Title

Urgent need for treatment addressing co-use of tobacco and cannabis: An updated review and considerations for future interventions

Authors

Nguyen, Nhung
Bold, Krysten W
McClure, Erin A

Publication Date

2024-11-01

DOI

10.1016/j.addbeh.2024.108118

Peer reviewed

HHS Public Access

Author manuscript

Addict Behav. Author manuscript; available in PMC 2024 November 01.

Published in final edited form as:

Addict Behav. 2024 November ; 158: 108118. doi:10.1016/j.addbeh.2024.108118.

Urgent need for treatment addressing co-use of tobacco and cannabis: an updated review and considerations for future interventions

Nhung Nguyen, PhD[a,b,§], **Krysten W Bold, PhD**[c,d], **Erin A McClure, PhD**[e,f]

[a]Center for Tobacco Control Research and Education, University of California San Francisco, California, USA.

[b]Division of General Internal Medicine, Department of Medicine, University of California San Francisco, California, USA.

[c]Department of Psychiatry, Yale School of Medicine, Connecticut, USA.

[d]Yale Cancer Center, Connecticut, USA

[e]Department of Psychiatry and Behavioral Sciences, Medical University of South Carolina, South Carolina, USA.

[f]Hollings Cancer Center, Medical University of South Carolina, South Carolina, USA.

Abstract

Background: There are no clinical practice guidelines addressing the treatment of tobacco-cannabis co-use and a dearth of studies to inform treatment for co-use. This narrative review aims to (1) summarize promising intervention components used in published co-use treatment studies, (2) describe key gaps and emerging issues in co-use, and (3) provide recommendations and considerations in the development and evaluation of co-use interventions.

Methods: We conducted a literature search in June 2024 across several databases to update previous reviews on tobacco-cannabis co-use treatment. We found 9 published intervention studies that specifically addressed treatment for both substances. Data from these studies were manually extracted and summarized.

Results: Most of the 9 included studies (1) focused on acceptability and/or feasibility, (2) provided both psychosocial/behavioral and pharmacotherapy intervention components, (3) were conducted in adults, and (4) were delivered in-person, with some having digital asynchronous components, for a 5-to-12-week duration. The most common psychosocial/behavioral strategies used were Cognitive Behavioral Therapy, Motivational Interviewing, and Contingency Management; while the most common pharmacotherapy was Nicotine Replacement Therapy. There was no evidence of compensatory use of tobacco or cannabis when providing simultaneous treatment for both substances.

[§]**Correspondence**: Nhung Nguyen, UCSF Center for Tobacco Control Research and Education and Division of General Internal Medicine, 530 Parnassus Ave., Suite 366, San Francisco, CA 94143. nhung.nguyen@ucsf.edu.

Declaration of competing Interests: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Conclusions: The literature to date provides support for well-integrated multi-component interventions of psychosocial/behavioral and pharmacotherapy strategies for co-use treatment. This review reinforces an urgent need for treatments targeting tobacco and cannabis co-use. Future interventions should address key gaps, including co-use of vaporized products among youth and young adults, tailored interventions for priority populations, and digital applications to increase reach and advance health equity.

Keywords

Smoking cessation; tobacco use disorder; marijuana; cannabis use disorder; polysubstance use; treatment; review

1. Introduction

Co-use of tobacco and cannabis products (defined here as use of both substances either separately or simultaneously in the past 30 days) is a public health issue that continues to grow (Agrawal et al., 2012; Hindocha & McClure, 2021; Weinberger et al., 2022). National data from the United States (US) in 2018 showed that 48% of young adults (ages 18–24) and 28% of adults (ages 25+) who use tobacco reported past-month co-use (Cohn & Chen, 2022). In 2021, co-use was as common as use of tobacco alone and more common than use of cannabis alone among US adolescents (Do et al., 2024). Expanding cannabis legalization in the US may increase cannabis use, potentially leading to increased tobacco-cannabis co-use over time (Nargis & Asare, 2023). Moreover, evolving product landscapes for both tobacco and cannabis facilitate co-use via new products outside of traditional combustible products (Nguyen et al., 2019). Indeed, co-use via vaporized products among adolescents and young adults (AYAs) is considered “a looming public health emergency” given the popularity of vaping in this age group (Carlini et al., 2022; Miech et al., 2019, 2020, 2021; Roberts et al., 2022). According to national data, in 2023, 11.8% and 8.6% of adolescents reported past 30-day vaping of nicotine and cannabis, respectively (Miech, R. A. et al., 2024). In 2022, 17.2% and 13.9% of young adults reported past 30-day vaping of nicotine and cannabis, respectively (Patrick, M. E. et al., 2023). Furthermore, co-use can occur via a variety of possible combinations, including same product use (e.g., blunts - cigar wrapper filled with cannabis) or through different product types (e.g., co-use of oral nicotine and combustible cannabis, co-use of e-cigarettes with edible cannabis), adding more complexity to co-use treatment (Nguyen et al., 2024).

The co-use of tobacco and cannabis poses greater health harm than use of each substance alone. Research indicates that co-use increases additive exposure to toxicants and the risk of mental health disorders (Do et al., 2024; Meier & Hatsukami, 2016; Nguyen, Peyser, et al., 2023; Peters et al., 2012; Smith et al., 2020). Co-use is also associated with greater use and dependence of both tobacco and cannabis and results in poorer cessation outcomes for these substances (Hindocha et al., 2015; McClure et al., 2020; Walsh et al., 2020; Weinberger et al., 2018). The extent of health harms varies across patterns of co-use, with worse physical and mental health functioning being associated with simultaneous co-use (using both substances at the same time) or sequential co-use (using one substance after the other, in close temporal proximity) compared to using each substance separately (Tucker

et al., 2019). Further, co-use is prevalent among individuals identifying as Black/African American, Hispanic, and from a sexual/gender minority group, which may exacerbate health disparities in these subpopulations (Ehlke et al., 2023; Montgomery et al., 2017; Nguyen et al., 2021).

To date, there are no clinical practice guidelines for treating tobacco-cannabis co-use. Three reviews published in 2020, including our own, were focused on the treatment-related concerns pertaining to co-use and presented data on cessation outcomes from single-substance or co-use treatment studies published up to April 2019. McClure et al. summarized the impact of co-use on tobacco/cannabis treatment outcomes and compensatory substance use during cessation (McClure et al., 2020). Walsh et al. summarized intervention efficacy on tobacco/cannabis cessation outcomes via a meta-analysis of single-substance or multi-substance intervention trials (Walsh et al., 2020). Nguyen et al. summarized digital applications (e.g., ecological momentary assessments, mobile sensors) for assessment and intervention targeting co-use (Nguyen et al., 2020). Together, these reviews highlighted that existing interventions predominantly targeted cessation for a single substance, and only a handful of interventions addressed co-cessation (quitting both tobacco and cannabis), primarily through feasibility or pilot studies. However, none of these reviews provided a detailed overview of intervention components and resulting treatment outcomes. The published interventions used variable strategies and components to address co-use, which requires further exploration to inform the field on the most promising co-use intervention components. In addition, emerging issues about co-use in the current changing landscape (e.g., co-use via vaporized products, health disparities related to co-use) require updating and re-evaluating the previous reviews. More work in co-use treatment and more guidance on the next steps for developing and evaluating treatment strategies is needed. This requires a better understanding of promising intervention components that have been evaluated and the emerging issues that must be addressed in the current context. To provide an overview with detailed summaries of co-use treatment interventions, we conducted a narrative review of the various studies that have been conducted (1) to describe specific intervention components used in published co-use treatment studies, (2) to comment on promising intervention approaches that could be tested through randomized controlled trials, (3) to identify emerging issues and key gaps for co-use treatment, and (4) to provide recommendations for future co-use intervention work. The narrative review approach offers the flexibility to synthesize findings across diverse studies, offering a broad descriptive summary of topics within the context of co-use treatment (Sukhera, 2022).

