



# HHS Public Access

Author manuscript

*J Subst Abuse Treat.* Author manuscript; available in PMC 2022 August 01.

Published in final edited form as:

*J Subst Abuse Treat.* 2021 August ; 127: 108367. doi:10.1016/j.jsat.2021.108367.

## The role of social network support in treatment outcomes for medication for opioid use disorder: A systematic review

Navin Kumar<sup>a,\*</sup>, William Oles<sup>b</sup>, Benjamin A. Howell<sup>c</sup>, Kamila Janmohamed<sup>b</sup>, Selena T. Lee<sup>b</sup>, Melissa C. Funaro<sup>d</sup>, Patrick G. O'Connor<sup>e</sup>, Marcus Alexander<sup>b,f</sup>

<sup>a</sup>Department of Sociology and Yale Institute for Network Science, Yale University, 17 Hillhouse Ave, New Haven, CT 06520, United States of America

<sup>b</sup>Yale Institute for Network Science, Yale University, United States of America

<sup>c</sup>National Clinician Scholars Program and Section of General Internal Medicine, Yale University School of Medicine and Yale-New Haven Hospital, and VA Connecticut Healthcare System, United States of America

<sup>d</sup>Harvey Cushing/John Hay Whitney Medical Library, Yale University, United States of America

<sup>e</sup>Section of Internal Medicine, Yale University School of Medicine and Yale-New Haven Hospital, United States of America

<sup>f</sup>Frank H. Netter MD School of Medicine, United States of America

### Abstract

**Background:** Social connections can lead to contagion of healthy behaviors. Successful treatment of patients with opioid use disorder may lay in rebuilding social networks. Strong social networks of support can reinforce the benefits of medication treatments that are the current standard of care and the most effective tool physicians have to fight the opioid epidemic.

**Methods:** The research team conducted a systematic review of electronic research databases, specialist journals and grey literature up to August 2020 to identify randomized controlled trials of social network support in patient populations receiving medication for opioid use disorder (MOUD). The research team placed the studies into a framework of dynamic social networks, examining the role of networks before MOUD treatment is initiated, during the treatment, and in

\*Corresponding author. navin.kumar@yale.edu (N. Kumar).

<sup>1</sup>Human Nature Lab.

CRedit authorship contribution statement

Navin Kumar: Conceptualization, Methodology, Software, Data curation, Writing- Original draft preparation.

William Oles: Conceptualization, Methodology, Software, Data curation, Writing- Original draft preparation.

Benjamin A. Howell: Conceptualization, Methodology, Software, Data curation, Writing- Original draft preparation.

Kamila Janmohamed: Conceptualization, Methodology, Software, Data curation, Writing- Original draft preparation.

Selena T. Lee: Conceptualization, Methodology, Software, Data curation, Writing- Original draft preparation.

Melissa C. Funaro: Conceptualization, Methodology, Software, Data curation, Writing- Original draft preparation.

Patrick G. O'Connor: Conceptualization, Methodology, Software, Data curation, Writing- Original draft preparation.

Marcus Alexander: Conceptualization, Methodology, Software, Data curation, Writing- Original draft preparation.

Declaration of competing interest

The authors have declared no competing interest.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jsat.2021.108367>.

the long-term following the treatment. The research team analyzed the results across three sources of social network support: partner relationships, family, and peer networks.

**Results:** Of 5193 articles screened, eight studies were identified as meeting inclusion criteria. Five studies indicated that social network support had a statistically significant effect on improved MOUD treatment outcomes. We find the strongest support for the positive impact of family social network support.

**Conclusions:** Social networks significantly shape effectiveness of opioid use disorder treatments. While negative social ties reinforce addiction, positive social support networks can amplify the benefits of medication treatments. Targeted interventions to improve treatment outcomes can be designed and added to MOUD treatment with their effects evaluated in improving patients' odds of recovery from opioid use disorder and reversing the rising trend in opioid deaths.

### Keywords

Medication-assisted treatment; Opioid use disorder; Social network; Social support; Treatment access

---

## 1. Introduction

Increasing access to medication for opioid use disorder (MOUD) treatment programs is a key public health strategy in combating the opioid overdose epidemic (Crowley et al., 2017; Murthy, 2016). MOUD has shown several benefits such as decreases in mortality, increases in treatment adherence, decreases in heroin use, and augmented health, social and criminal justice outcomes (Gowing et al., 2008; Mattick et al., 2009; Tilson et al., 2007). MOUD refers to several medications, primarily opioid-agonist medications, like methadone and buprenorphine, and opioid-antagonist medications, like naltrexone (Hedrich et al., 2012). Although MOUD approaches are the most efficacious evidence-based treatment for opioid use disorder (Fanucchi et al., 2019), a significant number of MOUD patients do not have favorable treatment outcomes (Burns et al., 2015; Feelemyer et al., 2014), signaling the need to explore factors beyond medication that might affect treatment outcomes. Overall, less research has focused on how patients' social environments and social networks are associated with treatment outcomes.

Phenomena as diverse as cooperation, obesity, drug use, smoking, and alcohol use are associated with social network structure (Christakis & Fowler, 2008; Fowler & Christakis, 2010; Kim et al., 2015; Shakya et al., 2017). For example, changes in the alcohol consumption behavior of a person's social network had a statistically significant effect on that person's subsequent alcohol consumption behavior (Rosenquist et al., 2010), and an increase in the proportion of adolescent classmates who drink will increase the likelihood of drinking participation and frequency (Ali & Dwyer, 2010). Social network support-based randomized controlled trials (RCTs) also indicate improving one's level of social network support can increase the number of abstinent days for individuals with alcohol use disorder (Litt et al., 2016). Regarding smoking, a 30-year longitudinal study indicated that smoking behavior spreads through close and distant social ties, and that groups of interconnected

people often stop smoking in concert (Christakis & Fowler, 2008). Also, greater social network support was associated with higher levels of nicotine patch adherence among HIV+ smokers (de Dios et al., 2016). Similarly, a social network support RCT to reduce family members' smoking was effective at increasing self-reported abstinence (Chan et al., 2017). These studies suggest the importance of social network support in improving substance use outcomes. The insights from such studies suggest that augmenting or manipulating social network support among opioid use disorder patients could improve treatment outcomes. However, limited research has been extended to patients with opioid use disorder on the role of social network support on MOUD treatment outcomes, especially on the changes in such networks over the treatment timeline, perhaps due to stigma and institutional barriers (Grella et al., 2020). Previous systematic reviews have detailed psychosocial interventions that complement MOUD (Brown, 2018; Dugosh et al., 2016; Dutra et al., 2008) and the effectiveness of psychosocial plus pharmacological intervention versus pharmacological intervention alone (Amato et al., 2011). However, only a small subset of psychosocial interventions, such as family counseling or network therapy, actively involve patient social relationships in treatment (Moran et al., 2019).

