



Assessing a pilot scheme of intensive support and assertive linkage in levels of engagement, retention, and recovery capital for people in recovery housing using quasi-experimental methods

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ABSTRACT

Introduction: Strong and ever-growing evidence highlights the effectiveness of recovery housing in supporting and sustaining substance use disorder (SUD) recovery, especially when augmented by intensive support that includes assertive linkages to community services. This study aims to evaluate a pilot intensive recovery support (IRS) intervention for individuals ($n = 175$) entering certified Level II and III recovery residences. These individuals met at least three out of five conditions (no health insurance; no driving license; substance use in the last 14 days; current unemployment; possession of less than \$75 capital). The study assesses the impact of the IRS on engagement, retention, and changes in recovery capital, compared to the business-as-usual Standard Recovery Support (SRS) approach ($n = 1758$).

Methods: The study employed quasi-experimental techniques to create weighted and balanced counterfactual groups. These groups, derived from the Recovery Capital assessment tool (REC-CAP), enabled comparison of outcomes between people receiving IRS and those undergoing SRS.

Results: After reweighting for resident demographics, service needs, and barriers to recovery, those receiving IRS exhibited improved retention rates, reduced likelihood of disengagement, and growth in recovery capital after living in the residence for 6–9 months.

Conclusion: The results from this pilot intervention indicate that intensive recovery support, which integrates assertive community linkages and enhanced recovery coaching, outperforms a balanced counterfactual group in engagement, length of stay, and recovery capital growth. We suggest that this model may be particularly beneficial to those entering Level II and Level III recovery housing with lower levels of recovery capital at admission.

1. Introduction

Individuals with a substance use disorder (SUD) characteristically

demonstrate a continuous pattern of substance use and related risky behaviors despite experiencing progressively adverse consequences. This behavior affects relationships, health and well-being, daily

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functioning and inflicts considerable social harm. From a criminological perspective, the impact of addiction is also evident in high rates of arrest, incarceration, and reoffending behaviors (Evans, Huang, & Hser, 2011). Recovery from SUDs is a multifaceted and personalized journey that requires consistent and prolonged efforts to enhance overall well-being (Best et al., 2016). Key domains of recovery include improved physical and mental health, societal participation, control over substance use, a fulfilling life, and reaching one's potential (White, 2007). Recovery capital (RC) is an especially important construct in mapping the success of addiction recovery as it provides the building blocks for overcoming the challenges of recovery and maintaining long-term sobriety. RC refers to the internal and external resources that an individual can access in their journey to recovery, including social support, financial stability, housing, and personal and community resilience (Cloud & Granfield, 2008). When an individual enters addiction treatment and additionally receives non-clinical recovery support services, they stand to benefit because these services address substance use and foster the development of recovery capital (Hennessy, 2017).

Residential settings, such as recovery housing, are well suited to building recovery capital (Cano, Best, Edwards, & Lehman, 2017). Recovery residences can provide structure, support, and an environment that motivates an individual to form positive habits and behaviors during their recovery journey. Compared to those attending only outpatient treatment, individuals attending outpatient treatment and living in recovery housing often achieve a more satisfactory discharge and experience longer stays in outpatient treatment (Mericle, Mahoney, Korcha, Delucchi, & Polcin, 2019). Recovery housing supports a diverse range of individuals at different stages in their recovery journey and often follows inpatient treatment to advance progress and strengthen the skills necessary for sustained recovery. Two well-studied models of recovery housing are Oxford Houses (OHs) and Sober Living Houses (SLHs) in California. Oxford Houses are peer-run, self-governed, and democratic living settings where all costs and responsibilities for day-to-day operations are shared among the residents (Jason & Ferrari, 2010). California Sober Living Houses, on the other hand, are more structured living environments, as there is a house manager (often a senior or former resident) for the residence who is responsible for overseeing the day-to-day operations of the residence (Mericle et al., 2019; Polcin & Henderson, 2008). Both provide a supportive and drug-free living environment for individuals in recovery.

In the United States, the National Alliance for Recovery Residences (NARR) sets standards for various recovery residences, with the aim of increasing the quality of recovery housing (NARR, 2018). The NARR Standard delineates four types of recovery housing based on the level of support provided to residents living in them. Level I residences are peer-run and provide peer support only, such as in the OH model. Level II residences also provide peer support but are "monitored" by a house manager, such as in the California SLH model. Level III and IV residences build upon the support provided by Levels I and II but add additional services such as non-clinical recovery support (Level III) and/or clinical services (Level IV). Regardless of level, recovery residences can play a key role in the lives of individuals in recovery through the development of recovery capital (Cano et al., 2017; Polcin, Mahoney, Witbrodt, & Mericle, 2021).

