068 (87.0)	

Abbreviation: NH, non-Hispanic; PRS, peer recovery services.
[a] P-values for from Chi-square test.

attaining the minimum desirable utilization is presented in the previously referenced legislative report.

2.4. Statistical methods

2.4.1. Inverse probability of treatment weights

The propensity score matched populations were further adjusted with inverse probability of treatment weighting (IPTW) (Robins et al., 2000) to address potential residual confounding. Stabilized IPTW (Cole and Hernán, 2008) were created with logistic regression using the covariates in Appendix B that were used for the propensity score modeling.

2.4.2. Statistical analysis

We used weighted difference-in-differences analysis to estimate the effect of PRS initiation on primary outcomes over 12 months of follow-up. All models were generalized estimating equations (GEE) run in R 4.1.2 using the package 'geepack' (Halekoh et al., 2006). The GEE models were fitted with robust standard errors to account for repeated observations of participants.

The GEE models were run with a binomial distribution (event occurred versus did not) and a log-link function. The condition-by-time interaction term represents the relative risk ratio among the exposed relative to the change in relative risk among the unexposed. Because PRS and comparison patients were selected to have similar baseline risk, the relative risk ratio approximates the relative risk of the outcome for PRS versus comparison patients. The condition-by-time interaction terms at 3, 6, 9, and 12 months of follow-up were the main effects of interest.

3. Results

3.1. Study population

We identified 3545 individuals in MMIS who had at least one PRS claim during the study period (Appendix A). Of those, 1495 lacked a recorded qualifying assessment and 674 had fewer than 3 months of Medicaid coverage prior to their index date, for an eligible population of 1374. There were 21,606 eligible comparison persons with a prior SUD diagnosis, a qualifying assessment, and Medicaid coverage. Propensity score matches were made for 1227 (89%) eligible PRS initiators.

Descriptive statistics are presented in Table 1. Among matched individuals, the most frequent age group was 26–35 years (42.4%) and the majority (60.0%) were male. Approximately half (49.2%) were non-Hispanic White, while 20.9% had no recorded race or ethnicity. A minority of the population had recorded inpatient (3.0%) or outpatient (38.2%) SUD treatment within 3 months of their index date, though a substantial majority had earlier records of inpatient (67.5%) or outpatient (87.1%) SUD treatment. There were no statistically significant differences between the matched exposed and comparison populations on measured time invariant or pre-treatment characteristics.

Only 266 of 1227 PRS participants (21.7%) completed the minimum desirable amount of utilization, defined in 2.4.2. Notably, 37% of exposed individuals had just one PRS claim and a majority had one or two claims.

3.2. Primary outcomes

In the 3 months prior to the index date, 3.8% (95% confidence interval [CI], 2.3–6.4) of PRS initiators and 3.3% (95% CI, 2.3–4.9) of the comparison population were diagnosed with non-fatal drug or alcohol poisoning (see Table 2). In the 12 months following the index date, drug and alcohol poisoning occurred at a generally decreasing rate in both groups (Fig. 1A). In the fourth quarter following the index date, 3.1% (95% CI, 2.0–4.6) and 1.9% (95% CI, 1.2–3.1) of PRS initiators had non-fatal drug or alcohol poisoning, though the change in relative risk was not statistically significant in Quarter 4 (relative risk ratio 1.4; 95% CI, 0.61–3.2) or overall (Type III ANOVA, $P = 0.24$). Although the overall mortality ratio was not statistically significantly different between groups (Type III ANOVA, $P = .089$), there were more deaths among PRS initiators (1.8% at 12 months; 95% CI, 1.1–3.0) than in the comparison population (0.6% at 12 months; 95% CI, 0.3–1.5; Fig. 1B).

There was a statistically significant relative increase in the chances that a PRS participant completed outpatient SUD treatment during follow-up (Fig. 1C). During the baseline period, 19.3% of PRS participants (95% CI, 16.8–22.2) and 19.1% of comparison participants (95% CI, 16.8–21.8) completed an outpatient treatment program. Over 12 months of follow-up, an additional 12.1% of PRS participants (95% CI, 10.1–14.5) completed outpatient treatment, while 7.5% of comparison participants (95% CI, 5.0–9.5) did so. There was a 61% greater increase in outpatient completions among PRS participants (95% CI, 1.1–2.3; Type III ANOVA, $P = 0.010$).

