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A Qualitative Systematic Review of Cigarette Smoking Cessation Interventions for Persons Living with HIV

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Abstract
Persons living with HIV (PLWH) have disproportionately high rates of both cigarette smoking and tobacco-induced negative health outcomes. The goal of this qualitative systematic review was to identify gaps in the existing literature and future directions for smoking cessation support for PLWH. Three online databases were searched from their inception through December 31, 2017, using designated search terms. Peer-reviewed English-language articles that documented an intervention designed to increase smoking cessation among PLWH were reviewed. Data were abstracted using a standardized form to document study and intervention characteristics and results. Thirty-two articles, describing 28 unique intervention studies, met inclusion criteria. Interventions consisted primarily of combinations of counseling, pharmacotherapy, and the use of information and communications technology; few interventions were implemented at the clinic level. Thirteen interventions resulted in significant improvements in cessation-related outcomes. Information and communications technology and clinic-level interventions had the greatest potential for increasing smoking cessation among PLWH. Efficacious interventions designed for PLWH in the US South, and for groups of PLWH facing additional health disparities (e.g., communities of color and sexual and gender minorities), are needed. There is also a need for more rigorous research designs to test the efficacy of interventions designed to increase cessation-related outcomes among PLWH.

Keywords Smoking · Cessation · Persons living with HIV · Intervention · Systematic review

Introduction

Despite decreasing cigarette smoking rates in the general US population, the rate of smoking among persons living with HIV (PLWH) remains disproportionately high. As of 2016, an estimated 15.5% of US adults 18 years or older smoked cigarettes [1], but recent estimated rates among PLWH range from 42.4% to 70% [2–5]. There are a variety of health risks related to smoking that may be enhanced by the presence of HIV infection, including increased susceptibility to pneumonia and chronic obstructive pulmonary disease and an increased risk of non-AIDS-defining cancers [4, 6–9]. The negative effects of smoking for PLWH can also limit the HIV treatment benefits of antiretroviral therapy (ART) [10, 11]. PLWH have an increased risk of cancer on average compared to the general population overall, and lung cancer is currently a leading cause of mortality among PLWH [11–13]. PLWH who are on ART with viral suppression but smoke cigarettes are predicted to lose more life years to smoking than to HIV infection [11, 13]. PLWH who smoke are also less likely to quit smoking than persons who do not have HIV (32.4% vs. 51.7%) [4].

Thus, smoking cigarettes is an important modifiable risk factor that should be a high priority among PLWH, even amid other important health care priorities. However, the need for smoking cessation and the potential health risks of smoking are often not thoroughly emphasized to PLWH by health care providers, in part due to multiple competing health care needs of this population. Therefore, interventions for PLWH and providers that care for PLWH are necessary to increase cessation among this population.

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There are many evidence-based smoking cessation interventions with varying degrees of efficacy, efficiency, and cost. These include pharmacotherapy, counseling, information and communications technology (i.e., utilizing the Internet, email, cell phones, or text messaging), and clinic-level interventions. Pharmacotherapy used in smoking cessation interventions, such as nicotine replacement therapy (NRT), bupropion, and varenicline, can be applied among PLWH who smoke as there are limited to no drug interactions when combined with ART [14]. In addition to pharmacotherapy-based interventions, counseling-based interventions can include brief information sessions, individual or group therapy, and motivational interviewing. Many interventions combine pharmacotherapy with counseling to increase cessation-related outcomes [15]. Information and communications technology interventions, including the use of cell phones for delivery of counseling and Internet-based cessation interventions, have also recently been developed and used, including with PLWH [16].

Clinic-level interventions can also be implemented to address the challenges of engaging PLWH in smoking cessation by encouraging provider and clinic staff involvement in promoting cessation. Based on extensive evidence supporting the use of screening and brief interventions, the US Public Health Services Clinical Practice Guideline for Treating Tobacco Use and Dependence (PHS Guidelines) recommends clinic-level interventions, such as tobacco-user identification systems coupled with provider-led interventions that focus on robust patient care to help patients quit (e.g., the 5 As [Ask, Advise, Assess, Assist, Arrange] and pharmacotherapy) [17]. The importance of providers' role in supporting smoking cessation through the 5As for PLWH has been well documented. Recommendations for smoking cessation by providers during regular care, even brief advice (e.g., 3 min), and further involvement in cessation interventions in clinical settings have been found to increase cessation attempts and abstinence rates in the general population [17, 18]. However, providers working with PLWH are less likely to emphasize smoking cessation recommendations than providers working with persons who do not have HIV [19]. For populations with multiple competing health care needs such as PLWH, the effective engagement of providers and clinic staff in smoking cessation efforts is an important goal.

There is also a need for particular attention to PLWH who may be especially susceptible to tobacco-induced disease. For example, persons living in the US South have among the highest rates of HIV infection in the country [20], live in a region with strong ties to tobacco growing and manufacturing, and have high rates of smoking [21]. Persons of color, particularly African American/Black and Latinx[1] communities, bear a disproportionate burden of HIV infection and also face smoking-related health disparities [22–24]. African Americans/Blacks, for example, have similar smoking rates to Whites but are more likely to die from tobacco-induced diseases and have fewer successful quit attempts, and some Latinx subgroups (e.g., Puerto Ricans) have higher smoking rates than the general population [22, 23]. Gay, bisexual, and other men who have sex with men (MSM) and transgender women are also disproportionately affected by HIV and have higher rates of smoking than their heterosexual and cisgender peers, respectively [25–28]. In addition, communities of color and lesbian, gay, bisexual, and transgender (LGBT) communities are more heavily targeted by tobacco industry marketing [22, 23, 27].

Purpose

In order to reduce smoking rates among PLWH and promote cessation to improve their health, interventions are needed to address their unique needs. The purpose of this qualitative systematic review was to assess the literature on smoking cessation interventions for PLWH and to identify gaps and opportunities for future intervention-oriented research.

Methods

A qualitative systematic review [29] of the published literature was conducted using three online databases: PubMed, PsychInfo, and EBSCO Academic Search Premier. The Boolean terms and search terms used were: (HIV OR HIV/AIDS OR AIDS) AND (tobacco OR smoking) AND (cessation OR quit OR abstinence) AND (intervention OR program OR treatment). Databases were searched from their inception through December 31, 2017. Citations from previous systematic reviews of smoking cessation interventions with PLWH were also searched for relevant papers.

After initial search results were retrieved from the databases, articles written in English were further screened. Articles from peer-reviewed journals describing interventions for smoking cessation in adults (≥ 18 years old) living with HIV were included. Duplicates were removed, and search results were screened by title and abstract to determine whether the articles met criteria for inclusion in the review. Finally, relevant articles were selected and interventions described by those articles were identified.

Data Collection

An abstraction form was created to abstract data from the identified articles. This form collected information on intervention study location, participant description (i.e., sample size and demographic characteristics), theories/models, intervention description, study design, primary cessation-related behavioral outcome measures, and study results. Articles that did not describe an intervention or did not report sufficient

[1] Latinx is a gender-neutral term used in lieu of Latina and Latino.

information to be abstractable were excluded. Data from multiple articles that described the same intervention study were abstracted under the same intervention.

Results

The initial search retrieved 1031 English articles. From these articles, 65 potentially relevant articles were identified by screening their titles and abstracts. Screening the full text of the potentially relevant articles initially identified led to the exclusion of 15 articles, and an additional 18 were excluded during data abstraction based on the criteria described above. From the remaining 32 articles, 28 unique intervention studies were identified, and data were abstracted from these articles (See Fig. 1).

