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ORIGINAL ARTICLE

The cost-effectiveness of long-term post-treatment peer recovery support services in the United States

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ABSTRACT

Background: Peer recovery support services (PRSS) have been widely adopted across a variety of settings, but little is known about their economic impact.
Objectives: To conduct a cost-effectiveness analysis of long-term, PRSS delivered after specialty substance use disorder (SUD) treatment (post-treatment), and to describe the development of a free, web-based cost-effectiveness calculator based on this analysis.
Methods: Using publicly available data from a variety of sources, post-treatment PRSS were compared to specialty SUD treatment from the societal (broad perspective including costs like participant time) and health systems perspectives (only costs borne by health system), and in terms of quality-adjusted life years (QALYs) added and people in recovery. Whenever possible, 2019 data were used to avoid the impacts of COVID-19. Standard willingness-to-pay thresholds and additional treatment episode cost ($17,203.74) were used. One-way and probabilistic sensitivity analyses were conducted. Two recovery community organizations (RCOs) were involved in model refinement and calculator development in 2022.
Results: Post-treatment PRSS were cost-effective to all thresholds and perspectives: $5,898.60 per QALY and $10,562.08 per person in recovery from the health system perspective, and $3,421.58 per QALY and $6,126.72 per person in recovery from the societal perspective, and post-treatment PRSS remained cost-effective across a variety of conditions in the sensitivity analyses. A cost-effectiveness calculator was developed from the analysis and is available at https://go.uth.edu/cea.
Conclusions: In light of finding PRSS cost-effective, the expansion of PRSS across the US should continue, and may be aided by using the cost-effectiveness calculator to estimate tailored results for a specific program.

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Peer recovery support services; cost-effectiveness analysis; cost-effectiveness calculator; recovery community organizations; recovery community centers; peer coaching

Introduction

Substance use disorder (SUD) affects a substantial portion of the US population (7.4%) and costs the US an estimated $442 billion annually (1, 2). While substantial progress has been made in improving SUD outcomes, gaps remain in the national infrastructure for addressing SUD and supporting recovery long-term. Most people who need SUD treatment do not receive it (1), and the few who do frequently require multiple, costly treatment episodes: 60.6% of those admitted to treatment in 2020 had at least one previous treatment attempt and 18.5% had five or more previous attempts (3).

In the past two decades, *peer recovery support services* (PRSS) have expanded across the US., gaining traction as state credentialed professional positions reimbursable under Medicaid in at least 37 states (4, 5). State-certified *peer workers* deliver PRSS, leveraging their lived experiences of SUD recovery to serve people currently challenged by problematic substance use. While peer workers are trained and credentialed, the PRSS they deliver are non-clinical, and are distinct from clinical SUD services. Peer workers are employed across a variety of settings and at varying intensities, but the evidence base supporting all forms of PRSS implementation has lagged behind the expansion of this flexible and promising intervention (6–8). However, some forms of PRSS, including long-term PRSS (9, 10), which is delivered at low intensities (i.e., approximately once per week) over a period of 6 months or more, have some evidence of effectiveness. In addition to the need for additional effectiveness studies, there are currently no economic evaluations of PRSS.

PRSS are promising in two additional ways. First, because peer worker training is relatively fast compared to clinicians (11), this workforce can be more quickly

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trained and deployed to address behavioral healthcare gaps. Second, PRSS offers an important pathway to employment for people with SUD histories, because that history is a prerequisite for the role, and not a detriment. Economic evaluations can help further the adoption, implementation, and maintenance of these programs.

There are several challenges to the economic evaluation of PRSS and other peer-driven SUD services. First, the very flexibility that makes PRSS an attractive intervention means that it is challenging to model features like service utilization, peer worker time, or participant time costs unless a single form of PRSS implementation is defined and modeled. A second challenge is selecting an appropriate comparator: because most people with SUD do not get any treatment in a given year (1), it is tempting to compare PRSS to real-world conditions and estimate the economic impacts of PRSS compared to receiving no services. However, such a comparison would overly favor the impacts of PRSS. Instead, it is necessary to compare PRSS to a more ideal standard of care such as specialty SUD treatment even if most individuals do not receive such treatment. While there are a variety of available appropriate comparator modalities of treatment, using a well-studied comparator that has a discrete termination (e.g., transitioning from acute specialty SUD treatment to the community and engagement in long-term PRSS) is also useful for modeling. However, as the varied use of PRSS continues to proliferate, the opportunity to assess PRSS cost-effectiveness in other contexts will become increasingly possible.

