Drug and Alcohol Dependence 194 (2019) 410–429

Contents lists available at ScienceDirect

Drug and Alcohol Dependence

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

Interventions to address substance use and sexual risk among gay, bisexual and other men who have sex with men who use methamphetamine: A systematic review

Rod Knight[a,b,*], Mohammad Karamouzian[a,c], Anna Carson[a], Joshua Edward[d], Patrizia Carrieri[e], Jean Shoveller[c], Nadia Fairbairn[a,b], Evan Wood[a,b], Danya Fast[a,b]

[a] British Columbia Centre on Substance Use, Vancouver, Canada
[b] Department of Medicine, University of British Columbia, Canada
[c] School of Population and Public Health, University of British Columbia, Vancouver, Canada
[d] British Columbia Centre for Disease Control, Vancouver, Canada
[e] Institute de la Santé et de la Recherché Médical (INSERM), Marseille, France

ARTICLE INFO

Keywords:
Methamphetamine
Gay and bisexual men
Men who have sex with men
Sexual health

ABSTRACT

Background: Methamphetamine use is common among some populations of gay, bisexual and other men who have sex with men (gbMSM). This study reviewed the status of research on the efficacy of interventions that address harms among gbMSM who use methamphetamine.

Methods: We searched MEDLINE, PsycINFO, CINAHL, Embase, Cochrane Central Register of Controlled Trials, Web of Science, and Google Scholar to identify publications from inception to October 23, 2017, that assessed an intervention addressing methamphetamine use among gbMSM.

Results: Of 1896 potential studies and 935 unique articles screened for inclusion, 28 eligible studies assessed 26 different interventions in the following categories: pharmacological (n = 5); psychosocial (n = 20); harm reduction (n = 1). Given that outcome variables were measured in highly variable ways, we were unable to conduct a meta-analysis of intervention effects. However, 22 studies reported a statistically significant effect on one or more methamphetamine-related outcomes. Among 21 studies that included measures of sexual health-related outcomes, 18 reported a significant effect on one or more sexual health-related outcomes, and 15 of those reported a concurrent effect on both drug- and sexual health-related outcomes.

Conclusions: This is the first review to provide compelling evidence that integrating interventions to address both drug- and sexual-related harms for gbMSM who use methamphetamine can be efficacious. Future research should focus on identifying differential effects of various intervention approaches by social positioning, as well as prioritize future evaluations of integrated harm reduction interventions (e.g., the distribution of harm reduction kits within sexual health care settings).

1. Introduction

Across global settings, including North America, Europe, East and South-East Asia, and Australia (United Nations Office on Drugs and Crime, 2017), methamphetamine (MA) use manifests within many gay, bisexual and other men who have sex with men's (gbMSM) sexual and social lives (Ciketic et al., 2012). A growing body of research also indicates that the use of MA, used alone or in combination with other substances, is among the primary contemporary drivers of high-risk sexual behavior among gbMSM (e.g., unprotected anal intercourse with multiple concurrent partners), significantly contributing to the elevated rates of HIV and other sexually transmitted and blood-borne infections (STBBIs) that gbMSM experience today (Bradshaw et al., 2003; Celentano et al., 2006; Colfax et al., 2004; Ferlatte et al., 2014; Marshall et al., 2011). As such, epidemiological data now clearly indicate an association between MA use and high viral loads among HIV-positive men and an increased risk of HIV/STBBIs transmission or acquisition among gbMSM more broadly (Carey et al., 2009; Cunningham et al., 2015; Plankey et al., 2017). This growing body of evidence also now indicates that the elevated rates of HIV/STBBIs among gbMSM is highly associated with the *sexualized use of MA,* i.e., intensive use of MA and other substances (e.g., gamma-hydroxybutyrate – GHB) to maximize

* Corresponding author at: British Columbia Centre on Substance Use, 4th Floor, 1045 Howe Street, Vancouver, B.C., V6Z 2A9, Canada.
E-mail address: bccsu-rk@bccsu.ubc.ca (R. Knight).

https://doi.org/10.1016/j.drugalcdep.2018.09.023
Received 26 May 2018; Received in revised form 13 September 2018; Accepted 14 September 2018
Available online 03 November 2018
0376-8716/

pleasure and sociability with sex partners – a practice colloquially known in Canada as "*Party 'n Play*" (or "PnP") and "*Chemsex*" in other regions (e.g., Europe) (Daskalopoulou et al., 2014; Melendez-Torres and Bourne, 2016; Sewell et al., 2017).

In addition to the sexual-related harms associated with MA use among some gbMSM, regular and heavy MA use can also lead to other serious drug-related harms, including psychosocial and physical health problems such as cardiovascular and/or cerebrovascular pathology, clinical dependence, drug-induced psychosis, depression, suicide, anxiety and a tendency toward anti-social behavior (Ciketic et al., 2012). As such, there is a strong public health impetus to advance interventions that can effectively address a spectrum of drug- and sexual-related harms experienced by gbMSM who use MA (Nga Thi Thu et al., 2015).

Given that MA use carries a set of corresponding health risks and social consequences (e.g., MA use is criminalized in many settings), for the purpose of the current review, we turn our attention towards interventions that seek to address MA use broadly – regardless of whether MA use is classified as hazardous, problematic, or based on a substance use disorder diagnosis (e.g., as diagnosed via the Diagnostical Statistical Manual (DSM) IV). Some psychosocial interventions have demonstrated moderate efficacy for addressing MA use among people who use MA broadly, including cognitive behavioral therapy, contingency management and motivational interviewing (Baker and Lee, 2003; Hill, 2015; Shearer, 2007). Currently, however, there is no widely accepted pharmacological treatment for MA (Ciketic et al., 2012; Morely et al., 2017). Critically, very little is currently known about how various MA interventions can meet the needs of diverse groups of gbMSM who use MA (Heath et al., 2012; Melendez-Torres and Bonell, 2014). This article provides a systematic review of interventions addressing MA use among gbMSM guided by: (i) a primary research question: *What is the status of research on the efficacy of interventions to address substance use among gbMSM who use MA?*; and (ii) a secondary research question: *What is the status of the research on the efficacy of MA interventions in also addressing sexual risk among gbMSM who use MA?* By answering each of these research questions through a systematic review of the literature, our objective is to identify effective intervention strategies and to inform a renewed research agenda regarding the development of evidence-based interventions in this area.

2. Methods

2.1. Search strategy

Following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist (Moher et al., 2009) (see Supplemental Table 1), we searched for studies involving treatment for MA use and care interventions among gbMSM that were in English and published in peer-reviewed journals from inception through to October 23, 2017. We also searched the grey literature to capture relevant articles. The search strategy is summarized in Table 1 and full details are provided in supplemental Table 2.

2.2. Eligibility criteria

The population, interventions, comparisons, outcomes and study designs considered for review are listed in Table 2. Studies that did not provide post-intervention results were excluded.

2.3. Data extraction, analysis, and quality assessment

Titles and abstracts of retrieved articles were screened to identify studies that potentially met our inclusion criteria. Full texts of all potentially eligible articles were retrieved and independently assessed for full inclusion criteria by two review authors (MK and RK). Disagreement or uncertainty between the review authors was resolved through further discussion at team meetings. Each included study was coded by two reviewers for study characteristics (e.g., study date and location), participant characteristics (e.g., target population, age, ethnicity), intervention characteristics (e.g., components, delivery method, duration, setting) and outcomes (e.g., main findings). Extracted data were summarized across included studies with respect to: participants and characteristics of studies; interventions and effects; and differential effects in outcomes across participant sub-groups (e.g., by serostatus; ethno-racial identity).

Risk of bias was assessed using the Cochrane risk of bias instrument for RCTs (Higgins et al., 2011). RCTs were examined for selection bias, performance bias, detection bias, attrition bias, reporting bias, and other potential sources of bias (e.g., use of unclear methods for handling missing data, funding conflict of interest). RCTs were considered at high risk of bias when at least one item was assessed as high risk of bias. For non-randomized uncontrolled studies, individual study quality was assessed using the National Heart, Lung and Blood Institute's (NHLBI) Quality Assessment Tool for Before-After (Pre-Post) Studies With No Control Group where quality was assessed as low (scoring 0–4), moderate (scoring 5–8) and high (scoring 9–12) (National Institutes of Health, 2014).

3. Results

Our search strategy identified a total of 1896 studies of which 935 unique eligible records were screened for inclusion in the study. Abstract and full-text screening resulted in a total of 28 included articles assessing 26 independent interventions (two studies were secondary analyses of trial data previously reported (Fletcher et al., 2014; Fletcher and Reback, 2013)). A summary of this process is presented in the PRISMA Flow Diagram in Fig. 1.

3.1. Participants and characteristics of studies

Twelve studies used a pre-post study design (Carrico et al., 2014;

Table 1
Search strategy.

Search concepts Note: *Search terms were combined using appropriate Boolean operators and included subject heading terms or key words for four key themes and were tailored to fit each database requirements*	Men who have sex with men (e.g., homosexuality OR bisexuality OR men who have sex with men OR gay men OR MSM) AND methamphetamine (e.g., amphetamine-related disorders, meth dependence) AND pharmacological or psychological interventions (e.g., Mirtazapine OR Modafinil OR psychotherapy OR cognitive therapy OR motivational interviewing)
Databases	MEDLINE, PsycINFO, CINAHL, Embase, Cochrane Central Register of Controlled Trials, Web of Science, and Google Scholar.
Other search strategies	In addition to electronic databases, hand searches of the bibliographies of relevant published works and previous reviews, relevant recent conference proceedings (i.e., Harm Reduction International Conference, American Psychiatric Association, European Congress of Psychiatry), and a comprehensive grey literature search (i.e., grey literature databases, dissertations, reports, clinical trials registries (http://www.clinicaltrials.gov)) were also performed.
PROSPERO I.D.	This review was registered with PROSPERO (CRD42017079471) on 27/11/2017.

Table 2
Population, interventions, comparisons, outcomes and study design (PICOS) criteria for study inclusion.

Criteria	Definition
Population	Gay, bisexual or other men who have sex with men
Intervention	Interventions to address/reduce MA use and associated harms and risk behaviors
Comparison	Placebo or other/no interventions
Outcomes	MA use (***primary***) and sexual health risk behavior (***secondary; when included***, though if this was not assessed the study was still eligible for inclusion). We also assessed other drug-related harms when they were reported (e.g., harms that were reported due to polysubstance use; reporting injection drug use).
Study Designs	Randomized controlled trials or pre-post study designs

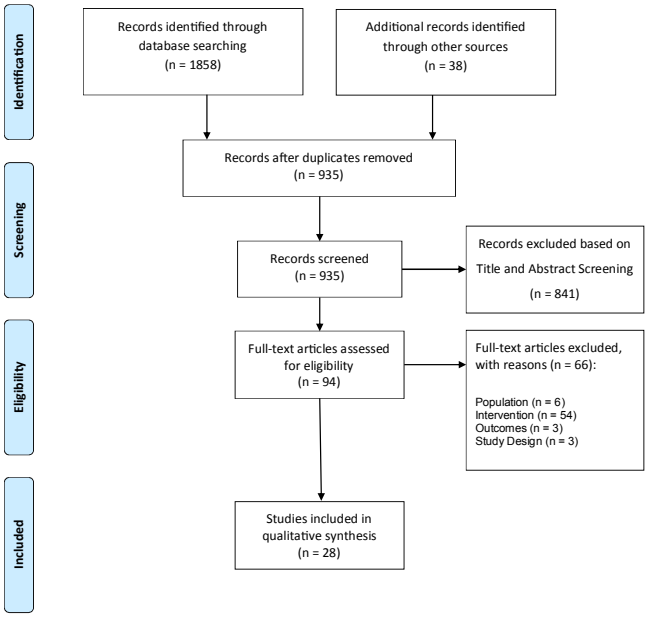

Fig. 1. Flow diagram of the selection and review process.

Landovitz et al., 2012; Lea et al., 2017; Lyons et al., 2014; McElhiney et al., 2009; Mimiaga et al., 2012; Reback and Fletcher, 2017; Reback et al., 2012; S. Shoptaw et al., 2006; Strona et al., 2006; Wu et al., 2011; Zule et al., 2012) and 16 employed randomized controlled trials (RCTs) (Carrico et al., 2015a, b; Coffin et al., 2018; Colfax et al., 2011; Das et al., 2010; Fletcher et al., 2014; Fletcher and Reback, 2013; Menza et al., 2010; Nyamathi et al., 2017; Parsons et al., 2014; Reback et al., 2010; Reback and Shoptaw, 2014; Santos et al., 2016, 2014; Shoptaw et al., 2008, 2005). The 28 studies included a total of 3665 participants at baseline, with sample sizes ranging from 13 to 422 and a median sample size of 88. All studies were conducted in high-income countries, with 27 from the USA (Carrico et al., 2014, 2015a, b; Coffin et al., 2018; Colfax et al., 2011; Das et al., 2010; Fletcher et al., 2014; Fletcher and Reback, 2013; Landovitz et al., 2012; Lyons et al., 2014; McElhiney et al., 2009; Menza et al., 2010; Mimiaga et al., 2012; Nyamathi et al., 2017; Parsons et al., 2014; Reback and Fletcher, 2017; Reback et al., 2012, 2010; Reback and Shoptaw, 2014; Santos et al., 2016, 2014; S. Shoptaw et al., 2006, 2008, 2005; Strona et al., 2006; Wu et al., 2011; Zule et al., 2012) and one from Australia (Lea et al., 2017). Further details on the characteristics of study participants are reported in Table 3.

4. Inclusion criteria and baseline characteristics of study samples

4.1. Inclusion/exclusion criteria

Inclusion/exclusion criteria for each study are reported in Table 4. Ten studies excluded participants with psychiatric conditions that would limit their capacity and/or safety to be involved in the research (Coffin et al., 2018; Colfax et al., 2011; Das et al., 2010; Fletcher and Reback, 2013; McElhiney et al., 2009; Reback et al., 2010; Reback and Shoptaw, 2014; Santos et al., 2016; Shoptaw et al., 2008, 2005). Eight studies reported including individuals who were not willing to quit MA use (Menza et al., 2010; Reback et al., 2010; Wu et al., 2011; Reback et al., 2012; Fletcher and Reback, 2013; Fletcher et al., 2014; Parsons et al., 2014; Landovitz et al., 2012) and ten reported including individuals who expressed a willingness to quit MA use (Shoptaw et al., 2006, 2008; Das et al., 2010; Colfax et al., 2011; Reback and Shoptaw, 2014; Santos et al., 2016; Lea et al., 2017; Shoptaw et al., 2005; McElhiney et al., 2009; Coffin et al., 2018); the remaining ten did not include 'willingness to quit' as an inclusion criterion (note: these remaining ten also did not report on what composition of their samples was willing or unwilling to quit) (Strona et al., 2006; Mimiaga et al., 2012; Zule et al., 2012; Carrico et al., 2014; Lyons et al., 2014; Santos et al., 2014; Carrico et al., 2015a, b; Nyamathi et al., 2017; Reback and Fletcher, 2017).