The purpose of the paper is to review existing RCTs on the following research question: For MOUD patients, what role does social network support, or lack thereof, have on MOUD treatment outcomes? Social support was operationalized as documented instrumental behaviors intended to support MOUD treatment (positive), or behaviors intended to undermine such treatment (negative). These behaviors could include comments, advice, providing reassurance, attention, modeling, etc. The review sought to provide policymakers, administrators, practitioners and researchers with a systematic and reproducible strategy to query the literature around the role of social network support on MOUD treatment outcomes.

## 2. Methods

The research team conformed to frameworks and standard tools of the Preferred Reporting Items for Systematic Review and Meta-analysis Protocols (PRISMA-P) (Higgins & Green, 2011; Liberati et al., 2009; Moher et al., 2015) and Synthesis without meta-analysis (SWiM) guidelines (Campbell et al., 2020). The protocol was pre-registered on PROSPERO (CRD42018095645) on May 24, 2018.

### 2.1. Search strategy

A systematic search of the literature was performed on August 30, 2018 and updated on August 3, 2020 to capture any new studies. Databases searched included Ovid MEDLINE, Embase, APA Psycinfo, and Sociological Abstracts. A medical librarian (MF) consulted on methodology and ran a medical subject heading (MeSH) analysis of known key articles provided by the research team [[mesh.med.yale.edu](http://mesh.med.yale.edu)]. In each database, scoping searches were used alongside an iterative process to translate and refine the searches. To maximize sensitivity, the formal search used a minimal controlled vocabulary terms and synonymous free-text words to capture concepts for “social network support” and “medication for opioid use disorder” (see the Appendix for full list of search terms). The search was limited to

English language. No date limit was applied. In addition, the authors searched references in previous reviews/guidelines, and [clinicaltrials.gov](https://clinicaltrials.gov).

**2.1.1. Inclusion/exclusion criteria**—Studies that met the following criteria were included:

- randomized controlled trials published in peer-reviewed journals; other scientific publications (e.g., scientific monographs); non-peer reviewed journals and grey literature (technical reports, conference papers). Studies excluded from review were observational studies, quasi-experimental studies, case reports, systematic literature reviews, qualitative studies, opinion pieces, editorials, comments, news articles, and letters.
- participants sought treatment for opioid use or met criteria for opioid use disorder.
- one or more variants of MOUD were offered (e.g., methadone, buprenorphine, naltrexone).
- the study reported social network support (e.g., family/partner/peer support, social network interventions (Huberman et al., 2008; Pearson, 1986)) as interventions.
- the study reported a form of adherence to MOUD as an outcome (e.g., medication adherence, concurrent abstinence during treatment, program retention).
- the study did not exclusively look at peer support groups (e.g., Narcotics Anonymous) or group psychotherapy as a form of social support. Studies involving peer support group attendance as a form of treatment are both numerous and valuable and are therefore significant enough to be deserving of their own review.

## 2.2. Category assignment

Studies were assigned into the following categories based on when social network support was assessed: pre-treatment, during treatment, and post-treatment. These categories refer to when the assessment was first administered in the study as social network support was assessed at multiple time points in some studies. Pre-treatment indicated studies where social network support was assessed at baseline, before patients commenced an MOUD program. During treatment connoted studies where social network support was assessed while participants were actively participating in an MOUD program. Post-treatment denoted studies where social network support was determined after patients had completed the prescribed MOUD program. The intention of the abovementioned categorization was to investigate whether the presence or lack of social support seems to be more important at a certain point in the treatment timeline and, more generally, whether there are gaps in the literature at particular points of the timeline.

Studies were assigned to one of the following social network support categories: family, partner, peer. Multiple forms of social network support were assessed in some studies.

In general, studies that explored partner relationships were often classified as assessing family relationships as well, so the classification results have significant overlap. Family social network support connoted studies where family members such as parents, siblings, or children provided support to the patient. Partner social network support denoted studies where partners, married or otherwise, provided support to the patient. Peer social network support denoted studies where peers such as friends, colleagues or other patients provided support. Studies which solely assessed the impact of mutual peer support groups (e.g., Narcotics Anonymous, Alcoholics Anonymous) or group psychotherapy were excluded. The research team acknowledges the importance of such programs and the wealth of literature on their potential efficacy, and therefore believe that they warrant their own review. It should be noted that some studies describe general family relationships, which may be inherently inclusive of a partner; therefore, any studies which noted general family relationships were assumed to assess both family and partner relationships in our category assignment. Studies were also assigned as assessing either negative or positive social network support. Some studies assessed both positive and negative social network relationships.

### 2.3. Outcomes

Examples of primary outcomes were 1) MOUD retention which refers to time in treatment or length of stay; 2) MOUD adherence which pertains to medication (days the patient took their MOUD etc.); 3) opioid or other illicit drug use (cocaine, methamphetamine etc.), defined as the percentage of urine samples negative for opioids and/or self-reported drug use.

### 2.4. Data extraction, review methods, quality assessments and data synthesis

A standardized template was utilized to extract data from each study. More detail on data extraction, review methods, quality assessments and data synthesis can be found in the Appendix.

## 3. Results

### 3.1. Included studies

Results from the study selection process are indicated in Fig. 1 and general study characteristics are displayed in Table 1 (see Appendix for more detail). Systematic searches yielded 7995 papers imported for screening, with 5193 studies screened for review (2802 duplicates, see Fig. 1). Screening yielded 225 articles for full-text review by two independent reviewers. Eight RCTs were deemed relevant to the review, summarized in Table 1. Five studies indicated that at least one variant of social network support assessed in the study had a statistically significant causal relationship with MOUD treatment outcomes. Two studies assessed social network support pre-treatment, eight during treatment, and two post-treatment. Six studies detailed family social network support, seven indicated partner support, and two explored peer social network support. The United States (four studies) was the most represented nation. Treatment and comparison groups were all drawn from patients with opioid use disorder. Five interventions involved methadone, two involved naltrexone, and one involved methadone or buprenorphine. Studies described in the results section

were ones with large effect sizes or had novel interventions. Effect sizes (Cohen's *d*) were provided where available and we prioritized opioid-related outcomes (see Table 3).

### 3.2. Quality assessments

Table 2 indicated study quality. Allocation concealment was rarely reported and its impact on bias was not clear. Relevant evidence and statistical significance (see Fig. 2) were indicated with a harvest plot (Crowther et al., 2011). No studies met all five criteria. One study met four criteria and the remaining met between one and three criteria.

### 3.3. Pre-treatment

Studies characterized as assessing social network characteristics pretreatment were often studies which gathered baseline survey information about their participants, typically at treatment initiation. Information at this point in the treatment timeline is of particular importance for two reasons: first, because it reveals patterns in the social network composition of individuals entering MOUD programs, and second, because levels of support at treatment initiation may be predictive of treatment success at later time points. Two studies assessed participant social network support pre-treatment. Both studies indicated that social network support had an effect on MOUD treatment outcomes.