By comparison, there were no meaningful differences in trends for inpatient treatment admission (Fig. 1D). In the 12 months prior to their index date, 21.1% (95% CI, 18.1–24.6) of PRS participants and 19.9% (95% CI, 17.5–22.6) of comparison participants were admitted to inpatient treatment. In the 12 months following their index date, 20.6% (95% CI, 17.9–23.7) of PRS participants were admitted to inpatient treatment at least once, compared with 18.6% of the comparison population. The change in relative risk was minimal (1.04 over 12 months; 95% CI, 0.80–1.37; Type III ANOVA, $P = 0.38$).

4. Discussion

To our knowledge, this is the first evaluation of a statewide implementation of PRS. Our findings are consistent with prior research in certain areas, notably the positive impact on outpatient treatment completion. However, our investigation reveals contrasting results in other areas, such as overdose incidents and inpatient treatment admissions. Reviews of prior research reported moderate improvements in these outcomes, while our study found no statistically significant impact. Although the PRS participants were more likely to complete outpatient treatment, we saw no statistically significant differences in non-fatal overdoses or inpatient SUD treatment admission. While rare, mortality was more common among PRS participants. Based on prior literature and conversations with community partners, we hypothesized that PRS patients would see improvements in each of those areas.

While our findings revealed that Minnesota's statewide PRS program retained part of the observed benefit in smaller studies, specifically in the completion of outpatient SUD treatment, other observed benefits of PRS were not apparent in statewide implementation. Extensive public administration literature emphasizes the challenge of replicating small-scale programs as large-scale public policy implementation (Cartwright and Hardie, 2012; Hill and Hupe, 2002). In the context of this real-world implementation, there could be multiple reasons why Medicaid-reimbursed PRS did not yield the results obtained in smaller studies. Understanding this difference and how to support peers to improve impacts for patients is a vital question.

One reason could be disjointed or inadequate funding for elements of PRS that are not directly billable. Recent research highlights the need for sustainable, cohesive funding of PRS across a variety of settings (Chapman et al., 2018; Myrick and Del Vecchio, 2016; Stack et al., 2022). Sustainable funding, either through long-term grants or rates that cover operational overhead, may increase providers' ability to effectively deploy PRS. Relatedly, PRS infrastructure may be underdeveloped relative to the need for services. Scholars have highlighted the need to build the peer workforce and related support system, while practitioners in recovery and treatment organizations echo the sentiment (Chapman et al., 2018; Laudet and Humphreys, 2013; Stack et al., 2022). Training should align with goals; for example, although providers identified overdose prevention as a service goal, current peer training standards do not require harm reduction/safe use training. Investing in training and certification for aspiring peers, increasing employers' capacity to

Table 2
Means and relative risk ratios of outcomes for peer recovery services (PRS) initiators and comparison patients in propensity score-matched cohorts, Minnesota 2019–2021.

Outcome		Estimated means (95% confidence interval)					Relative Risk Ratio (95% confidence interval)				
		Baseline	3 months	6 months	9 months	12 months	Baseline to 3 months	Baseline to 6 months	Baseline to 9 months	Baseline to 12 months	Type III ANOVA - *P* value[a]
1+ Non-Fatal Overdose											
	PRS Initiators	3.8 (2.3–6.4)	3.8 (2.6–5.5)	2.8 (1.8–4.3)	3.3 (2.1–5.0)	3.1 (2.0–4.6)	1.02 (0.47–2.21)	0.67 (0.31–1.49)	1.35 (0.55–3.34)	1.40 (0.61–3.19)	0.24
	Comparison	3.3 (2.3–4.9)	3.2 (2.2–4.8)	3.6 (2.4–5.4)	2.1 (1.2–3.6)	1.9 (1.2–3.1)					
All-Cause Mortality											
	PRS Initiators	N/A	0.4 (0.2–1.0)	0.7 (0.4–1.4)	1.4 (0.9–2.4)	1.8 (1.1–3.0)	1.7 (0.4–7.2)	1.6 (0.5–4.9)	3.3 (1.1–10.1)	2.8 (1.0–7.8)	0.089[b]
	Comparison	N/A	0.2 (0.1–0.8)	0.5 (0.2–1.1)	0.4 (0.2–1.2)	0.6 (0.3–1.5)					
Outpatient Treatment Completion											
	PRS Initiators	19.3 (16.8–22.2)	7.4 (5.9–9.3)	9.1 (7.4–11.2)	10.7 (8.9–13.0)	12.1 (10.1–14.5)	2.37*** (1.48–3.8)	1.79** (1.2–2.67)	1.64** (1.14–2.36)	1.61** (1.14–2.27)	0.010**
	Comparison	19.1 (16.8–21.8)	3.1 (2.1–4.5)	5.0 (3.8–6.7)	6.5 (5.0–8.4)	7.5 (5.0–9.5)					
Inpatient Treatment Admission											
	PRS Initiators	21.1 (18.1–24.6)	8.1 (6.3–10.2)	13.7 (11.5–16.4)	16.8 (14.3–19.7)	20.6 (17.9–23.7)	1.14 (0.77–1.69)	1.15 (0.83–1.59)	1.00 (0.75–1.34)	1.04 (0.8–1.37)	0.38
	Comparison	19.9 (17.5–22.6)	6.7 (5.1–8.6)	11.3 (9.2–13.8)	15.8 (13.4–18.6)	18.6 (16.0–21.5)					