4.2. Sample baseline substance use characteristics

Seven studies reported including participants who were characterized as 'meth dependent', including six that determined this criterion via the Diagnostic Statistical Manual (DSM-IV) (Coffin et al., 2018; Colfax et al., 2011; Das et al., 2010; Landovitz et al., 2012; Reback et al., 2010; Shoptaw et al., 2005) and one that did not report on how dependence was assessed (Strona et al., 2006). Five studies characterized sample baseline consumption as 'regular meth users' and this was assessed differently across studies, including: through the use of DSM-IV criteria (McElhiney et al., 2009); using MA weekly over the past three months (Carrico et al., 2015a); using MA at least twice per month (Santos et al., 2016); any use in the past seven days or a signed referral from a physician documenting current MA dependence (Shoptaw et al., 2006); and one study that did not report on measurement (Reback et al., 2012). Three studies characterized the baseline sample as comprising 'recreational users', operationalized differently across the studies, including: reporting MA use at least twice in the previous two months (Zule et al., 2012); using the NIDA-CTN Addiction Severity Index-Lite (ASI-Lite) (Mimiaga et al., 2012); and reporting no more than episodic use defined as less than weekly use (Santos et al., 2014). One study characterized the baseline sample as 'non-recreational users', defined as using MA at least once in the past 60 days (Wu et al., 2011). Twelve studies did not provide a description of baseline consumption patterns (e.g., 'meth-dependent'; 'recreational user'); however, of these, one included participants who reported ≥ 2 episodes of meth use in the previous month (Menza et al., 2010), one included participants who reported any MA use in the previous month (Carrico et al., 2015b) and one included participants who reported any MA use in the past three months (Nyamathi et al., 2017). The remaining nine did not include a measurement for baseline MA use patterns as inclusion/exclusion criteria (Carrico et al., 2014; Fletcher et al., 2014; Fletcher and Reback, 2013; Lea et al., 2017; Lyons et al., 2014; Parsons et al., 2014; Reback and Fletcher, 2017; Reback and Shoptaw, 2014; Shoptaw et al., 2008).

Thirteen studies measured and reported on injection status (Coffin et al., 2018; Colfax et al., 2011; Das et al., 2010; Lea et al., 2017; McElhiney et al., 2009; Menza et al., 2010; Mimiaga et al., 2012; Nyamathi et al., 2017; Reback et al., 2012; Reback and Shoptaw, 2014;

Table 3
Participant Characteristics of Studies Assessing Meth Treatment Outcomes among MSM*.

Author (year)	Sample population	Ethnicity	Sexual orientation/MSM definition/details	HIV status	Baseline drug use characteristics	Baseline sexual behavior
Shoptaw et al. (2005)	N = 162 Age: Mean (SD) = 37 (6)	Caucasian (80%); Hispanic (13%); African American (3%); Asian American (3%); Native American (1%)	Gay/bisexual men	HIV + (60.5%)	Frequency of meth use: Meth dependent (DSM-IV) Poly substance use: NR Injection drug use: 39.5% meth injection Previous addiction treatment: NR [1]Willingness to quit required: Yes	# of sexual partners: Mean of 9.9 (LM) CAI: Mean of 2.2 CRAI; Mean of 4 CIAI Meth use with sex: NR
Shoptaw et al. (2006)	N = 143 Age: NR	NR	Men who have sex with men	HIV + (77.6%)	Frequency of meth use: Regular meth user Poly substance use: NR Injection drug use: 54.5% meth injection Previous addiction treatment: NR Willingness to quit required: Yes	# of sexual partners: 43% > 2 partners (LM) CAI: 70.6% CIAI; 67.8% CRAI last month Meth use with sex: 88.1%
Strona et al. (2006)	N = 178 Age: NR	NR	Gay and bisexual men	HIV + (68%)	Frequency of meth use: Meth dependent Poly substance use: NR Injection drug use: NR Previous addiction treatment: NR Willingness to quit required: NR	# of sexual partners: 46% ≥3 sex partners (LM) CAI: 53% CIAI; 46% CRAI Meth use with sex: 91%
Shoptaw et al. (2008)	N = 128 Age: Mean (SD) = 37 (7.7)	White (65%); Latino (22%); Other (13%)	Gay or bisexual men	HIV + (55%)	Frequency of meth use: Meth as the primary substance of use (75%) Poly substance use: Yes Injection drug use: 12.5% IDU Previous addiction treatment: NR Willingness to quit required: Yes	# of sexual partners: Mean of 6.8 (LM) CAI: Mean of 2 CRAI; Mean of 2.4 CIAI Meth use with sex: NR
McElhiney et al. (2009)	N = 13 Age: Mean (SD) = 38 (6)	White (69%); Hispanic (23%); Black (8%)	Gay men	HIV + (84.6%)	Frequency of meth use: Regular meth user (DSM-IV) Poly substance use: NR Injection drug use: 31% IDU Previous addiction treatment: NR Willingness to quit required: Yes	# of sexual partners: NR CAI: NR Meth use with sex: NR
Das et al. (2010)	N = 30 Age: Mean (SD) = 36.5 (3.3)	White (50%); Hispanic (20%); Black (10%); Other (20%)	Self-reporting anal sex with men in past 3 months	HIV + (43%)	Frequency of meth use: Meth dependent (SCID) Poly substance use: Yes Injection drug use: 50% IDU (LM) Previous addiction treatment: 40% Willingness to quit required: Yes	# of sexual partners: Mean of 8 (LM) CAI: 23% CIAI; 30% CRAI Meth use with sex: 53%
Menza et al. (2010)	N = 127 Age: Median (Range) = 39 (18-60)	Black/African American (8%); Hispanic/Latino (13%); Native American (6%); White (60%); Other (13%)	Gay/Homosexual (63%); Bisexual (22%); Straight/ Heterosexual (1%); Queer, same Gender loving/other (14%)	HIV + (55%)	Frequency of meth use: Meth using MSM (65% weekly or daily meth use (L6W)) Poly substance use: Yes Injection drug use: 54% meth injection Previous addiction treatment: 25% Willingness to quit required: No	# of sexual partners (L6W): Median of 3 CAI: 28% Meth use with sex: 80%
Reback et al. (2010) – **followed up by the following analyses: Fletcher and**	N = 131 Age: Mean (SD) = 36.4 (8.7)	Caucasian (53.4%); African American (22.9%); Latino (16.8%); Other (6.9%)	Self-reporting sex with a man in the previous 12 months	HIV + (28.3%)	Frequency of meth use: Meth dependent (DSM-IV) Poly substance use: Yes Injection drug use: NR	# of sexual partners: NR CAI: NR Meth use with sex: NR

(*continued on next page*)

Table 3 (*continued*)

Author (year)	Sample population	Ethnicity	Sexual orientation/MSM definition/details	HIV status	Baseline drug use characteristics	Baseline sexual behavior
Reback (2013)* and Fletcher et al. (2014)*					Previous addiction treatment: NR Willingness to quit required: No	
Colfax et al. (2011)	N = 60 Age: Mean (SD) = 40.5 (9)	White (62%); African American (18%); Latino (12%); Other (8%)	Self-reporting anal sex with men in the past 3 months	HIV + (53%)	Frequency of meth use: Meth dependent (DSM-IV) Poly substance use: NR Injection drug use: 45% IDU Previous addiction treatment: 50% Willingness to quit required: Yes	# of sexual partners (LM): Mean of 10.5 CAI: Mean of 1.2 CRAI; Mean of 2.7 CIAI Meth use with sex: 68%
Wu et al. (2011)	N = 68 Age: Mean (SD): 41.5 (8.7)	Black/African American (91.2%); Latino/Hispanic (7.4%); Mixed (1.5%)	Gay/Homosexual (84%); Bisexual (13%); Straight/ Heterosexual (3%)	HIV + (94.1%)	Frequency of meth use: Meth using MSM (77.9% used meth L2M) Poly substance use: Yes Injection drug use: NR Previous addiction treatment: NR Willingness to quit required: No	# of sexual partners (at baseline): 81% > 1 partners CAI: 85% Meth use with sex: NR
Landovitz et al. (2012)	N = 53 Age: Mean (SD) = 36.1 (7.9)	Caucasian/White (4.7%); African American/black (9.4%); Hispanic/ Latino (30.2%); Asian/Pacific Islander (1.9%); Other (3.8%)	Gay (83%); Bisexual (15.1%); Other (1.9%)	HIV + (0.0%) (HIV - serostatus verified at baseline, individuals with HIV + serostatus excluded)	Frequency of meth use: Meth dependent (DSM-IV) Poly substance use: Yes Injection drug use: NR Previous addiction treatment: NR Willingness to quit required: No	# of sexual partners: Mean of 5.1 (LM) CAI: Mean of 6.5 Meth use with sex: NR
Mimiaga et al. (2012)	N = 16 Age: Mean (SD) = 40 (9.5)	Caucasian/ White (62.5%); Racial/ Ethnic Minority (37.5%)	Gay (75%); Not Gay (25%) (All had reported CAI with another man)	HIV + (0.0%) (HIV - serostatus verified at baseline, individuals with HIV + serostatus excluded)	Frequency of meth use: Regular meth user (Addiction Severity Index) Poly substance use: Yes Injection drug use: 25% IDU Previous addiction treatment: Mean of 3.6 times Willingness to quit required: NR	# of sexual partners: NR CAI: Mean of 5.9 (L3M) Meth use with sex: Mean of 4.4 episodes (L3M)
Reback et al. (2012)	N = 52 Age: Mean (SD) = 36.5 (8.9)	Caucasian/White (34.6%); African American/Black (21.2%); Hispanic/ Latino (38.5%); Multi/Other (5.8%)	Gay (80.8%); Bisexual (19.2%)	HIV + (59.6%)	Frequency of meth use: Regular meth user Poly substance use: NR Injection drug use: 20.8% Previous addiction treatment: NR Willingness to quit required: No	# of sexual partners: Mean of 4.4. HIV + non-primary partners (L2M) CAI: Mean of 2.2. CIAI; Mean of 7.7 CRAI Meth use with sex: NR
Zule et al. (2012)	N = 39 Age: Mean (SD) = 38.3 (8.5)	African American (52%); Non-Hispanic White (45%); Other (5%)	Gay/Homosexual (68%); Bisexual (26%); Straight/ Heterosexual (6%)	HIV + (48%)	Frequency of meth use: Meth using MSM (Mean of 9.4 meth use days (L2M)) Poly substance use: Yes Injection drug use: NR Previous addiction treatment: 15% Willingness to quit required: NR	# of sexual partners: Mean of 4.8 (L2M) CAI: Mean of 5 CRAI (L2M); Mean of 5.3 CIAI (L2M) Meth use with sex: NR
Carrico et al. (2014)	N1 = 123; N2 = 88 **Study 1:** Age: Mean (SD) = 40.7 (7.5); **Study 2:** Age: Mean (SD) = 43.3 (9)	**Study 1:** African American (7.5%); Hispanic/Latino (21.7%); Caucasian (65.8%); Asian/Pacific Islander (1.7%); American Indian (0.8%); **Study 2:** African American (11.4%); Hispanic/Latino (13.6%); Caucasian (67.1%); Asian/Pacific Islander (2.3%); Multicultural (5.7%)	**Study 1:** Gay (89.1%); Bisexual (8.4%); Straight (0.8%); Unsure (1.7%) **Study 2:** Gay (96.6%); Bisexual (2.3%); Straight (1.1%) (All MSM)	**Study 1:** HIV + (63.6%); **Study 2:** HIV + (65.9%)	Frequency of meth use: Meth-using MSM; **Study 1:** Mean of 4.85 meth use days (LM); **Study 2:** Mean of 5.23 meth use days (LM) Poly substance use: Yes Injection drug use: NR Previous addiction treatment: NR Willingness to quit required: No	# of sexual partners: **Study 2:** Mean of 5.1 partners on meth (L3M) CAI: **Study 2:** Mean of 35 any CAI Meth use with sex: **Study 2:** Mean of 23 any CRAI on meth; Mean of 17 any CIAI on meth
Lyons et al. (2014)			NR	HIV + (78%)		

(*continued on next page*)

Table 3 (*continued*)