To help address the gap in economic evaluations of PRSS, this study assessed the cost-effectiveness of long-term PRSS delivered after specialty SUD treatment, using secondary data available in the peer-reviewed and gray literature identified in a previous systematic review (12). The analytic model was converted into a free, web-based cost-effectiveness calculator for long-term PRSS. This study was supported by a grant through the Recovery Research Institute's pilot grant program (via NIDA R24DA051988).

Materials and methods

This study was reviewed and declared exempt by the Committee for the Protection of Human Subjects at the University of Texas Health Science Center at Houston (HSC-SPH-21-1057). Table 1 provides details on all data sources used in this model-based cost-effectiveness analysis. Several data sources are nationally representative (1, 13–17), but other key sources represent a single state (10, 18) or a subset of US states (4, 9, 19, 20).

Table 1. Model parameters for long-term, post-treatment peer recovery support services cost-effectiveness analysis.

Variable	Base Case	Low	High	Source	Model
Tpp – Peer worker reimbursement per 15 minutes	$8.97	$3.66	$24.49	(4, 14)	H,S
Tpu – PRSS service utilization (in 15 minute increments)	212	76	472	(9, 18)	H,S
Tt – Cost of specialty SUD treatment	$17,203.74	$10,623.54	$23,783.94	(23–25)	H,S
Nt – Total receiving specialty SUD treatment	2,572,000	2,423,000	2,721,000	(13)	H,S
Api – per-person averted medical costs under PRSS^	$1,186.66	$949.32	$1,423.99	(10)	H
Ati – per-person averted medical costs under treatment only^	$913.05	$730.44	$1,095.66	(19)	H
Ci – per-person averted societal costs among those in recovery (PRSS or treatment only)^	$7,690.77	$6,152.62	$9,228.92	(27, 28)	S
Pp – Per-person, per-episode patient time costs for participating in PRSS	$1,479.23	$530.29	$3,293.38	(9, 18, 29)	S
Proportions					
Rp – Return to chaotic substance use prevalence among those receiving PRSS, year 1	17%	9%	50%	(10)	H,S
Rt – Return to chaotic substance use among those receiving treatment only, year 1	50%	40%	87%	(30, 31)	H,S
Retp – Retention of participants in long-term PRSS to completion/graduation/1 year.^	70%	10%	90%	(10)	H,S
D – In 2019, the 2015-2019 average percentage of people with SUD who received specialty SUD treatment in a given year, used in the estimation of costs of returning to chaotic substance use. Not used in one-way sensitivity analysis.	10%	*	*	(13)	H,S
Utility Weights					
Recovery utility^	0.8	0.5	1	(21, 22)	H,S
SUD utility	0.586	0.359	0.741	(22)	H,S

H = health System Perspective Model.
S = Societal Perspective Model.
^ = Estimated range of variation not available in the literature, so examined an arbitrarily selected range of variation, typically ±20%.

Parameter estimation and model construction

A microsimulation approach (a computational model) was used to simulate the accompanying costs and outcomes of specialty SUD treatment alone or treatment plus PRSS. In our microsimulation model, a cohort representing the US specialty SUD treatment population was simulated as completing treatment, then receiving either 1 year of long-term PRSS (the intervention condition) or no PRSS (treatment as usual [TAU]), relying on the beneficial effects of specialty SUD treatment alone. After receiving either PRSS or TAU, participants entered one of three mutually exclusive and collectively exhaustive health states: recovery (operationalized as abstinence or sustained, reduced substance use, explained further below), chaotic substance use, or deceased. The simulated cohort began at age 38 (average US treatment population age; 3), and quality-adjusted life expectancy (QALE) was estimated through age 82. The quality of life adjustment (also called utility) of the recovery health state was estimated as an average between US adult quality of life (21) and the least-impactful form of SUD (mild alcohol use disorder, disutility of 0.259 (22), converted to a utility is 0.741): $(0.867 + 0.741)/2 = 0.8$. For the chaotic substance use health state, we averaged across all disutility values (after converting to utility) for types of SUD from the Global Burden of Disease study (22) to arrive at an average utility of 0.586. A schematic of the basic model is presented in Figure 1.