*p <.05 **p <.01 ***p <.001.
Abbreviation: PRS, peer recovery services.
[a] Unless otherwise specified, the Type III ANOVA is the test of the treatment-by-time interaction, the measure of differences-in-differences.
[b] Type III ANOVA test of the treatment term.

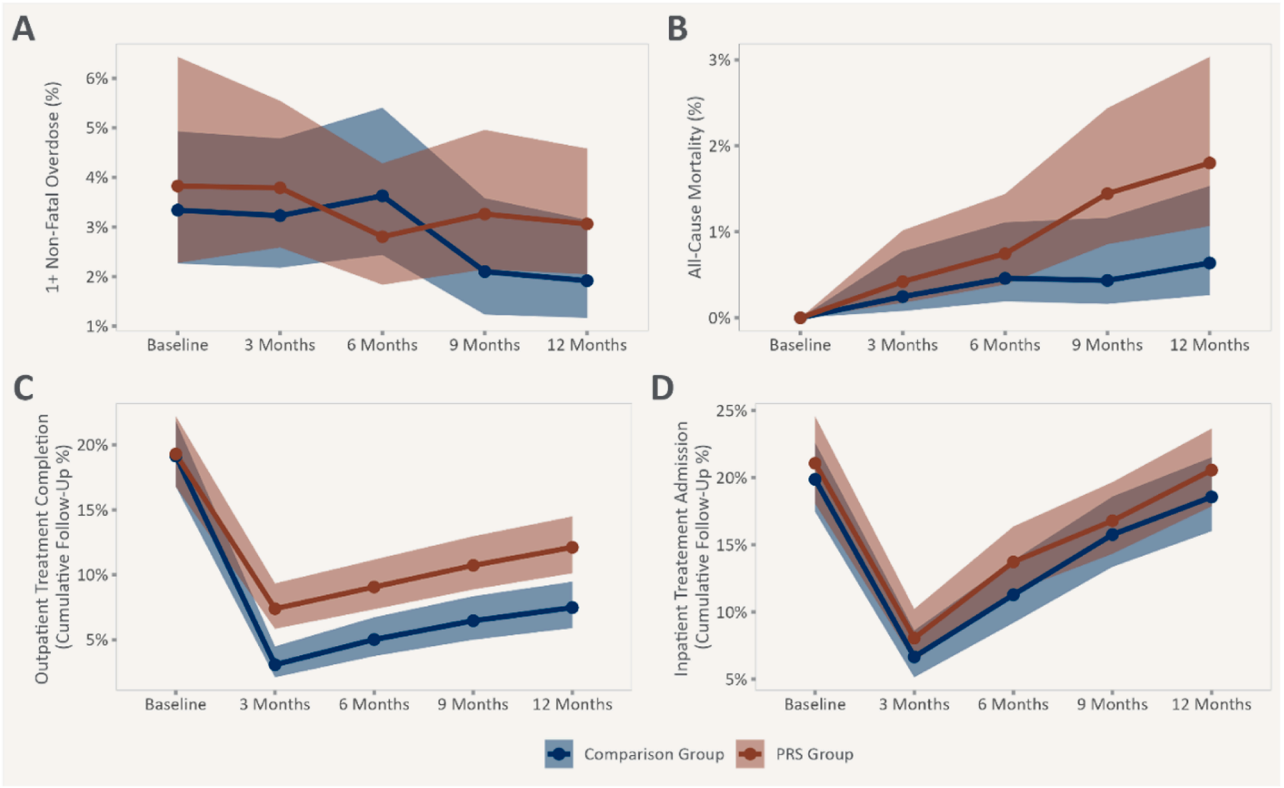


Fig. 1. Main outcomes among Medicaid-reimbursed peer recovery services initiators and comparison patients in propensity score-matched cohorts, Minnesota 2019–2021.

expand mentoring and associated supports, and building out community resources for people seeking recovery may also help realize the potential benefits of PRS.