Author (year)	Sample population	Ethnicity	Sexual orientation/MSM definition/details	HIV status	Baseline drug use characteristics	Baseline sexual behavior
	N = 70 Age: Mean (SD) = 44.3 (8)	Black or African American (72%); Latino or Hispanic (6%); White (13%); Multiracial (6%)			Frequency of meth use: Stimulant using MSM (23% meth use LM) Poly substance use: Yes Injection drug use: NR Previous addiction treatment: NR Willingness to quit required: NR	# of sexual partners: NR CAI: 81% Meth use with sex: 74%
Parsons et al. (2014)	N = 143 Age: 18-29 years	White (37.1%); Latino (28.7%); Black (21.0%); Other (13.3%)	Gay (91.6%); Bisexual (8.4%)	HIV+ (0.0%)	Frequency of meth use: Stimulant using MSM (16.7% meth use LM) Poly substance use: Yes Injection drug use: NR Previous addiction treatment: NR Willingness to quit required: No	# of sexual partners: NR CAI: 83.9% any CAI (LM) Meth use with sex: NR
Reback and Shoptaw (2014)	N1 = 40; N2 = 46; N3 = 171 **Study 1:** Age: Mean (SD) = 38.5 (5.4); **Study 2:** Age: Mean (SD) = 37 (6.4) **Study 3:** Age: Mean (SD) = 39.9 (8.2)	**Study 1:** Caucasian (85%); Hispanic (5%); African American (5%); Other (5%); **Study 2:** Caucasian (72%); Hispanic (22%); African American (0%); Other (6%); **Study 3:** Caucasian (59%); Hispanic (21%); African American (8%); Other (12%)	NR	**Study 1:** HIV+ (55%) **Study 2:** HIV+ (63%) **Study 3:** HIV+ (63.2)	Frequency of meth use: **Study 1:** Mean of 10.4 meth use days (LM); **Study 2:** Mean of 6.3 days (LM); **Study 3:** Mean of 11.2 meth use days (LM) Poly substance use: NR Injection drug use: **Study 1:** 40%; **Study 2:** 36%; **Study 3:** 48% Previous addiction treatment: NR Willingness to quit required: Yes	# of sexual partners: **Study 1:** Mean of 10.1 (LM); **Study 2:** Mean of 9.4 (LM); **Study 3:** Mean of 9.8 (LM) CAI: **Study 1:** Mean of 3.1 CRAI; Mean of 7.1 CIAI; **Study 2:** Mean of 3.2 CRAI; Mean of 2.5 CIAI; **Study 3:** Mean of 5.4 CRAI; Mean of 5.7 CIAI Meth use with sex: NR
Santos et al. (2014)	N = 326 Age: Mean (SD) = 33.6 (10.1)	White (47%); Latino/Hispanic (26%); Asian/Pacific Islander (11%); Black/African (10%); Other (6%)	NR	NR	Frequency of meth use: Recreational/episodic meth use (< weekly use within two hours before/during sex; 9.5% Meth use) Poly substance use: Yes Injection drug use: NR Previous addiction treatment: NR Willingness to quit required: NR	# of sexual partners: NR CAI: NR Meth use with sex: NR
Carrico et al. (2015)[a]	N = 21 Age: Mean (SD) = 41.1 (9)	Caucasian (47.6%); African American (23.8%); Hispanic/Latino (23.8%); Multicultural Heritage (4.8%)	All MSM, predominantly or exclusively gay (71.4%) (Further identity statistics not reported)	HIV+ (48%)	Frequency of meth use: Regular meth use (weekly use) Poly substance use: NR Injection drug use: NR Previous addiction treatment: NR Willingness to quit required: NR	# of sexual partners: NR CAI: Mean of 0.15 episodes Meth use with sex: NR
Carrico et al. (2015)[b]	N = 23 Age: Mean (SD) = 45.5 (7.6)	White (52%); African American (30%); Other (18%)	All MSM, predominantly or exclusively gay (85%) (Further identity statistics not reported)	HIV+ (100%)	Frequency of meth use: Meth-using MSM (Mean of 6.4 meth use days (LM)) Poly substance use: NR Injection drug use: NR Previous addiction treatment: NR Willingness to quit required: NR	# of sexual partners: Mean of 1.5 (anal sex) (L3M) CAI: NR Meth use with sex: NR
Santos et al. (2016)	N = 30 Age: Mean (SD) = 43 (9.3)	White (40%); Hispanic/Latino (17%); Black (30%); Asian or Pacific Islander (7%); Other (6%)	NR	HIV+ (40%)	Frequency of meth use: Regular meth use (at least twice/month) Poly substance use: Yes Injection drug use: NR Previous addiction treatment: 53.3% Willingness to quit required: Yes	# of sexual partners: NR CAI: NR Meth use with sex: 30% > 50% of the time (LM)
Lea et al. (2017)	N = 101 Age: Median (IQR) = 41 (31-44)	Australian (69.3%); Aboriginal/Torres Strait Islander (n = 3)	Gay (99%); Bisexual (1%)	HIV+ (56.4%)	Frequency of meth use: Meth using MSM (82.2% meth use LM) Poly substance use: Yes	# of sexual partners: NR CAI: NR Meth use with sex: NR

(*continued on next page*)

Table 3 (*continued*)

Author (year)	Sample population	Ethnicity	Sexual orientation/MSM definition/details	HIV status	Baseline drug use characteristics	Baseline sexual behavior
					Injection drug use: 58.4% meth injection (LM); 64.4% IDU (L3M) Previous addiction treatment: 100% Willingness to quit required: Yes	
Nyamathi et al. (2017)	N = 422 Age: Mean (SD) = 34.4 (8.1)	African American (35.5%) White (36.5%); Hispanic (14.7%); Other (13.3%)	NR	HIV + (14.8%)	Frequency of meth use: Meth using MSM (76% meth use (L3M)) Poly substance use: Yes Injection drug use: NR Previous addiction treatment: NR Willingness to quit required: NR	# of sexual partners (at baseline): 36% multiple sex partners CAI: NR Meth use with sex: NR
Reback and Fletcher (2017)	N = 585 Age: Mean (SD) = 37.6 (10.2)	African-American (25.5%) Asian/ Pacific Islander (2.2%) Caucasian (32.3%) Hispanic (22.6%) Multiracial (17.5%)	Gay (61.6%) Bisexual (38%) Heterosexual (0.3%)	HIV + (20.1%)	Frequency of meth use: Meth as the 2nd most frequently used substance (44.4% (LM)) after Marijuana Poly substance use: NR Injection drug use: NR Previous addiction treatment: NR Willingness to quit required: No	# of sexual partners: NR CAI: 34.7% at last sexual encounter Meth use with sex: NR
Coffin et al. (2018)	N = 100 Age: Mean (SD) = 43.2 (8.5)	White (55%) Africa-American (19%) Latino (18%) Asian and Pacific Islander (4%)	NR	HIV + (74%)	Frequency of meth use: Meth-dependent (SCID) Poly substance use: NR Injection drug use: 51% meth injection Previous addiction treatment: 58% Willingness to quit required: Yes	# of sexual partners: Mean of 5 (LM) CAI: Mean of 1.5 episodes (LM) Meth use with sex: 63% > 50% of time

[1]If an intervention required that participants agree to abstinence from MA use, 'Willingness to quit required' was assessed as a feature of the intervention (e.g., Yes). If an intervention did not require a participant to remain abstinent, it was assessed as 'No'. If the authors did not include information about whether or not study participants were required to agree to abstinence it was assessed as 'Not Reported' (NR).
*Abbreviations: SD: Standard Deviation; IQR: Interquartile Range; NR: Not Reported; DSM-IV: Diagnostic and Statistical Manual of Mental Disorders, 4th edition; SCID: Structural Clinical Interview for Diagnostic and Statistical Manual of Mental Disorders; LM: Last Month; L3M: Last 3 Months; LW: Last Week; L6W: Last 6 Weeks; IDU: Injection Drug Use; CAI: Condomless Anal Intercourse; CRAI: Condomless Receptive Anal Intercourse; CIAI: Condomless Insertive Anal Intercourse.

Table 4
Characteristics of Interventions for Meth Treatment among MSM*.

Author (year)	Intervention description	Inclusion/Exclusion Criteria	Main Findings
Shoptaw et al. (2005)	CBT, CM, CBT + CM, and GCBT for 16 weeks; thrice weekly urine visits Setting: Outpatient Design/Location: RCT/USA	Exclusion criteria: Medical or psychiatric conditions that precluded safe study involvement; inability to comply with the research requirements; and meth dependence required more intensive intervention than outpatient treatment	**At 16 weeks (end of treatment):** * *CBT showed shorter retention than CM and CBT + CM ($P < 0.05$)* * CBT showed shorter average number of days of documented meth abstinence than CM and CBT + CM, $P < 0.001$ * CM, CBT + CM, and GCBT had higher average number of negative urine samples for meth during treatment than CBT ($P < 0.05$) **At 52-week follow up (post-enrolment):** * GCBT had the lowest percentage of negative urine samples and the highest number of meth use days * GCBT reduced receptive CAI at 4 weeks ($P < 0.01$) but no group differences at 52 weeks * All groups reduced number of sexual partners ($P < 0.001$) * Reductions in Addiction Severity Index scores for the drug use and psychiatric scales ($P < 0.0001$)
Shoptaw et al. (2006)	PROP for 12 weeks; thrice weekly urine visits Setting: Outpatient Design/Location: Pre-Post (No control group)/ USA	Inclusion criteria: Meth-using MSM seeking to reduce or eliminate their use of the drug; and having a positive pre-baseline urine test or medical documentation of current meth dependence to initiate treatment	**At 12 weeks (end of treatment):** *Of those screened, 111 began CM treatment and averaged 15 (42%) meth-free urine samples out of a possible 36 samples during the 12-week treatment period; 60% completed 4 weeks of treatment; 48% 8 weeks and 30% 12 weeks * Clinical responses to CM in PROP were similar to CM delivered in drug treatment programs, supporting the adaptability and effectiveness of CM to non-traditional drug treatment settings
Strona et al. (2006)	PROP for 12 weeks; thrice weekly urine visits Setting: Outpatient Design/Location: Pre-Post (No control group)/ USA	Inclusion criteria: Meth dependent; not enrolled in a current drug treatment program; and consent to provide an observed urine collection three times a week for 12 weeks	**At 12 weeks (end of treatment):** * The 10-week completion rate was 40% and the 12-week completion rate was 35%. * Among participants who completed PROP, 63% self-reported a recent STD at baseline compared to 33% of the non-completers ($P < 0.05$). * PROP completers were also significantly more likely to have reported use of meth with sex at enrollment compared to non-completers (98% versus 85%; $P < 0.05$) * Of the urine samples collected from PROP participants, 96% were negative for meth * Significant reduction in the number of sex partners among PROP participants ($P < 0.05$)
Shoptaw et al. (2008)	GCBT, GSST; 48 group sessions for 16 weeks; thrice weekly urine visits Setting: Outpatient Design/Location: RCT/USA	Exclusion criteria: Psychiatric or medical condition that interfered with safe study participation; needed a higher level of care for their substance abuse or a medically supervised detoxification; unable to comply with thrice-weekly study visits; and dependent on opioids or benzodiazepines	**At 52-week follow-up (post-enrolment):** * No overall statistically significant differences were observed between conditions along retention, substance use, or HIV-related sexual risk behaviors * Among meth-using participants, the GCBT condition showed significant effects over GSST for reducing and sustaining reductions of meth ($P < 0.01$) * Significant reductions in meth use and concomitant sexual risky behaviors were observed for all of the participants ($P < 0.05$)
McElhiney et al. (2009)	12 weeks of Modafinil followed by 4 weeks of placebo; started with two weeks of twice	Inclusion criteria: Current diagnosis of stimulant abuse or dependence; and no psychotic or bipolar disorders or	**At week 16 (end of treatment):** * 10 (77%) patients completed the trial, six of whom reduced their meth

(*continued on next page*)

Table 4 (*continued*)

Author (year)	Intervention description	Inclusion/Exclusion Criteria	Main Findings
	weekly sessions with a motivational enhancement emphasis followed by weekly CBT sessions for the remaining 14 weeks. Setting: Outpatient Design/Location: Pre-Post (No control group)/ USA	untreated major depressive disorder	use by > 50%. * Modafinil may be most useful for crystal users at the point when they start to taper or discontinue crystal use, and that the combination therapy conducted by a therapist able to address sexual issues promotes treatment retention * 54% of the patients experienced medication side effects including headaches, nausea, tachycardia, and irritability, which tended to appear early in the trial and were mild and transient.
Das et al. (2010)	Bupropion/ 150 mg 1 pill every morning for 1 week, then two 150 mg pills every morning thereafter; participants received weekly substance use counseling, provided weekly urine specimens, and completed monthly audio-computer assisted self-interview (ACASI) behavioral risk assessments. Setting: Outpatient Design/Location: RCT/USA	Inclusion criteria: Meth dependence by Structured Clinical Interview for DSM disorders (SCID); willingness to reduce or stop meth use; age 18–60 years; anal sex with men in past 3 months while using meth; meth-metabolite positive urine at screening; no acute medical or psychiatric illness; no history of seizure; no evidence of current major depression or history of antidepressant use within the past month; no use of pseudoephedrine-containing products; and HIV-infected individuals with CD4 cell count above 200 cells/ml (if HIV+)	**At week 12 (end of treatment):** * 90% completed the trial and adherence by MEMS cap (P = 0.98) and by self-report (P = 0.21) did not differ significantly by treatment assignment. * Reductions in meth-metabolite-positive urines were similar in the bupropion and placebo groups (P = 0.63) * No serious adverse events occurred and no significant differences were observed between the two treatment groups (P = 0.11) * Participants in both arms reported similar declines in the median number of sex partners (P = 0.46) * Participants in both arms reported similar declines in number of male partners with whom meth was used (P = 0.71) as well as unprotected insertive (P = 0.90) and receptive (P = 0.62) anal sex with sero-discordant partners. * The declines in prevalence of unprotected sero-discordant anal sex were similar in both groups (P = 0.09)
Menza et al. (2010)	CM for 12 weeks; twice-weekly urine visits Setting: Outpatient Design/Location: RCT/USA	Inclusion criteria: ≥18 years; willingness to be randomized; no plans to move from the study catchment area within 6 months of enrollment; ≥1 episodes of anal sex and ≥2 episodes of meth use in the previous month; and no mutually monogamous relationship with a partner of the same HIV status lasting ≥2 years	**At 24-week follow-up (post-enrolment):** * CM participants were somewhat more likely to provide urine samples containing meth than control participants (RR = 1.21; 95%CI: 0.95, 1.54) * CM participants were significantly more likely to report weekly or more frequent meth use and use of more than eight quarters of meth during the intervention and post-intervention periods (RR = 1.76; 95%CI: 1.13, 2.73 and RR = 3.02; 95%CI: 1.47, 6.23, respectively) meaning that CM is not likely to have a large, sustained effect on meth use * CM participants were less likely than control participants to report non-concordant CAI during the subsequent 24-week follow-up period (RR = 0.851 95% CI: 0.21, 1.25)
Reback et al. (2010), **Fletcher and Reback (2013)˄**, Fletcher et al. (2014)#	CM or control condition; participants in the CM condition earned points (redeemable at an onsite store) for completing the targeted health-promoting behaviors and for drug/alcohol abstinence; twice weekly urine tests Setting: Outpatient Design/Location: RCT/USA	Inclusion criteria: Attendance in a minimum of three groups or counseling sessions; ≥18 years; substance-dependent based on DSM-IV; non-treatment-seeking; homeless; self-reporting sex with a man in the previous year; and understand the consent forms	**At 52-week follow-up (post-enrolment):** * Participants in the CM condition achieved greater reductions in meth use and greater increases in health-promoting behaviors (P < 0.01) * Reductions in substance use were maintained to 9- and 12-month follow-up evaluations (P < 0.05) **At 52-week follow-up˄ (post-enrolment):** * Individuals with ASPD provided more meth-negative urine samples than participants without ASPD (P < 0.05) * Participants with ASPD earned fewer vouchers for health-

(*continued on next page*)

Table 4 (*continued*)