2. Methods

2.1. Bibliographic search

We conducted a literature search in PubMed, EMABSE, PsycINFO, and Google Scholar in June 2024 to update the reference list from previous reviews on co-use treatment. We searched for intervention studies that specifically addressed treatment for both tobacco and cannabis, rather than addressing treatment for tobacco or cannabis alone. Search strategies were developed using a combination of terms relating to tobacco use treatment and cannabis use treatment and were also based on search strategies in the previous reviews

(see the Supplemental document). We also reviewed the cited references in the previous reviews (McClure et al., 2020; Nguyen et al., 2020; Walsh et al., 2020) and in the papers returned from our search to identify any additional studies. NN conducted the search and preliminarily screened titles and abstracts. KWB and EAM also screened abstracts. Reaching 100% consensus among authors was used to determine inclusion in the review.

2.2. Identification of included studies

Inclusion criteria for studies were: (1) treatment studies assessing treatment-relevant variables (e.g., readiness to quit, abstinence); (2) providing treatment for both tobacco and cannabis; (3) measuring use of both tobacco and cannabis pre- and post-intervention via biochemical verification and/or self-report; (4) published up to June 2024; and (5) written in English. We excluded prevention studies and treatment studies that focused on a single substance. There were no limits on age, setting, study design, or intervention duration.

2.3. Data extraction and synthesis

Data extraction forms were developed by EAM and KWB. Data from included studies were extracted for study setting and design, samples (e.g., demographics, eligibility), and interventions tested (e.g., content, duration, and format). To quantify specific intervention components used in included studies, a rating form was developed to capture the presence of common evidence-based clinical practice guideline components for tobacco treatment (Fiore et al., 2008), as well as fields for additional intervention components that were identified when reviewing included studies. While this review focused on a summary of intervention components, we also extracted treatment outcome data (e.g., abstinence, reduction, readiness to quit), when available. All authors reviewed full-text articles and extracted data independently. Following individual review, authors met to discuss findings and resolve any discrepancies for included studies.

3. Results

3.1. Search results

A total of 264 published studies were identified through the search process (500 studies were found, and 236 duplicates were removed; see PRISMA flowchart in the Supplemental document). After screening the titles and abstracts, 18 potentially relevant articles were selected for full-text review. Of these, 9 articles that specifically addressed tobacco and cannabis co-use treatment were included in data extraction and summarization (Table 1).

3.2. Study characteristics

Of the 9 included studies, five (56%) were pilot or feasibility single-arm (uncontrolled) studies (Adams et al., 2018; Becker et al., 2015; Beckham et al., 2018; Hill et al., 2013; Lee et al., 2015), three (33%) were randomized controlled trials (Becker et al., 2014; Carpenter et al., 2024; Lee et al., 2019), and one (11%) was a case series study (Lee et al., 2014). Seven studies (78%) were from the US and two (22%) were from Switzerland (Becker et al., 2014, 2015).

3.3. Sample characteristics

Sample sizes varied, ranging from 5 participants in one pilot feasibility trial (Beckham et al., 2018) to 325 participants (Becker et al., 2014) in one randomized controlled trial. All studies recruited adults aged 18–65 years old. Several studies did not present the age range of participants included in study procedures. The mean age of the study samples ranged from 28–52 years of age. None of the studies reported the number or proportion of participants between the ages of 18–21 and none specifically focused on AYAs. Across the study samples, proportions of females ranged from 14% to 80%, while proportions of non-White participants ranged from 8% to 100% or were not reported. Most studies recruited participants from cannabis or substance use disorder treatment clinics or settings. Inclusion criteria varied by study, with 8 out of 9 studies requiring current use of both tobacco and cannabis (one study allowed adults who formerly smoked cigarettes to be enrolled [n=1]). Interest in quitting both tobacco and cannabis was required in 5 of 9 studies (56%) and one focused on increasing readiness to quit rather than cessation (Becker et al., 2014). Common exclusion criteria included not speaking English (US-based studies) or German (Switzerland-based studies), unstable and/or serious medical or psychiatric disorders (e.g., imminent risk of suicide or homicide, cardiac disease, psychosis, schizophrenia, etc.), diagnosis of a substance use disorder (SUD; not tobacco or cannabis) or in SUD treatment, smoking cessation or CUD treatment, being pregnant, or having medical conditions that prevented use of NRT (e.g., heart attack). Some studies excluded individuals who used other tobacco products rather than cigarettes.

3.4. Summary of the published interventions

Overall, the 9 studies included in this review show that providing treatment concurrently for both tobacco and cannabis is acceptable and feasible among adults with co-use. All included studies targeted co-use of combustible products, mostly cigarettes and smoked cannabis. There is less robust evidence available regarding abstinence or reduction outcomes given the variety of outcomes used and the absence of a control group in many of the included studies. Though preliminary, many interventions showed initial signals of efficacy to promote abstinence or reduction in use, but none of the studies were powered on efficacy. Overall, this review found that the majority of co-use treatment interventions to date have: (1) employed individual counseling strategies, (2) used a combination of digital tools to deliver content asynchronously, in addition to synchronous, real-time content delivery from trained staff, (3) the most common behavioral treatment was CBT, (4) common skills or techniques employed included, identifying triggers, setting a quit date, distraction, coping with craving, and managing withdrawal, and (5) smoking cessation pharmacotherapy was often used to augment psychosocial treatment. Table 1 includes details on the intervention and control conditions, while Table 2 visualizes the presence of specific intervention components used across studies.

3.4.1. Intervention format and duration—Three studies (33%) provided remote interventions (telehealth, smartphone, website), three (33%) provided in-person interventions at SUD treatment clinics, and three (33%) provided a combination of computer-delivered and in-person interventions in cannabis use disorder (CUD) treatment settings (Lee et al., 2014, 2015, 2019). The intervention duration ranged from 5 weeks to 12

weeks, except for Becker et al. 2014, which targeted readiness to quit and included a single 25-minute psychoeducation session.

3.4.2. Intervention components

Behavioral therapy: The most common behavioral treatment used among studies was Cognitive Behavioral Therapy (CBT), followed by Motivational Interviewing (MI) and Contingency Management (CM). Common behavioral skills/techniques of study interventions were identifying triggers, setting a quit date, distraction, coping with craving, and managing withdrawal. Most studies employed individual counseling as a fundamental intervention strategy. Only Becker et al. 2015 study focused on group counseling and provided an optional session for individual counseling. Eight of 9 studies (89%) used synchronous, real-time delivery of intervention content via trained staff. Five out of these eight studies also used digital tools (computer, website, smartphone, telephone) to deliver psychosocial intervention components asynchronously. Becker et al. 2014 study used a fully asynchronous delivery of a single psychoeducation session via website.

Pharmacotherapy: Except for Becker et al. 2014, all interventions provided access to or referrals for pharmacotherapy for tobacco. Four of 9 studies (44%) provided combination Nicotine Replacement Therapy (NRT patch plus short-acting lozenge/gum), one provided single NRT (Hill et al., 2013), one provided varenicline (Adams et al., 2018), and one provided access and prescriptions for NRT and varenicline (Becker 2015). While pharmacotherapy was provided in the majority of studies, this was typically an adjunct to psychosocial treatment.

Treatment order: Seven studies (78%) provided treatment for both tobacco and cannabis simultaneously, except for Becker et al. 2014 study which focused on increasing readiness to quit both tobacco and cannabis, and Lee et al. 2019 study that specifically tested simultaneous vs. sequential tobacco treatment integrated into CUD treatment. These seven studies found the simultaneous treatment approach acceptable, and the Lee study did not find differences in the outcomes between simultaneous compared to sequential tobacco treatment delivery.

3.4.3. Intervention outcomes—

The primary outcomes that were assessed varied by study, including retention, completion of treatment modules or sessions, feasibility/acceptability, pharmacotherapy initiation and adherence, change in tobacco and cannabis use and abstinence, readiness to quit, making quit attempts, craving, and withdrawal.

Cessation outcomes, when presented, were end-of-treatment abstinence rates that were biochemically confirmed. Tobacco abstinence was validated through breath carbon monoxide or saliva cotinine (metabolite of nicotine) in 8 studies, while cannabis abstinence was validated by urinary or saliva cannabinoids testing (THC detection) in 6 studies. Abstinence rates varied widely for tobacco (0–40%) and cannabis (0–83%), with the highest rates of abstinence achieved by Beckham et al. 2015, a feasibility trial conducted in a small sample size (n=5).