These issues could be limiting the effectiveness of PRS by inhibiting therapeutic alliance between peers and patients. PRS partners in Minnesota articulated that therapeutic alliance is critical for program maintenance and effectiveness, and a range of literature demonstrates its critical role in behavioral health (Horvath et al., 2011; Martin et al., 2000). Indeed, we found just 21.7% of PRS participants continued for the minimum desired utilization. We also found in our per-protocol analysis, however, outcomes for individuals with more sustained PRS participation were not meaningfully different than for the entire sample. This indicates that there could be larger dynamics dictating both the low amount of "adherence" to minimum desired participation as well as PRS's lack of impact on important outcomes, including the funding, training, and therapeutic alliance issues described above. Efforts to strengthen therapeutic alliances through training, continued education, mentoring, and diversifying the PRS workforce may increase the effectiveness of PRS. Ultimately, however, these are anecdotes from providers and policy experts; further study is needed to understand why program impacts did not align with the expressed goals and expectations of partners.

4.1. Limitations

As a retrospective observational cohort study using administrative data, there are several limitations that could have impacted our ability to measure desired constructs and observe outcomes. Importantly, patients self-selected treatment. Our methods, including matching on time-varying, pre-baseline measures of the outcomes of interest, were designed to match exposed patients to individuals with the same counterfactual outcomes. However, this assumption is not testable, and real-world tradeoffs such as matching on only certain variables and requiring only a minimum three-month Medicaid enrollment baseline could have failed to eliminate all such confounding. Further, while we were able to match on the baseline history of other outcomes, mortality is an inherently prospective risk so we cannot be certain the PRS and comparison populations had similar counterfactual risks of mortality. We also did not have access to underlying cause of death, which may not be related to SUD. Instead, mortality may be seen as an outcome that minimizes measurement error, compared to nonfatal overdose which is measured only if the person received medical treatment.

Second, we were limited to administrative data for matching and analysis. These data were collected for program eligibility, reporting, and financial purposes, rather than research, and they may not be ideal measures of the constructs we sought. For example, we could only identify diagnosed drug and alcohol poisonings in claims submitted for reimbursement. If patients did not seek care, we would not be able to measure that event. We also could not ask patients directly about drug or alcohol consumption and had to rely on formal SUD diagnosis, overdose records, and entry into treatment. We also know that certain data are unknown, including race which was missing for 21% of patients. Notably, we did not ask patients why they stopped PRS after one or two sessions; this information would be beneficial in understanding the extent to which issues with therapeutic alliance affected the program's performance.

Third, we did not have data on comparable peer recovery services from funding sources other than Medicaid. Both exposed and comparison patients could have received similar services through other sources, which would reduce the observed impact of Medicaid-reimbursed PRS relative to the comparison condition. However, because other sources of PRS are available, that is the "business as usual" alternative to Medicaid-funded PRS, our program of interest. In addition, because we emulated an intention-to-treat design in which the exposure was initiating PRS, our results may not be generalizable to settings with higher PRS retention. That said, the strength of this paper is that shows what happens

when PRS is implemented in the real-world where resources to ensure fidelity to the model are not always available.

Finally, our analysis pools together patients with many different, and overlapping, substances of use. Eligibility for PRS is linked to SUD severity, not the type of SUD, and many or most patients had been identified as using two or more different substances. While our earlier analysis identified similar outcomes for patients diagnosed with opioid use disorder (OUD) than for those without OUD (Appendix C), we did not conduct separate subgroup analyses for other people with other substances of use. If the efficacy of PRS did differ by substance of use then our pooled results may not generalize to subpopulations or the populations where the mix of SUDs differs.