Intervention Locations and Participant Characteristics

Of the 28 intervention studies outlined in Table 1, seven were conducted in the US Northeast [31, 33, 44, 45, 47, 51, 55, 56, 62], five in the South [34–36, 46, 58–60], five in the Midwest [32, 40, 49, 52, 61], and four in the West [42, 48, 54, 57]; six were conducted in international settings [30, 37–39, 41, 53] and the location of one study was not specified [43].

Intervention study sample sizes ranged from 15 [61] to 1689 [41], with half of the studies having sample sizes under 100 [30, 34, 37–39, 43, 46, 48, 49, 52, 54, 57, 58, 61]. Ten of the 28 intervention studies had samples that were majority African American/Black [33, 35, 36, 43–46, 49, 51, 55, 58–60], but only one intervention was tailored specifically for African American/Black communities [49]. Eleven had Latinx representation that ranged from 8 to 100% [31, 42, 44, 45, 47, 48, 51, 54–60], of which five presented any Latinx-specific findings [31, 47, 51, 54, 56, 57]. Four intervention studies explicitly noted American Indian/Native American representation [31, 42, 47, 51, 55], but these groups only constituted 2 to 6% of the sample population, and thus no significant results were identified specifically for this group. Only one intervention study included an Asian or Asian American participant [58]. Seven intervention studies included men who identified as gay, bisexual, or other MSM, who constituted between 25 to 84% of study samples [30, 38, 41, 42, 49, 58–60], and six documented participation of transgender persons but only in small numbers constituting 1 to 3% of study samples [30, 42–44, 51, 55]. Only one study described an intervention that was specifically designed to address the needs of MSM in a culturally congruent manner [49], and none were focused specifically on transgender persons.

Theoretical Underpinnings

Twenty-four of the 28 interventions described a theoretical model or framework. The most commonly used theories included cognitive behavioral therapy (CBT), which was used in 10 of the interventions [30, 32, 39, 42, 43, 46, 49, 53, 58–60]; the transtheoretical model of change (TTM), which was used in four interventions [31, 39, 41, 47, 53]; social cognitive theory (SCT), which was used in two interventions [44, 45, 51]; and the Screening, Brief Intervention, and Referral for Treatment (SBIRT) model, which was also used in two interventions [34–36]. Two intervention studies did not

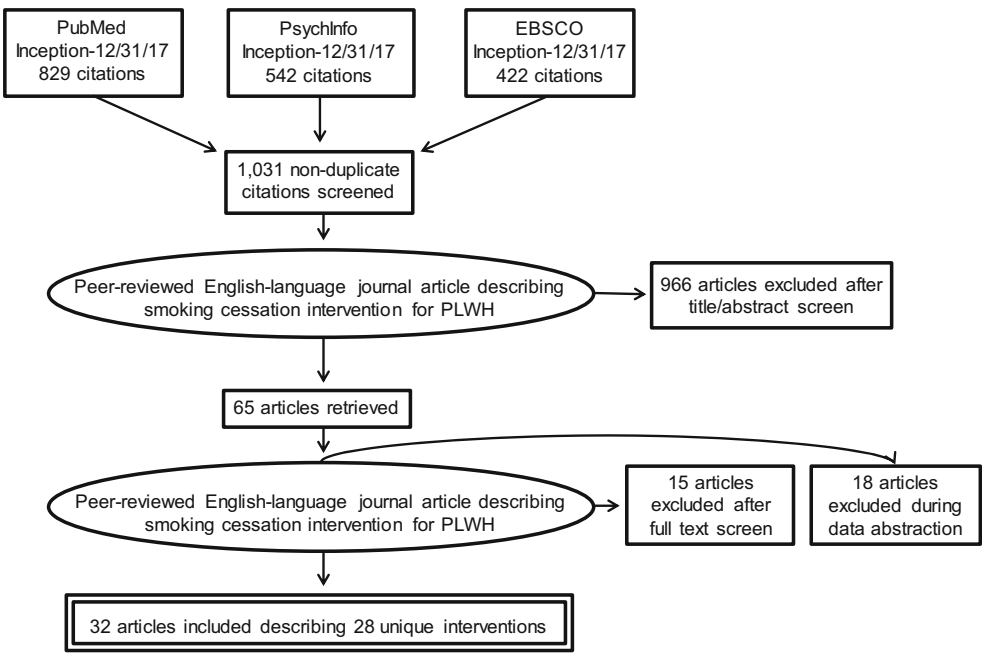

Fig. 1 PRISMA diagram of steps of the qualitative systematic review of the literature

Table 1 Review of smoking cessation interventions for persons living with HIV

Study	Location	Description of participants	Theories/models	Description of intervention	Study design	Primary cessation-related outcome measures	Results
Balfour et al. (2017) [30]	Canada	$N = 50$; 4% African American/Black; 57% LGB; 2% transgender	CBT, Ottawa model for smoking cessation	5 face-to-face individual counseling sessions over 24 weeks and Rx for 10-week supply of NRT	Quasi-experimental design (results compared to Lloyd-Richardson et al. study [31]). Data collection at baseline, quit date, 4, 12, and 24 weeks post-quit date.	Self-reported continuous abstinence, biochemically verified via expired CO levels < 10 ppm	Abstinence rate at follow-up significantly higher than in comparison study ($p < 0.001$)
Browning et al. (2016) [32]	Ohio	$N = 247$; 56% White	CBT, PHS guidelines	Weekly nurse-delivered phone-based counseling sessions and provision of varenicline or NRT over 12 weeks	Single-group longitudinal design. Data collection at baseline, 3-, and 12-month follow-up.	Self-reported 7-day PPA, biochemically verified via saliva cotinine screen or expired CO levels < 8 ppm, and number of 24-h quit attempts in past year.	10% abstinence rate at 12 months; no p value reported
Chew et al. (2014) [33]	New Jersey	$N = 774$; among intervention group ($n = 123$): 85% African American/Black	N.D.	1 1-h face-to-face individual counseling session and Rx for NRT, varenicline, bupropion, or combination	Prospective cohort study with case-control analysis. Data collection at baseline and 6-month follow-up	Self-reported 7-day PPA	16% abstinence rate at 6 months; no p value reported
Cropsey et al. (2013) [34]	Alabama	$N = 40$; 58% African American/Black	SBIRT Model	Clinic-level strategies (electronic screening and documentation of patient smoking status) and provision of 1 20-min face-to-face individual counseling session, 3 weeks of NRT, and workbook with daily smoking diary	Randomized pilot study. Data collection at baseline and 2-, 4-, and 8-week follow-up	Self-reported cigarettes smoked per day.	Trend toward reduction in cigarettes per day among intervention group (N.S.).
Cropsey et al. (2015) [35]; Valera et al. (2017) [36]	Alabama	$N = 100$; 75% African American/Black	SBIRT Model	Clinic-level strategies (patients who smoke identified via EMR and offered varenicline, bupropion, or NRT based on algorithm) and provision of 1 20-min face-to-face individual counseling session	Randomized pilot clinical trial. Data collection at baseline; every 2 weeks during 12-week intervention period; and at 1-month follow-up	Self-reported cigarettes smoked per day and 24-h quit attempts	Significantly greater reduction in cigarettes per day and more quit attempts among intervention participants; no p value reported
Cui et al. (2012) [37]	Canada	$N = 36$; 92% White	PHS Guidelines	Varenicline twice daily over 12 weeks, with brief counseling delivered by physician or trained counselor and provision of written materials	Multicenter pilot study. Data collection at baseline, 4-, 12-, and 24-week follow-up	4-week continuous abstinence, biochemically verified via serum cotinine screen; self-reported 7-day	28% continuous abstinence rate and 42% 7-day PPA at 24 weeks; significant decrease in cigarettes per day ($p < 0.05$)

Table 1 (continued)