Findings related to co-abstinence outcomes are still preliminary at this stage given the variability in outcomes across studies and the single-arm design employed by many included studies. Seven studies (78%) reported abstinence from tobacco and cannabis separately, and only two studies (22%) reported the rates of achieving co-abstinence for both tobacco and cannabis (Becker et al., 2015; Beckham et al., 2018). Only three of 9 studies (33%) assessed abstinence rates for tobacco or cannabis at 6 months, considered a gold-standard outcome for use in meta-analysis, and these studies found decreases in prolonged abstinence since the end of treatment. Notably, there was no clear evidence of compensatory effects (i.e., increased use of one substance to compensate for decreased use of the other substance) in the studies that examined this.

4. Discussion

This narrative review summarizes and highlights promising intervention components used in published treatment studies addressing co-use of tobacco and cannabis and recommends the next steps for future co-use treatment development and evaluation. Previously published co-use reviews have focused on treatment outcomes among participants who were co-using, but the focus of those reviews did not include a description and summary of intervention components used to address both tobacco and cannabis. The current review provides new insight into important gaps to be addressed in co-use treatment and promising approaches and components that could be adapted and further developed while considering emerging challenges in addressing co-use.

4.1. Potential intervention strategies for co-use treatment

Co-use patterns, cessation goals, and treatment tailoring: Interventions may need to be tailored to address different co-use patterns and product combinations (e.g., using both tobacco and cannabis simultaneously vs. separately; using various combinations, including inhaled and oral products, etc.) (Nguyen et al., 2024). Patterns of co-use may be associated with differential levels of use and have been shown to have differential impacts on cessation (McClure et al., 2020; Nguyen, Thrul, et al., 2023). Research is needed to understand which treatment approaches are most efficacious for specific co-use patterns, such as simultaneous vs. separate co-use, in addition to how to address varying product combinations.

Assessing treatment goals specific to interest in quitting or reducing use may also be necessary for tailoring, specifically regarding cannabis use. Within the cannabis field, non-abstinence-based outcomes (e.g., reductions in use) are often key outcomes (Loflin et al., 2020; Tomko et al., 2019), which may also be a consideration for assessing outcomes of co-use treatment. For those not interested in cannabis cessation, strategies may include targeting readiness to quit and motivating a quit attempt and/or providing intervention content to support reductions in use, as was done in one included intervention study (Carpenter et al., 2024).

The complexity of co-use includes heterogeneous patterns of product combinations and temporal relationships in use patterns (Nguyen et al., 2024). As co-use interventions are developed and evaluated, it is essential that there be consensus on definitions of co-use and treatment outcomes, which are not currently defined or validated in the field (Hindocha &

McClure, 2021; McClure, 2021; McRobbie et al., 2021). To rigorously evaluate intervention strategies, trials should incorporate biochemical verification methods of abstinence or reduction of both tobacco and cannabis. Established and novel biomarkers will be beneficial to validate co-cessation, such as epigenetic biomarkers for smoke exposure and/or urinary or oral fluid metabolites of both tobacco and cannabis use (Andersen et al., 2021; Yakimavets et al., 2022).

Pharmacotherapy for co-use: Another promising area for future research includes assessing new and existing pharmacotherapies to address co-use. While several evidence-based pharmacotherapies exist for tobacco cessation, there are currently no FDA-approved pharmacotherapies for CUD, and psychosocial interventions addressing CUD yield only modest efficacy (Winters et al., 2021). Ongoing work is underway to evaluate varenicline for CUD (McRae-Clark et al., 2021), and more work is needed to understand the potential benefit of varenicline for co-use. For instance, the Adams study reviewed here evaluated the feasibility of varenicline to treat co-use, and preliminary findings indicate that varenicline reduced cannabis craving and withdrawal, but no statistical testing was conducted. None of the other studies reviewed tested pharmacotherapy as the primary intervention component. Additional ongoing work aims to evaluate other pharmacotherapy options. For instance, N-acetylcysteine (NAC) is being tested to target both cigarette smoking and cannabis among co-users in a randomized control trial (Herbst et al., 2023), and a phase II-a trial in the UK found that 400mg cannabidiol decreased cannabis and cigarette use among those who use spliffs (Freeman et al., 2020).

4.2. Need for interventions addressing the co-use of non-combustible products among adolescents and young adults

The published co-use interventions were developed and tested for adult populations and focused on co-use of combustible products (e.g., spliffs, cigarettes, joints). Only one study mentioned the inclusion of a psychosocial module addressing e-cigarettes, but the specific content of that module is unclear (Lee et al., 2019). Increasing rates of co-use via non-combustible products, especially vaporized products among AYA populations (Roberts et al., 2022), highlight a key gap identified in the existing co-use intervention research. To the best of our knowledge, there are no co-use interventions that have been delivered to AYAs and none that have been developed for co-use that address new and alternative tobacco or cannabis products.

The lack of treatment research among AYAs may be multifactorial. Greater attention is often given to prevention rather than treatment of tobacco and cannabis use to mitigate adolescent substance onset. Additionally, ethical and legal considerations (e.g., required parental consent, illegal use of tobacco and cannabis under 21 years old) and practical issues (e.g., difficult recruitment and retention) can make including adolescents in clinical trials challenging. However, including adolescents in intervention research is crucial to reducing the progression of substance use addiction and long-term health risks. As a roadmap to close this treatment gap, future research should focus on early warning signals in adolescent tobacco and cannabis use as a means to reach out for treatment and develop tailored interventions targeting the most commonly used products among AYAs.

Several opportunities exist to leverage ongoing or established intervention work to address co-use among AYAs. First, interventions for co-use of combustible products among adults could be adapted to treat co-use of vaporized products among youth. Second, emerging intervention research is accumulating that is focused on quitting tobacco/nicotine vaping among AYAs (Caponnetto et al., 2023; Graham et al., 2021; Lyu et al., 2022; Palmer et al., 2023), which could be adapted to address cannabis vaping and/or co-vaping among youth. Third, digital interventions (e.g., mobile apps, text messages, gamification, and social media) appear to be well-suited to increase reach and engagement in co-use treatment among AYAs (Berg, Krishnan, et al., 2021).

4.3. Health equity considerations in co-use intervention development

Health equity and improving treatment outcomes among priority populations will be an important consideration moving forward, given that co-use patterns, as well as facilitators and barriers to quitting, may vary across sociodemographic groups, cultural and policy contexts, religious beliefs, and geographic locations (Chu et al., 2023; Montgomery et al., 2017; Philbin et al., 2022; Weinberger et al., 2022). For example, co-use interventions targeting Black/African American individuals may focus on the most relevant products, such as blunt use, which is the most prevalent among this population (Montgomery et al., 2017). Input from target populations early and iteratively may help to ensure that an intervention appropriately addresses the unique needs and preferences for co-cessation. As we found that English and German were the only languages used in the included interventions, linguistic and cultural adaptations may help to increase acceptability and efficacy among specific groups (e.g., Spanish-speaking people, American Indians, and Alaska Natives) (Hai et al., 2021; Soto et al., 2022).

In addition, the published interventions often excluded people who had a dependence on alcohol/other drugs and psychiatric conditions. However, polysubstance use and psychiatric distress are common among people with co-use and may impact treatment outcomes (Nguyen, Peyser, et al., 2023; Peters et al., 2014). Thus, future interventions should consider including individuals with alcohol/substance use and psychiatric conditions as improving cessation outcomes among these groups is important for reducing health disparities related to co-use.