4.2. Conclusion

This retrospective matched-cohort study found that SUD patients who initiated Minnesota's Medicaid-reimbursed PRS were more likely to complete outpatient treatment than the comparison population, but did not see benefits in other goals of the program, including inpatient treatment admission, drug and alcohol overdose, and death. We suggest challenges in the design and implementation of this new statewide Medicaid benefit reduced its effectiveness compared with benefits observed in prior research. In particular, partners pointed to lack of investment in training and retaining a diverse workforce and lack of provider infrastructure to support peers. While research shows peers can be an important part of the continuum of care for people with SUD, more intentional investment and time to build infrastructure could make strengthen peers' ability to help individuals reach long-term recovery.

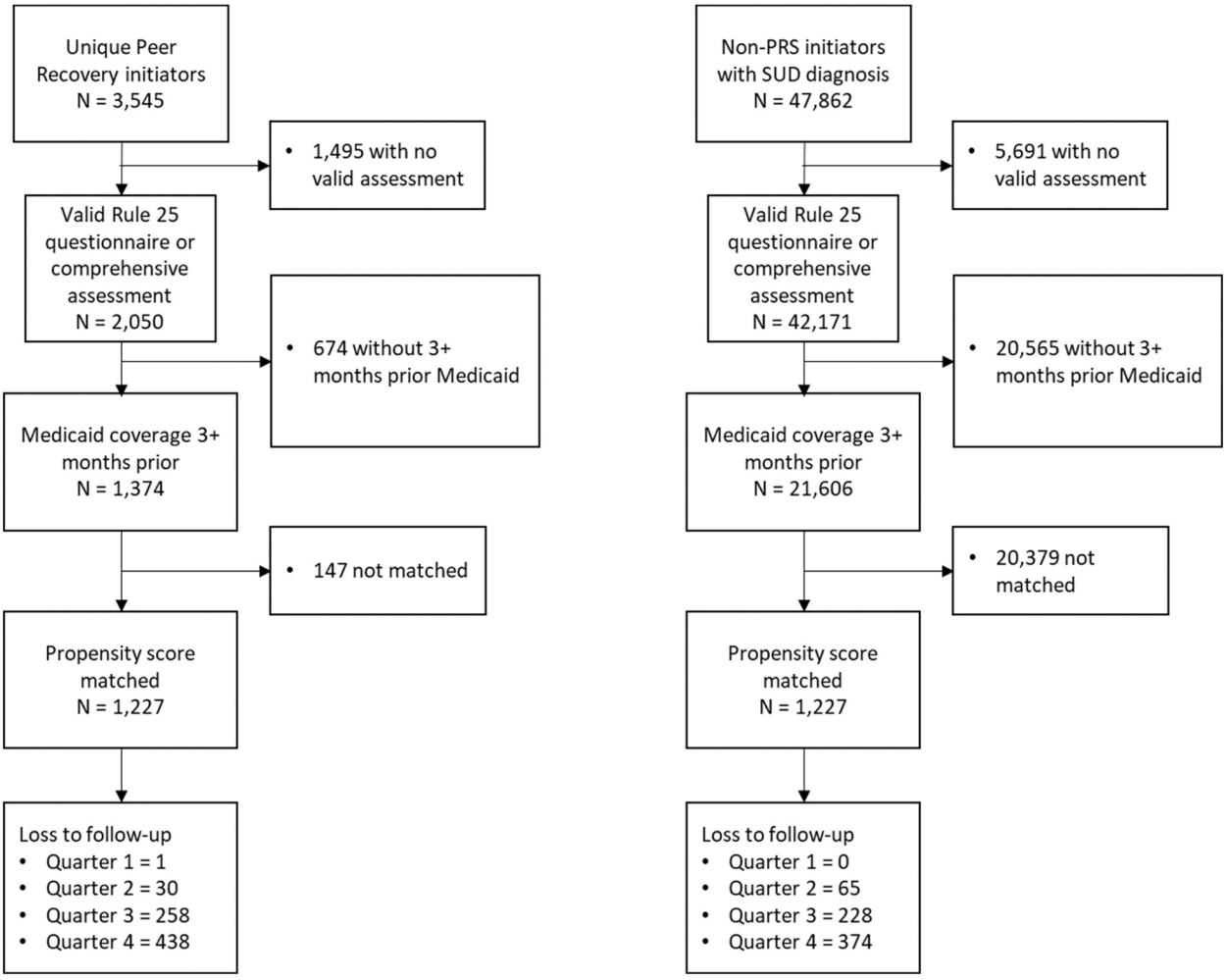
CRediT authorship contribution statement

Ben Nguyen: Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Formal analysis, Data curation. **Aaron T. Berger:** Writing – review & editing, Writing – original draft, Validation, Methodology, Formal analysis, Data curation, Conceptualization. **Sean L. Barton:** Writing – review & editing, Writing – original draft, Validation, Methodology, Data curation. **Cody R. Tuttle:** Writing – review & editing, Writing – original draft, Visualization, Validation, Project administration, Methodology, Formal analysis, Data curation, Conceptualization. **Weston Merrick:** Writing – review & editing, Writing – original draft, Supervision, Project administration, Conceptualization.