Two models were constructed from the health system and societal perspectives, both limited to US parameters only. Parameter estimates and range of variation used for sensitivity analyses are presented in Table 1. Peer worker reimbursement per 15-min increment (*Tpp*) was estimated by averaging across hourly wages divided by four for community health workers, as the Bureau of Labor Statistics includes peer workers in this category (14), and across US state-specific Medicaid reimbursement rates cataloged by Videka and colleagues (4). PRSS service utilization (*Tpu*) was estimated in 15-min increments and was averaged between reported service utilization patterns among 3,459 long-term PRSS participants at 20 recovery community organizations (RCOs) in the US (9). and Medicaid service utilization patterns reported in Texas (18). The Ashford and colleagues' data (9) were used to construct the range of variation for sensitivity analyses, using one standard deviation from average participant engagement time, which presented a wider range of uncertainty compared to the Texas Medicaid estimates (18). The simulated cohort total size (*Nt*) was drawn from the National Survey on Drug Use and Health (13) for 2019. Wherever practical, 2019 estimates were used to avoid the impacts of the COVID-19 pandemic.

The cost of a specialty treatment episode (*Tt*) was estimated by first taking two robust but older estimates of treatment episode cost (23, 24), adjusting both estimates using the Consumer Price Index (25) to 2019

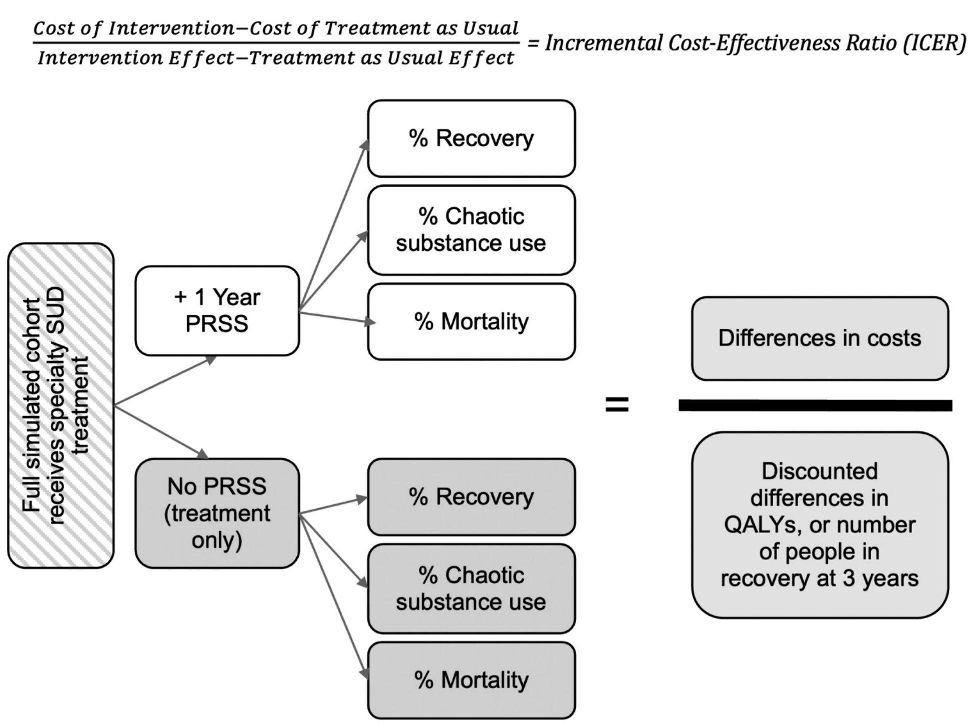

Figure 1. Schematic of the model used to estimate the cost-effectiveness of long-term, post-treatment peer recovery support services.

dollars, then averaging the two adjusted estimates together for an estimate of $17,203 per treatment episode. Averted medical costs for the PRSS condition (*Ap*) were estimated from an evaluation report of a Medicaid waiver demonstration project of long-term PRSS in Texas (10) that reported changes in healthcare utilization from baseline to 12-month follow-up among 1,226 people receiving long-term PRSS. Healthcare utilization was reported as number of days of use of outpatient, inpatient, or emergency room services in three categories in the past 30 days: physical, mental health, or SUD-related issues (10). Numbers reported for the Mangrum and colleagues (10) evaluation report were converted into a percent change for each category of healthcare. Costs for each type of service were from Peterson and colleagues (26) and adjusted for inflation from 2016 to 2019 dollars. The total averted medical cost estimate for the full simulated cohort was also converted to a per-person averted medical cost estimate for the post-treatment PRSS condition (*Api*). Averted medical costs for the TAU condition (*At*) followed a similar methodology, using an estimated percent reduction in healthcare utilization from a study of inpatient specialty treatment (19) that used the same service categories, and the same cost estimates (26) were applied to estimate a per-person averted medical cost under TAU (*Ati*). Averted medical costs were used in the health system perspective model only.