Author (year)	Intervention description	Inclusion/Exclusion Criteria	Main Findings
			promoting/ prosocial behaviors than participants without ASPD (P < 0.01) * Participants with ASPD displayed superior meth abstinence outcomes regardless of CM schedule **At 52-week follow-up# (post-enrolment):** * Participants who used meth during the intervention exhibited less time between voucher redemptions than individuals who achieved abstinence from meth (RR = 0.66; 95% CI: 0.44,0.99) * Voucher redemption logs may be cost-effective and unobtrusive tools for measuring study participants' tendency to delay gratification
Colfax et al. (2011)	Daily oral Mirtazapine (30 mg) or placebo; both arms included 30-minute weekly substance use counseling; 12 weeks; weekly urine samples Setting: Outpatient Design/Location: RCT/USA	Inclusion criteria: meth dependence based on DSM-IV; interest in reducing or ceasing meth use; 18-60 years; self-reported anal sex with men in the past 3 months while using meth; meth metabolite–positive urine test result at screening; no acute medical or psychiatric illness; no current major depression disorder; history of antidepressant use within the past 4 weeks; and CD4 cell count over 200/μL (for HIV + participants)	**At week 12 (end of treatment):** * Intervention was associated with decreases in sexual risk including number of male partners (P = 0.04), number of male partners with whom meth was used (P = .009), episodes of CRAI (P = 0.003), and CIAI (P = 0.001) * There were no serious adverse events related to study drug or significant differences in adverse events by arm (P = 0.99) *The addition of mirtazapine to substance use counseling decreased meth use among active users (RR = 0.57; 95% CI, 0.35-0.93) despite low to moderate medication adherence.
Wu et al. (2011)	Seven 90-minute-session couple-based intervention using experienced facilitators;	Inclusion Criteria: ≥18 years; having a primary main male partner; self-identify as African American and/or black; having	**At week 8 (end of treatment)** * Participants reported significantly less meth use

Table 4 (*continued*)

Author (year)	Intervention description	Inclusion/Exclusion Criteria	Main Findings
	Setting: Outpatient Design/Location: Pre-Post (No control group)/ USA	had condomless anal intercourse with a man who is a non-main partner in the past 60 days; meth use at least once in the past 60 days; not being either in or seeking drug treatment; identify each other as their main partner; and not newly diagnosed as HIV- positive within the last 6 months	(P < 0.001), any illicit drug use (P < 0.01), and number of illicit drugs used(P < 0.01) * Participants reported significantly fewer sexual partners, fewer episodes of condomless anal intercourse (P < 0.001), and greater condom use with their main partner (P < 0.001)
Landovitz et al. (2012)	HIV-uninfected MSM reporting recent meth use initiated on tenofovir/ emtricitabine-based PEP; all participants began the voucher-based CM intervention upon study entry; thrice weekly urine visits Setting: Outpatient Design/Location: Pre-Post (No control group)/ USA	Inclusion criteria: Self-identifying as MSM; ≥18 years; HIV-; self-reporting meth use within the previous month; CAI with an HIV + or HIV-serostatus-unknown partner in the previous 90 days	**At 13-week follow-up (post-enrolment):** *Meth abstinence during CM treatment increased PEP adherence per clean urine toxicology sample provided, and increased the odds of PEP course completion (OR: 1.17, 95% CI: 1.04–1.31) * PEP, when combined with CM, is safe, feasible, and acceptable as an HIV prevention strategy in meth-using MSM * Meth abstinence during CM treatment increased PEP adherence and increased the odds of PEP course completion * Average number of days of Meth use (P < 0.001), average number of uses per day (P < 0.001), and money spent on meth (P < 0.05) decreased significantly. Moreover, meth-free urine samples increased (P < 0.05) significantly * Participants reported significantly fewer mean episodes of CAI (P = 0.05) and number of sex partners decreased significantly (P < 0.05) * Prevalence and 3-month incidence rates of syphilis, rectal gonorrhea,

(*continued on next page*)

Table 4 (*continued*)

Author (year)	Intervention description	Inclusion/Exclusion Criteria	Main Findings
			pharyngeal gonorrhea, and rectal chlamydia were high in contrast with reported decreases in sexual risk behavior
Mimiaga et al. (2012)	Project IMPACT intervention (10 sessions 10 sessions of behavioral activation with integrated HIV risk reduction counseling, approximately 50 min each); three assessment visits Setting: Outpatient Design/Location: Pre-Post (No control group)/ USA	Inclusion Criteria: ≥18 years; self-reporting CAI with a non-monogamous male sexual partner while concurrently using crystal meth in the past 3 months; and HIV-	**At 26-week follow-up (post-enrolment):** * Significant decrease over time in the number of crystal meth episodes in the previous 3 months (P < 0.0001) and the number of days of crystal meth use in the past month (P = 0.010) * Mean CAI episodes decreased significantly (P = 0.0015) * Statistically significant reductions in depressive symptoms and poly-substance use (P < 0.05) * Adding behavioral activation to risk reduction counseling for meth using MSM with problematic crystal meth use may be beneficial
Reback et al. (2012)	Two-week test-messaging intervention Setting: Outpatient Design/Location: Pre-Post (No control group)/ USA	Inclusion Criteria: identifying as male; 18-65 years; CAI with a non-primary male partner in the previous two months; used meth in the previous two months; not currently in or seeking drug treatment; HIV-; current resident of Los Angeles County not planning to move in the next five months; agreeing to comply with study procedures; willing to participate in a two-week text-messaging intervention.	**At 8-week follow-up (post-enrolment):** * Significant decreases in frequency of meth use (P < 0.01) and unprotected sex while on meth (P < 0.01) and a significant increase in self-reported abstinence from meth use (P < 0.001) * Significant reductions in CAI with HIV + partner (P < 0.01) * Significant reductions in CRAI, and CIAI with HIV- partners (P < 0.05) * Text messaging is a promising intervention for reaching and changing HIV high-risk behaviors among out-of-treatment, meth using MSM
Zule et al. (2012)	A single-session motivational	Inclusion criteria: ≥18 years; self-	**At 8-week follow-up (post-**

Table 4 (*continued*)

Author (year)	Intervention description	Inclusion/Exclusion Criteria	Main Findings
	interviewing (MI) intervention; eight sections taking an average of 55 minutes that reviewed patterns of meth use and sexual behavior, enhanced motivation to change and developed a plan for change Setting: Outpatient Design/Location: Pre-Post (No control group)/ USA	reporting meth use at least twice in the previous two months; and self-reporting CAI with a non-primary male partner in the previous two months	**enrolment):** * Reductions in meth use (P = 0.023) and number of sex partners (P = 0.037) during the last 2 months * Significant reduction in CAI (P = 0.013) and self-reported CAI at last sex with a non-primary partner (P = 0.001) * A single-session MI intervention may be beneficial in reducing meth use and sexual risk among meth using MSM
Carrico et al. (2014)	Stonewall Project model using the following management strategies Stonewall Project model include: (1) transitioning to less potent modes of meth administration; (2) promoting self-care strategies while using meth; (3) delivering education about safer injection practices Setting: Outpatient; and 4) delivering sexual risk-reduction interventions Design/Location: Pre-Post (No control group)/ USA	Inclusion criteria: Meth-using MSM receiving treatment at the Stonewall Project who provided consent	**At 52-week follow-up (post-enrolment):** * Participants in study 1 reported reductions in cocaine/crack use (IRR = 0.54; 95% CI: 0.32, 0.91), increases in cannabis use (IRR = 1.46; 95% CI: 1.02, 2.09) but not in meth use (P > 0.05) * Study 2 participants reported reductions in meth use over the 6-months follow-up (IRR = 0.71; 95% CI: 0.52, 0.96) * Study 2 participants reported reductions in number of anal sex partners (IRR = 0.45; 95% CI: 0.27,0.73) as well as decreased odds of receptive anal sex (IRR = 0.53; 95% CI: 0.30, 0.94) while using meth over the 6-months follow-up * Clients may reduce stimulant use and concomitant sexual risk-taking behavior during harm reduction substance abuse treatment
Lyons et al. (2014)	"C-TALK" intervention; 10 small-group sessions of 1.5 hr each, led by either MSM peers who were former stimulant users (two facilitators)	Inclusion criteria: Men who reported using stimulants before or during condomless anal intercourse in the previous 6 months	**At 12-week follow-up (post-enrolment):** * Significant declines were seen between baseline and follow-up in both meth use (P < 0.001) and

(*continued on next page*)

Table 4 (*continued*)

Author (year)	Intervention description	Inclusion/Exclusion Criteria	Main Findings
	or an MSM drug and alcohol counselor (one facilitator). Setting: Outpatient Design/Location: Pre-Post (No control group)/ USA		CAI while using meth ($P < 0.02$) * 40% of the sample reported no stimulant use in the 3-month follow-up period
Parsons et al. (2014)	Four sessions of MI or four sessions of content-matched education; Participants were followed every three months for one year; Setting: Outpatient Design/Location: RCT/USA	Inclusion criteria: Young gay and bisexual men; residing in the New York City metropolitan area; 18–29 years; self-reporting as HIV-; and at least five days of drug use and at least one incident of CAI with a high-risk male partner in the last 90 days	**At 52-week follow-up (post-enrolment):** * Significant reductions in any meth use over time * Young gbMSM in the MI condition were less likely to use drugs ($P < 0.01$) and engage in CAI ($P < 0.01$) than those in the education condition * Significant reductions in CAI ($P < 0.001$) * Findings support the utility of MI, compared to a content-matched education condition, to significantly reduce both CAI and drug use among YGBM
Reback and Shoptaw (2014)	**Study 1:** Four treatment conditions: CM, standard CBT, a combination of standard CBT + CM, or the GCBT intervention **Study 2:** Two treatment conditions: the GCBT intervention or a gay-specific social support therapy (GSST) intervention. **Study 3:** All participants received the modified GCBT intervention and a low-cost CM intervention. Setting: Outpatient Design/Location: RCT/USA	Inclusion criteria: Self-identified gbMSM; 18-65 years; seeking treatment for meth abuse; no psychiatric or medical conditions that precluded safe study participation; and ability to comply with study requirements	**At 26-week follow-up (post-enrolment):** * Modified GCBT + CM produced significantly fewer consecutive weeks of meth abstinence at the end of treatment and fewer male sexual partners at 26 weeks follow-up than the first trial of GCBT ($P < 0.05$) * Modified GCBT + CM produced greater effects in reducing the number of male sexual partners ($P < 0.01$) * The original GCBT produced more and mostly short-term beneficial drug use outcomes, though sexual behavior changes consistently favored the modified GCBT + CM * Most benefits are retained with the modified GCBT + CM

Table 4 (*continued*)

Author (year)	Intervention description	Inclusion/Exclusion Criteria	Main Findings
			intervention * The modified GCBT brought about greater reductions in the number of male sexual partners, but all GCBT conditions reduced CAI at similar levels.
Santos et al. (2014)	Brief Personalized Cognitive Counseling intervention with rapid HIV testing or to rapid HIV testing only control; followed over 6 months. Setting: Outpatient Design/Location: RCT/USA	Inclusion criteria: Reporting no more than episodic use (defined as less than weekly use) within two hours before/ during sex of one of the following target sub- stances previously identified as drivers of HIV risk among MSM: meth, cocaine/crack, amyl nitrite ("poppers"), and binge-drinking	**At 26-week follow-up (post-enrolment):** * No reduction in any meth use (RR = 0.72; 95% CI: 0.36,1.42) * Personalized Cognitive Counseling was associated with significant reductions in number of CAI events while under the influence of meth (RR = 0.26; 95% CI = 0.08, 0.84)
Carrico et al. (2015)[a]	ARTEMIS: 5 individual sessions targeting positive affect regulation; CM: 12 weeks of thrice weekly urine visits; After completing 4 weeks of a 12-week CM program, participants were randomized to receive ARTEMIS + CM or CM-only. Setting: Outpatient Design/Location: RCT/USA	Inclusion criteria: Self-identify as male; report having anal sex with a man in the past year; and report using meth at least weekly on average during the 3 months prior to CM	**At 26-week follow-up (post-enrolment):** * Participants in ARTEMIS + CM reported modest increases in positive affect at two-month post-randomization ($P < 0.05$), but these were not maintained through the 6-month follow-up ($P > 0.05$) * Participants in CM-only reported significant reductions in negative affect immediately at two-month post-randomization ($P < 0.05$) that were not maintained through the 6-month follow-up ($P > 0.05$) * No significant concurrent effects on stimulant use or sexual risk taking were observed over time ($P > 0.05$).
Carrico et al. (2015)[b]	Expressive writing, neutral writing; 7 individual 20-min sessions Setting: Outpatient Design/Location: RCT/USA	Inclusion criteria: Self-identify as male; report having anal sex with a man in the past year; diagnosed with HIV for at least 3 months; and report using meth in the past 30 days	**At 13-week follow-up (post-enrolment):** * Expressive writing reduced meth use at 4 weeks, but not 13 weeks * Those in the RAP intervention reported significant reductions in the

(*continued on next page*)

Table 4 (*continued*)

Author (year)	Intervention description	Inclusion/Exclusion Criteria	Main Findings
			frequency of meth use immediately following the 1-month RAP intervention period ($P < 0.01$) * Attention-control participants reported significant decreases in HIV-related traumatic stress while RAP intervention participants reported no significant changes * RAP participants reported significant decreases in the number of HIV transmission risk partners while using methamphetamine.
Santos et al. (2016)	50 mg Naltrexone or placebo for 8 weeks for targeted administration; Substance use counseling and behavioral assessments were conducted every 2 weeks. Setting: Outpatient Design/Location: RCT/USA	Inclusion criteria: Active meth use (at least twice per month) and binge-drinking (at least weekly); AI with men in past 3 months while under the influence of meth or alcohol; interest in reducing or stopping their meth use and binge drinking; 18–70 years; no acute medical or psychiatric illnesses; no known allergy or adverse reaction to naltrexone, no current opioid use or dependence; D4 count > 200 in HIV + participants; and no dependence on alcohol or meth	**At 8-week follow-up (post-enrolment):** * In frequent meth user, naltrexone was associated with reductions in meth using days (IRR = 0.78; 95% CI: 0.62,0.99) and binge-drinking days (IRR = 0.72; 95% CI: 0.54, 0.97) reductions. * Naltrexone participants had greater reductions in serodiscordant receptive anal intercourse (IRR = 0.15; 95% CI: 0.05, 0.42) and serodiscordant condomless receptive anal intercourse (IRR = 0.11; 95% CI: 0.03, 0.37) * Targeted naltrexone is a feasible, acceptable, and tolerable intervention strategy for nondependent meth-using and binge-drinking MSM.
Lea et al. (2017)	gbMSM receiving treatment for meth use from a Substance Support Service were interviewed at treatment commencement, 4 sessions (follow-up 1) and 8 sessions (follow-up 2) completing	Inclusion criteria: Self-identifying as gay or bisexual; ≥18 years; seeking treatment for meth use; meth listed as the principal drug of concern in their client records; English language proficiency; and	**At 1-week follow-up (post-enrolment):** * Significant reduction in the median days of meth use ($P = 0.001$) * Significant reduction in the proportion of participants