**3.3.1. Family social network support**—A single study demonstrated that family social network support pretreatment improved treatment outcomes (Fals-Stewart & O'Farrell, 2003). Men ( $N = 124$ ) entering treatment for opioid use disorder who were living with a family member were randomly assigned to one of two 24-week treatments: behavioral family counseling (BFC) and individual treatment or individual-based treatment only (IBT; patients were given naltrexone, but there was no family involvement). BFC patients, compared with their IBT counterparts, used more naltrexone, had more days abstinent from opioids and other drugs during treatment and during the year after treatment.

**3.3.2. Partner social network support**—Two studies demonstrated that partner social network support pretreatment improved treatment outcomes. One study used Behavioral Couples Therapy with partners using positive reinforcement of abstinence (Fals-Stewart et al., 2001). The study found that patients in the couples therapy condition ( $N = 19$ ) had fewer positive urine tests during treatment compared to people in the individual therapy condition ( $N = 17$ ).

### 3.4. During treatment

Studies characterized as assessing social network support during treatment were either ones that gathered self-report information about participant social ties after treatment had already begun or studies that actively involved participant social ties in treatment. All studies inherently had at least one during-treatment component to be included in the review. Eight studies assessed participant social network support during treatment. Five studies indicated that during-treatment-assessed social network support affected MOUD treatment outcomes.

**3.4.1. Family social network support**—Four out of six studies exploring family social network support during treatment demonstrated a statistically significant effect on

treatment outcomes (Carroll et al., 2001; Catalano et al., 1999; Day et al., 2018; Fals-Stewart & O'Farrell, 2003; Gu et al., 2013; Yandoli et al., 2002). One study ( $N=119$ ) explored the efficacy of family therapy versus standard treatment involving methadone and individual counseling, finding that there was a significantly larger number of drug-free participants in the treatment group at both 6- and 12-month follow-ups (Yandoli et al., 2002). Family support included attendance in biweekly therapy sessions which emphasized rebuilding relationships and methadone reduction. Another study randomly employed Brief Social Behavior and Network Therapy—which allowed MOUD patients to map their social network of significant others and invite them to treatment sessions—found no significant difference in number of days abstinent from heroin between the treatment group ( $N=26$ ), control ( $N=30$ ), and individual therapy groups ( $N=27$ ) at three or 12 month follow-ups (Day et al., 2018).

**3.4.2. Partner social network support**—Four of seven studies exploring partner social network support during treatment noted a significant causal relationship with treatment outcomes. In general, studies which explored partner relationships were often classified as assessing family relationships, so the classification results have significant overlap. Two studies looked specifically at the impact of partner-specific involvement in treatment. One study employed Behavioral Couples Therapy centered around partners practicing positive reinforcement of abstinence, finding that individuals in the couples therapy condition ( $N=19$ ) had fewer positive urine screens during treatment than people in the individual therapy condition ( $N=17$ ) (Fals-Stewart et al., 2001). Another study ( $N=48$ ) utilized an intervention to educate spouses about a harm reduction approach and found no significant difference in retention at one month or six months (Hojjat et al., 2017).

**3.4.3. Peer social network support**—None of the two studies which explored peer social support during treatment found a significant causal relationship with treatment outcomes.

### 3.5. Post-treatment

Studies characterized as assessing social network support Post-treatment were individuals that elicited information from study participants with a follow-up that lasted beyond the end of treatment termination. One study indicated that post-treatment-assessed social network support had an effect on MOUD treatment outcomes, while the other study found no relationship.

**3.5.1. Family social network support**—Both post-treatment studies explored at least one form of family social ties. In one study, parents in MOUD were randomly assigned to the Focus on Families intervention—a curriculum that combines parent skills training and home-based case management—and given a follow-up interview within a month of the program termination. Parents in the intervention group ( $N=82$ ) had a lower frequency of opiate use at follow-up compared to the control group ( $N=62$ ) (Catalano et al., 1999).

**3.5.2. Partner social network support**—Two post-treatment studies assessed partner social support, with one reporting a statistically significant result. The study included a

randomly assigned Behavioral Family Counseling component of which a high proportion of participants completed with their partner, and also elicited post-treatment information of participants at a one-year follow-up. Both the treatment and control groups in the study saw significant decreases in percentage of days abstinent and length of continuous abstinence that year (Fals-Stewart & O'Farrell, 2003).

**3.5.3. Peer social network support**—One study assessed peer social network support but did not demonstrate statistically significant results (Day et al., 2018).

### 3.6. Negative and positive social connections

Seven studies investigated positive social network support, two studies investigated negative social network ties, and one study investigated both positive and negative social ties (note overlap in classifications). Of the studies that assessed an aspect of positive social support, five included family ties, seven included partner ties, and two included peer ties. Of the studies that assessed an aspect of negative social ties, one included family ties, one included partner ties, and one included peer ties (see table in Appendix).

### 3.7. Synthesis

Table 3 synthesized included studies and indicated if there were statistically significant findings or no effect. Effect sizes were generally medium. Table 3 also indicated whether biases may have understated or over-reported treatment effects, if any. Evidence was not consistent for all points at which social network support was assessed, although studies overall indicated that social network support, or lack thereof, was statistically significantly associated with MOUD treatment outcomes. The above information was derived from Tables 1 and 2. Bias was considered likely to understate positive outcomes in no studies, to exaggerate in two and unclear in the remaining studies. The most common source of bias was lack of intent-to-treat analysis.

## 4. Discussion

The presented systematic review represents the current body of knowledge on the role of social network support and social network ties on MOUD treatment outcomes. Results generally support the idea that social network ties have an effect on MOUD treatment outcomes.

Results suggested that MOUD outcomes were generally improved using social network support interventions. Despite the wide body of work on the efficacy of administering psychosocial interventions in addition to pharmacological treatment, and the numerous reviews to in this regard (Brown, 2018; Dugosh et al., 2016; Dutra et al., 2008), there is very little work looking into psychosocial interventions which specifically involve significant others in patient networks. While one study utilized network mapping methods to identify others to participate in therapy (Day et al., 2018), the most prominent positive effects of interventions involving network members seemed to be relationship-specific, such as couples therapy between partners (Fals-Stewart et al., 2001; Yandoli et al., 2002) or parent skills training between parents and children (Catalano et al., 1999).



While the results of our review did not decisively indicate whether a particular social network relationship was inherently important, the evidence base for family social network support appears the most significant. More generally, many of the studies reviewed here reveal that characteristics of relationships, and not the particular types of relationships, may be the most important aspects of social ties during treatment. For example, evidence from several studies across different time points suggests that, regardless of the type of relationship, having and maintaining social ties during treatment that are non-judgmental of MOUD or abstinence-positive (Catalano et al., 1999; Hojjat et al., 2017; Yandoli et al., 2002) or that are mutually non-substance-using (Fals-Stewart & O'Farrell, 2003) is positively associated with successful treatment outcomes.