Recovery residences can enhance recovery capital by using "assertive linkage" to boost the quality and continuity of care for individuals recovering from addiction. Assertive linkage delivers services like transportation or the facilitation of mutual aid engagement, which ensures that individuals can reach treatment facilities, support groups, and other vital resources. Through connecting individuals engaging with recovery support to these resources, recovery residences actively foster the growth of recovery capital. Introducing individuals to a like-minded community can ensure that they receive the appropriate support and resources needed to overcome their substance use. This will also reduce the risk of future drug-related criminal activities through processes of peer-supported engagement and by providing transportation (Manning

et al., 2012; Timko, DeBenedetti, & Billow, 2006). Assertive linkage to social and community capital supports residents in building healthy coping skills, reducing the likelihood of reoffending, and ultimately overcoming addiction (Godley, Godley, Dennis, Funk, & Passetti, 2007). As a result of this, assertive linkage benefits individuals, creates safer communities, and reduces the strain on criminal justice resources (Best, Irving, Collinson, Andersson, & Edwards, 2017). With respect to the current study, assertive linkage plays a differentiating role between our IRS and SRS groups.

The field of addiction treatment has advanced significantly with the development of evidence-based and "just-in-time" interventions (Kornfield et al., 2018; Naughton et al., 2021), but for those with more severe substance use, identifying the intensity of needed treatment and post-treatment recovery support services is especially important. The intensity of interventions for someone at high risk of a substance use disorder could largely determine whether they achieve a successful recovery outcome. Those with a more severe substance use disorder proportionally require more intensive and prolonged treatment and recovery support services to overcome their addiction (De Leon, Melnick, & Cleland, 2008; White, 2008). The current paper builds on recent work on recovery capital research using administrative data collected in recovery residences. This study examines outcomes using the Recovery Capital Assessment Tool (REC-CAP, Best et al., 2023; Härd, Best, Sondhi, Lehman, & Riccardi, 2022). Previous findings with this tool show that retention in recovery housing associates with reduced barriers to recovery and growth in recovery strengths. Using data from residents entering recovery housing operated by members of the Virginia Association of Recovery Residences (VARR), this study sought to examine differences between those entering residences who received intensive recovery support (IRS) services (involving assertive linkage to a range of community capital resources), and those receiving standard recovery support services (SRS). Using statistical techniques to balance residents who received IRS vs. SRS on demographic and other clinical characteristics, the analysis examined differences in engagement, length of stay, and change in recovery capital from the baseline assessment. The analyses were based on the following hypotheses:

- H1.** Those in the IRS group will have lower disengagement rates after their initial assessment than those in the SRS group.
- H2.** Those in the IRS group will stay longer in the residence than those in the SRS group.
- H3.** Those in the IRS group will gain more recovery capital over time than those in the SRS group.

The findings from this study can highlight the value of providing residents intensive recovery support early in their stays, particularly among individuals at high-risk or those who are otherwise underserved. By comparing these two recovery residence groups, this study can also provide preliminary support for assertive linkage and resident matching interventions delivered in recovery residence settings.

2. Methods

2.1. Setting and participants

This study included a total of 101 VARR residences in the analysis. The residences are primarily single-sex residences for males and females in recovery from alcohol or other substance use disorders (one residence is gender neutral, specifically serving the LGBTQIA+ community). The residences are located throughout Virginia, primarily in residential neighborhoods, and had a mean of 9.4 residents with a range of 3–21 at the time of data collection. VARR residences operate at Level II and Level III, as defined by NARR, but common to all residences is recovery support for abstinence, general well-being, and community reintegration. Data for this study came from an administrative dataset containing information on a total of 1933 residents who began treatment between

February 2020 and August 2022. All residents completed a baseline REC-CAP assessment typically within 72 h of admission to the residence. The analysis only included data from residents if they signed a consent for their data to be used for research purposes. Within our sample, 175 were VARR-certified IRS clients and 1758 were business-as-usual SRS clients. Residents completed the REC-CAP once again at 45 days, 90 days, and at 90-day intervals thereafter, with 1287 individuals completing more than one assessment.