Table 4 (*continued*)

Author (year)	Intervention description	Inclusion/Exclusion Criteria	Main Findings
	measures of meth use and dependence, other substance use, injecting risk practices, psychological distress, and quality of life Setting: Outpatient Design/Location: Pre-Post (No control group)/ Australia	providing informed consent	reporting meth dependence ($P < 0.001$) * Significant reductions in psychological distress, and significant improvements in quality of life ($P < 0.001$) * Clients showed reductions in meth use and improved psychosocial functioning over time, demonstrating the potential effectiveness of a LGBTI-specific treatment service.
Nyamathi et al. (2017)	A Nurse Case Management Plus Contingency Management or a Standard Education Plus Contingency Management program; 20 to 30-minute sessions delivered by G/B community peers individually or group-based; aimed at promoting strategies to reduce risk of hepatitis and HIV; 16 weeks; thrice weekly urine visits Setting: Outpatient Design/Location: RCT/USA	Inclusion criteria: 18-46 years; being homeless; stimulant use within the past 3 months; and no participation in substance abuse treatment in the past 30 days	**At 34-week follow-up (post-enrolment):** * Regardless of group assignment, significant and clinically relevant reductions were observed in meth use ($P = 0.001$) * Significant linear decline in reporting multiple partners ($P = 0.001$) in all groups
Reback and Fletcher, 2017	Individual sessions were offered at 30, 60 and 90-day time-points; participants received $5 gift cards for each individual or group session attended up to a maximum of $50. Setting: Outpatient Design/Location: Pre-post/USA	Inclusion criteria: self-identified male; reporting sex with another male in the past year; and self-reporting use of any substance in past year	**At 12-week follow-up (post-enrolment):** * Marginally significant reduction in meth use (AOR = 0.83; $P = 0.061$) * Significant reduction in sexual risk behaviors including: sex while high or drunk, HIV serodiscordant CAI and HIV serodiscordant partner (both $p = < 0.01$) and CAI ($p < 0.001$).
Coffin et al. (2018)	3 monthly intramuscular injections of naltrexone 380 mg (extended release) or placebo for 12	Inclusion criteria: Meth-dependent; willingness to quit; 18–65 years; anal sex with men while under the influence of meth (L6M); no	**At 12-week follow-up (post-enrolment):** * Similar reduction in meth-positive urines in naltrexone and placebo groups

(*continued on next page*)

Table 4 (*continued*)

Author (year)	Intervention description	Inclusion/Exclusion Criteria	Main Findings
	weeks; weekly urine visits and 30-minute substance use counseling using cognitive behavioral therapy and motivational interviewing Setting: Outpatient Design/Location: RCT/USA	acute medical or psychiatric illnesses; no current opioid use or dependence; CD4 count > 200 in HIV + participants; and no known intolerance or hypersensitivity to naltrexone	(IRR) = 0.95, 95% (CI) = 0.76–1.20. * Sexual risk behaviors declined similarly in both arms (all P > 0.05). * No serious adverse events in both groups * Extended-release naltrexone does not appear to reduce meth use or sexual risk behaviors among meth-dependent MSM

* Abbreviations: CBT: Cognitive–Behavioral Therapy; CM: Contingency Management; GCBT: Gay-Specific Cognitive–Behavioral Therapy; GSST: Gay-Specific Social Support Therapy; MI: Motivational Interviewing; PROP: Positive Reinforcement Opportunity Project; gbMSM: gay, bisexual and other men who have sex with men; CAI: Condomless Anal Intercourse; CRAI: Condomless Receptive Anal Intercourse; CIAI: Condomless Insertive Anal Intercourse; PEP: Post Exposure Prophylaxis; RCT: Randomized Controlled Trial; IRR: Incidence Rate Ratio; RR: Rate Ratio; LM: Last month; CI: Confidence Interval; P: P-value.

Shoptaw et al., 2006, 2008; Shoptaw et al., 2005) with samples of between 12.5%–64.4% reporting injecting; the remaining studies did not report on injection status. Seventeen studies measured and reported on polysubstance use, including studies that reported on the use of cocaine, alcohol, cannabis, and ecstasy (Carrico et al., 2014; Das et al., 2010; Fletcher et al., 2014; Fletcher and Reback, 2013; Landovitz et al., 2012; Lea et al., 2017; Lyons et al., 2014; Menza et al., 2010; Mimiaga et al., 2012; Nyamathi et al., 2017; Parsons et al., 2014; Reback et al., 2010; Santos et al., 2016, 2014; Shoptaw et al., 2008; Wu et al., 2011; Zule et al., 2012); the remaining eleven did not provide information on polysubstance use (Carrico et al., 2015a, b; Coffin et al., 2018; Colfax et al., 2011; McElhiney et al., 2009; Reback and Fletcher, 2017; Reback et al., 2012; Reback and Shoptaw, 2014; Shoptaw et al., 2006, 2005; Strona et al., 2006).

4.3. Study quality

Of the 16 RCTs, four were assessed as having a low risk of bias (Coffin et al., 2018; Colfax et al., 2011; Menza et al., 2010; Santos et al., 2016) with the remaining having either an unclear or high risk of bias. Of the 12 non-randomized pre-post studies, all were assessed as moderate quality (i.e., no 'fatal flaw' was observed, but some risk of bias was present). See supplemental Tables 3 and 4 for full details.

4.4. Measurement of MA use

Four studies reported measuring MA use through a urinalysis for methamphetamines via direct observation (e.g., a research assistant) (Menza et al., 2010; Shoptaw et al., 2006, 2005; Strona et al., 2006), while 15 studies used urinalysis without reporting on direct observation (Carrico et al., 2014, 2015a; Carrico et al., 2015b; Coffin et al., 2018; Colfax et al., 2011; Das et al., 2010; Fletcher et al., 2014; Fletcher and Reback, 2013; Landovitz et al., 2012; McElhiney et al., 2009; Nyamathi et al., 2017; Reback et al., 2012, 2010; Reback and Shoptaw, 2014; Shoptaw et al., 2008). The remaining nine studies used self-reported measures of MA use (Lea et al., 2017; Lyons et al., 2014; Mimiaga et al., 2012; Parsons et al., 2014; Reback and Fletcher, 2017; Santos et al., 2016, 2014; Wu et al., 2011; Zule et al., 2012).

5. Interventions and effects

Twenty-two of the 28 studies reported a statistically significant effect on one or more MA-related outcomes (Carrico et al., 2014, 2015b; Colfax et al., 2011; Fletcher et al., 2014; Fletcher and Reback, 2013; Landovitz et al., 2012; Lea et al., 2017; Lyons et al., 2014; Mimiaga et al., 2012; Nyamathi et al., 2017; Parsons et al., 2014; Reback and Fletcher, 2017; Reback et al., 2012, 2010; Reback and Shoptaw, 2014; Santos et al., 2016, 2014; Shoptaw et al., 2008, 2005; Strona et al., 2006; Wu et al., 2011; Zule et al., 2012). Among the 23 studies that included measures of sexual health-related outcomes, 18 reported a statistically significant effect on one or more sexual health-related outcomes such as having sex while under the influence of drugs or engaging in condomless anal intercourse (CAI) (Carrico et al., 2014; Colfax et al., 2011; Landovitz et al., 2012; Lyons et al., 2014; Menza et al., 2010; Mimiaga et al., 2012; Nyamathi et al., 2017; Parsons et al., 2014; Reback and Fletcher, 2017; Reback et al., 2012; Reback and Shoptaw, 2014; Santos et al., 2016, 2014; Shoptaw et al., 2008, 2005; Strona et al., 2006; Wu et al., 2011; Zule et al., 2012). Of those, 15 reported a concurrent effect on both MA and sexual health-related outcomes (Carrico et al., 2014; Colfax et al., 2011; Landovitz et al., 2012; Lyons et al., 2014; Mimiaga et al., 2012; Nyamathi et al., 2017; Parsons et al., 2014; Reback and Fletcher, 2017; Reback et al., 2012; Santos et al., 2016; Shoptaw et al., 2008, 2005; Strona et al., 2006; Wu et al., 2011; Zule et al., 2012). Of the 28 studies, all assessed out-patient interventions in the following intervention categories: (i) pharmacological (n = 5); (ii) psychosocial (n = 22); and (iii) harm reduction (n = 1).[1] Further details regarding the characteristics of interventions, including significant and other main findings, are reported above in Table 4. Supplemental Table 5 summarizes the evidence of efficacy by intervention modality.

5.1. Pharmacological interventions

Clinical care guidelines developed to address MA dependence generally acknowledge that there are no evidence-based pharmaceutical treatments available that would be equivalent to treatments for opioid use disorder (e.g., methadone) (Hill, 2015). As such, there are currently no widely accepted pharmacological treatments for MA use (Ciketic et al., 2012; Morely et al., 2017), despite increasing trial data involving a variety of treatments, including dopamine agonists, antagonists and psychostimulants.

Four RCTs assessed pharmacological interventions against placebo. Das et al. (2010) provided participants with a once-daily dose of Bupropion (atypical antidepressant, agonist) and weekly substance use counseling sessions; no difference was reported between the bupropion and placebo arms for both MA use and median number of sexual partners after 12-weeks of treatment. Colfax et al. (2011) combined Mirtazapine (atypical antidepressant, agonist) with 30-minute weekly substance use counseling sessions for 12-weeks and found a decrease in MA use despite sub-optimal adherence to the medication. The study condition was also associated with decreases in sexual risk behavior, including the number of partners and episodes of CRAI and CIAI (Colfax et al., 2011). Santos et al. (2016) provided participants with 'on-demand' naltrexone (antagonist) (e.g., during cravings or in anticipation of MA use) and substance use counseling every 2-weeks. At 8-week follow-up, naltrexone was associated with significant sexual risk reductions, including reductions in sero-discordant receptive anal

[1] If an intervention required that participants agree to abstinence from MA use, 'Willingness to quit required' was assessed as a feature of the intervention (e.g., Yes). If an intervention did not require a participant to remain abstinent, it was assessed as 'No'. If the authors did not include information about whether or not study participants were required to agree to abstinence it was assessed as 'Not Reported' (NR).

Table 5
Differential effects of meth treatment interventions among MSM by social positioning.