Societal costs were estimated for criminal legal system involvement, non-treatment healthcare costs, and lost productivity. Estimates for alcohol use disorder were drawn from Sacks et al. (27) and estimates for drug use disorder were drawn from the National Drug Intelligence Center (28), with cost categories already captured elsewhere in the model or represented by utility removed for both sets of estimates. Costs were adjusted to 2019 dollars from 2007 dollars (28) and 2010 dollars (27), and then reduced to account for the overlap between individuals with alcohol use disorder *and* drug use disorder (11.8%; 13), for an estimated $7,690 societal costs per individual with SUD (*Ci*). Total societal costs (*C*) used in this analysis were then estimated as $Nt*Ci = C$. To estimate averted societal costs, the number of people retained in the recovery health state in each condition (for example, $(1\text{-}Rt)*Nt$ for TAU condition) were multiplied by *Ci* and subtracted from *C*. Patient time costs were not estimated for specialty SUD treatment episodes because a substantial portion of the SUD treatment-needing population may not be able to engage in work as a tradeoff for treatment time, negating the need for a patient time costs under TAU. Instead, only participant time costs for the PRSS condition were estimated (*Pp*). *Pp* was estimated by multiplying *Tpu* by the June average hourly earnings of US adults for 2019 ($27.91) (29); to produce a per-person, per-episode participant time cost. Participant time costs and societal costs were used only in the societal perspective model.

Returning to chaotic substance use was estimated from Mangrum and colleagues (10) using the inverse of the percentage of participants who were abstinent or sustaining a reduction in substance use at 12-month follow-up (1–83% = 17%) for the PRSS condition (*Rp*) and from McLellan et al. (30) for the TAU condition (50%; *Rt*). Mangrum and colleagues (10) measured past-month abstinence or sustained reduced substance use across four check-in periods at 3-, 6-, 9- and 12-months post-baseline. The high end of the range of variation for *Rt* was drawn from a meta-analysis of psychosocial SUD treatments with an estimate of 87% to 61% returning to chaotic substance use (31), and the low end was drawn from McLellan et al. (30) at 40%. The low end of the range of variation for *Rp* was drawn from Ashford and colleagues (9%; 9) and the high was set to match the average from McLellan et al. (30). Finally, from the Mangrum et al. (10) evaluation, 71% of participants were retained to the 9-month mark, and 68% were retained to the 12-month mark, and an average between the two was used as retention to completion of PRSS (*Retp*) as advised by RCO key informants. Those who were not retained to PRSS completion (1-*Retp*) were assigned the same parameters as the TAU group. When estimating the costs of an additional specialty treatment episode among those who had returned to chaotic substance use, only *D*% were assumed to attend specialty treatment again after the initial episode, drawn from the 2015–2019 reported receipt of specialty SUD treatment among those with a need for treatment (1).

To estimate the base case, the entire simulated cohort received specialty SUD treatment as the starting point. Then, the entire cohort was modeled to receive either 1 year of PRSS, or to receive no PRSS (TAU) and rely on the effects of specialty SUD treatment alone. For the base case, 1 year of averted medical costs (health system perspective) and 1 year of societal costs (societal perspective) were estimated. For both conditions (PRSS and TAU), *D*% of participants in the chaotic substance use health state went to specialty SUD treatment again, incurring that cost in year 1. One year of *Pp* was estimated for *Retp* PRSS participants in the societal perspective PRSS condition. Thus, all numerator costs in the base case were estimated for a one-year time horizon. However, all QALE for the simulated cohort were estimated using a lifetime time horizon (beginning at age 38 and simulated through age 82), with QALE difference expressed as quality-adjusted life years

(QALYs). QALYs gained beyond year 1 were discounted at 3%. Because RCO key informants indicated that QALYs were not easily interpretable by stakeholders, we also estimated the number of people retained in the recovery health state three post-treatment, which was not discounted.