Study	Location	Description of participants	Theories/models	Description of intervention	Study design	Primary cessation-related outcome measures	Results
						PPA; and cigarettes smoked per day.	
Cummins et al. (2005) [38]	Australia	$N = 45$ ($n = 27$ participated in intervention); 84% LGB	SRT	1 face-to-face individual counseling session delivered by social worker and 8–12 weeks of NRT, daily smoking diary, written materials, and hotline number	Single-group longitudinal study. Data collection at baseline and at 4 follow-ups every 6 weeks for 5 months.	Self-reported smoking cessation and reduction in nicotine intake.	6 out of 27 participants (22%) reported cessation and 11 (40%) reported reduced nicotine intake at 5 months; no p value reported
Elzi et al. (2006) [39]	Switzerland	$N = 34$	TTM; CBT	Weekly 30-min nurse-delivered face-to-face individual counseling sessions for first month and monthly sessions for following 11 months; NRT provided to interested participants.	Pilot study with non-randomized control group ($n = 383$). Data collection at baseline and 3-month follow-up.	Self-reported 12-month smoking abstinence.	Abstinence rate at follow-up significantly higher among intervention group than control group (OR 6.2, 95% CI 2.8–14.3)
Ferketich et al. (2013) [40]	Ohio	$N = 228$; among varenicline group ($n = 118$): 61% White	PHS Guidelines	Varenicline or NRT, 1 face-to-face individual counseling session and 11 weekly phone-based counseling sessions delivered by advanced practice nurse over 3 months.	Quasi-experimental study design with non-random group assignment; participants who used varenicline were compared to those who used NRT. Data collection at baseline and 3-month follow-up.	Self-reported 7-day PPA, biochemically verified via expired CO levels < 10 ppm or saliva cotinine concentrations < 15 ng/ml.	2.54 times greater odds of reporting abstinence among varenicline group than among NRT group (95% CI 1.43–4.49)
Huber et al. (2012) [41]	Switzerland	$N = 1689$ clinic patients seen during intervention period; 45% MSM	TTM	Clinic-level strategies including half-day training in smoking cessation counseling and pharmacotherapy for all providers and checklist for providers to document patients' smoking status and receipt of counseling.	Part of multi-site prospective observational cohort study; smoking cessation outcomes were compared between participating clinic and other clinics that did not receive the intervention.	Smoking prevalence among patients, smoking cessation (defined as 6 months or more of nicotine abstinence), and smoking relapses.	Participating clinic had increased smoking cessation ($p = 0.004$) and fewer smoking relapses ($p = 0.007$) compared with other sites
Humfleet et al. (2013) [42]	California	$N = 209$; 27% African American/Black; 14% Latinx, 2% American Indian/Native American; 69% LGB; 3% transgender	CBT	6 20–40 min face-to-face individual counseling sessions delivered by social work or psychology clinicians over 12 weeks and NRT or 12-month access to web-based intervention with 5	RCT with individual counseling intervention + NRT, web-based intervention + NRT, and self-help comparison intervention + NRT groups. Data collection at baseline, 2-, 24-, 36-, and 52-week follow-up	Self-reported 7-day PPA, biochemically verified via expired CO levels <10 ppm, and sustained abstinence (not exceeding 7 consecutive days of smoking).	N.S.

Table 1 (continued)

Study	Location	Description of participants	Theories/models	Description of intervention	Study design	Primary cessation-related outcome measures	Results
				interactive educational units and NRT.			
Ingersoll et al. (2009) [43]	N.D.	N = 40; 95% African American/Black; 3% transgender	CBT; Elicit-Provide-Elicit Model for MI; Self-Guided Change Model	1 MI session delivered by psychologist or counselor and at least 1 month of NRT or self-guided change reading packet with written information and self-assessment exercises and at least 1 month of NRT.	RCT comparing MI intervention + NRT and self-guided change intervention + NRT. Data collection at baseline, 1-, and 3-month follow-up	Self-reported smoking abstinence, biochemically verified via expired CO levels <3 ppm; self-reported cigarettes smoked per day; and smoking days.	N.S.
Krebs et al. (2015) [44]; Tseng et al. (2017) [45]	New York	*N* = 158; 51% African American/Black, 32% Latinx; 3% transgender	Information-Motivation-Behavioral Skills Model (includes components from SCT and TPB)	2 daily text messages, 7 standardized phone-based counseling sessions with MI component, and 12 weeks of varenicline.	3-arm RCT with text messaging + standard care, text messaging + counseling/MI + standard care, and standard care (varenicline) alone groups. Data collection at baseline, 1-, 4-, 8- and, 12-week follow-up	Self-reported 7-day PPA, biochemically verified via expired CO levels <8 ppm.	Significantly higher probability of abstinence in text messaging + counseling/MI + standard care group compared to standard care alone group ($p = 0.05$)
Lazev et al. (2004) [46]	Texas	N = 20; 80% African American/Black	CBT; PHS Guidelines	6 counseling sessions over 2 weeks on provided prepaid cell phone and provision of written materials and hotline number.	Single-group study with pre-test and immediate post-test	Self-reported quit attempts and 2-week end of treatment PPA rate.	19 participants (95%) had made quit attempt and 15 (75%) were abstinent 2 weeks post-quit date; no *p* value reported
Lloyd-Richardson et al. (2009) [31]; de Dios et al. (2016) [47]	New England	*N* = 444; 19% African American/Black, 16% Latinx, 5% Cape Verdean, 5% American Indian/Native American	TTM; FRAMES Model for MI	4 30-min MI sessions and quit-day counseling phone call delivered by health educator, with materials tailored to PLWH; 8 weeks of NRT provided to participants who were willing to set a quit date.	RCT with MI intervention + NRT and standard care intervention + NRT groups. Data collection at baseline, 2-, 4-, and 6-month follow-up	Self-reported 7-day PPA, biochemically verified via expired CO levels <10 ppm.	N.S.
Manuel et al. (2013) [48]	California Illinois	*N* = 30; 47% African American/Black, 13% Latinx; 33% LGB; 100% female	PHS Guidelines	1 MI session delivered by therapist and referral to NRT programs.	Randomized pilot study with intervention and prescribed advice control groups. Data collection at baseline and 1-month follow-up	Self-reported 7-day PPA, biochemically verified via urine screen for nicotine and cotinine, and cigarettes smoked per day.	No significant differences in abstinence rates between groups at follow-up, but significant decrease in cigarettes per day in intervention compared to control group

Table 1 (continued)