2.2. Intervention

To qualify for the VARR Intensive Program, new residents had to meet a minimum of three of the following five conditions which are indicative of high service need:

- a. Missing, expired, and/or no health insurance
- b. Missing, expired, and/or no driver's license and/or Identification Card
- c. Currently unemployed
- d. Current financial capital under \$75.00 (USD)
- e. Last use of substances under 14 days

If the client met three out of five of the conditions during the baseline completion of the REC-CAP, the recovery navigator contacted the VARR office for IRS approval. Once approved (all qualified residents received approval), the resident was offered the intensive 30-day IRS program, which consisted of the following support services:

- i. **Weekly Stipend** - A weekly stipend of at least \$60.00 (USD) to be used for groceries, toiletries, hygiene products, clothes, and bedding if needed.
- ii. **Transportation** - This included transportation to various recovery-related services or appointments to meet the resident's recovery needs (e.g., *addiction specialist appointments, prescription pick up, in-person therapy/counseling, grocery store, and criminal justice appointments*).
- iii. **Day Program** - Structured daily (7 days/week) recovery programming consisting of recovery or skill-building-related classes, curriculum, peer support groups and/or support groups. Day programming occurred off-site from the recovery residence. A combination of recovery housing staff, volunteers, and paid service providers delivered day programming.
- iv. **Recovery coaching/mentoring** - This service consisted of one-on-one peer support and mentoring, which included the development of a recovery plan based on the REC-CAP. Staff of the recovery residence organization performed recovery coaching/mentoring. It occurred on-site and off-site, although predominantly off-site from the recovery residence.

2.3. Measures

We collected resident data using the REC-CAP, a validated assessment of recovery capital (Cano et al., 2017). The REC-CAP assessment measured both positive and negative recovery capital at each administration. Positive recovery capital, or outcomes that enhance one's recovery journey, used five strength domains to assess overall well-being, commitment to sobriety, personal, social, and community capital. This produced an overall score ranging from 0 to 100 and followed the method reported in Best et al. (2023). Specialists in recovery settings designed this assessment to provide measures for recovery care planning, administering it on a 90-day completion and review cycle. The Advanced Recovery Management System (ARMS - an online system that VARR residences use) managed the REC-CAP data and monitored recovery capital growth. A designated peer navigator from VARR conducted daily checks to identify residents due for their next assessment. Those due would meet with the peer navigator at the residence and

subsequently complete the follow-up assessments online.

2.3.1. Outcomes

We used three outcome measures to evaluate the effectiveness of the interventions. Our first outcome measure was the retention rate of residents in the recovery homes, created by dichotomizing residents who had an initial assessment and then failed to complete subsequent REC-CAP assessments from those who did. The second outcome measure was the length of stay in the recovery house, defined as the time (in days) between their admission and discharge dates. Finally, we monitored recovery capital changes from baseline over time, using the recovery capital metrics obtained from the REC-CAP instrument. The REC-CAP includes a 50-item scale measuring personal and social recovery capital representing the Assessment of Recovery Capital Score (ARC Score, Groshkova, Best, & White, 2013). Retention rates in the recovery residences will serve as a proxy outcome for the effectiveness of residence engagement, as longer stays in the recovery homes are generally associated with better outcomes (Hser, Evans, Huang, & Anglin, 2004).

2.3.2. Prognostics

The REC-CAP incorporates sociodemographic information on each resident (age, sex, ethnicity) with perceptions of five components of wellbeing: psychological and physical health, quality of life, support networks, and housing satisfaction measured on scales of 0–20. We measured barriers to recovery (accommodation, substance use, risk-taking, involvement with the criminal justice system and levels of engagement with work, training and volunteering) via a dichotomous yes/no scale. We also measured residents' needs through a series of eight questions relating to: the perceived need for drug, alcohol, and mental health treatment, housing support, employment services, primary healthcare support (medical services), family relationship support and other support services. Each question in this series had a dichotomized yes/no response.

2.4. Statistical analysis

To balance the IRS and SRS groups across prognostics, we employed methods outlined by Hernán and Robins (2020) to establish counterfactual populations. Our analytical framework utilized two approaches to create a counterfactual group of individuals who received the intervention. To understand differences in engagement and retention length, we considered 21 prognostics recorded for each resident: five barriers, eight needs, sex, age, ethnic background, psychological health, physical health, accommodation status, quality of life perceptions, and the extent of a person's support. Except for sex (whose distribution between groups was already even, see Table 1), all prognostics entered the binary model of treatment allocation to derive Inverse Probability Weights for rebalancing the distribution of the prognostics across the intervention types. To estimate average treatment effects, weights were coupled to a Regression Adjustment (IPWRA), conducted by the commands "teffects" for disengagement and "stteffects" for retention length in Stata Release 16. A plot of absolute standardized mean differences between intervention groups before and after weighting, as recommended by Austin and Stuart (2015), is in the Supplementary Material (Supplementary Fig. 1). The distribution of the twenty prognostics across the two interventions was much more balanced following the weighting process, which we confirmed using an overidentification hypothesis test (Imai & Ratkovic, 2014).

Our second analytical approach was to model change from the baseline REC-CAP score over up to six assessments after the initial assessment. Here we fit a marginal structural model for repeated measures (MSM), which is a two-step process. First, the method required computing inverse probability weights in their stabilized version over multiple time points. These are weights used in statistical modeling to adjust for confounding variables by creating a 'pseudo-population' in which the treatment assignment is independent of the confounders, thus

Table 1
Summary statistics by SRS and IRS group at baseline assessment.