To estimate QALE, all participants were assumed to be in the recovery state at the start of the simulation. In year 1, ((1–*Rp*)**Retp*) participants remained in the recovery health state in the post-treatment PRSS condition, and approximately *Rp***Retp* and *Rt**(1-*Retp*) participants returned to chaotic substance use or died in the PRSS condition. In the TAU condition, approximately *Rt* participants returned to chaotic substance use in year 1, and 1–*Rt* remained in recovery. Mortality was estimated using background mortality probabilities for five-year age groups and was adjusted higher for *both* the recovery and chaotic substance use health states to account for the greater prevalence of comorbid physical health conditions among people in recovery and the greater risk of mortality among people in chaotic substance use (15–17, 20). The SUD health state consisted of approximately *Rp***Retp* and *Rt**(1–*Retp*) for PRSS and approximately *Rt* for TAU participants because this health state was the remaining percent of participants when mortality was estimated, so slightly lower than if calculated directly. Individuals were simulated to have a greater likelihood of remaining in the recovery health state if they were in the recovery health state the previous year (recovery-to-recovery health state transition) for TAU based on previous longitudinal research which found that the risk of returning to chaotic substance use stabilizes after 3 years of maintained recovery (32). This is also the justification for selecting *number of people in recovery at three years* as one of the denominators of interest in addition to QALYs added. For TAU, the recovery-to-recovery health state transition rises from 0.5 to 0.66 to 0.86 in years 1, 2, and 3, respectively. Because the simulated cohort only receives PRSS during year 1, the effects of PRSS are modeled only in year 1: *Retp*% of PRSS participants have a recovery-to-recovery stage transition probability of 0.83 in year 1, while 1-*Retp*% have the same stage transition probability as the TAU group (0.5). After year 1, recovery-to-recovery state transition probabilities for the PRSS group are the same as TAU (0.6 and 0.86 for years 2 and 3, respectively).

The base case formula for estimating health system perspective PRSS cost began with estimating service delivery costs as *Tpp*Tpu*Nt*, which was then added to the cost of repeat treatment episodes for those retained in the PRSS condition but return to chaotic substance use (*Retp*Rp*Nt*D* Tt*), and added to those who are *not* retained in long-term PRSS services and return to chaotic substance use (*(1–Retp)*Rt*Nt*D*Tt*). Averted medical costs were then subtracted, first for those retained in long-term PRSS (*Retp*Nt*Api*) and for those who were not retained in long-term PRSS but were assumed to have TAU reductions in healthcare costs (*(1-Retp)*Nt*Ati*). The costs of TAU were then subtracted from the costs of PRSS, with TAU costs estimated as only the cost of additional treatment episodes among those who return to chaotic substance use (*Rt*Nt*D*Tt*), with averted medical costs subtracted (*Ati*Nt*). The difference in costs between PRSS and TAU were then divided by the difference in QALYs added or number of people in recovery at 3 years post-treatment (*Qp* – *Qt*).

For the societal perspective, PRSS intervention costs were modeled the same for PRSS service delivery, but with participant time costs added for those retained in PRSS (*Retp*Nt*Pp*). Repeat treatment episodes cost was modeled the same as for the health system perspective and added to PRSS costs. Total societal costs were then added (*C*) with averted societal costs for those retained in the recovery health state subtracted (*Ci*((1-Rp)*Retp)*Nt* for those retained in PRSS and in recovery and *Ci*(1-Retp)*(1-Rt)*Nt* for those not retained in PRSS but retained in recovery). TAU costs were subtracted from total PRSS costs, with TAU costs modeled as only repeat treatment episode costs (same as health system perspective) and averted societal costs subtracted from total societal costs (*C-(Ci*(1-Rt)*Nt)*). This difference between PRSS and TAU costs were then divided by (*Qp* – *Qt*) just as for the health system perspective. Because we examined effects two ways and from two perspectives, we estimated four incremental cost-effectiveness ratios (ICERs).

Assessing cost-effectiveness

Four willingness-to-pay (WTP) thresholds were assessed: the standard $50,000, $100,000 and $200,000 per QALY thresholds (33), and a threshold that is more relevant to the SUD context (34): the cost of an additional specialty treatment episode ($17,203.74 in 2019 dollars; 23–25).

Base case cost-effectiveness was assessed, in addition to one-way and probabilistic sensitivity analyses. Base case cost-effectiveness analysis and one-way sensitivity analyses were conducted in Excel (35). Probabilistic sensitivity analyses were conducted by simulating 10,000 iterations of random variation for all variables – with appropriate probability distributions assigned (see Supplementary Table S2) in R (36) and STATA (37) and estimating the resulting ICERs across those 10,000 iterations in STATA. The range of variation for one-way sensitivity analyses are provided in Table 1, along with all parameters.