Study	Location	Description of participants	Theories/models	Description of intervention	Study design	Primary cessation-related outcome measures	Results
Matthews et al. (2013) [49]		$N = 31$; 100% African American/Black; 90% gay or bisexual	CBT, PHS Guidelines, intervention model from King et al. [50]	6 weekly 90-min small-group counseling sessions delivered by clinician and 4-week supply of NRT	Single-group feasibility and acceptability study. Data collection at baseline, 1-, and 3-month follow-up	Self-reported 7-day PPA, biochemically verified via expired CO levels <8 ppm, and cigarettes smoked per day.	6% abstinence rates at 3 months; significant reduction in cigarettes per day among participants who did not quit smoking ($p < 0.05$)
Moadel et al. (2012) [51]	New York	$N = 145$; mean age = 49; 86% African American/Black, 23% Latinx, 3% American Indian/ Native American; 1% transgender	SCT	8 intensive small-group counseling sessions delivered by professional and peer co-facilitators over 7 weeks using curriculum tailored to PLWH; participants were offered 3 months of NRT.	RCT with intervention and standard care groups. Data collection at baseline, 42-, and 132-day (3-month) follow-up.	Self-reported 7-day PPA, biochemically verified via expired CO levels <10 ppm.	Trend toward higher abstinence rates in intervention group compared to standard care group (N.S.); when participants who were lost to follow-up and/or did not attend sessions were excluded, intervention was significantly associated with higher abstinence rates.
Mussulman et al. (2018) [52]	Kansas	$n = 25$; 48% African American	N.D.	Clinic-level intervention designed for delivery to hospitalized PLWH who smoke; at bedside, hospital staff called quitline for on-the-spot smoking cessation enrollment and counseling	RCT pilot study with warm handoff intervention group and fax referral at discharge group. Data collection at baseline, 1-, and 6-month follow-up.	Self-reported 6-month abstinence, biochemically verified via salivary cotinine <15 ng/ml.	Trend toward higher abstinence rates in intervention group compared to standard care group (N.S.)
Nerín, et al. (2007) [53]	Spain	$N = 1120$	TTM; CBT	9 group counseling sessions delivered over 3 months and pharmacotherapy (NRT or bupropion) administered over 8 weeks	Single-group longitudinal study. Data collection at baseline; 1-week; and 1-, 3-, and 6-month follow-up.	Self-reported continued smoking abstinence, biochemically verified via expired CO levels <10 ppm.	Probability of abstinence at 6-months was 62.2%; no p value reported
Shadel et al. (2016) [54]	California	$N = 49$; 100% Latinx	N.D.	1 20-min face-to-face individual counseling session delivered by bilingual staff and provision of written materials and 8 weeks of NRT.	Formative qualitative study; semi-structured telephone interviews with intervention participants 1–2 times per week for 8 weeks.	Adherence to NRT	88% adherence to NRT at follow-up; no p value reported
Shuter et al. (2014) [55]	New York	$N = 138$; among intervention group ($n = 69$): 78% African American/Black, 49% Latinx, 6% American Indian/ Native American; 1% transgender	SCT; intervention model from Moadel et al. [51]	8 interactive web-based sessions over 7 weeks; participants were offered Rx for 3-month supply of NRT.	RCT with intervention and standard care groups. Data collection at baseline, 6-week, and 3-month follow-up.	Self-reported 7-day PPA, biochemically verified via expired CO levels < 10 ppm	Trend toward higher abstinence rates in intervention group compared to standard care group (N.S.).
Stanton et al. (2015) [56]	U.S. Northeast	$N = 302$; 100% Latinx; 79% heterosexual	TRA	2 face-to-face individual counseling sessions +2	RCT with tailored intervention and	Self-reported 7-day PPA, biochemically	No significant differences in abstinence rates between groups

Table 1 (continued)

Study	Location	Description of participants	Theories/models	Description of intervention	Study design	Primary cessation-related outcome measures	Results
				additional sessions on relapse prevention with option to bring social support buddy to all sessions, phone call on quit date +2 additional 10-min booster phone calls, culturally tailored written materials and videos, and 8 weeks of NRT.	non-tailored enhanced standard care groups. Data collection at baseline, 6-, and 12-month follow-up.	verified via expired CO levels <10 ppm, cigarettes smoked per day, and smoking frequency.	at follow-up, but significant reduction in heavy smoking (>10 cigarettes per day).
Tucker et al. (2017) [57]	California	N = 40; 100% Latinx	N.D.	1 face-to-face individual counseling session that included module on adherence delivered by bilingual staff and provision of written materials and 8 weeks of NRT.	Randomized pilot study with adherence-focused intervention and standard brief smoking cessation treatment groups. Data collection at baseline and 3-month follow-up.	7-day point prevalence, biochemically verified via expired CO levels <5 ppm, and 90-day continuous abstinence	Abstinence rates 2–3 times higher in intervention group compared to standard group (clinically meaningful though N.S.)
Vidrine et al. (2006) [58]	Texas	*N* = 95; 72% African American/Black, 8% Latinx; 38% MSM	CBT; PHS Guidelines	8 scheduled counseling sessions over 2 months on provided prepaid cell phone and provision of hotline number, written materials, and 10 weeks of NRT.	RCT with intervention and recommended standard of care groups. Data collection at baseline and 3-month follow-up.	Self-reported 24-h PPA and 7-day sustained abstinence, biochemically verified via expired CO levels < 7 ppm	Intervention group more likely to report 24-h abstinence (statistically significant; $p = 0.016$) and 7-day abstinence (trending) at follow-up
Vidrine et al. (2012) [59]; Aigner et al. (2017) [60]	Texas	*N* = 474; 77% African American/Black, 9% Latinx; 25% MSM	CBT; PHS Guidelines	11 scheduled counseling sessions over 3 months on prepaid cell phone and provision of hotline number, written materials, and information about how to obtain NRT.	RCT with intervention and usual care groups. Data collection at baseline, 3- (immediate post-intervention), 6-, and 12-month follow-up.	Self-reported 7-day PPA, biochemically verified 24-h abstinence (expired CO level < 7 ppm), self-reported 30-day abstinence, and self-reported continuous abstinence.	Intervention group 4.33 times more likely to report 7-day abstinence at 3 months ($p < .0001$); other abstinence measures also statistically significant
Wewers et al. (2000) [61]	Ohio	N = 15; mean age = 40; 100% male	IDT; PHS Guidelines	3 face-to-face individual counseling sessions and weekly phone calls delivered by peer educator (PLWH who formerly smoked) and nurse manager over 8 weeks; participants also received 6 weeks of NRT.	Feasibility study; participants were randomized to intervention or control group. Data collection at baseline, 8-week (immediate post-intervention), and 8-month follow-up.	Self-reported 7-day PPA and continuous abstinence (0 cigarettes smoked since quit date), biochemically verified via expired CO levels < 8 ppm	Significantly higher rates of 7-day ($p = 0.002$) and continuous ($p = 0.006$) abstinence in intervention group compared to control group at 8 months
Zwiebel & Hughes (2010) [62]	New York	*N* > 1564 patient charts	Ask-Advise-Assess-Assist Framework	Clinic-level strategies included training of clinic staff about smoking cessation; tracking sheet to record patients' tobacco use; nurse-delivered	Longitudinal study using quarterly review of randomly selected patient charts over 18 months	Number of active smokers among patient population	The number of patients who were active smokers decreased from 45% to 33% within the first 4 months of the intervention; no *p* value reported

Table 1 (continued)

Study	Location	Description of participants	Theories/models	Description of intervention	Study design	Primary cessation-related outcome measures	Results
				counseling sessions and 2 90-min workshops delivered by nurse, social worker, and dietician for patients who smoke; and referrals for telephone counseling programs, hotlines, and NRT starter kits.			

CBT cognitive behavioral therapy, *CI* confidence interval, *CO* carbon monoxide, *EMR* electronic medical records, *FRAMES* Feedback, Responsibility, Advice, Menu, Empathy, Self-efficacy, *IDT* innovation diffusion theory, *LGB* lesbian, gay, or bisexual, *MI* motivational interviewing, *N.D.* not described, *N.S.* not significant, *OR* odds ratio, *ppm* parts per million, *Rx* prescription, *SBIRT* Screening, Brief Intervention, and Referral for Treatment, *SCT* social cognitive theory, *SRT* self-regulation theory, *TPB* theory of planned behavior, *TRA* theory of reasoned action, *TTM* transtheoretical model of change, *PHS* U.S. Public Health Service

report a theoretical underpinning or framework beyond the PHS Guidelines [37, 40], which were used in eight of the intervention studies overall [32, 37, 40, 46, 48, 49, 58–60]. Four intervention studies did not report any theoretical underpinning [33, 52, 54, 57].