Leveraging digital tools for co-use interventions may be one method to develop scalable and personalized interventions, as well as increase reach to priority populations, thus advancing health equity (Jaworski et al., 2023). Strategies for digital applications in co-use interventions have been described in our previous review (e.g., automated delivery of counseling or behavioral supports via apps or websites) (Nguyen et al., 2020). As applications of Artificial Intelligence (AI) and machine learning (ML) in healthcare are mounting, future work may consider leveraging these technologies for co-use treatment (Oyebode et al., 2023) with thoughtful consideration of potential ethical and social implications (Ti et al., 2021). Likewise, social media provides a platform for intervention delivery that can support interpersonal communication, social and peer support, and wide reach to target populations (Pagoto et al., 2016). Social media-delivered interventions have been developed for tobacco cessation (Thrul et al., 2019) and cannabis cessation (Bonar

et al., 2022), suggesting that co-use interventions could be adapted and deployed through this platform. Finally, telehealth has been increasingly used as a solution for healthcare disruptions since the COVID-19 pandemic (Avalone et al., 2022; Wosik et al., 2020). As shown in Beckham et al. 2018, telehealth represents a scalable means to deliver co-use treatment. As 43% of quitline callers who reported co-use wanted to quit cannabis use (Carpenter, 2020), the brief quitline intervention shown in Carpenter et al. 2024 exemplified a way to incorporate co-use treatment into already established telehealth tobacco treatment resources (Carpenter et al., 2024).

4.4. Limitations

Findings should be considered in light of several limitations. Due to the nature of a narrative review and the varied studies identified in our search, a meta-analysis or other synthesis of the findings was not possible. Study selection was restricted to those published in English. The limited number of studies with small sample sizes and varied characteristics limits the opportunity to draw firm conclusions about intervention effectiveness or to identify the most effective intervention components. Many studies were single-arm feasibility trials, which demonstrated acceptability and interest in interventions, but not strong signals of efficacy. While our search strategy was robust, differing terminology in the field may have resulted in not all studies being identified and included.

5. Conclusions

This narrative review reinforces an unmet and urgent need for novel treatments targeting the co-use of tobacco and cannabis. The available evidence on co-use interventions thus far is limited, and most studies have been feasibility and acceptability trials. The current evidence supports both tobacco and cannabis cessation content as an integrated intervention. There was no evidence of compensatory substance use when providing simultaneous treatment for both substances, suggesting that both can be treated at the same time with a low risk of adverse consequences. Notably, all included studies were conducted among adults, focused on co-use of combustible products, and most included relatively small sample sizes. The evolving product marketplace and increased prevalence of tobacco and cannabis co-use, particularly co-use of vaporized products in AYA populations, demonstrate a clear need for more work in this area. This review identifies key gaps and areas for further research and highlights the need to develop and evaluate co-use interventions using a health equity lens to reduce health disparities and improve co-use treatment outcomes.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments:

The authors would like to thank Josephine Tan, MLIS, and Eileen Chen, MLIS, librarians at the University of California, San Francisco, for helping with the literature search.

Role of funding sources:

This work is supported by the California Tobacco-Related Disease Research Program (grant number T32KT5071 to NN), the National Institute on Drug Abuse (NIDA; grant number K01DA056693 to NN; grant number K12DA000167 to KWB), and the National Cancer Institute (NCI; grant numbers R37 CA237245 and R01 CA276066 to EAM). The content is solely the responsibility of the authors and does not necessarily represent the official views of the funding organizations.

Data availability statement:

The data used in this review paper are primarily derived from publicly available, existing literature. All relevant data are within the paper and its supplemental document.

References

Adams TR, Arnsten JH, Ning Y, Nahvi S. Feasibility and Preliminary Effectiveness of Varenicline for Treating Co-Occurring Cannabis and Tobacco Use. J Psychoactive Drugs. 2018 Jan-Mar;50(1):12–18. doi: 10.1080/02791072.2017.1370746. Epub 2017 Sep 27. PMID: 28952897; PMCID: PMC5871554. [PubMed: 28952897]

Agrawal A, Budney AJ, & Lynskey MT (2012). The co-occurring use and misuse of cannabis and tobacco: A review. Addiction, 107(7), Article 7. DOI: 10.1111/j.1360-0443.2012.03837.x.

Andersen A, Gerrard M, Gibbons FX, Beach SRH, & Philibert R. (2021). An examination of risk factors for tobacco and cannabis smoke exposure in adolescents using an epigenetic biomarker. Frontiers in Psychiatry, 12. https://www.frontiersin.org/articles/10.3389/fpsyt.2021.688384.

Avalone L, King C, Popeo D, Perkel C, Abara CJ, Linn-Walton R, Gasca V, Vitagliano L, Barron C, & Fattal O. (2022). Increased attendance during rapid implementation of telehealth for substance use disorders during COVID-19 at the largest public hospital system in the United States. Substance Use & Misuse, 57(8), 1322–1327. 10.1080/10826084.2022.2079140 [PubMed: 35611875]

Becker J, Haug S, Kraemer T, & Schaub MP (2015). Feasibility of a group cessation program for co-smokers of cannabis and tobacco. Drug and Alcohol Review, 34(4), 418–426. 10.1111/dar.12244 [PubMed: 25676414]

Becker J, Haug S, Sullivan R, & Schaub MP (2014). Effectiveness of different webbased interventions to prepare co-smokers of cigarettes and cannabis for double cessation: A three-arm randomized controlled trial. Journal of Medical Internet Research, 16(12), Article e3246. 10.2196/jmir.3246

Beckham JC, Adkisson KA, Hertzberg J, Kimbrel NA, Budney AJ, Stephens RS, Moore SD, & Calhoun PS (2018). Mobile contingency management as an adjunctive treatment for co-morbid cannabis use disorder and cigarette smoking. Addictive Behaviors, 79, 86–92. 10.1016/j.addbeh.2017.12.007 [PubMed: 29268146]

Berg CJ, Krishnan N, Graham AL, Abroms LC. A synthesis of the literature to inform vaping cessation interventions for young adults. Addict Behav. 2021 Aug;119: 106898. doi: 10.1016/j.addbeh.2021.106898. Epub 2021 Mar 8. PMID: 33894483; PMCID: PMC8113079.

Bonar EE, Goldstick JE, Chapman L, Bauermeister JA, Young SD, McAfee J, & Walton MA (2022). A social media intervention for cannabis use among emerging adults: Randomized controlled trial. Drug and Alcohol Dependence, 232, Article 109345. 10.1016/j.drugalcdep.2022.109345

Caponnetto P, Campagna D, Ahluwalia JS, Russell C, Maglia M, Riela PM, Longo CF, Busa B, & Polosa R. (2023). Varenicline and counseling for vaping cessation: A double-blind, randomized, parallel-group, placebo-controlled trial. BMC Medicine, 21(1), Article 220. 10.1186/s12916-023-02919-2

Carlini BH, Garrett SB, & Nims LN (2022). The kids are not all right: E-cigarettes, cannabis co-use, and an emerging public health crisis—A Commentary on Roberts et al. (2022). Journal of Studies on Alcohol and Drugs, 83(5), 771–772. DOI: 10.15288/jsad.2022.83.771. [PubMed: 36136449]

Carpenter KM (2020). Marijuana use and adherence to smoking cessation treatment among callers to tobacco quitlines. Preventing Chronic Disease, 17. 10.5888/pcd17.200110

Carpenter KM, Walker DD, Mullis K, Berlin HM, Short E, Javitz HS, Carlini BH. Testing a Brief Quitline Intervention for Tobacco Cannabis Co-Users: A Randomized Controlled Pilot Study. Tob

Use Insights. 2024 Jun 12;17:1179173X241261302. doi: 10.1177/1179173X241261302. PMID: 38873657; PMCID: PMC11171437.

Chu A, Chaiton M, Kaufman P, Goodwin RD, Lin J, Hindocha C, Goodman S, & Hammond D. (2023). Co-use, simultaneous use, and mixing of cannabis and tobacco: A cross-national comparison of Canada and the US by Cannabis Administration Type. International Journal of Environmental Research and Public Health, 20(5), 4206. 10.3390/ijerph20054206 [PubMed: 36901216]

Cohn AM, & Chen S. (2022). Age groups differences in the prevalence and popularity of individual tobacco product use in young adult and adult marijuana and tobacco co-users and tobacco-only users: Findings from Wave 4 of the population assessment of tobacco and health study. Drug and Alcohol Dependence, 233, Article 109278. 10.1016/j.drugalcdep.2022.109278

Do VV, Ling PM, Chaffee BW, Nguyen N. Concurrent Use of Tobacco and Cannabis and Internalizing and Externalizing Problems in US Youths. JAMA Netw Open. 2024 Jul 1;7(7):e2419976. doi: 10.1001/jamanetworkopen.2024.19976. PMID: 38958977; PMCID: PMC11222996.