Declaration of Competing Interest

All authors report no competing interests or disclosures.

Appendix A. Peer Recovery Services cohort participant inclusion and sample size flow chart, Minnesota 2019–2021



Appendix B. Variables, data sources, and time periods used in propensity score matching and inverse probability of treatment weights

Variable	Source	Time period
Age group	MMIS	Index date
Sex	MMIS	Current value in data
Region of residence	MMIS	Current value in data
Race	MMIS	Current value in data
Marital status	MMIS	Current value in data
Number of minor children	DAANES	Most recent treatment admission before index date
Past ICD-10 SUD diagnosis: alcohol, cannabis, opioid, cocaine/other stimulant, other	MMIS	Post-October 1, 2015
Rule 25/Comprehensive assessment risk rating: dimensions A, B, C, D, E, F	MMIS, DAANES	Most recent Rule 25 assessment or comprehensive assessment before index date
Date of first ICD-10 SUD diagnosis	MMIS	Post-October 1, 2015
Date of first ICD-10 behavioral/mental health diagnosis	MMIS	Post-October 1, 2015
Recent diagnosis of drug poisoning	MMIS	1, 2, and 3 months prior to index date
Past inpatient treatment admission	DAANES	Ever in records; 1, 2, and 3 months prior to index date
Recent inpatient treatment completion	DAANES	1, 2, and 3 months prior to index date
Past outpatient treatment admission	DAANES	Ever in records; 1, 2, and 3 months prior to index date
Recent outpatient treatment completion	DAANES	1, 2, and 3 months prior to index date
Lifetime treatment admissions	DAANES	Most recent treatment admission before index date
Lifetime detox admissions	DAANES	Most recent detox admission before index date
Recent screened-in child maltreatment report	SSIS	1, 2, and 3 months prior to index date
Recent physician office visit	MMIS	1, 2, and 3 months prior to index date
Past criminal justice involvement: any charge, felony charge, conviction, felony sentence, prison sentence, confinement, probation	Minnesota Courts	Ever in records; 1 year prior to index date
Past housing status: No record, unknown or declined, incarcerated, hospital or other service provider, unstable housing	MAXIS	Ever in records; 1 quarter prior to index date
Mental health status: Serious Mental Illness/Serious and Persistent Mental Illness	MMIS	1 year prior to index date

Note: MAXIS is not an acronym; it is a master computer system that determines eligibility for public assistance programs. Abbreviations: DAANES, Drug and Alcohol Abuse Normative Evaluation System; MMIS, Minnesota Medicaid Information System; SSIS, Social Service Information System.

Appendix C. Sensitivity Analyses (Per-protocol and subgroup analysis)

A prior version of this report was pre-registered with the Open Sciences Framework and presented to the Minnesota state legislature. This prior version included a per protocol analysis that examined the impact of PRS for patients who had more sustained participation, meeting the minimum desired utilization. It also included subgroup analysis analyzing impacts for clients with opioid-use disorder vs those without. Findings for these analyses, as well as other subgroup analysis, were substantively very similar to the results found in this paper, which is why we did not include them here. Subgroup analyses can be found in Appendix F of the prior report, linked here.

Appendix D. Assessment Process and Criteria for Participation

For PRS to be eligible for Medicaid reimbursement, clients must have a diagnosed substance use disorder, take a standardized chemical dependence assessment, either through Rule 25 with a county official, or directly through a treatment provider. The assessment examines a client's medical need for different levels of treatment on a severity scale of 0–4 across 6 dimensions: (1) intoxication and withdrawal; (2) biomedical; (3) emotional, behavioral, and cognitive; (4) readiness for change; (5) relapse and continued use; and (6) recovery environment. Clients must have a score of at least 1 on dimensions 4, 5, and 6 to be eligible for Medicaid to reimburse PRS. A score of 1 or higher indicates need for modest to intense support in these dimensions.