Study Designs

There were 15 randomized controlled trials (RCTs) among the 28 intervention studies, all of which involved randomization at the participant level [31, 34–36, 42–45, 47, 48, 51, 52, 55–61]. Of these RCTs, cessation rates at follow-up ranged from 4 to 63%, and seven produced statistically significant improvements in cessation-related outcomes [35, 36, 44, 45, 48, 56, 58–61].

The 13 intervention studies that were not RCTs were primarily single-group longitudinal studies with pre- and post-test and pilot studies with non-randomized control groups [30, 32, 33, 37–41, 46, 49, 53, 54, 62]. Among these non-randomized studies, cessation rates at follow-up ranged from 6 to 75%, and six demonstrated significant improvements in cessation-related outcomes [30, 37, 39–41, 49].

Among the 21 intervention studies that included a comparison group, comparison group participants received usual care [31, 34–36, 39, 44, 45, 47, 48, 51, 52, 55, 57–61] or a comparison intervention such as self-guided reading or brief advice sessions [40, 42, 43, 56].

Outcome Measures

Across the intervention studies, the measures used to determine cessation-related outcomes varied. Reported outcome measures included self-reported 24-h [58–60], 7-day [31–33, 37, 40, 42, 44, 45, 47–49, 51, 55–61], and 2-week [46] point prevalence abstinence (PPA); self-reported 4-week [37], 30-day [59, 60], 90-day [57], 6-month [41, 52], 12-month [39], or continuous abstinence [30, 43, 53, 59–61] or cessation [38]; self-reported number of cigarettes smoked per day [34–37, 43, 48, 49, 56] or daily nicotine intake [38]; self-reported quit attempts [32, 35, 36, 46]; and adherence to NRT [54]. The most frequently used measures were 7-day PPA, usually at 3 or 6 months after baseline, and self-reported number of cigarettes smoked per day. Self-reported measures were often biochemically verified using expired carbon monoxide measures (e.g., three [43], five [57], seven [58], eight [32, 44, 45, 49, 61], or 10 [30, 31, 40, 42, 47, 51, 53, 55, 56] parts per million) or cotinine or nicotine levels in blood [37], saliva [32, 40, 52], or urine [48].

Follow-up periods for collecting data on outcome measures varied from immediate post-test [46] to 1 month [35, 36, 48] to 1 year [32, 42, 56, 59, 60].

Intervention Results by Strategy

Most interventions used multiple strategies, including combinations of counseling, pharmacotherapy, and information and communications technology.

Counseling was a widely used intervention strategy, and several different kinds of counseling approaches were applied. Twenty-four of the 28 interventions used one or more forms of counseling [30–40, 42–49, 51, 53, 54, 56–61]. Thirteen interventions used face-to-face individual counseling delivery methods [30, 33–40, 42, 54, 56, 57, 61], 9 used phone-based counseling [31, 32, 40, 44–47, 56, 58–61], and 3 used group counseling [49, 51, 53]. Four of the counseling interventions used motivational interviewing techniques [31, 43–45, 47, 48]. Eight interventions included a single counseling session [33–36, 38, 43, 48, 54, 57] and 16 were multi-session, ranging from 2 to 15 sessions [30–32, 37, 39, 40, 42, 44–47, 49, 51, 53, 56, 58–61]. Fourteen of the intervention studies using counseling were RCTs [31, 34–36, 42–45, 47, 48, 51, 55–61].

All of the 13 intervention studies that used face-to-face individual counseling also included pharmacotherapy, and 7 showed statistically significant improvements in cessation-related outcomes [30, 35–37, 39, 40, 56, 61]. Three of these successful interventions also included a cell phone-based counseling component [40, 56, 61].

Of the three group counseling interventions, all used combined strategies that also included pharmacotherapy, but only one demonstrated a significant improvement in cessation-related outcomes (significant reduction in cigarettes smoked per day) [49]. Another resulted in a trend toward higher cessation rates in the intervention group and produced significant results when participants who were lost to follow-up or did not attend intervention sessions were excluded [51].

All four interventions using motivational interviewing also used pharmacotherapy, and two showed significant improvements in cessation-related outcomes [44, 45, 48], one of which also incorporated cell phone voice and text communications [44, 45].

Eleven interventions incorporated the use of information and communications technology [31, 32, 40, 42, 44–47, 55, 56, 58–61]. These included all nine phone-based counseling interventions, of which all but one [46] incorporated pharmacotherapy and six had statistically significant improvements in cessation-related outcomes [40, 44, 45, 56, 58–61]. In addition to the three phone-based counseling interventions with significant results that also included face-to-face individual counseling [40, 56, 61], another also included text messaging and a motivational interviewing component [44, 45]. Two interventions were web-based [42, 55], both in combination with NRT and one with a face-to-face individual counseling component [42]; however, neither produced significant improvements in cessation-related outcomes.

Nearly all ($n = 24$) of the reviewed interventions used some form of pharmacotherapy [30–40, 42–45, 47–49, 51, 53–61], which included NRT, bupropion, and varenicline; three out of the four interventions that did not use pharmacotherapy were clinic-level interventions [41, 52, 62]. Of the interventions that used pharmacotherapy, 17 offered NRT alone [30, 31, 34, 38, 39, 42, 43, 47–49, 51, 54–61], 2 offered varenicline alone [37, 44, 45], 2 offered both NRT and varenicline [32, 40], 1 offered both NRT and bupropion [53], and 2 offered all three forms of pharmacotherapy [33, 35, 36]. Fourteen of the intervention studies that used pharmacotherapy were RCTs [31, 34–36, 42–45, 47, 48, 51, 55–61], 7 of which showed statistically significant improvements in cessation-related outcomes [35, 36, 44, 45, 48, 56, 58–61]; 5 of the 10 intervention studies that involved pharmacotherapy and did not randomize participants also produced statistically significant results [30, 37, 39, 40, 49]. All of the studies using pharmacotherapy paired this with another intervention strategy.

There were only five clinic-level smoking cessation interventions [34–36, 41, 52, 62]. Clinic-level interventions involved changes to the clinic environment in order to promote smoking cessation for PLWH. Intervention components included trainings for staff [41, 62], checklists or electronic processes for screening and documenting patients' smoking status [34, 41, 62], electronic algorithms to create personalized treatment plans [35, 36], and processes for making referrals for smoking cessation services [52, 62]. These strategies were often implemented in combination with individual-level strategies such as counseling and pharmacotherapy [34–36]. All of the clinic-level smoking cessation intervention studies reported increases in smoking cessation, though not all were statistically significant. Of the five intervention studies that involved clinic-level strategies, three were RCTs (with randomization at the patient level) [34–36, 52] and one had significant results [35, 36]; this intervention also involved the use of NRT and face-to-face individual counseling. One of the clinic-level intervention studies that did not involve randomization or any other intervention strategies also produced significant improvements in cessation-related outcomes [41].

Discussion

The importance of developing interventions tailored to specific at-risk populations has been noted by other reviews of smoking cessation interventions among PLWH [63], yet there are still many gaps within the literature in terms of interventions for PLWH with identities that are part of marginalized groups. Although a few studies evaluated interventions that were tailored specifically to the racial/ethnic, sexual, and/or gender identities of their participants, more studies aimed at developing, implementing, and evaluating culturally congruent interventions are needed. In particular, there is a need for

more studies that focus on PLWH who are from underrepresented racial/ethnic groups such as Asian Americans or American Indian/Native Americans and PLWH who are sexual and gender minorities, particularly MSM and transgender women of color. It is important that these interventions consider the specific cultural, social, and structural factors that influence smoking within these groups, as behaviors, barriers to cessation, and resources may differ across different groups of PLWH. Such culturally congruent interventions may be more likely to achieve successful results among these particularly vulnerable groups than interventions not tailored to these specific contexts.