Ehlke SJ, Kendzor DE, Smith MA, Sifat MS, Boozary LK, & Cohn AM (2023). Single-use, co-use, and polysubstance use of alcohol, tobacco, and cannabis in sexual minority and heterosexual females. The American Journal on Addictions, 32 (1), 66–75. 10.1111/ajad.13344 [PubMed: 36250728]

Fiore M, Jáen C. Baker T, Bailey W, & Benowitz N. (2008). Treating tobacco use and dependence: 2008 Update. Clinical practice guideline. US Department of Health and Human Services.

Freeman TP, Hindocha C, Baio G, Shaban NDC, Thomas EM, Astbury D, Freeman AM, Lees R, Craft S, Morrison PD, Bloomfield MAP, O'Ryan D, Kinghorn J, Morgan CJA, Mofeez A, Curran HV. Cannabidiol for the treatment of cannabis use disorder: a phase 2a, double-blind, placebo-controlled, randomised, adaptive Bayesian trial. Lancet Psychiatry. 2020 Oct;7(10):865–874. doi: 10.1016/S2215-0366(20)30290-X. Epub 2020 Jul 28. PMID: 32735782; PMCID: PMC7116091. [PubMed: 32735782]

Graham AL, Amato MS, Cha S, Jacobs MA, Bottcher MM, & Papandonatos GD (2021). Effectiveness of a vaping cessation text message program among young adult e-cigarette users: A randomized clinical trial. JAMA Internal Medicine. 10.1001/jamainternmed.2021.1793

Hai AH, Lee CS, Abbas BT, Bo A, Morgan H, & Delva J. (2021). Culturally adapted evidence-based treatments for adults with substance use problems: A systematic review and meta-analysis. Drug and Alcohol Dependence, 226, Article 108856. 10.1016/j.drugalcdep.2021.108856

Herbst ED, Pennington DL, Borsari B, Manuel J, Yalch M, Alcid E, Martinez Rivas M, Delacruz J, Rossi N, Garcia B, Wong N, & Batki SL (2023). Nacetylcysteine for smoking cessation among dual users of tobacco and cannabis: Protocol and rationale for a randomized controlled trial. Contemporary Clinical Trials, 131, Article 107250. 10.1016/j.cct.2023.107250

Hill KP, Toto LH, Lukas SE, Weiss RD, Trksak GH, Rodolico JM, & Greenfield SF (2013). Cognitive behavioral therapy and the nicotine transdermal patch for dual nicotine and cannabis dependence: A pilot study. The American Journal on Addictions, 22(3), 233–238. 10.1111/j.1521-0391.2012.12007.x [PubMed: 23617864]

Hindocha C, & McClure EA (2021). Unknown population-level harms of cannabis and tobacco co-use: If you don't measure it, you can't manage it. Addiction, 116(7), Article 7. DOI: 10.1111/add.15290.

Hindocha C, Shaban NDC, Freeman TP, Das RK, Gale G, Schafer G, Falconer CJ, Morgan CJA, & Curran HV (2015). Associations between cigarette smoking and cannabis dependence: A longitudinal study of young cannabis users in the United Kingdom. Drug and Alcohol Dependence, 148, 165–171. 10.1016/j.drugalcdep.2015.01.004 [PubMed: 25622777]

Jaworski BK, Webb Hooper M, Aklin WM, Jean-Francois B, Elwood WN, Belis D, Riley WT, & Hunter CM (2023). Advancing digital health equity: Directions for behavioral and social science research. Translational Behavioral Medicine, 13(3), 132–139. 10.1093/tbm/ibac088 [PubMed: 36318232]

Lee DC, Budney AJ, Brunette MF, Hughes JR, Etter J-F, & Stanger C. (2014). Treatment models for targeting tobacco use during treatment for cannabis use disorder: Case series. Addictive Behaviors, 39(8), 1224–1230. 10.1016/j.addbeh.2014.04.010 [PubMed: 24813547]

Lee DC, Budney AJ, Brunette MF, Hughes JR, Etter J-F, & Stanger C. (2015). Outcomes from a computer-assisted intervention simultaneously targeting cannabis and tobacco use. Drug and Alcohol Dependence, 155, 134–140. 10.1016/j.drugalcdep.2015.08.001 [PubMed: 26307942]

Lee DC, Walker DD, Hughes JR, Brunette MF, Scherer E, Stanger C, Etter J-F, Auty S, & Budney AJ (2019). Sequential and simultaneous treatment approaches to cannabis use disorder and tobacco use. Journal of Substance Abuse Treatment, 98, 39–46. 10.1016/j.jsat.2018.12.005 [PubMed: 30665602]

Loflin MJE, Kiluk BD, Huestis MA, Aklin WM, Budney AJ, Carroll KM, D'Souza DC, Dworkin RH, Gray KM, Hasin DS, Lee DC, Le Foll B, Levin FR, Lile JA, Mason BJ, McRae-Clark AL, Montoya I, Peters EN, Ramey T, & Strain EC (2020). The state of clinical outcome assessments for cannabis use disorder clinical trials: A review and research agenda. Drug and Alcohol Dependence, 212, Article 107993. 10.1016/j.drugalcdep.2020.107993

Lyu JC, Olson SS, Ramo DE, & Ling PM (2022). Delivering vaping cessation interventions to adolescents and young adults on Instagram: Protocol for a randomized controlled trial. BMC Public Health, 22(1), 2311. 10.1186/s12889-022-14606-7 [PubMed: 36496358]

McClure EA (2021). Accurate and sufficient measurement of cannabis and tobacco couse: agreement, consensus and the path forward. Addiction, 116(7), 1636–1637. 10.1111/add.15497. Epub 2021 Apr 14. PMID: 33855758; PMCID: PMC10042226. [PubMed: 33855758]

McClure EA, Rabin RA, Lee DC, & Hindocha C. (2020). Treatment implications associated with cannabis and tobacco co-use. Current Addiction Reports, 7(4), Article 10.1007/s40429-020-00334-8

McRae-Clark AL, Gray KM, Baker NL, Sherman BJ, Squeglia L, Sahlem GL,Wagner A, & Tomko R. (2021). Varenicline as a treatment for cannabis use disorder: A placebo-controlled pilot trial. Drug and Alcohol Dependence, 229(Pt B), Article 109111. 10.1016/j.drugalcdep.2021.109111

McRobbie H, Boland VC, & Courtney RJ (2021). Assessing cannabis and tobacco co-use: the pros and cons of additional data collection. Addiction, 116, 1631–1633. [PubMed: 33417256]

Meier E, & Hatsukami DK (2016). A review of the additive health risk of cannabis and tobacco co-use. Drug and Alcohol Dependence, 166, 6–12. 10.1016/j.drugalcdep.2016.07.013 [PubMed: 27476751]

Miech RA, Johnston LD, Patrick ME, & O'Malley PM (2024). Monitoring the Future national survey results on drug use, 1975–2023: Overview and detailed results for secondary school students. (Monitoring the Future Monograph Series). Institute for Social Research, University of Michigan. https://monitoringthefuture.org/results/annual-reports/.

Miech R, Johnston L, O'Malley PM, Bachman JG, & Patrick ME (2019). Trends in adolescent vaping, 2017–2019. The New England Journal of Medicine, 381(15),1490–1491. 10.1056/NEJMc1910739 [PubMed: 31532955]

Miech R, Leventhal A, Johnston L, O'Malley PM, Patrick ME, & Barrington-Trimis J. (2021). Trends in use and perceptions of nicotine vaping among US Youth From 2017 to 2020. JAMA Pediatrics, 175(2), 185–190. 10.1001/jamapediatrics.2020.5667 [PubMed: 33320241]

Miech R, Patrick ME, O'Malley PM, Johnston LD, & Bachman JG (2020). Trends in reported Marijuana vaping among US adolescents, 2017–2019. JAMA, 323 (5), Article 5. DOI: 10.1001/jama.2019.20185.