RCO involvement and cost-effectiveness calculator

After constructing a preliminary cost-effectiveness analytic model, ten staff at two RCOs (Communities for Recovery and RecoveryATX, in Austin, Texas) were engaged to provide feedback on the model's face validity and relevance to stakeholders. The model face validity session was held by video call, lasted 90 min, 30 min of which consisted of a plain language primer on cost-effectiveness analysis, with the remaining time for a walk-through of model components, checking with RCO staff that services were accurately modeled. Feedback was integrated into the final model. The base case was used to create a cost-effectiveness calculator for long-term, post-treatment PRSS, with key variables converted to accept user input. All inputs and outputs for the calculator were pre-tested with the same two RCOs during a second, 60-min video call session. All RCO feedback was integrated into the final pilot calculator prior to its launch.

Results

Base case

Compared to specialty SUD treatment alone, long-term, post-treatment PRSS was cost-effective to all WTP thresholds, across both health system and societal perspectives, and in terms of both QALYs added and additional people in recovery at 3 years. ICERs are presented along with full cost-effectiveness results in Table 2.

One-way sensitivity analyses

Full one-way sensitivity analysis results are presented in Table 3. The only variables that produced cost-effectiveness ratios outside of all WTP thresholds were the returning to chaotic substance use among the PRSS condition (*Rp*): at the highest range of variation, approaching 50%, cost-effectiveness ratios exceeded the $200,000 WTP threshold. For all other variables, PRSS were cost-effective across the entire range of variation to at least one threshold. The cost-effectiveness model was least sensitive to the underlying specialty SUD treatment population (*Nt*) and relatively insensitive to peer worker pay (*Tpp*), service utilization (*Tpu*), the cost of specialty SUD treatment (*Tt*), rates of returning to chaotic substance use among those receiving treatment only (*Rt*), SUD utility, averted medical (*Api* and *Ati*) and societal costs (*Ci*), and participant time costs (*Pp*). The remaining variables – recovery utility and retention in PRSS (*Retp*) – remained below at least one WTP threshold but produced less cost-effective values at the extreme ends of variation. Thus, the model was most sensitive to PRSS effectiveness (*Rp*), followed by retention in long-term PRSS (*Retp*), and recovery utility.

Probabilistic sensitivity analysis

Figure 2 presents the cost-effectiveness acceptability curve for the four ICERs examined over 10,000 simulated iterations. The probability of cost-effectiveness at the lowest WTP threshold ($17,204) ranged between 60.64% (societal perspective, cost per additional person in recovery at 3 years) and 75.34%

Table 2. Cost-effectiveness table for long-term, post-treatment peer recovery support services.

Intervention	Total Cost	Total Effectiveness	Incremental Cost	Incremental Effectiveness	ICER*
Health System Perspective					
Specialty SUD treatment alone	-$135,973,281	25,439,966 QALYs added 783,843 people in recovery, year 3	–	–	–
Treatment + long-term PRSS	$3,237,597,197	26,011,893 QALYs added 1,103,247 people in recovery, year 3	$3,373,570,477	571,927 QALYs added 319,404 people in recovery, year 3	$5,898.60 $10,562.08
Societal Perspective					
Specialty SUD treatment alone	-$7,677,929,256	25,439,966 QALYs added 783,843 people in recovery, year 3	–	–	–
Treatment + long-term PRSS	-$5,721,031,671	26,011,893 QALYs added 1,103,247 people in recovery, year 3	$1,956,897,584	571,927 QALYs added 319,404 people in recovery, year 3	$3,421.58 $6,126.72

* ICER = Incremental Cost-Effectiveness Ratio.

Table 3. Result of the one-way sensitivity analyses for long-term, post-treatment peer recovery support services.