Although the number of interventions developed to promote smoking cessation among PLWH in the South is similar to the number of interventions developed in other regions, it is important to note that there have only been two research teams in two states within the South working on these types of intervention studies, which explore the efficacy of cell phone and electronic algorithm interventions. There remains little diversity in these studies, both in terms of intervention strategies and population groups for which the interventions are designed. Furthermore, contextual factors in the South may mean that some intervention strategies may be more appropriate and feasible than others; for example, a high proportion of persons in the South live in rural settings [64] and may face challenges traveling long distances to clinics to participate in multi-session face-to-face interventions. Given the disproportionate burden of HIV and smoking and the unique context of the South, more varied research is needed in this region.

There have been a number of pilot studies and quasi-experimental studies that show promising results; however, more robust studies with more statistical power are needed to obtain more generalizable results. Due to the wide variety of measures used to assess smoking cessation, it is difficult to compare across studies and to gauge the relative success of interventions. It is important that future studies utilize reliable and standardized measures for cessation to ensure internal and external validity; it is also recommended that a standard be established in order to more effectively compare the results of different types of interventions among different populations of PLWH.

Most of the studies used a theoretical framework to design their interventions. The TTM is based on the understanding that there are discrete stages in the process of behavioral change that relate to the likelihood of successful behavior modification and assumes that individuals must be ready to change their behavior before being encouraged to act. The SBIRT model, on the other hand, does not require expressed interest or readiness for change in order for an individual to be offered an opportunity to participate in a behavior change intervention. Interventions informed by both frameworks have been found to be feasible and promising, but there are fewer interventions that explore the idea of offering cessation opportunities to all PLWH who smoke, regardless of stated openness to or readiness for behavioral change. Studies that further explore the theoretical differences in these two frameworks would be helpful in determining the best theoretical foundation for smoking cessation among PLWH. In particular, more studies using SBIRT and other models that do not rely on patient interest and readiness to quit smoking are warranted.

Despite having been found to be effective for promoting smoking cessation in the general population [65–67], intervention studies using motivational interviewing have had mixed results. However, no findings indicated that the unique characteristics of PLWH would make this strategy inappropriate or not well-suited for this population.

The use of information and communications technology in interventions produced promising results. Cell phone-based counseling tended to yield positive results, and intervention studies that provided prepaid cell phones to study participants may have been particularly effective in part because some PLWH do not have regular access to cell phone service. Web-based interventions had less success in producing statistically significant outcomes. Web-based intervention studies may be able to increase their efficacy and cessation rates by ensuring that participants have regular and easy access to computers and a reliable Internet connection, and further studies with improved experimental designs are necessary to better gauge the efficacy and feasibility of these types of interventions.

Clinic-level interventions are especially promising for PLWH who smoke because this population tends to come into contact with providers on a regular basis due to HIV-related medical care. Studies have found that care provider recommendations for smoking cessation increase attempts; however, cessation has not been found to be a priority among HIV care providers. Providers may need additional training to understand smoking cessation for PLWH and the unique barriers to cessation that this population faces. For example, studies have documented that PLWH indicate that they would welcome education or smoking cessation information from their provider, but that the topic is rarely addressed by providers [68]. Clinic-level interventions have the potential to help address these issues; some of those reviewed showed high feasibility and efficacy in their results, but there were few examples of these types of interventions. Thus, more studies are needed to identify effective models for clinic-level interventions to increase smoking cessation in an HIV care setting.

Conclusions

Cigarette smoking is a modifiable factor that poses great health risk to PLWH. This review identified a need for more robust studies focused on specific vulnerable groups to explore various strategies and theoretical frameworks for

smoking cessation among PLWH. In particular, more smoking cessation interventions for PLWH are necessary in the South and for historically marginalized and underrepresented groups such as PLWH of color and PLWH who are sexual and gender minorities. Pilot or quasi-experimental studies have been conducted for PLWH, but more rigorous studies are necessary to better assess intervention effectiveness and increase generalizability of findings. Additionally, standardized measures for cessation must be identified to better compare and gauge the relative efficacy of various interventions across different populations. Intervention types that merit further development and research are those that utilize the SBIRT model, operate at the clinic level, and utilize web-based strategies.

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References

1. Centers for Disease Control and Prevention (2018) Smoking is down, but almost 38 million American adults still smoke. https://www.cdc.gov/media/releases/2018/p0118-smoking-rates-declining.html. Accessed 4 Nov 2018
2. Centers for Disease Control and Prevention (2018) Burden of tobacco use in the U.S. https://www.cdc.gov/tobacco/campaign/tips/resources/data/cigarette-smoking-in-united-states.html. Accessed 4 Nov 2018
3. U.S. Department of Health & Human Services (2017) Smoking and HIV. https://www.hiv.gov/hiv-basics/staying-in-hiv-care/other-related-health-issues/smoking. Accessed 4 Nov 2018
4. Mdodo R, Frazier EL, Dube SR, Mattson CL, Sutton MY, Brooks JT, Skarbinski J (2015) Cigarette smoking prevalence among adults with HIV compared with the general adult population in the United States: cross-sectional surveys. Ann Intern Med 162:335–344. https://doi.org/10.7326/M14-0954
5. Reynolds NR (2009) Cigarette smoking and HIV: more evidence for action. AIDS Educ Prev 21:106–121. https://doi.org/10.1521/aeap.2009.21.3_supp.106
6. Miguez-Burbano MJ, Ashkin D, Rodriguez A, Duncan R, Pitchenik A, Quintero N, Flores M, Shor-Posner G (2005) Increased risk of Pneumocystis carinii and community-acquired pneumonia with tobacco use in HIV disease. Int J Infect Dis 9:208–217. https://doi.org/10.1016/j.ijid.2004.07.010
7. Bénard A, Mercié P, Alioum A et al (2010) Bacterial pneumonia among HIV-infected patients: decreased risk after tobacco smoking cessation. ANRS CO3 Aquitaine cohort, 2000-2007. PLoS One 5:e8896. https://doi.org/10.1371/journal.pone.0008896
8. Morris A, George MP, Crothers K, Huang L, Lucht L, Kessinger C, Kleerup EC, on behalf of the Lung HIV Study (2011) HIV and chronic obstructive pulmonary disease: is it worse and why? Proc Am Thorac Soc 8:320–325. https://doi.org/10.1513/pats.201006-045WR
9. Althoffm Keri N, Gange SJ, Achenbach C et al (2015) Smoking outweighs HIV-related risk factors for non–AIDS-defining cancers. Presented at Conference on Retroviruses and Opportunistic Infections, Seattle, Washington
10. Zhao L, Li F, Zhang Y, Elbourkadi N, Wang Z, Yu C, Taylor EW (2010) Mechanisms and genes involved in enhancement of HIV infectivity by tobacco smoke. Toxicology 278:242–248. https://doi.org/10.1016/j.tox.2010.09.010
11. Helleberg M, May MT, Sterne JAC, Obel N (2014) Impact of smoking on life expectancy among HIV-infected individuals: the ART cohort collaboration. Presented at conference on retroviruses and opportunistic infections, Boston, MA
12. Reddy KP, Kong CY, Hyle EP, Baggett TP, Huang M, Parker RA, Paltiel AD, Losina E, Weinstein MC, Freedberg KA, Walensky RP (2017) Lung cancer mortality associated with smoking and smoking cessation among people living with HIV in the United States. JAMA Intern Med 177:1613–1621. https://doi.org/10.1001/jamainternmed.2017.4349
13. Helleberg M, Gerstoft J, Afzal JS et al (2014) Impact of smoking on risk of cancer among HIV patients compared to the background population. Presented at Conference on Retroviruses and Opportunistic Infections, Boston, MA
14. Nahvi S, Cooperman NA (2009) Review: the need for smoking cessation among HIV-positive smokers. AIDS Educ Prev 21:14–27. https://doi.org/10.1521/aeap.2009.21.3_supp.14
15. Lifson AR, Lando HA (2012) Smoking and HIV: prevalence, health risks, and cessation strategies. Curr HIV/AIDS Rep 9:223–230. https://doi.org/10.1007/s11904-012-0121-0
16. Chander G, Stanton C, Hutton HE, Abrams DB, Pearson J, Knowlton A, Latkin C, Holtgrave D, Moore RD, Niaura R (2012) Are smokers with HIV using information and communication technology? Implications for behavioral interventions. AIDS Behav 16:383–388. https://doi.org/10.1007/s10461-011-9914-1
17. Fiore MC, Roberto Jaén C, Baker TB et al (2008) Treating tobacco use and dependence: 2008 update. U.S. Department of Health and Human Services, Washington, DC
18. Stead LF, Buitrago D, Preciado N, Sanchez G, Hartmann-Boyce J, Lancaster T, Cochrane Tobacco Addiction Group (2013) Physician advice for smoking cessation. Cochrane Database Syst Rev: CD000165. https://doi.org/10.1002/14651858.CD000165.pub4
19. Crothers K, Goulet JL, Rodriguez-Barradas MC, Gibert CL, Butt AA, Braithwaite RS, Peck R, Justice AC (2007) Decreased awareness of current smoking among health care providers of HIV-positive compared to HIV-negative veterans. J Gen Intern Med 22:749–754. https://doi.org/10.1007/s11606-007-0158-8
20. Reif S, Pence BW, Hall I, Hu X, Whetten K, Wilson E (2015) HIV diagnoses, prevalence and outcomes in nine southern states. J Community Health 40:642–651. https://doi.org/10.1007/s10900-014-9979-7
21. Jamal A, Homa DM, O'Connor E, Babb SD, Caraballo RS, Singh T, Hu SS, King BA (2015) Current cigarette smoking among adults - United States, 2005-2014. MMWR Morb Mortal Wkly Rep 64:1233–1240. https://doi.org/10.15585/mmwr.mm6444a2
22. Centers for Disease Control and Prevention (2018) Hispanics/Latinos and tobacco use. http://www.cdc.gov/tobacco/basic_information/health_disparities/hispanics-latinos/. Accessed 21 Nov 2018
23. Centers for Disease Control and Prevention (2018) African Americans and tobacco use. http://www.cdc.gov/tobacco/basic_information/health_disparities/african-americans/. Accessed 21 Nov 2018
24. Centers for Disease Control and Prevention (2018) HIV in the United States: At a glance. https://www.cdc.gov/hiv/statistics/overview/ataglance.html. Accessed 21 Nov 2018
25. Phillips JC, Oliffe JL, Ensom MHH, Bottorff JL, Bissell LJL, Boomer J, O'Brien KMK, Howard T, Khara M (2012) An overlooked majority: HIV-positive gay men who smoke. J Men's Health 9:17–24. https://doi.org/10.1016/j.jomh.2011.11.003
26. Akhtar-Khaleel WZ, Cook RL, Shoptaw S, Surkan P, Stall R, Beyth RJ, Teplin LA, Plankey M (2016) Trends and predictors of cigarette smoking among HIV seropositive and seronegative men: the multicenter AIDS cohort study. AIDS Behav 20:622–632. https://doi.org/10.1007/s10461-015-1099-6