Prognostics	SRS (n = 1758)	IRS (n = 175)
Binary prognostics		
Ethnicity: White	65.2 %	77.1 %
Sex: Males	64.1 %	64.6 %
Numeric prognostics		
Barriers		
- Accommodation	26.1 %	42.3 %
- Substance use	58.7 %	81.1 %
- Risk-Taking	15.4 %	34.9 %
- Criminal Justice	63.6 %	66.9 %
- Employment, Education, Training	35.9 %	15.4 %
Needs		
- Mental Health	43.0 %	65.1 %
- Drug Treatment	35.2 %	53.1 %
- Alcohol Treatment	15.6 %	16.6 %
- Housing	32.7 %	44.0 %
- Employment, Education, Training	41.6 %	58.3 %
- Primary Care	39.7 %	52.6 %
- Family	18.1 %	22.3 %
- Other Needs	7.5 %	9.1 %
Psychological Health (0–20)	13.5	11.3
Physical Health (0–20)	14.3	13.0
Accommodation Satisfaction (0–20)	14.4	13.8
Quality of Life (0–20)	12.8	10.4
Quality of Support Network (0–20)	14.2	12.0
Recovery Group Participation Scale (0–14)	7.4	5.3
Age	38.0	34.5
REC-CAP Composite Index (0–100)	38.1	31.1

allowing one to estimate the causal effect of the treatment alone. The analysis incorporated stabilized weights to reduce variability in the model estimates. This approach addresses such time-varying confounders as described by [Hernán and Robins \(2020\)](#). In this method, each individual is weighted based on the inverse of the conditional probability of receiving the treatment they received, modeling treatment allocation as a binary outcome.

After, this study proceeded to investigate the change from baseline REC-CAP score over assessments using a Generalized Estimating Equation (GEE) model for examining changes over time with an independent working correlation that included the stabilized weights, with interest focusing on differences between interventions over assessments. The marginal model created the counterfactual group in which all measures including time-varying confounders were balanced. We created this model using the methodology outlined in [Faries and Kadziola \(2010\)](#) and included seven prognostics: baseline REC-CAP score, age, gender, ethnicity, assessment number, intervention, and assessment number-by-intervention interaction. For this component, the authors conducted the modeling using SAS (University Edition). More information about this process can be found in the Supplementary Material.

3. Results

3.1. Comparison of IRS and SRS groups

Of the 1933 residents who completed a baseline REC-CAP assessment, 1758 received SRS (91 %) and 175 (9 %) received IRS. Before weighting, all prognostics showed marked discrepancies across the two groups, notably for ethnicity, with 77.1 % of IRS residents being white compared to 65.2 % of SRS residents. All six numerical prognostics show discrepancies in the mean value between intervention groups, especially age, where IRS residents were, on average, 3.5 years younger than SRS residents. Overall, the IRS group presented as more complex, with more recovery barriers and unmet needs. The REC-CAP score was notably lower in the IRS group (mean 31.1) than in the SRS group at the intake assessment point (38.1).

3.2. Engagement and retention

[Table 2](#) presents results from the counterfactual models for estimating average treatment effects ([Hernán & Robins, 2020](#)). The models show what the impact would be if all residents in this study were to move from SRS to IRS. In such a scenario, the models indicate an estimated 17.8 percentage points decrease (from 34.8 % to 17.0 %) in disengagement rate from the recovery residences, with 95 % CI (12.4, 23.3). The more intensive intervention resulted in a higher percentage of residents remaining in recovery housing. If all residents in this study were to be moved from SRS to IRS, those who remain engaged would be retained on average for 48 days longer (from 207 to 255 days), with 95 % CI (0, 96.5). Given our data, this implies that more intensive interventions positively affect engagement rate and retention length relative to support-as-usual approaches.

3.3. Changes in recovery capital

We further examined changes in the REC-CAP scores in each intervention group relative to the initial baseline REC-CAP score (defined as Assessment 0) in models that included weights to balance the groups. [Fig. 1](#) shows that by the third assessment (between 90–180 days) after baseline, the predicted change from the baseline REC-CAP score eliminated the gap between the IRS and SRS. There was also a noticeable increase in the predicted mean change from the baseline REC-CAP assessment to the sixth and final assessment (between one year and one year and three months after the baseline assessment). However, the number of residents receiving this final assessment for the intensive group was too small ($n = 8$) to derive firm conclusions. [Table 3](#) presents step-down Holm multiplicity-adjusted p -values and Bonferroni-adjusted 95 % confidence intervals using estimated effect sizes and their precision ([Lang & Altman, 2013](#)). While the mean change in REC-CAP score from baseline is lower in the IRS group than in the SRS group in the first two follow-up assessments, the trend is reversed over assessments 3, 4 and 5, with a steady increase over time. It is not until assessment 6 that the estimated treatment difference becomes statistically significant, at 5.3 units higher in IRS than in SRS residents, though not precisely estimated as its 95 % CI is wide (0.4, 10.2), due to the few residents across all IRS assessments, particularly by assessment 6. However, it should be noted that over time, both models show improvements in recovery capital; changes in the intensive model are more marked though.