	Cost per QALY Added		Cost per Person in Recovery at Y3	
Variable	Low	High	Low	High
Health System Perspective				
Tpp – Peer worker pay	$840.92	$20,699.82	$1,505.76	$37,065.27
Tpu – PRSS utilization (15 minute units)	$415.59	$16,380.83	$744.15	$29,331.65
Tt – Cost of specialty SUD treatment	$7,378.18	$4,419.02	$13,211.43	$7,912.73
Rp – Return to chaotic use among PRSS	$4,398.94	$251,843.12	$7,876.78	$450,948.04
Rt – Return to chaotic use among TAU	$11,356.32	$1,497.01	$20,334.71	$2,680.55
Retp – Retention in PRSS through completion/graduation or to 1 year	$51,092.59	$3,270.04	$91,487.08	$5,855.37
Nt – Total receiving specialty SUD treatment in Texas	$5,898.60	No change	$10,562.08	No change
Api – Averted medical costs for PRSS	$6,892.07	$4,905.13	$12,341.00	$8,783.16
Ati – Averted medical costs for TAU	$5,077.39	$6,719.81	$9,091.61	$12,032.55
Recovery utility (0.6-1)*	$70,454.63	$3,078.15	N/A, not impacted by utility	
SUD utility	$2,902.30	$19,990.90	N/A, not impacted by utility	
Societal Perspective				
Tpp – Peer worker pay	-$1,636.10	$18,222.81	-$2,929.61	$32,629.90
Tpu – PRSS utilization (15 minute units)	-$5,043.16	$19,620.16	-$9,030.32	$35,132.01
Tt – Cost of specialty SUD treatment	$4,105.15	$2,738.02	$7,350.72	$4,902.72
Rp – Return to chaotic use among PRSS	$846.34	$425,761.09	$1,515.47	$762,364.00
Rt – Return to chaotic use among TAU	$11,257.58	-$2,898.06	$20,157.89	-$5,189.29
Retp – Retention in PRSS through completion/graduation or to 1 year	$82,610.24	$488.67	$147,923.01	$875.02
Nt – Total receiving specialty SUD treatment in Texas	$3,421.58	No change	$6,126.72	No change
Ci – per-person averted societal costs among those in recovery (PRSS or treatment only)	$5,573.95	$2,378.21	$9,980.76	$4,258.44
Pp – Per-person, per-episode patient time costs for participating in PRSS	$439.85	$9,137.93	$787.60	$16,362.45
Recovery utility (0.6-1)*	$47,491.46	$2,074.90	N/A, not impacted by utility	
SUD utility	$1,956.36	$13,475.30	N/A, not impacted by utility	

* = Incremental effectiveness values below a recovery utility weight of 0.6 were negative, indicating the program was less effective than treatment alone when recovery utility is below 0.6.

(health system perspective, cost per QALY). The probability of cost-effectiveness at the $50,000 threshold ranged from 85.44% (health system perspective, cost per additional person in recovery at 3 years) to 94.18% (societal perspective, cost per QALY). At the $100,000 WTP threshold, the probability of cost-effectiveness was above 94% for all perspectives and outcomes examined, and above 98% at the $200,000 WTP threshold.

Cost-effectiveness calculator

After integrating feedback and completing pre-testing of the calculator with two RCOs, the web-based calculator underwent testing for accessibility and compliance with the Americans with Disabilities Act and was launched at https://go.uth.edu/cea. The calculator also includes a component estimating bystander naloxone distribution cost-effectiveness using user inputs. The calculator is in

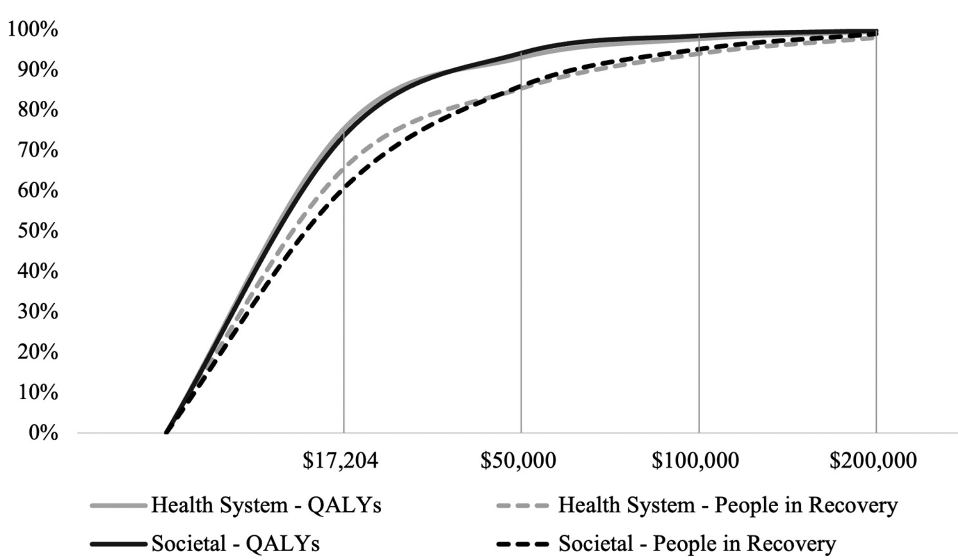

Figure 2. Cost-effectiveness acceptability curve demonstrating the probability of post-treatment PRSS being cost-effective compared to specialty SUD treatment only, simulated over 10,000 iterations. Between 60.64% and 75.34% of the time, post-treatment PRSS will be cost-effective to the first willingness-to-pay threshold ($17,204) compared to treatment alone. By the $50,000 willingness-to-pay threshold, post-treatment PRSS will be cost-effective >85% of the time.

the pilot phase with feedback continually gathered for future refinement and additional components.