27. Centers for Disease Control and Prevention (2018) Lesbian, gay, bisexual, and transgender persons and tobacco use. http://www.cdc.gov/tobacco/basic_information/health_disparities/african-americans/. Accessed 21 Nov 2018
28. Centers for Disease Control and Prevention (2018) HIV among transgender people. https://www.cdc.gov/hiv/group/gender/transgender/index.html. Accessed 21 Nov 2018
29. Meade MO, Richardson WS (1998) Selecting and appraising studies for systematic review. In: Mulrow CD, Cook D (eds) Systematic reviews: synthesis of best evidence for health care decisions. ACP Press, Philadelphia, pp 81–90
30. Balfour L, Wiebe SA, Cameron WD, Sandre D, Pipe A, Cooper C, Angel J, Garber G, Holly C, Dalgleish TL, Tasca GA, MacPherson PA (2017) An HIV-tailored quit-smoking counselling pilot intervention targeting depressive symptoms plus nicotine replacement therapy. AIDS Care 29:24–31. https://doi.org/10.1080/09540121.2016.1201195
31. Lloyd-Richardson EE, Stanton CA, Papandonatos GD, Shadel WG, Stein M, Tashima K, Flanigan T, Morrow K, Neighbors C, Niaura R (2009) Motivation and patch treatment for HIV+ smokers: a randomized controlled trial. Addiction 104:1891–1900. https://doi.org/10.1111/j.1360-0443.2009.02623.x
32. Browning KK, Wewers ME, Ferketich AK, Diaz P, Koletar SL, Reynolds NR (2016) Adherence to tobacco dependence treatment among HIV-infected smokers. AIDS Behav 20:608–621. https://doi.org/10.1007/s10461-015-1059-1
33. Chew D, Steinberg MB, Thomas P et al (2014) Evaluation of a smoking cessation program for HIV infected individuals in an urban HIV clinic: challenges and lessons learned. AIDS Res Treat 2014:237834. https://doi.org/10.1155/2014/237834
34. Cropsey KL, Hendricks PS, Jardin B, Clark CB, Katiyar N, Willig J, Mugavero M, Raper JL, Saag M, Carpenter MJ (2013) A pilot study of screening, brief intervention, and referral for treatment (SBIRT) in non-treatment seeking smokers with HIV. Addict Behav 38:2541–2546. https://doi.org/10.1016/j.addbeh.2013.05.003
35. Cropsey KL, Jardin BF, Burkholder GA, Clark CB, Raper JL, Saag MS (2015) An algorithm approach to determining smoking cessation treatment for persons living with HIV/AIDS: results of a pilot trial. J Acquir Immune Defic Syndr 69:291–298. https://doi.org/10.1097/QAI.0000000000000579
36. Valera P, McClernon FJ, Burkholder F et al (2017) A pilot trial examining African American and White responses to algorithm-guided smoking cessation medication selection in persons living with HIV. AIDS Behav 21:1975–1984. https://doi.org/10.1007/s10461-016-1634-0
37. Cui Q, Robinson L, Elston D, Smaill F, Cohen J, Quan C, McFarland N, Thabane L, McIvor A, Zeidler J, Smieja M (2012) Safety and tolerability of varenicline tartrate (Champix(®)/Chantix(®)) for smoking cessation in HIV-infected subjects: a pilot open-label study. AIDS Patient Care STDs 26:12–19. https://doi.org/10.1089/apc.2011.0199
38. Cummins D, Trotter G, Moussa M, Turham G (2005) Smoking cessation for clients who are HIV-positive. Nurs Stand 20:41–47. https://doi.org/10.7748/ns2005.11.20.12.41.c4016
39. Elzi L, Spoerl D, Voggensperger J et al (2006) A smoking cessation programme in HIV-infected individuals: a pilot study. Antivir Ther 11:787–795
40. Ferketich AK, Diaz P, Browning KK, Lu B, Koletar SL, Reynolds NR, Wewers ME (2013) Safety of varenicline among smokers enrolled in the lung HIV study. Nicotine Tob Res 15:247–254. https://doi.org/10.1093/ntr/nts121
41. Huber M, Ledergerber B, Sauter R, Young J, Fehr J, Cusini A, Battegay M, Calmy A, Orasch C, Nicca D, Bernasconi E, Jaccard R, Held L, Weber R, Swiss HIV Cohort Study Group (2012) Outcome of smoking cessation counselling of HIV-positive persons by HIV care physicians. HIV Medicine 13:387–397. https://doi.org/10.1111/j.1468-1293.2011.00984.x
42. Humfleet GL, Hall SM, Delucchi KL, Dilley JW (2013) A randomized clinical trial of smoking cessation treatments provided in HIV clinical care settings. Nicotine Tob Res 15:1436–1445. https://doi.org/10.1093/ntr/ntt005
43. Ingersoll KS, Cropsey KL, Heckman CJ (2009) A test of motivational plus nicotine replacement interventions for HIV positive smokers. AIDS Behav 13:545–554. https://doi.org/10.1007/s10461-007-9334-4
44. Krebs P, Tseng T-Y, Pham H, Wong S, Sherman SE, Shelley D, Furberg RD, Wolfe H (2015) Formative evaluation of a text messaging intervention to promote varenicline adherence among tobacco-dependent persons with HIV. J Health Commun 20:1021–1025. https://doi.org/10.1080/10810730.2015.1018595
45. Tuo-Yen T, Krebs P, Schoenthaler A et al (2017) Combining text messaging and telephone counseling to increase varenicline adherence and smoking abstinence among cigarette smokers living with HIV: a randomized controlled study. AIDS Behav 21:1964–1974. https://doi.org/10.1007/s10461-016-1538-z
46. Lazev A, Vidrine D, Arduino R, Gritz E (2004) Increasing access to smoking cessation treatment in a low-income, HIV-positive population: the feasibility of using cellular telephones. Nicotine Tob Res 6:281–286. https://doi.org/10.1080/14622200410001676314
47. de Dios MA, Stanton CA, Cano MÁ et al (2016) The influence of social support on smoking cessation treatment adherence among HIV+ smokers. Nicotine Tob Res 18:1126–1133. https://doi.org/10.1093/ntr/ntv144
48. Manuel JK, Lum PJ, Hengl NS, Sorensen JL (2013) Smoking cessation interventions with female smokers living with HIV/AIDS: a randomized pilot study of motivational interviewing. AIDS Care 25:820–827. https://doi.org/10.1080/09540121.2012.733331
49. Matthews AK, Conrad M, Kuhns L, Vargas M, King AC (2013) Project exhale: preliminary evaluation of a tailored smoking cessation treatment for HIV-positive African American smokers. AIDS Patient Care STDs 27:22–32. https://doi.org/10.1089/apc.2012.0253
50. King A, Sánchez-Johnsen L, Van Orman S et al (2008) A pilot community-based intensive smoking cessation intervention in African Americans: feasibility, acceptability and early outcome indicators. J Natl Med Assoc 100:208–217
51. Moadel AB, Bernstein SL, Mermelstein RJ, Arnsten JH, Dolce EH, Shuter J (2012) A randomized controlled trial of a tailored group smoking cessation intervention for HIV-infected smokers. J Acquir Immune Defic Syndr 61:208–215. https://doi.org/10.1097/QAI.0b013e3182645679
52. Mussulman LM, Faseru B, Fitzgerald S, Nazir N, Patel V, Richter KP (2018) A randomized, controlled pilot study of warm handoff versus fax referral for hospital-initiated smoking cessation among people living with HIV/AIDS. Addict Behav 78:205–208. https://doi.org/10.1016/j.addbeh.2017.11.035
53. Nerín I, Novella P, Beamonte A et al (2007) Results of smoking cessation therapy in a specialist unit. Archivos De Bronconeumologia 43:669–673
54. Shadel WG, Galvan FH, Tucker JS (2016) Developing a nicotine patch adherence intervention for HIV-positive Latino smokers. Addict Behav 59:52–57. https://doi.org/10.1016/j.addbeh.2016.03.037
55. Shuter J, Morales DA, Considine-Dunn SE, An LC, Stanton CA (2014) Feasibility and preliminary efficacy of a web-based smoking cessation intervention for HIV-infected smokers: a randomized controlled trial. J Acquir Immune Defic Syndr 67:59–66. https://doi.org/10.1097/QAI.0000000000000226
56. Stanton CA, Papandonatos GD, Shuter J, Bicki A, Lloyd-Richardson EE, de Dios MA, Morrow KM, Makgoeng SB, Tashima KT, Niaura RS (2015) Outcomes of a tailored intervention