4. Discussion

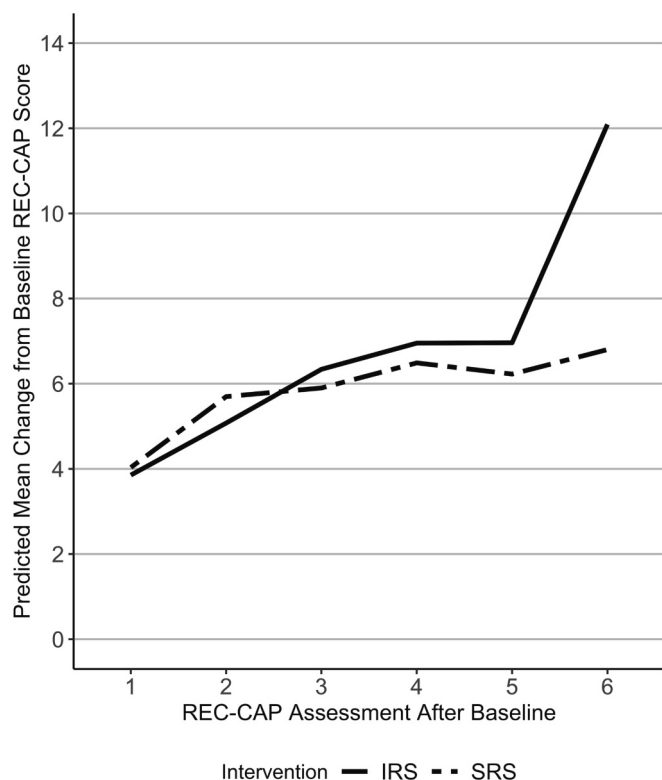
Research on recovery housing consistently shows positive outcomes, particularly with respect to reduced substance use and improvements in functioning, including increased employment and reductions in criminal activity ([Reif et al., 2014](#)). Research in the field is increasingly turning to examining factors that drive improved outcomes, such as gains in recovery capital and interventions that can be delivered in the context of recovery housing to further enhance outcomes ([Polcin, Korch, Witbrodt, Mericle, & Mahoney, 2018](#); [Witbrodt, Polcin, Korch, & Li, 2019](#)). Using statistical techniques to strengthen causal inference by creating weighted counterfactual groups, the present study examined differences in engagement, length of stay, and gains in recovery capital between residents who received IRS (which included peer recovery coach and assertive linkage to mutual aid and appointment attendance) compared to SRS.

Although crude measures showed that SRS residents stayed longer, once balanced on key prognostics, IRS residents performed better. Indeed, models estimating the average treatment effects for residents in both groups found that those in the IRS group had lower rates of disengagement and longer retention in recovery residences compared to those in the SRS group. This study also demonstrates that providing enhanced recovery housing services can positively affect not only retention but also recovery capital as measured by the REC-CAP

Table 2

Average treatment effect of disengagement and retention length from recovery residences.

Outcome metric	Potential outcome means for SRS	Potential outcome means for IRS	Average treatment effect	P-value	95 % CI lower	95 % CI upper
Disengagement (%)	34.8	17.0	-17.8	<0.001	-23.3	-12.4
Retention length (number of days)	207.3	255.5	48.2	0.05	0	96.5

**Fig. 1.** REC-CAP Score (GEE model with stabilized IPT weights).

instrument, with positive recovery capital trajectories across the sample but significantly greater gains over time among those provided with intensive support in the initial period of their stay. It would appear that the intensive support creates the foundations on which recovery capital can be built.

Our analyses show a relationship with changes in recovery capital over time, such that improvements for the IRS group become more marked relative to SRS clients by the third assessment between 90 and 180 days days, suggesting a key point at which intensive interventions may become embedded in behavioral changes. Recovery capital encompasses the personal resources individuals utilize to initiate and maintain their recovery journey, providing the necessary support for continued progress long after leaving recovery housing. To the extent that recovery housing and services provided therein can foster gains in recovery capital, the results of this study are demonstrative of how

recovery housing may contribute to improved outcomes.