Montgomery L, Robinson C, Seaman EL, & Haeny AM (2017). A scoping review and meta-analysis of psychosocial and pharmacological treatments for cannabis and tobacco use among African Americans. Psychology of Addictive Behaviors: Journal of the Society of Psychologists in Addictive Behaviors, 31(8), 922–943. 10.1037/adb0000326 [PubMed: 29199844]

Nargis N, & Asare S. (2023). Legalization of access to cannabis: A growing agenda for tobacco control research in the USA. The Lancet Regional Health – Americas, 28. 10.1016/j.lana.2023.100630

Nguyen N, Barrington-Trimis JL, Urman R, Cho J, McConnell R, Leventhal AM, & Halpern-Felsher B. (2019). Past 30-day co-use of tobacco and marijuana products among adolescents and young adults in California. Addictive Behaviors, 98, Article 106053. 10.1016/j.addbeh.2019.106053

Nguyen N, Islam S, Llanes KD, Koester KA, & Ling PM (2024). Classification of patterns of tobacco and cannabis co-use based on temporal proximity: A qualitative study among young adults. Addictive Behaviors, 152, Article 107971. 10.1016/j.addbeh.2024.107971

Nguyen N, McQuoid J, Neilands TB, Dermody SS, Holmes LM, Ling PM, & Thrul J. (2021). Same-day use of cigarettes, alcohol, and cannabis among sexual minority and heterosexual young adult smokers. Psychology of Addictive Behaviors: Journal of the Society of Psychologists in Addictive Behaviors, 35(2), Article 2. 10.1037/adb0000678

Nguyen N, Nguyen C, & Thrul J. (2020). Digital health for assessment and intervention targeting tobacco and cannabis co-use. Current Addiction Reports, 7(3), 268–279. 10.1007/s40429-020-00317-9 [PubMed: 33643768]

Nguyen N, Peyser ND, Olgin JE, Pletcher MJ, Beatty AL, Modrow MF, Carton TW, Khatib R, Djibo DA, Ling PM, & Marcus GM (2023). Associations between tobacco and cannabis use and anxiety and depression among adults in the United States: Findings from the COVID-19 Citizen Science Study. PLOS ONE.

Nguyen N, Thrul J, Neilands TB, & Ling PM (2023). Associations between product type and intensity of tobacco and cannabis co-use on the same day among young adult smokers: Smartphone-based daily-diary study. JMIR mHealth and uHealth, 11, Article e40736. 10.2196/40736

Oyebode O, Fowles J, Steeves D, & Orji R. (2023). Machine learning techniques in adaptive and personalized systems for health and wellness. International Journal of Human-Computer Interaction, 39(9), 1938–1962. 10.1080/10447318.2022.2089085

Pagoto S, Waring ME, May CN, Ding EY, Kunz WH, Hayes R, & Oleski JL(2016). Adapting behavioral interventions for social media delivery. Journal of Medical Internet Research, 18(1), Article e24. 10.2196/jmir.5086

Palmer AM, Carpenter MJ, Rojewski AM, Haire K, Baker NL, & Toll BA (2023). Nicotine replacement therapy for vaping cessation among mono and dual users: A mixed methods preliminary study. Addictive Behaviors, 139, Article 107579. 10.1016/j.addbeh.2022.107579

Patrick ME, Miech RA, Johnston LD, & O'Malley PM (2023). Monitoring the Future Panel Study annual report: National data on substance use among adults ages 19 to. In Monitoring the Future Monograph Series, 60 pp. 1976–2022). Institute for Social Research, University of Michigan.

Peters EN, Budney AJ, & Carroll KM (2012). Clinical correlates of co-occurring cannabis and tobacco use: A systematic review. Addiction (Abingdon, England), 107 (8), 1404–1417. 10.1111/j.1360-0443.2012.03843.x [PubMed: 22340422]

Peters EN, Schwartz RP, Wang S, O'Grady KE, Blanco C. Psychiatric, psychosocial, and physical health correlates of co-occurring cannabis use disorders and nicotine dependence. Drug Alcohol Depend. 2014 Jan 1;134:228–234. doi: 10.1016/j.drugalcdep.2013.10.003. Epub 2013 Oct 14. PMID: 24183498; PMCID: PMC3865597. [PubMed: 24183498]

Philbin MM, Giovenco DP, & Mauro PM (2022). Commentary on Weinberger et al.: Tobacco and cannabis policies as drivers of nicotine and cannabis co-use - research and measurement implications to move the field forward. Addiction, 117(6), 1778–1780. 10.1111/add.15885 [PubMed: 35362234]

Roberts ME, Tackett AP, Singer JM, Wagner DD, Lu B, Wagener TL, Brinkman M, Klein EG, Vickerman KA, Wold LE, Gumina RJ, & Mohler PJ (2022). Dual use of E-cigarettes and cannabis among young people in America: A new public health hurdle? Journal of Studies on Alcohol and Drugs, 83(5), 768–770. 10.15288/jsad.2022.83.768 [PubMed: 36136448]

Smith DM, O'connor RJ, Wei B, Travers M, Hyland A, & Goniewicz ML (2020). Nicotine and toxicant exposure among concurrent users (co-users) of tobacco and cannabis. Nicotine & Tobacco Research: Official Journal of the Society for Research on Nicotine and Tobacco, 22(8), 1354–1363. 10.1093/ntr/ntz122 [PubMed: 31388679]

Soto C, West AE, Ramos GG, & Unger JB (2022). Substance and behavioral addictions among American Indian and Alaska native populations. International Journal of Environmental Research and Public Health, 19(5), Article 2974. 10.3390/ijerph19052974

Sukhera J. (2022). Narrative reviews: Flexible, rigorous, and practical. Journal of Graduate Medical Education, 14(4), 414–417. 10.4300/JGME-D-22-00480.1 [PubMed: 35991099]

Thrul J, Tormohlen KN, & Meacham MC (2019). Social media for tobacco smoking cessation intervention: A review of the literature. Current Addiction Reports, 6(2),126–138. [PubMed: 31485388]

Ti L, Ho A, & Knight R. (2021). Towards equitable AI interventions for people who use drugs: Key areas that require ethical investment. Journal of Addiction Medicine, 15(2), Article 96. 10.1097/ADM.0000000000000722

Tomko RL, Gray KM, Huestis MA, Squeglia LM, Baker NL, & McClure EA (2019). Measuring within-individual cannabis reduction in clinical trials: A review of the methodological challenges. Current Addiction Reports, 6(4), 429–436. 10.1007/s40429-019-00290-y [PubMed: 32133273]

Tucker JS, Pedersen ER, Seelam R, Dunbar MS, Shih RA, & D'Amico EJ (2019). Types of cannabis and tobacco/nicotine co-use and associated outcomes in young adulthood. Psychology of Addictive Behaviors: Journal of the Society of Psychologists in Addictive Behaviors, 33(4), Article 4. 10.1037/adb0000464

Walsh H, McNeill A, Purssell E, & Duaso M. (2020). A systematic review and Bayesian meta-analysis of interventions which target or assess co-use of tobacco and cannabis in single- or multi-substance interventions. Addiction (Abingdon, England), 115(10), 1800–1814. 10.1111/add.14993 [PubMed: 32003088]

Weinberger AH, Platt J, Copeland J, & Goodwin RD (2018). Is cannabis use associated with increased risk of cigarette smoking initiation, persistence, and relapse? Longitudinal data from a representative sample of US adults. The Journal of Clinical Psychiatry, 79(2), Article 17m11522. 10.4088/JCP.17m11522

Weinberger AH, Wyka K, Kim JH, Smart R, Mangold M, Schanzer E, Wu M, & Goodwin RD (2022). A difference-in-difference approach to examining the impact of cannabis legalization on disparities in the use of cigarettes and cannabis in the United States, 2004–17. Addiction (Abingdon, England), 117(6), 1768–1777. 10.1111/add.15795 [PubMed: 34985165]

Winters KC, Mader J, Budney AJ, Stanger C, Knapp AA, & Walker DD (2021). Interventions for cannabis use disorder. Current Opinion in Psychology, 38, 67–74. 10.1016/j.copsyc.2020.11.002 [PubMed: 33338844]

Wosik J, Fudim M, Cameron B, Gellad ZF, Cho A, Phinney D, Curtis S, Roman M, Poon EG, Ferranti J, Katz JN, & Tcheng J. (2020). Telehealth transformation: COVID-19 and the rise of virtual care. Journal of the American Medical Informatics Association: JAMIA, 27(6), Article 6. 10.1093/jamia/ocaa067

Yakimavets V, Qiu T, Panuwet P, D'Souza PE, Brennan PA, Dunlop AL, Barry Ryan P, & Boyd Barr D. (2022). Simultaneous quantification of urinary tobacco and marijuana metabolites using solid-supported liquid-liquid extraction coupled with liquid chromatography tandem mass spectrometry. Journal of Chromatography. B, Analytical Technologies in the Biomedical and Life Sciences, 1208, 123378. DOI: 10.1016/j.jchromb.2022.123378.