for cigarette smoking cessation among Latinos living with HIV/AIDS. Nicotine Tob Res 17:975–982. https://doi.org/10.1093/ntr/ntv014
57. Tucker JS, Shadel WG, Galvan FH, Naranjo D, Lopez C, Setodji C (2017) Pilot evaluation of a brief intervention to improve nicotine patch adherence among smokers living with HIV/AIDS. Psychol Addict Behav 31:148–153. https://doi.org/10.1037/adb0000221
58. Vidrine DJ, Arduino RC, Lazev AB, Gritz ER (2006) A randomized trial of a proactive cellular telephone intervention for smokers living with HIV/AIDS. AIDS 20:253–260. https://doi.org/10.1097/01.aids.0000198094.23691.58
59. Vidrine DJ, Marks RM, Arduino RC, Gritz ER (2012) Efficacy of cell phone-delivered smoking cessation counseling for persons living with HIV/AIDS: 3-month outcomes. Nicotine Tob Res 14:106–110. https://doi.org/10.1093/ntr/ntr121
60. Aigner CJ, Gritz ER, Tamí-Maury I, Baum GP, Arduino RC, Vidrine DJ (2017) The role of pain in quitting among human immunodeficiency virus (HIV)-positive smokers enrolled in a smoking cessation trial. Subst Abus 38:249–252. https://doi.org/10.1080/08897077.2017.1291466
61. Wewers ME, Neidig JL, Kihm KE (2000) The feasibility of a nurse-managed, peer-led tobacco cessation intervention among HIV-positive smokers. J Assoc Nurses AIDS Care 11:37–44. https://doi.org/10.1016/S1055-3290(06)60353-1
62. Zwiebel MA, Hughes V (2010) Smoking cessation efforts in one New York City HIV clinic. J Assoc Nurses AIDS Care 21:11–15. https://doi.org/10.1016/j.jana.2009.10.001
63. Moscou-Jackson G, Commodore-Mensah Y, Farley J, DiGiacomo M (2014) Smoking-cessation interventions in people living with HIV infection: a systematic review. J Assoc Nurses AIDS Care 25:32–45. https://doi.org/10.1016/j.jana.2013.04.005
64. U.S. Census Bureau (2016) Life off the highway: a snapshot of rural America. https://www.census.gov/newsroom/blogs/random-samplings/2016/12/life_off_the_highway.html. Accessed 14 Jan 2019
65. Heckman CJ, Egleston BL, Hofmann MT (2010) Efficacy of motivational interviewing for smoking cessation: a systematic review and meta-analysis. Tob Control 19:410–416. https://doi.org/10.1136/tc.2009.033175
66. Hettema JE, Hendricks PS (2010) Motivational interviewing for smoking cessation: a meta-analytic review. J Consult Clin Psychol 78:868–884. https://doi.org/10.1037/a0021498
67. Lai DT, Cahill K, Qin Y, Tang J-L (2010) Motivational interviewing for smoking cessation. Cochrane Database Syst Rev:CD006936. https://doi.org/10.1002/14651858.CD006936.pub2
68. Shirley D, Thibodeau L, Catz SL, McCoy K, Jorenby DE, Safdar N, Sosman JM (2018) Cessation-related information, motivation, and behavioral skills in smokers living with HIV. AIDS Care 30:131–139. https://doi.org/10.1080/09540121.2017.1367088