Our findings are of great relevance given the current gap in understanding of MOUD treatment outcomes, and particularly problems raised by rates of high attrition and high illicit substance use concurrent with treatment. The results presented here suggest that social network information can be utilized to personalize existing interventions or to innovate new approaches. With psychosocial interventions that supplement pharmacological treatment becoming the norm in combating opioid use disorder, it is critical that researchers develop the most efficacious MOUD interventions. The current review also provides wider policy implications. Governments and public health authorities seeking to improve treatment outcomes might incorporate successful, network-targeting MOUD interventions noted in our review. Public health authorities can encourage treatment providers to explore social network support or other similar techniques to augment MOUD. Such agencies might also incentivize treatment providers to include different forms of social network support in their programs to determine which is most efficacious and simultaneously build upon the research base of network support in MOUD approaches. Similarly, in absence of a large evidence base for social network support-based MOUD approaches, treatment providers with generic approaches (i.e., without any form of behavioral/psychosocial intervention) might informally encourage patients to seek social support from their family, friends or peers.

The research team noted the limited number of studies involving social network support around MOUD treatment outcomes compared to similar work in improving other substance use disorder outcomes (e.g. alcohol use disorder and tobacco use disorder). Moreover, when the research team details kinds of social ties that seem to have emerged in our review, the research team notes that the research on other substance use disorders have established far more prescriptive social network support RCTs to improve treatment outcomes. The research team suggests that insights from social network support RCTs around other substance use disorders be used to design RCTs for augmenting MOUD outcomes. For example, the alcohol use disorder literature has examples of network support interventions that have shown advantages for some persons (Litt et al., 2016), and in particular highlight the influence of non-using close friends (models for non-use) and for behavioral support for abstinence. An included study (Catalano et al., 1999) highlighted the complexities in working with parents who both have opioid use disorder, and the alcohol use disorder literature may have relevant insights, such as studying partners in which one does not have a substance use disorder (McAweeney et al., 2005). Similarly, included studies (Carroll et al., 2001) demonstrated that significant other support added little to contingency management, perhaps indicating the difficulties around patient participation (Day et al., 2018; Hojjat et

al., 2017) - an issue detailed in the alcohol use disorder literature (Pedersen et al., 2011; Thomson et al., 2008). Future work can also detail means to reduce barriers in conducting social network support RCTs around MOUD outcomes.

The research team also notes that some studies did not indicate a significant effect for social network support in improving MOUD treatment outcomes, and that effect sizes were variable. Such studies may suggest that certain social network support interventions are ineffective or require more research. The number of studies not reporting statistically significant outcomes, and variable effect sizes may be due to variable study quality with most of the studies having key methodological concerns. The research team emphasized more robust study designs (RCTs) and assessed the probable impact of bias to compensate for methodological weaknesses. Possible sources of bias included group baseline differences, selection bias, attrition bias, and differential rates of follow-up. Selection bias may have exaggerated or under-reported treatment effects. If rates of attrition were relatively high or greater in untreated groups, there may be a possibility that treatment effects were overestimated if participants lost to follow-up had greater negative outcomes. A few studies in the review conducted analysis to control for bias through multivariate analysis and/or comparison of losses to follow-up with individuals followed-up. Attempts to account for biases may not always be successful, and the research team thus assessed the risk of biases (see Table 2), providing an assessment of probable impact of bias on various outcomes.

Limitations also arose from differences in methods of reviewed studies, making it more complex to assess or synthesize all studies under the same rubric, making a meta-analysis of studies not possible. The details provided on methods and analysis was highly varied, possibly leading to fluctuations in the confidence level of results. The research team noted that some studies (Catalano et al., 1999; Day et al., 2018; Hojjat et al., 2017) used non-objective measures of substance use (e.g. self-report) and not urinalysis testing, and did not administer measures of social support (Catalano et al., 1999), further impacting quality of findings. An author of two of the included studies (Fals-Stewart et al., 2001; Fals-Stewart & O'Farrell, 2003) has been accused of ethical concerns (Heisel, 2010), affecting veracity of results. Finally, there were limitations in our classification method that arose from the high variability between study methods and analysis. Additionally, peer relationships in particular were limited by definition in our review, often unspecified or generally specified as friends. Future studies might aim to assess 'weak' peer ties, such as co-workers, employers, or clinic care providers.

#### 4.1. Conclusions

Although evidence was mixed, social network support measured across various points in the treatment timeline generally improved MOUD treatment outcomes, with preliminary findings showing some promise for the subset of patients choosing to engage in a social network-oriented approach. Interventions around social network support could potentially augment MOUD treatment outcomes, possibly playing a role in mitigating the current opioid epidemic. Future research should explore social network changes across the treatment timeline and leverage patterns in the changes to address obstacles to MOUD success.