Addict Behav. Author manuscript; available in PMC 2024 November 01.

Table 1:

Characteristics of the published treatment interventions targeting co-use of tobacco and cannabis (N=9 studies)

Author, year (country; sample size)	Adams et al. 2018 (US; n=7)	Becker et al. 2014 (Switzerland; n=325)	Becker et al. 2015 (Switzerland; n=77)	Beckham et al. 2018 (US; n=5)	Hill et al. 2013 (US; n=12)	Lee et al. 2014 (US; n=6)	Lee et al. 2015 (US; n=32)	Lee et al. 2019 (US; n=67)	Carpenter et al. 2024 (n=102)
Design	Pilot feasibility study	3-arm RCT	Pilot feasibility single arm trial	Pilot feasibility single arm trial	Pilot feasibility single arm trial	Case series	Single arm trial (historical controls)	2-arm RCT	2-arm RCT
Setting	OUD treatment program	Remote (via website)	Addiction treatment centers	Remote (via mobile app and telehealth)	In person (clinical setting not specified)	CUD treatment	CUD treatment	CUD treatment	Quitline service in 4 states
Age (mean ±SD)	47 ± 10 (NR on range)	29 ± 10 (NR on range)	32 ± 8 (NR on range)	44 ± 9 (range 35–57) **	28 ± 11 (range 18–65) *	40 (NR on SD) (range 24–57) **	29 ± 12 (range 18–65) *	32 ± 11 (range 18–60) *	52 ± 14 (NR on range)
Female	14%	15–30%	25%	80%	58%	17%	22%	32%	50%
Race Ethnicity	Black (29%) NH White (14%) Hispanic (57%)	NR	NR	Black (100%) Hispanic (20%)	Black (8%) White (92%)	NR	Non-White (22%, NR on specific races) White (78%)	Black 18%) White (64%) Other/Multirace (18%)	White (73%) Black (16%) Other/ Multirace (11%) Hispanic (2%)
Language used	English	German	German	English	English	English	English	English	English
Inclusion criteria for tobacco and targeted products	Current (n=6) or former (n=1); Target cigarettes	Any tobacco use in the past 4 weeks; Target cigarettes	Daily use of tobacco; Target either cigarettes, pipe, or cigar	7 cigarettes in the past 7 days and smoking for at least the past year; Target cigarettes	DSM-IV nicotine dependence and CO≥7ppm; Target cigarettes	Daily use of cigarettes or use of blunts or spliffs; Target cigarettes, blunts, and spliffs	Daily use of cigarettes or use of blunts or spliffs; Target cigarettes, blunts, and spliffs	≥ 5 days/week using cigarettes or use of blunts or spliffs; Target cigarettes, blunts, and spliffs	Daily use of cigarettes with 5+ cigarettes/ day; Target cigarettes
Inclusion criteria for cannabis and targeted products	≥5 days/week of cannabis use; No information about specific products	Any cannabis use in the past 6 months; target smoked cannabis, but no information about specific products	At least once weekly use of smoked cannabis; no information about specific products	DSM-IV CUD; ≥40 using days of the past 90; target smoked cannabis, but no information about specific products.	DSM-IV CUD; target smoked cannabis, but no information about specific products.	DSM-IV CUD; ≥45 using days of the past 90; Target blunts, and spliffs.	DSM-IV CUD; ≥45 using days of the past 90; Target blunts, and spliffs.	DSM-IV CUD; ≥45 using days of the past 90; Target blunts, and spliffs.	≥9 using days of the past 30 days; not solely for medical purposes; used cannabis for psychoactive & physiological effects; Target smoking, vaping, and edible products

Study characteristics	Adams et al. 2018 (US; n=7)	Becker et al. 2014 (Switzerland; n=325)	Becker et al. 2015 (Switzerland; n=77)	Beckham et al. 2018 (US; n=5)	Hill et al. 2013 (US; n=12)	Lee et al. 2014 (US; n=6)	Lee et al. 2015 (US; n=32)	Lee et al. 2019 (US; n=67)	Carpenter et al. 2024 (US; n=102)
Exclusion criteria	−Unstable medical or psychiatric illness; −Pregnant, trying to conceive, or breastfeeding	−Not be computer literate	−Current serious psychiatric illness or a history of psychosis, schizophrenia or bipolar type I disorder; −In other smoking cessation treatment;	−Serious mental illness or psychotic disorder; −Hospitalized for psychiatric reasons; Report imminent risk for suicide or homicide; − Have a change in psychiatric medication during the study; −In CUD or smoking treatment; −Met criteria for other SUD or alcohol use disorder; −Use other forms of nicotine (cigars, pipes, or chewing tobacco) −Imprisoned; −Pregnant; −History of myocardial infarction and contraindication to NRT	−Serious psychiatric illness or history of psychosis, schizophrenia, bipolar type I disorder, or significant current suicidal or homicidal thoughts; −Diagnosis of other drug or alcohol dependence; −Significant cardiac disease; −Current treatments for cannabis or tobacco cessation; −Current use of bupropion; −Current use of smokeless tobacco;	−Severe psychological distress (i.e. active suicidal plans, psychosis, debilitating panic disorder); −Met criteria for other drug or alcohol dependence; −Use of non-tobacco nicotine (e.g., NRT); −In treatment for substance abuse; −Have medical condition preventing NRT use (i.e., current pregnancy, recent heart attack);	−Severe psychological distress (i.e. active suicidal plans, psychosis, debilitating panic disorder); −Met criteria for other drug or alcohol dependence, except for opiate dependence maintained by agonist replacement therapy; −Use of non-tobacco nicotine (e.g., NRT); −In treatment for substance abuse; −Have medical condition preventing NRT use (i.e., current pregnancy, recent heart attack); −Legal status interfering with participation; live >45 miles from the clinic; live with another participant;	−Severe psychological distress (i.e., active suicidal plans, psychosis, debilitating panic disorder); −Met criteria for other drug or alcohol dependence, except for opiate dependence maintained by agonist replacement therapy; −Use of non-tobacco nicotine (e.g., NRT) or exclusive use of smokeless tobacco; −In treatment for substance abuse −Have medical condition preventing NRT use (i.e., current pregnancy, recent heart attack) −Legal status interfering with participation; live >45 miles from the clinic; live with another participant;	−Less than 21 year old −Pregnant or not planning to become pregnant in the next 3 months −Report a diagnosis of schizophrenia −Have another member in the household participating in the study
Treatment seeking and quitting interest	Not required	Not required (focused on readiness to quit)	Not required	Willing to quit smoking both substances	Desire to quit both substances in the next 30 days	Seeking CUD treatment + Interest in quitting tobacco in the next 6 months	Seeking CUD treatment + Interest in quitting tobacco in the next 6 months	Seeking CUD treatment + Interest in quitting tobacco in the next 6 months	Ready to quit smoking in the next 30 days; Not required desire for changing cannabis use
Co-Use Intervention Condition/s	4 weeks of standard care (medication for OUD and individual counseling), followed by 4	Computer delivered 25-minute session on either: 1) Psychoeducation, 2) Self-assessment and	5–6 weekly 2-hour group sessions + 1 individual optional session; guided by a	App-based CM (4 weeks) + Telephone-based CBT (6 sessions) + NRT (8 weeks)	Integrated CBT manualized treatment for both tobacco and cannabis +	9 computer-delivered MET/CBT modules + Abstinence-based CM (weeks 3–12) + 3 individual	9 computer-delivered MET/CBT modules + Abstinence-based CM (weeks 3–12) + 3 individual	Simultaneous treatment (SIM): 9 computer-delivered MET, CBT, and CM for cannabis + 7 tobacco and co-	MET-based counseling for cannabis treatment was integrated and delivered simultaneously