Due to our sample size and the lower retention rates at later time-points, we were unable to draw firm conclusions at the sixth assessment. Nationally (in the USA), the recommended duration of stay in a recovery residence to obtain maximum benefit is suggested to be 90 days (Volkow, 2011), although research evidence is limited in this area. One longitudinal study found average retention in SLHs to be between 166 and 254 days, with standard errors of 163 and 169 days, respectively, indicating some variability (Polcin, Korcha, Bond, & Galloway, 2010). Factors such as personal commitments, family, and the speed at which an individual recovers also play a deterministic role in their tenure. While eight individuals remained in recovery housing at the sixth assessment (which is close to a one-year tenure), our data indicate that more than half of the IRS individuals ($n = 96$) remained at the recovery residences to at least the 90-day mark. This retention rate matches expectations based on estimated average recovery residence stays for Tier 2 and Tier 3 residences. As the intensive support is modeled after an inpatient treatment approach, the observed retention in the IRS group is promising, especially considering the inherent challenges of that population within this study.

Further research is needed to investigate the sensitivity and specificity of the REC-CAP in identifying high-needs groups for targeted interventions. The present study builds on our earlier work (Best et al., 2023; Härd et al., 2022) which suggests that certain demographic groups (i.e., age, gender, and/or ethnicity) may be more at risk of early drop-out. Baird, Cheng, and Xia (2022) also note demographic differences in SUD treatment retention. In this study, specific criteria indicative of greater service needs, not REC-CAP scores, determined the allocation of residents into the IRS group. However, data collected in REC-CAP enabled the balancing of the intervention group with a derived counterfactual group based on resident demographics, service needs, and barriers to recovery. This highlighted the IRS group as more complex, with more unmet needs and recovery barriers, suggesting that the REC-CAP may be useful in identifying residents needing additional support and services during their recovery residence stay.

Importantly, this study also points to the types of support and services that high-risk and underserved residents may need during their recovery housing stay. In addition to recovery support for abstinence, general well-being, and community reintegration that all residents in VARR houses benefit from, those in the IRS group also received support for basic needs (a modest stipend and transportation support) as well as enhanced recovery support services including an assessment of recovery needs and recovery planning as well as linkages to recovery programming and services to address other needs. It is common in Level II and Level III residences that house managers and peer recovery specialists act as “community connectors” to provide support to individuals who may be

Table 3

Summary of the intervention effect (IRS vs. SRS) at each assessment point after initial baseline assessment.

Assessment point after baseline assessment	Estimated difference in REC-CAP units	Standard error	Z value	Adjusted p-value	Adjusted estimate lower	Adjusted estimate upper
1	-0.18	0.94	-0.19	1.00	-2.66	2.30
2	-0.62	1.13	-0.55	1.00	-3.60	2.36
3	0.44	1.06	0.41	1.00	-2.36	3.24
4	0.46	1.86	0.25	1.00	-4.43	5.36
5	0.73	2.87	0.26	1.00	-6.83	8.30
6	5.29	1.86	2.84	0.03	0.38	10.20

vulnerable at the onset of recovery (McKnight & Block, 2011). The findings from this study reflect the importance of this additional support, as providing transportation and building community contacts builds effective scaffolding around individuals in the initial stages of recovery journeys. Careful assessment of the SUD severity and levels of recovery capital at treatment onset using the REC-CAP instrument could inform individualized clinical decisions related to the intensity of treatment recovery support services that an individual needs.

The present study also emphasizes the benefits of using strength-based measures (i.e., the REC-CAP assessment tool) to evaluate recovery interventions. It can help identify populations at high-risk of premature service disengagement and adverse post-treatment outcomes. This knowledge can inform the design and delivery of peer-based recovery support services via recovery coaches, guides, and mentors. Studies have yet to be conducted on individualized assessment to determine differences in the intensity and duration of such support across individuals and special populations. The findings of this study suggest the potential value in such a determination; however, this study has limitations that should be addressed. Although we created weighting to derive a balanced counterfactual group compared to intervention through quasi-experimentation of a pilot program, we note the need for a randomized controlled trial with a larger sample of individuals receiving IRS for conclusive results. Despite this, the study uses innovative methods and serves as a foundation for a more systematic assessment of the impact of intensive support on both retention and recovery capital building in recovery residences.

Author contributions

Matthew J. Belanger: Writing - Original Draft, Writing - Review & Editing, Formal Analysis, Visualization Preparation. **Arun Sondhi:** Methodology, Formal Analysis, Writing - Review & Editing. **Amy A. Mericle:** Conceptualization, Writing - Review & Editing. **Alessandro Leidi:** Methodology, Formal Analysis. **Maik Klein:** Writing - Review & Editing. **Beth Collinson:** Writing - Review & Editing. **David Patton:** Writing - Review & Editing. **William White:** Writing - Review & Editing. **Hao Chen:** Writing - Review & Editing. **Anthony Grimes:** Resources, Data Curation. **Matthew Conner:** Resources, Data Curation. **Bob De Triquet:** Resources, Data Curation. **David Best:** Conceptualization, Supervision, Project Administration, Funding Acquisition, Writing - Review & Editing.