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

## Acknowledgement and funding statement

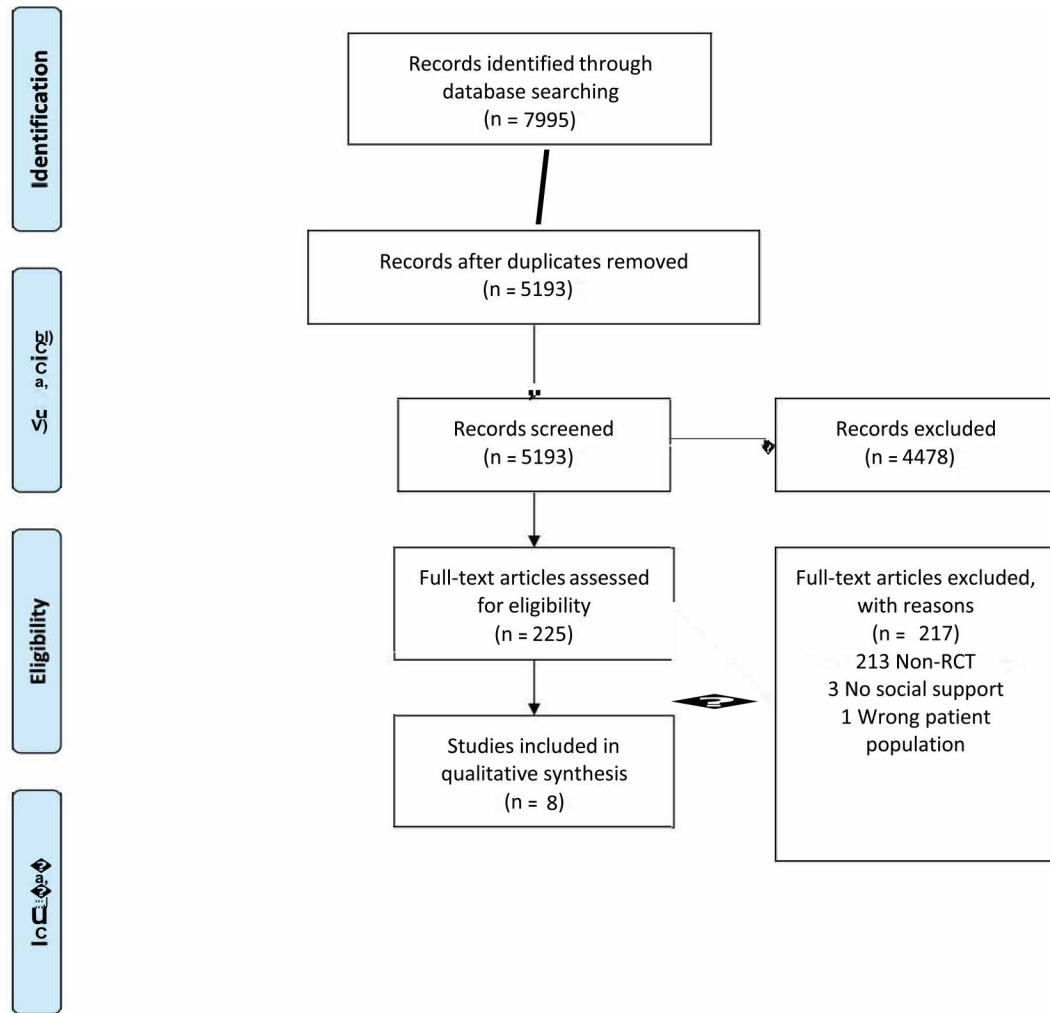
We thank Nicholas A Christakis, the reviewers and editors for their suggestions. Study was funded by Institution for Social and Policy Studies - Yale University, and The Horowitz Foundation for Social Policy.

## References

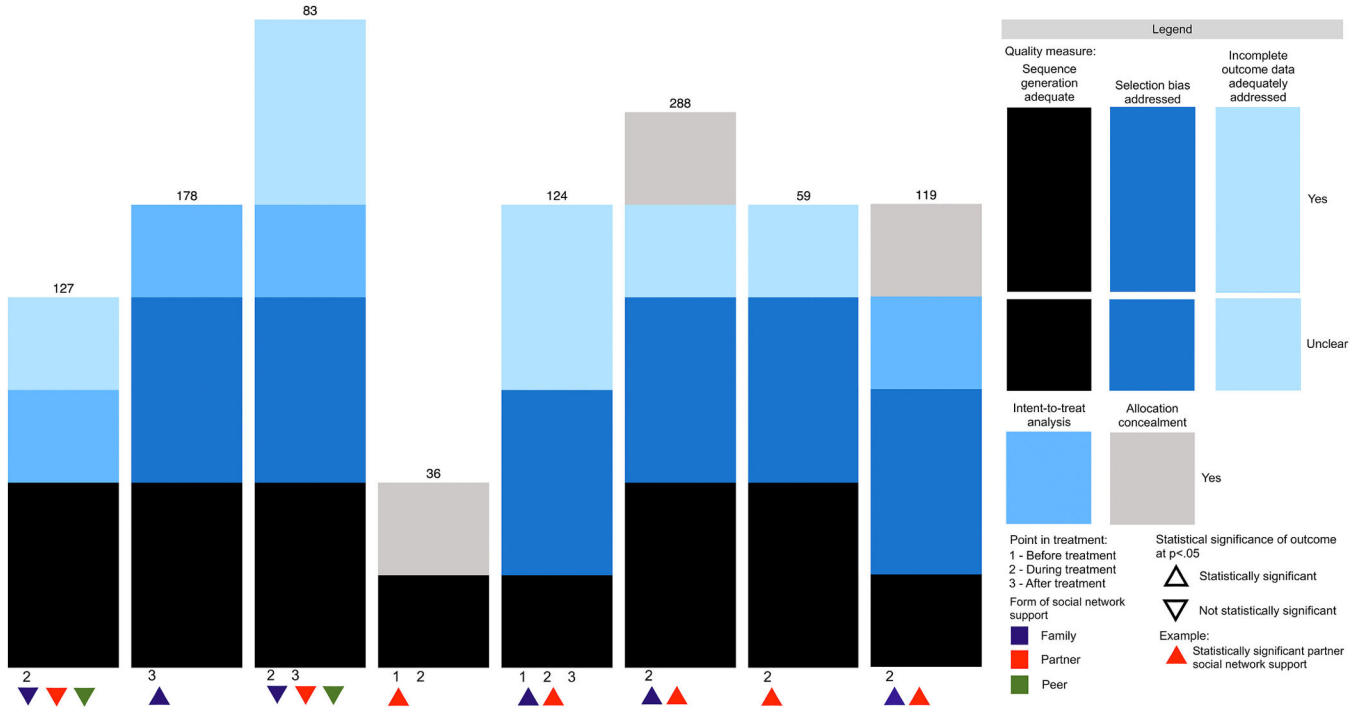
- Ali MM, & Dwyer DS (2010). Social network effects in alcohol consumption among adolescents. *Addictive Behaviors*, 35(4), 337–342. [PubMed: 20051311]
- Amato L, Minozzi S, Davoli M, & Vecchi S (2011). Psychosocial and pharmacological treatments versus pharmacological treatments for opioid detoxification. *Cochrane Database of Systematic Reviews*, 9.
- Brown AR (2018). A systematic review of psychosocial interventions in treatment of opioid addiction. *Journal of Social Work Practice in the Addictions*, 18(3), 249–269.
- Burns L, Gisev N, Larney S, Dobbins T, Gibson A, Kimber J, ... Degenhardt L (2015). A longitudinal comparison of retention in buprenorphine and methadone treatment for opioid dependence in new south wales, Australia. *Addiction*, 110(4), 646–655. [PubMed: 25516077]
- Campbell M, McKenzie JE, Sowden A, Katikireddi SV, Brennan SE, Ellis S, ... others. (2020). Synthesis without meta-analysis (swim) in systematic reviews: reporting guideline. *bmj*, 368.
- Carroll KM, Ball SA, Nich C, O'Connor PG, Eagan DA, Frankforter TL, ... Rounsaville BJ (2001). Targeting behavioral therapies to enhance naltrexone treatment of opioid dependence: Efficacy of contingency management and significant other involvement. *Archives of General Psychiatry*, 58(8), 755–761. Retrieved from <http://ovidsp.ovid.com/ovidweb.cgi?T=JS&CSC=Y&NEWS=N&PAGE=fulltext&D=med4&AN=11483141>. [PubMed: 11483141]
- Catalano RF, Gainey RR, Fleming CB, Haggerty KP, & Johnson NO (1999). An experimental intervention with families of substance abusers: One-year follow-up of the focus on families project. *Addiction*, 94(2), 241–254. Retrieved from <http://ovidsp.ovid.com/ovidweb.cgi?T=JS&CSC=Y&NEWS=N&PAGE=fulltext&D=med4&AN=10396792>. [PubMed: 10396792]
- Chan SSC, Cheung YTD, Fong DYT, Emmons K, Leung AYM, Leung DYP, & Lam TH (2017). Family-based smoking cessation intervention for smoking fathers and nonsmoking mothers with a child: A randomized controlled trial. *The Journal of Pediatrics*, 182, 260–266. [PubMed: 27989407]
- Christakis NA, & Fowler JH (2008). The collective dynamics of smoking in a large social network. *New England Journal of Medicine*, 358(21), 2249–2258.
- Crowley R, Kirschner N, Dunn AS, & Bornstein SS (2017). Health and public policy to facilitate effective prevention and treatment of substance use disorders involving illicit and prescription drugs: An american college of physicians position paper. *Annals of Internal Medicine*, 166(10), 733–736. [PubMed: 28346947]
- Crowther M, Avenell A, MacLennan G, & Mowatt G (2011). A further use for the harvest plot: A novel method for the presentation of data synthesis. *Research Synthesis Methods*, 2(2), 79–83. [PubMed: 26061676]
- Day E, Copello A, Seddon JL, Christie M, Bamber D, Powell C, ... Freemantle N (2018). A pilot feasibility randomised controlled trial of an adjunct brief social network intervention in opiate substitution treatment services. *BMC Psychiatry*, 18 (1), 8. Retrieved from. [PubMed: 29334921]
- de Dios MA, Stanton CA, Cano MA, Lloyd-Richardson E, & Niaura R (2016). The influence of social support on smoking cessation treatment adherence among hiv+ smokers. *Nicotine & Tobacco Research*, 18(5), 1126–1133. [PubMed: 26116086]
- Dugosh K, Abraham A, Seymour B, McLoyd K, Chalk M, & Festinger D (2016). A systematic review on the use of psychosocial interventions in conjunction with medications for the treatment of opioid addiction. *Journal of Addiction Medicine*, 10 (2), 91.