Characteristic	Differential intervention effects by social positioning
Sexual identity	* Seventeen studies reported sample compositions that included measures of sexual identity, including: seven studies reporting the inclusion of gay and bisexual men (Shoptaw et al., 2005; Strona et al., 2006; Shoptaw et al., 2008; Parsons et al., 2014; Reback et al., 2012; Lea et al., 2017; Nyamathi et al., 2017) * Seven studies reporting the inclusion of gay, bisexual, straight and other men (e.g., queer, unsure, not gay) (Landovitz et al., 2012; Wu et al., 2011; Menza et al., 2010; Carrico et al., 2014; Zule et al., 2012; Mimiaga et al., 2012; Reback and Fletcher, 2017); two studies reporting the inclusion of men described as 'mostly gay' (Carrico et al., 2015b, a) and one study reporting that it included 'some gay men' (McElhiney et al., 2009) * Seven studies used behavioural measures in place of identity measures (e.g., self-reported anal sex with men) (Shoptaw et al., 2006; Das et al., 2010; Reback et al., 2010; Colfax et al., 2011; Fletcher et al., 2014; Lyons et al., 2014; Santos et al., 2016); The remaining four studies did not provide details on the sexual identity of participants (Fletcher and Reback, 2013; Reback and Shoptaw, 2014; Santos et al., 2014; Coffin et al., 2018) * None of the studies reported on differential effects based on sexual identity.
Gender identity	* Three studies measured participant gender identity and reported enrolling transgender participants (Nyamathi et al., 2017; Carrico et al., 2014; Coffin et al., 2018), though these were small proportions of the study samples, including two of 211 participants (Carrico et al., 2014). * Nyamathi et al. (Nyamathi et al., 2017) enrolled 29 transgender participants but excluded these participants from the analysis. * Coffin et al. (Coffin et al., 2018) enrolled 4 transgender participants in their sample of 100, differential effects were not discussed.
HIV status	* Three studies reported samples that were HIV negative (Landovitz et al., 2012; Mimiaga et al., 2012; Parsons et al., 2014) and one study did not measure or report participant serostatus (Santos et al., 2014). * One study was comprised exclusively of HIV-positive individuals (Carrico et al., 2015b), four studies included a sample of > 75% HIV positive (Shoptaw et al., 2006; McElhiney et al., 2009; Wu et al., 2011; Lyons et al., 2014), ten of 50-75% HIV positive (Shoptaw et al., 2005; Strona et al., 2006; Shoptaw et al., 2008; Menza et al., 2010; Colfax et al., 2011; Reback et al., 2012; Carrico et al., 2014; Reback and Shoptaw, 2014; Lea et al., 2017; Coffin et al., 2018), seven of 25-49% HIV positive (Das et al., 2010; Reback et al., 2010; Zule et al., 2012; Fletcher and Reback, 2013; Fletcher et al., 2014; Carrico et al., 2015a; Santos et al., 2016) and two of < 25% HIV positive (Nyamathi et al., 2017; Reback and Fletcher, 2017). * Menza et al. (Menza et al., 2010) reported that HIV-positive participants were more likely to attend the 24-week follow-up appointment than HIV-negative participants and the authors attributed this effect to HIV-positive participants being more likely to recognize MA use as being 'problematic' and/or attributing their positive HIV seroprevalence to MA use. * Shoptaw et al. (Shoptaw et al., 2008) reported that those participants using MA had a higher prevalence of HIV rates than those who reported the use of other psychoactive substances (e.g., alcohol, cocaine). * Nyamathi et al. (Nyamathi et al., 2017) reported that HIV-positive participants were more likely to report MA use and multiple sexual partners at 16- and 32-week follow-up than HIV-negative participants. * Reback et al. (Reback et al., 2010) reported that HIV-positive participants completed more 'health-promoting' behavior associated with the intervention, while HIV-negative participants were more likely to abstain from MA use during the 32-week intervention. * Reback et al. (Reback et al., 2012) measured and reported differential effects based on the serostatus of the participants' primary partner; the findings indicated that participants with an HIV-negative primary partner reduced all sexual risk behavior measured, while those with an HIV-positive primary partner reported being more likely to engage in serosorting (i.e., fewer incidents of CRAI and more incidents of CIAI).
Socioeconomic status	* Twenty-five studies assessed one or more measures of socioeconomic status, including educational attainment (Shoptaw et al., 2005; Landovitz et al., 2012; Das et al., 2010; Colfax et al., 2011; Wu et al., 2011; Fletcher and Reback, 2013; Carrico et al., 2015a; Nyamathi et al., 2017; Carrico et al., 2014; Shoptaw et al., 2008; Zule et al., 2012; Mimiaga et al., 2012; Santos et al., 2014; McElhiney et al., 2009; Santos et al., 2016; Reback et al., 2012; Parsons et al., 2014; Menza et al., 2010; Reback and Fletcher, 2017; Coffin et al., 2018), employment status (Das et al., 2010; Colfax et al., 2011; Wu et al., 2011; Carrico et al., 2015b, a; Carrico et al., 2014; Lyons et al., 2014; Zule et al., 2012; Nyamathi et al., 2017; Mimiaga et al., 2012; Santos et al., 2014, 2016; McElhiney et al., 2009; Reback et al., 2012; Lea et al., 2017; Menza et al., 2010; Coffin et al., 2018) and income (Landovitz et al., 2012; Das et al., 2010; Colfax et al., 2011; Wu et al., 2011; Lyons et al., 2014; Shoptaw et al., 2008; Zule et al., 2012; Mimiaga et al., 2012; Santos et al., 2014, 2016; Reback et al., 2012; Parsons et al., 2014; Menza et al., 2010; Lea et al., 2017; Coffin et al., 2018). * Three studies did not measure or report on socio-economic status (Shoptaw et al., 2006; Strona et al., 2006; Reback and Shoptaw, 2014). * None of the studies reported on differential effects of interventions by socioeconomic status.
Ethno-racial characteristics	* Of the studies from the USA, 15 studies reported sample compositions with > 50% White/Caucasian participants (Shoptaw et al., 2005, 2008; McElhiney et al., 2009; Das et al., 2010; Menza et al., 2010; Reback et al., 2010; Colfax et al., 2011; Landovitz et al., 2012; Mimiaga et al., 2012; Fletcher and Reback, 2013; Carrico et al., 2014; Fletcher et al., 2014; Reback and Shoptaw, 2014; Carrico et al., 2015a; Coffin et al., 2018) and three with > 50% Black/African American participants (Wu et al., 2011; Zule et al., 2012; Lyons et al., 2014). * The study from Australia (Lea et al., 2017) reported a sample composition of 69.3% of participants being 'Australian' with the remaining unreported, though it is mentioned that three participants identified as 'Aboriginal and/or Torres Strait Islander'. * The remaining studies were comprised of over 30% Latino participants (Reback et al., 2012), White participants (Parsons et al., 2014; Santos et al., 2014; Carrico et al., 2015b; Santos et al., 2016; Reback and Fletcher, 2017) or White and African American participants (Nyamathi et al., 2017). * Two studies did not report the ethno-racial characteristics of their study samples (Shoptaw et al., 2006; Strona et al., 2006). * Reback et al. (Reback et al., 2010) reported that Caucasian men were more likely to complete the targeted 'health-promoting' behaviour and were also more likely to completely abstain from substance use when compared with African American and Latino participants. They also reported that Latino men in the CM condition showed no difference when compared with the control conditions, whereas Caucasian men showed an increase in targeted behaviors (e.g., reduction in sexual risk, increased MA abstinence). The authors hypothesize that this difference may be attributed to language difficulties and fear or distrust based upon the immigration status of Latino participants. * Nyamathi et al. (Nyamathi et al., 2017) reported that participants classified as 'other' ethnicity (i.e., ethno-racial identities other than the categories of White, Black, Hispanic or 'mixed') were less likely to report both having a regular health care provider and MA use during intervention follow up, and the authors highlight how this combination does not correspond to previous literature in this area. * Parsons et al. (Parsons et al., 2014) described how their study composition, comprising 60% men of color may have increased the magnitude of the intervention effect size in a favourable direction, including reduced CAI and substance use. * Finally, in discussing study findings, four studies indicated that ethnicity may have impacted intervention efficacy, but did not provide a hypothesis as to why this occurred (e.g., theoretical mechanisms or pathways) (Shoptaw et al., 2005; Wu et al., 2011; Lyons et al., 2014; Zule et al., 2012).
Age	* Twenty-two studies reported the sample mean age and provided the standard deviation (Shoptaw et al., 2005, 2008; McElhiney et al., 2009; Das et al., 2010; Reback et al., 2010; Colfax et al., 2011; Wu et al., 2011; Landovitz et al., 2012; Mimiaga et al., 2012; Reback et al., 2012; Zule et al., 2012; Fletcher and Reback, 2013; Carrico et al., 2014; Lyons et al., 2014; Reback and Shoptaw, 2014; Santos et al., 2014; Carrico et al., 2015b, a; Santos et al., 2016; Reback and Fletcher, 2017; Nyamathi et al., 2017; Coffin et al., 2018). * Three studies reported the sample's median age (Fletcher et al., 2014; Menza et al., 2010; Lea et al., 2017), with one also providing the sample

(*continued on next page*)

Table 5 (*continued*)

Characteristic	Differential intervention effects by social positioning
	age range (Menza et al., 2010). One study focused specifically on 'young' (i.e., 18-29 years) men and only provided a sample age range (Parsons et al., 2014). * Two studies did not provide information on the composition of the sample by age (Shoptaw et al., 2006; Strona et al., 2006). * Shoptaw et al. (2005) suggest that there may be differential intervention outcomes associated with a younger age that they did not have the capacity to interrogate because their sample mean was 37 years (Shoptaw et al., 2005). * The study focusing on young gbMSM who use MA argued that they did so because this population is disproportionately at risk for HIV (Parsons et al., 2014).
Geography	* Twenty-five studies were conducted in urban settings (Shoptaw et al., 2005, 2006; Strona et al., 2006; Shoptaw et al., 2008; McElhiney et al., 2009; Menza et al., 2010; Reback et al., 2010; Colfax et al., 2011; Landovitz et al., 2012; Mimiaga et al., 2012; Reback et al., 2012; Zule et al., 2012; Fletcher and Reback, 2013; Carrico et al., 2014; Fletcher et al., 2014; Parsons et al., 2014; Reback and Shoptaw, 2014; Santos et al., 2014; Carrico et al., 2015b, a; Santos et al., 2016; Lea et al., 2017; Nyamathi et al., 2017; Reback and Fletcher, 2017; Coffin et al., 2018). * Three studies did not include data on study setting (Das et al., 2010; Wu et al., 2011; Lyons et al., 2014).

intercourse and sero-discordant CRAI (compared with placebo) and among some participants was associated with a reduction in MA use. Coffin et al. (2018) found that extended-release naltrexone was not associated with reductions in either MA use or sexual risk behaviors among MSM.

McElhiney et al. (2009) conducted a pre-post study (no control) to assess Provigil (modafinil) for 12-weeks, followed by 4-weeks of placebo, combined throughout with 1–2 weekly sessions of cognitive behavioral therapy. The authors suggest that these preliminary pilot data indicate modafinil may be useful for MA users who are actively reducing/tapering their MA use; sexual health outcomes were not assessed.

5.2. Psychosocial interventions

5.2.1. Motivational interviewing

Motivational Interviewing (MI) has been defined as '*a collaborative, person-centered form of guiding to elicit and strengthen motivation for change*' (Miller and Rollnick, 2009). Broadly, MI is an approach to counseling that centers on an individual's internal motivations to change a behavior by building upon the information patients provide about their willingness to change and by focusing discussion on what would be needed to make those changes.

Parsons et al. (2014) randomized participants into four sessions of MI or 'content-matched' education among young MSM. At 52-week follow-up, participants in both conditions reported a reduction in MA use, while participants in the MI condition were less likely to engage in CAI.

Zule et al. (2012) used a pre-post study design to assess a single-session MI intervention among an 'out-of-treatment' sample of MSM who use MA, and participants were assessed with a follow-up interview two months later. The intervention was associated with a decrease in MA use, as well as the frequency of condomless anal intercourse, leading the authors to suggest single-session MI interventions may be helpful in settings where multi-session interventions are not feasible.

5.2.2 Contingency Management Interventions. Contingency Management (CM) is based on an approach in which positive reinforcements (e.g., monetary or other rewards) are used to reinforce a specified behavior (Hill, 2015). In the treatment of substance use disorder, CM draws on four key operating principles (Higgins and Delaney, 1991): (1) the surveillance of substance use (e.g., via urinalysis) to identify patterns of use, including abstinence; (2) the use of positive reinforcements when abstinence from a substance occurs; (3) the loss of reinforcements when substance use occurs; and (4) an emphasis on reinforcements.

Eight RCTs assessed contingency management (CM) interventions. Shoptaw et al. (2005) randomized participants to one of four treatment conditions: standard cognitive behavioural therapy (CBT), CM, combined CBT and CM, and a culturally tailored CBT (i.e., 'gay-specific' or 'GCBT'). Study findings indicated a maximal reduction of MA use within treatment conditions containing CM, whereas maximal reductions in CRAI was within the culturally tailored GCBT condition, but only during the first four weeks of the treatment. Menza et al. (2010) randomized participants to receive a CM intervention or referral to community resources (i.e., counseling, treatment, and other outreach services). Both conditions were comparably likely to provide urine samples containing MA and report non-concordant CAI, and both study conditions evidenced significant declines in CAI. However, during the post-intervention follow-up, CM participants were more likely to provide urine samples containing MA and report more frequent MA use during and post-intervention, leading the authors to conclude that CM as a stand-alone is not likely to yield sustained effects on MA use. Carrico et al. (2015a) randomized participants to a CM condition and a CM plus an intervention targeting positive affect (e.g., experiencing positive moods). Affective changes were not maintained, and no concurrent effects on stimulant use or sexual risk-taking were observed over the 6-month follow-up. Nyamathi et al. (2017) conducted an RCT with homeless gay and bisexual men to assess the impact of two 'culturally sensitive' intervention programs on the reduction of substance use and risky sexual behavior: a 'Nurse Case Management Plus Contingency Management' (NCM + CM) and a 'Standard Education Plus Contingency Management' (SE + CM) program. Both groups achieved a significant reduction in MA use and a decline in reporting multiple partners over time.

Three articles assessed a single intervention that randomized non-treatment-seeking homeless MSM into a CM intervention in which participants from both conditions could earn points for attending scheduled study visits and participating in HIV prevention program activities, while those in the CM condition also earned points for health-promoting behavior, including drug/alcohol abstinence and a set of pre-specified 'complex behaviors' ranging in scale from 'low impact' (e.g., scheduling a health care appointment) to 'high impact' (e.g., keeping a job for a month). None of these studies assessed sexual health outcomes. Reback et al. (2010) found that participants in the study condition achieved greater reductions in MA and alcohol use and greater increases in health-promoting behavior than those in the control condition. Fletcher and Reback (2013) identified how individuals with an antisocial personality disorder (ASPD) achieved significantly higher MA abstinence outcomes than their non-ASPD diagnosed counterparts; however, individuals with ASPD displayed suboptimal outcomes in achieving health-promoting behavior. Fletcher et al. (2014) identified how those who used MA during the intervention exhibited less time between voucher redemptions than individuals who were abstinent.

Reback and Shoptaw (2014) used meta-analysis to compare outcomes from three trials of which two are reported separately in this review (Shoptaw et al., 2005, 2008). The third trial comprised a pre-post intervention in which participants received a shortened (24 sessions versus 48) GCBT intervention and a lower-cost CM intervention. At 26-week follow-up the modified GCBT + CM intervention was associated with more MA use among participants (compared with the original GCBT intervention), but the shortened version resulted in greater reductions in number of male sexual partners.

Three pre-post studies assessed CM interventions, each running for

12-weeks. Both Shoptaw et al. (2006) and Strona et al. (2006) assessed a 'live' intervention (the Positive Reinforcement Opportunity Project – PROP, that had already been implemented prior to the study) in San Francisco. Strona et al. (2006) found that of the urine samples collected from PROP participants, most were negative for MA, thereby suggesting that participants who continued to use MA while enrolled in PROP were less likely to provide specimens after recent use. Nevertheless, PROP participants reported a significant reduction in the number of sex partners. Shoptaw et al. (2006) found that Clinical responses to CM in PROP were similar to CM delivered in other substance use treatment programs; sexual health outcomes were not assessed. Landovitz et al. (2012) assessed a CM intervention among participants who reported a recent high-risk sexual or injection drug exposure and who were subsequently initiated on Post-Exposure Prophylaxis. MA use and the number of sex partners decreased significantly, as well as reductions in episodes of CAI.

5.2.3 Other Psychosocial Interventions. Three studies conducted RCTs to assess 'other' psychosocial interventions, including those falling under two broad umbrellas: cognitive therapy and behavioral therapy. Broadly, these interventions aim to treat an individual in a way that emphasizes the influence that both psychological factors and the broader social environment have on a given risk behavior (e.g., drug- and sexual-related risk behavior).

Santos et al. (2014) randomized participants into conditions consisting of either a brief personalized cognitive counseling (PCC) intervention with rapid HIV testing or only rapid HIV testing. At the 26-month follow-up, there was no reduction in MA use, but those in the PCC condition reported reductions in CAI while using MA. Carrico et al. (2015b) randomized participants into either a 7-session, multicomponent resilient affective processing (RAP) intervention with expressive writing exercises regarding HIV-related stress versus a control that focused on writing exercises regarding 'neutral' topics. Those in the study condition reported reductions in MA use at four weeks but not at 13 weeks, as well as reductions in HIV-related traumatic stress; other sexual health outcomes were not assessed. Shoptaw et al. (2008) assessed two study conditions by randomly assigning participants to either 16 weeks of a 'gay-specific' cognitive behavioral therapy (GCBT) or to a 'gay-specific' social support therapy (GSST). GCBT was associated with an increased reduction in MA use at the 52-week follow-up; however, reductions in MA use and sexual risk practices were observed in both conditions.