	weeks of standard care plus Varenicline, or vice versa	normative feedback, 3) Motivational interviewing	manual targeting cannabis and tobacco derived from MI, CBT, relapse prevention, and self-control training		NRT for 10 weeks	counseling sessions (15–30 mins) + NRT (12 weeks) + 5 behavioral modules for tobacco	counseling sessions (15–30 mins) + NRT (12 weeks) + 5 behavioral modules for tobacco	use modules + NRT	with Quitline tobacco cessation telephone coaching.
Control group	within-subject crossover	Psychoeducation group with information on use of tobacco, cannabis, and co-use	NA	NA	NA	NA	Historical CUD treatment group (N=54)	SEQ is same as SIM, but tobacco treatment delivered during Weeks 13–24	Standard Quitline treatment (5 telephone coaching sessions + supplemental support via text automated messaging & web-based information)
Intervention duration	8 weeks	single 25-minute session	5–6 weekly sessions	6–8 weeks	10 weeks	12 weeks	12 weeks	12 weeks	5–10 weeks
Delivery format	In-person individual counseling	Web-based	In-person individual & group counseling	CM app, telephone CBT, telehealth clinic for NRT	In-person individual counseling	Computer-delivered modules + in-person	Computer-delivered modules + in-person	Computer-delivered modules + in-person	Telephone coaching sessions
Counseling	Individual	NA	group with 1 optional individual session	Individual	NA	Individual	Individual	Individual	Individual
Behavioral therapy	MI and CBT for OUD that may address cannabis or tobacco use	Personalized normative feedback, MI, and psychoeducation for both tobacco and cannabis	derived from MI, CBT, relapse prevention model, and self-control practices for both tobacco and cannabis	CBT for both tobacco and cannabis	CBT for both tobacco and cannabis	Psychoeducational and behavioral therapy modules for tobacco; CBT, MET, CM modules for cannabis	Psychoeducational and behavioral therapy modules for tobacco; CBT, MET, CM modules for cannabis	Psychoeducational and behavioral therapy modules for tobacco; CBT, MET, CM modules for cannabis	SCT and USPHS Clinical Practice Guideline for tobacco and MET/MI for cannabis
Medication	Varenicline; all participants also received OUD medication	NA	NRT and Varenicline	Combination NRT	NRT patch	Combination NRT	Combination NRT	Combination NRT	NRT (not specify single or combination)
Tobacco Outcomes	CPD reduced from baseline (13 to 5), was	NA	32.5% and 10.4% self-reported	40% abstinent at EOT; 36.2% days abstinent;	Cigarettes smoked/day significantly	No participant quit successfully; 50% initiated NRT;	No differences in EOT abstinence (12.5% vs 4%), but	No differences in tobacco outcomes between SIM vs.	No differences in tobacco outcomes at 3-

	numerically similar between conditions (5 vs. 5); but no change in CO and abstinence; Tobacco abstinence was validated by expired CO test.		abstinence at EOT and 6 months, respectively; tobacco abstinence was validated by saliva cotinine.	tobacco abstinence was validated by expired CO test and saliva cotinine.	decreased from baseline to Week 10 (12.6 to 2.1); tobacco abstinence was validated by saliva cotinine.	50% made quit attempts; 83% made reduction attempts; Tobacco abstinence was validated by expired CO test.	greater reduction in cigarettes smoked/day in the intervention group; 66% set a quit date; 56% made one quit attempt; Tobacco abstinence was validated by expired CO/urine test.	SEQ (5.9% vs. 3.0% of continuous abstinence during weeks 5–12, and 17.6% vs. 9.1% at EOT), Tobacco abstinence was validated by expired CO/urine test.	month follow up. ITT 7-day abstinence was 25% for the intervention vs. 29% for the control; Cigarettes/day decreased by 7.0 for the intervention vs. 7.9 for the control. Tobacco abstinence was validated by saliva cotinine.
Cannabis Outcomes	14.3% abstinence; cannabis craving and withdrawal and frequency of use per day reduced; Cannabis abstinence was validated by urine testing	NA	23.4% and 19.5% self-reported abstinence at EOT and 6 months, respectively; cannabis abstinence was not validated.	80% were abstinent; 54.2% days abstinent; Cannabis abstinence was validated by saliva and urine testing	Number of inhalations per day reduced but was not significant (10.0 to 8.0; p=0.37); Cannabis abstinence was validated by urine testing	83% achieved some abstinence during the 12 weeks; Cannabis abstinence was validated by urine testing.	EOT abstinence of the intervention group vs. control: 44% vs. 35% Cannabis use was similar to controls (3.6 vs. 3.1 weeks of abstinence); Cannabis abstinence was validated by urine testing.	No differences between SIM vs. SEQ; weeks of continuous abstinence: 4.0 vs. 3.7; EOT abstinence: 20.6% vs. 18.2%; Cannabis abstinence was validated by urine testing.	No differences in cannabis outcomes at 3-month follow up. Past-30 days of cannabis use decreased by 3.8 days for the intervention vs. 3.0 days for the control. Hazardous cannabis use decreased in both the intervention (from 74% to 50%) and the control (from 65% to 62%)
6-month outcome assessment	No	NA	Yes	Yes	No	No	No	Yes	No
Increased use of tobacco or cannabis (compensator)	NR	NA	No evidence of increased use of tobacco and cannabis	NR	No evidence of increased use in cannabis	None reported (no increase in cannabis use)	None reported (no increase in cannabis use)	No direct evidence of compensatory use	No direct evidence of compensatory use
Retention	100%	80%	62%	100%	58%	100%	66%	No differences, but poor participation to tobacco treatment in SEQ group	Average number of phone calls completed by the intervention was 3.6 (SD = 1.5) vs. by the control group

									3.4 calls (SD = 1.8)

Note: RCT: Randomized Controlled Trials; DSM: Diagnostic and Statistical Manual of Mental Disorders; OUD: Opioid use disorder; CO: carbon monoxide; NA: Not applicable; CUD: Cannabis Use Disorder; NR: Not Reported; CBT: Cognitive Behavioral Therapy; MI: Motivational Interviewing; MET: Motivational Enhancement Therapy; CM: Contingency Management; EOT: End of Treatment; SIM: simultaneous treatment; SEQ: Sequential treatment; SCT: Social Cognitive Theory; USPHS: U.S Public Health Service. ITT: Intent-to-treat;

*age range reported from eligibility criteria,

**age range reported from enrolled participants.

Table 2:

Presence of specific intervention components in the published tobacco and cannabis co-use treatment studies (N= 9 studies)

Intervention Component		Adam 2018	Becker 2014	Becker 2015	Beckham 2018	Hill 2013	Lee 2014	Lee 2015	Lee 2019	Carpenter 2024
Intervention format	Individual counseling									
	Group counseling									
	Digital tool or computer delivered									
	Manual-based synchronous delivery									
Behavioral treatment	CBT									
	MI/MET									
	CM									
Behavioral skill or technique integrated in study intervention	Self-monitoring									
	Managing withdrawal									
	Coping with craving									
	Identifying triggers									
	Setting a quit date									
	Relapse prevention									
	Refusal skills									
	Managing mood									
	Harm reduction									
	Social support									
	Reasons for quitting									
Pharmacotherapy	NRT			not specified	Combination NRT	Single NRT	Combination NRT	Combination NRT	Combination NRT	not specified
	Varenicline									
Treatment order	Sequential									
	Simultaneous									
Cessation goal for both tobacco and cannabis	Abstinence									
	Reduction									

Note: CBT: Cognitive Behavioral Therapy; MI: Motivational Interviewing; MET: Motivational Enhancement Therapy; CM: Contingency Management; NRT: Nicotine Replacement Therapy; Adam 2018 study provided CBT for Opioid use disorder; In the Carpenter et al. 2024 study, abstinence goal was for tobacco and reduction goal was for cannabis.