- Dutra L, Stathopoulou G, Basden SL, Leyro TM, Powers MB, & Otto MW (2008). A meta-analytic review of psychosocial interventions for substance use disorders. *American Journal of Psychiatry*, 165(2), 179–187.
- Fals-Stewart W, & O'Farrell TJ (2003). Behavioral family counseling and naltrexone for male opioid-dependent patients. *Journal of Consulting & Clinical Psychology*, 71 (3), 432–442. Retrieved from <http://ovidsp.ovid.com/ovidweb.cgi?T=JS&CSC=Y&NEWS=N&PAGE=fulltext&D=med4&AN=12795568>. [PubMed: 12795568]
- Fals-Stewart W, O'Farrell TJ, & Birchler GR (2001). Behavioral couples therapy for male methadone maintenance patients: Effects on drug-using behavior and relationship adjustment. *Behavior Therapy*, 32(2), 391–411. Retrieved from <http://ovidsp.ovid.com/ovidweb.cgi?T=JS&CSC=Y&NEWS=N&PAGE=fulltext&D=emed7&AN=32995881>.
- Fanucchi L, Springer SA, & Korthuis PT (2019). Medications for treatment of opioid use disorder among persons living with hiv. *Current HIV/AIDS Reports*, 16(1), 1–6. [PubMed: 30684117]
- Feelemyer J, Des Jarlais D, Arasteh K, Abdul-Quader AS, & Hagan H (2014). Retention of participants in medication-assisted programs in low-and middle-income countries: An international systematic review. *Addiction*, 109(1), 20–32. [PubMed: 23859638]
- Fowler JH, & Christakis NA (2010). Cooperative behavior cascades in human social networks. *Proceedings of the National Academy of Sciences*, 107(12), 5334–5338.
- Gowing L, Farrell M, Bornemann R, Sullivan LE, & Ali R (2008). Substitution treatment of injecting opioid users for prevention of hiv infection. *Cochrane Database of Systematic Reviews*, 2.
- Grella CE, Ostle E, Scott CK, Dennis M, & Carnavale J (2020). A scoping review of barriers and facilitators to implementation of medications for treatment of opioid use disorder within the criminal justice system. *International Journal of Drug Policy*, 81, 102768. [PubMed: 32446130]
- Gu J, Lau JT, Xu H, Zhong Y, Hao Y, Zhao Y, ... Ling W (2013). A randomized controlled trial to evaluate the relative efficacy of the addition of a psycho-social intervention to standard-of-care services in reducing attrition and improving attendance among first-time users of methadone maintenance treatment in China. *AIDS & Behavior*, 17(6), 2002–2010. Retrieved from. [PubMed: 23413126]
- Hedrich D, Alves P, Farrell M, Stöver H, Møller L, & Mayet S (2012). The effectiveness of opioid maintenance treatment in prison settings: A systematic review. *Addiction*, 107(3), 501–517. [PubMed: 21955033]
- Heisel W (2010). Doctors behaving badly: Drug researcher was addicted to falsehoods. *Center for Health Journalism*. <https://www.centerforhealthjournalism.org/blogs/doctors-behaving-badlydrug-researcher-was-addicted-falsehoods>.
- Higgins JP, & Green S (2011). *Cochrane handbook for systematic reviews of interventions* (Vol. 4). John Wiley & Sons.
- Hojjat SK, Rezaei M, Hatami SE, Kohestani M, & Norozi Khalili M (2017). The effectiveness of group family training about the principles of harm reduction approach on marital satisfaction of spouses of patients under methadone maintenance treatment. *Journal of Sex & Marital Therapy*, 43(1), 68–77. Retrieved from. [PubMed: 26743023]
- Huberman BA, Romero DM, & Wu F (2008). Social networks that matter: Twitter under the microscope. *arXiv preprint arXiv:0812.1045*.
- Kim DA, Hwang AR, Stafford D, Hughes DA, O'Malley AJ, Fowler JH, & Christakis NA (2015). Social network targeting to maximise population behaviour change: A cluster randomised controlled trial. *The Lancet*, 386(9989), 145–153.
- Liberati A, Altman D, Tetzlaff J, Mulrow C, Gøtzsche P, Ioannidis J, ... Moher D (2009). The prisma statement for reporting systematic reviews and meta-analyses of studies that evaluate healthcare interventions. *Bmj*, 339.
- Litt MD, Kadden RM, Tennen H, & Kabela-Cormier E (2016). Network support ii: Randomized controlled trial of network support treatment and cognitive behavioral therapy for alcohol use disorder. *Drug and Alcohol Dependence*, 165, 203–212. [PubMed: 27354234]
- Mattick RP, Breen C, Kimber J, & Davoli M (2009). Methadone maintenance therapy versus no opioid replacement therapy for opioid dependence. *Cochrane Database of Systematic Reviews*, 3.