Six studies used pre-post study designs to assess the remaining psychosocial interventions. Mimiaga et al. (2012) offered participants ten sessions of a behavioral activation intervention (a treatment for depression that aims to provide patients with the ability to 're-engage' in life's activities) combined with HIV risk-reduction counseling. At 26-week follow-up, participants reported a decrease in MA use and CAI. Wu et al. (2011) assessed a seven-session couple-based intervention for Black couples. To be eligible, at least one member of each dyad needed to report using MA. Participants reported a decrease in MA use and number of sexual partners and episodes of CAI, as well as increased condom use with their 'main' partner. Lyons et al. (2014) conducted a 10-session peer-led social-cognitive theory group-based intervention that included a 'healthy sexuality' component. At 12-week follow-up, participants reported a decrease in both MA use and CAI while using MA. Lea et al. (2017) – the only non-US study based in Australia – assessed patients using services at an LGBTI-specific clinic providing out-patient counseling for MA use. At 6 and 10-week median follow-up, participants reported a reduction in MA use and the proportion of those reporting MA dependence decreased; sexual health outcomes were not assessed. Reback et al. (2012) conducted a pre-post study to assess a two-week text messaging intervention that provided interactive and passive social support and health education text messages transmitted in real-time with gay and bisexual men. At follow-up, there were significant decreases in the frequency of MA use and CAI while using MA, as well as an overall decrease in MA use. Participants also reported reductions of CAI with both HIV-positive and -negative partners. Reback and Fletcher, 2017 assessed data collected through a 'homegrown' (e.g., locally designed) community-based risk reduction intervention that involved up to 3 individual counseling sessions and unlimited group sessions over four-time points. The intervention was associated with a marginally significant decrease in MA use, as well as a decrease in self-reporting of sexual behaviors, including CAI and reports of sex with HIV serodiscordant partners and reports of sex while using MA.

5.3. Harm reduction interventions

Harm reduction is an approach to intervention that aims to reduce harms associated with any given behavior, including substance use and sexual behavior. Harm reduction interventions are often positioned as a 'first step' towards other treatment modalities or as a treatment outcome itself (Hill, 2015). Here, we classify 'harm reduction interventions' as those in which the primary aim is to prevent MA-related harms (e.g., needle exchanges, self-care strategies while using), rather than the reduction or prevention of MA use itself.

One pre-post study by Carrico et al. (2014) assessed a community-based harm reduction intervention (The Stonewall Project), including strategies for patients to: (1) transition to less potent modes of MA administration (e.g., injecting to smoking, smoking to snorting); (2) promoting self-care strategies while using MA; and (3) delivering education about safer injection practices with linkage to needle exchanges and access to sterile syringes. Two studies were reported within this article, with only the second analysis reporting decreases in sexual risk-taking behavior while using MA.

Two studies classified and reported above under 'psychosocial' also reported secondary outcomes associated with harm reduction related to MA use; however, the primary aims of both the intervention and empirical analyses were not to reduce harms associated with MA use. Lea et al. (2017) reported a decline in the sharing of injecting equipment at follow-up. Reback et al. (2012) reported a reduction in participants who had injected MA in the previous two months.

5.4. Differential intervention effects by social positioning

Most studies did not report on the differential effects of various intervention approaches by social positioning. Table 5 describes the details of interventions effects by social positioning, including sexual identity, gender identity, HIV status, socioeconomic status, ethno-racial characteristics, age, and geography.

Only HIV serostatus and ethno-racial identity were addressed within statistical analyses regarding differential intervention effects. Menza et al. (2010) reported that HIV-positive participants were more likely to attend the 24-week follow-up appointment than HIV-negative participants and the authors attributed this effect to HIV-positive participants being more likely to recognize MA use as being 'problematic' and/or attributing their positive HIV seroprevalence to MA use. Shoptaw et al. (2008) reported that those participants using MA had a higher prevalence of HIV rates than those who reported the use of other psychoactive substances (e.g., alcohol, cocaine). Another study Nyamathi et al. (2017) reported that HIV-positive participants were more likely to report MA use and multiple sexual partners at 16- and 32-week follow-up than HIV-negative participants. Reback et al. (2010) reported that HIV-positive participants completed more 'health-promoting' behavior associated with the intervention, while HIV-negative participants were more likely to abstain from MA use during the 32-week intervention. Finally, Reback et al. (2012) measured and reported differential effects based on the serostatus of the participants' primary partner; the findings indicated that participants with an HIV-negative primary partner reduced all sexual risk behavior measured, while those with an HIV-positive primary partner reported being more likely to engage in serosorting (i.e., fewer incidents of CRAI and more incidents of CIAI).

In terms of ethno-racial identity and differential effects, Reback

et al. (2010) reported that Caucasian men were more likely to complete the targeted 'health-promoting' behavior and were also more likely to completely abstain from substance use when compared with African American and Latino participants. They also reported that Latino men in the CM condition showed no difference when compared with the control conditions, whereas Caucasian men showed an increase in targeted behaviors (e.g., reduction in sexual risk, increased MA abstinence). The authors hypothesize that this difference may be attributed to language difficulties and fear or distrust based upon the immigration status of Latino participants. Nyamathi et al. (2017) reported that participants classified as 'other' ethnicity (i.e., ethno-racial identities other than the categories of White, Black, Hispanic or 'Mixed') were less likely to report both having a regular health care provider and MA use during intervention follow up, and the authors highlight how this combination does not correspond to previous literature in this area. Parsons et al. (2014) described how their study composition, comprising 60% men of color may have increased the magnitude of the intervention effect size in a favorable direction, including reduced CAI and substance use. Finally, in discussing study findings, four studies indicated that ethnicity may have impacted intervention efficacy, but did not provide a hypothesis as to why this occurred (e.g., theoretical mechanisms or pathways) (Shoptaw et al., 2005; Wu et al., 2011; Lyons et al., 2014; Zule et al., 2012).

6. Discussion

Our systematic review of interventions addressing harms among gbMSM who use MA included a total of 26 different interventions assessed by 28 studies comprised of 16 RCTs and 12 pre-post study designs. Of the 26 interventions, all assessed out-patient interventions in the following intervention categories: pharmacological (n = 5; ~19%); psychosocial (n = 20; ~77%); and harm reduction (n = 1; ~4%). Twenty-seven studies took place in the US and one in Australia. Twenty-two studies reported a statistically significant effect on one or more MA-related outcomes. Among the 23 studies that included measures of sexual health-related outcomes (e.g., HIV risk behavior), 18 reported a statistically significant effect on one or more sexual health-related outcomes, and 15 of those reported a concurrent effect on both MA and sexual health-related outcomes.

Our review supports previous research with other populations who use MA indicating that, while pharmacological interventions demonstrate limited efficacy for the treatment of MA (Brensilver et al., 2013; Pérez-Mañá et al., 2013), psychosocial interventions tend to hold more promise (Baker and Lee, 2003; Shearer, 2007). Nevertheless, the results of this analysis need to be interpreted with caution. For example, of the 16 RCTs, only four were assessed as having a low risk of bias, with the remaining having either an unclear or high risk. Likewise, all 12 of the pre-post studies were assessed as being of only moderate quality. Second, study outcomes were measured and reported in highly inconsistent and variable ways; as such, we were unable to pool and assess the results through the conduct of a meta-analysis. Future research involving the treatment of MA among gbMSM should seek to use standardized metrics and indicators regarding both measures of substance use (e.g., by using measures from the NIDA-CTN Addiction Severity Index-Lite (Mimiaga et al., 2012)) and sexual behavior (e.g., by using measures from the National HIV/AIDS Strategy for the United States 2015 indicators for MSM (Office of National AIDS Policy, 2015)) whenever possible in order to facilitate the development of a more consistent evidence base in this area.

The studies in our review included a diverse set of participants with a wide range of lived experiences (e.g., participants ranged from being homeless, unemployed and without a high school education to fully-employed, with annual incomes over $100,000 and graduate-level educations), as well as diverse sexual identities. Despite the heterogeneity within many of the study samples, only HIV serostatus and ethno-racial identity were addressed within statistical analyses regarding differential intervention effects. Conversely, none of the studies assessed how social positioning, including sexual and gender identity, geography, age, and socio-economic status shaped differential intervention effects, despite a robust body of evidence indicating that these constructs are key mediators of both drug- and sexual health-related outcomes (Stockman and Strathdee, 2010). Identifying how interventions can produce different outcomes for different sub-groups of gbMSM will provide critical insights into whether or not a given intervention has the capacity to ameliorate social inequalities (Lorenc et al., 2013). While the absence of assessments regarding differential effects may be, in part, due to limitations with study design (e.g., insufficiently powered sample sizes), we suggest that future research regarding MA interventions be designed in ways that differential effects can be more clearly assessed, including through the use of stratified randomized or stepped-wedge designs in RCTs.

Despite these limitations, the results of our review provide compelling support for the development of interventions that address *both* drug- and sexual health-related outcomes among gbMSM who use MA. Further, the development of a 'mix' of interventions that can concomitantly address psychological and social processes, as well as an individual's given pharmacological needs, will be more likely to sustain reductions in drug- and sexual-related risk among gbMSM. For example, community-based interventions that address the psychosocial needs of gbMSM (e.g., addressing social isolation) can provide gbMSM who use MA with the support they need to engage with other intervention modalities, including clinic-based services and/or uptake of pharmacological strategies (e.g., Pre-Exposure Prophylaxis (PrEP); pharmacotherapies for substance use disorders).

Finally, based on our findings, future research is needed to identify how harm reduction interventions can be implemented to address harms among gbMSM who use MA, an intervention modality that, to date, is notably absent from the literature. Based on our assessment of the psychosocial interventions in our review, harm reduction philosophies, strategies and measures could also be integrated more fulsomely within efficacious psychosocial interventions and the assessment of those interventions. While we recognize that the lack of attention to harm reduction outcomes may be an artifact of the contexts within which the majority of the interventions were carried out (i.e., the USA, where many federal and state laws do not support harm reduction approaches such as syringe exchanges), we find the lack of reporting on harm reduction outcomes worrisome – particularly in a medical context where there is currently no 'gold standard' in MA use treatment. We call for more integrated approaches to both addressing and assessing harm reduction outcomes across various intervention modalities. For example, interventions that include nutritional interventions for those using MA (e.g., interventions that address the importance of food, water, and sleep, and the provision of clean pipe kits to reduce injection-related harm) is warranted at this time. Similarly, there are many effective harm reduction interventions that can be concurrently integrated to address sexual health-related harms, including access to condoms, water-based lubricants (Rapid Response Service, 2015), as well as universal access to pharmacological regimens like PrEP and Post Exposure Prophylaxis (PEP). Finally, given that the sexualized use of MA among gbMSM in the settings included in our review is prevalent, disregarding sexual health risk in MA interventions and research is a missed opportunity.

6.1. Limitations

A limitation of this review – the first review assessing interventions to address harms among gbMSM who use MA – is that we were unable to conduct a meta-analysis of the pooled findings due to the high heterogeneity of both intervention design and the outcomes measured. Second, while we used a highly comprehensive approach to searching the literature, potentially relevant studies may not have been identified (e.g., non-English articles). Nevertheless, these findings provide a

systematic 'snapshot' to inform potentially promising intervention strategies, as well as the identification of key research priorities in this area going forward.

7. Conclusion

This is the first systematic review that provides compelling evidence that integrating interventions to address both drug- and sexual-related harms for gbMSM who use MA can be efficacious. Future research in this area should use standardized metrics and indicators regarding both measures of substance use and sexual behavior whenever possible in order to develop a more coherent evidence base. More attention is also needed around the assessment of harm reduction measures (e.g., syringe exchanges, drug testing interventions, nutritional supplements, clean meth pipes), rather than exclusively on MA usage patterns – particularly in a medical context in which there is no "gold standard" or one-size-fits-all approach for treating MA use. Finally, future research should also focus on identifying differential effects of various intervention approaches by social positioning (e.g., age, sexual identity) and usage patterns, as well as prioritize future evaluations of integrated harm reduction interventions and measures (e.g., the distribution of harm reduction kits via sexual health care settings).

Role of funding source

Drs. Knight and Fast are supported by a Michael Smith Foundation for Health Research Scholar Awards. This research was funded by the Canadian Institutes of Health Research (funding reference number PCS-152596, PJT-148818 & CTW-155550). This research was also undertaken, in part, thanks to funding from the Canada Research Chairs program through a Tier 1 Canada Research Chair in Inner City Medicine which supports Dr. Evan Wood. Dr. Nadia Fairbairn is supported by a MSFHR/St. Paul's Hospital Foundation Scholar Award. Mohammad Karamouzian is supported by the Vanier Canada Graduate and Pierre Elliot Trudeau Doctoral Scholarships. The above funding sources had no involvement in the planning, preparation, and submission of the review paper.

Contributors

All co-authors materially participated in the research and/or article preparation. RK and MK performed systematic review activities (e.g., study retrieval, coding, data extraction, data analysis, and interpretation) and prepared the first draft of the manuscript. Remaining authors provided feedback to each iteration of the review paper as it progressed until all authors agreed on the final product.

Conflict of interest

No conflict declared.

Acknowledgement

We would like to thank Michelle Pang and Nahal Torabi for providing administrative support as we prepared this manuscript.

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.drugalcdep.2018.09.023.

References

Baker, A., Lee, N.K., 2003. A review of psychosocial interventions for amphetamine use. Drug Alcohol Rev. 22, 323–335.

Bradshaw, D., Matthews, G., Danta, M., 2013. Sexually transmitted hepatitis C infection: the new epidemic in MSM? Curr. Opin. Infect. Dis. 26, 66–72.

Brensilver, M., Heinzerling, K.G., Shoptaw, S., 2013. Pharmacotherapy of amphetamine-type stimulant dependence: an update. Drug Alcohol Rev. 32, 449–460.

Carey, J.W., Mejia, R., Bingham, T., Ciesielski, C., Gelaude, D., Herbst, J.H., Sinunu, M., Sey, E., Prachand, N., Jenkins, R.A., Stall, R., 2009. Drug use, high-risk sex behaviors, and increased risk for recent HIV infection among men who have sex with men in Chicago and Los Angeles. AIDS Behav. 13, 1084–1096.

Carrico, A.W., Flentje, A., Gruber, V.A., Woods, W.J., Discepola, M.V., Dilworth, S.E., Neilands, T.B., Jain, J., Siever, M.D., 2014. Community-based harm reduction substance abuse treatment with methamphetamine-using men who have sex with men. J. Urban Health 91, 555–567.

Carrico, A.W., Gomez, W., Siever, M.D., Discepola, M.V., Dilworth, S.E., Moskowitz, J.T., 2015a. Pilot randomized controlled trial of an integrative intervention with methamphetamine-using men who have sex with men. Arch. Sex. Behav. 44, 1861–1867.

Carrico, A.W., Nation, A., Gomez, W., Sundberg, J., Dilworth, S.E., Johnson, M.O., Moskowitz, J.T., Rose, C.D., 2015b. Pilot trial of an expressive writing intervention with HIV-positive methamphetamine-using men who have sex with men. Psychol. Addict. Behav. 29, 277–282.