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Declaration of competing interest

All authors declare no financial or non-financial competing interests.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.josat.2023.209283>.

References

Austin, P. C., & Stuart, E. A. (2015). Moving towards best practice when using inverse probability of treatment weighting (IPTW) using the propensity score to estimate causal treatment effects in observational studies. *Statistics in Medicine*, 34(28), 3661–3679.

- Baird, A., Cheng, Y., & Xia, Y. (2022). Use of machine learning to examine disparities in completion of substance use disorder treatment. *PLoS One*, 17(9), Article e0275054. <https://doi.org/10.1371/journal.pone.0275054>
- Best, D., Beckwith, M., Haslam, C., Alexander Haslam, S., Jetten, J., Mawson, E., & Lubman, D. I. (2016). Overcoming alcohol and other drug addiction as a process of social identity transition: The social identity model of recovery (SIMOR). *Addiction Research & Theory*, 24(2), 111–123. <https://doi.org/10.3109/16066359.2015.1075980>
- Best, D., Irving, J., Collinson, B., Andersson, C., & Edwards, M. (2017). Recovery networks and community connections: Identifying connection needs and community linkage opportunities in early recovery populations. *Alcoholism Treatment Quarterly*, 35(1), 2–15. <https://doi.org/10.1080/07347324.2016.1256718>
- Best, D., Sondhi, A., Best, J., Lehman, J., Grimes, A., Conner, M., & DeTriquet, R. (2023). Using recovery capital to predict retention and change in recovery residences in Virginia, USA. *Alcoholism Treatment Quarterly*, 1–13. <https://doi.org/10.1080/07347324.2023.2182246>
- Cano, I., Best, D., Edwards, M., & Lehman, J. (2017). Recovery capital pathways: Modelling the components of recovery wellbeing. *Drug and Alcohol Dependence*, 181, 11–19. <https://doi.org/10.1016/j.drugalcdep.2017.09.002>
- Cloud, W., & Granfield, R. (2008). Conceptualizing recovery capital: Expansion of a theoretical construct. *Substance Use & Misuse*, 43(12–13), 1971–1986.
- De Leon, G., Melnick, G., & Cleland, C. M. (2008). Client matching: A severity-treatment intensity paradigm. *Journal of Addictive Diseases*, 27(3), 99–113. <https://doi.org/10.1080/10550880802122703>
- Evans, E., Huang, D., & Hser, Y.-I. (2011). High-risk offenders participating in court-supervised substance abuse treatment: Characteristics, treatment received, and factors associated with recidivism. *The Journal of Behavioral Health Services & Research*, 38(4), 510–525. <https://doi.org/10.1007/s11414-011-9241-3>
- Faries, D. E., & Kadziola, Z. A. (2010). Analysis of longitudinal observational data using marginal structural models. In 211. *Analysis of observational health care data using SAS*.
- Godley, M. D., Godley, S. H., Dennis, M. L., Funk, R. R., & Passetti, L. L. (2007). The effect of assertive continuing care on continuing care linkage, adherence and abstinence following residential treatment for adolescents with substance use disorders. *Addiction*, 102(1), 81–93. <https://doi.org/10.1111/j.1360-0443.2006.01648.x>
- Groshkova, T., Best, D., & White, W. (2013). The assessment of recovery capital: Properties and psychometrics of a measure of addiction recovery strengths: Assessment of recovery capital. *Drug and Alcohol Review*, 32(2), 187–194. <https://doi.org/10.1111/j.1465-3362.2012.00489.x>
- Härd, S., Best, D., Sondhi, A., Lehman, J., & Riccardi, R. (2022). The growth of recovery capital in clients of recovery residences in Florida, USA: A quantitative pilot study of changes in REC-CAP profile scores. *Substance Abuse Treatment, Prevention, and Policy*, 17(1), 58.
- Hennessy, E. A. (2017). Recovery capital: A systematic review of the literature. *Addiction Research & Theory*, 25(5), 349–360. <https://doi.org/10.1080/16066359.2017.1297990>
- Hernán, M. A., & Robins, J. M. (2020). Causal inference—What if. https://www.hsph.harvard.edu/wp-content/uploads/sites/1268/2020/02/ci_hernanrobins_21feb20.pdf.
- Hser, Y.-I., Evans, E., Huang, D., & Anglin, D. M. (2004). Relationship between drug treatment services, retention, and outcomes. *Psychiatric Services*, 55(7), 767–774. <https://doi.org/10.1176/appi.ps.55.7.767>
- Imai, K., & Ratkovic, M. (2014). Covariate balancing propensity score. *Journal of the Royal Statistical Society: Series B: Statistical Methodology*, 243–263.
- Jason, L. A., & Ferrari, J. R. (2010). Oxford house recovery homes: Characteristics and effectiveness. *Psychological Services*, 7(2), 92–102. <https://doi.org/10.1037/a0017932>
- Kornfield, R., Sarma, P., Shah, D., McTavish, F., Landucci, G., Pe-Romashko, K., & Gustafson, D. (2018). Detecting recovery problems just in time: Application of automated linguistic analysis and supervised machine learning to an online substance abuse forum. *Journal of Medical Internet Research*, 20(6). <https://doi.org/10.2196/10136>
- Lang, T., & Altman, D. (2013). Basic statistical reporting for articles published in clinical medical journals: The SAMPL guidelines. In *Science Editors' Handbook, European Association of Science Editors* (pp. 1–9).
- Manning, V., Best, D., Faulkner, N., Titherington, E., Morinan, A., Kearney, F., ... Strang, J. (2012). Does active referral by a doctor or 12-step peer improve 12-step meeting attendance? Results from a pilot randomised control trial. *Drug and Alcohol Dependence*, 126(1–2), 131–137. <https://doi.org/10.1016/j.drugalcdep.2012.05.004>
- McKnight, J., & Block, P. (2011). *The abundant community: Awakening the power of families and neighborhoods*. ReadHowYouWant. com.
- Mericle, A. A., Mahoney, E., Korch, R., Delucchi, K., & Polcin, D. L. (2019). Sober living house characteristics: A multilevel analyses of factors associated with improved outcomes. *Journal of Substance Abuse Treatment*, 98, 28–38. <https://doi.org/10.1016/j.josat.2018.12.004>
- National Alliance for Recovery Residences. (2018). NARR Standard 3.0. https://narronline.org/wp-content/uploads/2018/11/NARR_Standard_V.3.0_release_11-2018.pdf
- Naughton, F., Brown, C., High, J., Notley, C., Mascolo, C., Coleman, T., ... Hope, A. (2021). Randomised controlled trial of a just-in-time adaptive intervention (JITAI) smoking cessation smartphone app: The quit sense feasibility trial protocol. *BMJ Open*, 11(4), Article e048204. <https://doi.org/10.1136/bmjopen-2020-048204>
- Polcin, D. L., & Henderson, D. M. (2008). A clean and sober place to live: Philosophy, structure, and purported therapeutic factors in sober living houses. *Journal of Psychoactive Drugs*, 40(2), 153–159. <https://doi.org/10.1080/02791072.2008.10400625>