- McAweeney MJ, Zucker RA, Fitzgerald HE, Puttler LI, & Wong MM (2005). Individual and partner predictors of recovery from alcohol-use disorder over a nine-year interval: Findings from a community sample of alcoholic married men. *Journal of Studies on Alcohol*, 66(2), 220–228. [PubMed: 15957673]
- Moher D, Shamseer L, Clarke M, Ghersi D, Liberati A, Petticrew M, ... Stewart LA (2015). Preferred reporting items for systematic review and meta-analysis protocols (prisma-p) 2015 statement. *Systematic Reviews*, 4(1), 1. [PubMed: 25554246]
- Moran G, Knudsen H, & Snyder C (2019, July). Psychosocial supports in medication-assisted treatment: Recent evidence and current practice (tech. rep.). Department of Health and Human Services. Retrieved 2020-08-05. from <https://aspe.hhs.gov/basic-report/psychosocial-supports-medication-assisted-treatment-recent-evidence-and-current-practice>.
- Murthy VH (2016). Ending the opioid epidemic—A call to action. *New England Journal of Medicine*, 375(25), 2413–2415.
- Pearson JE (1986). The definition and measurement of social support. *Journal of Counseling & Development*, 64(6), 390–395. 10.1002/j.15566676.1986.tb01144.x.
- Pedersen B, Oppedal K, Egund L, & Tønnesen H (2011). Will emergency and surgical patients participate in and complete alcohol interventions? A systematic review. *BMC Surgery*, 11(1), 1–8. [PubMed: 21211005]
- Rosenquist JN, Murabito J, Fowler JH, & Christakis NA (2010). The spread of alcohol consumption behavior in a large social network. *Annals of Internal Medicine*, 152(7), 426–433. [PubMed: 20368648]
- Shakya HB, Stafford D, Hughes DA, Keegan T, Negron R, Broome J, ... others. (2017). Exploiting social influence to magnify population-level behaviour change in maternal and child health: Study protocol for a randomised controlled trial of network targeting algorithms in rural Honduras. *BMJ Open*, 7(3), Article e012996.
- Thomson CL, Morley KC, Teesson M, Sannibale C, & Haber PS (2008). Issues with recruitment to randomised controlled trials in the drug and alcohol field: A literature review and Australian case study. *Drug and Alcohol Review*, 27(2), 115–122. [PubMed: 18264870]
- Tilson H, Aramrattana A, Bozette S, Celentano D, Falco M, Hammett T, ... others. (2007). Preventing HIV infection among injecting drug users in high-risk countries: An assessment of the evidence. Washington, DC: Institute of Medicine.
- Yandoli D, Eisler I, Robbins C, Mulleady G, & Dare C (2002). A comparative study of family therapy in the treatment of opiate users in a London drug clinic. *Journal of Family Therapy*, 24(4), 402–422. Retrieved from <http://ovidsp.ovid.com/ovidweb.cgi?T=JS&CSC=Y&NEWS=N&PAGE=fulltext&D=psyc4&AN=2002-06352-005> 10.1111/1467-6427.00227.



**Fig. 1.** PRISMA flow diagram. Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) flow diagram of study selection, detailing stages of selection, exclusion, and review.



**Fig. 2.** Study harvest plot. Evidence for studies regarding the role of social network support on treatment outcomes for medication for opioid use disorder. Each study falls into a category represented by a stacked bar. The height of each component corresponds to a quality score representing the suitability of study design with respect to five quality measures: allocation concealment, addressing of incomplete outcome data, intent-to-treat analysis, addressing of selection bias and adequate sequence generation. Each bar is annotated with the sample size, statistical significance of outcome, and form of social network support. Studies without above quality measures are represented with no bar.

**Table 1**  
Study characteristics related to MOUD drug used, target population, outcome, number of participants, study length.

Author, date	Place	MOUD drug	Population	Outcomes	Sample characteristics (N, % male, age, ethnicity)	Study length
Carroll et al., 2001	USA	Naltrexone	Opioid dependent patients who had completed outpatient detoxification	Compliance with naltrexone treatment	N: 127 (total), 44 (naltrexone), 35 (naltrexone + CM), 48 (naltrexone + CM + SO) % male: 76 Mean age: 32 Ethnicity: 77% White	Unclear
Catalano et al., 1999	USA	Methadone	Opioid dependent parents who had been in methadone treatment for a minimum of 90 days and have one or more children between the ages of 3 and 14 years old living with them at least 50% of the week	Self-reported frequency of use of marijuana, cocaine, opiates and drug use in previous month	N: 144 (total), 62 (control), 82 (FOF) % male: 25 Mean age: 35.4 Ethnicity: 77% White; 18% Black; Mixed/Other: 5%	3 years
Day et al., 2018	UK	Methadone or buprenorphine	Opioid dependent individuals who had been prescribed methadone or buprenorphine for the past 12 months and had reported heroin use on one or more days 28 days prior to beginning of the study	Number of days of heroin use in the past month	N: 83 (total), 30 (TAU), (TAU + B-SNBT), (TAU + PGS) % male: 79 Mean age: 35.5 Ethnicity: 73% White; 14% South Asian; 4% Black; 8% Mixed	1 year
Fals-Stewart et al., 2001	USA	Methadone	Opioid dependent male partners who had been married for at least 1 year or in a stable common-law relationship for at least 2 years who had to refrain from seeking additional substance abuse treatment except for self-help meetings like Alcoholics Anonymous	Urine tests	N: 43 (total), 22 (individual counseling), 21 (BCT) % male: 100 Mean age: 38.1 Ethnicity: 18% White; 15% Black; 3% Hispanic	3 years
Fals-Stewart & O'Farrell, 2003	USA	Naltrexone	Opioid dependent individuals living with at least one parent/spouse/intimate partner/family member willing to participate and did not have a current substance use disorder or meet DSM-III-R criteria for schizophrenia, bipolar disorder, or psychosis	Percentage of opioid-free urines	N: 124 (total), 62 (individual counseling), 62 (BFC) % male: 100 Mean age: 32.9 Ethnicity: 66% White; 26% Black; 3% Hispanic; 5% Other	1 years
Gu et al., 2013	China	Methadone	Heroin dependent patients recently admitted to the three participating MMT clinics	Attrition from the MMT service, which was defined as a failure to visit the MMT clinic consecutively for at least 1 month immediately prior to the study's completion date	N: 288 (total), 146 (control), 142 (psychosocial intervention) % male: 92 Mean age: NA Ethnicity: 98.9% Han	1 year
Hojjat et al., 2017	Iran	Methadone	Individuals with a substance dependent husband with no history of drug dependence	Relapse rate	Total N: 50 (total), 25 (control), 25 (partner education intervention) % male: 100 Mean age: 31.5 Ethnicity: NA	1 year and 2 months
Yandoli et al., 2002	UK	Methadone	Patients with at least six months' duration of opioid dependence who agreed to be seen with their partner/family during treatment if required	Frequency of opiate use (allocated as opiate free, occasional users, regular users)	N: 119 (total), 40 (low-contact), 38 (standard), 41 (family counseling) % male: 63 Mean age: 28.2 Ethnicity: NA	14 months