Discussion

Compared to specialty SUD treatment alone, post-treatment PRSS is cost-effective across a wide range of variation, and from both the health system and societal perspectives. Long-term PRSS has been shown to improve outcomes for people with SUD by extending low-intensity support over a time span that would not be feasible for acute specialty treatment. Another long-term intervention for SUD that is widely accepted and recognized – methadone for opioid use disorder treatment – was estimated to cost $16,000 per QALY in a recent study, which was the most cost-effective of the interventions assessed in that study (38). While PRSS cost per QALY is substantially lower, this comparison is intended to highlight PRSS as a cost-effective complement – not a replacement – to other cost-effective treatment methods. Health systems should consider how they can incorporate long-term PRSS into care plans for people with SUD by leveraging existing resources such as RCOs and other community providers of long-term PRSS, or by incorporating those services when not available in the community. PRSS have been integrated into general medical settings and have shown promising outcomes even at shorter time scales (39). Partnerships between local RCOs and hospitals have helped to dispatch peer workers to bridge hospitalized patients from the acute care setting into longer-term community-based PRSS care (40).

The efficiency of PRSS was most impacted by the effectiveness of long-term PRSS compared to specialty SUD treatment alone, as well as participant retention, therefore efforts to ensure that PRSS are delivered effectively and in a way that engages and retains participants long-term should be made. While the relationship between PRSS effectiveness and peer worker job satisfaction has not been examined, it is possible that peer workers with longer job site tenure and higher job satisfaction could potentially deliver services more effectively than a scenario where peer worker turnover is high. One study found that peer worker job satisfaction is tied to pay, with higher job satisfaction among those with higher pay (41). While low peer worker pay remains a challenge to retention of peer workers nationally, it is notable that peer worker pay had little impact on cost-effectiveness in the model compared to PRSS effectiveness, retention in PRSS, or recovery utility, but more research is needed. Further, more research is needed to refine recovery utility estimates as it is a high-impact variable in the model.

Limitations include the need for additional research on PRSS described previously, as well as the model-based design for the cost-effectiveness analysis. While model-based economic analyses are common in the literature (42–44), by design they necessitate the use of parameters from multiple studies that may represent heterogeneous populations or approaches. For example, the primary source of parameters related to PRSS effectiveness was the Mangrum and colleagues report (10), which is limited to participants in Texas. Future cost-effectiveness analyses that accompany a randomized controlled trial of PRSS will strengthen the evidence for PRSS cost-effectiveness. To add additional rigor to this study and address this limitation, we undertook two forms of sensitivity analyses examining the full range of potential variation in each parameter as described above. We also addressed this limitation by including multiple data sources whenever possible, such as in the case of estimating PRSS costs, which included both Bureau of Labor Statistics wage information and Medicaid reimbursement rates from across the US (4, 14). A second limitation is that, while data from 2019 were used whenever possible, service utilization was partially modeled off data collected during the COVID-19 pandemic (9). Future research should examine whether and how PRSS service utilization patterns were impacted by the COVID-19 pandemic, and how cost-effectiveness was impacted. Third, adjusting costs for inflation to 2019 dollar values does not capture all changes in care delivery that may have occurred in intervening years, but instead represents a compromise approach, much like our method for estimating recovery utility.

Evidence for the cost-effectiveness of peer-driven substance use interventions is needed, and this study helps to fill that gap by estimating the cost-effectiveness of long-term PRSS as an adjunct to specialty SUD treatment. Economic evaluation evidence can support the need for funding by demonstrating that the interventions represent a good balance between resources invested and the benefit to public health produced by the intervention. While future research is needed to determine whether cost-effectiveness calculators can help motivate adoption or can be used as funding decision-making aids, it is reasonable to assume that tailoring economic evaluation information to an individual program could be a useful tool for organizations seeking funding or for communities deciding how to spend existing funds. As the evidence base for PRSS and other peer-driven interventions grows, it is critical that the economic evaluation evidence base grows in parallel.

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SCM was an uncompensated board member for an organization that provided feedback and served as a part-time contractor providing evaluation services for the second organization providing feedback during the study period. The remaining authors have no disclosures.

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