- Polcin, D. L., Korch, R., Bond, J., & Galloway, G. (2010). What did we learn from our study on sober living houses and where do we go from here? *Journal of Psychoactive Drugs*, 42(4), 425–433.
- Polcin, D. L., Korch, R., Witbrodt, J., Mericle, A. A., & Mahoney, E. (2018). Motivational interviewing case management (MICM) for persons on probation or parole entering sober living houses. *Criminal Justice and Behavior*, 45(11), 1634–1659. <https://doi.org/10.1177/0093854818784099>
- Polcin, D. L., Mahoney, E., Witbrodt, J., & Mericle, A. A. (2021). Recovery home environment characteristics associated with recovery capital. *Journal of Drug Issues*, 51(2), 253–267. <https://doi.org/10.1177/0022042620978393>
- Reif, S., George, P., Braude, L., Dougherty, R. H., Daniels, A. S., Ghose, S. S., & Delphin-Rittmon, M. E. (2014). Recovery housing: Assessing the evidence. *Psychiatric Services*, 65(3), 295–300. <https://doi.org/10.1176/appi.ps.201300243>
- Timko, C., DeBenedetti, A., & Billow, R. (2006). Intensive referral to 12-step self-help groups and 6-month substance use disorder outcomes. *Addiction*, 101(5), 678–688.
- Volkow, N. D. (2011). *Principles of drug addiction treatment: A research-based guide*. DIANE Publishing.
- White, W. (2008). *Recovery management and recovery-oriented systems of care*.
- White, W. L. (2007). Addiction recovery: Its definition and conceptual boundaries. *Journal of Substance Abuse Treatment*, 33(3), 229–241. <https://doi.org/10.1016/j.jsat.2007.04.015>
- Witbrodt, J., Polcin, D., Korch, R., & Li, L. (2019). Beneficial effects of motivational interviewing case management: A latent class analysis of recovery capital among sober living residents with criminal justice involvement. *Drug and Alcohol Dependence*, 200, 124–132. <https://doi.org/10.1016/j.drugalcdep.2019.03.017>