Celentano, D.D., Valleroy, L.A., Sifakis, F., MacKellar, D.A., Hylton, J., Thiede, H., McFarland, W., Shehan, D.A., Stoyanoff, S.R., LaLota, M., Koblin, B.A., Katz, M.H., Torian, L.V., 2006. Associations between substance use and sexual risk among very young men who have sex with men. Sex. Transm. Dis. 33, 265–271.

Ciketic, S., Hayatbakhsh, M.R., Doran, C.M., Najman, J.K., McKeting, R., 2012. A review of psychological and pharmacological treatment options for methamphetamine dependence. J. Subst. Use 17, 363–383.

Coffin, P.O., Santos, G.M., Hern, J., Vittinghoff, E., Santos, D., Matheson, T., Colfax, G., Batki, S.L., 2018. Extended-release naltrexone for methamphetamine dependence among men who have sex with men: a randomized placebo-controlled trial. Addiction 113, 268–278.

Colfax, G., Vittinghoff, E., Husnik, M.J., McKiran, D., Buchbinder, S., Koblin, B., Celum, C., Chesney, M., Huang, Y., Mayer, K., Bozeman, S., Judson, F.N., Bryant, K.J., Coates, T.J., 2004. Substance use and sexual risk: a participant- and episode-level analysis among a cohort of men who have sex with men. Am. J. Epidemiol. 159, 1002–1012.

Colfax, G.N., Santos, G.-M., Das, M., Santos, D.M., Matheson, T., Gasper, J., Shoptaw, S., Vittinghoff, E., 2011. Mirtazapine to reduce methamphetamine use a randomized controlled trial. Arch. Gen. Psychiatry 68, 1168–1175.

Cunningham, E.B., Jacka, B., DeBeck, K., Applegate, T.A., Harrigan, P.R., Krajden, M., Marshall, B.D.L., Montaner, J., Dias Lima, V., Olmstead, A., Milloy, M.-J., Wood, E., Grebely, J., 2015. Methamphetamine injecting is associated with phylogenetic clustering of hepatitis C virus infection among street-involved youth in Vancouver, Canada. Drug Alcohol Depend. 152, 272–276.

Das, M., Santos, D., Matheson, T., Santos, G.M., Vittinghoff, E., Shoptaw, S., Colfax, G.N., 2010. Feasibility and acceptability of a phase II randomized pharmacologic intervention for methamphetamine dependence in high-risk men who have sex with men. AIDS 24, 991–1000.

Daskalopoulou, M., Rodger, A., Phillips, Sherr, L., Speakman, A., Collins, S., Elford, J., Johnson, M.A., Gilson, R., Fisher, M., Wilkins, E., Anderson, J., McDonnell, J., Edwards, S., Perry, N., O'Connell, R., Lascar, M., Jones, M., Johnson, A.M., Har, G., Miners, A., Geretti, A.M., Burman, W.J., Lampe, F.C., 2014. Recreational drug use, polydrug use, and sexual behavior in HIV-diagnosed men who have sex with men in the UK: results from the cross-sectional ASTRA study. Lancet HIV 1, e22–31.

Ferlatte, O., Hottes, T.S., Trussler, T., Marchand, R., 2014. Evidence of a syndemic among young Canadian gay and bisexual men: uncovering the associations between anti-gay experiences, psychosocial issues, and HIV risk. AIDS Behav. 18, 1256–1263.

Fletcher, J.B., Reback, C.J., 2013. Antisocial personality disorder predicts methamphetamine treatment outcomes in homeless, substance-dependent men who have sex with men. J. Subst. Abuse Treat. 45, 266–722.

Fletcher, J.B., Dierst-Davies, R., Reback, C.J., 2014. Contingency management voucher redemption as an indicator of delayed gratification. J. Subst. Abuse Treat. 47, 73–77.

Heath, J., Lanoye, A., Maisto, S.A., 2012. The role of alcohol and substance use in risky sexual behavior among older men who have sex with men: a review and critique of the current literature. AIDS Behav. 16, 578–589.

Higgins, J.P., Altman, D.G., Gotzsche, P.C., Juni, P., Moher, D., Oxman, A.D., Savovic, J., Schulz, K.F., Weeks, L., Sterne, J.A.C., 2011. The Cochrane Collaboration's tool for assessing risk of bias in randomised trials. BMJ 343, d5928.

Higgins, S.T., Delaney, D.D., 1991. A behavioral approach to achieving initial cocaine abstinence. Am. J. Psychol. 148, 1218.

Hill, R., 2015. Evidence-based Practices for Treatment of Methamphetamine Dependency: a Review. Retrieved from:. Community Engaged Scholarship Institute, Guelph, ON. https://atrium.lib.uoguelph.ca/xmlui/handle/10214/8902.

Landovitz, R.J., Fletcher, J.B., Inzhakova, G., Lake, J.E., Shoptaw, S., Reback, C.J., 2012. A novel combination HIV prevention strategy: post-exposure prophylaxis with contingency management for substance abuse treatment among methamphetamine-using men who have sex with men. AIDS Patient Care STDS 26, 320–328.

Lea, T., Kolstee, J., Lambert, S., Ness, R., Hannan, S., Holt, M., 2017. Methamphetamine treatment outcomes among gay men attending a LGBTI-specific treatment service in Sydney, Australia. PLoS One 12, e0172560.

Lorenc, T., Petticrew, M., Welch, V., Tugwell, P., 2013. What types of interventions generate inequalities? Evidence from systematic reviews. J. Epidemiol. Commun. Health 67, 190–193.

Lyons, T., Tilmon, S., Fontaine, Y.-M., 2014. Development of a small-group intervention for stimulant-using men who have sex with men. J. Groups Addict. Recover. 9, 54–70.

Marshall, B.D., Wood, E., Shoveller, J.A., Patterson, T.L., Montaner, J.S., Kerr, T., 2011.

Pathways to HIV risk and vulnerability among lesbian, gay, bisexual, and transgendered methamphetamine users: a multi-cohort gender-based analysis. BMC Public Health 11, 20.
McElhiney, M.C., Rabkin, J.G., Rabkin, R., Nunez, E.V., 2009. Provigil (Modafinil) plus cognitive behavioral therapy for methamphetamine use in HIV plus gay men: a pilot study. Am. J. Drug Alcohol Abuse 35, 34–37.
Melendez-Torres, G.J., Bonell, C., 2014. Systematic review of cognitive behavioural interventions for HIV risk reduction in substance-using men who have sex with men. Int. J. STD AIDS 25, 627–635.
Melendez-Torres, G.J., Bourne, A., 2016. Illicit drug use and its association with sexual risk behavior among MSM: more questions than answers? Curr. Opin. Infect. Dis. 29, 58–63.
Menza, T.W., Jameson, D.R., Hughes, J.P., 2010. Contingency management to reduce methamphetamine use and sexual risk among men who have sex with men: a randomized controlled trial. BMC Public Health 10, 774.
Miller, W.R., Rollnick, S., 2009. Ten things that motivational interviewing is not. Behav. Cogn. Psychother. 37, 129–140.
Mimiaga, M.J., Reisner, S.L., Pantalone, D.W., O'Cleirigh, C., Mayer, K.H., Safren, S.A., 2012. A pilot trial of integrated behavioral activation and sexual risk reduction counseling for HIV-uninfected men who have sex with men abusing crystal methamphetamine. AIDS Patient Care STDS 26, 681–693.
Moher, D., Liberati, A., Tetzlaff, J., Altman, D.G., 2009. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. Ann. Intern. Med. 151, 264–269.
National Institutes of Health - National Heart, Lung, and Blood Institute, 2014. Quality Assessment Tool for Before-After (Pre-Post) studies with no control group. Available from: https://www.nhlbi.nih.gov/health-pro/guidelines/in-develop/cardiovascular-risk-reduction/tools/before-after.
Nga Thi Thu, V., Maher, L., Zablotska, I., 2015. Amphetamine-type stimulants and HIV infection among men who have sex with men: implications on HIV research and prevention from a systematic review and meta-analysis. J. Acquir. Immune Defic. Syndr. 18, 19273.
Nyamathi, A., Reback, C.J., Shoptaw, S., Salem, B.E., Zhang, S., Yadav, K., 2017. Impact of tailored interventions to reduce drug use and sexual risk behaviors among homeless gay and bisexual men. Am. J. Mens Health 11, 208–220.
Office of National Aids Policy, 2015. National HIV/AIDS Strategy for the United States: Updated to 2020. Retrieved from:. https://www.hiv.gov/sites/default/files/nhas-2020-action-plan.pdf.
Parsons, J.T., Lelutiu-Weinberger, C., Botsko, M., Golub, S.A., 2014. A randomized controlled trial utilizing motivational interviewing to reduce HIV risk and drug use in young gay and bisexual men. J. Consult. Clin. Psychol. 82, 9.
Pérez-Mañá, C., Castells, X., Torrens, M., Capella, D., Farre, M., 2013. Efficacy of psychostimulant drugs for amphetamine abuse or dependence. Cochrane Database Syst. Rev. 2 CD009695.
Plankey, M.W., Ostrow, D.G., Stall, R., Cox, C., Li, X., Peck, J.A., Jacobson, L.P., 2007. The relationship between methamphetamine and popper use and risk of HIV seroconversion in the multicenter AIDS cohort study. J. Acquir. Immune Defic. Syndr. 45, 85–92.
Rapid Response Service, 2015. Crystal Methamphetamine Use, Sexual Risk Behaviours and Harm Reduction Among Men Who Have Sex With Men, vol. 93 Ontario HIV Treatment Network, Toronto, ON. http://www.ohtn.on.ca/wp-content/uploads/2015/05/RR93-Crystal-Meth-Harm-Reduction.pdf.
Reback, C.J., Peck, J.A., Dierst-Davies, R., 2010. Contingency management among homeless, out-of-treatment men who have sex with men. J. Subst. Abuse Treat. 39, 255–263.
Reback, C.J., Grant, D.L., Fletcher, J.B., Branson, C.M., Shoptaw, S., Bowers, J.R., Charania, M., Mansergh, G., 2012. Text messaging reduces HIV risk behaviors among methamphetamine-using men who have sex with men. AIDS Behav. 16, 1993–2002.
Reback, C.J., Shoptaw, S., 2014. Development of an evidence-based, gay-specific cognitive behavioral therapy intervention for methamphetamine-abusing gay and bisexual men. Addict. Behav. 39, 1286–1291.
Reback, C.J., Fletcher, J.B., 2017. Outcomes from a homegrown HIV prevention program for extremely high-risk, substance-using men who have sex with men with multiple health disparities. J. Gay Lesbian Soc. Serv. 29, 5.
Morely, K.C., Cornish, J.L., Faingold, A., Wood, K., Haber, P.S., 2017. Pharmacotherapeutic agents in the treatment of methamphetamine dependence. Expert Opin. Investig. Drugs 26, 563–578.
Santos, G.-M., Coffin, P.O., Vittinghoff, E., DeMicco, E., Das, M., Matheson, T., Raiford, J.L., Carry, M., Colfax, G., Herbst, J.H., Dilley, J.W., 2014. Substance use and drinking outcomes in personalized cognitive counseling randomized trial for episodic substance-using men who have sex with men. Drug Alcohol Depend. 138, 234–239.
Santos, G.-M., Coffin, P., Santos, D., Haffaker, S., Matheson, T., Euren, J., DeMartini, A., Rowe, C., Hahn, J.A., Vlahov, D., Vittinghoff, E., Batki, S.L., 2016. Feasibility, acceptability, and tolerability of targeted naltrexone for nondependent methamphetamine-using and binge-drinking men who have sex with men. J. Acquir. Immune Defic. Syndr. 72, 21–30.
Sewell, J., Miltz, A., Lampe, F.C., Cambiano, V., Speakman, A., Phillips, A.N., Stuart, D., Gilson, R., Asboe, D., Nwokolo, N., Clarke, A., Collins, S., Hart, G., Elford, J., Rodger, A.J., 2017. Poly drug use, chemsex drug use, and associations with sexual risk behavior in HIV-negative men who have sex with men attending sexual health clinics. Int. J. Drug Policy 43, 33–43.
Shearer, J., 2007. Psychosocial approaches to psychostimulant dependence: a systematic review. J. Subst. Abuse Treat. 32, 41–52.
Shoptaw, S., Reback, C.J., Peck, J.A., Yang, X., Rotheram-Fuller, E., Larkins, S., Veniegas, R.C., Freese, T.E., Hucks-Ortiz, C., 2005. Behavioral treatment approaches for methamphetamine dependence and HIV-related sexual risk behaviors among urban gay and bisexual men. Drug Alcohol Depend. 78, 125–134.
Shoptaw, S., Klausner, J.D., Reback, C.J., Tierney, S., Stansell, J., Hare, C.B., Gibson, S., Siever, M., King, W.D., Kao, U., Dang, J., 2006. A public health response to the methamphetamine epidemic: the implementation of contingency management to treat methamphetamine dependence. BMC Public Health 6, 214.
Shoptaw, S., Reback, C.J., Larkins, S., Wang, P.C., Rotheram-Fuller, E., Dang, J., Yang, X., 2008. Outcomes using two tailored behavioral treatments for substance abuse in urban gay and bisexual men. J. Subst. Abuse Treat. 35, 285–293.
Stockman, J.K., Strathdee, S.A., 2010. HIV among people who use drugs: a global perspective of populations at risk. J. Acquir. Immune Defic. Syndr. 55, S17.
Strona, F.V., McCright, J., Hjord, H., Ahrens, K., Tierney, S., Shoptaw, S., Klausner, J.D., 2006. The acceptability and feasibility of the Positive Reinforcement Opportunity Project, a community-based contingency management methamphetamine treatment program for gay and bisexual men in San Francisco. J. Psychoactive Drugs 3, 377–383.
United Nations Office on Drugs and Crime, 2017. World Drug Report 2016. Available from:. . http://www.unodc.org/wdr2016/en/ats.html.
Wu, E., El-Bassel, N., McVinney, L.D., Hess, L., Remien, R.H., Charania, M., Mansergh, G., 2011. Feasibility and promise of a couple-based HIV/STI preventive intervention for methamphetamine-using, black men who have sex with men. AIDS Behav. 15, 1745–1754.
Zule, W.A., Poulton, W.E., Coomes, C.M., Mansergh, G., Charania, M., Wechsberg, W.M., Jones, H.E., 2012. Results of a pilot study to reduce methamphetamine use and sexual risk behaviors among methamphetamine-using men who have sex with men (MSM) not currently in treatment. J. Psychoactive Drugs 44, 351–358.