References

Austin, P.C., 2011. Optimal caliper widths for propensity-score matching when estimating differences in means and differences in proportions in observational studies. Pharm. Stat. 150–161. https://doi.org/10.1002/pst.433.

Bassuk, E.L., Hanson, J., Greene, R.N., Richard, M., Laudet, A., 2016. Peer-delivered recovery support services for addictions in the United States: a systematic review. J. Subst. Abus. Treat. 63, 1–9. https://doi.org/10.1016/j.jsat.2016.01.003.

Cartwright, N., Hardie, J., 2012. Evidence-Based Policy: A Practical Guide to Doing It Better. Oxford University Press, New York.

Chapman, S.A., Blash, L.K., Mayer, K., Spetz, J., 2018. Emerging roles for peer providers in mental health and substance use disorders. Am. J. Prev. Med. 54, S267–S274. https://doi.org/10.1016/j.amepre.2018.02.019.

Cole, S.R., Hernán, M.A., 2008. Constructing inverse probability weights for marginal structural models. Am. J. Epidemiol. 168, 656–664. https://doi.org/10.1093/aje/kwn164.

Eddie, D., Hoffman, L., Vilsaint, C., Abry, A., Bergman, B., Hoeppner, B., Weinstein, C., Kelly, J.F., 2019. Lived experience in new models of care for substance use disorder: a systematic review of peer recovery support services and recovery coaching. Front. Psychol. 10, 1–12. https://doi.org/10.3389/fpsyg.2019.01052.

Halekoh, U., Højsgaard, S., Yan, J., 2006. The R package geepack for generalized estimating equations. J. Stat. Softw. 15, 1–11. https://doi.org/10.18637/JSS.V015.I02.

Hernán, M.A., Robins, J.M., 2016. Using big data to emulate a target trial when a randomized trial is not available. Am. J. Epidemiol. 183, 758–764. https://doi.org/10.1093/aje/kwv254.

Hill, M., Hupe, P., 2002. Implementing Public Policy: Governance in Theory and in Practice. SAGE Publications, London.

Horvath, A.O., Del Re, A.C., Flückiger, C., Symonds, D., 2011. Alliance in individual psychotherapy. Psychotherapy 48, 9–16. https://doi.org/10.1037/A0022186.

Laudet, A.B., Humphreys, K., 2013. Promoting recovery in an evolving policy context: what do we know and what do we need to know about recovery support services? J. Subst. Abus. Treat. 45, 126–133. https://doi.org/10.1016/j.jsat.2013.01.009.

Martin, D.J., Garske, J.P., Katherine Davis, M., 2000. Relation of the therapeutic alliance with outcome and other variables: a meta-analytic review. J. Consult. Clin. Psychol. 68, 438–450. https://doi.org/10.1037/0022-006X.68.3.438.

Myrick, K., Del Vecchio, P., 2016. Peer support services in the behavioral healthcare workforce: state of the field. Psychiatr. Rehabil. J. 39, 197–203. https://doi.org/10.1037/prj0000188.

Reif, S., Braude, L., Lyman, D.R., Dougherty, R.H., Daniels, A.S., Ghose, S.S., Salim, O., Delphin-Rittmon, M.E., 2014. Peer recovery support for individuals with substance use disorders: assessing the evidence. Psychiatr. Serv. https://doi.org/10.1176/appi.ps.201400047.

Robins, J.M., Hernán, M.Á., Brumback, B., 2000. Marginal structural models and causal inference in epidemiology. Epidemiology 11, 550–560. https://doi.org/10.1097/00001648-200009000-00011.

Stack, E., Hildebran, C., Leichtling, G., Waddell, E.N., Leahy, J.M., Martin, E., Korthuis, P.T., 2022. Peer recovery support services across the continuum, community, hospital, corrections, and treatment and recovery agency settings-a

narrative review. J. Addict. Med. https://doi.org/10.1097/ADM.0000000000000810.
State of Minnesota Revisor of Statutes, 2021. 245G.11, Minnesota Statutes.
Von Elm, E., Altman, D.G., Egger, M., Pocock, S.J., Gøtzsche, P.C., Vandenbroucke, J.P., 2007. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. Epidemiology 18, 800–804. https://doi.org/10.1097/EDE.0b013e3181577654.