Abbreviations: B-SBNT (Brief Social Behavior and Network Therapy), BCT - Behavioral couples therapy (refers to intensive therapy treatment involving once-weekly couples therapy, individual counseling and methadone for substance-abusing participants), BMT - Buprenorphine maintenance treatment, FOF - Focus on Families intervention (refers to parent skills training and case management), HIP - high intervention program of methadone plus individual counseling, CM - Contingency management, CRA - Community reinforcement approach (refers to a combination of psychoeducation, pharmacotherapy, compliance therapy, relation therapy and job counseling), LAAM - Levo-alpha-acetyl/methadol harm reduction, MFT- Multiple family therapy (refers to a combination of multi-



Author Manuscript Author Manuscript Author Manuscript Author Manuscript Author Manuscript  
generational, structural and general supportive approaches to therapy for patients and their families), MMT - Methadone maintenance treatment, PGS - Personal Goal Setting counseling, SO - significant other involvement, TAU - treatment as usual.

**Table 2**

Quality of studies.

Study	Sequence generation adequate	Allocation concealment	Baseline data/selection bias	Incomplete outcome data adequately addressed	Intent to-treat analysis	Other limitations discussed by authors	Possible impact of bias on treatment
Carroll et al., 2001	Yes: urn randomization program	Unclear	No	Unclear: high attrition after detoxification	Yes	Retrospective study. Those that dropped out prior to randomization more likely to be women.	Unclear
Catalano et al., 1999	Yes: block randomization	Unclear	Yes, no randomization	Unclear	Unclear	Retrospective study. Follow-up data unavailable. Generalizability depends on the skills of NCM caring for patients.	Unclear
Day et al., 2018	Yes: independent randomization algorithm	None: Open trial	Yes, no randomization	Yes: high attrition in experimental group addressed with high recruitment in experimental group	Yes	Organizational barriers. Discontinuity in staff delivering treatment. Inadequate recruitment for outcome measurement.	Unclear
Fals-Stewart & O'Farrell, 2003	Unclear	Unclear	Yes, no randomization	Yes: multiple imputation	No	Naltrexone pharmacotherapy intervention not fully standardized or manually driven. Complacence measured by self-reports. Key secondary outcomes (family relationship function and HIV-risk) behaviors not measured. Poor generalizability due to study sample characteristics and low rate of study participation.	Exaggerate
Fals-Stewart et al., 2001	Unclear	Unclear	Yes, no randomization	No: 5 participants who did not complete treatment were excluded	No	Small sample size. Recall bias from strategy used for scheduling interviews with patients. Underreporting due to stigma and impact of opioid dependence. Bias from retrospective data collection, lack of blinding and the use of proxy informants.	Unclear
Gu et al., 2013	Yes: block randomization	Adequate: Central allocation	Yes, no randomization	Unclear: attrition from MMT service was primary outcome	No	Small sample size. Sample overrepresented males. Assessment of family interaction processes limited by self-reporting measures.	Unclear
Hojjat et al., 2017	Yes: computerized random numbers	Unclear	Yes, no randomization	Unclear: reported no missing data	No	Patients in cohort experiments other interventions not captured by study.	Unclear
Yandoli et al., 2002	Unclear	Adequate: Central allocation	Yes, no randomization	No: follow-up groups not comparable; high attrition at second follow up leading to differences between treatment groups.	Yes	Temporal ambiguity due to cross-sectional design. Recall bias and social desirability bias due to self-reporting. Underreporting of heroin use as the urine morphine test could only detect use in the past seven days rather than the 30 day period of self-reporting. Poor generalizability as drug-using patterns and economic situations differ across other provinces.	Exaggerate

Table 3

Synthesis.

Study	Statistical significance of outcome at $p < .05$	Form of social network support	Point in treatment timeline that social network is assessed	MOUD drug used	Intervention (if any)	Effect size (Cohen's $d$ )
Carroll et al., 2000	No effect	Family - parent, child, or sibling (non-using) Partner (non-using) Peer (non-using)	During treatment	Naltrexone	Significant other involvement + Contingency management + standard treatment Contingency management + standard treatment Standard: Naltrexone + treatment Cognitive Behavioral Therapy in group setting	N/A
Catalano et al., 1999	Statistically significant	Family - child (cohabiting)	During treatment	Methadone	Family counseling (Focus on Families intervention: parent skills training and home-based case management service) Standard: not specified	0.45
Day et al., 2018	No effect [Positive (family, partner, peer)] No effect [Negative (family, partner, peer)]	Family - siblings, Partner Peer parents, children	During and Post-treatment	Methadone or buprenorphine	Standard + Brief Social Behavior and Network Therapy (B-SBNT) Standard + Personal Goal Setting (PSG) Standard: individual case management	N/A
Fals-Stewart et al., 2001	Statistically significant	Partner (cohabiting, non-using)	Pre- and During treatment	Methadone	Behavioral Couples Therapy + standard treatment Standard: MMT + individual counseling	0.43
Fals-Stewart & O'Farrell, 2003	Statistically significant	Family (cohabiting, non-using) Partner (cohabiting, non-using)	Pre-, During and Post-treatment	Naltrexone	Behavioral family counseling + standard treatment Standard: individual based therapy (individual counseling, group counseling)	0.34
Gu et al., 2013	Statistically significant	Family - parents, siblings Partner	During treatment	Methadone	Behavioral maintenance therapy + standard treatment Standard: MMT (no counseling)	2.0
Hojjat et al., 2016	No effect	Partner (cohabiting)	During treatment	Methadone	Standard + Group training Standard: MMT	N/A
Yandoli et al., 2002	Statistically significant	Family Partner	During treatment	Methadone	Supportive psychotherapy + standard treatment Family therapy + standard treatment Standard: MMT (called low contact treatment)	2.5

Abbreviations: BMT - Buprenorphine maintenance treatment, CM - Contingency management, LAAM - Levo-alpha-acetyl/methadol harm reduction, MMT - Methadone maintenance treatment.

Note: For the Statistical significance of outcome at  $p < .05$  column, we denoted the statistical significance of positive and negative ties if such information was provided (see Appendix). N/A in effect size column refers to studies with no effect, or effect size could not be calculated from data provided.